



TECHNICAL DATA SHEET  
NBL-3



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## 1 FEATURES

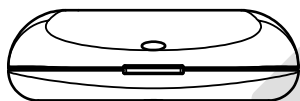
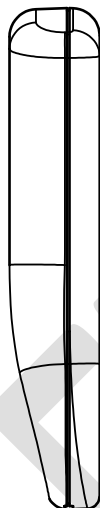
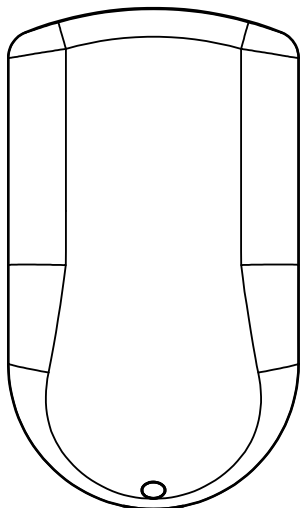
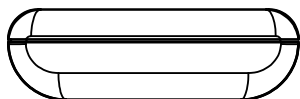
- Mifare® Classic, Desfire card supports
- Bluetooth low energy module
- Two AAA battery supply
- Up to 3 years battery operation
- Built-in two LED indicators
- Built-in two buttons
- UID and card DATA available
- Configure via BL link
- Firmware update via Bluetooth
- Operating temperature -40°C to +85°C
- Enclosure size: 100x58x18
- Additional sensors in NBL-3:
  - Temperature
  - Humidity
  - Magnetic field
  - Light



## 2 FUNCTIONALITY

- Unpaired reader (state after default reset) is waiting for button only
- Reader scans for transponder detect or button press all time when is paired
- In case above event occurs, reader sends advertising packet for  $T_a$  time in period  $T_b$ . Defaults:  $T_a=50\text{sec}$ ,  $T_b=100\text{ms}$
- During advertising green led is flashing slowly. Reader stops blinking and advertising after disconnection.
- Depending on configuration, read card ID can be present on advertising packet or/and on characteristic
- Reader close connection and goes into low power 60 seconds after last data exchange.
- Each LED can be controlled on GATT services
- Reader can be on/off by long button press
- Reader perform sensor measurement in period which is configurable
- Button and magnetic field sensor reacts immediately
- If any sensor value is out of margin, reader wakes up and sends advertising packet
- Sensors configuration is set by GATT services.

### 3 DIMENSIONS



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## 4 BROADCASTING PACKET STRUCTURE

EIR Type	Description / Value	LEN																																										
Flags – 0x01	0x06 GeneralDiscoverable, BrEdrNotSupported	3B																																										
Complete name – 0x09	'NBL-3'	7B																																										
Service data – 0x16	Data format:	21B																																										
<table border="1"> <thead> <tr> <th>BYTE:</th> <th>0..1</th> <th>2</th> <th>3</th> <th>4..5</th> <th>6..7</th> <th>8</th> <th>9</th> <th>10..18</th> </tr> </thead> <tbody> <tr> <td>Field:</td> <td>UUID</td> <td>Status</td> <td>Batt</td> <td>Temp</td> <td>Humi</td> <td>Light</td> <td>CID_Len</td> <td>CID</td> </tr> </tbody> </table>			BYTE:	0..1	2	3	4..5	6..7	8	9	10..18	Field:	UUID	Status	Batt	Temp	Humi	Light	CID_Len	CID																								
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Total packet length: 31B

## 5 GATT SERVER FUNCTIONALITY

GATT Structure:

- [Device Information Service](#)
  - Manufacturer Name Characteristic
  - Model Number Characteristic
  - Serial Number Characteristic
  - Hardware Revision Characteristic
  - Firmware Revision Characteristic
  - System ID Characteristic
- [Device Status/Operation Service](#)
  - [Led Control Characteristic](#)
  - [Reset Characteristic](#)
  - [Device Status0 Characteristic](#)
  - [Device Status1 Characteristic](#)
- [General Configuration Service](#)
  - [Periods Characteristic](#)
  - [Advertising time Characteristic](#)
  - [Advertising payload Characteristic](#)
  - [Active sensor Characteristic](#)

- [Light sensor configuration Characteristic](#)
- [Temperature sensor configuration Characteristic](#)
- [Humidity sensor configuration Characteristic](#)
- [Led/button configuration Characteristic](#)
- [Configuration of Card Reading Mode Service](#)
  - [Card Config0 Characteristic](#)
  - [Card Config1 Characteristic](#)
  - [Card Config2 Characteristic](#)

## 5.1 DEVICE INFORMATION SERVICE

**UUID** 0x180A

**DESCRIPTION**

## 5.2 CHARACTERISTIC

Characteristic	UUID	Type	Sample Value
Manufacturer Name	2A29	Read	Netronix
Model Number	2A24	Read	NBL-3
Serial Number	2A25	Read	0000
Hardware Revision	2A27	Read	0x00800102 (for NBL-V3)
Firmware Revision	2A26	Read	X.Y
System ID	2A23	Read	t.b.d.

