

UM11514

NHS31xx therapy adherence app

Rev. 2.04 — 23 August 2021

User manual

Document information

Information	Content
Keywords	NHS31xx, Therapy adherence
Abstract	This user manual describes how to use the NHS31xx therapy adherence demo PCB.



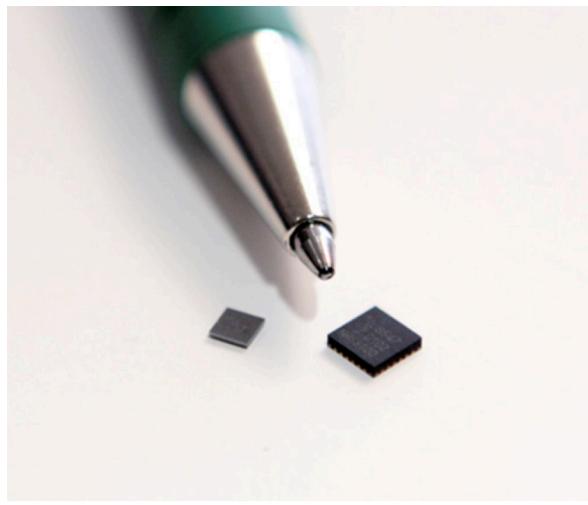
Revision history

Rev	Date	Description
v.2.0	20210823	Text and graphics have changed throughout the document.
v.1.2	20180615	Initial version

1 Introduction

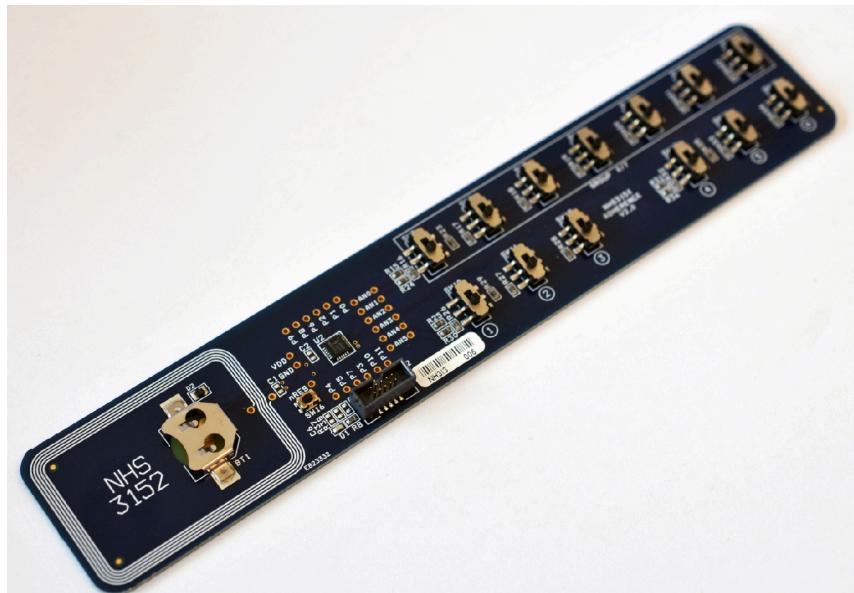
A cost-effective, small, and fully configurable therapy adherence monitoring solution can easily be demonstrated using this app. The NHS3100THADADK demo PCB featuring an NHS3100 IC and the NHS3152THADADK featuring an NHS3152 IC can be used with the app.

All communication with the chip, configuration and data readout, occurs via the NFC interface using standard NDEF messages.



aaa-030803

Figure 1. An NHS3100 IC in a WLCSP25 and an HVQFN24 package



aaa-031114

Figure 2. A NHS3152THADADK demo PCB featuring an NHS3152 IC

2 Prerequisites

To demonstrate the therapy adherence monitoring solution yourself, you need:

- An NHS31xx demo PCB. NXP Semiconductors provides two different PCBs that can be used for this solution.
 - NHS3100THADADK demo PCB
 - NHS3152THADADK demo PCB
- A coin cell battery of type CR1225 or compatible. This type of battery is best suited for use cases targeting room and fridge temperatures.
 - Insert the coin cell in the coin cell holder on the demo PCB. The negative electrode of the battery should be at the bottom, closest to the PCB.
 - When NHS31xx demo PCBs arrive, they already have a coin cell inserted.
- An NFC enabled smartphone

2.1 NHS3100THADADK demo PCB

The NHS3100THADADK demo PCB can be ordered via <https://www.nxp.com/part/NHS3100THADADK#/>.

