NFC Everywhere

Controller, frontend, and connected tag solutions for a new era in *NFC*

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01 Introduction

A Different Kind of Wireless

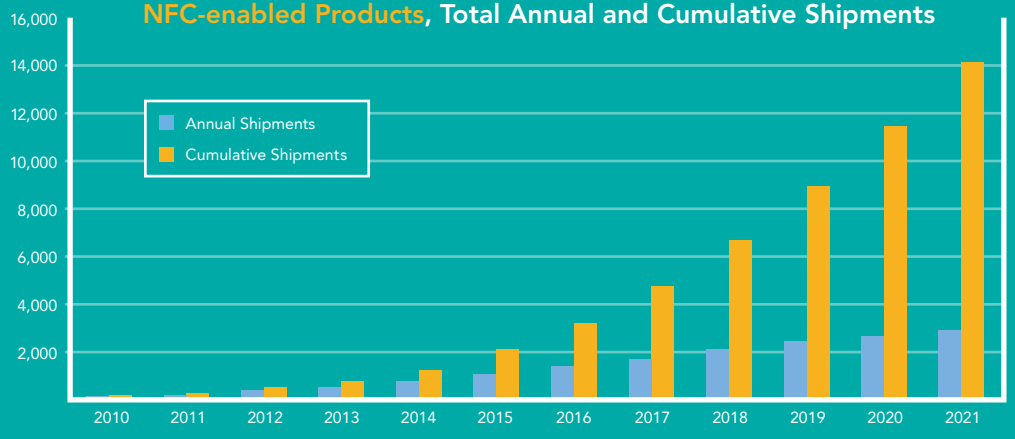
Near Field Communication (NFC) delivers short-range communication, similar to Bluetooth and WiFi, but with the ability to store and transmit data in much the same way that RFID tags and contactless smartcards do.

NFC is a proximity technology, which means it only works when two devices are brought close together or actually touch. When devices aren't near each other, NFC is dormant, so it's not drawing power or sharing information when it shouldn't.

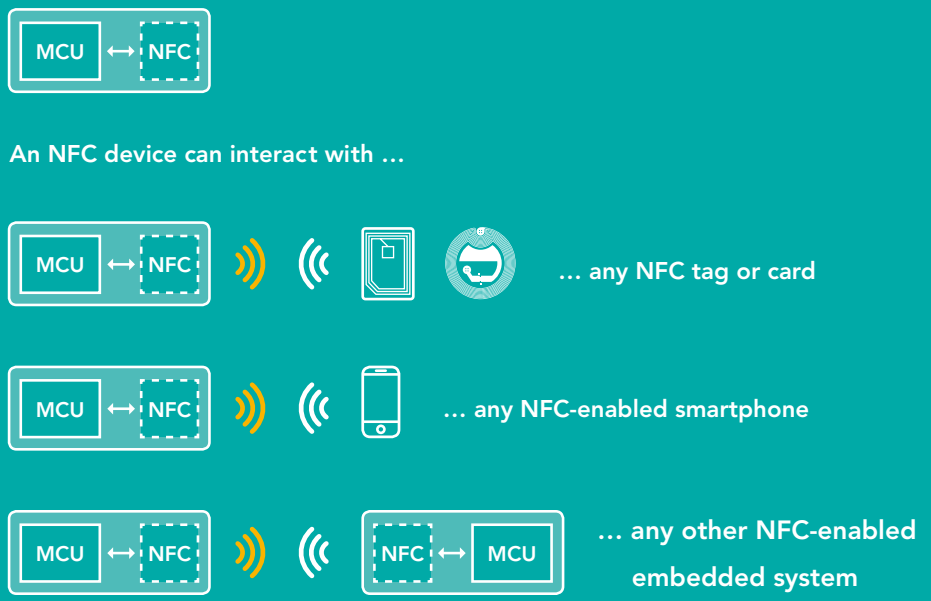
2 billion

NFC-enabled devices will be deployed in 2018

ABI Research, 2016



ABI Research, 2016



3 Big Reasons to Consider *NFC*

01

You'll Speak with Intention

With some wireless technologies, like Bluetooth, WiFi, and ZigBee, multiple devices can interact at once, and that can lead to confusion. NFC is more intuitive and more direct, since it only involves two devices at any given time. NFC's also secure by nature, since it does business over such a short distance. It's a bit like whispering – you get close, share a secret, and make eavesdropping a near impossibility.

02

You'll Use Power Very Efficiently

Only one of the devices needs to be powered for a two-way interaction to take place. The second device can save its battery for other things, or not have a battery at all. Learn more about NFC's unique energy-harvesting features on p 11.

03

You'll Play Well with Others

NFC is not a replacement for other wireless formats, but a trusted addition that makes life easier - especially when it comes to pairing and commissioning devices. Learn more about how NFC compares with other wireless protocols on p 33.

4 Big Reasons to Consider *NXP® for NFC*

1 We Co-Invented the Technology

NXP and NFC are tightly connected. We were there at its birth, and cofounded the NFC Forum, the standards-based organization that now includes more than 170 member companies. We've also played a pivotal role in expanding NFC's worldwide presence.

2 Nobody Ships More NFC ICs

We're the world's number-one supplier, with top positions in the mobile and infrastructure sectors. Also, our technology is in more than 80% of all NFC-enabled point-of-sales (POS) terminals, and more than 80% of all NFC-enabled smartphones.

3 Nobody Gives You More Ways to Succeed

Our NFC portfolio – the broadest in the industry – addresses every application and reflects our commitment to performance, power savings, and security. We're with you every step of the way, from product selection to final design, with support tools and a partner ecosystem that save you time and money.

4 We're in it for the Long Term

Having led the market for more than 20 years, we're committed to the long-term future of contactless. We consistently drive innovation, with new features like Dynamic Power Control (see p 22), and continuously build on our extensive patent portfolio, which covers foundational wireless technologies.

Simply put, you won't find anyone better suited to make NFC part of your world.

02 Use Cases

Access Control (Physical and Logical)

Use your phone to open doors at home, at work, or when you travel

Turn your wristband into a special-access pass

Grant temporary access to service personnel

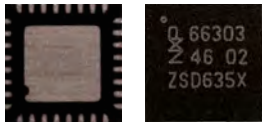
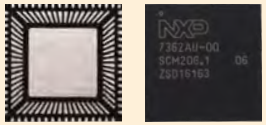
Increase productivity with fast access to specialized machinery

NFC brings mobility to the highest level of security for physical and logical access, so you can do more with your smartphone or a wearable. When you leave home, your phone or wristband can lock the door, and when you arrive at work, it can serve as your ID badge, your computer logon, and your authorization to use certain machines. Your device can also open your hotel room or be your event ticket. With NFC, you reduce waste, increase security, and gain the ability to grant or deny access, as needed, from a remote location.

- **Log time and attendance for secure areas**
- **Manage key distribution remotely**
- **Set limits for access times, for temporary personnel, service calls, and tourists**
- **Reduce maintenance and replacement costs, with fewer lost or damaged keys, cards, or badges**

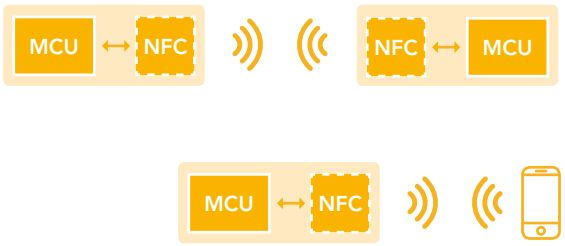
According to IHS Technology, NFC/smartcard solutions for conditional access are growing at nearly 13% a year. Security and simplicity is the reason why.

Which Product?

NFC Frontend **CLRC663 *plus*** 	If you already have a microcontroller on board, and need the best NFC performance with the lowest power consumption, especially in a battery-operated system, use this NFC frontend to push your design further.
NFC Controller with Customizable Firmware **PN7462** **PN736x** 	If you need a small footprint, for a door lock perhaps, use these all-in-one solutions to execute a fully custom application. No external MCU needed.
Contactless Multi-application Smart Card **MIFARE® DESFire® EV2** 	If you're designing a card-based access system, get the benefit of CC EAL5+ security – the same certification level bank cards and electronic passports use. This NFC-compatible MIFARE solution is also available in multiple form factors from key-fobs to wristbands.

