AN13936

PN7642 frequently asked questions

Rev. 2.0 — 14 October 2024 Application note

Document information

Information	Content
Keywords	FAQ, PN76, PN7642, secure key mode (SKM), MbedTLS, Crypto, Secure Key Store, frequently asked questions
Abstract	This document covers frequently asked questions in a question-answer style.

1 Introduction

This document is a collection of frequently asked question about PN7642 environment.

Most of the questions are covered in greater detail in other documents. It is highly recommended to get yourself familiar with the PN7642 and related documentation.

2 Firmware

2.1 Can the firmware be downgraded to another version?

Downgrading is only possible with minor versions. You cannot downgrade to another major version.

Minor downgrade: v02.07 → v02.01 = **possible**

Major downgrade: v02.xx → v01.xx = **not possible**

2.2 What is the maximum size of an NXP firmware update file (*.esfwu*)?

Maximum size of secure firmware update file (includes secure flash code, RF settings) ==> (0xD240) ==> **53,824 bytes**

Maximum size of secure firmware update file including ROM area settings and log area ==> (0xD8C0) ==> **55,488 bytes**

Maximum size of secure firmware update file including ROM area settings, and log area, and NXP configuration area ==> 0xDD10 ==> **56,592 bytes**

2.3 If an invalid command with a valid CRC is received in download mode. Does PN7642 stay in download mode?

Yes. If a valid packet format is received, PN7642 stops the HIF-Timeout timer (per default 500 ms) and stays in download mode. Only a valid exit command or VEN rest puts PN7642 out of the download mode.

2.4 Do the TPT keys change on a firmware update?

PN7642 C100 device comes by default with firmware v01.00. If you update a PN7642 C100 device to a newer firmware version like v02.02, the TPT keys remain the same.

The TPT_KEY is bound to the device version and independent of the firmware version. Updating the firmware does not change any key within the secure key store.

2.5 What is the difference between "xx.0x" and "xx.Fx" firmware version?

NXP always publishes two different firmware files for one version. The firmware file with "F" in its name is not updating the user settings area. The firmware update file with "0" instead of "F" always updates all the user settings as well.

PN7642Firmware_02.**0**0.esfwu → Is updating user configuration. Can be used to revert to factory settings.

PN7642Firmware_02.**F**0.esfwu → Is not updating user configuration. Can be used after you have configured your PN7642 to your hardware.

2.6 What is the difference between PN7642 C100 and C101?

The PN7642 is available in two versions: C100 and C101. The major difference between the two versions is the default configuration of PN7642, and not necessarily the firmware version.

- **C100**
  - Firmware version: v01.00
  - *Pin-less download*: **disabled** by default
- **C101**
  - Firmware version: v02.00
  - *Pin-less download*: **enabled** by default

The *Pin-less download* feature sets whether PN7642 probes DWL_REQ at boot-up to go to bootloader mode or not.

- If *Pin-less download* is disabled, PN7642 goes to bootloader mode only if DWL_REQ is high while booting.
- If *Pin-less download* is enabled, at power-on reset (POR), PN7642 goes to bootloader mode. To listen for bootloader commands, PN7642 remains in bootloader mode for some time (500 ms by default).

If PN7642 version C100 is updated with the same firmware version as PN7642 version C101, both versions have the same functionality. The only difference is the default configuration of the *Pin-less download* feature.

For firmware version v02.00 and above, the *Pin-less download* feature can be enabled on PN7642 version C100 with the API *PN76_Sys_OTPConfigs_EnableDwnldReqLessBoot()*.

Note: *OTP stands for One Time Programmable and is not reversible!*

CAUTION: *If Pin-less download is enabled— either via the API on PN7642 version C100, or by default on PN7642 version C101— USB Mass-storage mode (USB download) is not available.*

2.7 How can I set the application firmware version?

At the creation of a *.esfwu* file for the customer application, a version field is present. This version belongs to the user application and can be read out by the bootloader and the application itself.

