# User manual evaluation kit for NLM0011/NLM0010

## About this document

### Scope and purpose

This document describes Infineon's evaluation kit for the latest Near Field Communication (NFC) controller NLM0011/NLM0010 for LED power supply current configuration, and how to use it.

The kit provides a quick demonstration of all features of NLM0011, evaluates filter designs and starts the development process for application software.

### Intended audience

This document is intended for design and software engineers who want to improve their LED power supply current configuration application.

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# 1 Introduction

The evaluation kits EVAL_NLM0011_DC and EVAL_NLM0011_DC_RE can be seen as a tool for design and software engineers who want to use NLM0011/NLM0010. It can be used with the “NLM-PWM” mobile app or with a Feig reader.

It provides:

- Fast demonstration of all features of NLM0011, including:
  - Parameter setting (PWM frequency, operating hours, on/off counting)
  - Programming CLO table (also memory layout for making values faster without calculation)
  - Duty cycle settings and indication via LED ramp
- Evaluation of own PWM filter
- A start for the development process for application software, e.g. a Feig reader, without using a full system

# 2 Main features

The kit consists of:

- NFC board 3 to 5 V (DK_NLM_ 01)
- NFC board 5 to 25 V (DK_NLM_02)
- Demo board (DK_NLM_03)
- Product registration to get access to all information and software (including mobile app for smartphone, demo and evaluation software and user manual)
- USB cable (A to micro B)

Only included in option with Feig reader:

- Feig desktop reader ID CPR30-USB
- USB cable (A to mini B)

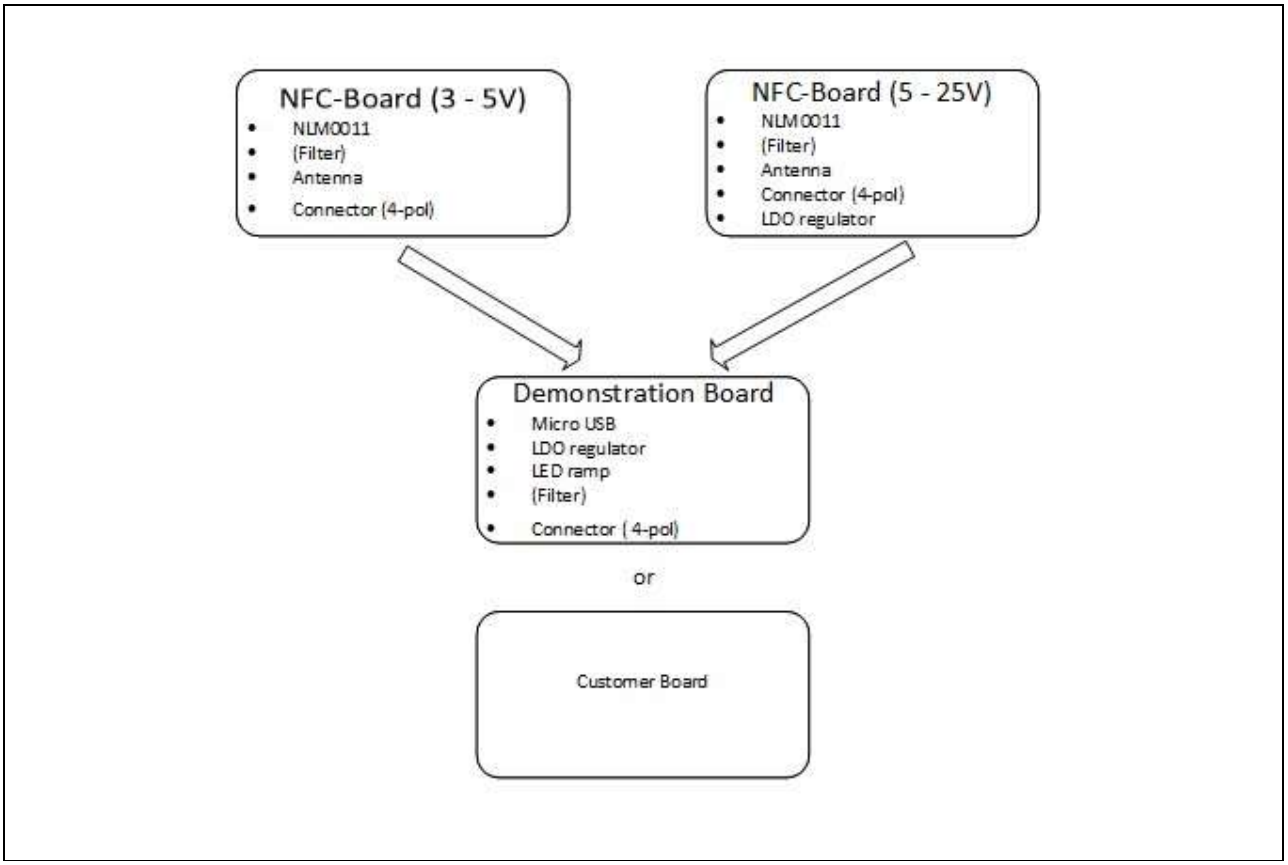



**Figure 1 Structure of the evaluation kit**

### Main features

When the mobile app is installed on an Android smartphone, or when using the Feig reader, the parameters can be set by programming the NFC boards. According to the set parameters on NFC boards, the LED ramp on the demo board displays the duty cycle (percentage of duty cycle$_{Imax}$). It is also possible to connect the NFC boards to their own applications. For this, the corresponding NFC board must be chosen. For applications with $V_{CC}$ = 3 to 5 V, use DK_NLM_02; for applications with $V_{CC}$ = 5 to 25 V, use DK_NLM_01. When using the demo board, both NFC boards can be connected. So it is also possible to start the development process for Feig application software only with this evaluation kit, without using a full system.

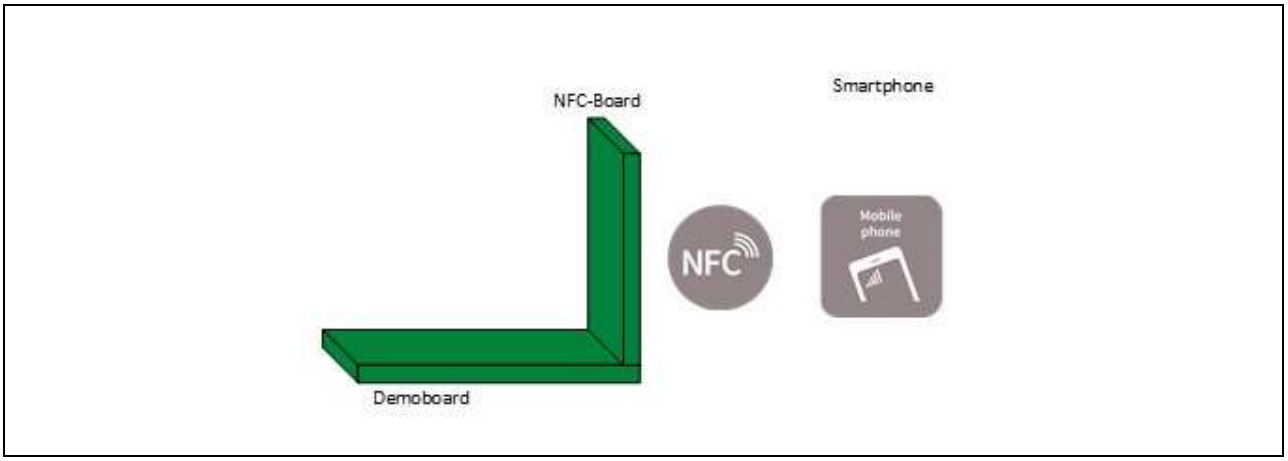



**Figure 2** **Set the parameters on NLM0011 via NFC and watch the LED ramp according to the set parameters (with preset filter on the demo board)**

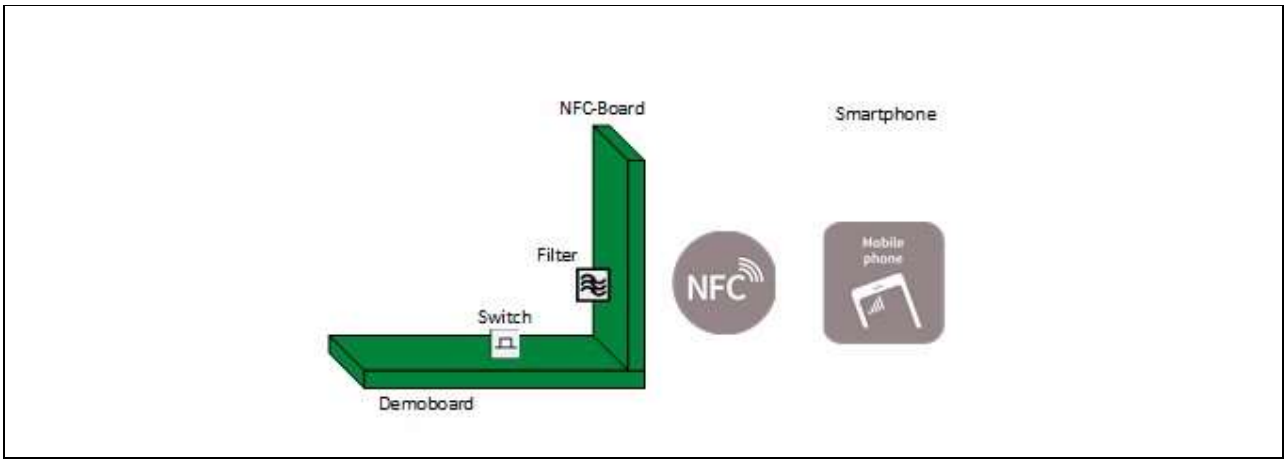



**Figure 3** **Set the parameters on NLM0011 and watch the LED ramp according to the set parameters (with own filter on the NFC board, filter on demo board disabled by the switch)**

## Main features

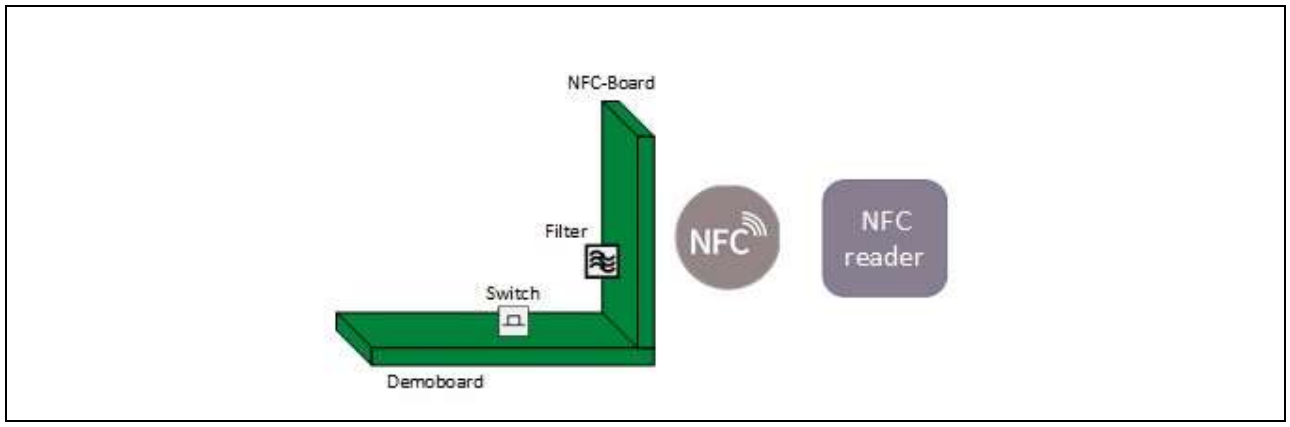



**Figure 4 Start developing process for application software for the Feig reader**

# 3 Mobile app

In order to use the mobile app, it must be installed on the smartphone and the NFC board must be in passive mode. That means it is not connected to $V_{CC}$.

***Attention:*** ***The mobile app is not suitable for production, but for quick demo purposes only.***

***Attention:*** ***Since some smartphones provide low energy, it must be ensured that a smartphone is used which provides sufficient energy via NFC.***

***Attention:*** ***The mobile app is not meant for productive use. e.g., it does not check the input fields for correct input by the user. Thus, in case of 'wrong' input by the user, the tool may react in unexpected way, i.e, write wrong data to the EEPROM.***

To install the mobile app:

- Connect the smartphone to a PC
- Move “NLM-PWM Demo.apk” from the USB stick to the phone

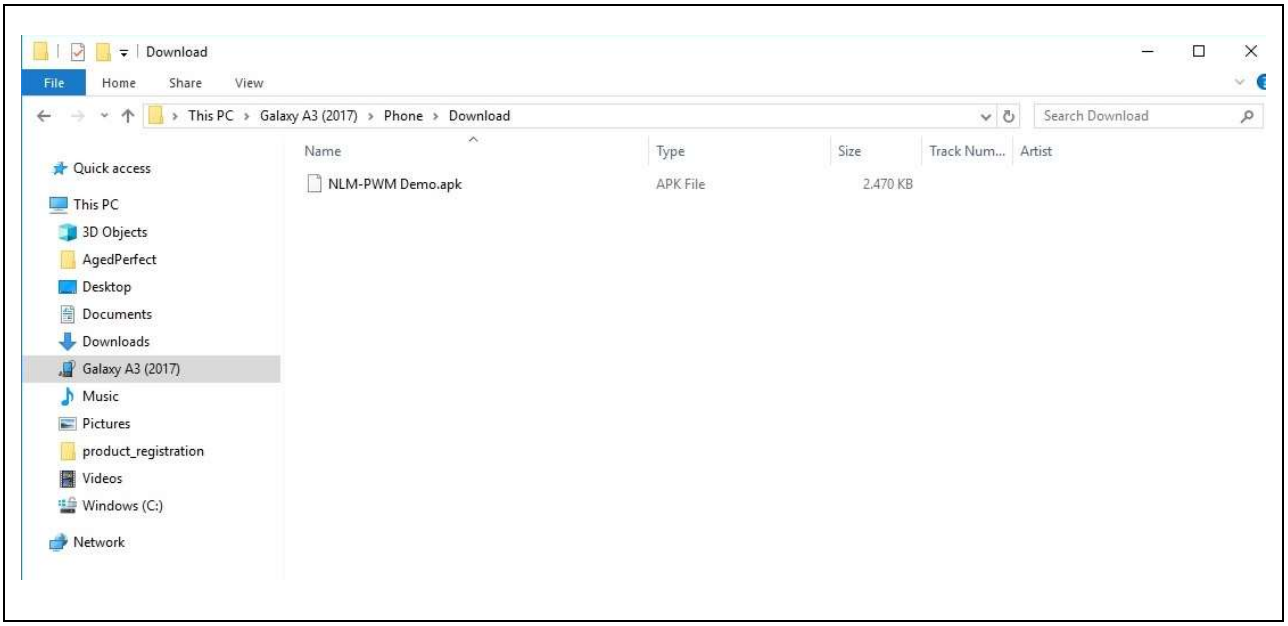



**Figure 5 Moving “NLM-PWM Demo.apk” to phone**

- Open file on phone
- Press “install” on the phone

## Mobile app

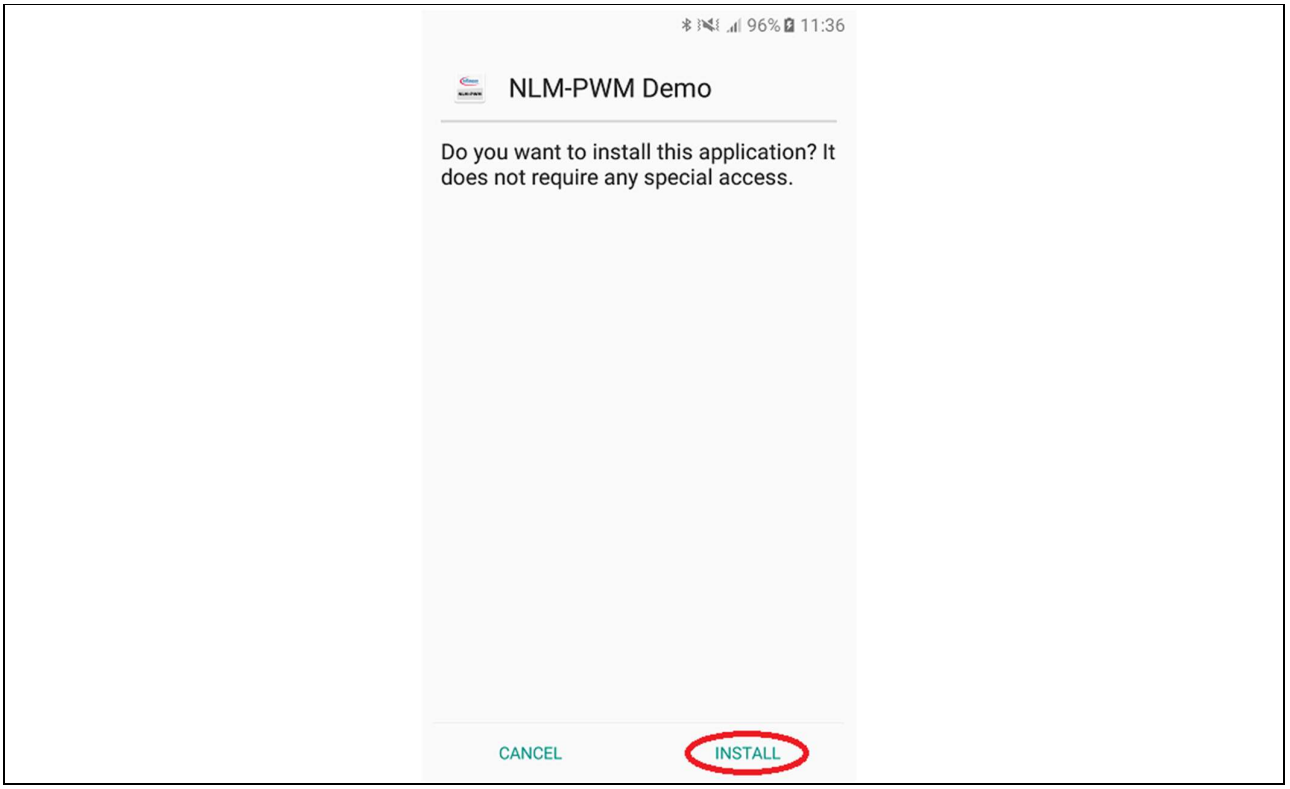



**Figure 6 Confirm installation of mobile app**

- Go to “Setting > Connections”
- Activate “NFC and Payment”

