

# NTAG 5 PRODUCT INTRODUCTION

## NFC FORUM TYPE 5 TAGS: NTAG 5 PRODUCT FAMILY PRESENTATION

PABLO FUENTES

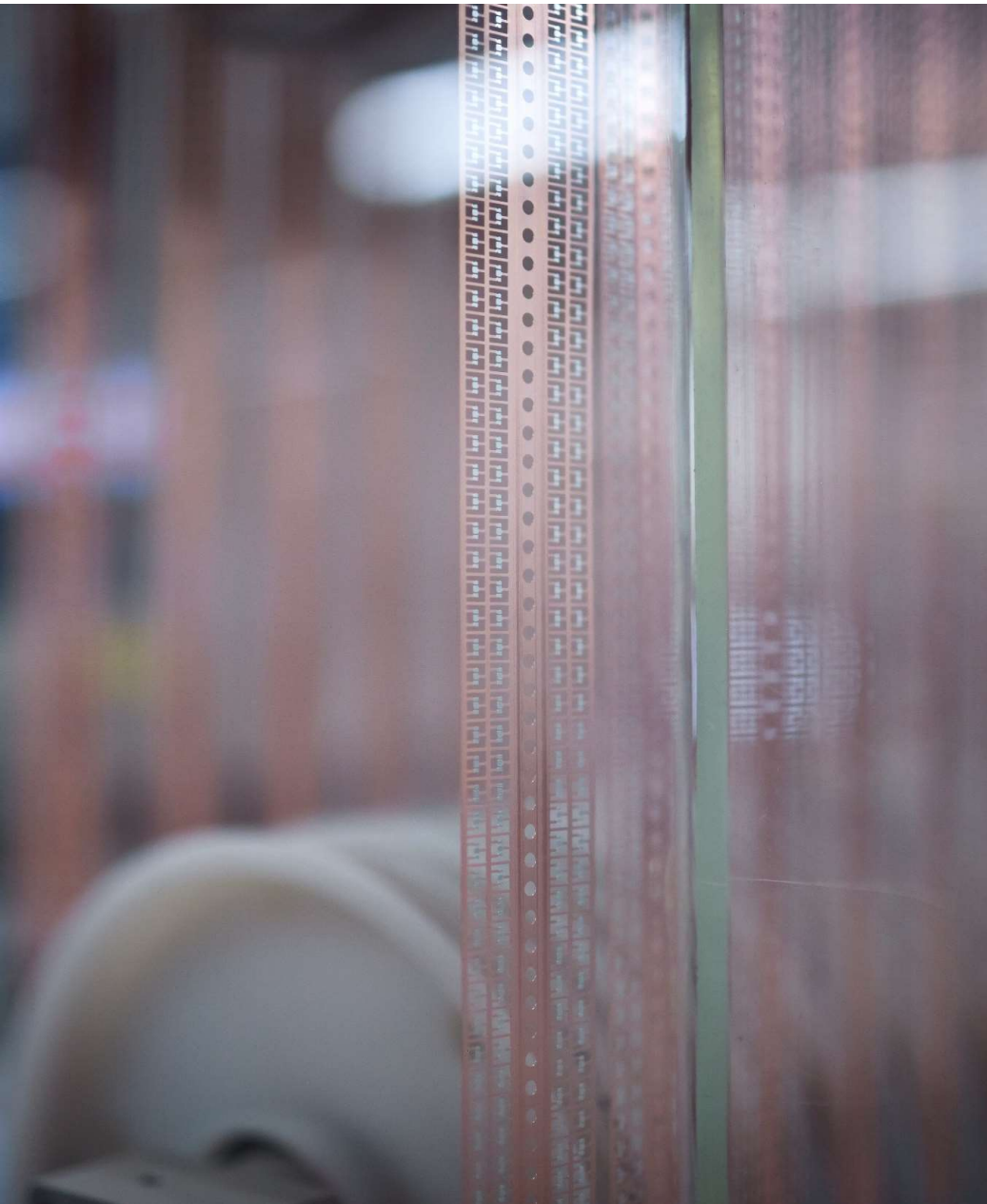
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PUBLIC



SECURE CONNECTIONS  
FOR A SMARTER WORLD



## Agenda

- Introduction
- Product positioning
- NTAG 5 switch
- NTAG 5 link
- NTAG 5 boost
- Summary
- More support