This version can only be set by the *.esfwu* creation and is updated by the NXP bootloader. It cannot be set from the application space or any other way.

3 Secure key store and cryptography

3.1 What is the SKM?

The acronym SKM stands for "Secure Key Mode". The secure key mode is a special mode of the PN7642, where you open a session to interact with the secure key store. Only if a valid session in the secure key mode is opened, keys can be provisioned, deleted, and purged from the secure key store.

3.2 When is the SKM authentication counter increased?

The authentication counter in SKM is increased:

1. If the challenge and response are proper.
2. If the challenge and response are not proper, or if invalid values are used for the key (128-bit or 256-bit key).
3. Any internal errors (failures) are returned by the crypto algorithms for decryption of the challenge, or for access to key store/internal SGI IPs.
4. Any internal error results in secure memory read comparison.

In all these conditions, the authentication counter is increased when APIs are called or when SKM boot mode is entered to work on keys.

3.3 Key store is locked, what can I do?

Once the key store is locked, it stays locked. There is no way to unlock the key store. All provisioned keys can be used and purged. But no new authentication to the key store is possible.

The counter for faulty authentications is not reset by any action. After ten unsuccessful authentications, the key store is locked.

Take special care with the examples, like the MIFARE DESFire example, that the correct TPT_KEYs are set.

Note: *In early versions of the SDK, the TPT_KEYs have not been set correctly. Running the MIFARE DESFire example without changing the TPT_KEY results in a failed authentication.*

3.4 When can I provision a APP_MASTER_KEY?

Provisioning of the secure key store is only possible if the secure key store is not locked and you must provision the APP_ROOT_KEY first.

- If the key store is locked, no further provisioning is possible. Keys within the key store are still valid and can be used, but no new key can be provisioned.
- If the APP_ROOT_KEY is not provisioned, the default TPT_KEYS (transport keys available in PN7642 data sheet) are still active. Provision both 128-bit and 256-bit APP_ROOT_KEYs before you provision any other key.

To obtain the SKM state, use the API "**PN76_Sys_SKM_Get_SKM_Info()**" which returns the SKM state (Figure 1).

bSkmState

uint8_t PN76_SKM_Data_SKM_Info_t::bSkmState

Secure Key Mode locked out status.

Bits	Values	Description
[0]	0x00	SKM is not locked.
	0x01	SKM is locked. Application will not be able to operate on application keys.
[3:1]	0x00	Reserved for future use.
[5:4]	0x00	Application root key 128-bit is not provisioned.
	0x01	Application root key 128-bit is provisioned.
	0x02	Application root key 128-bit is locked from further provisioning.
	0x03	Application keys are purged.
[7:6]	0x00	Application root key 256-bit is not provisioned.
	0x01	Application root key 256-bit is provisioned.
	0x02	Application root key 256-bit is locked from further provisioning.
	0x03	Application keys are purged.

Figure 1. SKM state

For how to work with the secure key mode (SKM) to provision the key store, use *pnev7642fama_pn_skm* example available in the SDK. And read the application note [2].

3.5 Why does the chip reset by calling EdDSA_Sign?

Before using any cryptographic operations and APIs on the PN7642, the module must be initialized. In addition, if keys or key derivation operations are used, the KeyStore must be initialized as well.

