AN13224

PN7160 dynamic power control guide

Rev. 1.2 — 9 November 2022 Application note

Document information

Information	Content
Keywords	NFC, PN7160, DPC, dynamic power control, NFC Factory Test application, Symmetrical tuning
Abstract	This application note is intended to provide guidelines regarding the way to use DPC. It also explains who to create the DPC command and how to measure the current and LUT position.

Revision history

Rev	Date	Description
1.2	20221109	DPC settings workflow updated
1.1	20210913	Security status changed into "Company public", no content change
1.0	20210825	Initial version

1 Introduction

PN7160 high output power permits achieving higher communication distance. This output power must be managed correctly to avoid any issues at close distance communication with cards.

The Dynamic Power Control (DPC 2.0) is a feature of the PN7160 that allows to control the transmitter current. Therefore the field strength depending on loading and detuning conditions. The DPC can be enabled and then dynamically adapts the output power neither requiring any additional resource on the host µC nor requiring additional components.

DPC offers an improved RF performance. On one hand, the overall Q factor of the antenna coil circuitry can be increased. On the other hand, the DPC antenna tuning provides an improved transfer function. The DPC as such can be used to extend the read range or to use smaller antennas, without exceeding the driver current specification of the NFC IC. Without exceeding the maximum field strength limits as given by the ISO/IEC 14443, NFC or EMVCo standards.

Unlike a standard DPC function (**DPC 1.0**) the **DPC 2.0** algorithm described in this document uses a true current measurement. Therefore the DPC calibration + correlation test is not required.

For the **DPC enabled**, the symmetrical antenna tuning should be used. For more details regarding the antenna tuning, refer to the dedicated Application Note (see [1]).

2 Asymmetrical versus symmetrical tuning

In the standard antenna design, we use a cut-off frequency of up to **22 MHz** to provide a proper detuning and loading behavior of the antenna. This high cut-off frequency helps to meet the minimum and maximum field strength limits with normal antennas without using Dynamic Power Control. Also it keeps the I_{TVDD} current below the maximum limit. In this case, we are talking about **asymmetrical tuning**.

Once the cut-off frequency is changed to **14.4 MHz -14.7 MHz**. The impedance changes to a “symmetrical” impedance ->**symmetrical tuning**.

The problem related to the “symmetrical” tuning is the loading and detuning behavior. While the impedance in case of the asymmetrical tuning increases under detuning and loading conditions, the impedance in case of the “symmetrical” tuning always decreases. Without any specific control of the output power, the decreasing impedance increases the driver current. Therefore the field strength, which might easily extend the allowed limits, i.e. it might exceed the IC specification for the driver current I_{TVDD} as well as it might exceed the field strength limits.

Therefore the Dynamic Power Control must be used to compensate the decreasing impedance and reduce the driver current automatically.

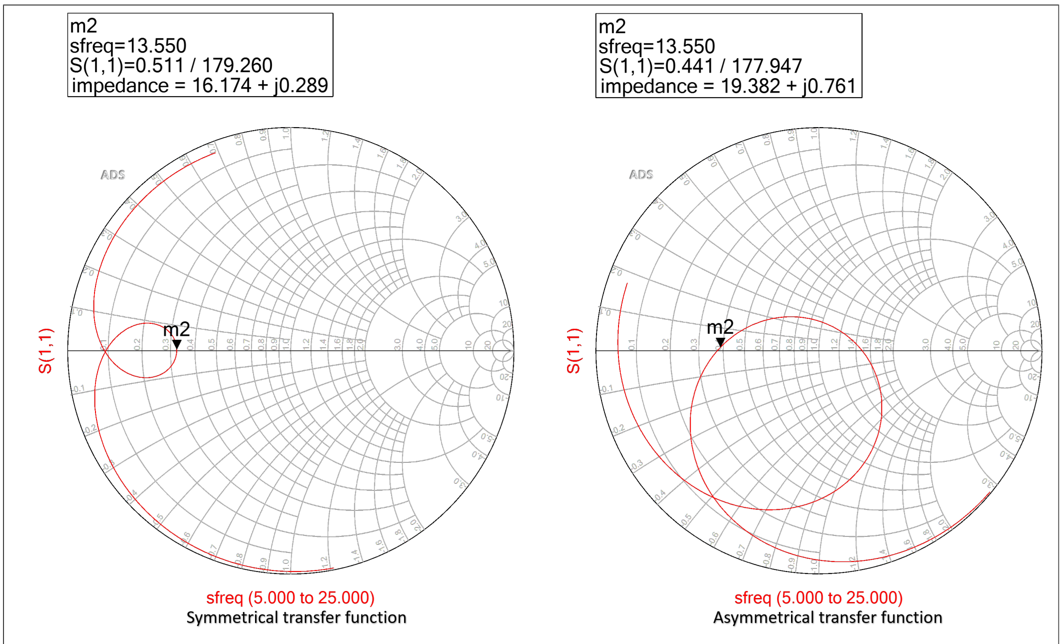


Figure 1. Symmetrical and asymmetrical tuning

Asymmetrical tuning

- More robust against detuning and loading → tuning increases under detuning and loading conditions
- Cut off frequency ≈ ***20 MHz - 22 MHz***
- No need to use DPC function
- Potentially lower operating volume
- Typically lower output power (Due to the higher target impedance, typically 20-25 Ω)

Symmetrical tuning

- More detuning and loading sensitive → tuning decreases under detuning and loading conditions
- Cut off frequency ≈ ***14.4 MHz -14.7 MHz***
- DPC function is required
- Increases the operating volume
- Allows using smaller antennas
- Typically higher output power (Due to the lower target impedance, typically 16-17 Ω)

3 Principle of DPC

When the user places a card, or mobile device or even the reference PICC close to the antenna, its causes a detuning and loading of the antenna. This can easily result in too much RF field (power transfer) for the PICC as well as too much driver current (I_{TVDD})