02 Use Cases

Pairing & Commissioning



Pair with Bluetooth devices faster, without conflicts

Create your own private concert hall, and share the experience

View images and videos on the big screen, with just a tap

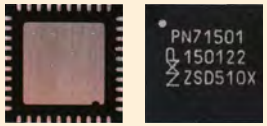
Add nodes to your home or office network in just seconds, without entering codes

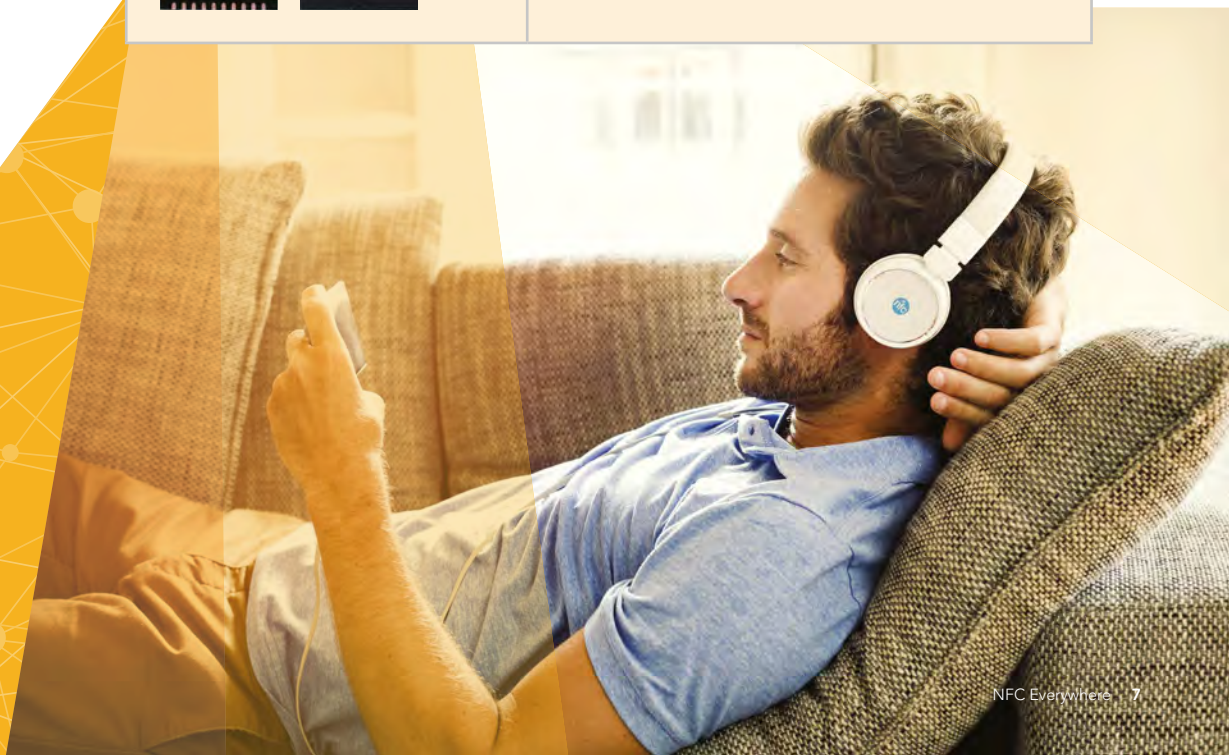
Just bringing two NFC-enabled devices close together is all it takes to create a connection. What's more, NFC can also trigger other protocols, like Bluetooth, ZigBee, or Wi-Fi. Pairing is practically instantaneous and, because NFC only works when you ask it to, there aren't any unintended device connections, and none of the device conflicts that can happen with Bluetooth. It's also easier to commission new devices or expand your home network, even if you're adding devices that don't have a battery – and there's no need to search for a connection or type in a serial number.

- **Enable two-way interactions with Peer-to-Peer mode**
- **Pair devices 20x faster than with BLE or Wi-Fi**
- **Identify a device instantly, without entering codes or creating device conflicts**
- **Make devices easier to use and reduce tech-support costs**
- **Exchange credentials securely, just by tapping**
- **Use protocol-agnostic operations to trigger actions**

Gartner predicts that, by 2020, there will be more than 20 billion connected devices in use. That's a lot of pairing and commissioning to be done.

Which Product?

NFC Connected Tag **NTAG® I²C *plus*** 	If you're working on a battery-powered design that already has a microcontroller, such as a speaker or IoT node, use this tag IC to wake the system and initiate Bluetooth or Wi-Fi pairing.
NFC Controller with Integrated Firmware **PN71xx** 	If you're running an OS, like Android, Windows, or Linux, use the embedded NFC firmware and NCI interface in these controllers to quickly add fully compliant NFC functionality. The PN71xx is also a good choice for routers that will interact with NTAG-equipped nodes.

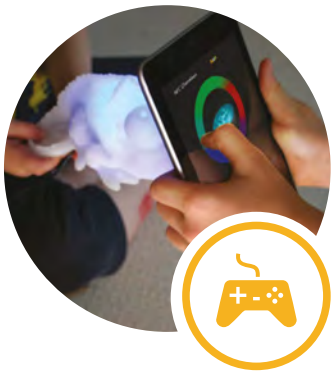


02 Use Cases

Authentication & Identification

Combat counterfeits by authenticating accessories and attachments

Ensure safety with branded replacements that automatically adjust settings



Create experiences that are more interactive – and more personal

Order branded replacements and consumables with a single tap, using authenticated redirection

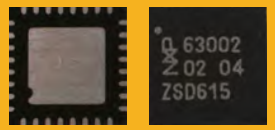
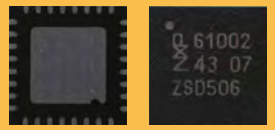
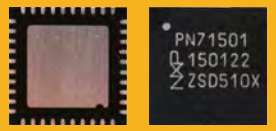
Boost manufacturing by automatically choosing the right tool every time

NFC is the one technology that makes it easier and safer, at every point of ownership, to enjoy any type of electronic device. From using personal-care items and household appliances to adjusting settings of smart gym equipment based on your very own profile, NFC can simplify configuration, increase personalization, enable reorders, enhance safety, and fight fakes. The same NFC operations increase automation in industrial settings, too, for greater efficiency.

- **Authenticate replacement parts and automatically adjust settings of the main unit based on the accessory attached**
- **Identify users and immediately provide personalized settings and preferences**
- **Send notifications when accessories are nearing replacement, and make offers based on usage patterns**

To combat counterfeiting, L'Oreal's Clarisonic facial cleanser authenticates replacement brushes by reading the unique brush ID. It then adjusts performance according to brush type, so you're always using the right speeds and pulse settings, and lets you know, based on usage, when it's time to get a new brush.

Which Product?

NFC Frontend **MFRC630** Tags **NTAG21x,** **MIFARE Ultralight® C** 	Tags based on NTAG and MIFARE offer a wide range of security options and can be read by all NFC phones. Once you've chosen a tag, the MFRC630 is an ideal single-protocol reader for this use case.
NFC Frontend **SLRC610** Tags **ICODE SLIX, ICODE DNA** 	If you need to support longer distances between the tag and its reader, then the SLRC610 reader, which works with ICODE tags, gives you the extra margin in read range.
NFC Controller with Integrated Firmware **PN71xx** 	If you're working with an OS, like Android, Windows, or Linux, use one of these controllers for plug-and-play functionality when reading NTAG, MIFARE, and ICODE tags.

02 Use Cases

Extended User Interface

Get all the details, with complete control over every setting and configuration

Enable full interactions with small, sealed devices that are not powered or don't have a battery at all

Read out data, access user manuals, or copy settings from one device to another

Use a screen to perform diagnostics and view error logs, even if the device is unpowered

Any NFC-enabled phone or tablet can serve as a temporary touchscreen for your product, enabling sophisticated interactions and configurability at little additional cost. Your product can be smaller, lighter, more rugged, and less expensive to produce – yet easier to use. NFC reduces the cost of ownership with easier configuration, faster diagnosis, and simpler troubleshooting. Energy harvesting lets you create a user interface even if your product doesn't have a battery.