See example *pnev7642fama_pn_mbedtls_demo* for a detailed how-to.

```
214     /* Initialize the crypto modules */
215     InitStatus = (PN76_Status_t)phmbedcrypto_Init();
216     if (InitStatus != PN76_STATUS_SUCCESS)
217     {
218         PRINTF("Crypto initialization failure\r\n");
219         while (1)
220             ;
221     }
222
223     /* Initialize the PN7642 KeyStore module */
224     eKeyStoreStatus = PN76_Sys_KeyStore_Init(&bKeyStoreStatus);
225
226     /* bKeyStoreStatus 6th bit means fatal error. */
227     if ((eKeyStoreStatus != PN76_STATUS_SUCCESS) || ((bKeyStoreStatus & 0x40U) != 0U))
228     {
229         PRINTF("Crypto initialization error\r\n");
230         while (1)
231             ; /* if Failed Do not go further */
232     }
```

Figure 2. Initialization of Crypto Unit and KeyStore

4 Host interface

4.1 What can I do if PN7642 does not answer on HIF I2C?

In the bootloader, PN7642 uses the values of ATX_C (I^2C Adr Bit 0) and ATX_D (I^2C Adr Bit 1) to set the I^2C address.

For more information about I^2C addressing and the I^2C host interface functionality, refer to [1].

I^2C_ADR1	I^2C_ADR0	I^2C address (R/W = 0, write)	I^2C address (R/W = 0, read)
0	0	0x28	0x28
0	1	0x29	0x29
1	0	0x2A	0x2A
1	1	0x2B	0x2B

Figure 3. I^2C interface addressing

5 Contact Interface

5.1 Why do I get a ATR parsing error?

The CT library can be initialized to be compliant with either ISO7816 or EMVCo. Especially at the ATR there are differences, which are incompatible with each other. Make sure to set the compliance to your required specification:

```
120
121 static void phExCcid_CtTask_Init(phhalCt_SlotType_t slotType)
122 {
123     g_CtTaskData.halCt.phhalCt_Params[0].pTDAPins = &g_CtTaskData.tda[0];
124     g_CtTaskData.halCt.phhalCt_Params[1].pTDAPins = &g_CtTaskData.tda[1];
125     g_CtTaskData.palCt.phalDataParams = &g_CtTaskData.halCt;
126     phpalCt_Init(&g_CtTaskData.palCt);
127     g_CtTaskData.palCt.sAtrParams.pbAtrBuffer = gbphCT7816_ApduRespBuffer;
128
129     phhalCt_Init(&g_CtTaskData.halCt, slotType);
130     phpalCt_SetConfig(&g_CtTaskData.palCt, E_CONF_COMPLIANCE, (uint8_t)E_ISO7816_ENABLE );
131 }
132
```

Figure 4. CT compliance configuration

6 Software

6.1 Difference between *libintfs.a* and *intfs.a* in the SDK?

Both *libintfs.a* and *intfs.a* libraries are available in the SDK.

The two libraries serve the same purpose, have the same content, but comply with different toolchain requirements. If you must use one library, pick any of the two available in the SDK.

6.2 NFC Cockpit is not working. What can I do?

Refer to the section *Firmware overview* in [3].

The NFC Cockpit application (*.bin*) is compiled for a particular firmware version of PN7642. Major firmware versions are not compatible because of API address changes. For example, the NFC Cockpit application compiled for PN7642 FW v1.0 does not run on PN7642 with firmware v2.0.

6.3 Why is the SDK not working with VSC?

Even though the MCUXpresso Visual Studio Code (VSC) extension is available, not all SDK versions are compatible. For example, PN7642 SDK version vxx.*12*.xx is not compatible. To be supported by the VSC extension, the SDK minimum version must be 14 (xx.14.xx).

Updates are planned to make the PN7642 SDK VSC compliant.

6.4 Why can't I see any output in the IDE console?

When importing an example from the SDK, you can choose the debug console. If the *SDK Debug Console* is 'Semihost', the debug output is in the IDE console. If *SDK Debug Console* is 'UART', the debug output can be grabbed on the debug UART.

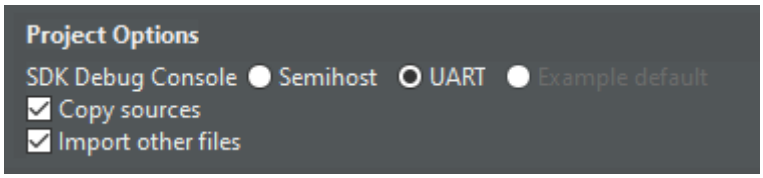

Figure 5. Example of project configuration for debug console

If you do not see any output in your MCUXpresso IDE console, cross-check the settings. You can change the settings for an example you have already imported.