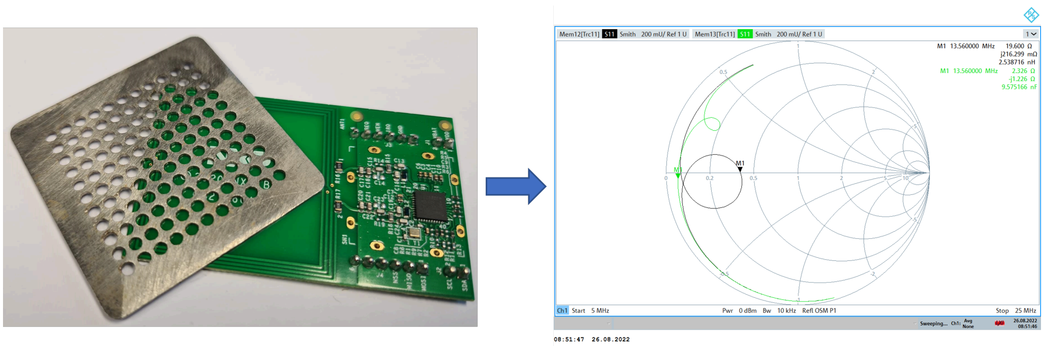


Figure 2. Typical antenna detuning

Figure 2 shows a typical **symmetrical** antenna tuning impedance on free-air (black trace) and under a loading condition (green trace). Due to this loading (for example, a piece of metal) the impedance decreases to values < 10 Ω. Without a proper DPC, the I_{TVDD} limit and also the maximum ISO/NFC forum power transfer limit would be exceeded.

Therefore a process is needed to control the output power and the driver current, and to adapt it to the loading and detuning, if needed. This process is automatically done with the dynamic power control (DPC).

If the DPC setting is inappropriate or disabled. The PN7160 TXLDO includes a current limiter function, which is configured to 300 mA ± 30 mA. The current limiter is enabled by default.

Figure 3 shows the principle of the dynamic power control, using the block diagram of a typical PN7160 circuitry:

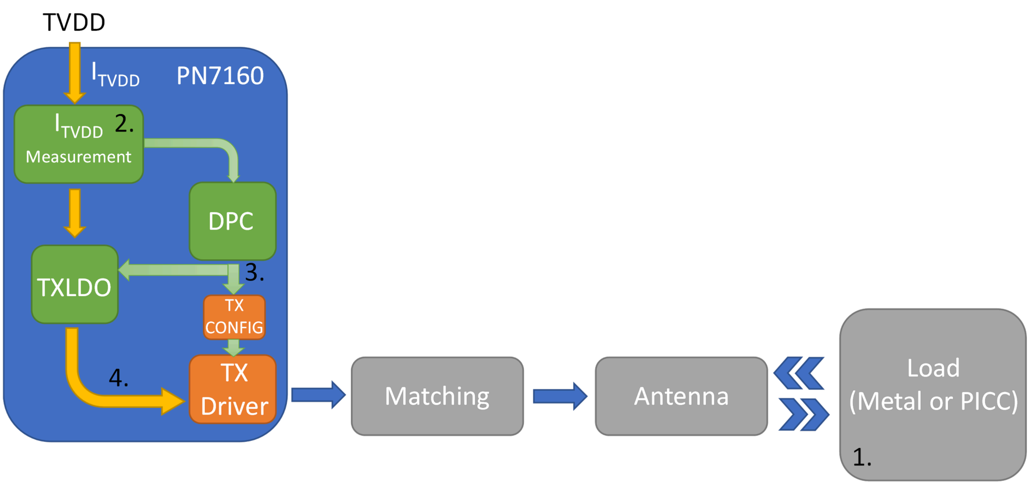


Figure 3. DPC principle

1. The load (card or smart device) decreases the impedance as shown in Figure 2
2. This increases the driver current I_{TVDD}, which is measured by the IC
3. As soon as a certain threshold of internal current is exceeded, the PN7160 dynamically changes the TX setting (TXLDO level and TX configuration). it reduces the output power
4. I_{TVDD} is reduced

The PN7160 has a lookup table (LUT) with several predefined TX settings. Depending on the I_{TVDD} internally measured by the firmware, it chooses a LUT entry.

Table 1. Look up table (LUT)

LUT	
Entry #1	TX settings #1
Entry #2	TX settings #2
Entry #3	TX settings #3
Entry #4	TX settings #4
Entry ...	TX settings ...
Entry #20	TX settings #20

3.1 Principle of DPC - Example (I_{TVDD} Current)

As soon as the PICC comes closer to the PCD antenna, the loading, and detuning causes an increase of the driver current I_{TVDD} as well as an increase of the power transfer.

- If the DPC is **disabled**, the TVDD current is limited by the current limiter to 300 mA (see below). This leads to stress on the integrated circuit and a drop in RF performance.
- If the DPC is **enabled** and properly set, the I_{TVDD} current is regulated based on the LUT inputs. In this case, the current should not exceed the target value (i.e. 220 mA).

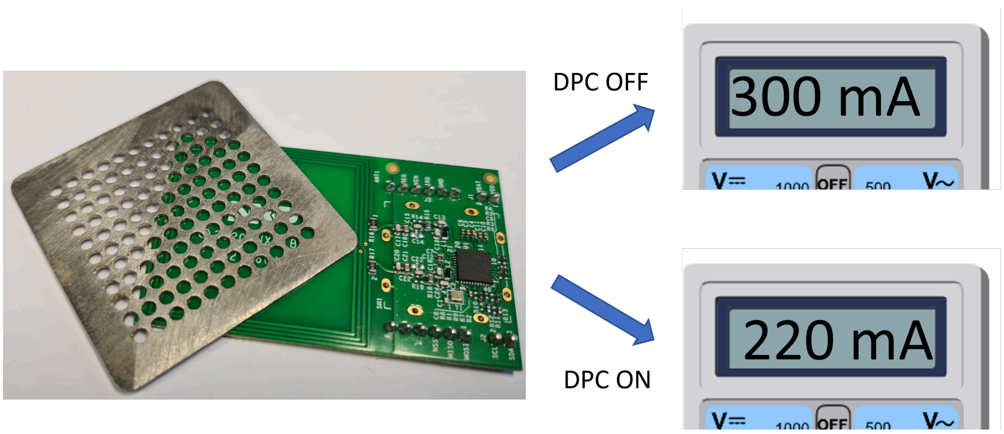


Figure 4. DPC ITVDD impact example

3.2 Principle of DPC - RF Field behavior

The figure below shows the RF Field behavior for the DPC enabled and disabled. A metal plate was approached to the antenna.

