

PN71xx family product presentation Plug-and-play NFC solutions

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Agenda

Session 11th July: PN71xx product presentation

- Product introduction, target market and use cases
- PN7150 vs PN7120
- Product technical specifications
- Software integration
- Product support package
- Final remarks

Session 20th July: PN71xx product support package

- PN71xx product support package overview
- OM5577 and OM5578 demo kit details and variants
- How to get started with OM5578/PN7150ARD
- ▶ How to get started with OM5578/PN7150RPI
- ▶ How to get started with OM5578/PN7150BBB





PN71xx family introduction



NXP is expanding its plug'n play NFC portfolio





When to choose a PN71xx NFC controller solution?

Do you need an active or passive solution?

A: I need an active device to generate the RF field

2 What operating system requirements do you have?

A: I want to integrate the NFC solution into a Linux/Android/Windows system

3 What do you need to interact with?

A: I want to read any ISO/IEC compliant cards and/or communicate with an NFC enabled device





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PN71xx - Plug-and-play NFC solutions



- Full NFC Forum-compliant controller
- Support NFC card emulation, reader/writer and peer-to-peer modes
- Compatible with ISO/IEC 14443-A&B, FeliCa and ISO/IEC 15693 cards
- Very easy to integrate thanks to the embedded firmware and NCI standardized interface
- Linux, Android and WinIoT drivers ease integration and reduce time to market
- Low power operation mode
- Standard packages: HVQFN40(PN7150), VFBGA49(PN7120)



Easy to use

Lower bill of materials

Optimized for portable applications





http://www.nxp.com/products/:PN7120A0EV http://www.nxp.com/products/:PN7150B0HN

PN71xx key benefits

Best plug'n play and high performance full NFC solutions make your application smarter!

Best plug'n play Fast to market	Smooth integration	High performance & interoperability
Standard NFC Interface (NCI) to the application host	Embedded FW minimizes host interactions and code size	Full NFC Forum compliant R/W, P2P and CE modes
Linux, Android and WinIoT drivers for OS applications	Low power detection mode, fully configurable	Standard (PN7120) or high (PN7150) output power
Code examples for RTOS and NullOs applications	Standard I ² C physical interface	NFC reader Tag type 1 to 5
Demo-kits interfacing with ARD, RPI and BBB platforms	BGA (PN7120) and QFN (PN7150) package	Passive (PN7120) or Active (PN7150) Load Modulation



NFC controller with integrated firmware benefits vs. NFC frontend

- To ease the integration of the NFC Controller as the integrator does not need to know and care about the various RF protocols
- To easily integrate in main OS (Linux, Android, Windows IoT) through standardized interface (NCI)
- To avoid critical timing constraint on host as the critical timings are handled by the embedded FW
- ► To optimize power consumption as:
 - the NFC controller can go in low power mode on its own as soon as requested
 - the host can be in sleep mode and be awakened by the controller only when entering
 - RF-communication
- To drastically lighten the host interactions as some functionalities such as all the RF protocols are autonomously handled by the FW





PN71xx target markets and use cases



PN71xx target market and use cases

The solution for any market which wants to make its application smarter with NFC



NFC simplifies your setup Easy Bluetooth and Wi-Fi pairing

 Easy pairing (BT, WiFi) of your portable device (smartphone, tablet, speaker, camera) to another consumer product (TV, STB, residential gateway, printers) through Bluetooth or Wi-Fi





 Bluetooth pairing of two headphones for sharing live music (Silent disco)





NFC simplifies your setup Smart home one-tap commissioning solution

CONTROL





NFC simplifies your setup Wi-Fi repeater set up





NFC solves the activation / installation process

Activation of a fiber gateway

Currently

- In many cases, the activation of a fiber STB requires a complex action
- Customer has to connect his PC to the STB through an Ethernet cable
- Then type a specific URL and fill his personal activation code, received by mail + ZIP code
- Failure for 50% of customers, who contact immediately the Telco hotline.