This demo board consists of:

1. An NHS3100 IC in an HVQFN24 package U2
2. An SWD connector J2
3. A coin cell holder for standalone operations BT1
4. One SW controllable LED D1
5. A tactile switch SW16 connected to the RESETN pin
6. All PIOs of the IC P0x. The PIOs are connected to each other in a matrix-like grid. The switches on the right side of the PCB can connect or disconnect the wiring between them.
7. GND and VDD
8. Antenna coil connections LA and LB. The white lines representing the NFC antenna is just markup. The NFC antenna is on the back side.

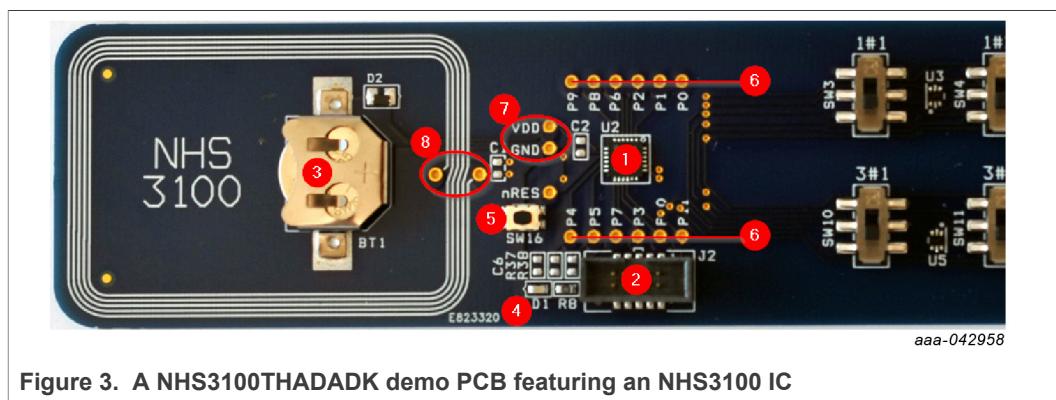


Figure 3. A NHS3100THADADK demo PCB featuring an NHS3100 IC

On the right side, 14 switches are present.

- When the switch is down, it represents a closed cavity with a pill still inside the blister.
- When the switch is up, it represents an open cavity with the pill extracted from the blister.

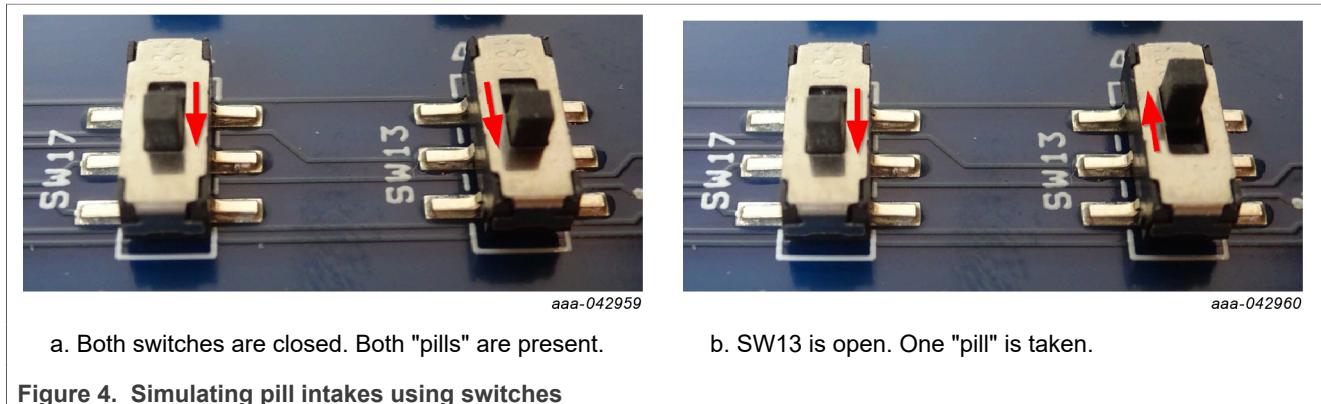


Figure 4. Simulating pill intakes using switches

2.2 NHS3152THADADK demo PCB

The NHS3100THADADK demo PCB can be ordered via <https://www.nxp.com/part/NHS3100THADADK#/>.