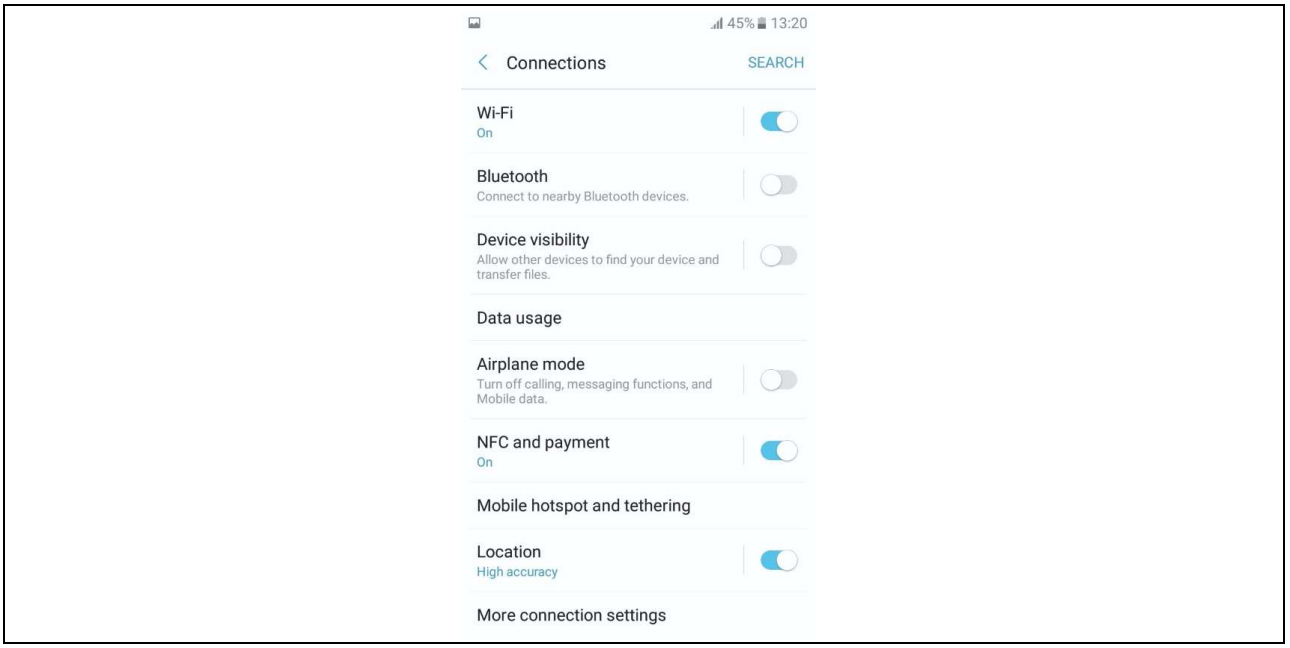



**Figure 7 Activating NFC**

**Mobile app**

- Start mobile app

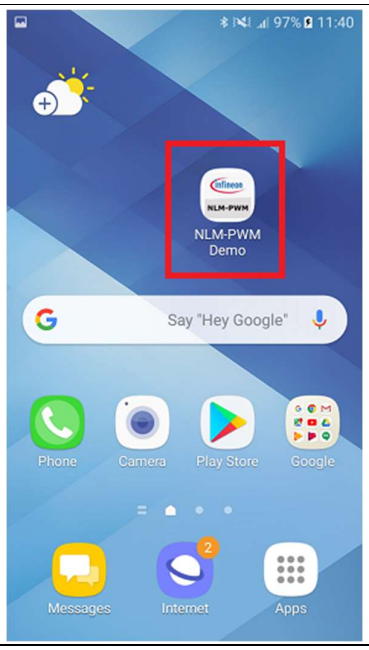



**Figure 8 Start mobile app**

Now the mobile app is ready for use.

## 3.1 Write parameters

When starting the mobile app for the first time, it looks like this:




**Figure 9 Preset parameters**

### Mobile app

Now the app is in “read mode”. To change to “write mode” tap in the top right-hand corner and deactivate “read only”.

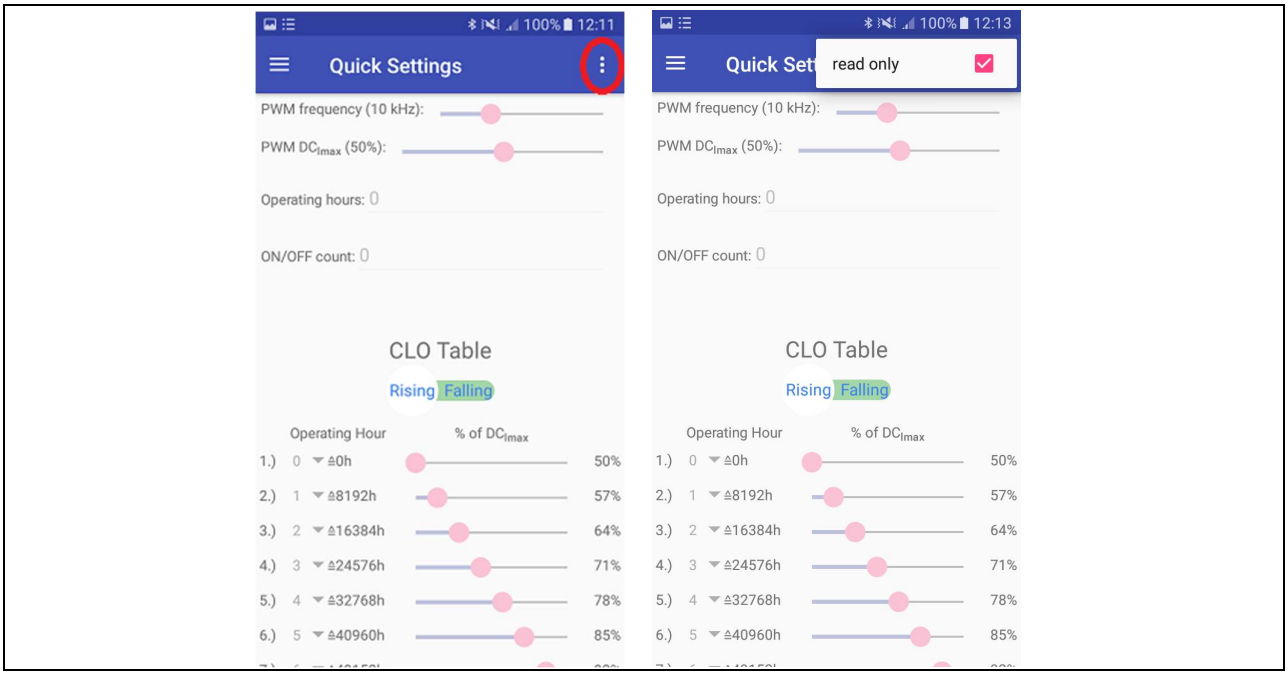



**Figure 10 Change mode**

Now the parameters can be set for:

- PWM frequency
- PWM $DC_{Imax}$
- Operating hours
- On/off count
- CLO table (8 points for operating hours and percentage of $DC_{Imax}$)
    - The value for operating hours has to be set as multiples of 8192 in a range from 0 to 15
    - The value for percentage of $DC_{Imax}$ has to be set in a range from 50 to 100 percent for rising curve and from 0 to 50 percent for falling curve
    - The slider must be set according to the chosen curve (falling or rising)

***Attention:*** ***For the CLO to work correctly, it is important that the first point for “Operating Hour” in the CLO is set to 0 hours.***

All parameters, exept for access codes, can be updated with this app.

## Mobile app

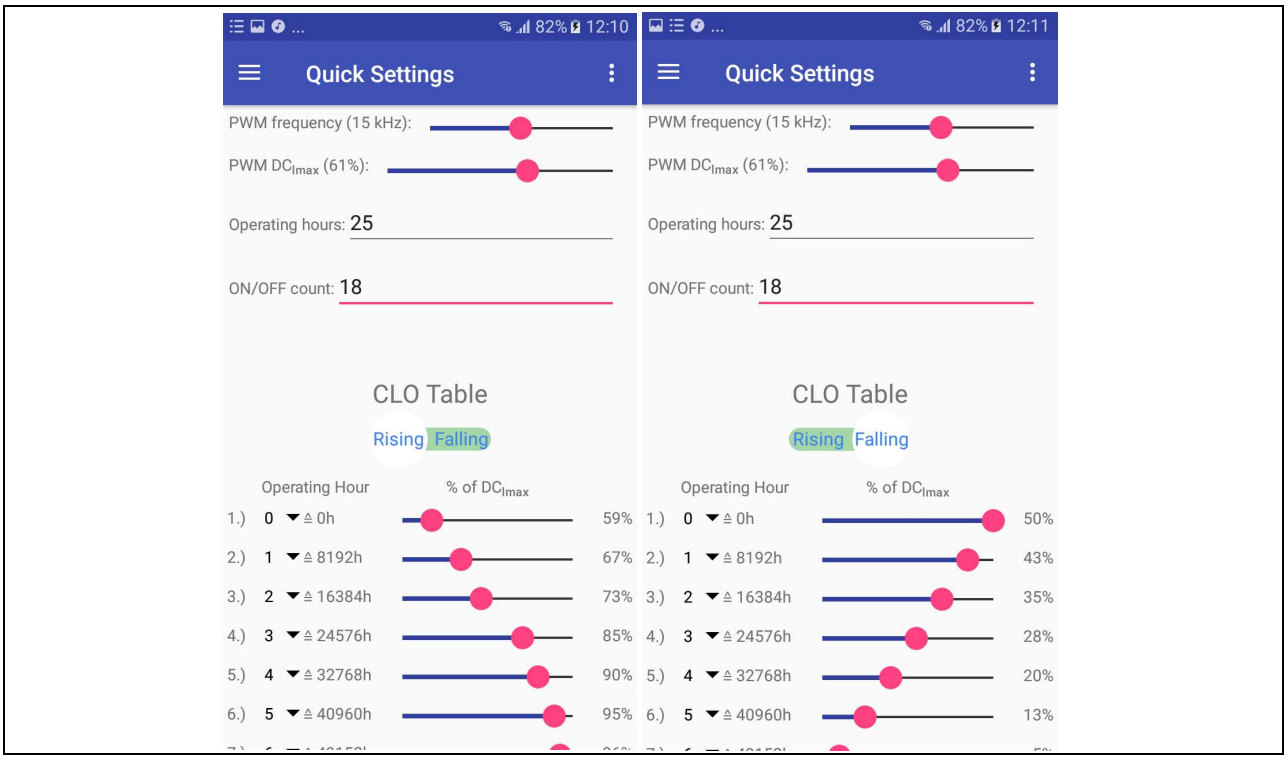



**Figure 11 Set parameters**

When all parameters are set in the app:

- Turn-on the phone's speaker.
- Position the phone close to the external NFC antenna.
- Move slowly up–down and left–right to test the antenna position inside the phone.
- When two antennas make contact, a short beep will be emitted.
- Watch the bottom line of the mobile app, where an indication of connection failure or success will pop up.
- If it is successful, the parameters entered in the mobile app are stored in EEPROM of NLM0011.

  As confirmation the app shows "Success!".
- If it fails, move the phone away and close to the antenna again to establish a new NFC connection. In case of fail the app shows "Operation failed!".

***Attention:*** ***The antenna position varies from phone to phone. So please make sure where the antenna of the smartphone is located exactly.***

***Attention:*** ***For a good antenna coupling, it is strongly recommended that the receiving and transmitting antennas are to be arranged parallel to one another and centrally above one another.***

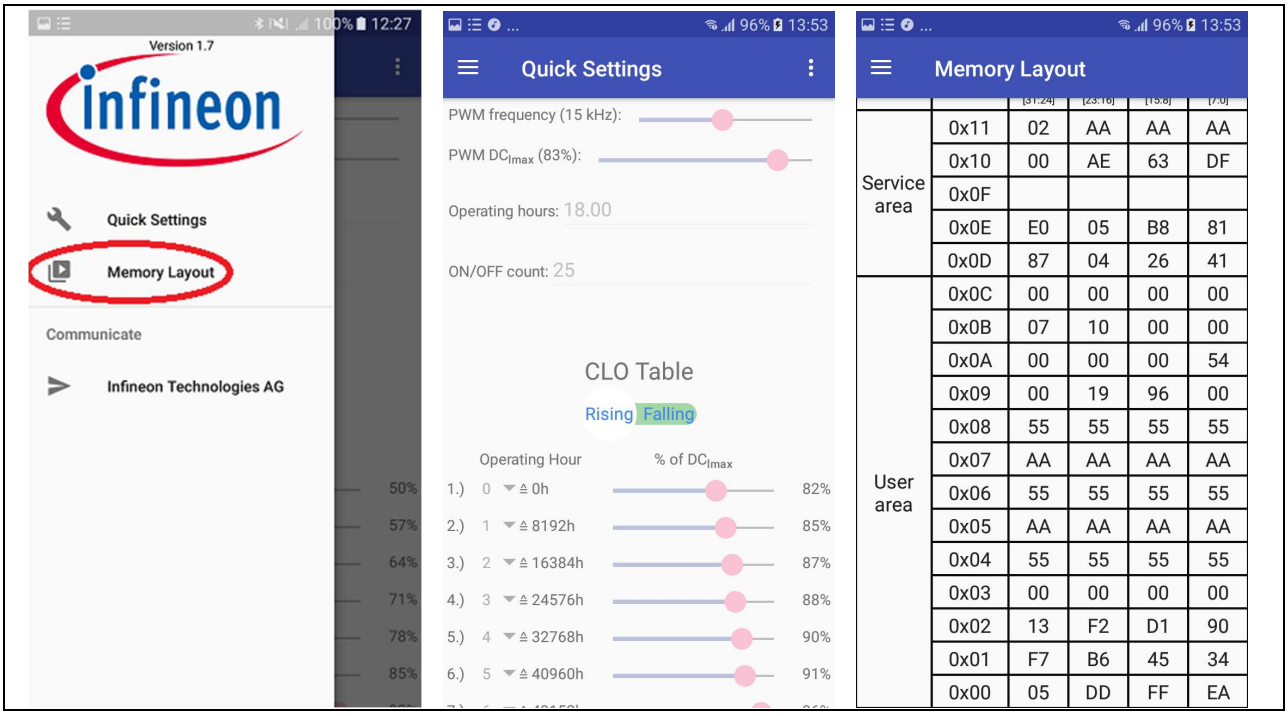
## 3.2 Read parameters

To read the EEPROM, change the mode again to “read mode” by tapping the right-hand corner of the display and activating “read only”.

Position the phone close to the external antenna again and wait until the NFC is successfully completed. The EEPROM data of NLM0011 is now read out successfully. As confirmation for reading success the app shows which type of NLM001x is detected (NLM0011 or NLM0010).

If it fails, move the phone away again and then close to the antenna to establish a new NFC connection.