- For the DPC OFF, there is no power regulation at all (except small drop because of the current limiter).
- For the DPC ON, the RF power is reduced by the changing the TX settings (see the jumps).

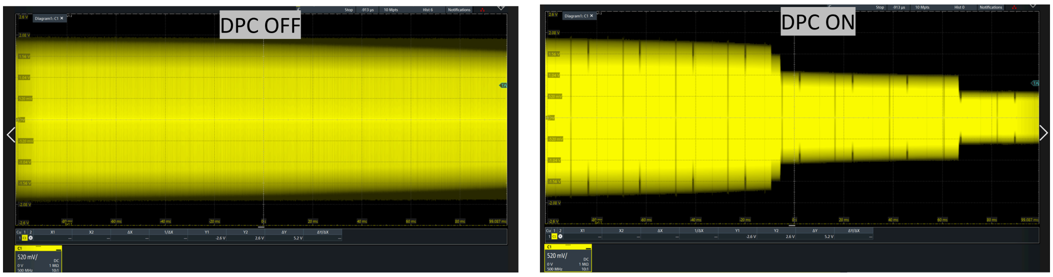


Figure 5. DPC regulation (RF Field)

4 Field strength test example (according to ISO/IEC 10373-6)

For the field strength tests, it is preferred to have the PCD send a continuous carrier, i.e. it performs no modulation. The field strength tests simply require the calibrated reference PICC and a DC voltage measurement device (volt meter or oscilloscope). The field strength is equivalent to the calibrated (and required) voltage level. ISO/IEC 10373-6 (see [6]) defines minimum voltage levels, corresponding to the minimum required field strength, and maximum voltage levels, corresponding to the maximum allowed field strength. The measured voltage levels must stay in between these limits.

The *OM27160 development kit* (see [7]) as the **PCD** and *ISO 10373-6 Test PICC Class 3* as **PICC** have been used for this measurement.

Figure 6 shows an example of PCD field strength measurement according to ISO/IEC 10373-6 for OM27160 development kit.

Without the DPC enabled, the maximum H-field limit is exceeded as well as the TX driver current (orange curve). Once the DPC is activated. The output power is reduced according to DPC configuration table (blue curve).

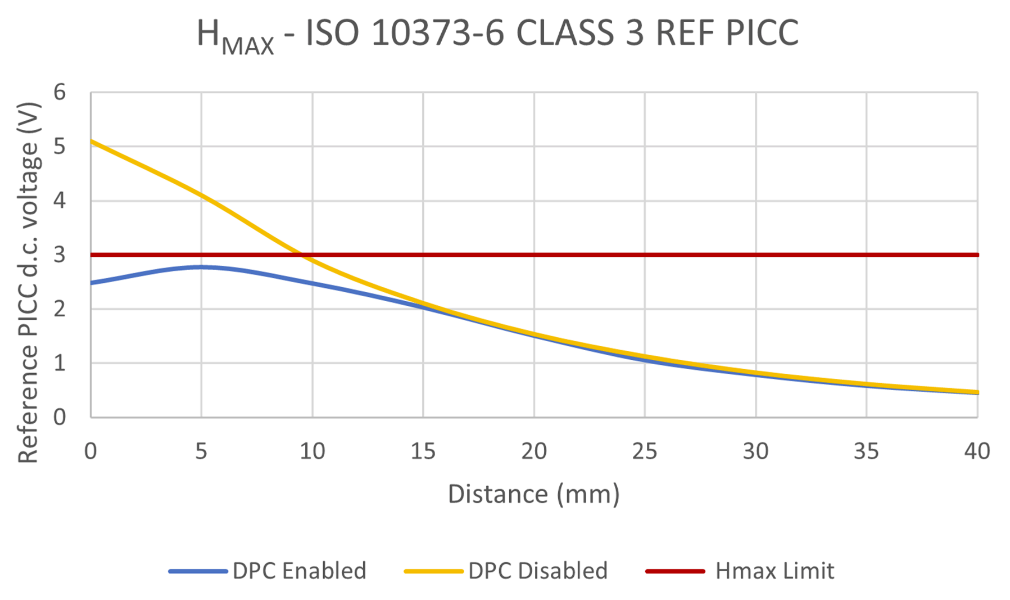


Figure 6. PCD field strength - Hmax

Figure 7 shows the TVDD current over distance. Without DPC function, the driver current is exceeded. DPC function ensures that the I_{TVDD} current stays below the required limit.