- Go to the *Quickstart Panel*.
- Select *Quick Settings*.
- Select *SDK Debug Console*.
- Select *Semihost console* or *UART console*.

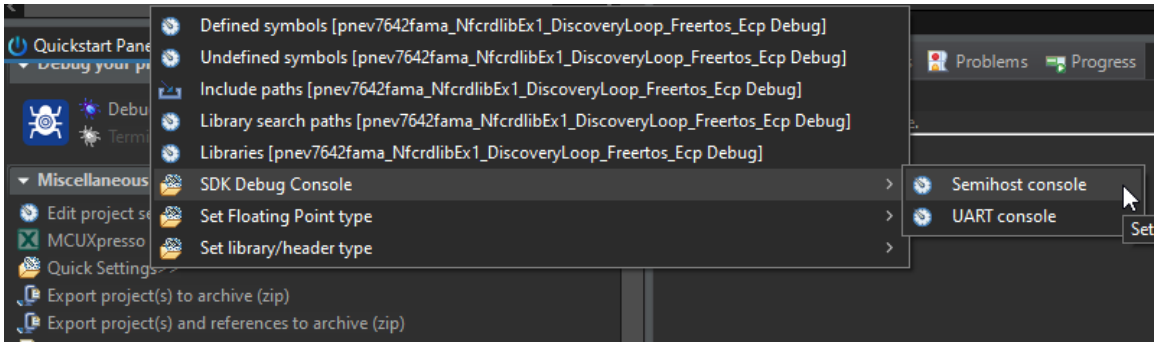

Figure 6. Quick settings for debug console

6.5 My examples are crashing. What to do?

Most examples rely on the underlying libraries. The libraries are built for a specific PN7642 firmware version. If the firmware version of PN7642 does not match the firmware version used by the SDK, all kinds of issues and unexpected behavior can occur.

For details on compatibility, refer to the section *Firmware overview* in [3]. And either update the firmware of your PN7642 to the SDK firmware, or use the correct SDK version for you PN7642.

6.6 Why is LPCD not going to standby?

On NXP Open-Controllers (PN7462 and PN7642), LPCD does not automatically set the chip to standby. By calling the LPCD API immediately after the measurement RF-Ping, the result is returned.

On NXP Closed-Controllers (PN5190, PN7160, PN7220, etc.), LPCD automatically sets the chip to standby.

This differing behavior was chosen on purpose to give the freedom of choice to the developer. As the PN7642 is an SoC, it can control other entities or fulfill other tasks in the user space.

The user can check the result of LPCD, and go to standby by calling one of the PN7642 standby modes (Standby, Deep Sleep, Ultra Low-Power Standby, etc.).

7 Documentation

7.1 Where do I find the API documentation?

The *PN7642 NFC Controller User API Documentation* is part of the SDK package. If you and open

- Unzip the SDK package.
- Open the *docs* directory.
- Unzip *PN76-FW-apiguide.zip*.
- Open the *index.html* file.