# Introduction



# Introduction

## NTAG 5 product family



### NTAG 5 switch

*NFC Forum-compliant PWM & GPIO bridge for lighting and gaming*



### NTAG 5 link

*NFC Forum-compliant I<sup>2</sup>C master bridge for IoT on demand*

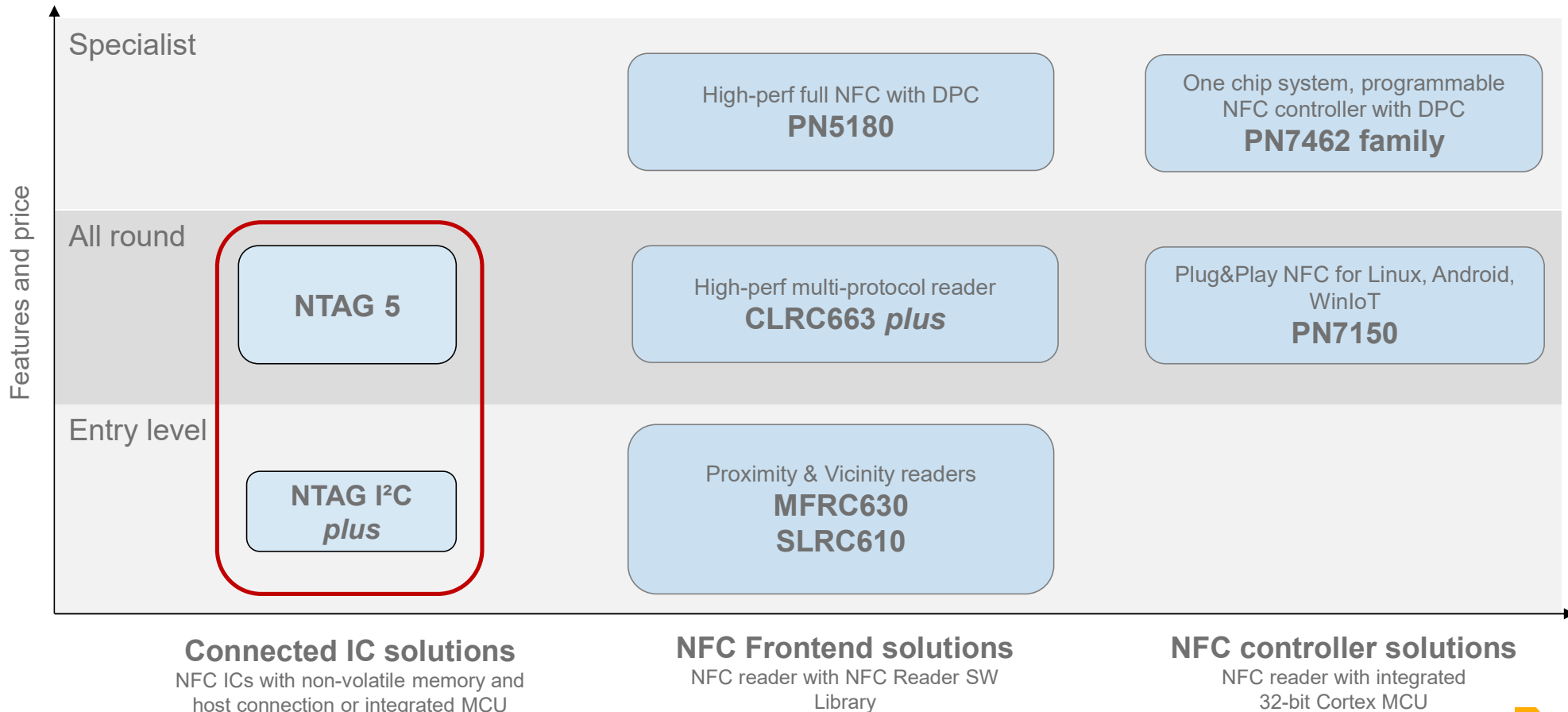


### NTAG 5 boost

*NFC Forum-compliant I<sup>2</sup>C bridge for tiny devices supporting very small antennas*