## 5.3 STATUS/OPERATION SERVICE

**UUID** 4d696372-6f63-6869-702d-524e00000001

**DESCRIPTION**

### 5.3.1 COMMAND CONTROL CHARACTERISTIC

**UUID** BF3FBD80063F11E59E00000000000001

**TYPE** Read/Write

**LENGHT** 20

**DESCRIPTION** Data format:

BYTE 0	BYTE[1..19]
CMD	Param

#### 5.3.1.1 KEEPALIVE COMMAND

The KeepAlive command prevents the device from going to sleep mode.

Format:

Byte	Field	Value	Description
BYTE 0	CMD	0x00	-

#### 5.3.1.2 RESET COMMAND

The Reset command restarts the device. After reboot, the device will be in bootloader mode for 10 seconds.

Format:

Byte	Field	Value	Description
BYTE 0	CMD	0xD0	-
BYTE[1..4]	PARAM	0x01, 0x02, 0x03, 0x04	-

#### 5.3.1.3 CONFIGRESET COMMAND

ConfigReset command returns to factory settings.

Format:

Byte	Field	Value	Description
BYTE 0	CMD	0xD4	-
BYTE[1..4]	PARAM	0x55, 0xAA, 0xA5, 0x5A	-

#### 5.3.1.4 SETPIN COMMAND

The SetPIN command allows you to:

- enable / disable PIN code during pairing
- PIN code setting

Format:

Byte	Field	Value	Description
BYTE 0	CMD	0x20	-
BYTE[1]	PIN_EN	0x00 lub 0x01	0 – PIN disabled 1 – PIN enabled
BYTE[2..7]	PIN[6]		6 byte PIN code, each byte must be in the range 0-9.

#### 5.3.1.5 LED COMMAND

The command allows you to control the LEDs

Format:

Byte	Field	Value	Description
BYTE 0	CMD	0x10	-
BYTE[1]	RedLedActivity	0x00..0x03, 0x0F	0x00 – turn off red LED 0x01 – turn on red LED for defined time 0x02 – blink slow red LED for defined time 0x03 – blink fast red LED for defined time 0x0F – do not change red LED state
BYTE[2]	RedLedTime	0x00..0xFF	Time in 100ms (0-25sec.)
BYTE[3]	GreenLedActivity	0x00..0x03, 0x0F	0x00 – turn off red LED 0x01 – turn on red LED for defined time 0x02 – blink slow red LED for defined time 0x03 – blink fast red LED for defined time 0x0F – do not change red LED state
BYTE[4]	GreenLedTime	0x00..0xFF	Time in 100ms (0-25sec.)

#### 5.3.1 RESET CHARACTERISTIC

<b>UUID</b>	BF3FBD80063F11E59E00000000000002
<b>TYPE</b>	Read/Write
<b>LENGHT</b>	???
<b>DESCRIPTION</b>	???

#### 5.3.2 DEVICE STATUS0 CHARACTERISTIC

<b>UUID</b>	BF3FBD80063F11E59E00000000000003												
<b>TYPE</b>	Read												
<b>LENGHT</b>	9												
<b>DESCRIPTION</b>	Data format:												
	<table border="1"> <thead> <tr> <th>BYTE 0</th> <th>BYTE[1..2]</th> <th>BYTE[3..4]</th> <th>BYTE[5..6]</th> <th>BYTE 7</th> <th>BYTE 8</th> </tr> </thead> <tbody> <tr> <td>State</td> <td>Temperature</td> <td>Humidity</td> <td>Light</td> <td>Battery</td> <td>I0</td> </tr> </tbody> </table>	BYTE 0	BYTE[1..2]	BYTE[3..4]	BYTE[5..6]	BYTE 7	BYTE 8	State	Temperature	Humidity	Light	Battery	I0
BYTE 0	BYTE[1..2]	BYTE[3..4]	BYTE[5..6]	BYTE 7	BYTE 8								
State	Temperature	Humidity	Light	Battery	I0								