- **Handle complex device settings easily on the phone/tablet touchscreen**
- **Offer new levels of interaction, without adding buttons or displays**
- **Connect your device to the Internet via the end user's phone or tablet**
- **Upgrade device firmware using the phone/tablet connection**
- **Use energy harvesting to draw power and extend battery life**
- **Implement password protection to avoid unauthorized use**

When precision matters, Schneider's Zelio Timer Relay uses NFC to deliver 50 times the accuracy of conventional timer relays.

Which Product?

Connected Tag **NTAG I²C *plus***	Adding this low-cost, small-footprint NFC interface makes your system compatible with any NFC phone or reader on the market.

Late-stage customization

The **NTAG I²C *plus*** supports zero-power configuration, so you can save on logistics costs with late-stage customization. Limit production variants by producing a generic item that can be configured in its unpowered state, just before shipping, through the packaging. Or let installers and consumers do the customizing for you, with a quick tap of their NFC-enabled phones.

More than 80% of all NFC-equipped smartphone models use NXP, which means our ICs are enabling a lot of extended user interfaces.

02 Use Cases

Device-to-Device and In-Device Communication

Let a fully sealed, battery-free sensor unit interact with the meter housing

Record mechanical-stress readings on moving parts

Avoid galvanic connections by letting machines talk without wires

Make wireless chargers smarter, with readings for battery level, temp, etc.

With NFC, any two electronic devices can open a line of communication, making it easy to share information, send instructions, or read data. What's more, NFC works with sealed devices, so sensors operating in difficult environments can easily interact with the control unit. Energy harvesting uses power from the active reader device, so the device doesn't need a battery to send or receive information. Systems with a battery can even remain in sleep mode while being read.

- **Get instant readouts of device status, usage, and diagnostics**
- **Give battery-free devices the ability to communicate**
- **Let two sealed, IP-rated devices share information**
- **Send data at up to 848 kbit/s with a reader or at up to 106 kbit/s with a connected tag**

Which Product?

NFC Frontend **MFRC630** 	If your system will be actively communicating with other devices or reading data from tags, use this high-performance yet cost-effective frontend to enable interaction.
Connected Tag **NTAG I²C *plus*** 	With this high-performance, energy-harvesting connected tag on board, your device can be read, measured, or made interactive – even if it doesn't have a power source.

02 Use Cases

Payment

NXP supplies all five of the top companies manufacturing payment products, and more than 80% of all NFC-enabled POS terminals embed NXP technology.

Offer new kinds of loyalty and couponing programs, with new levels of interaction

Let micro-merchants accept and confirm payments just like the mega-merchants

Get a snack or a drink, even if you left your cash at home

Create self-service kiosks that attract attention while selling more tickets

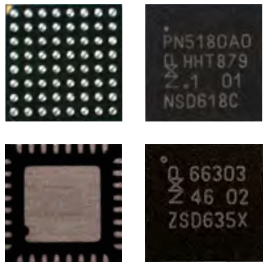
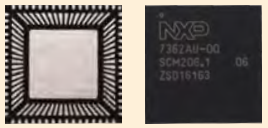
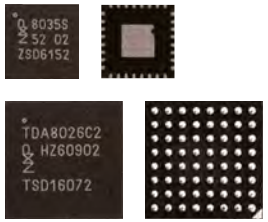
State-of-the-art contactless technology lets you do business with open systems like EMV, or with closed systems like MIFARE. You can count on full compatibility with every form factor, from smartcards and NFC-equipped mobile phones to wearables, tokens, and more. Using contactless technology also lets you increase consumer share-of-mind with value-added services, such as personalized messages, loyalty programs, and coupons based on recent purchases.

- **Offer tap-and-pay convenience with enhanced security**
- **Accept EMV and MIFARE payments, and send paperless receipts**
- **Increase engagement with messages, loyalty, and couponing**
- **Use system-level solutions to save design and certification time**

Get access to any kind of energy through prepaid systems

Use a secure, protected connection to access your bank or initiate transactions

Which Product?

NFC Frontend **PN5180** **CLRC663 *plus*** 	If you want your design to talk to any other NFC-enabled system, and you already have a microcontroller on board, use one of these EMVCo-compliant frontends to add secure payment functions.
NFC Controller with Customizable Firmware **PN7462** 	If you need a small footprint, use this single-chip solution to create a very compact design. You can easily add a coprocessor for time-critical functions in the EMVL1 protocol layer, for fast payment performance.
Contact reader front end **TDA8035** **TDA8026** 	If you want to support contact cards in your terminal, you can choose the single-slot TDA8035, or select the TDA8026 for use with multiple SAMs. Both offer full support for all classes of smartcard.

03 Products

Introducing the *NFC* Portfolio

As the leading provider of NFC solutions, we offer the widest selection of form, fit, and function.

Up the Security

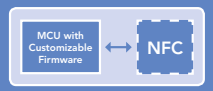
A Secure Access Module (SAM), a type of secure crypto coprocessor, can be used to encrypt data involved in an NFC transaction. The SAM can also verify encrypted data for authenticity, before the transaction, to make sure things like online purchases and building access can be trusted.

Connected Tags

These small, passive tag ICs are the best, most cost-effective solution when you have an NFC reader or NFC phone on the other side of the transaction. They use an RF interface that's fully compliant with the NFC Forum's specifications, and they support energy harvesting, so there's no need for a battery to power NFC interactions.

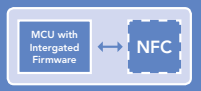
NFC Frontends

These NFC devices are the most flexible way to add NFC connectivity to a system. All our NFC frontends are supported by our NFC Reader Library (see p 24), so design-in is fast and easy.



NFC Controllers with Customizable Firmware

These highly integrated devices combine an NFC frontend with a freely programmable 32-bit Cortex-M0 microcontroller. They let you create a fully custom design, complete with NFC, in a very compact footprint. State-of-the-art options include support for both contactless and contact technologies, so you can deliver a system with maximum appeal and compatibility.



NFC Controllers with Integrated Firmware

These plug-and-play solutions combine an NFC frontend with a 32-bit Cortex-M0 microcontroller equipped with integrated firmware, and are optimized for use with an OS. They come with Linux, Android, and WinIoT drivers, and include an NCI interface, so they're fully compliant with the NFC Forum's specifications.

An NFC-Compatible Option: MIFARE® Contactless ICs

MIFARE, used in more than 80% of all contactless smartcards in use today, is based on the same ISO/IEC 14443 standard as NFC. MIFARE and NFC are fully compatible, which means NFC-enabled devices and tags are interoperable with the existing MIFARE infrastructure. MIFARE4mobile allows MIFARE applications to be integrated in NFC enabled mobile phones. NXP invented MIFARE more than 20 years ago and, since then, has established it as the leading contactless solution for convenience, flexibility, and scalability.

Our latest offerings cover the full range of contactless applications, from MIFARE Ultralight C, which enables low-cost, high-volume applications, to the advanced MIFARE DESFire family, which uses a cryptographic engine to secure transmission data in multi-application environments. All MIFARE products are available in various form factors and memory sizes.

For details, visit www.mifare.net.

Which *NFC* Product Category is Right for You?

A quick review of your design requirements can lead you to the right product category. Review the statement in the left-hand column, to see which product categories might meet your needs. Then refer to the specific product details, given on the following pages, to narrow your search.

	Connected Tag	NFC Frontend	NFC Controller with Customizable Firmware	NFC Controller with Integrated Firmware
I want to communicate with NFC smartphones	x	x	x	x
I want to add NFC to a non-powered system	x			
I want to read/write NFC/RFID HF tags		x	x	x
I want to add NFC to my OS-based design (Linux/Android/WinIoT)				x
I want the smallest HW footprint	x		x	
I want to add NFC to my host MCU	x	x		x
I want NFC with an integrated microcontroller			x	x
I want to offload the memory of my main MCU			x	

We Make *NFC* Easy

We reduce complexity, streamline tasks, and add flexibility at every point in development, so you can deliver a competitive advantage in record time. Links to the support tools listed below can be found on **nxp.com/nfc.**

NFC Implementation Process

Decide the functionality

Decide which functions you want in your application
(e.g. read cards only, write tags, exchange information with other devices, etc.).

Select IC

Start with the specs given in this brochure, then go online to get parametric searches. Nobody gives you more options to choose from.

Evaluate Features

Explore the possibilities with one of our development boards, then use that same board to start prototypying.

Prototype

Hardware

PCB design & antenna design

Software

Connected Tags

Writing code for your connected tags on the MCU is as easy as connecting additional memory to your MCU using the I²C connection. This enables easy firmware updates.