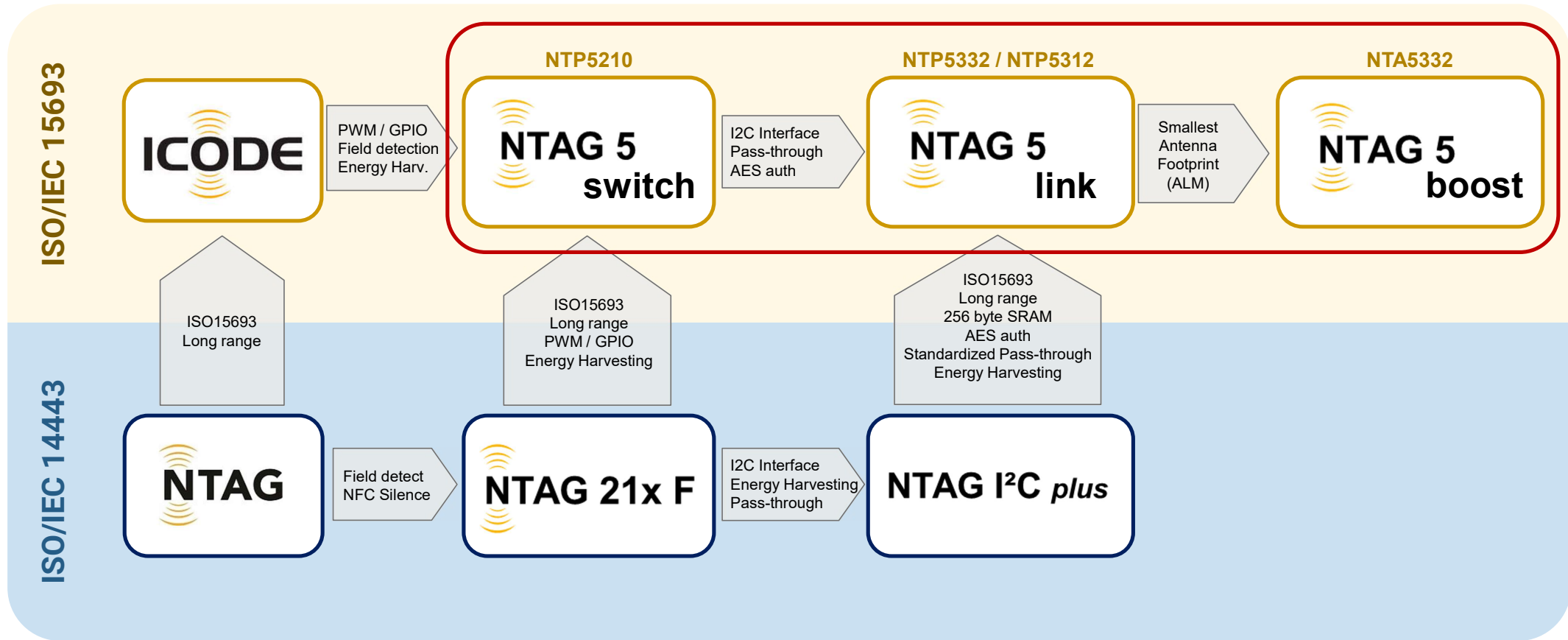
# Introduction

## Positioning of NXP's NTAG family in portfolio



# Introduction

## NTAG 5 Positioning



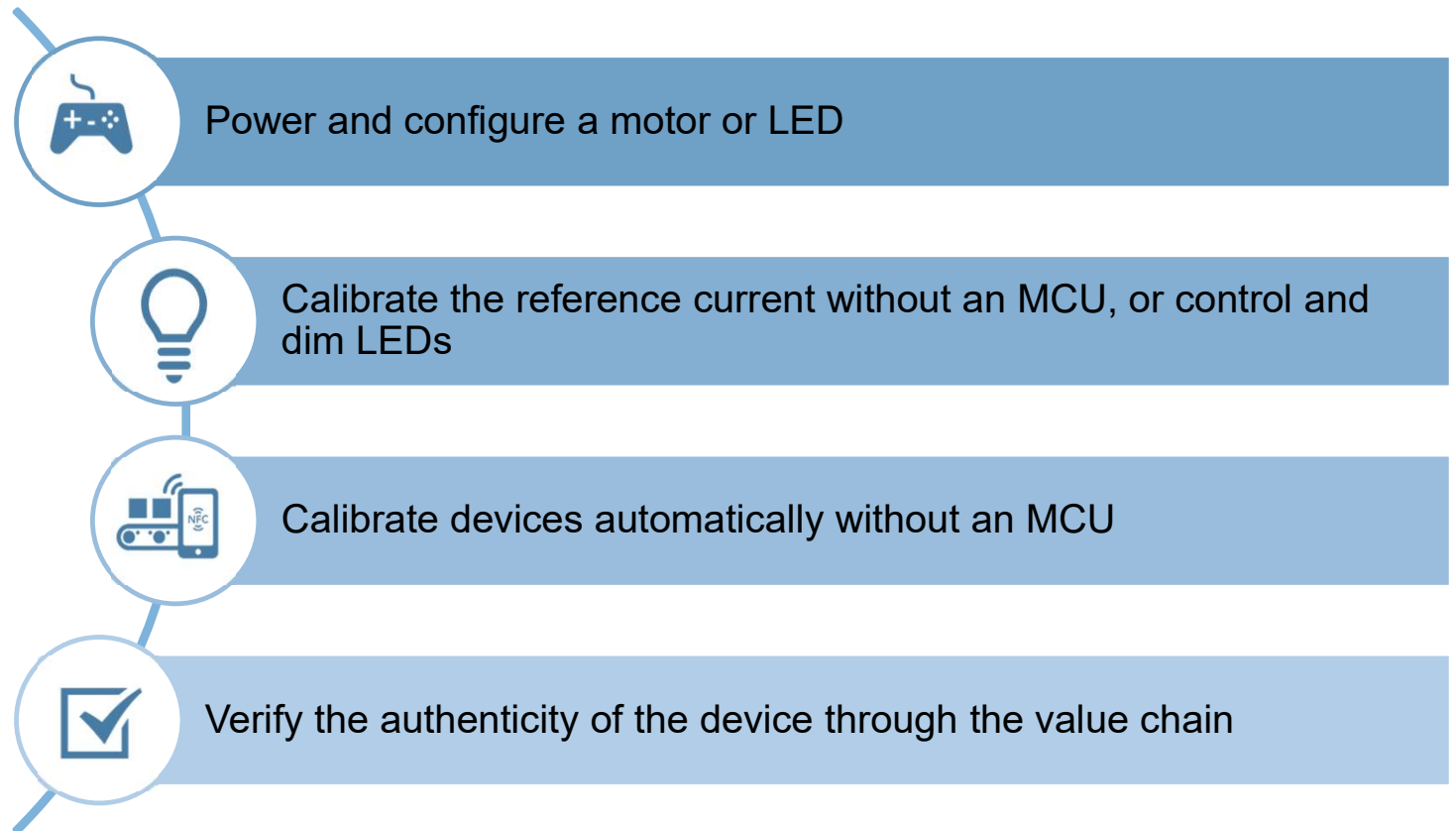
# NTAG 5 switch





## NTAG 5 switch

### NFC Forum compliant PWM and GPIO bridge





# NTAG 5 switch

## Technical product features

Main features			
<b>NFC Interface</b>	NFC Forum Type 5 Tag compliant ISO/IEC 15693 compliant, <b>up to 60 cm read range</b>		
<b>Memory</b>	512 byte user memory		
<b>Wired Interface</b>	Pulse Width Modulation	GPIO	Event detection
<b>Energy Harvesting</b>	Configurable output 1.8 V, 2.4 V or 3 V with up to 30 mW output power		
<b>Security</b>	32-bit or 64-bit password protection 3 configurable user memory areas ECC based reprogrammable originality signature		
<b>Temperature range</b>	-40°C to +85°C		