Field	Description																								
State	Button and sensor status. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="5" style="text-align: left;">MSB</th> <th colspan="3" style="text-align: right;">LSB</th> </tr> <tr> <th>Prox</th> <th>Temp</th> <th>Humi</th> <th>Light</th> <th>Card</th> <th>0</th> <th>B1</th> <th>B2</th> </tr> </thead> <tbody> <tr> <td colspan="8"> <ul style="list-style-type: none"> <li>• <b>Prox</b> – state of magnetic field sensor</li> <li>• <b>Temp</b> – 1 – temperature outside specified margins</li> <li>• <b>Humi</b> – 1 – humidity outside specified margins</li> <li>• <b>Light</b> – 1 – light outside specified margins</li> <li>• <b>Card</b> – XXX</li> <li>• <b>Btn1</b> – state of button 1</li> <li>• <b>Btn2</b> – state of button 2</li> </ul> </td> </tr> </tbody> </table>	MSB					LSB			Prox	Temp	Humi	Light	Card	0	B1	B2	<ul style="list-style-type: none"> <li>• <b>Prox</b> – state of magnetic field sensor</li> <li>• <b>Temp</b> – 1 – temperature outside specified margins</li> <li>• <b>Humi</b> – 1 – humidity outside specified margins</li> <li>• <b>Light</b> – 1 – light outside specified margins</li> <li>• <b>Card</b> – XXX</li> <li>• <b>Btn1</b> – state of button 1</li> <li>• <b>Btn2</b> – state of button 2</li> </ul>							
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Temperature	Measured temperature. To obtain value in Celsius degree use formula: $Temp = \frac{165(T_H * 256 + T_L)}{65535} - 40$																								
Humidity	Measured humidity. To obtain value in RH% use formula: $H = \frac{(H_H * 256 + H_L)}{65535}$																								
Light	Measured light.																								
Battery	Battery level in %.																								
IO	0x00																								

### 5.3.1 DEVICE STATUS1 CHARACTERISTIC

**UUID** BF3FBD80063F11E59E00000000000004

**TYPE** Read

**LENGHT** 17

**DESCRIPTION** Data format:

BYTE 0	BYTE[1..16]
CardID_Len	CardID

Field	Description
CardID_Len	ID length.
CardID	ID card number, padded with 0

### 5.4 GENERAL CONFIGURATION SERVICE

**UUID** 4d696372-6f63-6869-702d-524e00000002

**DESCRIPTION** to read / write configuration

#### 5.4.1 PERIODS CHARACTERISTIC

**UUID** bf3fbd80-063f-11e5-9e00-000000000011

**TYPE** Read/Write

**LENGHT** 4

**DESCRIPTION** Data format:

BYTE 0	BYTE 1	BYTE 2	BYTE 3
Scan sensor period		Current state advertising period	
SSP_H	SSP_L	CSAP_H	CSAP_L

- **Scan sensor period** – the period of time that data is read from temperature, humidity and light sensor.

$$Period[s] = (SSP\_H * 255 + SSP\_L)$$

**Range:** 0x0000 – 0xFFFF

**Default:** 0x0004 (4s)

- **Current state advertising period** – the time after which the device will start sending a broadcast packet, even if no data has changed.

$$Period[s] = (CSAP\_H * 255 + CSAP\_L)$$



**Range:** 0x0000 – 0xFFFF**Default:** 0x1770 (6000s)**5.4.2 ADVERTISING TIME CHARACTERISTIC****UUID** bf3fbd80-063f-11e5-9e00-000000000012**TYPE** Read/Write**LENGHT** 1**DESCRIPTION** Advertising time in seconds.**Range:** 1-255**Default:** 50**5.4.3 ADVERTISING PAYLOAD CHARACTERISTIC****UUID** bf3fbd80-063f-11e5-9e00-000000000013**TYPE** Read/Write**LENGHT** 1**DESCRIPTION** 0 – card ID is not present on Advertising packet.

1 – card ID is present on Advertising packet

**Default:** 1**5.4.4 ACTIVE SENSOR CHARACTERISTIC****UUID** bf3fbd80-063f-11e5-9e00-000000000014**TYPE** Read/Write**LENGHT** 1**DESCRIPTION** Data format:

BYTE 0
ActiveSensor

Field	Description				
ActiveSensor	<table border="1"> <thead> <tr> <th>MSB</th> <th>LSB</th> </tr> </thead> <tbody> <tr> <td>0 0 0</td> <td>Card ID   Humidity   Temperature   Light   Magnetic</td> </tr> </tbody> </table> <p>Bit set to 1 means that the sensor is active</p> <p><b>Default:</b> 0x1F</p>	MSB	LSB	0 0 0	Card ID   Humidity   Temperature   Light   Magnetic
MSB	LSB				
0 0 0	Card ID   Humidity   Temperature   Light   Magnetic				