The EEPROM data is visible in the “Menu” window. The EEPROM structure with data can be shown in “Memory Layout”.




| | | | | | |
|---|---|---|---|---|---|
| Service area | 0x11 | 02 | AA | AA | AA |
| | 0x10 | 00 | AE | 63 | DF |
| | 0x0F | | | | |
| | 0x0E | E0 | 05 | B8 | 81 |
| | 0x0D | 87 | 04 | 26 | 41 |
| User area | 0x0C | 00 | 00 | 00 | 00 |
| | 0x0B | 07 | 10 | 00 | 00 |
| | 0x0A | 00 | 00 | 00 | 54 |
| | 0x09 | 00 | 19 | 96 | 00 |
| | 0x08 | 55 | 55 | 55 | 55 |
| | 0x07 | AA | AA | AA | AA |
| | 0x06 | 55 | 55 | 55 | 55 |
| | 0x05 | AA | AA | AA | AA |
| | 0x04 | 55 | 55 | 55 | 55 |
| | 0x03 | 00 | 00 | 00 | 00 |
| | 0x02 | 13 | F2 | D1 | 90 |
| | 0x01 | F7 | B6 | 45 | 34 |
| | 0x00 | 05 | DD | FF | EA |

**Figure 12 Main menu, quick settings, memory layout**

In this way the mobile app can also be used for getting the hexadecimal code for the values in CLO.

***Attention:*** ***Because of internal roundings, it is not possible to set exactly 100 percent for PWM $DC_{Imax}$ in the mobile app. The highest value that can be set is 99 percent.***

# 4 FEIG reader

To select the right reader please use the selection guide on Feig website www.feig.de. It is strongly recommended to use a reader certified by Module-Driver interface Special Interest Group (MD-SIG).

For Feig readers Infineon provides two different software packages:

- NLM0011/NLM0010 Demo App
- NLM0011/NLM0010 Eval Tool

For both you have to install Java in the first step before use.

Please read the file License_Evaluation.pdf carefully.

***Attention: These tools are mentioned for demo purposes only. Do not use in production.***

***Attention: The tools are not meant for productive use, e.g., the tools do not check the input fields for correct input by the user. Thus, in case of 'wrong' input by the user, the tool may react in unexpected way, i.e, write wrong data to the EEPROM or issue unexpected JAVA error messages.***

## 4.1 NLM0011/NLM0010 Demo App

Start the NLM0011/NLM0010 Demo App by double clicking the NLM0011Demo.jar. If you encounter any problems, please read the README.TXT.

When opening the app it shows up like below:

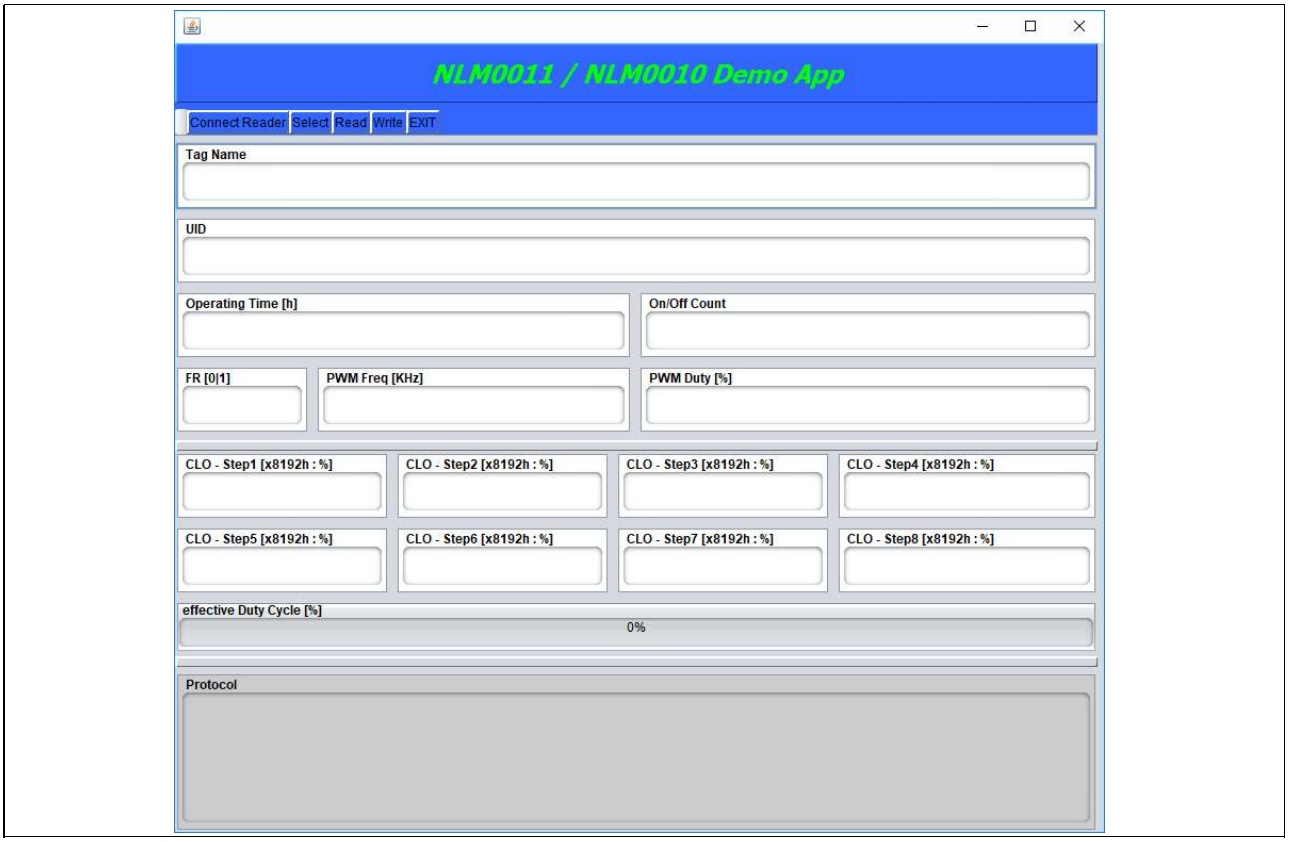



**Figure 13 NLM0011/NLM0010 Demo App**

### FEIG reader

To use the app together with a FEIG reader, please install all necessary drivers from FEIG and connect the reader to your PC.

***Attention:*** ***When using the FEIG CPR30-USB please make sure using FEIG firmware V1.07 and higher. In this case it is also recommended to set the modulation to 10 percent.***

*Note:* *According to ISO15693-3 standard, the b6 of the flags field (Nb_slots_flag) of the inventory command specifies whether 1slot or 16 slot anticollision algorithm. The NLM0011/0010 supports only the 1slot algorithm. Thus b6 of the flags field (Nb_slots_flag) of the inventory command has to be set to "1". Using the FEIG Reader built-in inventory command, please ensure that the corresponding NO-TS bit (CFG4: Transponder Parameters, Byte 4 – ISO15693-MODE, Bit 4 – NO-TS) is configured to "1" by using ISOStart (for CPR30 it is CPRStart) tool by Feig in expert mode (Configuration -> Transponder -> HF -> ISO_15693 -> Anticollision -> NoOfTimeslots = 1 timeslot). This information can also be found in the erratasheet.*

To start with the app, please connect the fully setup reader to your computer and click "Connect reader" in the top left corner of the app.

If the connection process was successful, "OK" will appear in the lower field for confirmation.

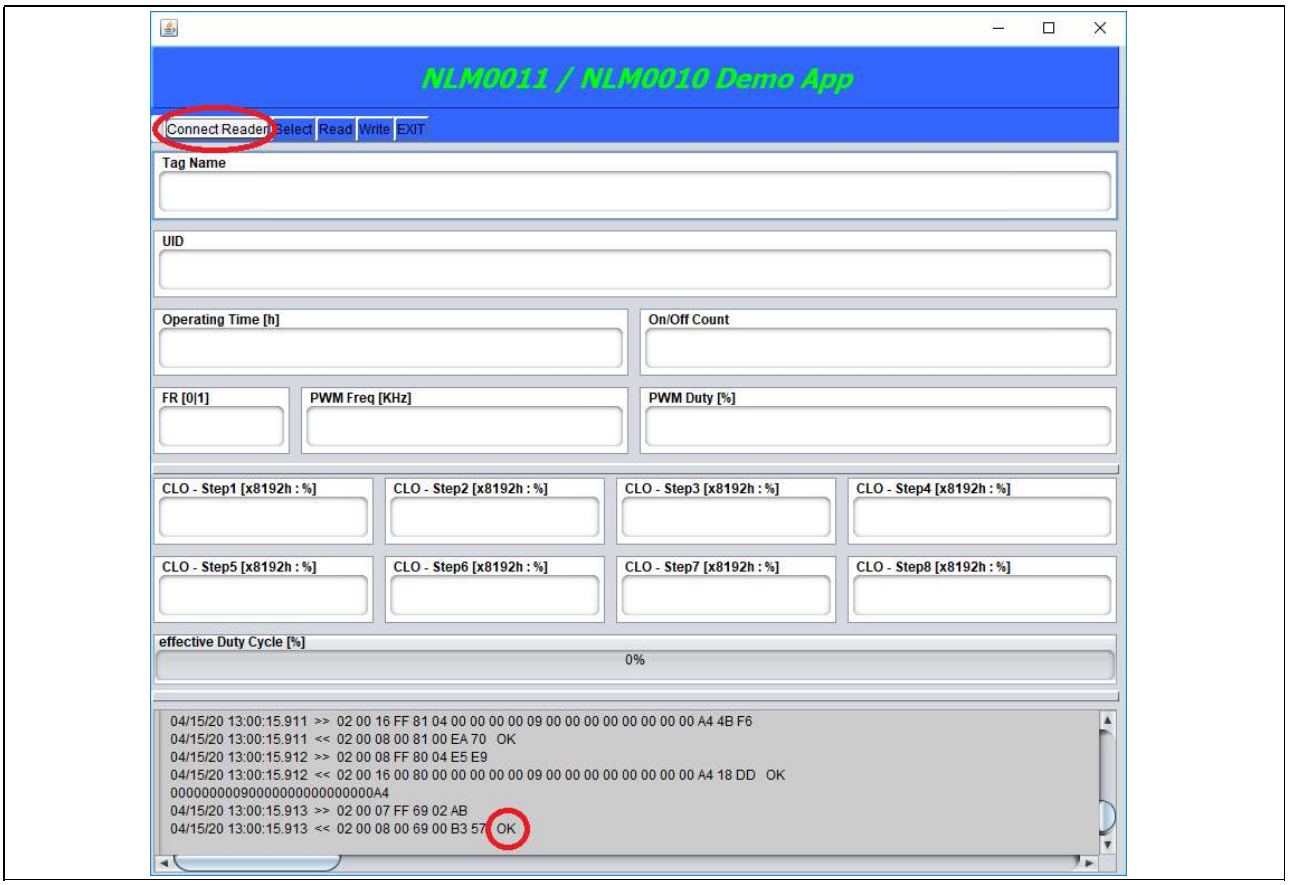



**Figure 14 Confirmation for successful reader connection**

### 4.1.1 Reading data from NLM001x

To read the stored data from EEPROM of the NLM001x, place board named “DK_NLM02”/”DK_NLM_01” on the rader antenna or, if connected already to board “DK_NLM_03” position the reader antenna parallel to the board “DK_NLM02”/”DK_NLM_01”.

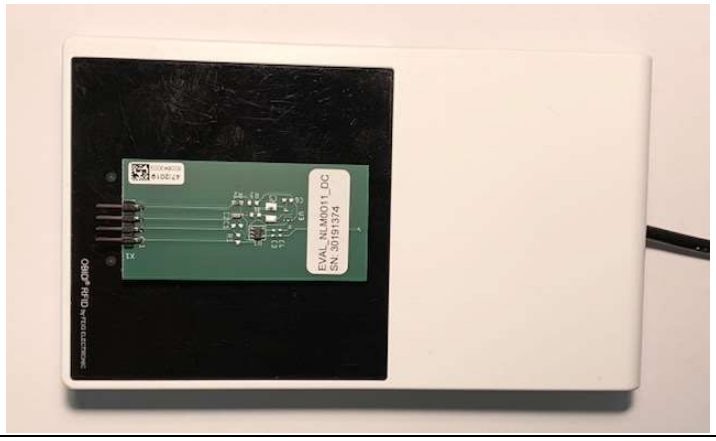



**Figure 15 Board “DK_NLM_02” placed on CPR30 reader**




**Figure 16 Connected boards placed reader antenna parallel to board antenna**

### FEIG reader

Now press “Select” to indentify the the NLM chip and afterwards press “Read” to get the data of the EEPROM.

