FAQ
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Frequently asked questions for RF430CL33xH devices

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Safety and Security (S2) NFC/RFID Applications

ABSTRACT

This guide contains a compilation of frequently asked questions concerning the RF430CL33xH series of devices. It serves as a central resource for anyone evaluating or designing with the RF430CL33xH devices. This guide includes links to recommended evaluation modules, reference designs, firmware examples, and other collateral that is relevant for the RF430CL33xH family.

Contents

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1 General Questions

1.1 *What protocols do the RF430CL33xH devices support?*

ISO/IEC 14443 Type B and NFC Forum Type 4B

1.2 *Are the RF430CL33xH devices NFC Forum compliant?*

Yes, the RF430CL33xH devices are designed to use NFC Forum standards, including the NDEF record standards.

1.3 *What is the NDEF message format?*

NFC tags use the NFC Data Exchange Format (NDEF) to store data within tags according to the NDEF standards. This allows any NFC-enabled devices to read the data from any NFC tag and interpret it. Most applications on NFC-enabled smartphones use NDEF when reading or writing data to NFC tags.

1.4 *What evaluation hardware should i get to evaluate the RF430CL33xH Devices?*

1.4.1 RF430CL330H evaluation hardware

The recommended hardware for evaluation is the Dynamic Dual Interface NFC Transponder BoosterPack™ Plug-in Module.

1.4.2 RF430CL331H evaluation hardware

No BoosterPack plug-in module with the RF430CL331H is available from TI as of this writing, but there are two methods to get the RF430CL331H on a BoosterPack plug-in module:

- Purchase the RF430CL331H BoosterPack plug-in module by DLP Design Inc. from Digi-Key, part number DLP-RF430CL331BP.
- Purchase a Dynamic Dual Interface NFC Transponder BoosterPack Plug-in Module from the TI store, sample an RF430CL331H device, and replace the RF430CL330H device in the DLP-RF430BP with the RF430CL331H device. These devices are fully pin compatible, so no other changes need to be made.

1.5 *What TI NFC reader/writer hardware and software is required to communicate with the RF430CL33xH?*

Use the TI NFCLink Standalone software solution:

- Purchase hardware in TI store.
- Download firmware.
- For details, see NFC/HF RFID Reader/Writer Using the TRF7970A.

1.6 *How do i read data from the RF430CL33xH?*

See TI example firmware projects in Section 4 and program the device with a firmware example that includes a predefined NDEF Text RTD message.

1.7 *How do I format or change data that is stored on the RF430CL33xH?*

TI example firmware projects contain examples of different NDEF record types. For a general reference that can be applied for the RF430CL33xH devices, see the NFCLink Standalone firmware for card emulation. The NFC card emulation using the TRF7970A application report includes a link to the firmware. The header file containing the NDEF record examples is located at [installed path]/nfclink/source/headers/ndef_image.h.

For technical details or information about message types not demonstrated in TI example firmware, see the following NFC Forum specifications: *Type 4 Tag Operation*, *NFC Data Exchange Format (NDEF)*, and *Record Type Definition (RTD)* for details about how format the capability container and payload data per the NFC Forum standards.

2 Differences Between the RF430CL330H and RF430CL331H Devices

2.1 Size for over-the-air data transmission

RF430CL330H message size

The RF430CL330H sends data over the air based on what is loaded to the 3KB of SRAM memory of the device. Due to this, the maximum message size that can be sent in one connection is 3KB. To send or receive more, the NFC connection must be reset, and new data must be loaded into or read from the RF430CL330H.

RF430CL331H message size

The RF430CL331H features a pass-through mode that allows for more flexibility in terms of data transfer sizes. Using this feature, the RF430CL331H repurposes the 3KB of SRAM it contains to be a buffer that passes data between the MCU it is connected to and the NFC reader/writer device communicating with it. The buffer makes is possible to send or receive large amounts of data without resetting the NFC connection. Therefore, the only limit of the message size is the amount of available memory on the microcontroller.

For example, if the RF430CL331H is used with a TI MSP430FR5969 MCU, which has 64KB of FRAM available, it is possible to send a 45KB message over the air in a single NFC connection to an NFC device.

NDEF message size limitations

The NFC Forum standards define the largest size of data in a single NDEF file as 65536 bytes. When more than 65536 bytes of data need to be sent, then the NDEF file system should be used to create multiple NDEF records, each of which are smaller than 65536 bytes.

A closed loop system that does not need to be NFC Forum compliant and does not communicate with NFC Forum compliant devices (for example, NFC-enabled smartphones or tablets) can ignore those limitations. The RF430CL331H hardware does not prevent the transmission of more data.

2.2 Required microcontroller management

RF430CL330H requirements

The RF430CL330H is designed to automatically handle all RF communications with an NFC device, essentially operating a black box device. After data is loaded through serial communication, that data can be made available to NFC devices with just a single register write.

The handling of the NFC communication is fully implemented within the standard operation of the RF430CL330H. This removes the overhead of managing the NFC communication from the host MCU.

RF430CL331H requirements

The RF430CL331H, to support the pass-through mode, has the drawback of requiring the host MCU to manage portions of the NFC communication during data exchange. After initial tag activation is completed, the RF430CL331H informs the host MCU through interrupts that a command has been received.

To react properly, the host MCU must fetch the information about the command from the RF430CL331H and determine through software what command was received.

Furthermore, it is the responsibility of the host MCU to ensure that the correct NFC Data Exchange Format (NDEF) headings are appended to each packet of data that is transmitted. All of these requirements are additional tasks for the host MCU when operating the RF430CL331H, but that are handled automatically by the RF430CL330H.

