AN13938

PN7220 - Analog and RF settings

Rev. 1.0 — 7 July 2023   **Application note**

Revision history

Revision history

Rev	Date	Description
v.1.0	20230707	Initial version

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1 Introduction

This document describes how to adjust analog and RF settings on the PN7220.

All these settings are stored permanently in EEPROM. The PN7220 is delivered with default settings, which are linked to the FW, i.e. the FW update overwrites all related settings.

These settings define the analog and RF behavior, and typically it is required to adjust some of them to adapt the antenna design and achieve the required performance (transmit power, waveshape behavior, receive sensitivity, loading behavior, current consumption, etc.). Normally NXP provides a GUI to support and simplify this adjustment and handling of settings (refer to [1]). But currently for the PN7220, the tool chain of the PN5190 (refer to [2]) has to be used to find the correct settings.

The settings then have to be manually transferred from the PN5190 XML file into the XML structure of the PN7220. Afterwards the PN7220 XML file can be pushed to the Android DH, and then be applied with a small Android application (CockPit_Util_V1_0), which writes all settings into the PN7220 EEPROM.

2 Preparation

Some preparation details must be done to be able store the correct settings into the PN7220.
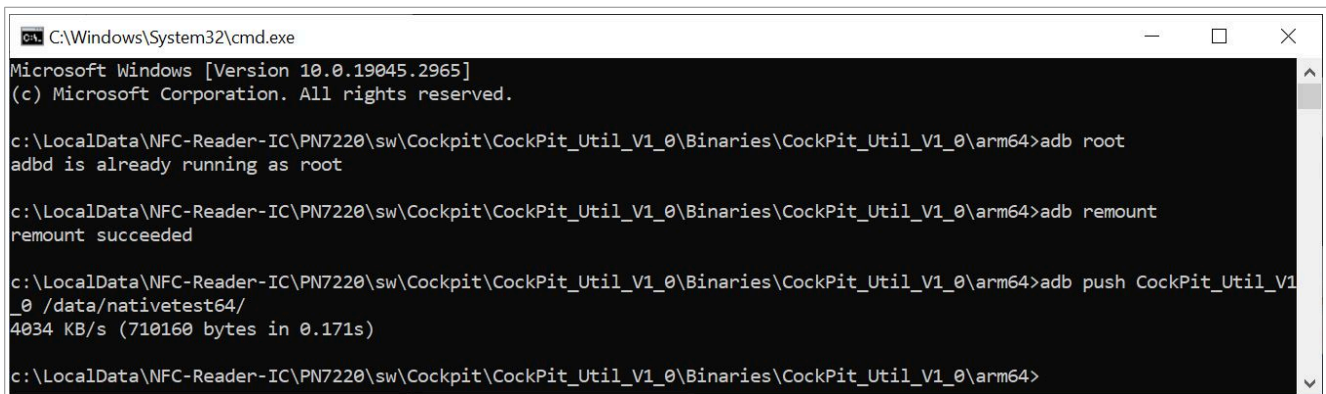
2.1 Install CockPit_Util_V1_0

The tool package includes the CockPit_Util_V1_0, which must be executed on the Android DH to save all settings into PN7220.

Push this file to the Android system, into /data/nativetest64/ folder.

Example (as shown in:

- open a CMD shell in c:\localfolder\PN7220\whatever_folder_you_use\CockPit_Util_V1_0\arm64\
- adb root
- adb remount
- adb push CockPit_Util_V1_0 /data/nativetest64/


```
C:\Windows\System32\cmd.exe                                              —   □   ×

Microsoft Windows [Version 10.0.19045.2965]
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c:\LocalData\NFC-Reader-IC\PN7220\sw\Cockpit\CockPit_Util_V1_0\Binaries\CockPit_Util_V1_0\arm64>adb root
adbd is already running as root

c:\LocalData\NFC-Reader-IC\PN7220\sw\Cockpit\CockPit_Util_V1_0\Binaries\CockPit_Util_V1_0\arm64>adb remount
remount succeeded

c:\LocalData\NFC-Reader-IC\PN7220\sw\Cockpit\CockPit_Util_V1_0\Binaries\CockPit_Util_V1_0\arm64>adb push CockPit_Util_V1
_0 /data/nativetest64/
4034 KB/s (710160 bytes in 0.171s)

c:\LocalData\NFC-Reader-IC\PN7220\sw\Cockpit\CockPit_Util_V1_0\Binaries\CockPit_Util_V1_0\arm64>
```

Figure 1. Installation of CockPit_Util_V1_0

2.2 Prepare XML settings

The CockPit_Util_V1_0 requires an XML file, containing all PN7220 RF and analog settings. These settings must be manually entered or changed. It is strongly recommended to start with the default settings, and only enter those changes, which are required.