NFC Frontends & NFC Controllers with Customizable Firmware

Write MCU code using the NFC Reader Library, which includes support for every relevant card and phone.

NFC Controllers with Integrated Firmware

Write MCU/MPU code using our code examples, which call functions already embedded in the NFC controller's firmware.

Test & Debug

Quickly fine-tune performance, catch errors, and fix bugs with standard-based design formats and support for the most popular development tools.

Get Certified

Our NFC solutions are designed to help you meet CE, FCC, and other regional requirements, and make it easier to pass EMVCo certification.

NXP Support

Online selection tools, including selection app, parametric search, and product details on nxp.com

Z-card with NFC Reader Portfolio

NFC Everywhere brochure, p 17

NFC use case and product webinars

Full range of development kits for every NFC Product

NFC Cockpit

Gerber files for development kits online

Compatibility with common MCU boards and single-board computers

NFC product support package and antenna design webinars

NFC Library

App notes

Design files for development kits

Sample code

Online trainings on software integration and antenna design

Tutorials

NFC Cockpit

DPC, strong RF power generation, RF wave shaping, and HW-based EMD error handling

EMVCo L1 (analog and digital) library in source code

Independent Design Houses certified by NXP IDH Partners

www.nxp.com/partners

select "HW/SW engineering service"

MobileKnowledge

IMST

INGENUTEC

Kronegger We enable NFC

ipTronix

ONE

Technical NFC Community

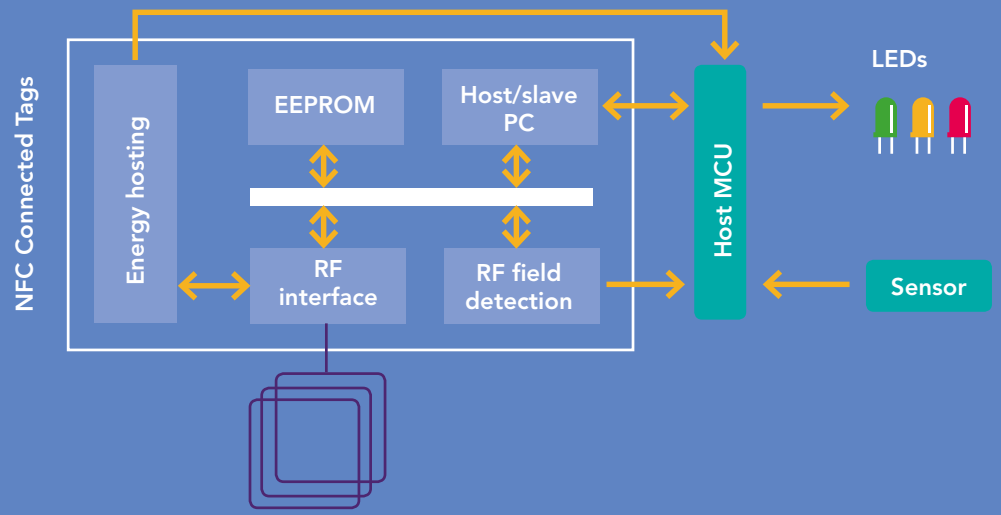
https://community.nxp.com/community/nfc

03 Products

Connected Tags

These Type 2 tags enable an easy link to the cloud by offering both, a RF and a host interface. The user memory can be configured for multiple rewrites or can be password protected, so data can't be manipulated. Our Originality Signature, an algorithm that supports digital elliptic curve cryptography (ECC), adds an extra level of security and enables tag validation without a cloud connection. Field detection, which can be used to wake the tag when it senses an NFC interaction, helps save power. NTAG I²C *plus* can also use the pass-through mode (SRAM) to act as a modem for direct communication between the NFC device and the MCU.

The **NTAG F** series delivers standards-based functionality that's ideally suited to pairing and commissioning tasks. **NTAG I²C *plus*** includes a wired I²C interface, for use with a microcontroller, and supports energy harvesting.



Software

Software integration with the NTAG I²C *plus* is easy. From the MCU side, the NTAG I²C *plus* looks like an I²C memory, and from the phone side it looks like an NFC tag. There are no protocols to follow, and in many cases no specific timings, either. Here are the main steps for software integration.

MCU/Embedded

- Download the sample MCU source code
- Adapt it to your application
- For static testing of the NFC device, use an NFC-enabled phone with the NTAG I²C Demo app or the USB reader from the OM5569-NT322ER demo kit, together with the "NTAG I²C Demo" software running on a Windows PC.

Phone/NFC device

- Download the sample Android source code
- Write your app
- To test your NFC app with an NTAG I²C *plus* counterpart, use either your own board (with MCU + NTAG I²C *plus* + your firmware), or the NTAG I²C *plus* Explorer Kit, plugged via USB into your Windows PC, and the "Peek&Poke" software.

All source code and PC software can be downloaded from the NTAG I²C *plus* Explorer Kit webpage. Search for "OM5569-NT322ER" on **nxp.com**

Selection Guide

	NTAG 216F/213F	NTAG I²C *plus*
NFC Forum Tag Format	Type 2	Type 2
User Memory (B)	888 (216F) 144 (213F)	888 or 1912
RF Baud Rate (kbit/s)	106	106
Fast READ Command	x	x
Fast WRITE Command		x
Originality Signature	x	x
NFC Counter	x	
Memory Access Protection	RF Interface	RF Interface & I²C (Read/Write)
Field Detection	x	x
Energy Harvesting		x
Pass-Through Mode (~40 kbit/s)		x

Evaluate, Prototype & Fine-Tune

OM5569-NT322E

NTAG I²C *plus* Explorer Kit

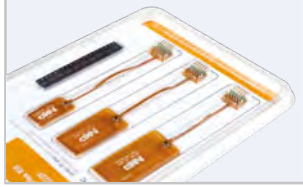
An all-in-one demonstration and development resource to evaluate the NTAG I²C *plus* in an electronic system. Use it to explore tag operation, the NFC RF communication link, and the I²C serial bus link.

OM5569-NT322ER

NTAG I²C *plus* Explorer Kit with NFC Reader

An extension of the OM5569, above, with the addition of an NFC reader, so you can experiment with NFC interactions that involve both a reader and a tag - without the need of an NFC-enabled smartphone.

OM5569-NT322F



NTAG I²C *plus* Flex Kit

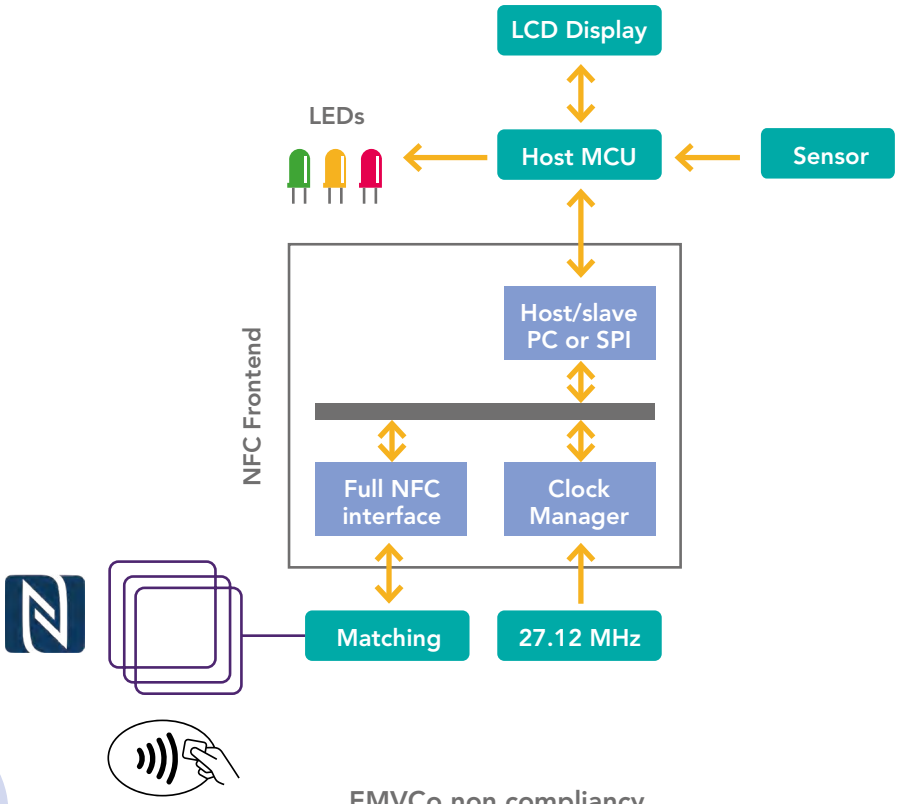
Use this antenna board as an add-on to either of the Explorer Kits, or use it with your own microcontroller as a prototyping tool.