Wired Interface Details	
Total number of lines	2 in/out (push/pull) 1 out (open drain) 1 Hard Power Down
Maximum number of GPIO's	2
Maximum number of PWM output	2
Event detection pin (e.g. field detection)	1

Product Type ID	12NC	Package	Dimensions	Packing	MOQ
NTP52101G0JT	9353 549 01431	SO8	3.6 x 6.2 x 1.35 mm (wave soldering compatible)	Reel 13"	2500
NTP52101G0JTT	9353 624 09431	TSSOP16	4.4 x 5.0 x 1.1 mm (wave soldering compatible)	Reel 13"	2500
NTP52101G0JHK	9353 547 31471	XQFN16	1.8 x 2.6 x 0.5 mm	Reel 7"	4000
NTP52101G0JUA	9353 859 92005	FFC	Bare die on wafer	Wafer	1

# NTAG 5 switch

## Memory distribution

- NTAG 5 Switch memory is distributed in two areas organized in blocks of 4 bytes:
  - User memory
  - Configuration Memory
- User memory area
  - Accessible using READ\_BLOCK and WRITE\_BLOCK commands
  - Block 0 is the capability container
  - NDEF message TLV (if present) starts after Capability Container
  - Latest block contains the 16-bit counter and its configuration byte
- Configuration memory area
  - Accessible using READ\_CONFIG and WRITE\_CONFIG commands
  - Stores all configuration options
  - Contains required security-related information (Passwords, privileges, originality signature...)
  - Access to configuration blocks can be blocked or password protected

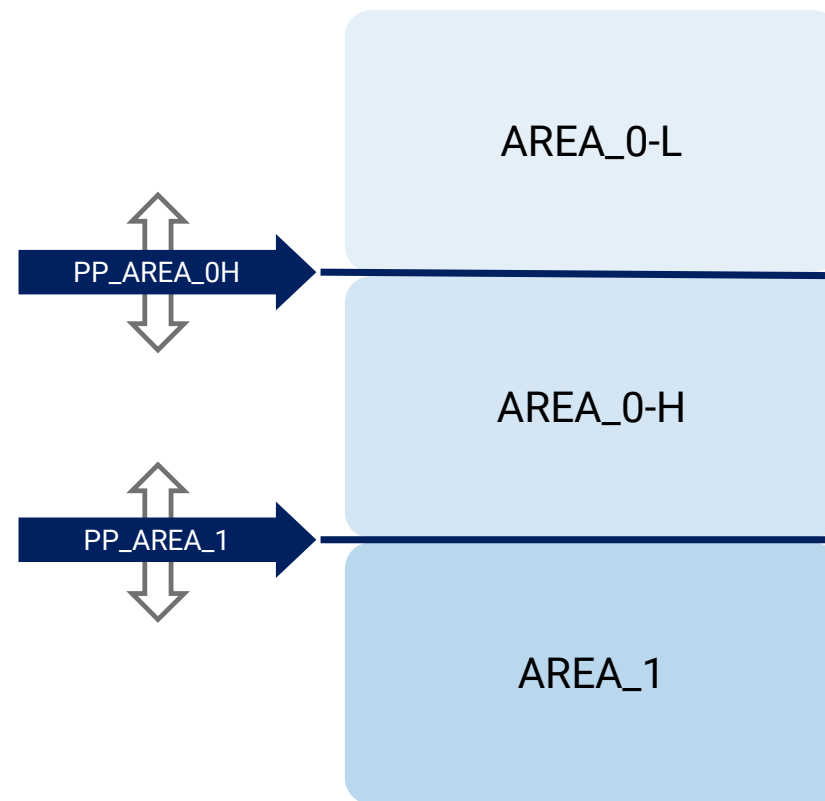
Block Address	Byte 0	Byte 1	Byte 2	Byte 3
NFC				
00h	Capability Container			
01h				
:	:	:	:	:
7Eh				
7Fh	Counter			

Block Address	Byte 0	Byte 1	Byte 2	Byte 3
NFC				
00h	Configuration area			
01h				
:				
ABh				

# NTAG 5 switch

## Protected User memory areas

- Up to three user memory areas configurable through pointers.
- Protection based on password authentication.
- Seven 32-bit passwords available depending on operation to protect.
- Different access conditions for AREA\_0-L & H sections:
  - Enable/Disable NFC Read protection
  - Enable/Disable NFC Write protection
- AREA\_1 can be used for more sensitive information.
  - Read and write operations always password-protected.
  - Independent read and write passwords (different from AREA\_0)
- 64-bit password protection can be enabled for read and write operations.