The starting point shall be the default settings from PN5190, as provided as part of the NFC Cockpit (refer to [1]).

In c:\nxp\NxpNfcCockpit_v7.2.0.0\cfg\PN5190\Default\ there are two set of settings provided:

- EEPROM_Settings_FactoryDefault.xml
- EEPROM_Settings_EMVCODefault.xml

The factory default settings of the PN5190 are the ones, which come together with a FW update, and correspond to the PN7220 default settings, as applied in the NFC Mode.

The EMVCo default settings of the PN5190 correspond to the PN7220 default settings as applied in the EMVCo mode.

So from both PN5190 XML files, the one XML file for the PN7220 can be generated.

Since the PN5190 shall be used to adjust all antenna and analog design parameters and to derive the related settings using e.g. the NFC Cockpit, the PN7220 XML file requires two XML files from the PN5190: one for

the optimum NFC operation, and one for the optimum EMVCo operation, which then will be combined in the PN7220.

2.2.1 Use of PN5190

The easiest and best way to tune and adjust the antenna for the PN7220 is the usage of the PN5190 as design-in vehicle. The PN5190 provides all the required documentation and tools (like [3], [4]or [5]). The PNEV5190BP (see [6]) can be used as shown in Figure 2 to connect and drive the PN7220 antenna. The original 45 mm x 45 mm antenna of the PNEV5190BP can be cut off and replaced with the PN7220 antenna, connected with a short wire. The required tuning can be assembled on tuning board, and then all required adjustments (and even compliance tests) can be done the the PN5190, resp. the PNEV5190BP.
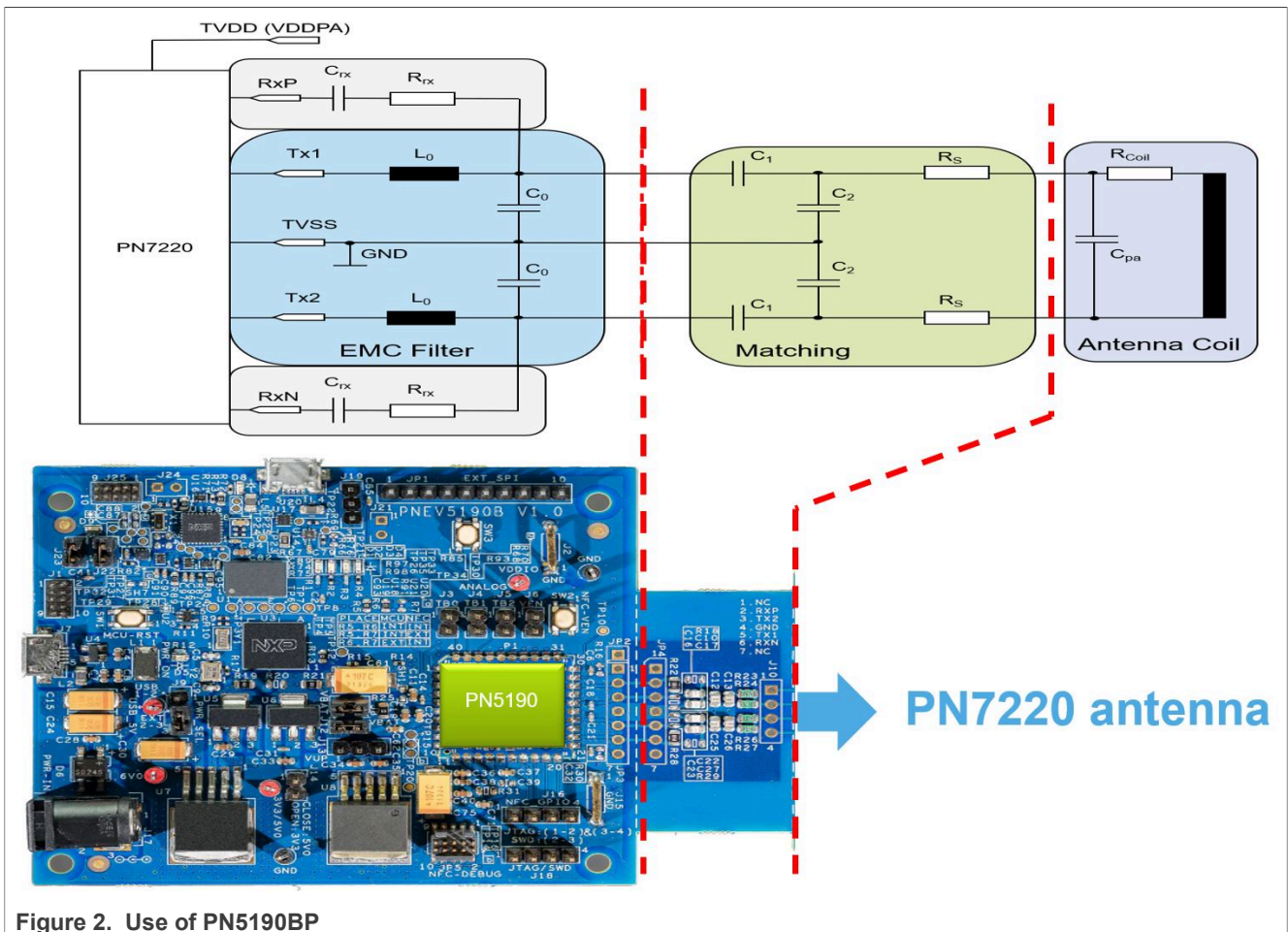