Download the "NTAG I²C Demoboard" app from the Google Play store

03 Products

NFC Frontends

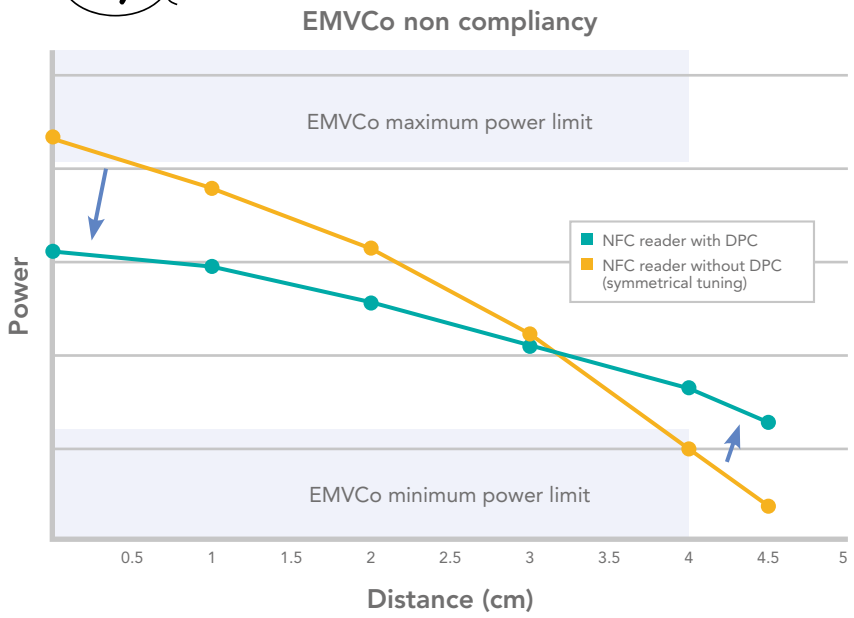
Our frontends are the most flexible way to upgrade your design to NFC connectivity. The **CLRC663 plus**, **MFRC630**, and **SLRC610** are primarily intended for use with contactless smartcards and tags, while the **PN5180** is designed for broad-based applications, connecting with everything from smartcards to mobile handsets. Libraries for embedded systems, fully compliant with ISO/IEC, EMV, and the NFC Forum, deliver reliable performance and simpler certification. Energy-saving features like low-power card detection extend battery life, and seamless integration with our NFC Reader Library means you can add or subtract functions with ease.



Product Highlight: PN5180 with DPC

The PN5180 offers the most advanced transmitter and receiver functionality. Dynamic Power Control (DPC), Adaptive Waveshaping Control (AWC), Adaptive Receiver Control (ARC) and automatic EMD Error Handling, according latest ISO/IEC14443 and EMVCo specifications, are executed without host interaction. These unique, fully autonomous features support preemptive multi-tasking operating systems like Linux or Android. The PN5180 is well suited for advanced contactless applications with EMVCocompliance.

Using DPC for automatic antenna optimization, the PN5180 improves performance when in the presence of metal, other cards, or a mobile phone. DPC helps reduce power consumption yet enables best output power for long reading distances, for higher overall performance and improved compliance with EMVCo.

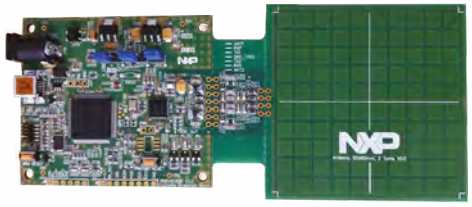


Selection Guide

	PN5180	CLRC663 *plus*	MFRC630	SLRC610
Reader/Writer				
ISO/IEC 14443 A&B	x	x	x	
FeliCa	x	x		
ISO/IEC 15693	x	x		x
ISO 18000-3M3	x	x		x
Reads NFC Forum Tag Type	1,2,3,4,5	1,2,3,4,5	1,2,4A	5
Peer-to-Peer Support				
Passive Initiator	x	x		
Active Initiator	x			
Card Emulation				
Emulate NFC Forum Tag Types	4A			
Other Features				
External Clock Support Eliminates 27.12-MHz Crystal	x			
Autonomous Transmitter And Receiver Control	x			
Best For Battery-Powered Designs		x		
Ambient Temperature Range	-30 to +85 °C	-40 to +105 °C	-25 to +85 °C	
Package	HVQFN, TFBGA	HVQFN		

Evaluate, Prototype & Fine-Tune

OM25180	**PN5180 Development Kit** This kit includes a PN5180 board optimized for reader and EMVCo applications), two different antenna boards (65 x 65 mm and 30 x 50 mm, equipped with matching components), three small matching boards for implementation of a custom antenna-matching circuit, an NFC sample card based on the NTAG216F (NFC Forum Type 2 Tag), and ten PN5180 samples in HVQFN packages.
OM26630	**CLRC663 *plus* Development Kit** This kit includes a CLRC663 *plus* board demonstrating the extended Low Power Card Detection, with optimizations for access control applications, plus different antenna boards, an NFC sample card, and ten CLRC663 *plus* samples in HVQFN packages.
CLEV6630A	**MFRC630/SLRC610 Development Board** This successor to the CLEV663B enables the evaluation of all MFRC630 and SLRC610 features. It comes with a 65 x 65 mm pre-matched antenna optimized for reader applications.
OM2xxxx	**NFC Antenna Kit** This kit comes with various ready-to-use antennas in popular sizes. The included matchings enable immediate prototyping.



03 Products

The *NFC* Reader Library

Everything you need to create your own software stack and application for a contactless reader – at no extra charge.

Our NFC Reader Library is a modular, multi-layer software library that provides all the application programming interfaces (APIs) needed to complete a design and prepare it for certification.

Available for free download, written in C programming language, and capable of supporting multiple design environments and platforms, the library includes all the latest features to ensure 100% standards compliance. It enables full interoperability with devices already deployed in the market, and saves time and money at every point in the design cycle.

Join the NFC Community and browse projects, questions, and answers regarding the NFC Reader Library, or make your own case and interact with our NFC experts:

https://nxp.surl.ms/NFCReaderLib

1 Focus on Scalability

The multi-layered software design ensures scalability of the software stack. Only the required software components and protocol implementations need to be enabled, so the final application has a smaller memory footprint.

2 Optimize Performance

Fine-tune your design with built-in MCU support, interrupt-based event handling, a full complement of host interfaces, free RTOS support, and compilers that produce highly compact, efficient code.

3 Simplify Test & Debug

Save time and effort by using the rich set of examples for all the most common functionalities, including call for inventory, polling, card emulation, application for EMVCo certification, low-power card detection, and dynamic power control.

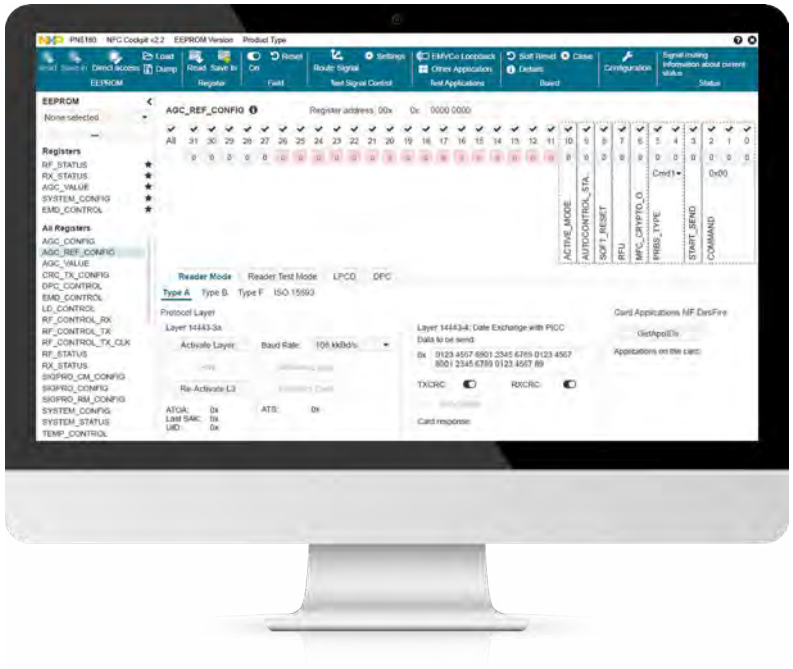
4 Validate Interoperability

Get ready for certification with test apps that cover everything from payment and ID cards to automotive, EMVCo L1, NFC Forum and ISO/IEC 10373-6 PiCC/PCD. Broaden compatibility with the MIFARE portfolio and LLCP/SNEP protocols for P2P mode.