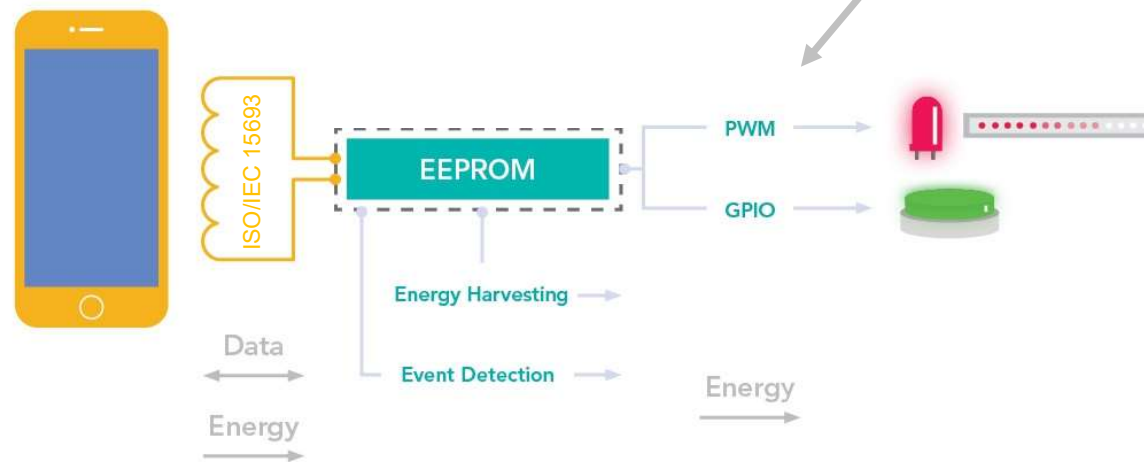
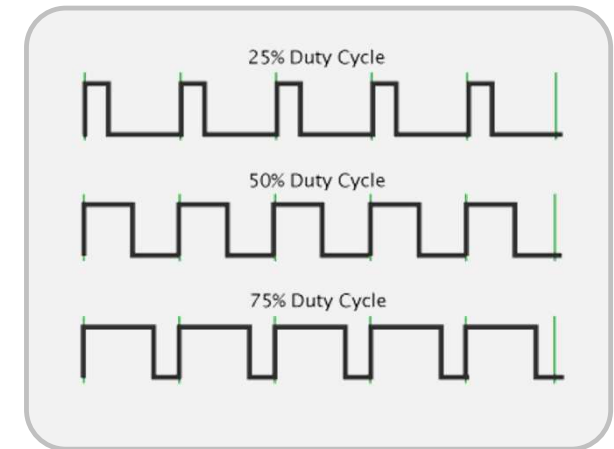


# NTAG 5 switch

## NFC Forum compliant PWM and GPIO bridge

- NTAG 5 switch includes a set of multiplexed pins, offering general-purpose I/O (GPIO) and pulse width modulation (PWM) as well as NFC field detection.
- The characteristics of the PWM or GPIO signal can be configured through NFC interface.
- These features can be used to switch on/off and control motor speed or LED brightness.

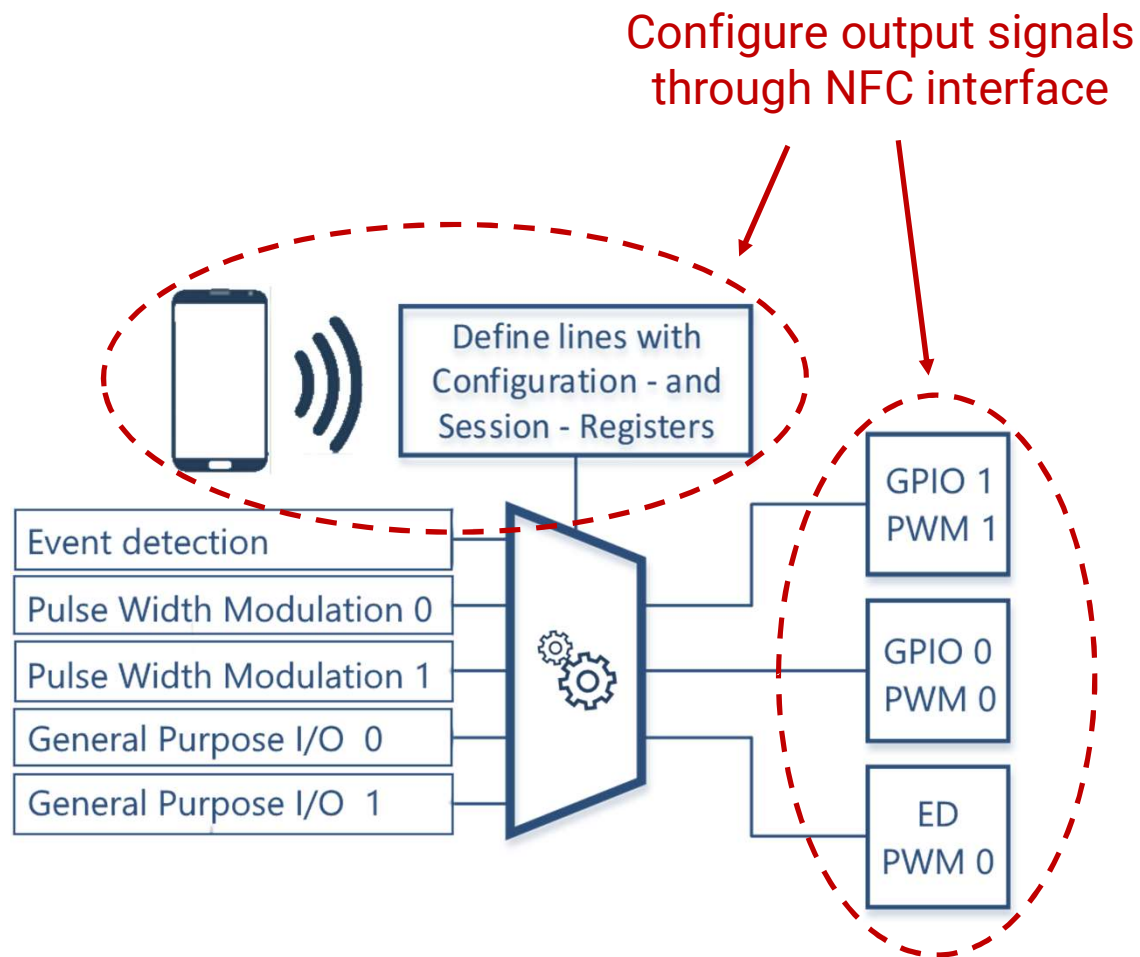
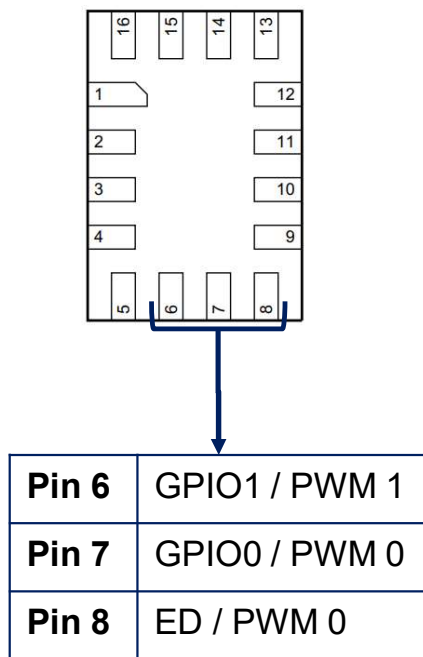
PWM signals example