This demo board consists of:

1. An NHS3152 IC in an HVQFN24 package U2
2. An SWD connector J2
3. A coin cell holder for standalone operations BT1
4. One SW controllable LED D1
5. A tactile switch SW16 connected to the RESETN pin
6. All PIOs of the IC P0x
7. GND and VDDBAT
8. Antenna coil connections LA and LB. The white lines representing the NFC antenna is just markup; the NFC antenna is on the back side.
9. All analog outputs of the IC ANAx.

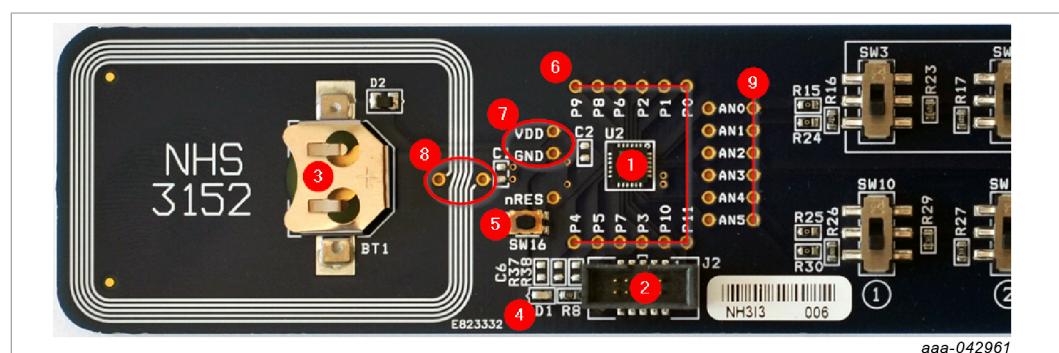


Figure 5. A NHS3152THADADK demo PCB featuring an NHS3152 IC

On the right side, 13 switches are present.

Two different approaches are demonstrated on the same PCB.

- ANA0 is connected with ANA1 using external wires on the PCB. The seven switches on the top right are in parallel with each other. They can each enable or disable the presence of a resistor. Each resistor has approximately the same value. In this setup, it is not possible to distinguish between different switches; only the count can be deduced.

- ANA2 is connected with ANA3 using external wires on the PCB. The three switches on the bottom right are in between, in parallel with each other.
- ANA4 is connected with ANA5 using external wires on the PCB. The three remaining switches on the bottom are in between, in parallel with each other.
- Each switch can enable or disable the presence of a resistor. Per group, each resistor has approximately double the value from the previous one.
- In this setup, it is possible to know exactly which pill was taken.

2.3 Embedded firmware

The PCBs must have the correct firmware flashed. The software running on the microcontroller in the NHS3100 and NHS3152 ICs control the HW blocks and peripherals. They determine the actual functionality that is demonstrated. The demo boards are not preflashed, so the customer must do this extra step. It allows the customer to choose the demo functionality and to use the binaries from the latest SDK.

The procedure to download the correct firmware image in the FLASH memory of the IC is described on the NXP webpages:

- For the NHS3100THADADK demo PCB, check <https://www.nxp.com/pages/:GS-NHS3100THADADK>
- For the NHS3152THADADK demo PCB, check <https://www.nxp.com/pages/:GS-NHS3152THADADK>

2.4 Android app

Any NFC-enabled Android cell phone running 5.0 Lollipop or higher can be used.

Download the Android app from the Google Play Store at <https://play.google.com/store/apps/details?id=com.nxp.nhs.demo.startstoptherapy> or use the QR code.



Figure 6. QR code for installing the Android app

2.5 iOS app

Any iOS smartphone, model iPhone 7 or newer can be used.

Download the iOS app from the Apple App Store at <https://apps.apple.com/us/app/nhs31xx-therapy-adherence/id1534326792> or use the QR code.



Figure 7. QR code for installing the iOS app

3 Usage

Launch the app. All interactions with the demonstrator board can be done with the app.

3.1 Initial screen

If it is the first time after installing the app, a popup is shown, requiring you to accept the NXP software evaluation license agreement.

After that, the initial screen is shown.