With NFC



Choose one of these 3 options

- 1. Code directly sent by Telco to customer NFC phone. Activation simply done by tapping phone to STB
- 2. Contactless card (with code inside) shipped to the customer. Activation done by tapping card to STB
- In shop, Telco employee taps NFC reader to the packed STB – no need to power-up





NFC makes it personal STB, TVs, remote control device personalization

- We can personalize device settings with just a single tap and avoid looking and reading user manuals.
- Configure settings using the smartphone rich user interface. Then, tap the smartphone against our STB or TV we are able to transmit those settings onto the device.
- The device can identify the specific user and is also able to provide personalized profile experience for each household member
- Parental controls can easily be applied to a set-top box or TV, to ensure that kids only watch suitable channels for a specified period of time





NFC for payment and secure services STB, remote control



Tap your reloadable prepaid card to your STB or remote to securely pay services when you like.

Pay telco services "as you go"

	The Comcast Gift Card		
o y	Tap your gift card (e.g. 10\$ HBO card, VoD card, Amazon card) to your STB or remote to purchase immediately your content.	Tap your transit card or reloadable prepaid card to your STB or remote to securely recharge it	
	Pay services or goods from gift card	Re-charge an existing card	



NFC gets you help faster than ever

Maintenance and troubleshooting

- Automate maintenance tasks with cloud assistance for troubleshooting and firmware updates
- System details like serial numbers and warranty codes are already programmed into the system, so customers don't need to look them (e.g. printed on the back)

- Adds convenience to end-user
- Reduce operator's support cost







NFC for medical, printers, home appliances and gaming





PN71xx key benefits per application

	STB TV	Residential Gateway	Remote control	Audio	Gaming	Printers	Healthcare medical	Home Appl.
Linux/ android/ WinloT drivers ease integration in O/S	~	~			✓	1	✓	
Low power consumption			✓	√	✓		✓	
Avoid critical timing constraints			1	1	✓	1	~	✓
Lighten host interaction	✓	✓			✓			
Plug'n play, no need to know RF protocols	1	1	1	√	✓	1	1	~



PN7120 & PN7150 positioning and features



PN71xx NFC controller positioning



Product Price

VFBGA49: 4.0 x 4.3 x 0.9mm, pitch 0.5mm **HVQFN40**: 6.0 x 6.0 x 0.85mm



PN7150 vs PN7120

	RESE PN7150	PN7120	Benefits
RF driver supply voltage	2.7V 4.75V	2.7V or 3.3V	More output power to work with smaller antenna or better performance
Card emulation mode	NFC forum T4T - ISO/IEC A&B NFC forum T3T - FeliCa	NFC forum T4T - ISO/IEC A&B	Enable FeliCa use cases (Japan, HK, Singapore)
Package	HVQFN40	VFBGA49	Decrease PCB manufacturing cost (no microvias)
Load modulation concept	Active Load Modulation*	Passive Load Modulation	Allow decreasing antenna size with same RF performance in Card Emulation and passive Target modes

* Active Load Modulation is the fact to actively drive RF signal with the transmitters during the modulation phase. It gives much stronger signal than the passive load modulation, which is just changing the transmitter impedance.



Active Load Modulation (ALM)



Active Load Modulation (PN7150)

The field used by the transponder to generate the response is self generated.

In CARD mode, the **PN7150** provides 2 different modes to generate LMA: **DUAL mode** and **SINGLE mode**.





SINGLE

The modulation is generated by actively driving 13.56 MHz with **TX1 or TX2**, the other pin is kept silent

DUAL

The modulation is generated by actively driving 13.56 MHz with **TX1 and TX2**. The modulation depth is doubled



Communication distance - PN7150 vs PN7120



PN7120 PN7150

Reader modeIncrease from 50% to 140%





Peer-to-peer mode - Increase of 67% Card mode - Increase of 260%



PN71xx product technical details



PN71xx technical product features

Characteristics

Full hardware and software compatibility

- Support for Linux, Android, Windows IoT, RTOS, NullOS
- Interface to Raspberry Pi, BeagleBone Black and all boards with Arduinocompatible header

Complete, power-efficient NFC control

- RF driver: 3.0 to 4.75V, 180mA max (PN7150); 2.7 to 3.3V, 180mA max (PN7120)
- NFC Forum device requirement v1.3
- Fully configurable polling loop with low-power mode
- Load modulation scheme; active (PN7150), passive (PN7120)