**5.4.5 LIGHT SENSOR CONFIGURATION CHARACTERISTIC****UUID** bf3fbd80-063f-11e5-9e00-000000000015**TYPE** Read/Write**LENGHT** 5**DESCRIPTION** Data format:

BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE 4
WorkMode	Light0		Light1	
WM	L0_H	L0_L	L1_H	L1_L

Field	Description
WorkMode	Sensor work mode: <ul style="list-style-type: none"> <li>WM=0 – Delta</li> <li>WM=1 – Margin</li> </ul> <p><b>Range:</b> 0-1</p> <p><b>Default:</b> 0</p>
Light0 Light1	For <b>WM=0</b> (Delta): <ul style="list-style-type: none"> <li><b>Light0</b> – base temperature</li> <li><b>Light1</b> – maximum allowable temperature change relative to base temperature</li> </ul> For <b>WM=1</b> :

- **Light0** – bottom margin
- **Light1** – top margin

**Range:** 0x0000-0xFFFF

**Default:** Light0 = 0x8000 (XXX), Light1 = 0x0300 (XXX)

**Default:** LightLow = 0x0000, LightHigh = 0xFFFF

#### 5.4.6 TEMPERATURE SENSOR CONFIGURATION CHARACTERISTIC

**UUID** bf3fbd80-063f-11e5-9e00-000000000016

**TYPE** Read/Write

**LENGHT** 5

**DESCRIPTION** Data format:

BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE 4
WorkMode	Temp0		Temp1	
WM	T0_H	T0_L	T1_H	T1_L

$$Tx_{HL} = \frac{(Temp + 40) * 65535}{165}$$

$$Tx_{HL} = Tx_H * 256 + Tx_L$$

Field	Description
WorkMode	Sensor work mode: <ul style="list-style-type: none"> <li>• WM=0 – Delta</li> <li>• WM=1 – Margin</li> </ul> <p><b>Range:</b> 0-1 <b>Default:</b> 0</p>
Temp0 Temp1	For <b>WM=0</b> (Delta): <ul style="list-style-type: none"> <li>• <b>Temp0</b> – base temperature</li> <li>• <b>Temp1</b> – maximum allowable temperature change relative to base temperature</li> </ul> For <b>WM=1</b> : <ul style="list-style-type: none"> <li>• <b>Temp0</b> – bottom margin</li> <li>• <b>Temp1</b> – top margin</li> </ul> <p><b>Range:</b> 0x0000-0xFFFF <b>Default:</b> Temp0 = 0x5D17 (20°C), Temp1 = 0x018E (1°C)</p>

#### 5.4.7 HUMIDITY SENSOR CONFIGURATION CHARACTERISTIC

**UUID** bf3fbd80-063f-11e5-9e00-000000000017

**TYPE** Read/Write

**LENGHT** 5

**DESCRIPTION** Data format:

BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE 4
WorkMode	Humi0		Humi1	
WM	H0_H	H0_L	H1_H	H1_L

$$Hx_{HL} = \frac{Humidity * 65535}{100}$$

$$Hx_{HL} = Hx_H * 256 + Hx_L$$

Field	Description
WorkMode	Sensor work mode: <ul style="list-style-type: none"> <li>• WM=0 – Delta</li> </ul>

	<ul style="list-style-type: none"> <li>WM=1 – Margin</li> </ul> <p><b>Range:</b> 0-1 <b>Default:</b> 0</p>
Humi0 Humi1	<p>For <b>WM=0</b> (Delta):</p> <ul style="list-style-type: none"> <li><b>Humi0</b> – base humidity</li> <li><b>Humi1</b> – maximum allowable humidity change relative to base humidity</li> </ul> <p>For <b>WM=1</b>:</p> <ul style="list-style-type: none"> <li><b>Humi0</b> – bottom margin</li> <li><b>Humi1</b> – top margin</li> </ul> <p><b>Range:</b> 0x0000-0xFFFF <b>Default:</b> Humi0 = 0x4CCC (30%), Humi1 = 0x051F (2%)</p>

#### 5.4.8 LED/BUTTON CONFIGURATION CHARACTERISTIC

<b>UUID</b>	bf3fbd80-063f-11e5-9e00-000000000018		
<b>TYPE</b>	Read/Write		
<b>LENGHT</b>	3		
<b>DESCRIPTION</b>	Data format:		
	<b>BYTE 0</b>	<b>BYTE1</b>	<b>BYTE2</b>
	LedMode	Btn1_WorkMode	Btn2_WorkMode
	<b>Field</b>	<b>Description</b>	
	LedMode	0 – disable internal LED messages 1 – internal LED messages priority is higher than user LED messages 2 – internal LED messages priority is lower than user LED messages <b>Default:</b> 1	
	Btn1_WorkMode Btn2_WorkMode	Button operation mode. 0 – normal 1 – toggle  <b>Default:</b> 0	