# NTAG 5 switch

## Wired Interface configuration

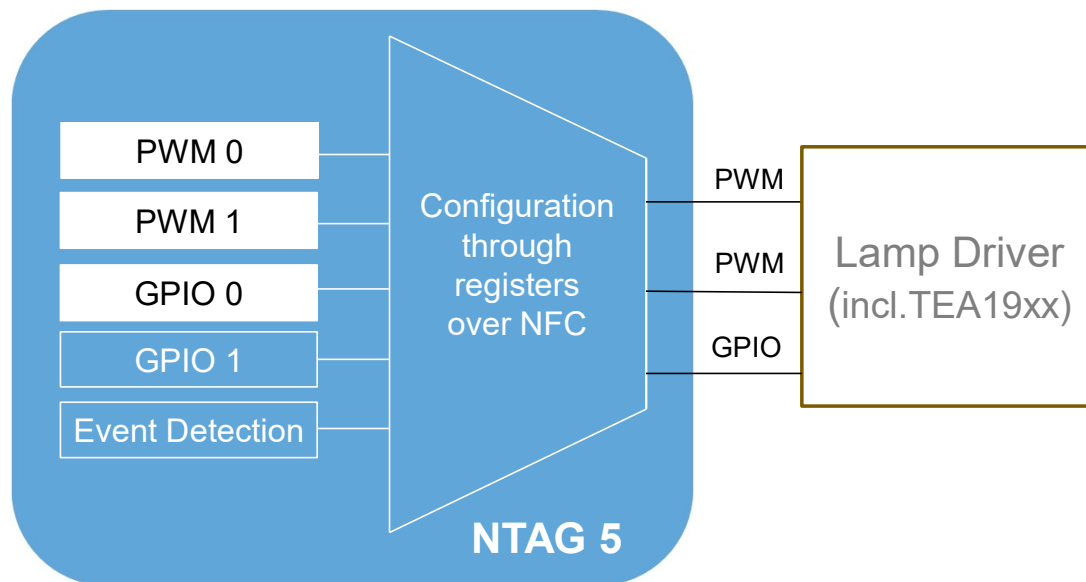
NTAG 5 Switch Pinning



# NTAG 5 switch

## Wired Interface configuration example

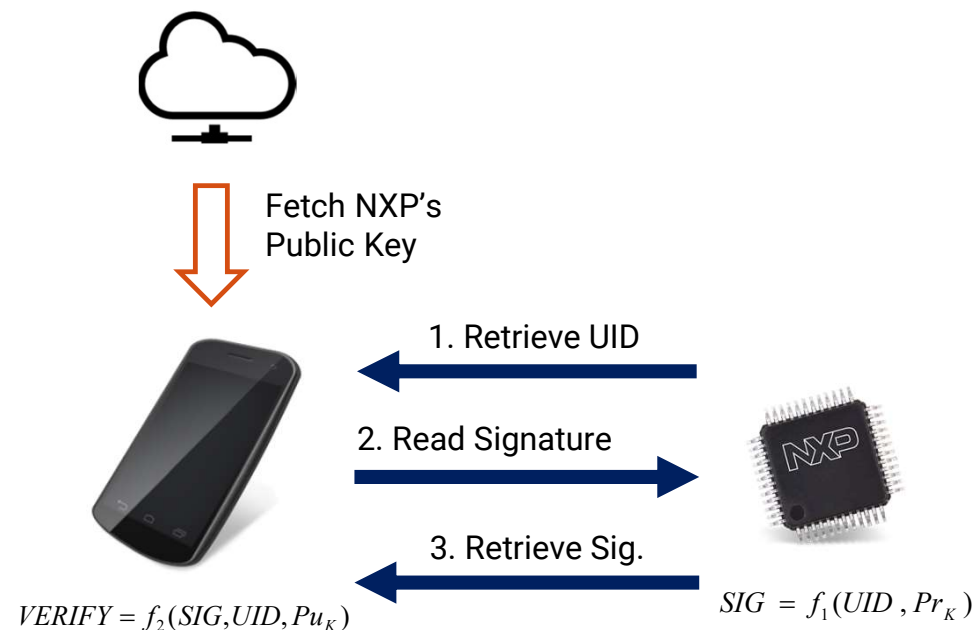
- Configure current for LED converter through PWM
- Configure second current for tunable white LED
- Use GPIO to enable or disable converter



# NTAG 5 switch

## Originality Signature

- NTAG 5 comes with pre-programmed proof-of-origin functionality to verify authenticity based on Elliptic Curve Cryptography (ECC).
- ECC-based originality signature can be reprogrammed or locked by the customer using the WRITE\_CONFIG command
- Signature can be retrieved using:
  - READ\_SIGNATURE command
  - READ\_CONFIG command over dedicated blocks
- Pre-programmed signature can be verified using the corresponding ECC public key provided by NXP.