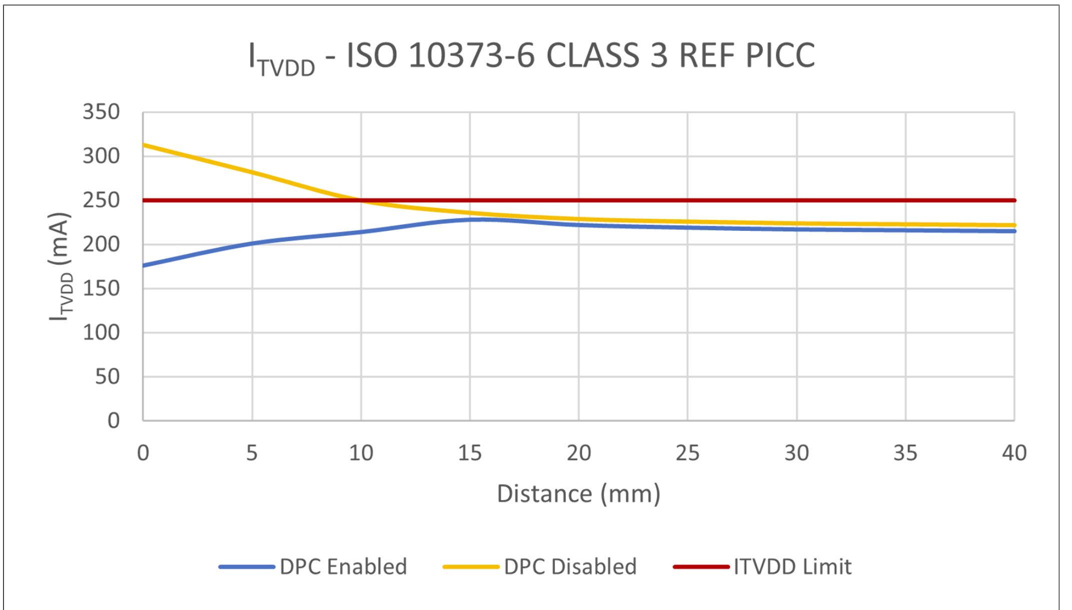


Figure 7. PCD - TX driver current

If the limit/field strength is exceeded even when DPC is activated. Then the LUT entry must be adapted accordingly (see Section 9) or higher matching target impedance should have taken into account.

5 DPC configuration

As described in PN7160 user manual (see [4]), DPC_CONFIG parameter allows enabling and configuring the DPC feature.

Table 2. DPC Configuration in E²PROM

Name and Rights	Description	Extension Tag	Length	Default Value
DPC_CONFIG **RW in E²PROM**	Settings to enable or disable the DPC	0xA0 0x0B	87	N/A

Byte 0 of DPC_CONFIG parameter defines how DPC feature is enabled or disabled:

- Bit[7] = DPC in Reader/Initiator Passive: 0: disabled, 1: enabled
- Bit[6] = DPC in Initiator Active: 0: disabled, 1: enabled
- Bit[5] = DPC in Target Active: 0: disabled, 1: enabled
- Bits[4:0] = must not be changed

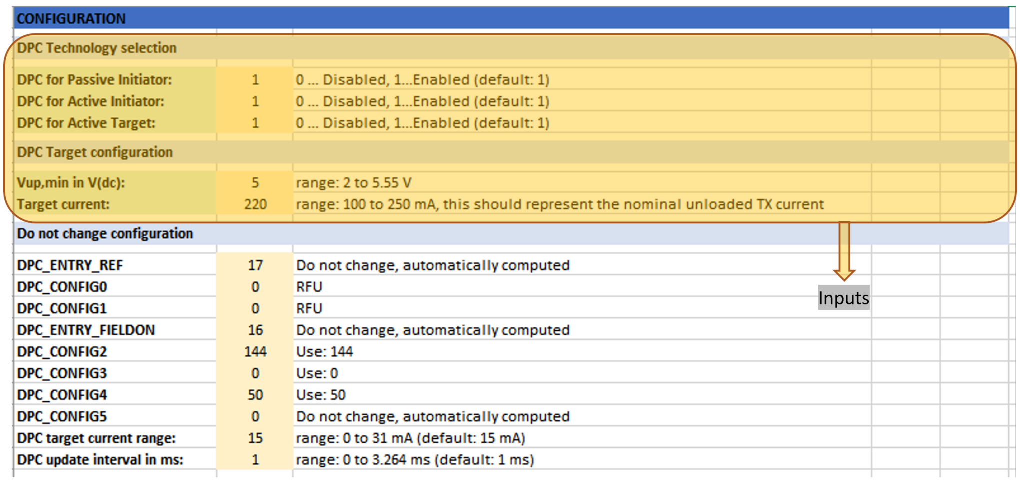
Bytes 7 to 86 of DPC_CONFIG parameter defines DPC lookup table (20 entries), each entry being defined of 4 bytes.

6 DPC configuration table

Computation of the LUT entries must be done using the PN7160 DPC configuration table (see [3]). This table helps building the appropriate NCI command to configure PN7160 DPC feature.

The following parameters impact the calculation of the TX settings of the DPC LUT entries and must be filled to the DPC configuration table "DPC config" sheet:

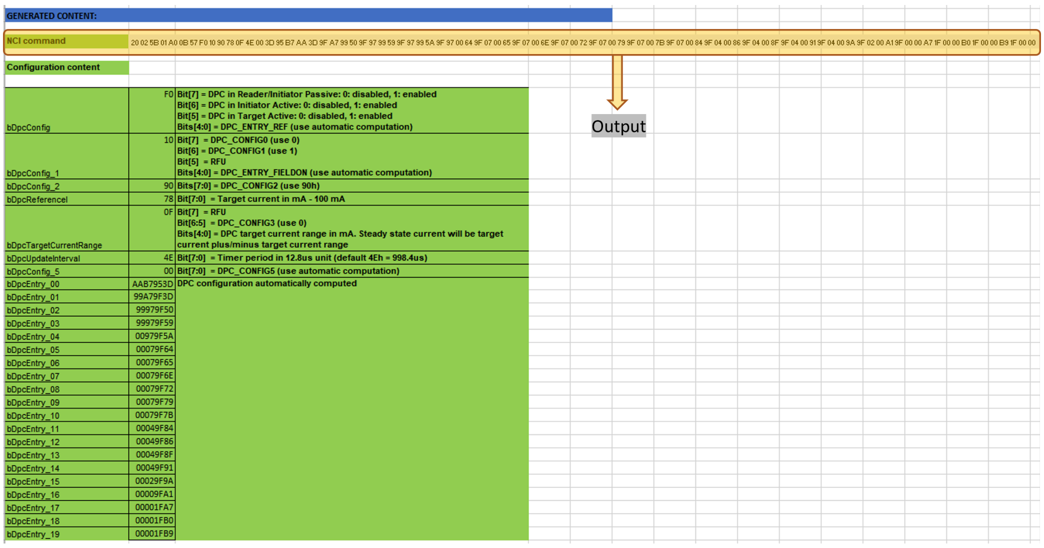
- VDD(up): Voltage that is provided to supply the TXLDO
- Target current: NXP recommends targeting 220 mA
- DPC enable or disable for different modes