Interfaces to host

- > I2C up to 3,4MBaud/s
- NFC Forum NCI 1.0 compliant protocol
- IRQ signal for improved synchronization
- Supply voltage: 1.8V to 3.3V

Supported RF protocols

Reader/Writer modes

- NFC Forum tags Type 1, 2, 3, 4 and 5
- ISO/IEC 14443 Type A & B, R/W up to 848 Kbps
- ISO/IEC 15693 Tags (ICODE)
- FeliCa tags up to 424 Kbps
- MIFARE 1K/4K
- MIFARE DESFire

Card modes (from Host)

- NFC Forum T4T (ISO/IEC 14443A&B) at 106 kbps
- NFC Forum T3T (FeliCa, PN7150 only)

P2P modes

Active and passive initiator and target according to ISO/IEC 18092 at all data rates (106 kbps to 424 kbps)

Package

HVQFN40 (PN7150); VFBGA49 (PN7120)



Block diagram

ARM Cortex-M0 for integrated firmware

Host interface

- Link with host controller (NCI over I2C)

Clock interface

 Clock source required when generating the RF field

Power interface

 Interface to power management unit (direct battery supply supported). PN7150 has 4.5V TX-LDO and PN7120 3V TX-LDO.

Antenna interface

- Link to an NFC antenna in order to enable communication with a remote contactless device





Power Management Unit – Battery monitor

Battery voltage monitor

Protects the mobile device battery from being discharged below critical levels.

It can be

- Enabled/disabled via EEPROM.
- Configured between 2.3V and 2.75V.





Power Management Unit – TX-LDO (PN7120)

Reader/writer mode



- Generates fixed output voltage.
- In reader/writer mode, the value of $V_{DD(TX)}$ is configured at 3.1 ± 0.2V
- The output voltage is used to generate the RF field
- Inactive during card mode

More info: AN11565 PN7120 Hardware design guide

Standby state



In standby state, the value of V_{DD(TX)} is around 2.5V with some ripples



Power Management Unit – TX-LDO (PN7150)

Configuration 1



- Generates fixed output voltage levels using V_{BAT}.
- In card emulation or reader/writer mode the output may be configured at 3.0, 3.3 and 3.6V
- The output voltage is used to generate the RF field.
- In standby state, fixed output of 2.5V

More info: AN11756 PN7150 Hardware design guide

Configuration 2



- Generates fixed output levels using the V_{BAT} and extra 5V external supply.
- In card emulation or reader/writer mode additional output levels may be configured:4.5V and 4.75V
- The output voltage is used to generate the RF field.
- In standby state, fixed output of 2.5V.



NFC antenna tuning procedure

Measure antenna coil Determine LCR values of the antenna coil

Define target impedance and Q-factor To optimize RF output power or battery life

Define the EMC filter *Filtering of unwanted harmonics*

Calculate matching components
Using provided excel sheet

Simulate the matching Using matching simulation tools

Assembly and measurement Field measurement and fine tuning

Adjust receiver circuit Tuning reader sensitivity



More info: AN11755 and AN11700 Antenna and tuning design guide



Power states

Monitor

Voltage battery monitor is enabled and battery level is below programmed battery level. The system is in power off mode.

Hard power down

The controller has battery enough for working but it is not enabled. This allows minimum power consumption. The system is powered off.

Standby

There is enough battery for working. Minimum part is supplied to enable wake-up sources. The system is in full power mode.

Active

There is battery enough for working. All blocks are supplied. The system is in full power mode.

Power State	V _{BAT}	V _{EN}	Power Mode
Monitor	Off	х	Power off
Hard power down	On	Off	Power Off
Standby	On	On	Full power mode
Active	On	On	Full power mode

VBAT: Input supply pin

VEN: reset pin. Set the device in hard power mode.