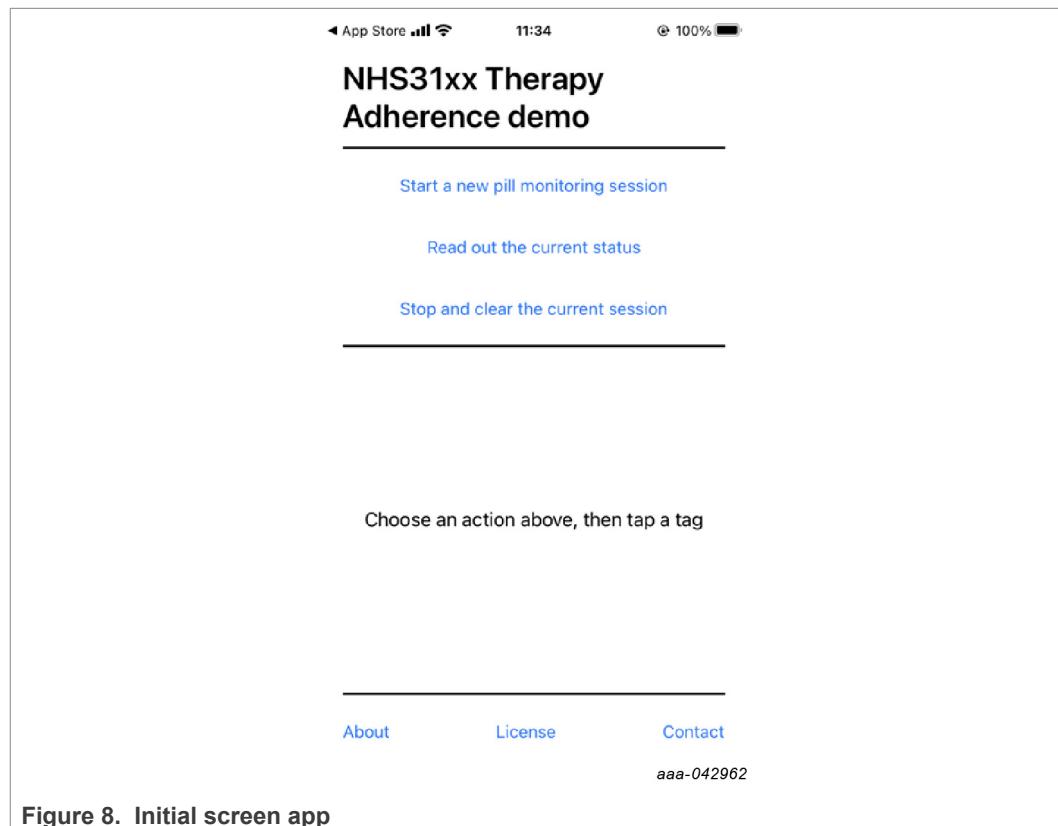


Figure 8. Initial screen app

3.2 Start a new pill monitoring session

Note: When using the NHS3152THADADK demo PCB, first check that all switches are closed, that is that all "pills" are present. To overcome the tolerances on the different resistors that are placed in series with the switches, the firmware performs a calibration measurement. When the calibration is done with some switches already open, wrong calculations are made in the firmware. The result is erroneous reporting of pill intakes.

If you inadvertently started a new pill monitoring session with one or more switches already open, you must close them all, then restart a new pill monitoring session.

From the three possible actions, tap "Start a new pill monitoring session". A popup asks you to tap the demonstrator board.