CONFIGURATION		
DPC Technology selection		
DPC for Passive Initiator:	1	0 ... Disabled, 1...Enabled (default: 1)
DPC for Active Initiator:	1	0 ... Disabled, 1...Enabled (default: 1)
DPC for Active Target:	1	0 ... Disabled, 1...Enabled (default: 1)
DPC Target configuration		
Vup,min in V(dc):	5	range: 2 to 5.55 V
Target current:	220	range: 100 to 250 mA, this should represent the nominal unloaded TX current
Do not change configuration		
DPC_ENTRY_REF	17	Do not change, automatically computed
DPC_CONFIG0	0	RFU
DPC_CONFIG1	0	RFU
DPC_ENTRY_FIELDON	16	Do not change, automatically computed
DPC_CONFIG2	144	Use: 144
DPC_CONFIG3	0	Use: 0
DPC_CONFIG4	50	Use: 50
DPC_CONFIG5	0	Do not change, automatically computed
DPC target current range:	15	range: 0 to 31 mA (default: 15 mA)
DPC update interval in ms:	1	range: 0 to 3.264 ms (default: 1 ms)

Figure 8. DPC configuration table "DPC config" sheet

The appropriate DPC NCI command is generated as output.



GENERATED CONTENT:		
NCI command	20 02 5B 01 A0 0B 57 F0 10 90 78 0F 4E 00 3D 95 B7 AA 3D 9F A7 99 50 9F 97 99 59 9F 97 99 5A 9F 97 00 64 9F 07 00 65 9F 07 00 6E 9F 07 00 72 9F 07 00 79 9F 07 00 7B 9F 07 00 84 9F 04 00 86 9F 04 00 8F 9F 04 00 91 9F 04 00 9A 9F 02 00 A1 9F 00 00 A7 1F 00 00 B0 1F 00 00 B9 1F 00 00	
Configuration content		
bDpcConfig	F0	Bit[7] = DPC in Reader/Initiator Passive: 0: disabled, 1: enabled Bit[6] = DPC in Initiator Active: 0: disabled, 1: enabled Bit[5] = DPC in Target Active: 0: disabled, 1: enabled Bits[4:0] = DPC_ENTRY_REF (use automatic computation)
bDpcConfig_1	10	Bit[7] = DPC_CONFIG0 (use 0) Bit[6] = DPC_CONFIG1 (use 1) Bit[5] = RFU Bits[4:0] = DPC_ENTRY_FIELDON (use automatic computation)
bDpcConfig_2	90	Bits[7:0] = DPC_CONFIG2 (use 90h)
bDpcReferenceI	78	Bit[7:0] = Target current in mA - 100 mA
bDpcTargetCurrentRange	0F	Bit[7] = RFU Bit[6:5] = DPC_CONFIG3 (use 0) Bits[4:0] = DPC target current range in mA. Steady state current will be target current plus/minus target current range
bDpcUpdateInterval	4E	Bit[7:0] = Timer period in 12.8us unit (default 4Eh = 998.4us)
bDpcConfig_5	00	Bit[7:0] = DPC_CONFIG5 (use automatic computation)
bDpcEntry_00	AAB7953D	DPC configuration automatically computed
bDpcEntry_01	99A79F3D	
bDpcEntry_02	99979F50	
bDpcEntry_03	99979F59	
bDpcEntry_04	00979F5A	
bDpcEntry_05	00079F64	
bDpcEntry_06	00079F65	
bDpcEntry_07	00079F6E	
bDpcEntry_08	00079F72	
bDpcEntry_09	00079F79	
bDpcEntry_10	00079F7B	
bDpcEntry_11	00049F84	
bDpcEntry_12	00049F86	
bDpcEntry_13	00049F8F	
bDpcEntry_14	00049F91	
bDpcEntry_15	00029F9A	
bDpcEntry_16	00009FA1	
bDpcEntry_17	00001FA7	
bDpcEntry_18	00001FB0	
bDpcEntry_19	00001FB9	

Figure 9. Generated DPC NCI command

7 DPC configuration steps

To configure the DPC, it is necessary to measure the current of the IC when the device has no load (on free air, far from any object that can load the device antenna). A dedicated PN7160 NCI command (Antenna self-test, see [4]) allows to retrieve the current internally measured during field ON.

Follow the instructions to activate and set up the DPC:

7.1 Disable DPC

It can be done with the help of the ***NFC Factory Test application*** (See[5]). Just send the following command via "**Set proprietary parameters value**" function.

```
20 02 5B 01 A0 0B 57 10 10 90 72 0F 4E 00 3F 95 B7 AA 3F 9F A7 99
52 9F 97 99 5B 9F 97 99 5D 9F 97 00 66 9F 07 00 68 9F 07 00 72 9F
07 00 75 9F 07 00 7D 9F 07 00 7F 9F 07 00 88 9F 04 00 8A 9F 04 00
93 9F 04 00 95 9F 04 00 9E 9F 02 00 A6 9F 00 00 AB 1F 00 00 B5 1F
00 00 BE 1F 00 00
```

See the example:

- **Tag ID:** A00B
- **Length:** 57
- **Value:** 10 10 90 ……. 1F 00 00

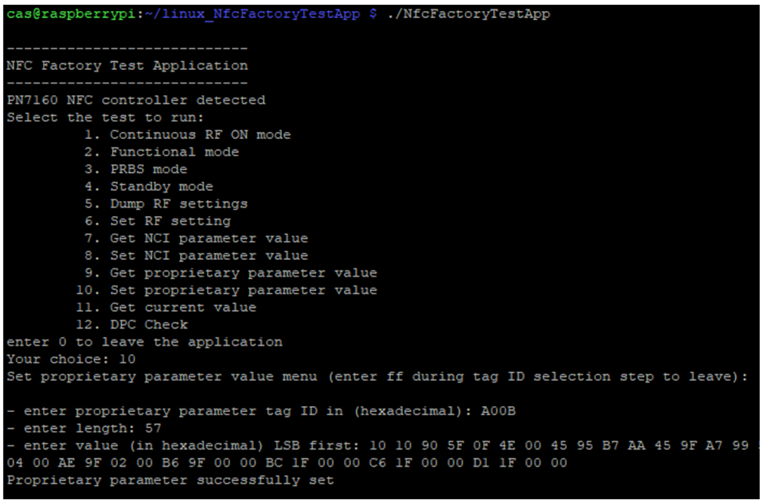


Figure 10. DPC Disable using the NFC Factory Test application

7.2 Measure the current (I_{TVDD})

Using your maximum TVDD configuration, measure the current with Antenna self-test 1 command: `2F 3D 02 01 80`.