Figure 2. Use of PN5190BP

After all PN5190 settings are derived and saved into the PN5190 EEPROM, the NFC Cockpit provides the option <Dump EEPRPM>, which then saves the settings in an XML file. This XML file can be used to copy the relevant settings manually into the PN7220 XML file.
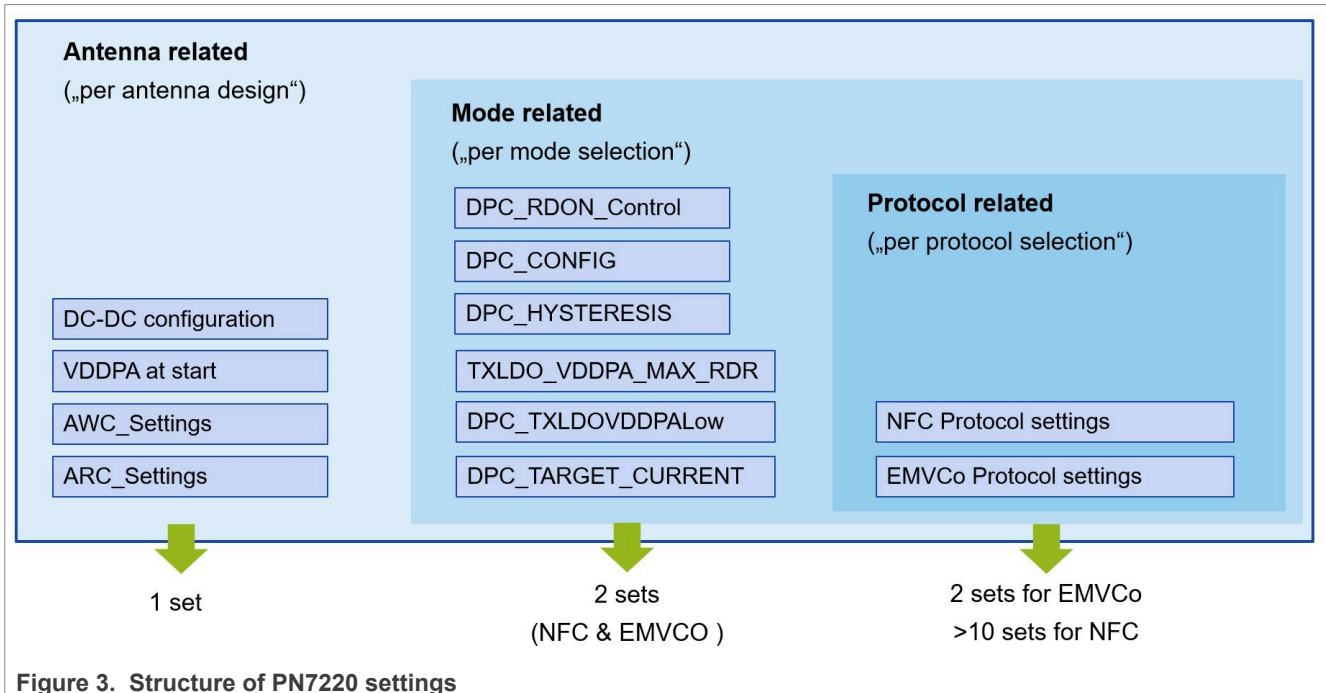
2.2.2 Relevant XML content