Details on how to check the signature are provided in [AN11350](#)

# NTAG 5 switch

## Use cases - Lighting



Control and dim  
LEDs



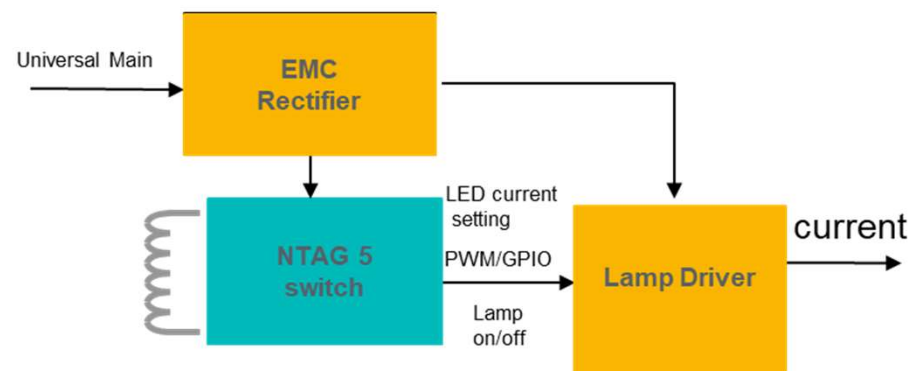
Calibrate the  
reference  
current without a  
MCU



Verify authenticity  
of the device

Relevant features:

- PWM to configure LED current
- GPIO to enable / disable LED
- Originality check of the product by reprogrammable ECC signature