For this, the ***NFC Factory Test application*** can be used as well. For example, the application can be extended as shown below.

The following part of the code has been added to the *NfcFactoryTestApp.c* main code.

```
static void current (int handle)
{
    char get[] = {0x2F, 0x3D, 0x02, 0x01, 0x00};
    char Answer[255];
    unsigned int temp;

    printf("Get current value (enter 'ff' during tag ID selection step to leave):\n");

    while (1)
    {
 printf("\n");

 printf("- enter 80 to get current value (hexadecimal): ");
 scanf("%x", &temp);

 if(temp == 0xff) break;

 get[4] = (char) temp;

 tml_transceive(handle, get, sizeof(get), Answer, sizeof(Answer));

 if ((Answer[0] != 0x4F) || (Answer[1] != 0x3D) || (Answer[3] != 0x00)) {
     printf("Error, cannot get parameter value\n");
        }
 else {
        printf("\n");
        printf("Current raw value= %.2Xh" , Answer[4]);
        printf("\n");
        printf("Range (00h->20 mA / 01h->60 mA / 02h->120 mA / 03h->160 mA)= %.2X  ", Answer[5]);
        printf("\n");
        }
    }
}
```

Also these two lines have been added to the "*do-while loop*" at the end of the *NfcFactoryTestApp.c* code.

```
printf("\t11. Get current value\n");
```

```
case 11: current(nHandle); break;
```

See the example of the current measurement using the NFC Factory Test application:

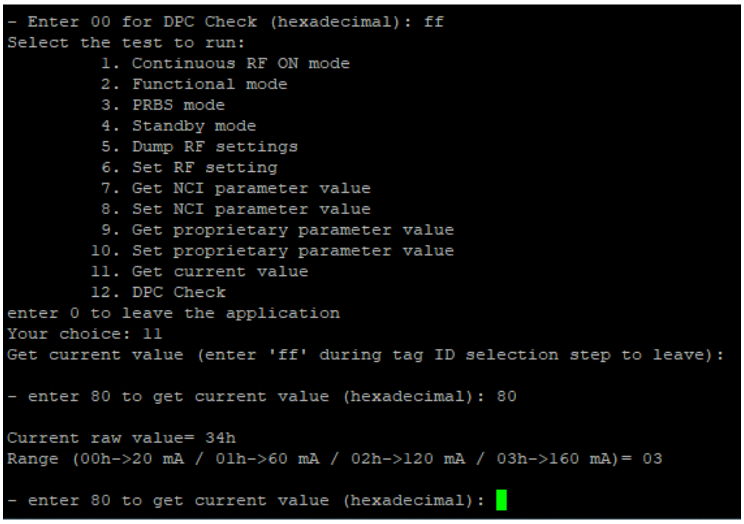


Figure 11. Current measurement

NCI Response is: `4F 3D 05 00` **`34 03`** `00 00`

Where:

- Response 6th byte indicates the measured **Range** 00h->20 mA / 01h->60 mA / 02h->120 mA / 03h->160 mA.
- Response 5th byte indicates the measured **Current raw value**: example 34_{hex} = 52_{dec}=52 mA

So the total current is 160 + 52 = **212 mA**

If the current is not the targeted value (i.e: 220 mA +/- 10 mA) reduce or increase matching impedance and repeat the measurement.

7.3 Generate DPC NCI command

Use the measured current value as the target current input of the configuration table *PN7160_PN81T_DPC_Config_Template_CAS_v1.0.xls* provided by NXP to create the NCI command.

For this example:

- **DPC for Passive Initiator** = 1
- **DPC for Active Initiator** = 1
- **DPC for Active Target** = 1
- **Vup,min in V(dc)** = 5 V
- **Target current** = 212 mA

CONFIGURATION		
DPC Technology selection		
DPC for Passive Initiator:	1	0 ... Disabled, 1...Enabled (default: 1)
DPC for Active Initiator:	1	0 ... Disabled, 1...Enabled (default: 1)
DPC for Active Target:	1	0 ... Disabled, 1...Enabled (default: 1)
DPC Target configuration		
Vup,min in V(dc):	5	range: 2 to 5.55 V
Target current:	212	range: 100 to 250 mA, this should represent the nominal unloaded TX current
Do not change configuration		
DPC_ENTRY_REF	17	Do not change, automatically computed
DPC_CONFIG0	0	RFU
DPC_CONFIG1	0	RFU
DPC_ENTRY_FIELDON	16	Do not change, automatically computed
DPC_CONFIG2	144	Use: 144
DPC_CONFIG3	0	Use: 0
DPC_CONFIG4	50	Use: 50
DPC_CONFIG5	0	Do not change, automatically computed
DPC target current range:	15	range: 0 to 31 mA (default: 15 mA)
DPC update interval in ms:	1	range: 0 to 3.264 ms (default: 1 ms)
GENERATED CONTENT:		
NCI command	20 02 5B 01 A0 0B 57 F0 10 90 70 0F 4E 00 40 95 B7 AA 40 9F A7 99 53 9F 97 99 5C 9F 97 99 5E 9F 97 00 67 9F 07 00 69 9F 07 00 73 9F 07 00 76 9F 07 00 7E 9F 07 00 80 9F 07 00 89 9F 04 00 8B 9F 04 00 95 9F 04 00 96 9F 04 00 A0 9F 02 00 A7 9F 00 00 AD 1F 00 00 B7 1F 00 00 C0 1F 00 00	

Figure 12. DPC Configuration table

7.4 Configurate DPC in EEPROM

Configure the DPC using the NCI command obtained from the configuration table.