The PN7220 uses a number of RF and analog related settings, which can easily be handled in one XML file. But not all of them are really relevant for a proper and optimum operation. Since currently the adjustment of those analog settings is done with the PN5190 and its related tool chain, the settings then have to manually copied from the PN5190 XML into the PN7220 XML.

As a starting point, the default settings for NFC operation as well as for EMVCo operation are the same for PN5190 and PN7220: the PN5190 default settings are part from the NFC Cockpit package in c:\nxp\NxpNfc Cockpit_v7.x.x.x\cfg\PN5190\Default\

Common Settings:

The PN7220 uses some common settings for both the NFC and the EMVCo operation as shown in Figure 3 on the left side. These parameters are antenna-related and shall be used in both modes of operation.

Figure 3. Structure of PN7220 settings

Mode-related settings:

These settings are related to the mode of operation:

1. the DPC control (DPC_CONFIG)
2. the hysteresis settings (even though typically not to be changed)
3. the maximum allowed VDDPA (TXLDO_VDDPA_MAX_RDR)
4. the minimum allowed VDDPA (DPC_TXLDOVDDPALow) and the related RDON feature
5. the target current (DPC_TARGET_CURRENT)

These settings define the overall RF output power behavior, and therefore typically can be different between EMVCo operation (full power) and NFC operation (reduced power).

NFC-related settings:

```
<Region RegionName="USER_PMU" RegionAccess="RW" RegionType="DATA">
    <Parameter Name="PwrConfig" Offset="0x00" Value="0xE4" />
    <Parameter Name="DcdcConfig" Offset="0x01" Value="0x31" />
    <Parameter Name="TxldoConfig" Offset="0x02" Value="0xFFFFAEA7" />
    <Parameter Name="TxldoStartVddpa" Offset="0x06" Value="0x00" />
    <Parameter Name="TxLdoVddpaMaxRdr" Offset="0x07" Value="0x2A" />
    <Parameter Name="TxLdoVddpaMaxCard" Offset="0x08" Value="0x2A" />
    <Parameter Name="BoostDefaultVoltage" Offset="0x09" Value="0x1D" />

    <Region RegionName="DPC_SETTINGS" RegionAccess="RW" RegionType="DATA">
```

```
        <Parameter Name="Config" Offset="0x68" Value="0x77" />
        <Parameter Name="TargetCurrent" Offset="0x69" Value="0x008C" />
        <Parameter Name="Hysteresis" Offset="0x6B" Value="0x14" />
        <Parameter Name="RFU" Offset="0x6C" Value="0x6A" />
        <Parameter Name="RFU" Offset="0x6D" Value="0x2A" />
        <Parameter Name="Hysteresis_Unloading" Offset="0x6E" Value="0x0A" />
        <Parameter Name="TXLDOVDDPALow" Offset="0x6F" Value="0x07" />
        <Parameter Name="TXGSN" Offset="0x70" Value="0x03" />
        <Parameter Name="VDDPALowLimitcontrol" Offset="0x71" Value="0x01" />
        <Parameter Name="InitialRDOn_RFOn" Offset="0x72" Value="0x03" />
```

EMVCo related settings:

```
    <Region RegionName="DPC_SETTINGS_EMVCO" RegionAccess="RW" RegionType="DATA">
        <Parameter Name="Config" Offset="0x68E" Value="0x77" />
        <Parameter Name="TargetCurrent" Offset="0x68F" Value="0x0132" />
        <Parameter Name="Hysteresis" Offset="0x691" Value="0x14" />
        <Parameter Name="RFU" Offset="0x692" Value="0x6A" />
        <Parameter Name="RFU" Offset="0x693" Value="0x2A" />
        <Parameter Name="Hysteresis_Unloading" Offset="0x694" Value="0x0A" />
        <Parameter Name="TXLDOVDDPALow" Offset="0x695" Value="0x08" />
        <Parameter Name="TXGSN" Offset="0x696" Value="0x08" />
        <Parameter Name="VDDPALowLimitcontrol" Offset="0x697" Value="0x01" />
        <Parameter Name="InitialRDOn_RFOn" Offset="0x698" Value="0x08" />

    <Region RegionName="USER_PMU_EMVCO" RegionAccess="RW" RegionType="DATA">
        <Parameter Name="TxLdoVddpaMaxRdr" Offset="0x6A6" Value="0x2A" />
    </Region>
```