#### 5.5 CONFIGURATION OF CARD READING MODE SERVICE

<b>UUID</b>	4d696372-6f63-6869-702d-524e00000003
<b>DESCRIPTION</b>	to write configuration

##### 5.5.1 CARD CONFIG0 CHARACTERISTIC

<b>UUID</b>	bf3fbd80-063f-11e5-9e00-000000000021
<b>TYPE</b>	Write
<b>LENGHT</b>	20
<b>DESCRIPTION</b>	Description is in document ND135 ( <i>NBL-X-MAN-EN Annex A</i> )

##### 5.5.2 CARD CONFIG1 CHARACTERISTIC

<b>UUID</b>	bf3fbd80-063f-11e5-9e00-000000000022
<b>TYPE</b>	Write
<b>LENGHT</b>	20
<b>DESCRIPTION</b>	Description is in document ND135 ( <i>NBL-X-MAN-EN Annex A</i> )

##### 5.5.3 CARD CONFIG2 CHARACTERISTIC

<b>UUID</b>	bf3fbd80-063f-11e5-9e00-000000000023
<b>TYPE</b>	Write
<b>LENGHT</b>	20
<b>DESCRIPTION</b>	Description is in document ND135 ( <i>NBL-X-MAN-EN Annex A</i> )

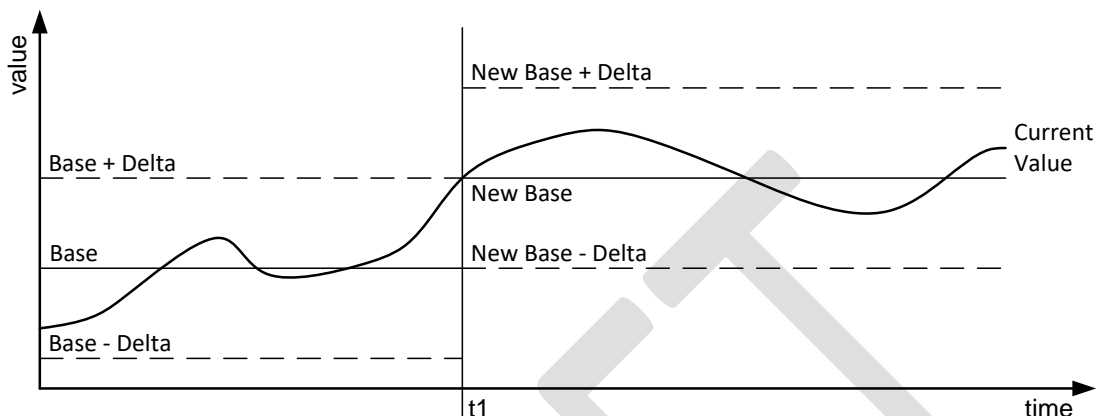
## 6 SENSOR WORK MODE

Work modes apply to temperature, humidity and light sensor.

### 6.1 DELTA

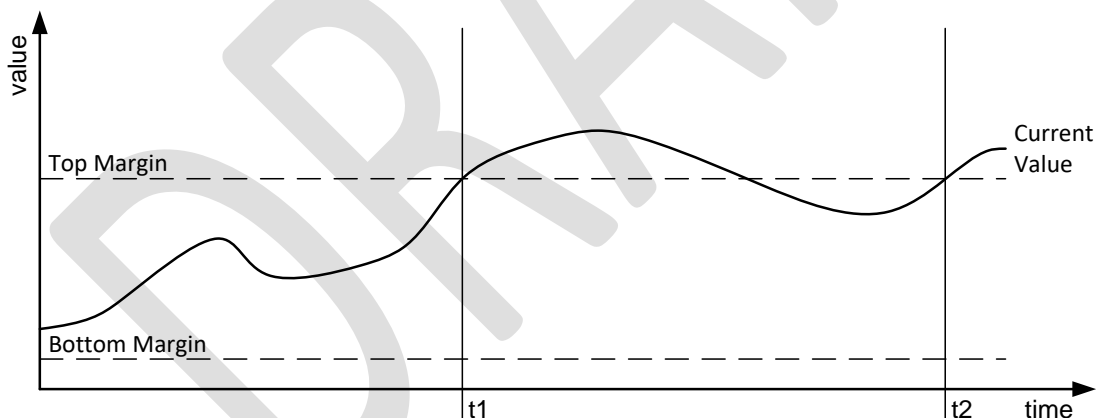
In Delta mode, the user can specify the base value and the maximum difference (delta) from the base value. If the measured value goes out of range (base value  $\pm$  delta) then:

- the device starts sending advertising packages
- the base value will be replaced by the current value of the measured parameter.