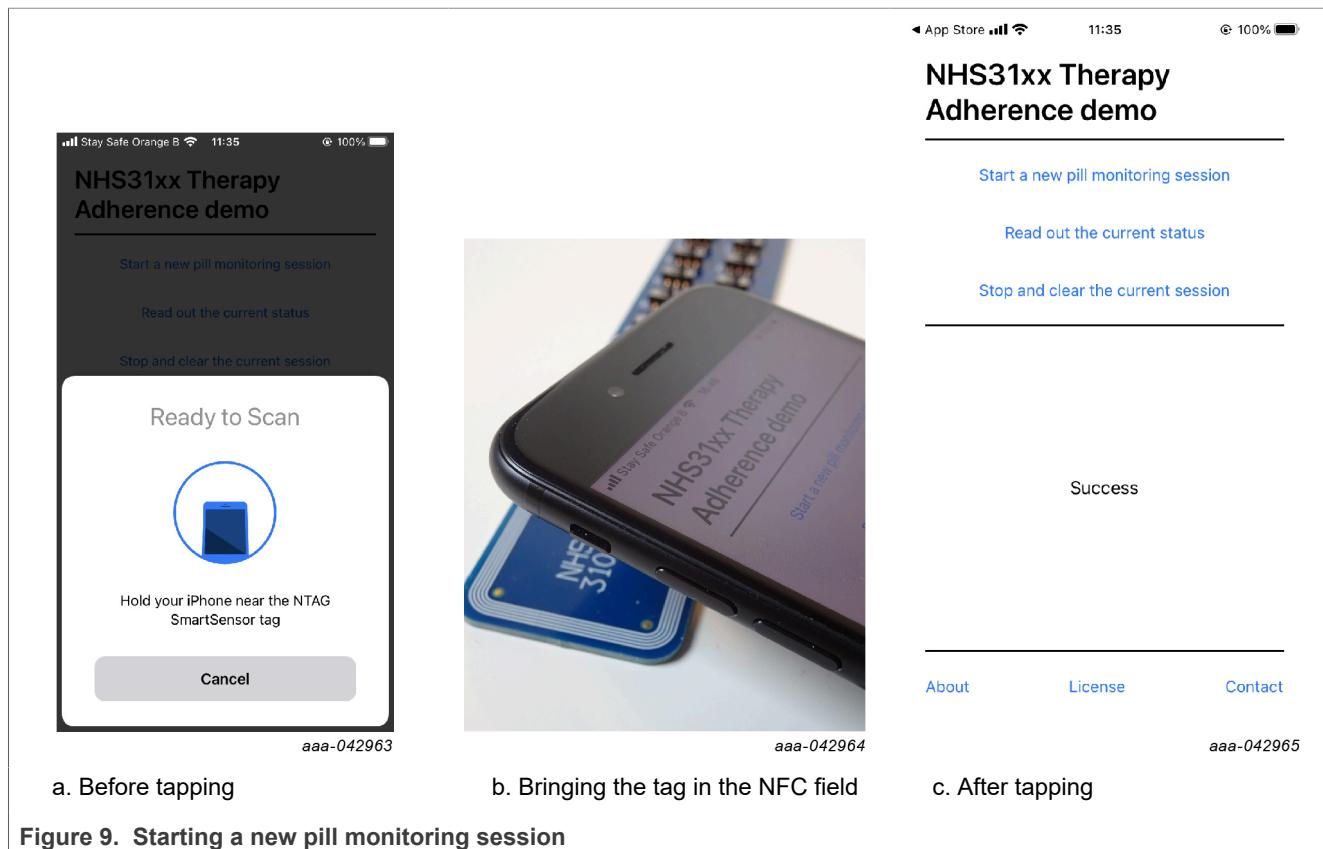
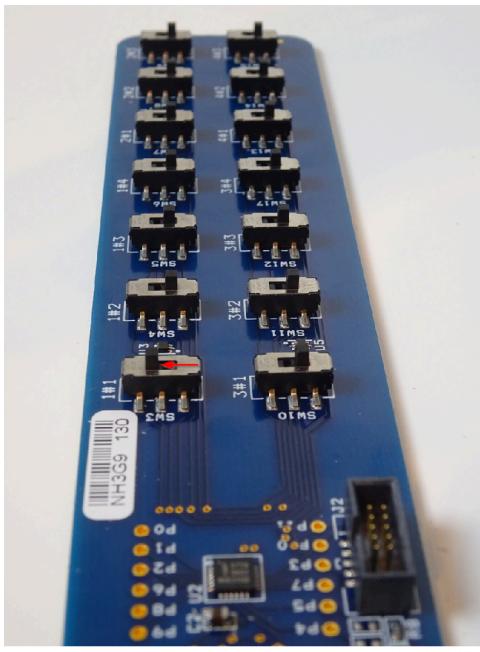


Figure 9. Starting a new pill monitoring session

3.3 Read out the current status

At any time, you can request to read out the current status. First, tap on the command "Read out the current status". When the popup is shown, tap the demonstrator board with your phone.



a. Status of the demonstrator board

◀ App Store 11:37 100%

NHS31xx Therapy Adherence demo

[Start a new pill monitoring session](#)

[Read out the current status](#)

[Stop and clear the current session](#)