Protocol-related settings:

A third section of settings is part of the RF Configuration, which is always copied into the register, when a certain protocol (like e.g. Type A 106) is loaded. These settings are protocol-related, and the PN7220 provides separate settings for A106, B106, F212, and F424 for the EMVCo operation and the NFC operation. All other supported NFC protocols have their own set of settings, which are only relevant in the NFC operation anyway.

On top of the protocol-related settings form the RF configuration area, there are the protocol-specific waveshaping settings, might be required to be different between NFC and EMVCo operation. These settings are added for the EMVCo operation (on top of the "normal" ones for NFC operation):

```
        <Parameter Name="ResidualAmplitudeLevel_EMVCoF212" Offset="0x5C"
 Value="0xCF" />
        <Parameter Name="EdgeType_EMVCoF212" Offset="0x5D" Value="0x22" />
        <Parameter Name="EdgeStyleConfiguration_EMVCoF212" Offset="0x5E"
 Value="0x65" />
        <Parameter Name="EdgeLength_EMVCoF212" Offset="0x5F" Value="0x10" />
        <Parameter Name="ResidualAmplitudeLevel_EMVCoF424" Offset="0x60"
 Value="0xCE" />
        <Parameter Name="EdgeType_EMVCoF424" Offset="0x61" Value="0x22" />
        <Parameter Name="EdgeStyleConfiguration_EMVCoF424" Offset="0x62"
 Value="0x55" />
        <Parameter Name="EdgeLength_EMVCoF424" Offset="0x63" Value="0x10" />

    <Region RegionName="RM_TECHNO_EMVCO_TX_SHAPING" RegionAccess="RW"
 RegionType="DATA">
        <Parameter Name="ResidualAmplitudeLevel_EMVCoA106" Offset="0x50E"
 Value="0x00" />
        <Parameter Name="EdgeType_EMVCoA106" Offset="0x50F" Value="0x33" />
```

```
        <Parameter Name="EdgeStyleConfiguration_EMVCoA106" Offset="0x510"
Value="0x64" />
        <Parameter Name="EdgeLength_EMVCoA106" Offset="0x511" Value="0x10" />
        <Parameter Name="ResidualAmplitudeLevel_EMVCoB106" Offset="0x512"
Value="0xCF" />
        <Parameter Name="EdgeType_EMVCoB106" Offset="0x513" Value="0x44" />
        <Parameter Name="EdgeStyleConfiguration_EMVCoB106" Offset="0x514"
Value="0x11" />
        <Parameter Name="EdgeLength_EMVCoB106" Offset="0x515" Value="0x10" />
```

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3 Save EEPROM settings

To apply new settings stored in a new XML to the PN7220, we can use the CockPit_Util_V1_0 tool. It works in 2 steps: Step one is required to push the XML data to the Android DH system, and the second step is then to execute the configuration tool "CockPit_Util_V1_0" on the Android DH system.

3.1 Push XML

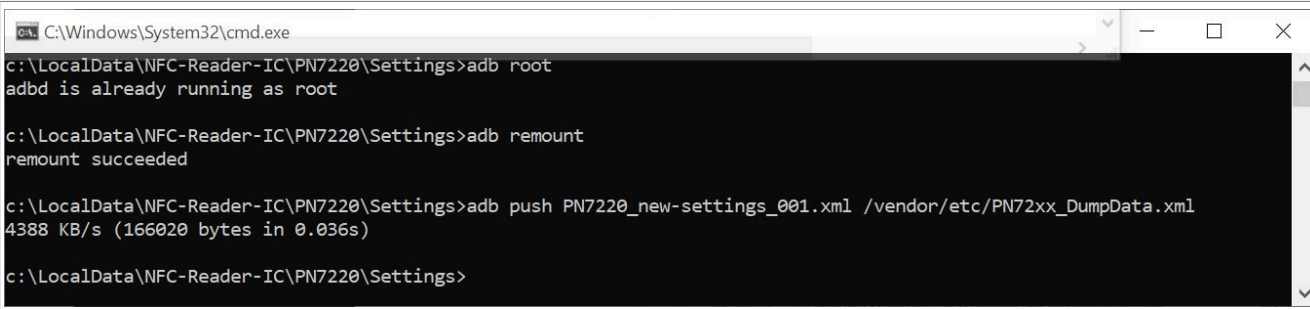Push the Pn72xx_DumpData.xml file to the Android system, into /vendor/etc/ folder

Example:

Start a CMD shell in the directory, where the XML settings are stored.