For this example, the command is: `20 02 5B 01 A0 0B 57 F0 10 90 72 0F 4E 00 3F 95 B7 AA 3F 9F A7 99 52 9F 97 99 5B 9F 97 99 5D 9F 97 00 66 9F 07 00 68 9F 07 00 72 9F 07 00 75 9F 07 00 7D 9F 07 00 7F 9F 07 00 88 9F 04 00 8A 9F 04 00 93 9F 04 00 95 9F 04 00 9E 9F 02 00 A6 9F 00 00 AB 1F 00 00 B5 1F 00 00 BE 1F 00 00`

For the configuration, the **NFC Factory Test application** can be used. The settings are done via "**Set proprietary parameters value**" function.

- **Tag ID:** A00B
- **Length:** 57
- **Value:** F0 10 90 ……. 1F 00 00

See the example:

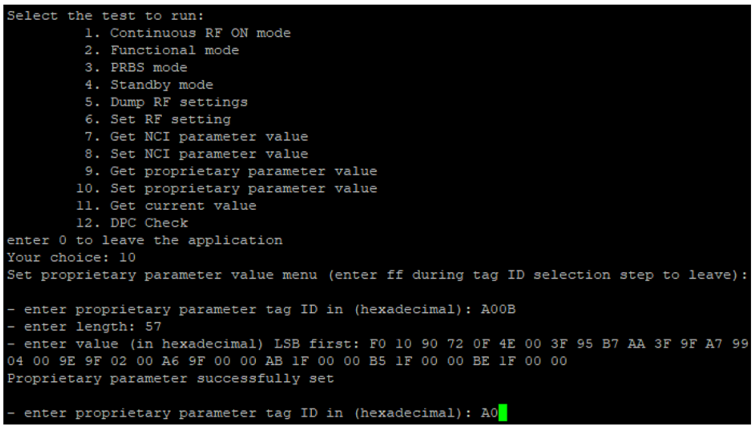


Figure 13. DPC Settings

Once the parameter is successfully set, the **DPC is activated** for the target current 212 mA +-10mA

8 DPC function check

When the DPC is activated it is possible to have some information about the DPC parameters, such as the measured current and the DPC entry used.

It is the purpose of PN7160 proprietary NCI command/response:

- command: 2F 3F 03 03 00 00
- response: 4F 3F *lengthstatus* "**B1B2**" "B3 B4" "B5 B6" "B7 B8"…....
  Where:
  - *status*: 00h indicates success, other value indicates error
  - *length*: from 1 up to 250, depending on the number of DPC interactions
  - **B1**: Measured Current (hexadecimal)/2
  - **B2**: Previous LUT index used

The DPC configuration table "DPC helper" sheet can be used to interpret graphically the result of the measurement.

For the DPC check, the ***NFC Factory Test application*** can be used.

For example, the application can be extended as shown below.

The following part of the code has been added to the *NfcFactoryTestApp.c* main code.

```
static void DPC (int handle)
{
    char get[] = {0x2F, 0x3F, 0x03, 0x03, 0x00, 0x00};
    char Answer[255];
    unsigned int temp;

    printf("DPC Check (enter 'ff' during tag ID selection step to leave):\n");

    while (1)
    {
 printf("\n");

 printf("- Enter 00 for DPC Check (hexadecimal): ");
 scanf("%x", &temp);

 if(temp == 0xff) break;

 get[5] = (char) temp;

 tml_transceive(handle, get, sizeof(get), Answer, sizeof(Answer));

 if ((Answer[0] != 0x4F) || (Answer[1] != 0x3F) || (Answer[3] != 0x00)) {
     printf("Error, cannot get parameter value\n");
        }
 else {
            printf("DPC check parameters=");
            printf("\n");
            printf("byte0 %.2Xh" , Answer[0]);
            printf("\n");
            printf("byte1 %.2Xh" , Answer[1]);
            printf("\n");
            printf("Lenght %.2Xh" , Answer[2]);
            printf("\n");
            printf("Status(00h OK) %.2Xh" , Answer[3]);
            printf("\n");
            printf("B1 %.2Xh" , Answer[4]);
            printf("\n");
            printf("B2 %.2Xh" , Answer[5]);
            printf("\n");
            printf("B3 %.2Xh" , Answer[6]);
            printf("\n");
            printf("B4 %.2Xh" , Answer[7]);
            printf("\n");
            printf("B5 %.2Xh" , Answer[8]);
            printf("\n");
            printf("B6 %.2Xh" , Answer[9]);
            printf("\n");
            printf("B7 %.2Xh" , Answer[10]);
            printf("\n");
            printf("B8 %.2Xh" , Answer[11]);
            printf("\n");
            printf("...");
            printf("\n");
        }
    }
}
```

Also these two lines have been added to the "d*o-while loop*" at the end of the *NfcFactoryTestApp.c* code.

```
printf("\t12. DPC Check\n");
```

```
case 12: DPC(nHandle); break;
```

Typically, The **B1** - **B8** is enough for the DPC checking. If required, the code can be extended to display more **B** values.

See the example below:

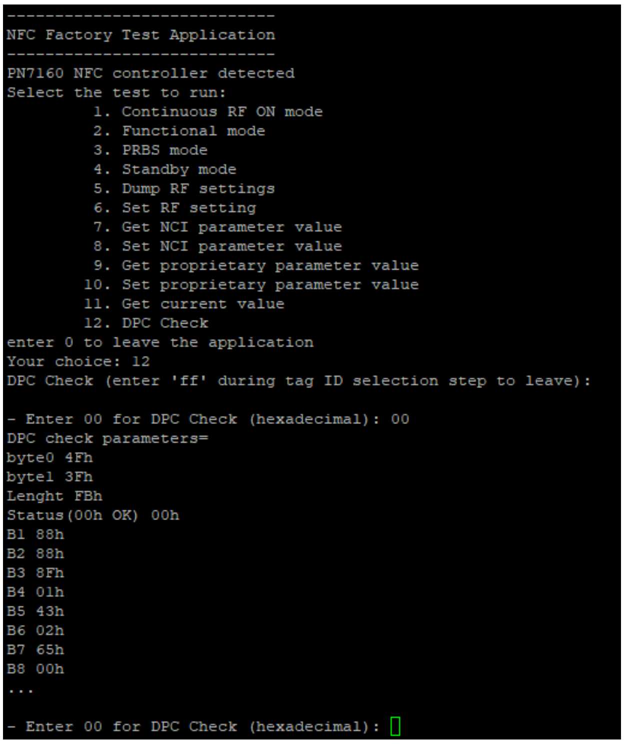


Figure 14. DPC Check - PICC placed directly on the PN7160 Antenna

As the output from the NFC Factory Test Application, the following data has been received.