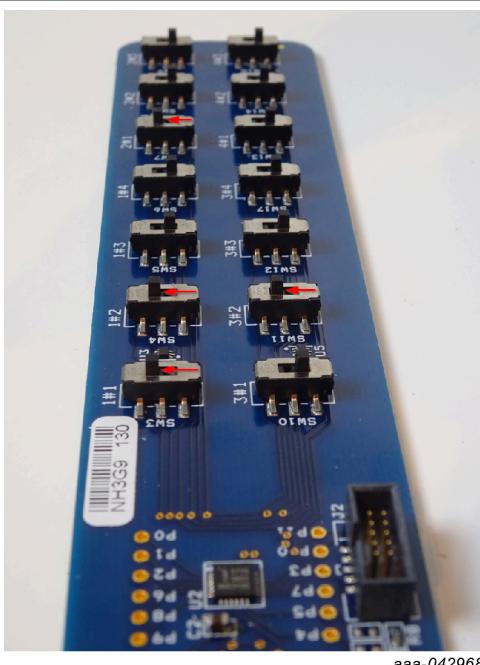
Adherence monitoring started 65 seconds ago. 13 pills remain.
1# 1 after 45 seconds

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b. Status reported by the embedded firmware

Figure 10. Checking the status after a first pill extraction



a. Status of the demonstrator board

◀ App Store 11:39 100%

NHS31xx Therapy Adherence demo

[Start a new pill monitoring session](#)

[Read out the current status](#)

[Stop and clear the current session](#)

Adherence monitoring started 3 minutes ago. 10 pills remain.
1# 1 after 45 seconds
1# 2 after 86 seconds
3# 2 after 96 seconds
2# 1 after 2 minutes

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b. Status reported by the embedded firmware

Figure 11. Checking the status after multiple pill extractions

3.4 Stop and clear the current session

To preserve battery life, the monitoring of the pill intakes can be stopped.

- Either on the demonstrator board:
Press the nRES tactile switch. The LED flashes once and the IC enters power-off mode.
- Or via the app:
Tap on "Stop and clear the current session".

Reset the switches to the initial position (down). If the reset is not done, a next pill monitoring session excludes the switches from the session.

4 Troubleshooting

4.1 The tag is not recognized

Is the NFC functionality on the phone enabled?

- If it is not enabled, enable it.
- If it is, try disabling and reenabling it.

Is the tag positioned correctly?

- Move the tag slowly over the back of the phone from top to bottom until you find the location of the NFC antenna on the phone. Some phones depict an NFC logo on the back to help you aiming correctly. iPhones and newer Android phones tend to have the NFC functionality near the top of the phone.

Is the tag distance optimal?

- On most phones, touching the tag with the phone yields the best results. On other phones, it is better to maintain a small distance. The maximum distance you can expect to reach is about 5 cm.

4.2 The tag is recognized, but the detailed status is not read out

Is the correct firmware running on the NHS31xx tag?

- Read out the current status and check the status that is listed. If it displays "Empty. Not yet configured.", displays the current temperature, reports a number of samples logged, or similar, the firmware for the NHS3100 temperature logger demo has been inadvertently programmed. Other firmware may cause the app to display a URL as plain text or can even cause the app to display nothing at all.

Reprogram the tag using the correct firmware image

`app_demo_dp_tadherence.bin` or `app_demo_dp_tadherence.hex`. application.

See the "Overview of supported methods for firmware flashing on NHS31xx ICs" application note (AN12328).

Is the correct flavor running on the NHS31xx tag?

- The sources of the therapy adherence firmware can be built in different flavors. Each flavor is suitable for running on a specific board. Boards can differ on the number of available switches, on the measurement principle - digital via GPIOs or resistive using the I2D and ADC, and more.
If the wrong firmware has been inadvertently programmed, you must reprogram the tag using a wired connection. See the "Overview of supported methods for firmware flashing on NHS31xx ICs" application note (AN12328).

Is the tag monitoring?

- Read out the current status and check the status that is listed. If the tag is idle, the text "Adherence monitoring has not yet started." is displayed. It means that, when the NFC field is removed, the IC enters power-off mode. Flipping a switch is not detected then.

Is the connection already lost?

- If communication was interrupted, you may have to restart the low-level process of establishing an NFC connection, which the NFC driver performs. Move the tag away and then back again within range of the phone.

Is the battery voltage level still sufficient?

- A battery is needed for standalone monitoring and to store the time with each pill intake correctly. For a correct operation, the voltage of the battery under load must be greater than 1.72 V. Check or replace the battery and retry.

4.3 Reporting

- When problems persist or when this manual fails to clarify behavior, report the matter to us. Reporting to us helps us to help you. It also helps to improve the demo and the underlying software.
- Include the demo PCB HW number and phone details such as manufacturer, model, and OS version.

5 Follow-up

For more information about this demo, the targeted use case, or the NHS31xx IC, check out the different web pages and materials offered at <https://www.nxp.com/NTAGSMARTSENSOR>.

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