<table>
<tr><td colspan="6">Application</td></tr>
<tr><td colspan="3">Application Layer (AL)
for card commands</td><td>NFC activity</td><td>SNEP</td><td rowspan="2">NFC
P2P</td></tr>
<tr><td>MIFARE card operations</td><td>NFC Forum tag type operations</td><td>. . .</td><td>Discovery loop</td><td>LLCP</td></tr>
<tr><td colspan="6">Protocol Abstraction Layer (PAL) for contactless communication protocols</td></tr>
<tr><td>ISO/IEC 14443 A</td><td>ISO/IEC 14443 B</td><td>FeliCa-compliant protocol</td><td>. . .</td><td colspan="2">ISO/IEC 18092 (P2P)</td></tr>
<tr><td colspan="6">Hardware Abstraction Layer (HAL) supporting our NFC solutions</td></tr>
<tr><td colspan="6">Generic</td></tr>
<tr><td colspan="2">NFC frontends</td><td colspan="4">NFC controller with customized firmware</td></tr>
<tr><td colspan="6">Bus Abstraction Layer (AL) with all low-level functions</td></tr>
<tr><td colspan="6">Generic</td></tr>
<tr><td>Interfaces</td><td>SPI</td><td>I²P</td><td>. . .</td><td colspan="2"></td></tr>
</table>

The NFC Reader Library is your free go-to source for quick product differentiation.

The *NFC* Cockpit



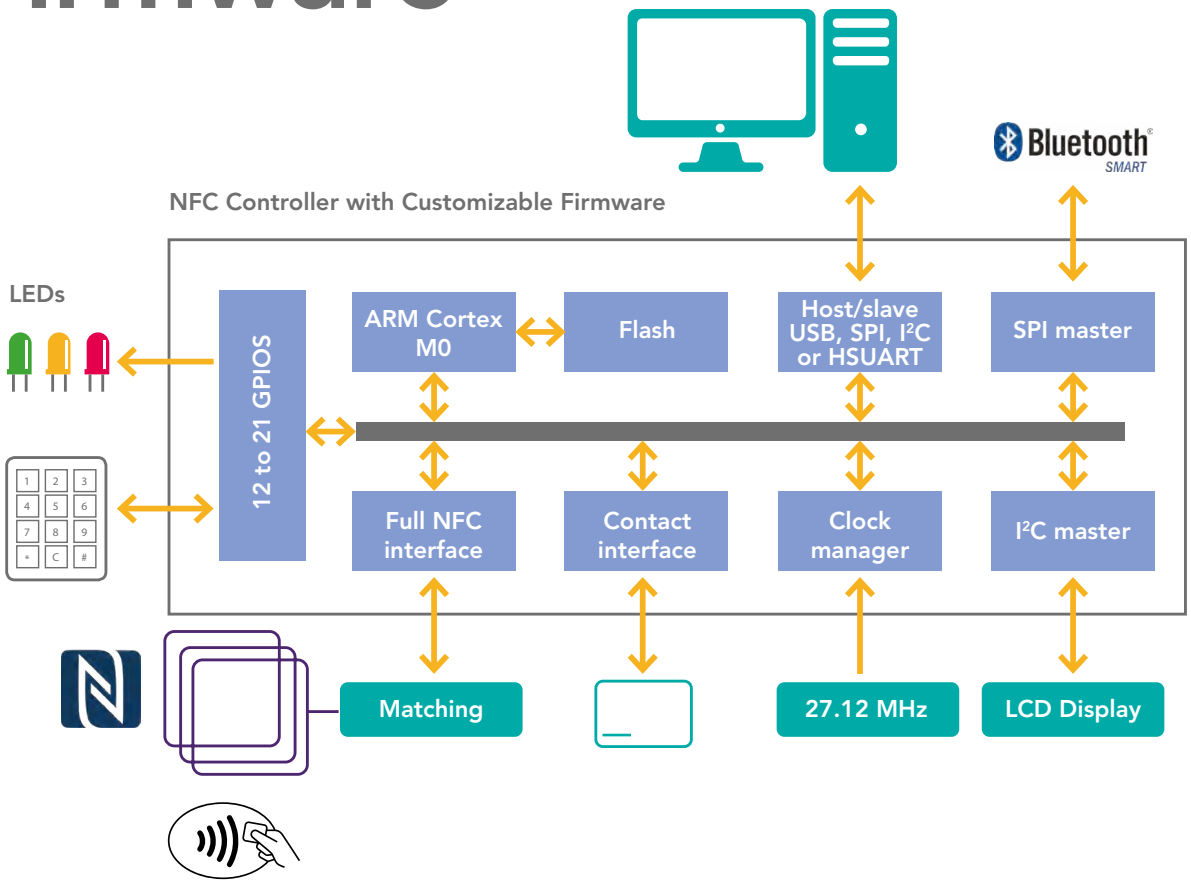
The CLRC663 *plus*, the PN5180, and the PN7462 family are supported by the NFC Cockpit, an intuitive graphical user interface (GUI) that lets you configure and adapt IC settings without writing a single line of software code.

- Let the hardware designers optimize antenna parameters, including wave shape, while the software designers work on other things
- Fine-tune the Dynamic Power Control and Low Power Card Detection settings
- Activate a contactless smartcard, including basic card communication, with options for APDU and EMVCo polling
- Implement firmware updates for the PN5180
- Access all EEPROM cells and registers

03 Products

NFC Controllers with Customizable Firmware

By combining an NFC frontend with an advanced, power-efficient 20-MHz ARM Cortex-M0 microcontroller, our all-in-one NFC controllers with customizable firmware are the best choice for compact systems, since they enable higher integration with fewer components. The flash memory can be loaded with fully-custom applications, and the optimized antenna operation, in combination with low-power modes, delivers best-in-class performance. All the controllers are accompanied by extensive support tools, including sample source code and the NFC Reader Library (see p 24).



Selection Guide

	PN7462	PN7362	PN7360
Flash Memory (KB)	160	160	80
Contact Interface	x		
HVQFN (9 x 9 mm)	x	x	x

Product Highlight: PN7462

The PN7462 extends the possibilities, with added features that make it easy to deliver the most advanced functionality. Ensure market interoperability with full MIFARE support. Full NFC Forum compliance, along with EMVCo for payments, saves time and gives you a shorter path to certification. Advanced power-management functions enable longer battery life, and DPC (see p 22) delivers optimized antenna performance. Use the ISO/IEC 7816 interface to communicate with contact cards. This highly integrated device lets you design a complete system with just one small package. Extensive host and peripheral interfaces include:

- Host/slave & master interfaces: I^2C, SPI, USB, HSUART
- Contact interface: UART, ISO/IEC 7816, EMVCo 4.3
- 12 to 21 GPIOs

Evaluate, Prototype & Fine-Tune

OM27462 	**PN7462/PN736x Development Kit** Designed for comprehensive application development, this kit contains a PN7462 board, two different antenna boards, three small antenna-matching boards for implementation of a custom antenna-matching circuit, a smartcard reader, SAM slot extensions, and ten PN7462 samples. Compatibility with the NFC Cockpit and PCB adaptors simplifies antenna matching. Full NFC Forum compliance and contact software libraries save time on code development.