### 6.2 MARGIN

In Margin mode, the user can specify the upper and lower value of the measured parameter. If the monitored parameter leaves the defined range, the device will start sending the advertising package (time  $t_1$  and  $t_2$  in the figure below).



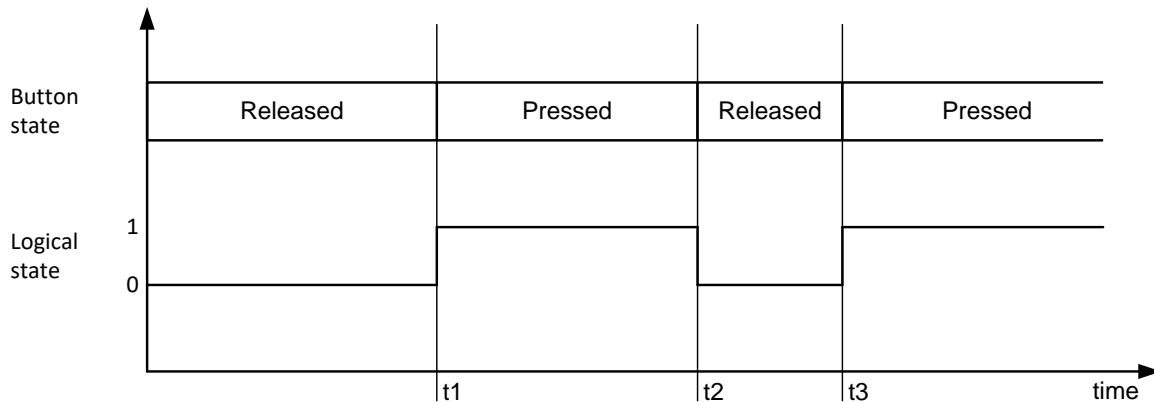
## 7 BUTTON WORK MODE

Each of the buttons can work in one of 2 modes:

- Normal
- toggle

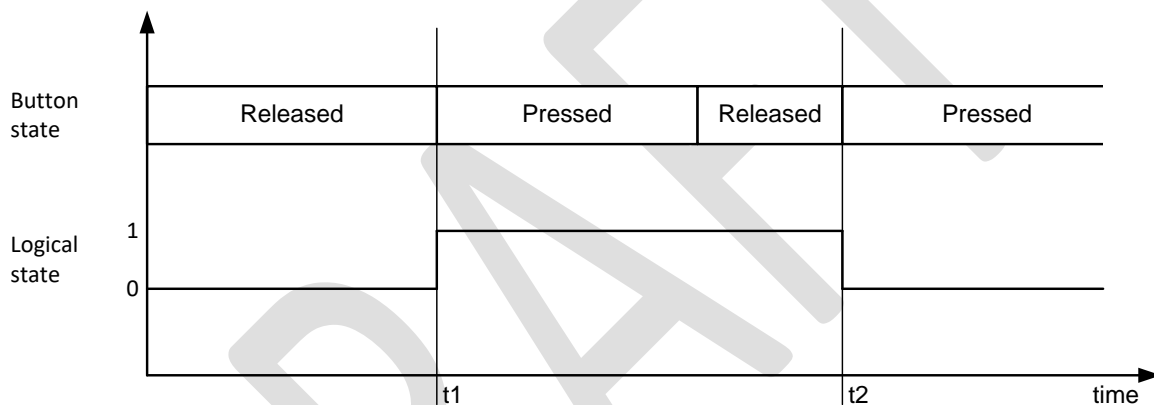
### 7.1 NORMAL

In Normal mode, the logical state directly reflects the physical state of the button. Each change of the button state causes the start sending of the advertising package / update of the data in the advertising package (time  $t_1$ ,  $t_2$  and  $t_3$  in the figure below).



## 7.2 TOGGLE

In toggle mode, the logic state changes to the opposite each time the button is pressed. Each change the logical state causes the start of sending the advertising package / data update in the advertising package (time t1 and t2 in the figure below).



## 8 POWER OFF / RESET TO DEFAULT SETTINGS

To set factory defaults and un-pairing both buttons must be pressed for 5 seconds additionally button 1 (blue) must be pressed first. It is also factory/transport configuration.

Procedure:

1. Press Button1 and hold
2. Press Button2 and hold
3. Keep the buttons pressed for 5 seconds.
4. The return to the factory settings will be signaled by flashing LED1 and LED2

## 9 POWER ON

Procedure:

1. Press Button2 and hold
2. Keep the button pressed for 5 seconds.
3. The PowerOn will be signaled by flashing LED1 and LED2

## 10 PARING

When device have defaults settings, reader waits for button then sends advertising packet for 60 seconds and blinks LEDs.