2.3 Serial communication options

The RF430CL330H supports both I^{2}C and SPI communication options. TI recommends I^{2}C due to better speed performance based on the device specifications.

The RF430CL331H supports I^{2}C communication.

2.4 Recommend applications

RF430CL330H applications

For NDEF applications that send less than 3KB of data, TI strongly recommends the RF430CL330H, because the device handles the communication automatically, which reduces overhead for the host MCU.

RF430CL331H applications

For applications in which more than 3KB of NDEF data needs to be sent or received in a single communication cycle, the RF430CL331H is the ideal device. The trade-off for being able to send and receive larger data packets is that the host MCU must take on the additional tasks as described in Section 2.2.

3 Hardware and Design Questions

3.1 Where can I get schematics and layout files for the RF430CL33xH?

Download the RF430CL330HTB Schematic and BOM.

Altium PCB files are available for a full reference design including host microcontroller.

3.2 How do I design and tune an antenna to 13.56 MHz for the RF430CL33xH devices?

See the RF430CL330H practical antenna design guide.

3.3 What reference designs are available for the RF430CL33xH devices?

General hardware design: Dynamic Near Field Communication (NFC) Type 4B Tag reference design

Battery-less temperature sensing with NFC and FRAM MCU: Dynamic Field-Powered NFC for Data Logging Access Control and Security Applications reference design

Battery-less temperature sensing with NFC and precision ADC: Passive NFC Temperature Patch reference design

Ultra-low-power multisensor data logger with NFC and FRAM MCU: Ultra-Low Power Multi-sensor Data Logger With NFC Interface reference design

3.4 What memory technology do the RF430CL33xH devices use?

The RF430CL33xH devices have SRAM memory, which allows for the fastest reading and provides unlimited read and write cycles. These devices require a microcontroller to load data to them on power up, which ensures the latest data is always current.

For applications in which data must be stored when the device is not powered, using TI microcontrollers with FRAM can allow for the retention of NFC data within FRAM. As an example, the Dynamic Field-Powered NFC for Data Logging Access Control and Security Applications reference design demonstrates a battery-less operation application with the RF430CL330H and a TI FRAM microcontroller. The devices are powered by energy harvesting from the RF field, and the TI FRAM microcontroller retains the NFC message while no power is present and loads the data to the RF430CL330H on power up.

4 Software Questions

4.1 *What software examples are available for the RF430CL33xH devices?*

4.1.1 RF430CL330H firmware examples

Basic example firmware

- RF430CL330H Example Code
- Recommended hardware is the MSP430™ LaunchPad™ Value Line Development Kit plus the Dynamic Dual Interface NFC Transponder BoosterPack Plug-in Module.
- This is a simple example with a text NDEF record.

Example firmware for passively powered applications

- TIDA-00217 Firmware
- This is the example firmware from the Dynamic Field-Powered NFC for Data Logging Access Control and Security Applications reference design, which features an RF field powered RF430CL330H application using the MSP430FR5969 MCU.

4.1.2 RF430CL331H firmware examples

Basic example firmware

- RF430CL331H Example Code
- This example firmware is for the MSP430F5529 USB LaunchPad development kit and also requires a BoosterPack plug-in module with the RF430CL331H on it. See Section 1.4 for details about the RF430CL331H BoosterPack plug-in modules.

Example firmware for ultra-low power and large data transfer applications

- Cold Chain Datalogger Demo Software
- This is the example firmware from the Ultralow Power Multi-sensor Data Logger with NFC Interface reference design, and it works with the Ultralow Power Multi-sensor Data Logger with NFC Interface evaluation module hardware.
- The example firmware demonstrates how to power optimize an RF430CL331H application when using an MSP430 FRAM device (MSP430FR5969). Additionally, the firmware covers how the microcontroller should handle the processing of large data transfers between the RF430CL331H and an NFC-enabled reader device.

4.2 *Is there a software example for Wi-Fi® pairing and handover?*

Yes, the Wi-Fi Enabled IoT Node With NFC Connection Handover reference design uses the TM4C1294, CC3100, and RF430CL330H and includes Wi-Fi® connection handover (pairing).

4.3 *Is there a software example for RTOS?*

Yes, the following reference designs use the RF430CL330H with a TM4C12x device along with TI-RTOS to manage the scheduling of tasks:

- Wi-Fi Enabled IoT Node With NFC Connection Handover reference design
- Secure IoT Gateway for *Bluetooth* ® Low Energy, Wi-Fi® and Sub-1 GHz Nodes reference design

5 Miscellaneous Questions

5.1 *Why does a passively powered RF430CL33xH device not work with Android™ phones, but it does work with TI NFC reader kits?*

All designs in which the RF430CL33xH is passively powered from the RF field rely on being able to harvest enough energy from the provided RF field of the NFC reader. Some Android phones do not output as much RF field power due to variations in their NFC polling methods, and that can cause a problem where the Android phone does not allow the RF430CL33xH device to harvest enough energy to turn on and respond to an RF command.

The TI NFC reader kits do not have this limitation because they provide a lot of power on a more consistent basis, and therefore allow a passively powered RF430CL33xH device to receive enough energy to turn on.

6 References

1. NFC Forum Specifications
2. RF430CL331H NFC type 4B tag platform and ISO/IEC 14443B dynamic transponder
3. RF430CL330H dynamic NFC interface transponder
4. NFC/HF RFID reader/writer using the TRF7970A
5. RF430CL330H practical antenna design guide
6. NFC card emulation using the TRF7970A

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from November 28, 2017 to March 13, 2019	**Page**
• Updated the link to purchase hardware in Section 1.5	2

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