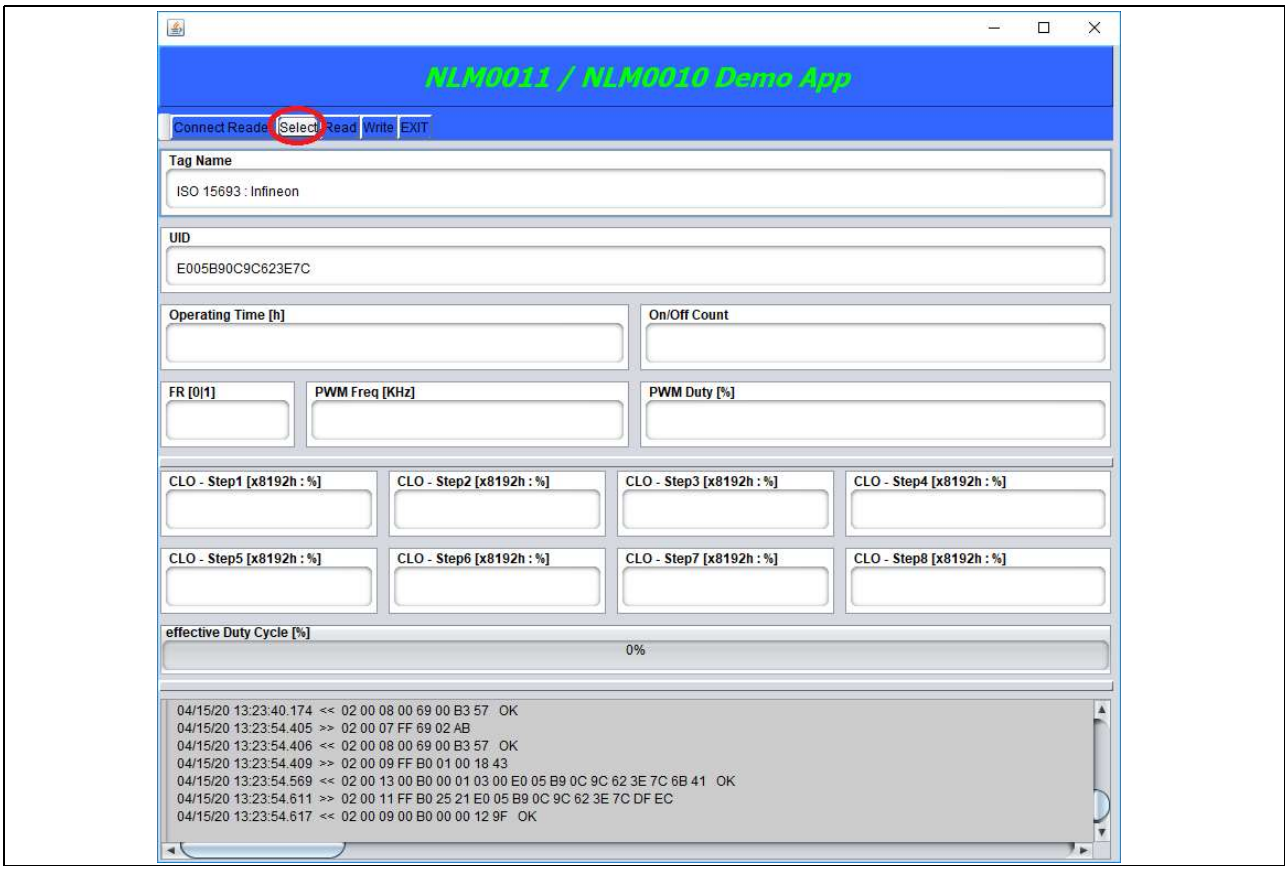



**Figure 17 “Select” view in the app**

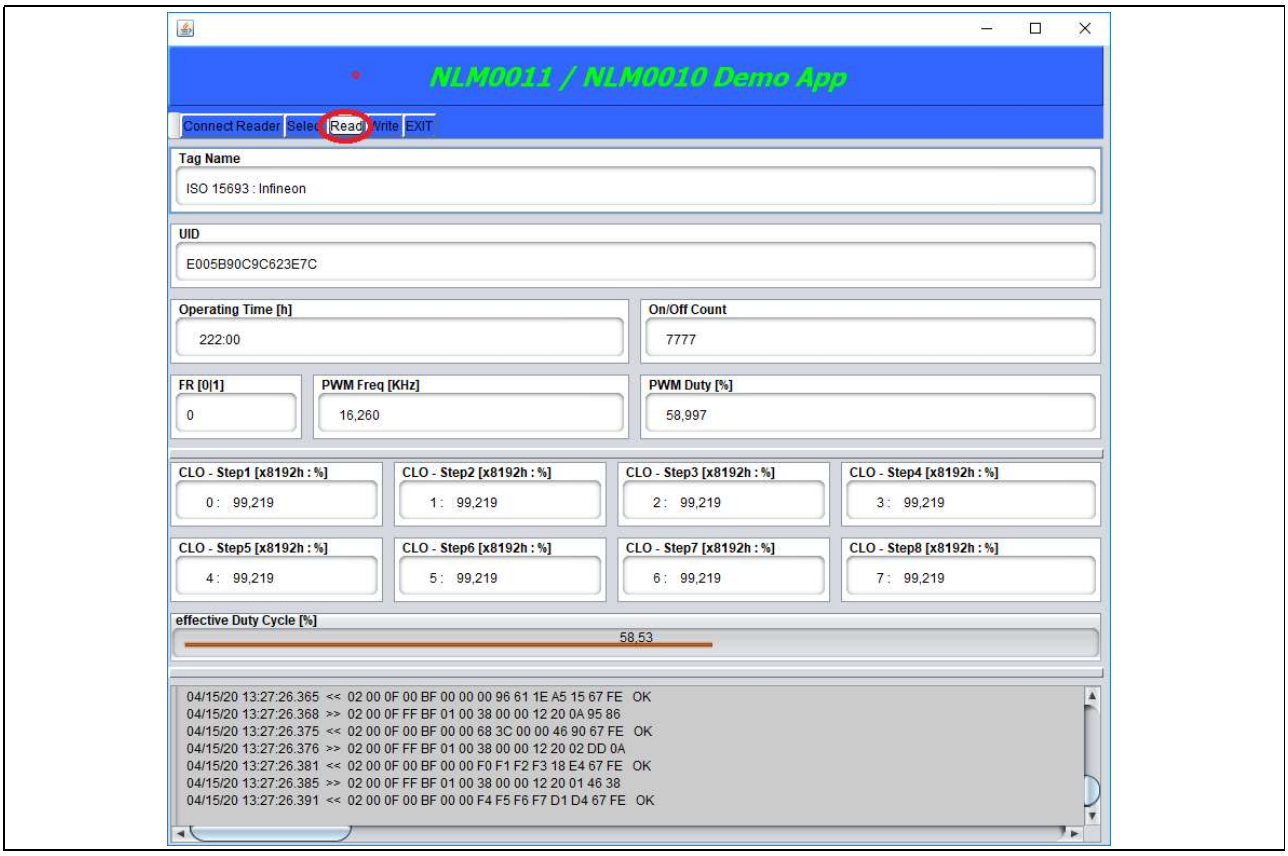



**Figure 18 “Read” view in the app**

Now the stored data of the EEPROM is shown in the app.

### 4.1.2 Setting/Writing data to NLM001x

To write data to the NLM001x, please position the board and reader like shown in chapter 4.1.1.

Type in the values you want to set.

***Attention:*** ***The app is not meant for productive usage e.g., it does not check the input fields for correct input by the user. Thus, in case of 'wrong' input by the user, the tool may react in unexpected way, i.e, write wrong data to the EEPROM or issue unexpected JAVA error messages.***

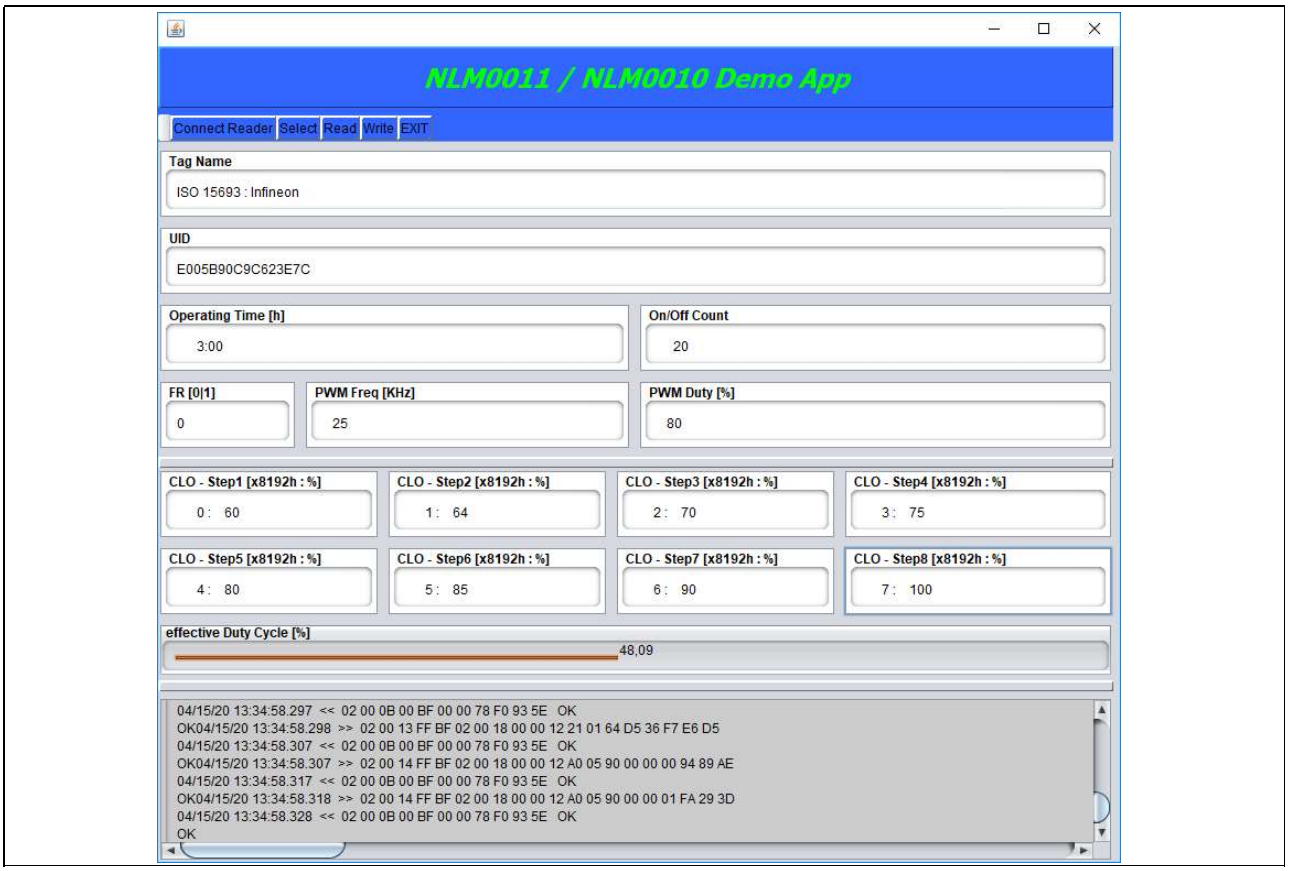



**Figure 19 Set targeted values**

To write the values into the EEPROM click “Write”. To check the values, click “Read”. The values that are now displayed differ slightly from those previously set. This is due to the internal resolution (please check datasheet and application notes for this topic).

## 4.2 NLM0011/NLM0010 Eval Tool

Start the NLM0011/NLM0010 Eval Tool by double clicking the NLM0011EvalTool.jar. If you encounter any problems, please read the README.TXT.

When opening the NLM0011/NLM0010 Eval Tool it shows up like below:

## FEIG reader

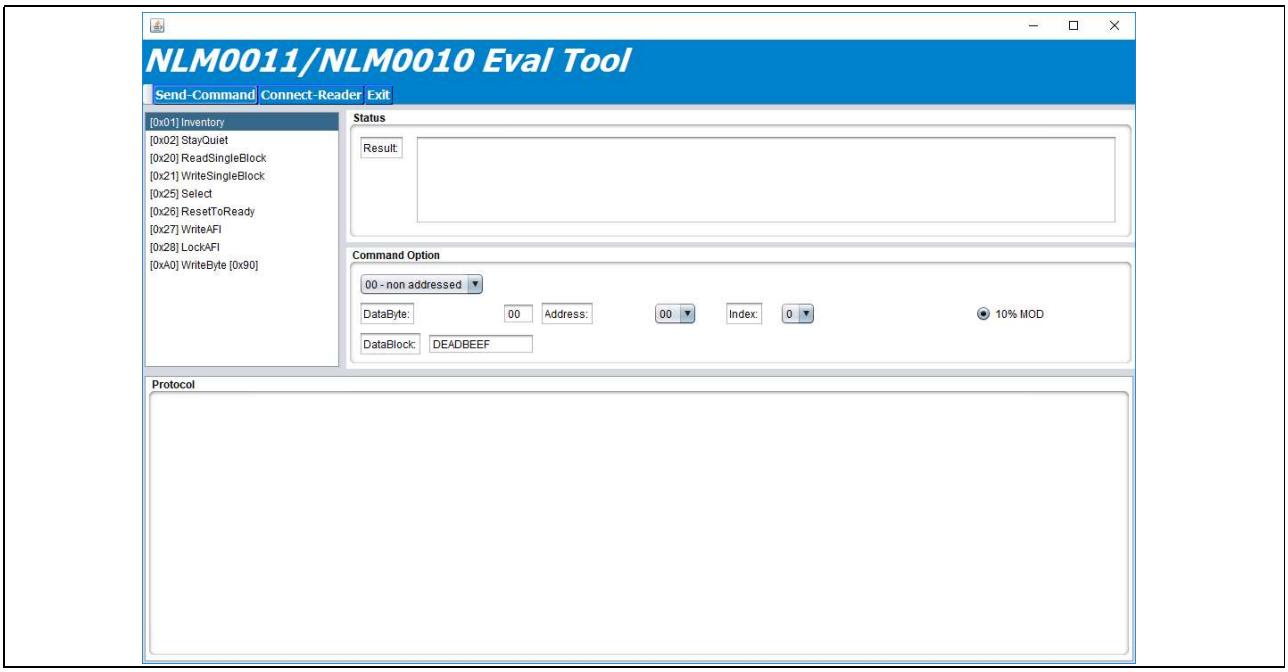



**Figure 20 NLM0011/NLM0010 Eval Tool**

To use the app together with a FEIG reader, please install all necessary drivers from FEIG and connect the reader to your PC.

***Attention:*** ***When using the FEIG CPR30-USB please make sure using FEIG firmware V1.07 and higher. In this case it is also recommended to set the modulation to 10 percent.***

*Note:* *According to ISO15693-3 standard, the b6 of the flags field (Nb_slots_flag) of the inventory command specifies whether 1slot or 16 slot anticollision algorithm. The NLM0011/0010 supports only the 1slot algorithm. Thus b6 of the flags field (Nb_slots_flag) of the inventory command has to be set to "1". Using the FEIG Reader built-in inventory command, please ensure that the corresponding NO-TS bit (CFG4: Transponder Parameters, Byte 4 – ISO15693-MODE, Bit 4 – NO-TS) is configured to "1" by using ISOStart (for CPR30 it is CPRStart) tool by Feig in expert mode (Configuration -> Transponder -> HF -> ISO_15693 -> Anticollision -> NoOfTimeslots = 1 timeslot). This information can also be found in the erratasheet.*

To start with the tool, please connect the fully setup reader to your computer and click "Connect reader" in the top left corner of the NLM0011/NLM0010 Eval Tool.

If the connection process was successful, "OK" will appear in the lower field for confirmation.

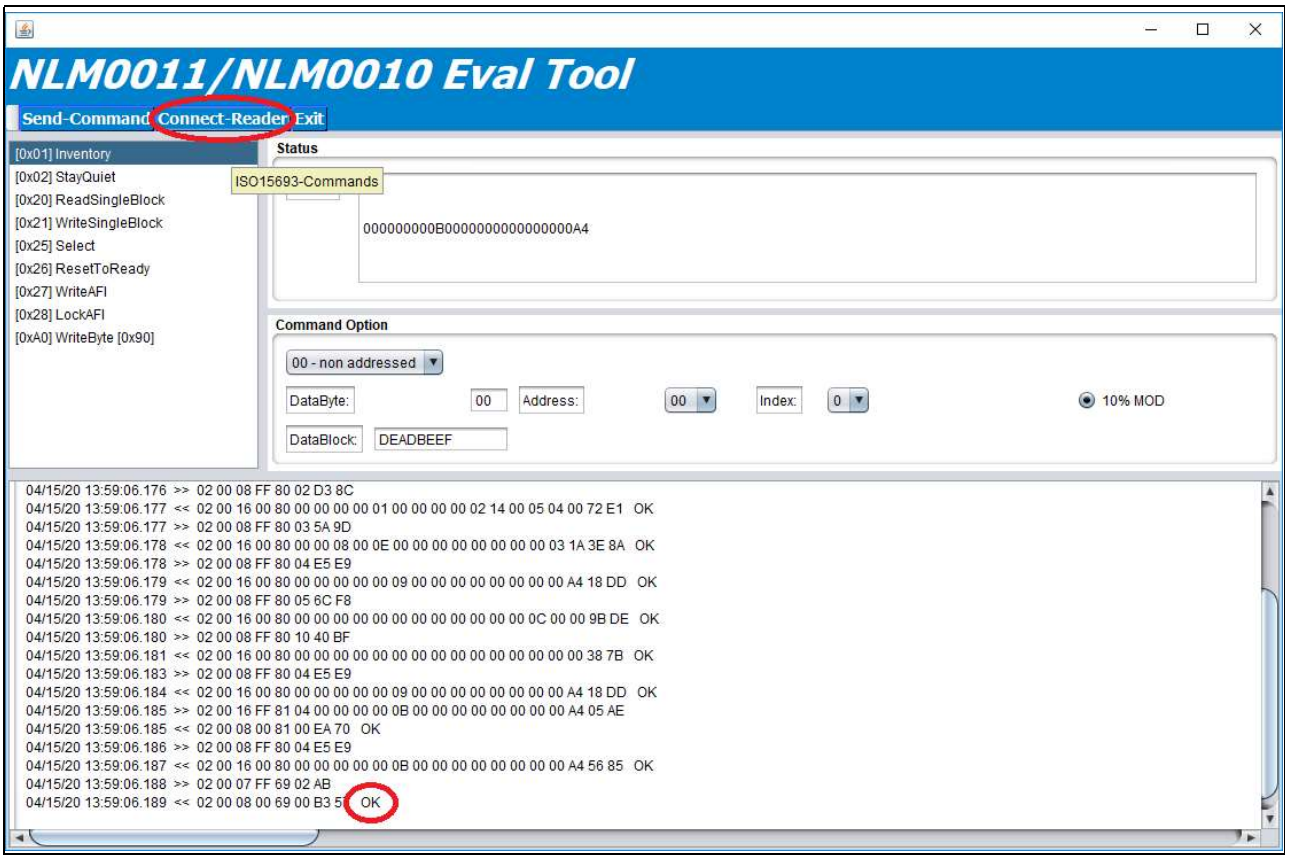



**Figure 21 Confirmation for successful reader connection**

### 4.2.1 Reading data from NLM001x

To read the stored data from EEPROM of the NLM001x, place board and reader like described in chapter 4.1.1.

Select the desired command from the list on the left by clicking on it and then click “Send-Command”. The result appears in the field “Result”.

For example, the “Inventory” command is desired, click “[0x01] Inventory”, then click “Send-Command” and the UID will appear in the “Result” window.