When the device is in the broadcast packet mode, it is possible to establish a connection via Bluetooth. If the connected device has not been paired before, NBL will initiate the pairing process. The pairing process with the device does not require a PIN code. After successful pairing, it is recommended to enter a PIN code. This can be done by writing an appropriate command to the CMD characteristics.

The NBL-3 can remember up to 8 pairing keys. Each subsequent pairing removes the earliest paired device from the list of paired devices.

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## 11 FIRMWARE UPDATE FUNCTIONALITY

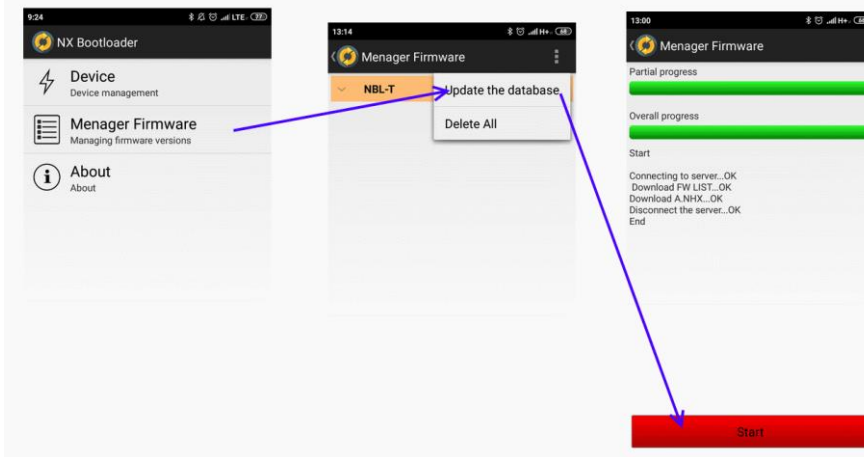
### 11.1 FIRMWARE UPDATE USING THE NBL TOOL APPLICATION

The firmware update is implemented using an application running on an android phone.

After the connection with the device, the application can start the bootloader mode. The bootloader mode can also be started by pressing the button 1 and the button 2 while switching on the power. The bootloader mode is signaled by a rapid blinking of the red LED.

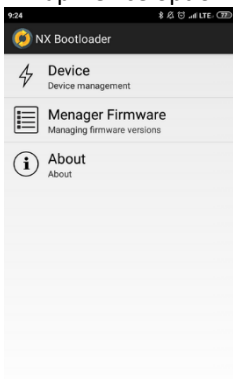
The firmware update procedure.