`4F 3F FB 00` **`88 88 8F 01 43 02 65 00`**

The data has been inputted to the DPC configuration table "**DPC helper**" sheet. The result is shown below.

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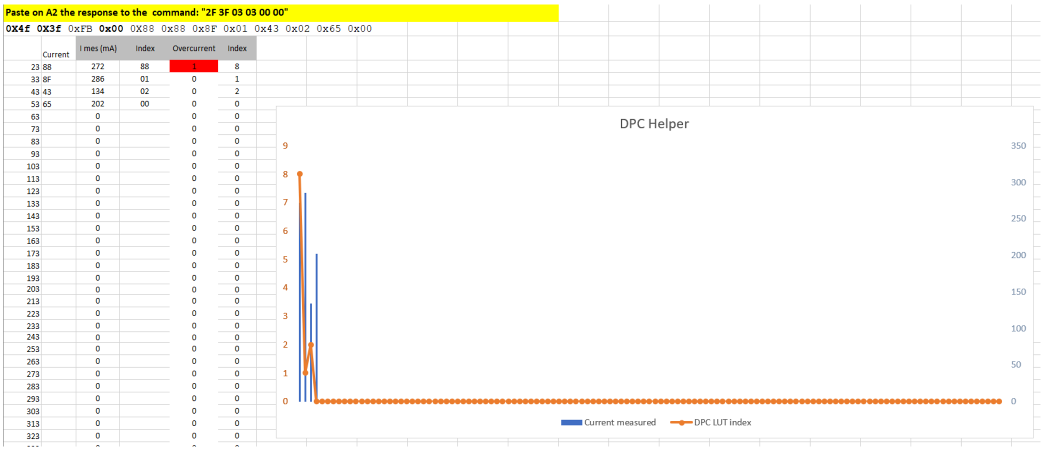

Figure 15. DPC configuration table "DPC helper" sheet

The figure shows the power regulation for PICC placed on the PN7160 Antenna. The current is regulated from 272 mA to approx. 202 mA.

9 DPC debug

If there is a fail during a test case, like power emission test case (where DUT power emission is measured) or a waveform shape measurement, it is possible to adapt the LUT entry used during the test.

The recommended steps are:

1. Use DPC helper command (see Section 8) to identify which entry is used during the test case
2. In case of FAIL:
   a. Check power emission test first:
      i. Use I reduction table, to reduce the power.
      ii. Use GSN if I reduction is not sufficient (note that value 0 shall not be used)
   b. Check waveforms:
      i. Use TX residual / Tau rising and falling to modify waveforms

Several parameters can be adjusted on DPC, to adapt the customer design to DPC. For each entry we can adapt the following parameters:

Reference Entry: 16	Voltage	Index Active (BYTE 1, 7)	GSN Values (CW + MOD) (BYTE 1, 3:0)	TxResidualCarrierChange (BYTE 2, 7:4)	Iref Reduction * 8 mA (BYTE 2, 3:0)	TauModFallingChange (BYTE 3, 7:4)	TauModRisingChange (BYTE 3, 3:0)	Config
bDpcEntry_00	1.7	1	F	0	0	0	0	00009F3D
bDpcEntry_01	1.7	1	F	0	0	0	0	00009F3D
bDpcEntry_02	2.2	1	F	0	0	0	0	00009F50
bDpcEntry_03	2.45	1	F	0	0	0	0	00009F59
bDpcEntry_04	2.5	1	F	0	0	0	0	00009F5A
bDpcEntry_05	2.75	1	F	0	0	0	0	00009F64

Figure 16. DPC configuration table "LUT generator" sheet

More details on these parameters can be found in PN7160 RF settings guide (see [2])

9.1 Index Active

This permits to activate or deactivate the entry. It is recommended to leave this parameter unmodified.

9.2 I ref Reduction

It reduces the current by 8 mA step. This can be useful to reduce the power during a power emission test on NFC Forum.

9.3 GSN Values

This parameter impacts the impedance of TX pins. Default value is Fh, reducing the value decreases power.

It is recommended to keep the default value and rather use I ref Reduction (Section 9.2) to reduce the power.

9.4 TX residual carrier

It plays on the modulation index mainly used for Type B and Type F. Higher the value is, higher the modulation index will be.

9.5 TauModFallingChange

It modifies the falling edge of modulation shape.

9.6 TauModRisingChange

It modifies the rising edge of modulation shape.

10 References

[1] AN13219 - PN7160 Antenna design and matching guide

[2] AN13218 - PN7160 RF settings guide

[3] SW6779 - PN7160 DPC configuration table

[4] UM11495 - PN7160 user manual

[5] AN13287 - PN7160 Linux porting guide

[6] ISO/IEC FCD 10373-6 - Cards and security devices for personal identification — Test methods

[7] OM27160 - Development Kits for PN7160 Plug’n Play NFC Controller

11 Abbreviations

Table 3.

Abbr.	Meaning
A/m	Ampere per meter (magnetic field strength measurement unit)
AN	Application Note
DPC	Dynamic Power Control
DUT	Device Under Test
EMC	ElectroMagnetic Compatibility
Hmin / Hmax	Minimal and Maximum magnetic field strength
H-field	Magnetic field
IC	Integrated Circuit
ISO/IEC	International Standard Organization / International Electrotechnical Community
mA	milli Ampere
MHz	Mega Hertz
NFC	Near Field Communication
NFCC	NFC Controller (i.e. PN7160)
PC	Personal Computer
PCB	Printed-circuit board
PCD	Proximity Coupling Device (Contactless reader)
PICC	Proximity Integrated Circuit Card (Contactless card)
Q / Q-factor	Quality Factor
RF	Radiofrequency
TBD	To Be Defined
V	Voltage
Vpp	Peak to peak voltage

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