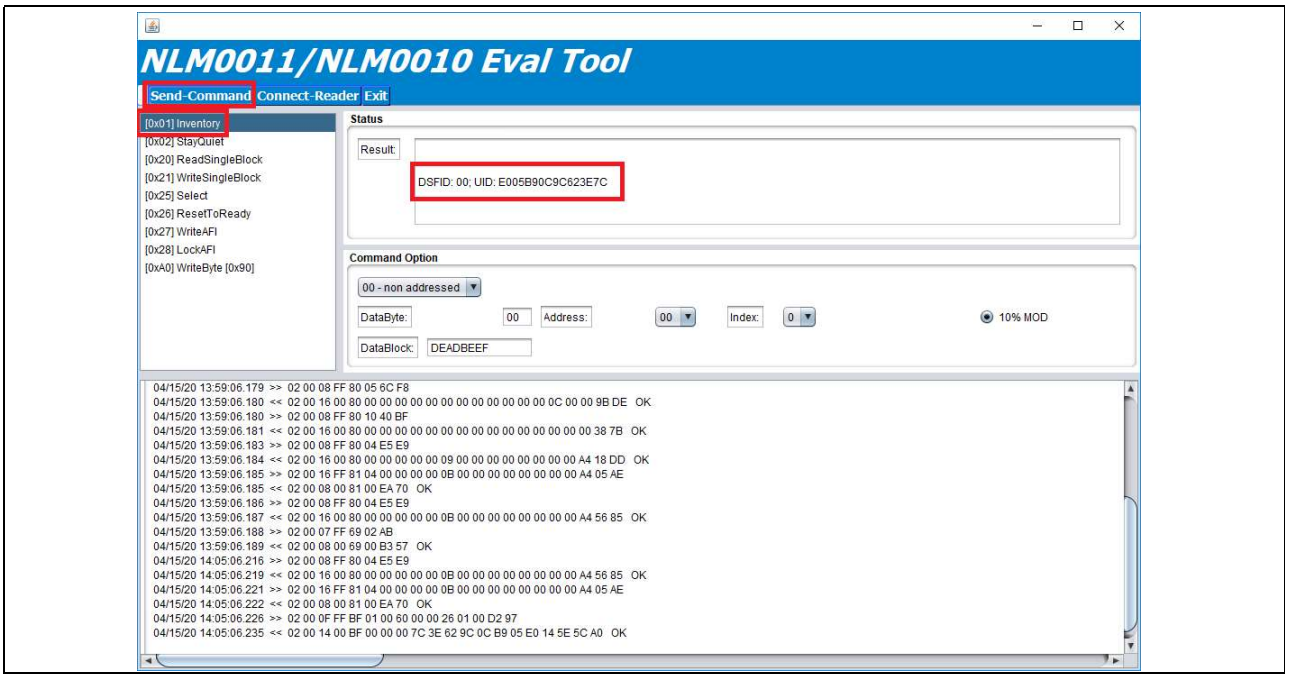



**Figure 22 Reading the UID/Inventory command**

It is also possible to do an addressed reading. Therefore first do an “Inventory” command to identify the NLM001x, then select “01-addressed” in the “Command Option” window. It can only be read in full blocks. For this select “ReadSingleBlock”, select the block in “Address”, also select if addressed or non-addressed and click “Send-Command”. The result appears in the “Result” window.

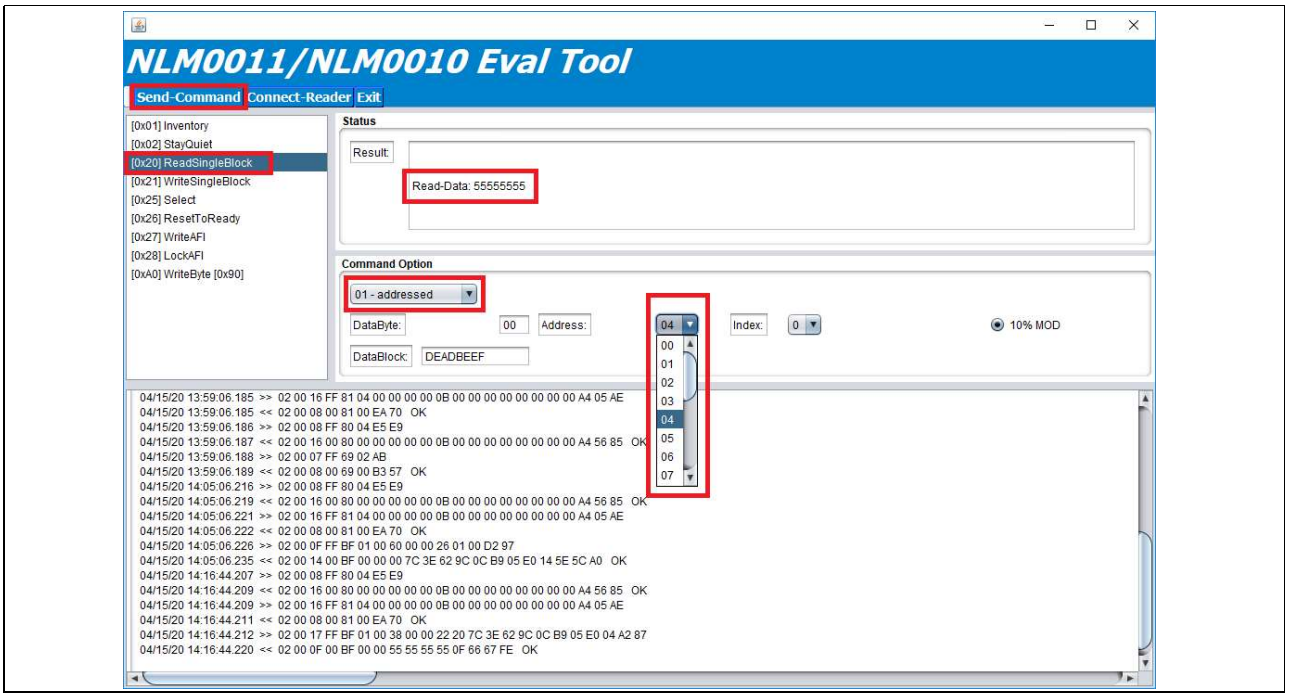



**Figure 23 ReadSingleBlock**

### 4.2.2 Setting/Writing data from NLM001x

To write data to the NLM001x, please position the board and reader like shown in chapter 4.1.1.

It is possible to write both in blocks and in bytes.

#### 4.2.2.1 Write in blocks

To write in blocks select the command “[0x21] WriteSingleBlock”. Then enter the desired data in the field “DataBlock”. The data must be entered in hexadecimal format.

After that select the desired datablock by selecting from the drop down menu at “Address”. Finally click “Send-Command” to set the data in the EEPROM. “OK” appears in the result window for confirmation.

It is also possible to write in addressed mode. Therefore do an “Inventory” command first to select the chip and then select “01-addressed” in “Command Option” and proceed as described above.

*Note: How to calculate the data for e.g., the CLO table, you can find out in the datasheet and the application note, which are available for download on the website.*

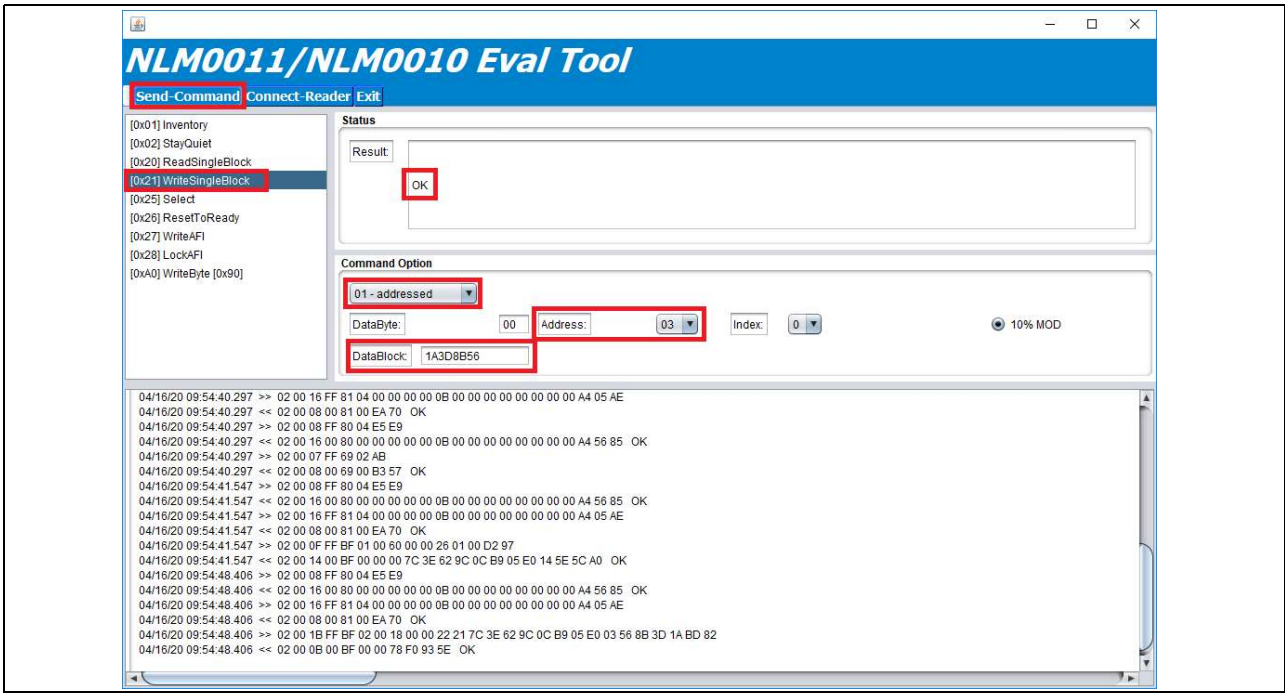



**Figure 24 Write in blocks**

#### 4.2.2.2 Write in bytes

To write in bytes select the command “[0xA0] WriteByte [0x90]”, set the desired value of the byte in “DataByte”, select the desired block in “Address” and select the desired index of the byte in the block in “Index”. Then click “Send-Command” to set the data in the EEPROM. “OK” appears in the result window for confirmation.

It is also possible to write in addressed mode. Therefore do an “Inventory” command first to select the chip and then select “addressed” in “Command Option” and proceed as described above.

### FEIG reader

*Note:* *How to calculate the data for e.g., the CLO table, you can find out in the datasheet and the application note, which are available for download on the website.*

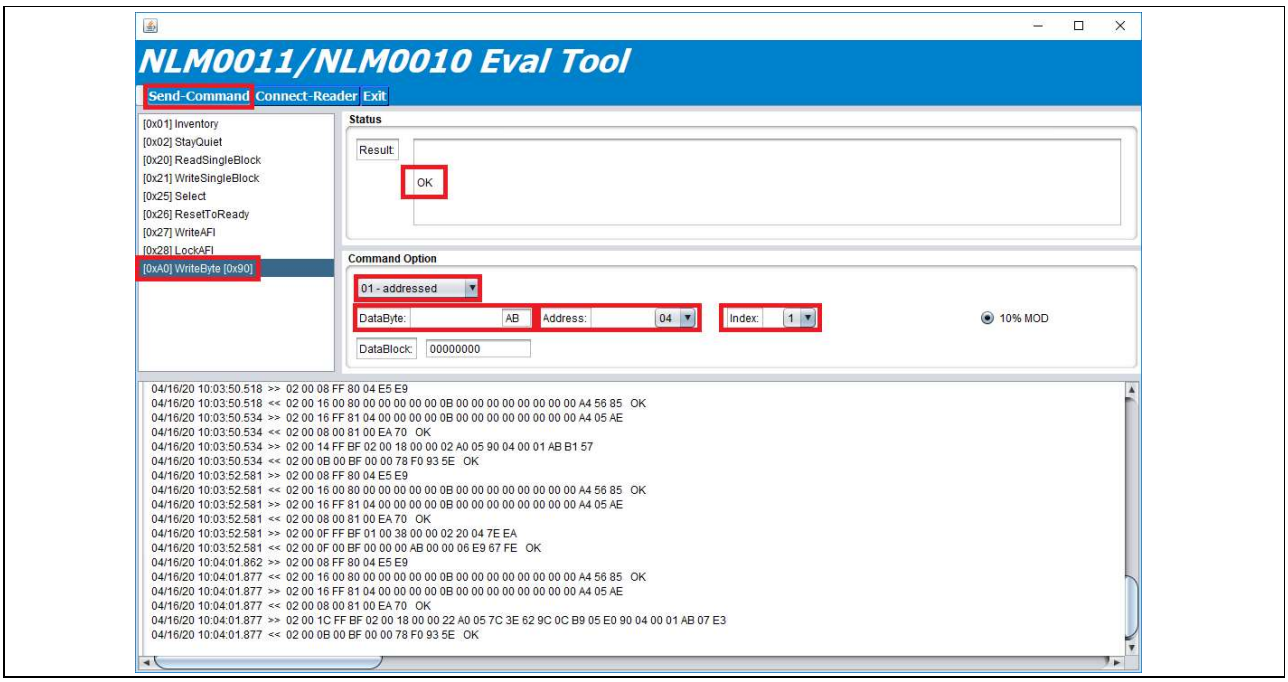



**Figure 25 Write in bytes**

# 5 Operational conditions and parameters

## 5.1 NFC board 3 to 5 V (DK_NLM_02)

**Table 1 Operational conditions DK_NLM_02**

| Parameter | Symbol | Limit values | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Board supply | $V_{CC}$ | 3 | | 5 | V | Power supply |
| PWM output | PWM | 2.7 | 2.8 | 2.9 | V | Unfiltered PWM output |
| PWM frequency | $f_{PWM}$ | 1 | | 30 | kHz | Frequency of PWM output |
| Ground | GND | 0 | | 0 | V | System GND |
| Ambient temperature | T | -40 | | +85 | °C | Ambient temperature in active and passive mode |

## 5.2 NFC board 5 – 25 V (DK_NLM_01)

**Table 2 Operational conditions DK_NLM_01**

| Parameter | Symbol | Limit values | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Board supply | $V_{CC}$ | 5 | | 25 | V | Power supply |
| PWM output | PWM | 2.7 | 2.8 | 2.9 | V | Unfiltered PWM output |
| PWM frequency | $f_{PWM}$ | 1 | | 30 | kHz | Frequency of PWM output |
| Ground | GND | 0 | | 0 | V | System GND |
| Ambient temperature | T | -40 | | +85 | °C | Ambient temperature in active and passive mode |

## 5.3 Demo board (DK_NLM_03)

**Table 3 Operational conditions DK_NLM_03**

| Parameter | Symbol | Limit values | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Board supply | $V_{CC}$ | 4.5 | 5 | 5.5 | V | Power supply |
| Ground | GND | 0 | | 0 | V | System GND |
| Ambient temperature | T | -20 | | +65 | °C | Ambient temperature in active and passive mode |

# 6 Evaluation boards

To use the kit, install the mobile app on an Android smartphone (chapter 3) or use the Feig reader (chapter 4).

## 6.1 NFC boards

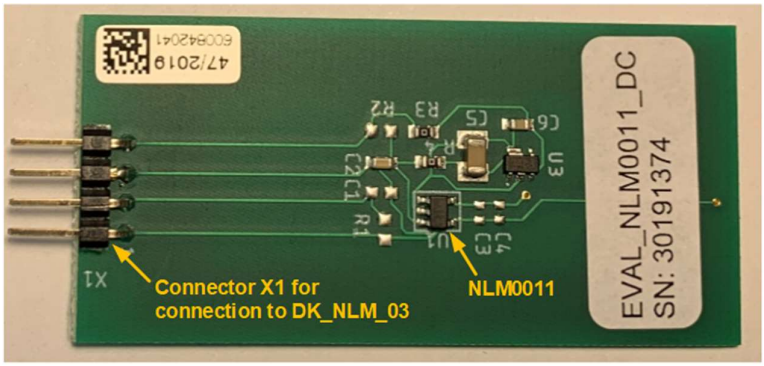



**Figure 26 Bottom view of DK_NLM_01**




**Figure 27 Top view of DK_NLM_01 with NFC antenna**

Both NFC boards include the NLM0011 chip and the antenna for NFC. Also the connector for connection to the demo board or own applications; the pin-out is shown below.

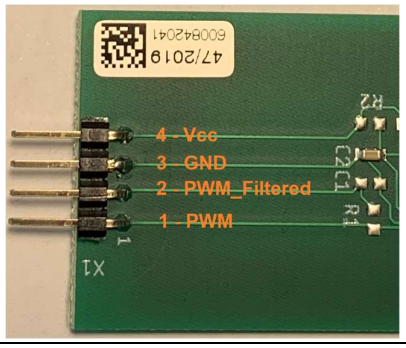



**Figure 28 Pin-out of X1 NFC boards**

**Evaluation boards**

The PWM_Filtered signal can only be measured on pin 2 of the NFC board, when an own filter (R1 and C1) is soldered onto the board, because the preset filter is mounted on the demo board.

Additionally, on the DK_NLM_01 board the components for the low drop-out (LDO) regulator are mounted, to enable $V_{CC}$ voltage from 5 to 25 V.

The EEPROM of the NFC boards can be read and written by mobile app as shown in chapter 3, or by Feig reader.

The read/write process is only possible in passive mode. That means the board is not connected to $V_{CC}$. This can be done by disconnecting the NFC board from the demo board or own applications, or by switching off the demo board.