Functional modes in active state

Idle

The PN71XX is active and host interface communication is ongoing

Listener

The PN71XX is active and is listening to external device

Poller

The PN71XX is active and is polling external device





Low power discovery mode

- Average power consumption depends on:
 - Polling modes enabled by host controller
 - Listen mode duration (standby current)
 - Antenna system used by the application (RF impedance)
- PN71xx implements two additional modes of Low Power Polling:
 - Low power tag detector
 - Replaces each regular polling cycle by an RF pulse (few µs)
 - It uses an enhanced HW reception path in order to reliably detect the insertion of a tag within the field.
 - NXP provides a proprietary extension to the NCI driver in order to enable and configure this mode
 - Hybrid mode
 - Introduces a regular polling cycle after a defined amount of LPCD pulses if a tag is still not detected

More info: AN11562 PN7120 Low Power mode configuration More info: AN11757 PN7150 Low Power mode configuration



Fig 1. Regular polling loop



Fig 2. Low power card detector loop





PN71xx host interface



PN71xx host interface



- PN71xx is connected to a host controller or MCU through an I²C bus (High-speed mode)
- The logical interface towards the host controller is NCI-compliant* with additional command set for NXP-specific product features



*NCI protocol interface according to NFC Forum standardization





NXP NCI extension

Features	NCI	PN7120- NCI	PN7150-NCI
RF Discovery activity (NFC Forum, EMVCo)			
Reader/Writer ISO-DEP for NFC-A & NFC-B, T1T, T2T, T3T, T4T			
Reader/Writer MIFARE Classic, MIFARE Plus, ISO15693, Kovio, Tag-S			
Card Emulation ISO-DEP for NFC-A & NFC-B			
Card Emulation T3T for NFC-F		n.a	
P2P passive (Initiator & Target)			
P2P active (Initiator & Target)			
RF bit rates for Listen mode & Poll mode: 106 Kbps (NFC-A & NFC-B), 212 Kbps (NFC-F), 424 Kbps (NFC-F)			
RF bit rates for Listen mode & Poll mode in technology NFC-A & NFC-B: 212 Kbps, 424 Kbps, 848 Kbps	•		
Configuration: Power management, RF settings, clocking schemes			
Others: Presence check			
Testing: Antenna self-test, PRBS test		n.a	
212 Kbps, 424 Kbps, 848 Kbps Configuration: Power management, RF settings, clocking schemes Others: Presence check Testing: Antenna self-test, PRBS test		n.a	

More info: UM10819 - PN7120 User Manual More info: UM10936 – PN7150 User Manual



Covered

Partially covered

Not covered

PN71xx software integration



PN71xx SW integration in Linux OS

Linux NFC architecture overview

- Interface Layer: exposes the library API
- Core Layer: implements NFC features (NCI, NDEF, Tag operations..)
- Hardware abstraction layer: provides connection to the kernel driver as well as basic functionalities like self-test or FW update
- ► List of features supported by Linux libnfc-nci stack:
 - NDEF tag support
 - MIFARE classic tag support
 - P2P, LLCP, SNEP
 - WiFi & Bluetooth handover
 - Raw tag command support
 - Propietary NCI command support
 - Host Card Emulation



Linux software stack source code is available on: https://github.com/NXPNFCLinux/linux_libnfc-nci



PN71xx SW integration in Android OS AOSP NFC architecture

- NFC service: API within the Android framework that provides access to the NFC functionality.
- JNI: Glue code between Java classes and Native classes (written in C/ C++)
- Libnfc-nci: Native library providing NFC functionality for which extension is added to support NXP proprietary features
- NXP NCI HAL: NXP hardware specific implementation supporting full capabilities
- I²C driver: Kernel module allowing to access NXP NCI based NFC controller hardware resource

Android patches are available:

- For Android KitKat on: <u>https://github.com/NXPNFCLinux/nxpnfc_android_kitkat</u>
- For Lollipop via: https://github.com/NXPNFCLinux/nxpnfc_android_lollipop





PN71xx SW integration Windows IoT OS Windows NFC architecture

- PN71xx is natively supported as a Proximity platform device by Windows10 IoT OS through the universal NFC device driver model.
 - Smart card DDI : Provides low level access for interacting with smart cards
 - Near Field Proximity DDI: Provides publish/subscribe ability for proximity message passing, including peer to peer exchange and receiving and writing data from NFC tags.
 - Radio Management DDI: Provides access for the Control Panel (CPL) application to set radio states (P2P, R&W) and SE (CE mode)



*DDI: Device Driver Interface (DDI)