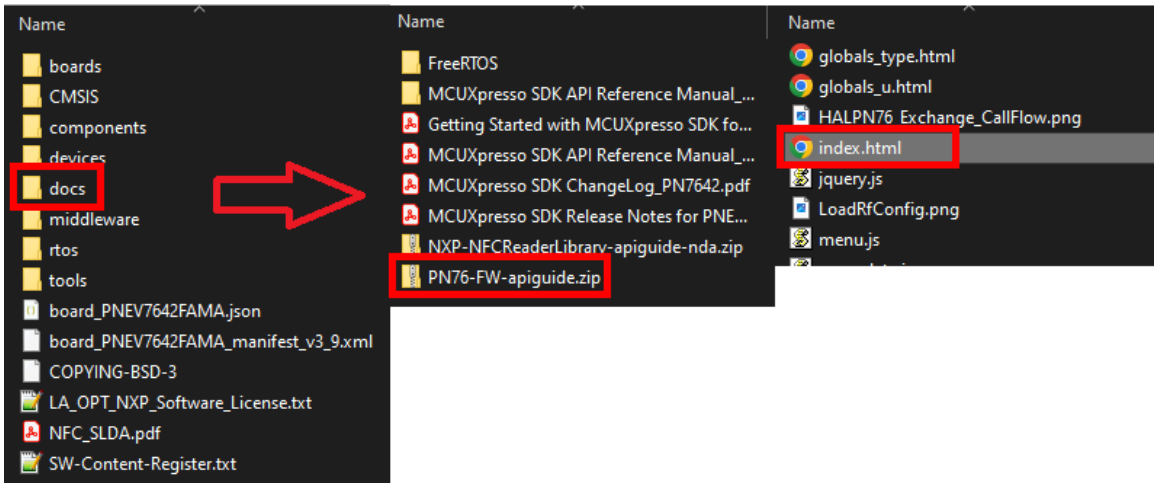

Figure 7. PN7642 API documentation location

The API documentation is generated with DoxyGen out of the actual SDK source code.

7.2 Why is the PN5190 mentioned in PN7642 documentation?

The PN5190 and PN7642 share the same hardware platform. Many of the hardware blocks are identical. The PN5190 has been on the marked a lot longer and more documentation for it has been created. Some documents are taken from the PN5190 and slightly altered for the PN7642. During this process, it can occur that renaming "PN5190" to "PN7642" has been missed.

8 Examples

8.1 Which keys to choose in NfcrdlibEx10_MIFAREDESFire?

At SDK version v2.15.0, the user has to define which TPT_KEYs are used. Three options are present in the example. The TPT_KEYs are listed in the data sheet [1].

- PN7642EV_C100: Define this if you use a PN7642 **C100** chip.
- PN7642EV_C101: Define this if you use a PN7642 **C101** chip.
- PN7642EV_INT: These are engineering samples and cannot be officially bought. Triple check the markings on your chip as you most probably do not have this chip version.

Where you set the define (a line above, preprocessor defines, others) does not matter as long as the right keys are enabled. Enabling the wrong key set can lead to locking the key store. A locked key store cannot be unlocked! See Section 3.3.

Note: *All PNEV7642 development boards are populated with a **C100** chip.*

9 Abbreviations

Table 1. Abbreviations

Acronym	Description
ESFWU	Encrypted secure firmware update
HIF	Host interface
KS	Key store
LPCD	Low Power Card Detection
OTP	One time programmable
POR	Power-on reset
SKM	Secure key mode
SOC	System on Chip
TPT_KEY	Transport key
ULP	Ultra Low Power
ULPCD	Ultra Low Power Card Detection

10 References

[1] Data sheet - PN7642 - Single chip solution with high-performance NFC reader, customizable MCU, and security toolbox (link)
[2] AN13720 - PN7642 Secure Key Mode demo application (link)
[3] AN13134 - PN76 family evaluation board quick start guide (link)

11 Revision history

Table 2. Revision history

Version	Release date	Description
AN13936 v.2.0	14 October 2024	Editorial changes. • Section 2.7 "How can I set the application firmware version?": added. • Section 3.5 "Why does the chip reset by calling EdDSA_Sign?": added. • Section 5 "Contact Interface": added. • Section 6.6 "Why is LPCD not going to standby?": added. • Section 7.2 "Why is the PN5190 mentioned in PN7642 documentation?": added. • Section 8 "Examples": added. • Section 9 "Abbreviations": updated.
AN13936 v.1.0	29 February 2024	• Initial version

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