## 6.2 Demo board (DK_NLM_03)

Features:

- Connector X1 for connection to NFC boards
- Dip-switch S1 for enabling own filter/preset filter of PWM signal
- On/off switch S2
- Micro-USB connector X2 for powering the demo board
- 8 LEDs for duty cycle indication (0 to 80 percent)

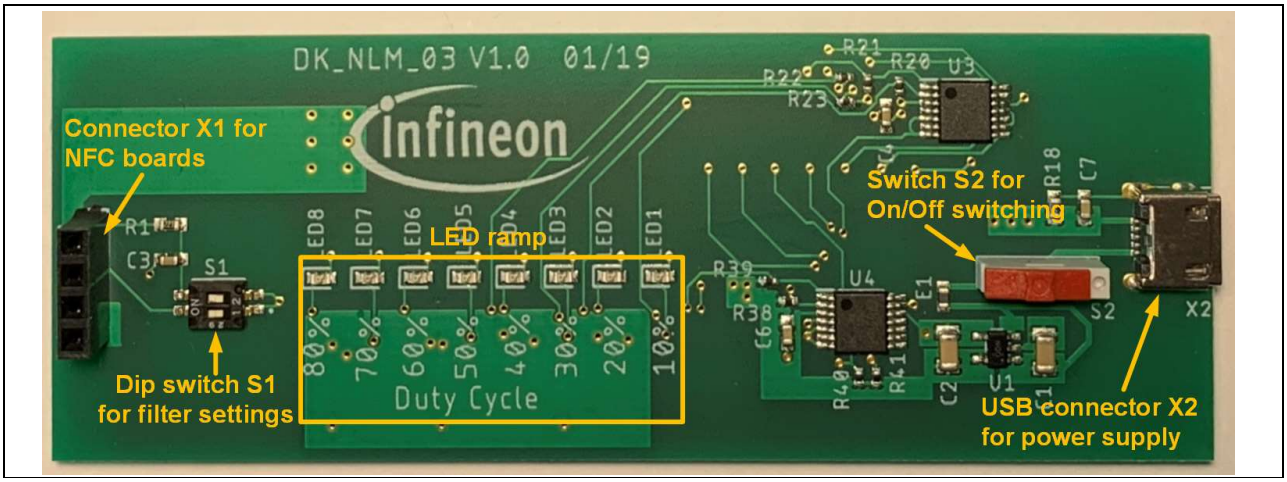



**Figure 29 Top view DK_NLM_03**

To indicate the set duty cycle, write all parameters to EEPROM on the NFC board and connect it to the demo board. Also connect the demo board via USB cable to a standard USB 5 V power supply (e.g. a laptop). To use the preset filter (R1, C3) on the demo board, the dip-switch must be set as shown below (position 2 → ON, position 1 → Off):

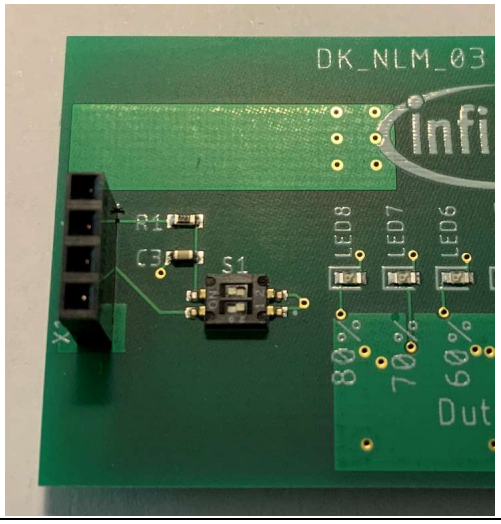



**Figure 30 Dip-switch S1 setting for preset filter**

The preset filter is dimensioned for PWM frequencies higher than 12.9 kHz (R1 = 22 kHz, C3 = 56 nF). In case an own filter is enabled, set position 1 of S1 to off and position 2 to on. Now the preset filter is disabled and an own filter can be soldered in on R1 and C1 on the NFC board.

Switch on the demo board by sliding switch S2 to the on position, as shown below:

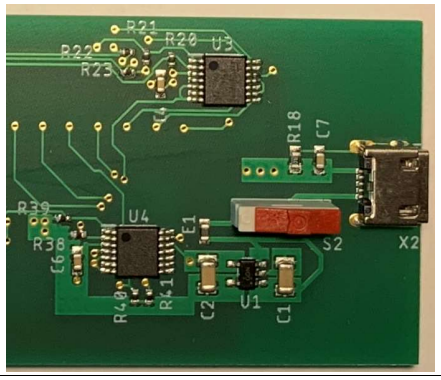



**Figure 31 Switch S2 on position**

The LEDs show the set duty cycle, a percentage of $DC_{Imax}$.

For example, app settings, written to EEPROM of NLM0011 in passive mode:

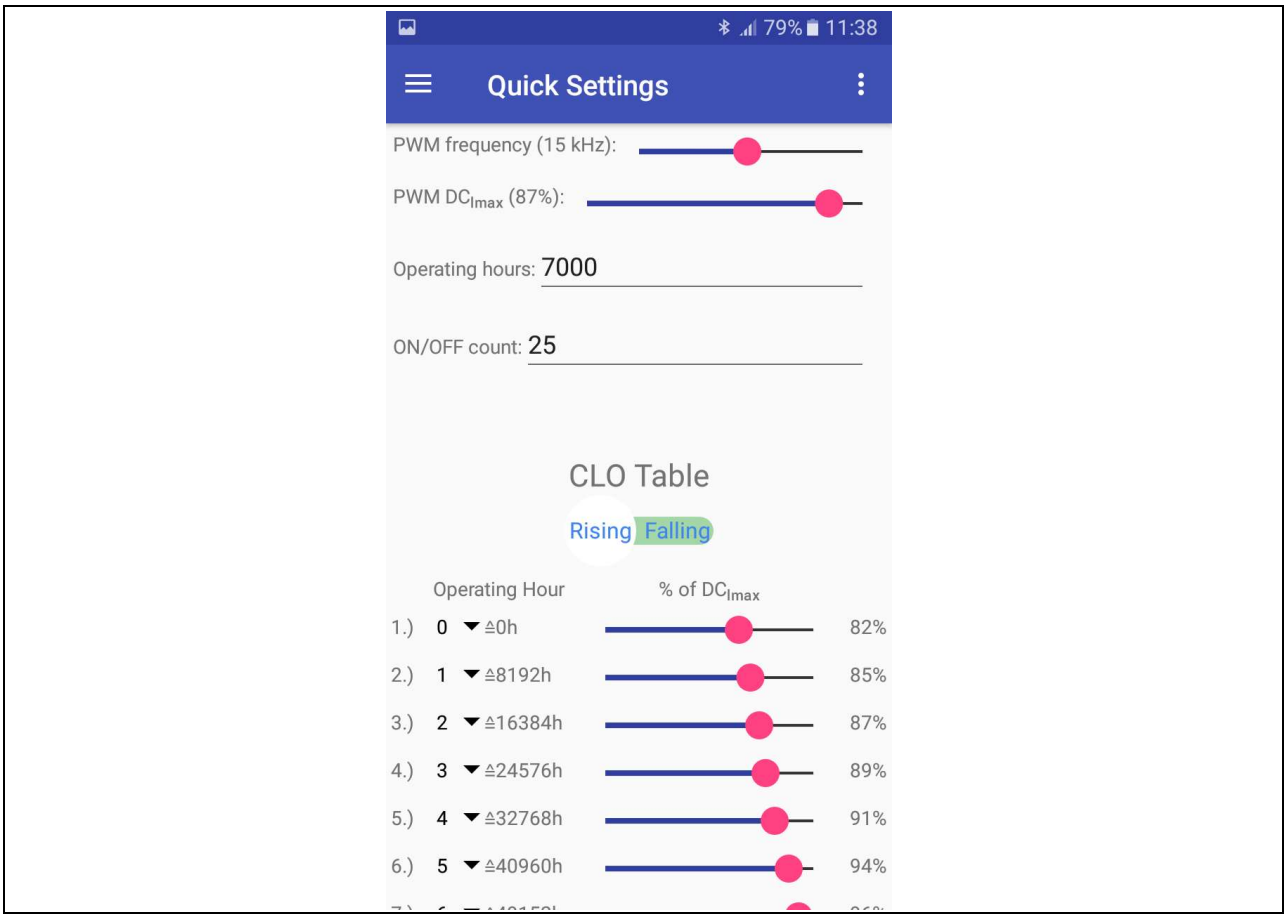



**Figure 32 App settings**

Because of the set parameters (operating hours = 70000 -> set point 1 in CLO), the percentage of $DC_{Imax}$ can be calculated as shown:

$$\%\ of\ DC_{Imax} = \frac{PWM\ DC_{Imax}}{100\%} \cdot \%\ of\ DC_{Imax}$$

$$\%\ of\ DC_{Imax} = \frac{87\%}{100\%} \cdot 82\% = 71.34\%$$

That means that on the demo board, seven LEDs should be lit.

## Evaluation boards

In this case, the demo board LED indication looks like this:

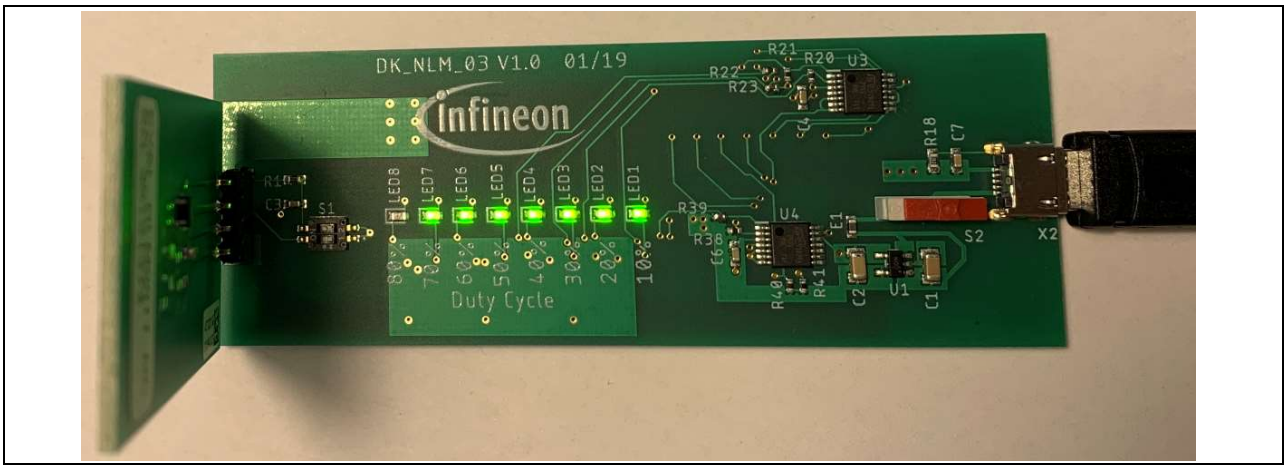



**Figure 33 LED indication for our example**

***Attention:*** ***When connecting the NFC board to the demo board, make sure that pin 1 of the NFC board is connected to pin 1 of the demo board (pin 1 is marked on each board).***