PN71xx SW integration in other platforms RTOS or Null OS

- NXP-NCI module offers high level NFC API for connection and configuration of the NFC controller:
 - Start of the NFC discovery
 - Wait for NFC discovery
 - Process the NFC discovery
- **NDEF library** module is composed of independent sub-modules:
 - RW_NDEF implements NDEF extraction from NFC Forum tags (all 4 NFC Forum defined tag types)
 - **P2P_NDEF** implements NDEF data exchange with P2P device (over NFC Forum LLCP and SNEP protocols)
 - **T4T_NDEF**_emu implements NDEF message exposure through card emulation (NFC Forum Type 4 Tag protocol)
- TML module brings HW abstraction to NFC library (abstract how the connection to NFC controller IC is managed).



^{*} Including Kinetis, LPCXpresso and i.MX platforms





Product support package

PN7120 NFC controller single board computer (SBC) kits: OM5577





PN7150 NFC controller single board computer (SBC) kits: OM5578





PN71xx Arduino demo kits

Compatible with board featuring Arduino compatible header









LPCXpresso boards

LPC8xx, LPC11xx, LPC12xx + any LPC controller & related boards: LPCXpresso824-MAX and LPCXpresso board for LPC11u37H

Kinetis & Freedom boards

K64F, KL43, KW40Z/KW41Z + most other Kinetis controller & related boards: FRDM-K64F, FRDM-KL43, FRDM-LW40Z/FRDM-KW41Z

i.MX boards

i.MX6, i.MX7 & related boards: i.MXUltralite Evaluation kit, Quick start board for SCM-i.MX 6DQ, UDOO Neo and UDOO Dual/Quad



PN71xx product support package in a nutshell

(<u>)</u>	NFC controller SBC kits	 OM5577/PN7120S – PN7120 Controller SBC kit OM5577/PN7120ARD – PN7120 NFC Controller SBC kit for Arduino OM5578/PN7150ARD – PN7150 NFC Controller SBC kit for Arduino OM5578/PN7150BBB– PN7150 NFC Controller SBC kit for BeableBone Black OM5578/PN7150RPI-– PN7150 NFC Controller SBC kit for Raspberry Pi 	
	SW support	 SW3735- NXP-NCI Kinetis Design Studio example SW3241- NXP-NCI LPCXpresso example SW3497- PN71x0 on RPI, WinIoT driver installation files OM55777_BBB_KITKAT – OM5577 BeagleBone Android KitKat demo image OM5577_BBB_LINUX- OM5577 ReagleBone Linux demo image OM5577_RPI_LINUX-OM5577 Raspberry Pi Linux demo image OM5577_RPI_WIN10IOT-OM5577 Raspberry Pi WinIoT10 demo image SW3497- PN71x0 on Raspberry Pi, WinIoT driver installation files 	 > OM5578 PN7150 UDOO Neo Linux system image > OM5578 PN7150 Beaglebone Black KitKat Linux system image > OM5578 PN7150 Beaglebone Black Linux system image > OM5578 PN7150 Raspberry Pi Linux system image > OM5578 PN71x0 Raspberry Pi 2 WinIoT > Linux NFC stack for NCI based NXP NFC Controllers > Android patches for KitKat > Android patches for Lollipop
Ē	Docs	 AN11646 – PN7120 NFC Controller SBC Kit Quick Start Guide AN11658 – NXP-NCI LPCXpresso example AN11845- NXP-NCI Kinetis Design Studio example UM10819 – PN7120 User Manual UM10878- NFC Controller SBC Kit User Manual AN11697 PN71x Linux Software Stack Integration Guidelines AN11700- PN7120 Product Quick Start Guide AN11690 NXP-NCI Android porting guidelines AN11564 PN7120 Antenna Design and Matching guide AN11656 PN120 Hardware design guide 	 AN11562 PN7120 Low Power Mode configuration AN11759 – Product quick start guide AN11755 – Antenna and tuning design guide AN11756 – Hardware design guide AN11757 – Low power mode configuration AN11767 – Windows IoT porting guidelines AN11758 – Raspberry Pi demo kit quick start guide AN11842 – BeagleBone demo kit quick start guide AN11841 – Arduino demo kit quick start guide UM10936 – User Manual