1. Run NX Bootloader application
2. Update the firmware database (tap: Menager Firmware -> Update the database -> Start)

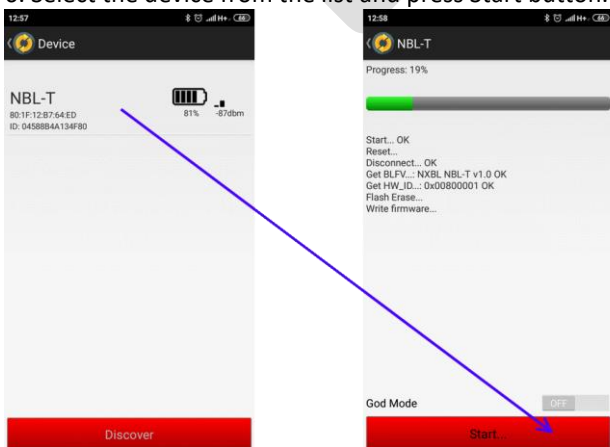


3. Back to main menu

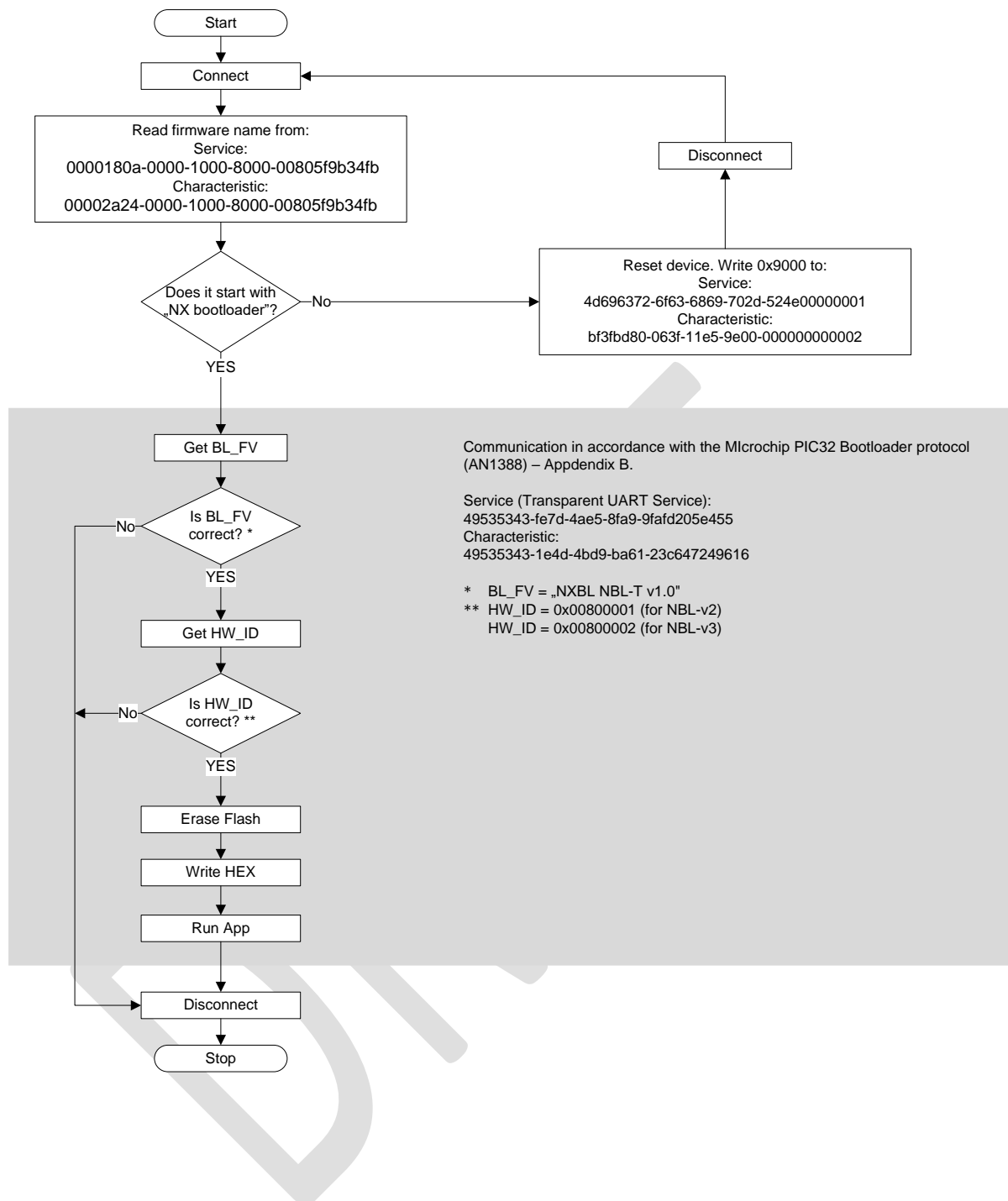
4. Tap Device option



5. Wake up the device - eg by applying the card or entering it into the bootloader mode
6. Select the device from the list and press Start button.



## 11.2 FIRMWARE UPGRADE ALGORITHM



Communication in accordance with the Microchip PIC32 Bootloader protocol (AN1388) – Appendix B.

Service (Transparent UART Service):  
49535343-fe7d-4ae5-8fa9-9fafd205e455  
Characteristic:  
49535343-1e4d-4bd9-ba61-23c647249616

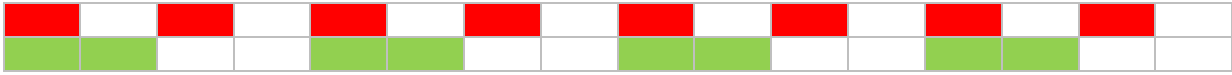
\* BL\_FV = „NXBL NBL-T v1.0“  
\*\* HW\_ID = 0x00800001 (for NBL-v2)  
HW\_ID = 0x00800002 (for NBL-v3)



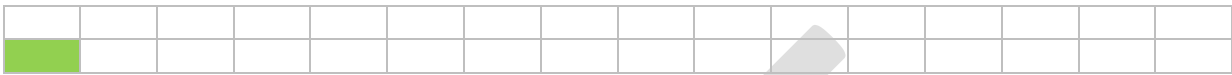
**12 BATTERY REPLACEMENT**

**13 LED**

**13.1 MSG\_START**



**13.2 MSG\_ADV**



**13.3 MSG\_CONN**



**13.4 MSG\_WAK\_UP**



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