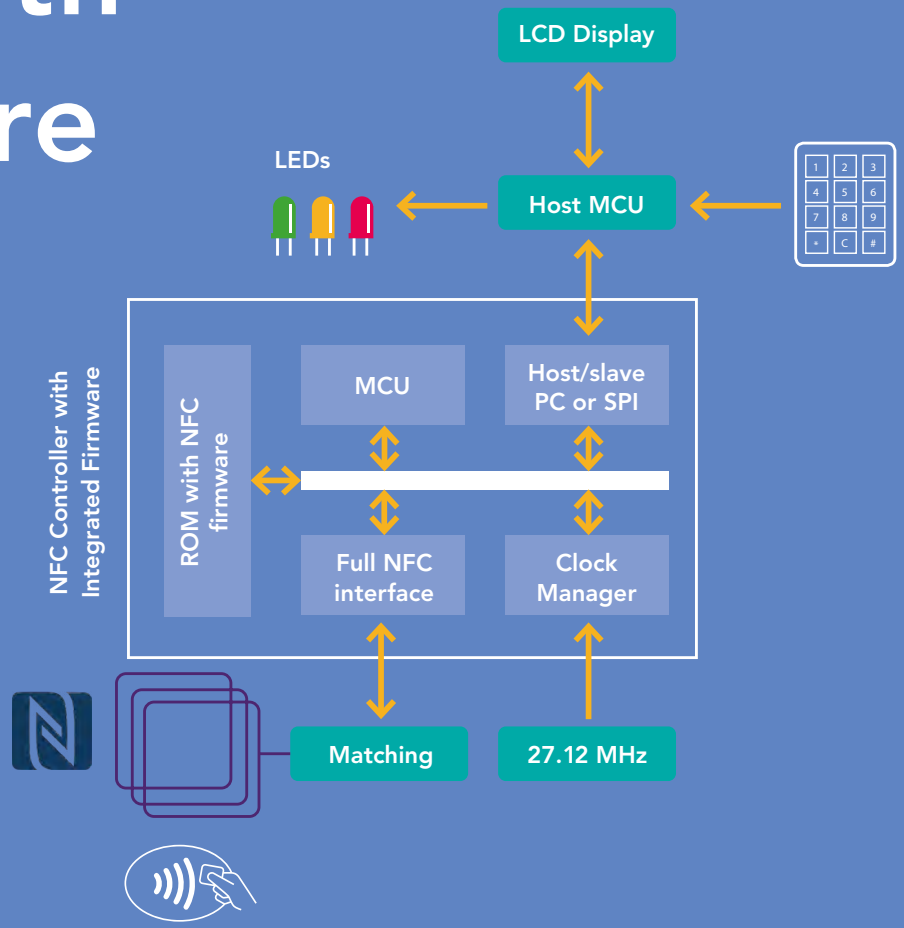
Software

The contactless and contact frontends of the controller are supported by the freely downloadable NFC Reader Library, see p 24. The frontend further supports Dynamic Power Control, see p 22.

03 Products

NFC Controllers with Integrated Firmware

Designed to save time when developing a system that uses an OS, our NFC controllers with integrated firmware combine an NFC frontend with an advanced, power-efficient 20-MHz ARM Cortex-M0 microcontroller, and come pre-loaded with drivers for Linux, Android, and WinIoT. They communicate via the NCI interface, to conform with the NFC Forum's guidelines for interactions with the system's main application processor. You can move quickly from initial prototype to full production, since these controllers support the most popular development platforms, and are supported by sample applications and source code. The PN7120 is optimized for footprint, while the PN7150 adds features for enhanced performance.



Product Highlight: PN7150

The PN7150 uses a broader supply voltage range to make it easier to balance the tradeoff between antenna size and performance, and supports FeliCa (both in reader and card emulation mode) for use in Japan, Hong Kong, Singapore, and elsewhere. Active Load Modulation produces a stronger signal, and lets you use a smaller antenna without impacting performance while operating in Card Emulation and passive target modes.

Selection Guide

	PN7150	PN7120
ROM with NFC Firmware	x	x
RF Driver Supply Voltage (V)	2.7 to 4.75	2.7 or 3.3
NFC Forum Type 3 Tag (FeliCa)	x	
Load Modulation Concept	Active	Passive
VFBGA49 (4.0 x 4.3 x 0.9 mm)		x
HVQFN40 (6 x 6 x 0.85 mm)	x	

Software for Every OS Integration

Our NFC controllers with integrated firmware are the perfect fit for systems that use a large OS.

Our libnfc-nci library offers easy, smooth integration into GNU Linux-based systems and has a high-level API for NFC functionality.

Patches to Android Open Source Project (AOSP) are available for simple integration into Android-based systems. The solution benefits from all the NFC implementations already available with Android.

Our NFC controllers are natively supported as proximity platform devices, through the universal NFC device driver model of the Win10 IoT OS.

We provide code examples running on NXP LPC, Kinetis, and i.MX MCUs, for a full NFC experience with an RTOS-based system, or a system that doesn't use an OS.

Evaluate, Prototype & Fine-Tune

OM5578/PN7150ARD 	**PN7150 Board with Arduino-Compatible Header** A PN7150 controller board with an Arduino interface board (for use with LPCXpresso, Kinetis, i.MX, and more), plus an NFC Forum Type 2 Tag.
OM5578/PN7150RPI 	**PN7150 Board for Raspberry Pi** A PN7150 controller board with a Raspberry Pi interface board and an NFC Forum Type 2 Tag.
OM5578/PN7150BBB 	**PN7150 Board for BeagleBone Black** A PN7150 controller board with a BeagleBone Black interface board and an NFC Forum Type 2 Tag.
OM5577/PN7120ARD 	**PN7120 Board with Arduino-Compatible Header** A PN7120 controller board with an Arduino interface board (for use with LPCXpresso, Kinetis, i.MX, and more), plus an NFC Forum Type 2 Tag.
OM5577/PN7120S 	**PN7120 Board for Raspberry Pi and BeagleBone Black** A PN7120 controller board, a Raspberry interface board, a BeagleBone Interface board, and an NFC Forum Type 2 Tag.

NFC Communication Modes

The Three Types of *NFC*

Read/Write Mode

This is where NFC spends most of its time, with one NFC-enabled device interacting with another to get information or initiate an action. The initiating device can read data in from the second device or write data out to it.

Peer-to-Peer Mode

Sometimes referred to as "P2P" mode, this is the one you can use to exchange files between smartphones, or receive loyalty points when making a purchase.

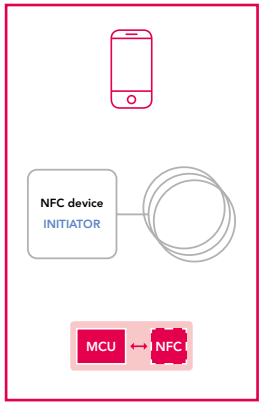
Card Emulation Mode

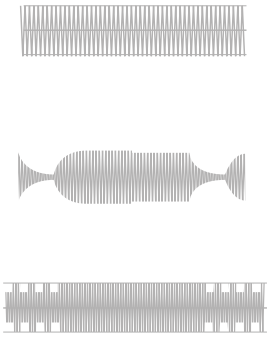
This mode, used almost exclusively by NFC smartphones, lets the system behave as an ISO/IEC 14443-compliant contactless smartcard. That means your phone can be used in the existing contactless infrastructure, for things like ticketing, access control, transit, tollgates, and payments. The mode takes very little power, and can work even when the phone is off.

Passive or Active Communication?

PASSIVE communication scheme

Read/Write, Passive Peer-to-Peer, and Card Emulation Modes





1 The initiator produces a 13.56 MHz carrier field

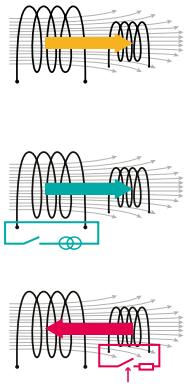
The field enables data exchanges and sends energy to the target.

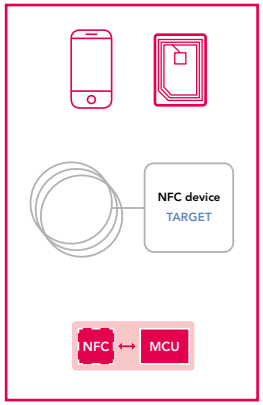
2 The initiator sends commands

The initiator transfers data by directly modulating the field.

3 The target responds

The target transfers data by load-modulating the field.