Final remarks



PN71xx - *Plug-and-play NFC solutions* Key facts



Full interoperable and NFC Forum compliant

Very easy to integrate thanks to embedded firmware and NCI standardized interface

Linux, Android and Windows IoT drivers ease integration and reduce time to market

High output power delivered thanks to 5V RF driver output voltage (PN7150)

Active Load Modulation to enhance the card mode performances (PN7150)

Delivered in standard packages: HVQFN40 (PN7150) and VFBGA49 (PN7120)

Demo kits and SW drivers, supporting most popular platforms



PN71xx family vs NFC portfolio

	Zero Power Access	Energy Harvesting	Embedded MCU	NFC Tag	Card in host mode	Reader & Writer		P2P mode	DPC	Active Load Modulation	ISO/IEC 7816 interface
NTAG I²C <i>plus</i>	Read& Write	10mA @ 2V		Tag Type 2							
CLRC663				Reader Tag Type 1,2,3,4,5		ISO/IEC14443 FeliCa	ISO/IEC15693 ISO18000-3M3	Passive Initator			
PN5180				Reader Tag Type 1,2,3,4,5	ISO/IEC 14443-A	ISO/IEC14443 FeliCa	ISO/IEC15693 ISO18000-3M3	Active& Passive	Yes	Yes	
PN7120			Yes, non Rewritable FW	Reader Tag Type 1,2,3,4,5	ISO/IEC 14443-A&B	ISO/IEC14443 FeliCa	ISO/IEC15693	Active& Passive			
PN7150			Yes, non Rewritable FW	Reader Tag Type 1,2,3,4,5	ISO/IEC 14443-A&B FeliCa	ISO/IEC14443 FeliCa	ISO/IEC15693	Active& Passive		Yes	
PN7462			Yes, customizable FW	Reader Tag Type 1,2,3,4,5	ISO/IEC 14443-A	ISO/IEC14443 FeliCa	ISO/IEC15693 ISO/IEC 18000-3M3	Active& Passive	Yes	Yes	Yes
					Card emulation	Read &	& Write	Peer-to- Peer			



Find your NFC toolkit at: <u>www.nxp.com</u>





NXP partner program

Partner List

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Our partners are listed in an alphabetical order below. Click on the company name to view a description of the company, their contact information, and a link to their website.

Company name	Туре	Region	Country	Application areas	Product foc us
Beijing Strong Tech Co., Ltd.	IDH	Greater China	China	Smart appliances NFC and reader IC's	MCU, Logic, GA, Interface, NFC
Britestone Limited	IDH	Greater China	China	NFC and reader IC's	NFC, MCU, Thyristors and Sensor
Engicam	IDH	EMEA	Italy	Smart appliances NFC and reader IC's	MCU, RFID, IPCamera
GOLD FULL ELECTRONICS (H.K.) CO., LIMITED	IDH				Logic, NFC tag module, GA
Golden IC Technology COLtd	IDH	Greater China	Taiwan	Smart appliances NFC and reader IC's	LPC8xx, LPC11xx, LPC1768, LPC4088, LPC4350, NFC, Logic IC
IMST	IDH	EMEA	Germany	NFC and reader IC's	NFC
ipTronix	IDH	EMEA	Italy	NFC and reader IC's	NFC
Kronegger GmbH	IDH	EMEA	Austria	NFC and reader IC's	NFC, RFID
MobileKnowledge	IDH	EMEA	Spain	NFC and reader IC's	NFC
New rFid Concept	IDH	EMEA	France	NEC and reader IC's	NEC

NXP > Support > NXP Partner Program > Partner List

Partner list (and search for NFC)







Software development in Android and iOS Embedded software for MCUs JCOP, Java Card operating Systems Hardware design and development Digital, analog, sensor acquisition, power management Wireless communications WiFi, ZigBee, Bluetooth, BLE Contactless antenna RF design, evaluation and testing

MIFARE applications End-to-end systems, readers and card-related designs **EMVco** applications Readers, cards, design for test compliancy (including PCI) Secure Element management GlobalPlatform compliant backend solutions Secure services provisioning OTA, TSM services



We help companies leverage the mobile and contactless revolution



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Get in touch with us







PN71xx - Plug-and-play NFC solutions

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