- adb root
- adb remount
- adb push Pn72xx_DumpData.xml /vendor/etc/

Note: *Rename the file while pushing it, if the filename is different. Example: adb push PN7220_new-settings_001.xml /vendor/etc/PN72xx_DumpData.xml*

Example is shown in Figure 4.

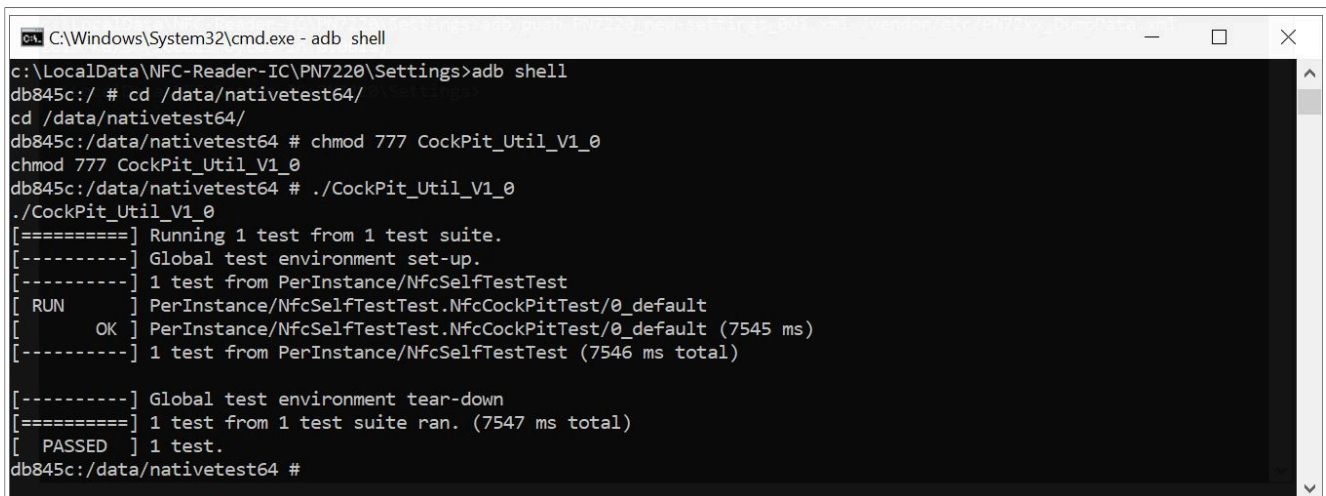**Figure 4. Push XML data**

3.2 Run CockPit_Util_V1_0

Then execute the configuration tool CockPit_Util_V1_0.

Example:

Start a CMD shell.

- adb shell
- cd /data/nativetest64/
- chmod 777 CockPit_Util_V1_0
- ./CockPit_Util_V1_0

Example is shown in Figure 5.

Figure 5. Run CockPit_Util_V1_0

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4 Abbreviations

Table 1. Abbreviations

Acronym	Description
DH	device host
FW	firmware

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5 References

[1] NFC Cockpit https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/nfc-cockpit-configuration-tool-for-nfc-ics:NFC-COCKPIT

[2] PN5190 homepage https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/nfc-frontend-supporting-challenging-rf-environment-for-payment-physical-access-control:PN5190

[3] PN5190 Antenna design guide https://www.nxp.com/docs/en/application-note/AN12549.pdf

[4] PN5190 Antenna design tools https://www.nxp.com/downloads/en/application-software/OT6824.zip

[5] PN5190 video tutorials https://www.nxp.com/design/training/pn5190-dynamic-power-control-quick-calibration-and-txshaping-demo:TIP-PN5190-DYNAMIC-POWER-CONTROL-DEMO

[6] PNEV5190BP https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/development-board-for-pn5190:PNEV5190BP

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