# 7 Schematic

## 7.1 NFC board DK_NLM_01

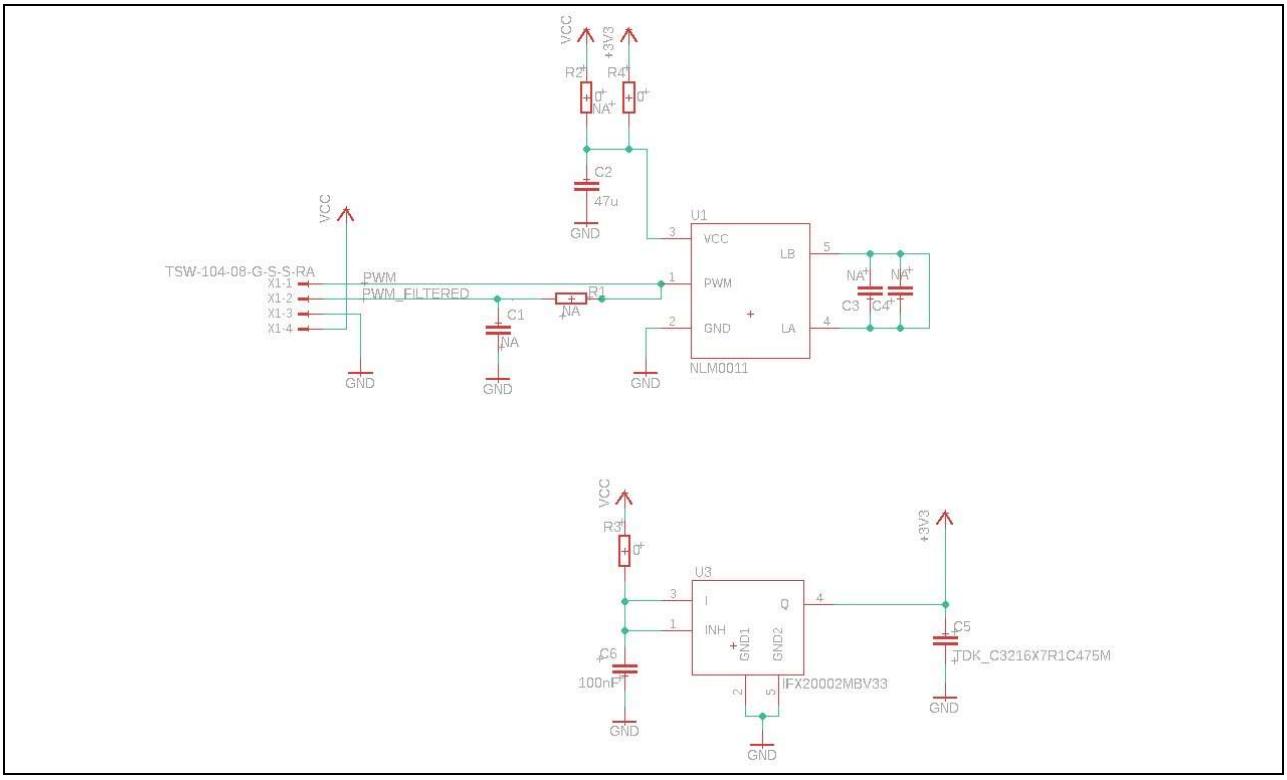



**Figure 34 Schematic of NFC board DK_NLM_01**

## 7.2 NFC board DK_NLM_02

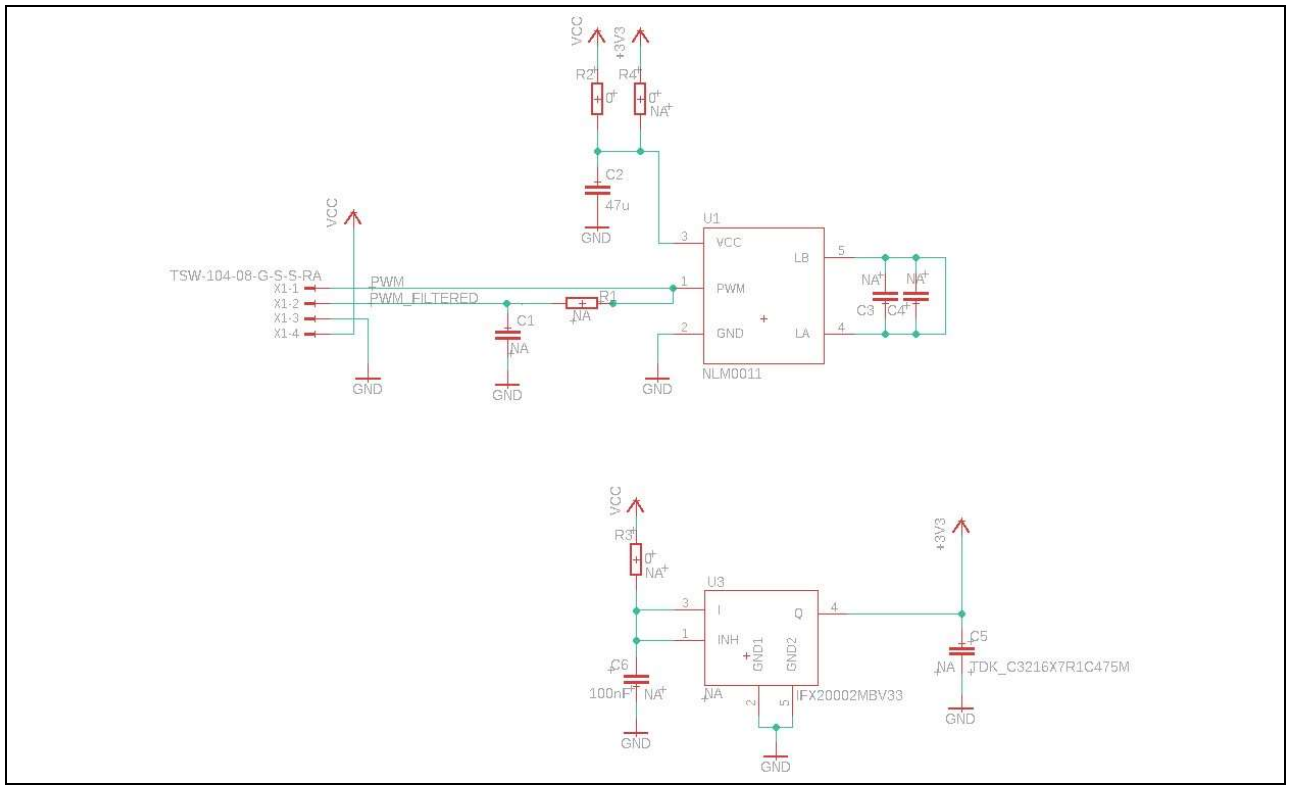



**Figure 35 Schematic of NFC board DK_NLM_02**

## 7.3 Demo board DK_NLM_03

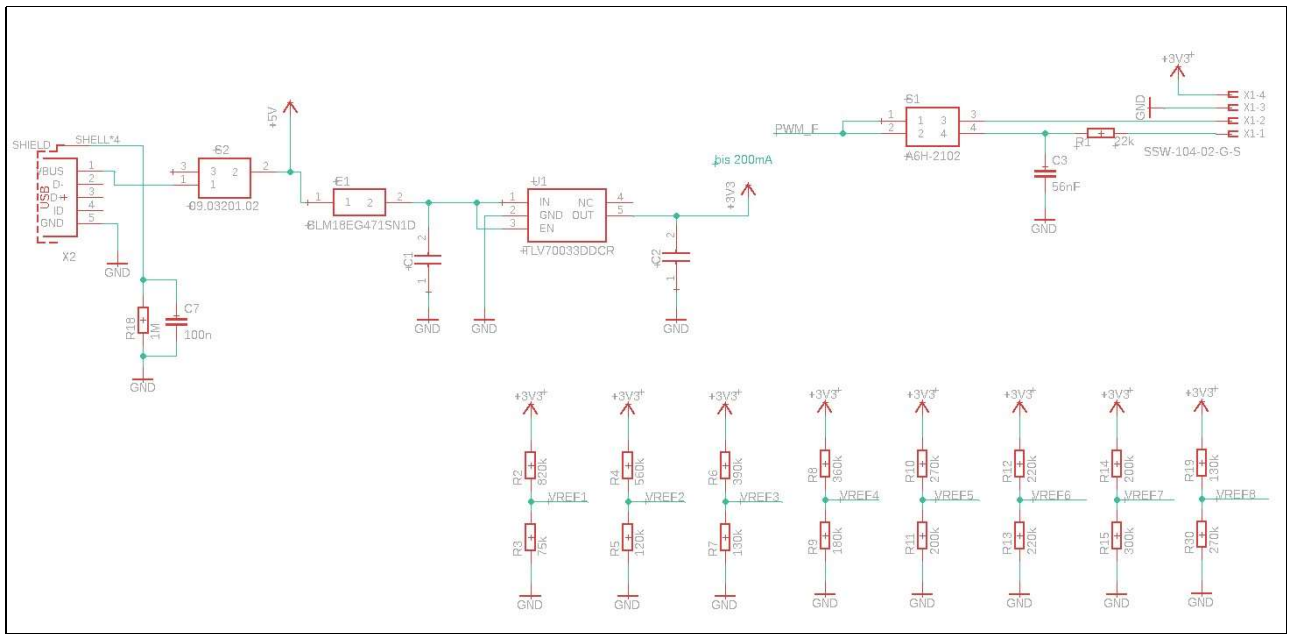



**Figure 36 Schematic of demo board DK_NLM_03**

## Schematic

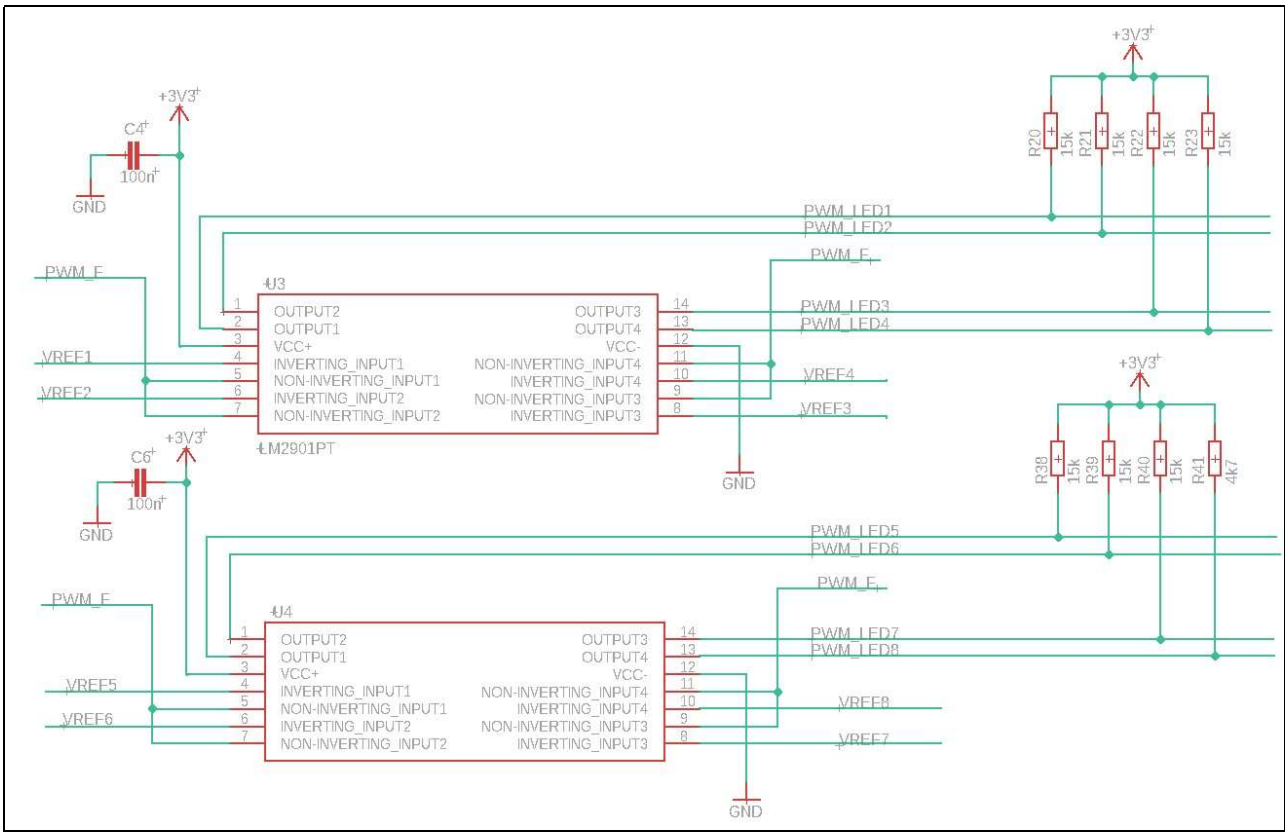



**Figure 37 Schematic of demo board DK_NLM_03**

## Schematic

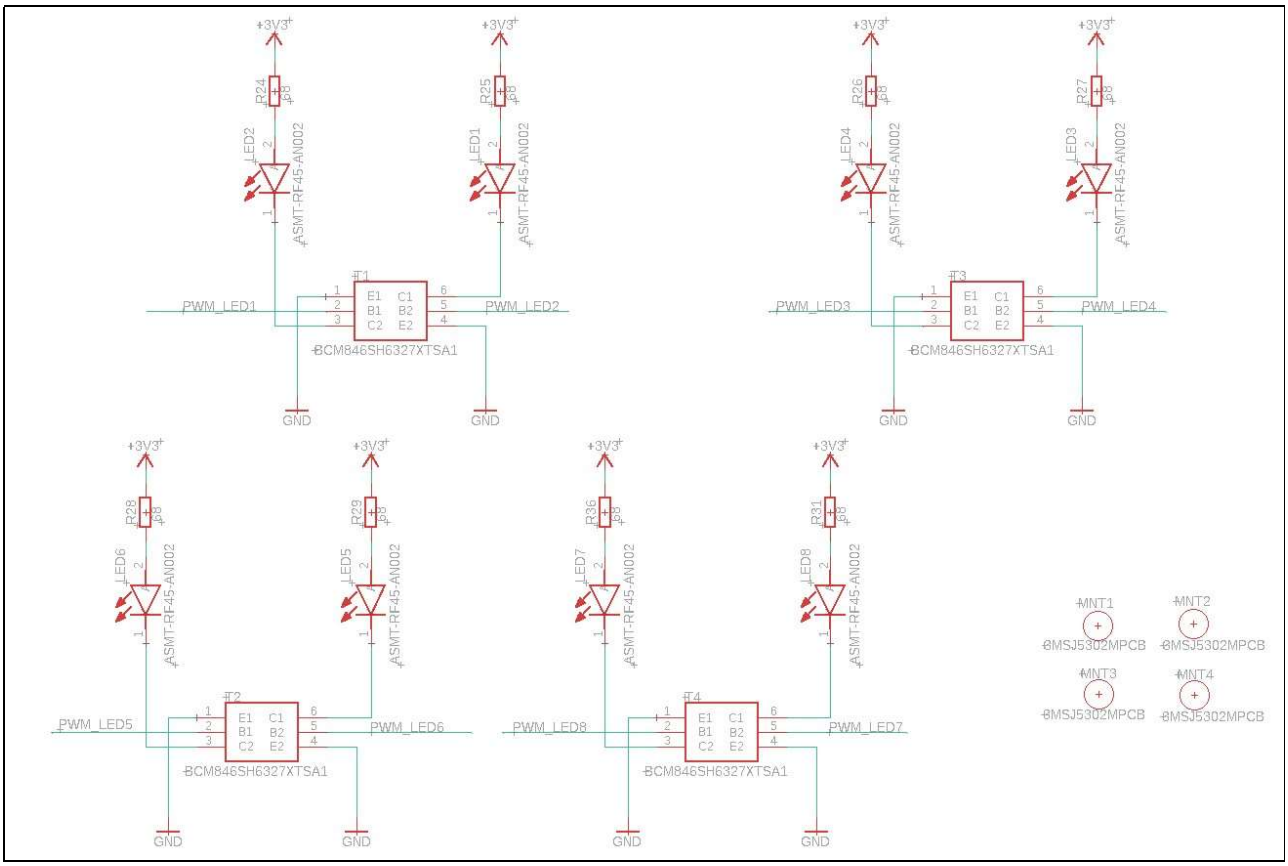



**Figure 38 Schematic of demo board DK_NLM_03**

# 8 Layout

## 8.1 NFC boards DK_NLM_01 and DK_NLM_02

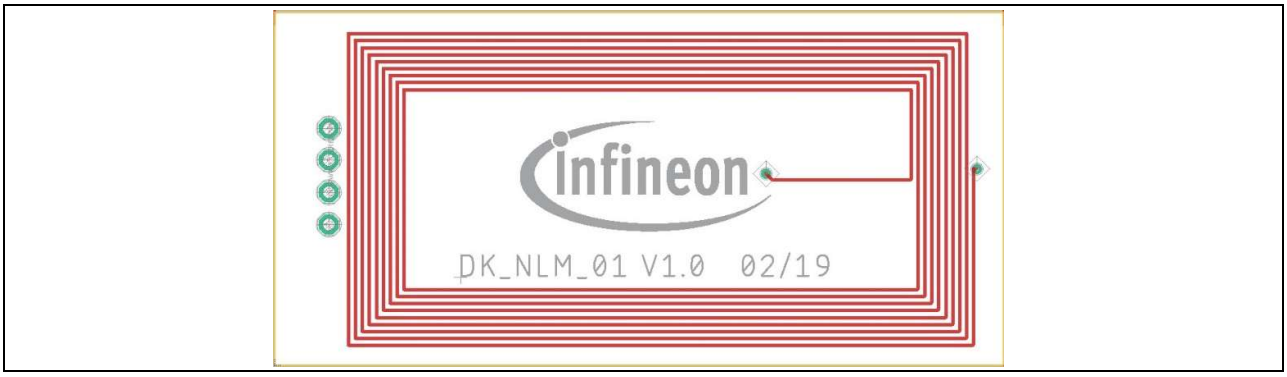



**Figure 39 Top layer of DK_NLM_01**




**Figure 40 Top layer of DK_NLM_02**

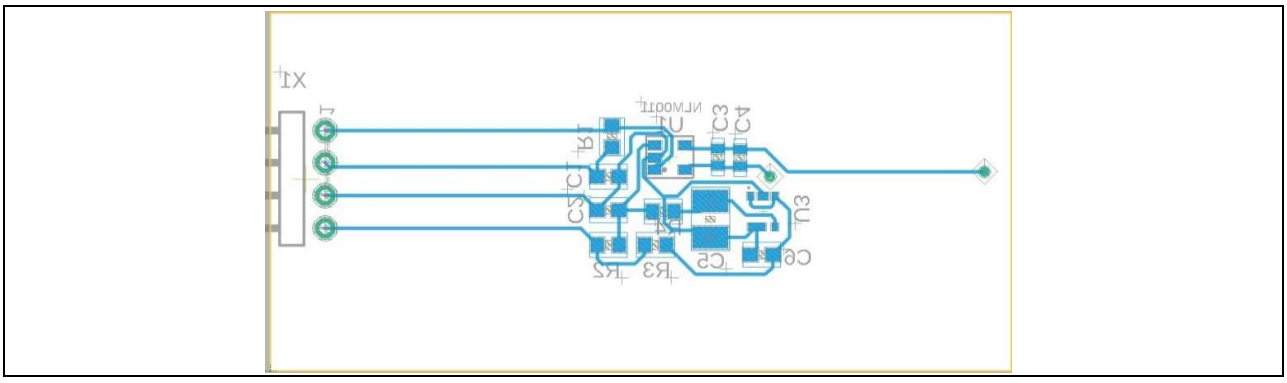


**Figure 41 Bottom layer of DK_NLM_01 and DK_NLM_02**

## 8.2 Demo board DK_NLM_03

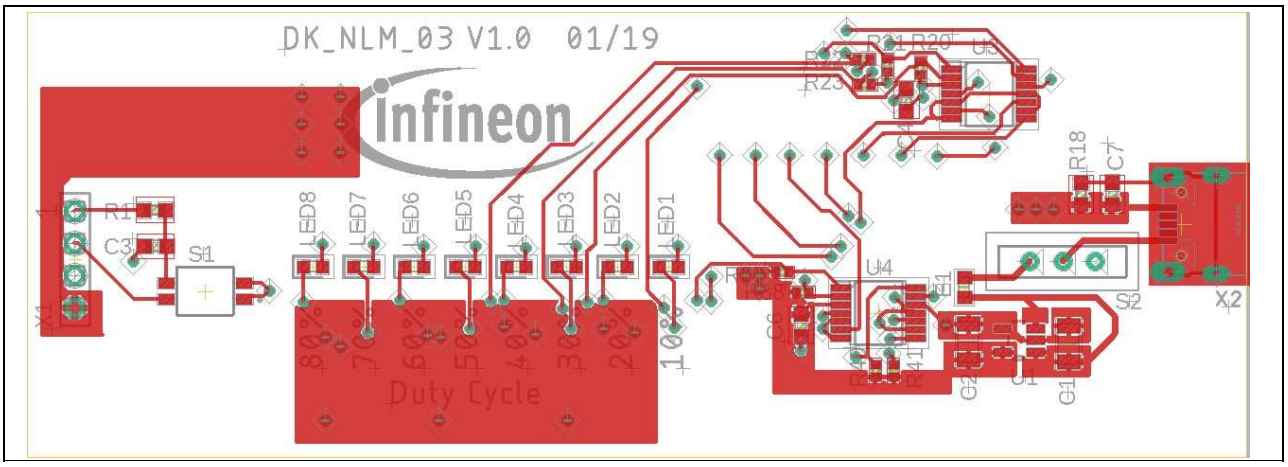



**Figure 42 Top layer of DK_NLM_03**

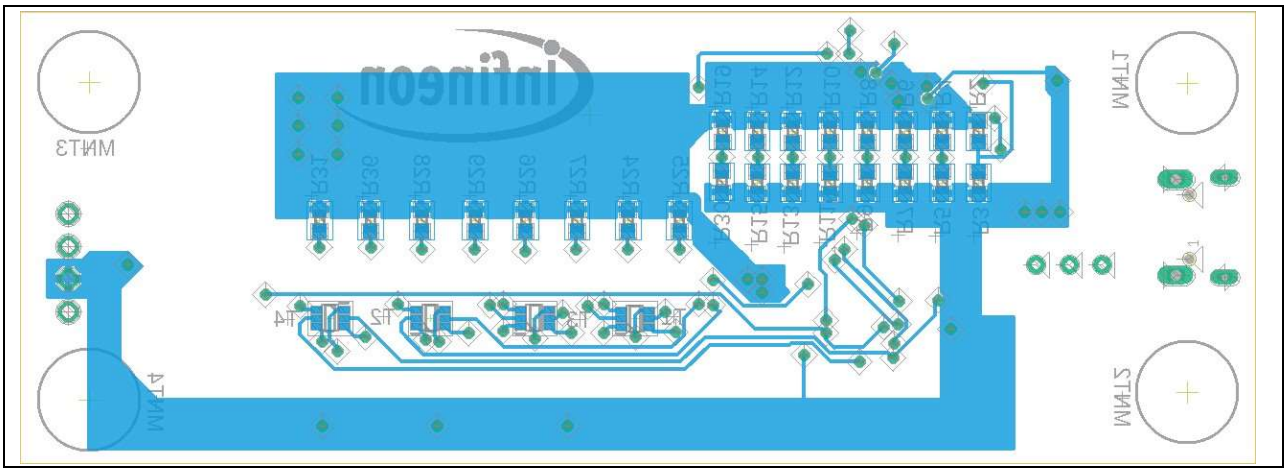


**Figure 43 Bottom layer of DK_NLM_03**

# 9 Bill of Materials (BOM)

## 9.1 NFC board DK_NLM_01

**Table 4 BOM of DK_NLM_01**

| Item number | Quantity | Part reference | Value | Package | Description |
|---|---|---|---|---|---|
| 1 | 2 | R3, R4 | 0 | 0603 | Resistor |
| 2 | 1 | C6 | 100 nF | 0603 | Capacitor |
| 3 | 1 | C2 | 47 µF | 0603 | Capacitor |
| 4 | 1 | U3 | IFX20002MBV33 | SCT595-5 | LDO |
| 5 | 1 | U1 | NLM0011 | SOT23-5 | NLM0011 Infineon |
| 6 | 1 | C5 | 47 pF | 1206 | TDK_C3216X7R1C475M |
| 7 | 1 | X1 | 4 | | TSW-104-08-G-S-S-RA Samtec |