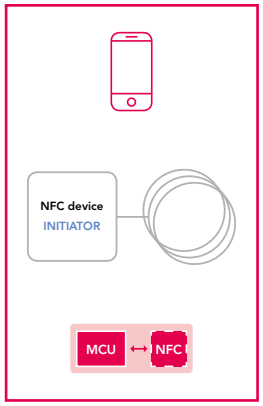


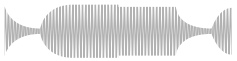


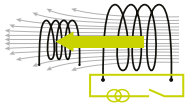
With passive communication, the target uses the RF field generated by the initiator, but with active communication, each side generates its own field. Which method you use depends on the operating mode.

ACTIVE communication scheme

Active Peer-to-Peer Mode





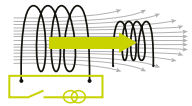


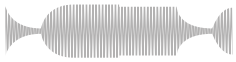
1 The initiator sends commands

The initiator generates a 13.56 MHz carrier field, uses Amplitude Shift Key (ASK) modulation to send commands, then cuts the field.

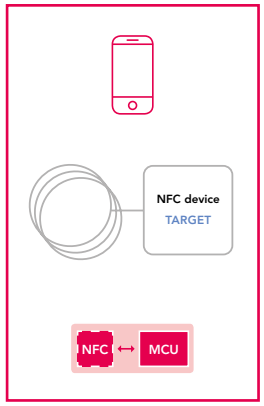
2 The target responds

Once the initiator cuts its field, the target generates its own and uses ASK modulation to send responses.





To avoid collisions, only the sending device emits an electromagnetic field. The send/receive roles are reversed as needed to support the transaction.



04 Tech Essentials

A Few More Details

NFC Forum Tag Types

The NFC Forum mandates that all their defined tag types be interoperable with NFC devices. All the tag types are based on existing contactless formats. Type 1 and 2 tags provide a basic set of features and can be compared to the MIFARE Ultralight format. Type 3 and 4 tags offer higher memory capacity and more advanced features. Type 3 tags are based on Japan Industry Standard JIS X 6319-4 primarily used in Japan and can be compared to FeliCa formats. Type 4 tags can be compared to MIFARE DESFire formats. Type 5 tags are designed for communication over longer ranges (up to 1m). Type 5 tags are based on the ISO/IEC 15693 standard, which is also known as vicinity RFID, and can be compared to ICODE SLIX formats.

NFC Forum	Type 1	Type 2	Type 3	Type 4	Type 5
ISO/IEC 14443 A	x	x			
JIS X 6319-4			x		
ISO/IEC 14443 A or B				x	
ISO/IEC 15693					x

Formats for Data Exchange (NDEF, RTD, SNEP)

All NFC Forum-compliant devices and tags support the same NFC Data Exchange Format (NDEF).

NDEF lets you encode data into the device or tag so it can share information with other NFC Forum-compliant devices and tags. The NDEF message sequence includes a series of records that contain data. The record structure varies depending on the type of data conveyed. Record formats are specified in the NFC Record Type Definition (RTD). When NDEF messages are exchanged in Peer-to-Peer mode, the transaction follows the Simple NDEF Exchange Protocol (SNEP), which improves reliability by making use of the Logical Link Control Protocol (LLCP) connection-oriented transport mode.

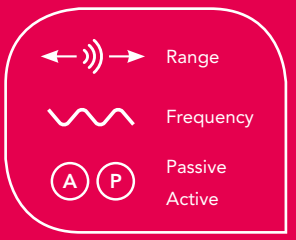
Common NFC Record Types

NDEF RTD	What It Covers
Device Information (Di)	Basic details about the device model and its identity, for use when the device acts as host
Smart Poster (Sp)	Text strings, such as URLs, SMS messages, or phone numbers stored in an NFC tag
Text (T)	Text strings in multiple languages
URI (U)	Universal Resource Identifiers (URIs), which include web addresses (URLs) and other network resources and files
Connection Handovers (Hr/Hs/Hc)	Pairing with Bluetooth, Wi-Fi, or other protocols. Includes record formats for handover request (Hr), select (Hs), and carrier (Hc).
Signature (Sig)	Provides an algorithm or certificate type for use as a digital signature

For more on these formats, check the NFC Forum website (nfc-forum.org).

The World of Wireless

The term "wireless" can refer to a number of different but related technologies, and has relevance in just about every kind of application. The table below gives a rough overview of what's what.



	Frequency	Range		
NFC (ISO/IEC 18092 NFC Forum)	**13.56 MHz**	**10 cm**	Smartphones, tablets, portable devices in a peer-to-peer network	A/P
Contactless (proximity) smartcards (ISO/IEC 14443)	**13.56 MHz**	**10 cm**	Ticketing, payment, access, passports, etc	P
RFID (ISO/IEC 18000-3)	**13.56 MHz**	**< 40 cm**	Tagging & tracking of goods and items for manufacturing, logistics, retail, etc	A/P
IrDA infrared	**Infrared**	**< 1 m**	Remote controls, mobile phones, computers	A
Bluetooth (IEEE 802.15.1)	**2.4 GHz**	**> 10 m**	Smartphones, tablets, audio equipment, printers, other devices in a personal area network (PAN)	A
Wi-Fi (IEEE 802.11)	**2.4 GHz**	**> 100 m**	Smartphones, tablets, laptops, routers, other devices in a local area network (LAN)	A
ZigBee (IEEE 802.15.4)	**2.4 GHz**	**> 100 m**	Lighting networks, home automation, industrial control	A
Thread (IEEE 802.15.4)	**2.4 GHz**	**> 100 m**	Sensors, actuators, lighting networks, home automation, industrial control	A
2/2.5/3G cellular	**450 MHz to 2.7 GHz**	**Several km**	Industrial devices, eMeters, Internet of Things (IoT) devices	A
4G cellular	**450 MHz to 2.7 GHz**	**Several km**	Smartphones, tablets	A

Relevant Standards & Specifications

NFC is compatible with a number of industry-defined formats. Here's a quick rundown, in alphanumeric order, of the ones most relevant to system designers.

Standard	Subject	Relationship to NFC
EMVCo	Payment	Provides guidelines for NFC systems that accept payments or act as payment cards. Level 1 addresses the conformance of interface modules.
FeliCa	Contactless Smartcard	Developed by Sony and used primarily in Hong Kong, Japan, and Singapore, FeliCa is a contactless RFID smart card system that complies with JIS: X6319-4 and is also included as a condition for compliance with the NFC Forum specification.
GlobalPlatform	Secure Element	Specifies a multi-application architecture for the secure elements used to protect transactions in NFC systems.
ISO/IEC 7816	Contact smartcard	Defines a contact format compatible with NFC and ISO/IEC 14443. Most ISO/IEC 14443 contactless cards use the ISO/IEC 7816-4 command set.
ISO/IEC 10373-6	Proximity Card	Defines test methods specific to proximity cards and objects.
ISO/IEC 14443	Proximity Card	Defines the most widely used standard for proximity cards, objects, and readers in payment, transport, identification, and more. Type A and Type B cards use the same transmission protocol, but differ in their modulation methods, coding schemes, and procedures for protocol utilization. NFC Forum Type 2 and Type 4 Tags are based on the ISO/IEC 14443 series.
ISO/IEC 15693	Vicinity Card	Defines a contactless card that can be read at a range of up to 1 m, a longer distance compared to proximity cards. The NFC Forum Type 5 Tag is based on ISO/IEC 15693, and delivers an expected read range with mobile phones that is slightly longer than with Type 2 Tags.
ISO/IEC 18000-3M3	Item-level RFID	Defines an EPC Global Gen2 HF reader with an air interface at 13.56 MHz, the same operating frequency as NFC. Used for highly stackable tags with fast bulk reading.
ISO/IEC 18092	NFC Interface and Protocol	Defines Near Field Communication. Incorporates portions of ISO/IEC 14443 and FeliCa.
MIFARE	Contactless Smartcard	Refers to a contactless smartcard format compatible with NFC. Includes proprietary technologies based on various levels of the ISO/IEC 14443 A standard.
MISRA-C	Automotive	Provides NFC developers with guidelines for C programming in automotive. Developed by the Motor Industry Software Reliability Association.
NFC Forum Specification	NFC Devices	Defines an NFC implementation that enables interoperability across NFC applications.

Take the Next Step

For more information on *NFC* Everywhere

www.nxp.com/nfc

Date of Release: November 2016