## 9.2 NFC board DK_NLM_02

**Table 5 BOM of DK_NLM_02**

| Item number | Quantity | Part reference | Value | Package | Description |
|---|---|---|---|---|---|
| 1 | 1 | R2 | 0 | 0603 | Resistor |
| 2 | 1 | C2 | 47 µF | 0603 | Capacitor |
| 3 | 1 | U1 | NLM0011 | SOT23-5 | NLM0011 Infineon |
| 4 | 1 | X1 | 4 | | TSW-104-08-G-S-S-RA Samtec |

## 9.3 Demo board DK_NLM_03

**Table 6**

| Item number | Quantity | Part reference | Value | Package | Description |
|---|---|---|---|---|---|
| 1 | 1 | X2 | | | 629105150521 Würth, horizontal Micro-USB |
| 2 | 1 | S2 | | | 09.03201.02 EOZ, two-way through-hole SIP switch |
| 3 | 3 | C4, C6, C7 | 100 nF | 0603 | Capacitor |
| 4 | 1 | C3 | 56 nF | 0603 | Capacitor |
| 5 | 1 | R5 | 120 kΩ 1 percent | 0603 | Resistor |
| 6 | 2 | R7, R19 | 130 kΩ 1 percent | 0603 | Resistor |
| 7 | 7 | R20, R21, R22, R23, R38, R39. | 15 kΩ 1 percent | 0402 | Resistor |

### Bill of Materials (BOM)

| Item number | Quantity | Part reference | Value | Package | Description |
|---|---|---|---|---|---|
| | | R40 | | | |
| 8 | 1 | R9 | 180 kΩ 1 percent | 0603 | Resistor |
| 9 | 1 | R18 | 1 MΩ 1 percent | 0603 | Resistor |
| 10 | 2 | R11, R14 | 200 kΩ 1 percent | 0603 | Resistor |
| 11 | 2 | R12, R13 | 220 kΩ 1 percent | 0603 | Resistor |
| 12 | 2 | R10, R30 | 270 kΩ 1 percent | 0603 | Resistor |
| 13 | 1 | R15 | 300 kΩ 1 percent | 0603 | Resistor |
| 14 | 1 | R8 | 360 kΩ 1 percent | 0603 | Resistor |
| 15 | 1 | R6 | 390 kΩ 1 percent | 0603 | Resistor |
| 16 | 4 | MNT1, MNT2, MNT3, MNT4 | | | 3MSJ5302MPCB 3M, Bumpon |
| 17 | 1 | R1 | 22 kΩ 1 percent | 0603 | Resistor |
| 18 | 1 | R41 | 4.7 kΩ 1 percent | 0402 | Resistor |
| 19 | 1 | R4 | 560 kΩ 1 percent | 0603 | Resistor |
| 20 | 8 | R24, R25, R26, R27, R28, R29, R31, R36 | 68 Ω 1 percent | 0603 | Resistor |
| 21 | 1 | R3 | 75 kΩ 1 percent | 0603 | Resistor |
| 22 | 1 | R2 | 820 kΩ 1 percent | 0603 | Resistor |
| 23 | 1 | S1 | | | A6H-2102 Omron, two-way surface-mount dip-switch |
| 24 | 8 | LED1, LED2, LED3, LED4, LED5, LED6, LED7, LED8 | | 0603 | ASMT-RF45-AN002 Avago, chip LED green |
| 25 | 4 | T1, T2, T3, T4 | | SOT65 | BCM846SH6327XTSA1 Infineon, bipolar transistor |
| 26 | 1 | E1 | | 0603 | BLM18EG471SN1D Murata, ferrite 470 R 500 mA |
| 27 | 2 | C1, C2 | 1 µF 16 V | 1206 | C1206X105K4RACAUTO Kemet, MLCC |
| 28 | 2 | U3, U4 | | SOP65 | LM2901PT ST, quad comparator |
| 29 | 1 | X1 | | | SSW-104-02-G-S Samtec, through-hole connector |
| 30 | 1 | U1 | | SOT95 | TLV70033DDCR TI, LDO regulator |

# 10 Feig reader application software

To program NLM0011/NLM0010, a NFC reader device is required. It could be a mobile phone with built-in NFC interface or a professional NFC reader device. For industrial applications, like LED lighting, typically a professional NFC reader device is used for reasons of ease of use, long sensing distance and highly reliable operation. The professional NFC reader device is connected to a PC and is controlled by PC software (NFC reader application software). The NFC reader application software is developed either by the vendor of the LED power supply, or the luminaire maker. Typically, vendors of the LED power supply provide their application software to OEM customers.

NFC readers from Feig GmbH are certified by the Module-Driver Interface Special Interest Group (MD-SIG). Using the Feig desktop reader ID CPR30-USB, we developed an application demo based on Feig application development SDK.

## 10.1 Command types and their execution method

NLM0011/NLM0010 support following nine NFC commands: Inventory, Stay Quiet, Read Single Block, Write Single Block, Select, Reset to Ready, Write AFI, Lock AFI, and Write Byte.

Using Feig SDK, a NFC command can be executed by using either the SendProtocol() function or the SendTransparent() function. The three commands below must be executed with the SendTransparent() function:

Read Single Block, Write Single Block, Write Byte.

Execution of other commands – Stay Quiet, Select, Reset to Ready, Write AFI, Lock AFI – are recommend to use the Send Protocol() function.

## 10.2 Code examples

Below two examples using transparent function and protocol function are developed for the Feig NFC reader. For complete source codes, please check the source code file provided. If you are using NFC readers from other vendors, please refer to the corresponding SDK .

### 10.2.1 Inventory command

In this example, the sendProtocol() function is used to execute “inventory” command. The benefit of using the sendProtocol() function is that a short command string can be used.

```
public int inventory(FedmIscTagHandler_Result result) throws
FePortDriverException, FeReaderDriverException, FedmException,
AgedPerfectException
{
        FeIscProtocol localFeIscProtocol = new FeIscProtocol();
        FedmIscReader     iscReader     = reader.getReaderImpl();
        FedmIscTagHandler iscTagHandler = tagHandler.getTagHandlerImpl();
        String cmd = new String();
        String uid = new String();
        uid        = iscTagHandler.getUid();

        result.data   = null;
```

```
       //build up NFC command string
         cmd = cmd + "01";                  // Inventory command
         cmd = cmd + "00";              // Mode: 00-nonaddressed only

//NFC command execution
         String str = iscReader.sendProtocol((byte)0xB0, cmd);

        //Exception handling
if (str.length() == 0) {
             throw new
FedmException(iscReader.getErrorText(Fedm.ERROR_NO_DATA),
Fedm.ERROR_NO_DATA);
         }

if(reader.getLastStatus() == (byte)0x95) {
             // we have a VICC error
             throw new
AgedPerfectException(AgedPerfectErrorCode.getErrorText(FeHexConvert.hexString
ToInteger(str)),
                          FeHexConvert.hexStringToInteger(str));
         } else if(iscReader.getLastStatus() == 0) {
             // we have a feedback from the Reader
             result.data       = new byte[8];
             result.data[0]    = (byte)localFeIscProtocol.recData[1];
             result.data[1]    = (byte)localFeIscProtocol.recData[2];
             result.data[2]    = (byte)localFeIscProtocol.recData[3];
             result.data[3]    = (byte)localFeIscProtocol.recData[4];
             result.data[4]    = (byte)localFeIscProtocol.recData[5];
             result.data[5]    = (byte)localFeIscProtocol.recData[6];
             result.data[6]    = (byte)localFeIscProtocol.recData[7];
             result.data[7]    = (byte)localFeIscProtocol.recData[8];
             String TrTypeStr = str.substring(2,4);
             String DsfidStr  = str.substring(4,6);
             String uidStr    = str.substring(6);
             jProtocol.append("TR-TYPE: " + TrTypeStr + "; DSFID: " + DsfidStr
+ "; UID: " + uidStr);
         }
         return reader.getLastStatus();
     }
```

### 10.2.2 Read single block command

In this example, the sendTransparent() function is used to execute the “read single block” command. The benefit of using the sendTransparent() function is that each bit in the command string can be defined. With good software architecture design, it can enable NFC vendor-independent or less-dependent application software development – the command string is identical and independent to the vendor of the NFC reader used.

```
public int readSingleBlock (byte address, byte db_n, FedmIscTagHandler_Result
result)
            throws FePortDriverException, FeReaderDriverException,
FedmException, AgedPerfectException {
        FeIscProtocol localFeIscProtocol = new FeIscProtocol();
        FedmIscReader iscReader          = reader.getReaderImpl();
        FedmIscTagHandler iscTagHandler  = tagHandler.getTagHandlerImpl();
        String cmd        = new String();
        String uid;
        String uidRev = new String();
        uid = iscTagHandler.getUid();
        for (int i=0; i < 15; i=i+2) {
            uidRev = uidRev + uid.substring(14-i, 16-i);
        }
        result.data   = null;


      //build up NFC command string
        cmd = cmd + "02";           // STX
        if (iscTagHandler.nonAddressedMode) {
            cmd = cmd + "000F";     // ALENGTH w/o UID plus CRC: 15
        }
        else {
            cmd = cmd + "0017";     // ALENGTH w UID and CRC: 23
        }
        cmd = cmd + "FF";           // COM-ADR
        cmd = cmd + "BF";           // CMD (Reader)
        cmd = cmd + "01";           // Mode 1: read request
        cmd = cmd + "0038";         // RSP-length in bits w/o SOF and EOF
        cmd = cmd + "0000";         // RSP-delay in multiples of 590ns
0x0000=0x021F=320,4us
        if (iscTagHandler.nonAddressedMode) {
            cmd = cmd + "12";       // flags: selected, high data-rate,
single sub-carrier
        } else {
```

### Feig reader application software

```
            cmd = cmd + "22";       // flags: addressed, high data-rate,
single sub-carrier
        }
        cmd = cmd + "20";           // ReadSingleBlock command
        if (!iscTagHandler.nonAddressedMode) {
            cmd = cmd + uidRev;     // UID reverse order
        }
        cmd = cmd + FeHexConvert.byteToHexString(address);     // Address

       //NFC command execution
String str = iscReader.sendTransparent(cmd, true);

//Exception handling
        localFeIscProtocol.recProtocol =
FeHexConvert.hexStringToByteArray(str);
        int i = iscReader.splitRecProtocol(localFeIscProtocol);
        if (i == (int)0x95) {
            int ISOErrorCode = localFeIscProtocol.recData[0];
            throw new
AgedPerfectException(AgedPerfectErrorCode.getErrorText(ISOErrorCode),
ISOErrorCode);
        }
        else if (i == 0) {
            result.data       = new byte[4];
            result.data[0]    = (byte)localFeIscProtocol.recData[4];
            result.data[1]    = (byte)localFeIscProtocol.recData[3];
            result.data[2]    = (byte)localFeIscProtocol.recData[2];
            result.data[3]    = (byte)localFeIscProtocol.recData[1];
            // for debug only:
            String DataStr    = new String();
            DataStr = DataStr +
FeHexConvert.byteToHexString((byte)localFeIscProtocol.recData[4]);
            DataStr = DataStr +
FeHexConvert.byteToHexString((byte)localFeIscProtocol.recData[3]);
            DataStr = DataStr +
FeHexConvert.byteToHexString((byte)localFeIscProtocol.recData[2]);
            DataStr = DataStr +
FeHexConvert.byteToHexString((byte)localFeIscProtocol.recData[1]);
            // for debug:
            //jProtocol.append("Read-Data: " + DataStr + "\n");
        }
        else {
```

```
            throw new
FedmException(iscReader.getErrorText(Fedm.ERROR_NO_DATA),
Fedm.ERROR_NO_DATA);
        }
        return reader.getLastStatus();
    }
```

### 10.2.3 Write single block command

In the „write single block“ example, the sendTranparent() function is used again. Compared to the previous “read single block” example, it can be seen that additional 4 data bytes have to be transferred. Care must be taken, that all multi-byte data fields, such as UID bytes or the 4 data bytes must be transferred in reverse order, i.e., least significant byte first and most significant byte last.

```
// [0x21] WriteSingleBlock
    public int writeSingleBlock(byte address, byte db_n, byte db_size, byte[]
db)
            throws FePortDriverException, FeReaderDriverException,
FedmException, NLM0011Exception {
        FeIscProtocol localFeIscProtocol = new FeIscProtocol();
       FedmIscReader iscReader = reader.getReaderImpl();
        FedmIscTagHandler iscTagHandler = tagHandler.getTagHandlerImpl();
        String cmd    = new String();
        String uid;
        String uidRev = new String();
        uid = iscTagHandler.getUid();
        for (int i=0; i < 15; i=i+2) {
            uidRev = uidRev + uid.substring(14-i, 16-i);
        }
        cmd = cmd + "02";           // STX
        if (iscTagHandler.nonAddressedMode) {
            cmd = cmd + "0013";     // ALENGTH w/o UID plus CRC:
19
        } else {
            cmd = cmd + "001B";     // ALENGTH w UID and CRC: 27
        }
        cmd = cmd + "FF";           // COM-ADR
        cmd = cmd + "BF";           // CMD (Reader)
        cmd = cmd + "02";           // Mode 2: write request
        cmd = cmd + "0018";         // RSP-length in bits w/o SOF and EOF:
32bit in error case
        cmd = cmd + "0000";         // RSP-delay in multiples of 590ns
0x0000=0x021F=320,4us
        if (iscTagHandler.nonAddressedMode) {
```

```
            cmd = cmd + "12";          // flags: selected, high data-rate,
single sub-carrier
        } else {
            cmd = cmd + "22";          // flags: addressed, high data-rate,
single sub-carrier
        }
        cmd = cmd + "21";            // WriteSingleBlock command
        if (!iscTagHandler.nonAddressedMode) {
            cmd = cmd + uidRev;      // UID reverse order
        }
        cmd = cmd + FeHexConvert.byteToHexString(address);      // Address
        for (int i = (db_size - 1); i >= 0; i--) {
            cmd = cmd + FeHexConvert.byteToHexString(db[i]);    // DataBlock
reverse - 4Bytes
        }
         String str = iscReader.sendTransparent(cmd, true);
        localFeIscProtocol.recProtocol =
FeHexConvert.hexStringToByteArray(str);
        int i = iscReader.splitRecProtocol(localFeIscProtocol);
        if (i == (int)0x95) {
            int ISOErrorCode = localFeIscProtocol.recData[0];
            throw new
NLM0011Exception(NLM0011ErrorCode.getErrorText(ISOErrorCode), ISOErrorCode);
        }
        else if (i == 0) {
            jProtocol.append("OK");


        }
        else {
            throw new
FedmException(iscReader.getErrorText(Fedm.ERROR_NO_DATA),
Fedm.ERROR_NO_DATA);
        }
        return reader.getLastStatus();
    }
```

## 10.3 Feig reader software and documents

USB drivers, documents, firmware and demo programs can be downloaded from the Feig download area at https://www.feig.de/en/login/. Login data can be found in the installation manual, which is delivered together with the Feig reader.

# 11 General information

## 11.1 Restrictions

This evaluation kit offers limited features that enable you to evaluate and test Infineon products. The evaluation kit is not an end product (or finished appliance), nor is it intended or authorized by Infineon to be integrated into end products. You are not authorized to use the evaluation kit in any production system.

## 11.2 Additional information

For further information, refer to: http://www.infineon.com/

## Revision history

| Document version | Date of release | Description of changes |
|---|---|---|
| V 1.0 | 06.03.19 | Initial version of document |
| V 1.1 | 19.07.19 | Changed all pictures of mobile app. Added falling curve. |
| V 1.2 | 20.08.19 | Minor changes in wording |
| V 1.3 | 28.08.19 | Update Figure 18 |
| V 1.4 | 16.12.19 | Update chapter 3 |
| V 1.5 | 04.06.20 | General document update, added chapter 4 |

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