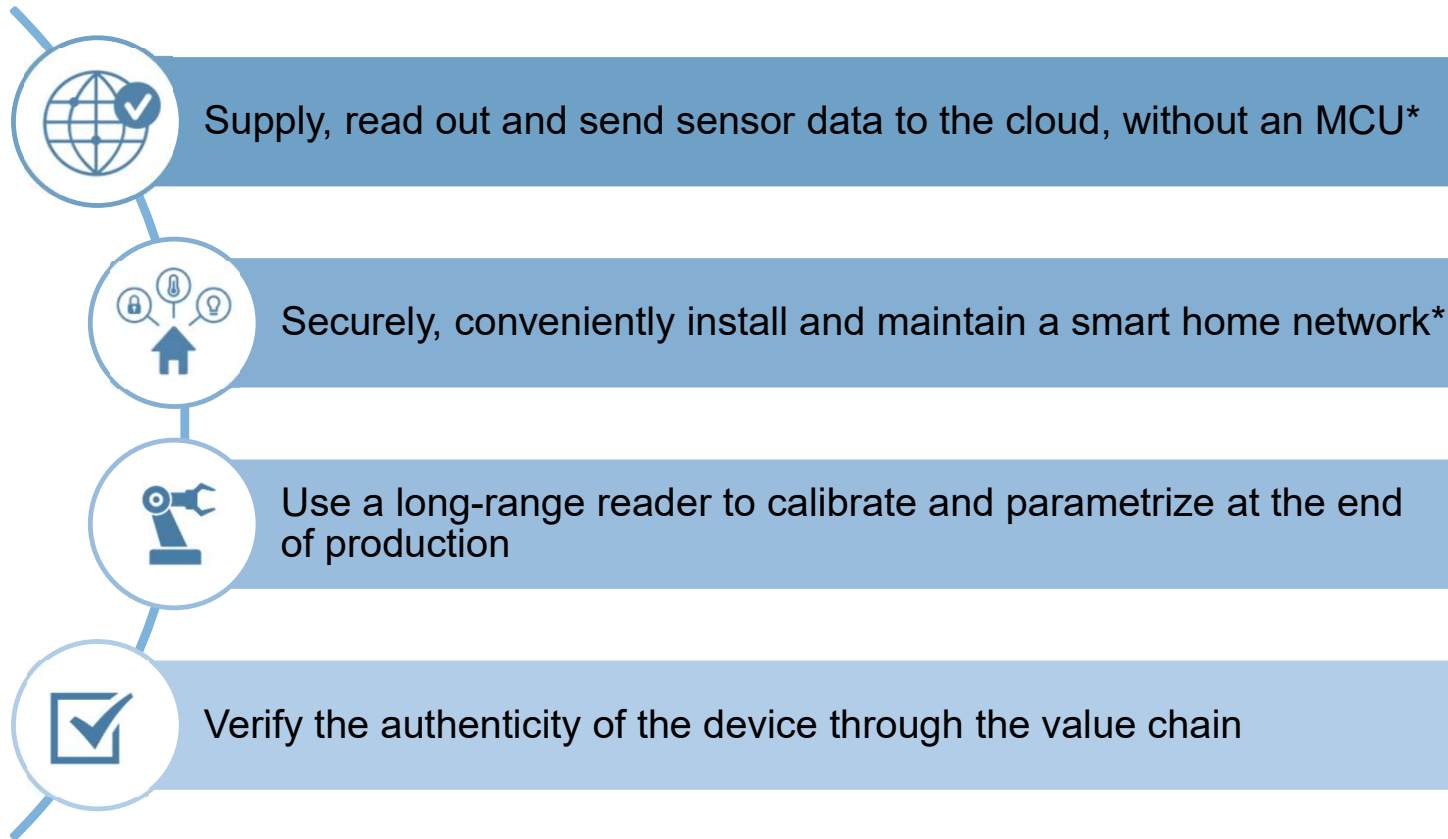


# NTAG 5 link



# NTAG 5 link

## NFC Forum compliant I2C bridge



# NTAG 5 link

## Technical product features

### Main features

NFC Interface	ISO/IEC 15693 compliant, up to <b>60 cm read range</b> NFC Forum Type 5 Tag compliant
Memory	2048 byte user memory 256 byte SRAM
Wired Interface	I <sup>2</sup> C slave (up to 400 kHz) or I <sup>2</sup> C transparent <b>master*</b> channel or Pulse Width Modulation/GPIO Event detection or PWM output Stand-by current < <b>6 µA @ RT</b> Hard power down current < <b>0.25 µA @ RT</b>
Energy Harvesting	Configurable output 1.8 V, 2.4 V or 3 V with up to <b>30 mW</b> output power
Security	<b>AES</b> 128 bit mutual authentication* or 32-bit or 64-bit password protection from NFC perspective 32-bit password from I <sup>2</sup> C perspective 3 configurable user memory areas ECC based reprogrammable originality signature NFC and I <sup>2</sup> C disable
Temperature range	-40°C to +85°C

### Wired Interface Details

GPIO / PWM	I <sup>2</sup> C lines may be used as GPIO's or PWM lines
Event Detection	Multiple events can be used as trigger to the host, or use ED pin as PWM channel in parallel to I <sup>2</sup> C
Transparent I <sup>2</sup> C master channel*	Attach and power any I <sup>2</sup> C slave like sensor or external memory without MCU
I <sup>2</sup> C slave	Standardized passthrough synchronization in addition to procedure from NTAG I2C <i>Plus</i> passthrough mode

Product Type ID	12NC	Package	Dimensions	Packing	MOQ
NTP53121G0JUA	9353 582 08005	FFC	Bare die on wafer	Wafer	Tbd
NTP53321G0JUA*	9353 582 09005				
NTP53121G0JT	9353 549 05431	SO8	3.6 x 6.2 x 1.35 mm No energy harv. hard power down	Reel 13"	2500
NTP53321G0JT*	9353 549 11431				
NTP53121G0JTT*	9353 624 11431	TSSOP16	4.4 x 5.0 x 1.1 mm	Reel 13"	2500
NTP53321G0JTT	9353 624 96431				
NTP53121G0JHK	9353 549 03471	XQFN16	1.8 x 2.6 x 0.5 mm	Reel 7"	4000
NTP53321G0JHK*	9353 549 09471				

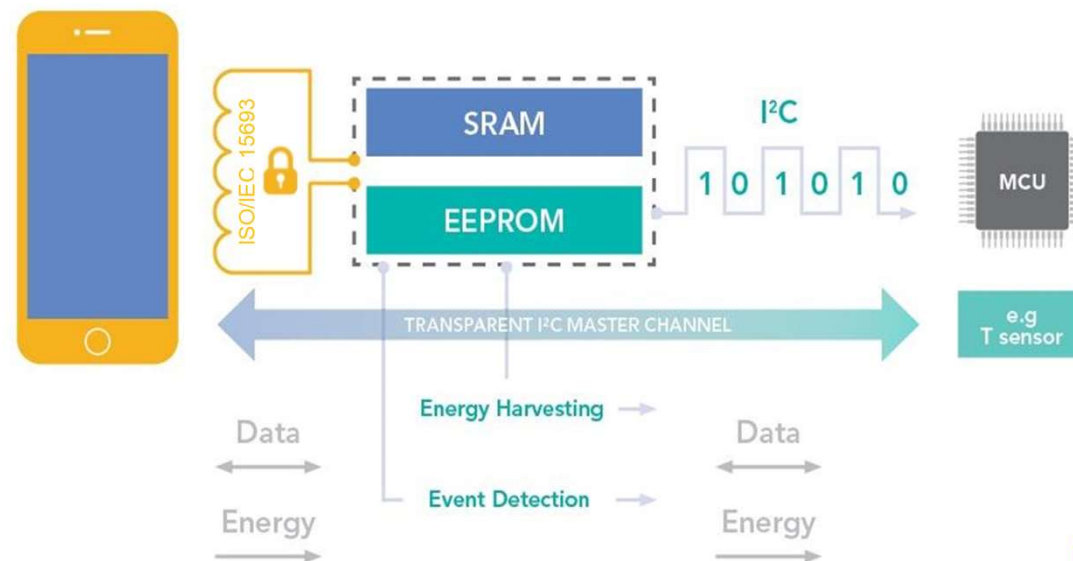
# NTAG 5 link

## NFC Forum compliant I<sup>2</sup>C bridge

- NTAG 5 link can act as a direct bridge between an NFC-enabled device and any I<sup>2</sup>C slave, such as a sensor or external memory.
- This is especially useful in environments that require zero-power, single-shot measurements.
- NTAG 5 link can be configured to work as I<sup>2</sup>C slave or I<sup>2</sup>C master\*. This allows the user to interact with a I<sup>2</sup>C microcontroller.

NTAG 5 link capabilities of I<sup>2</sup>C master mode\* can be found in **AN12368**

I<sup>2</sup>C bus specification and user manual can be found in **UM10204**

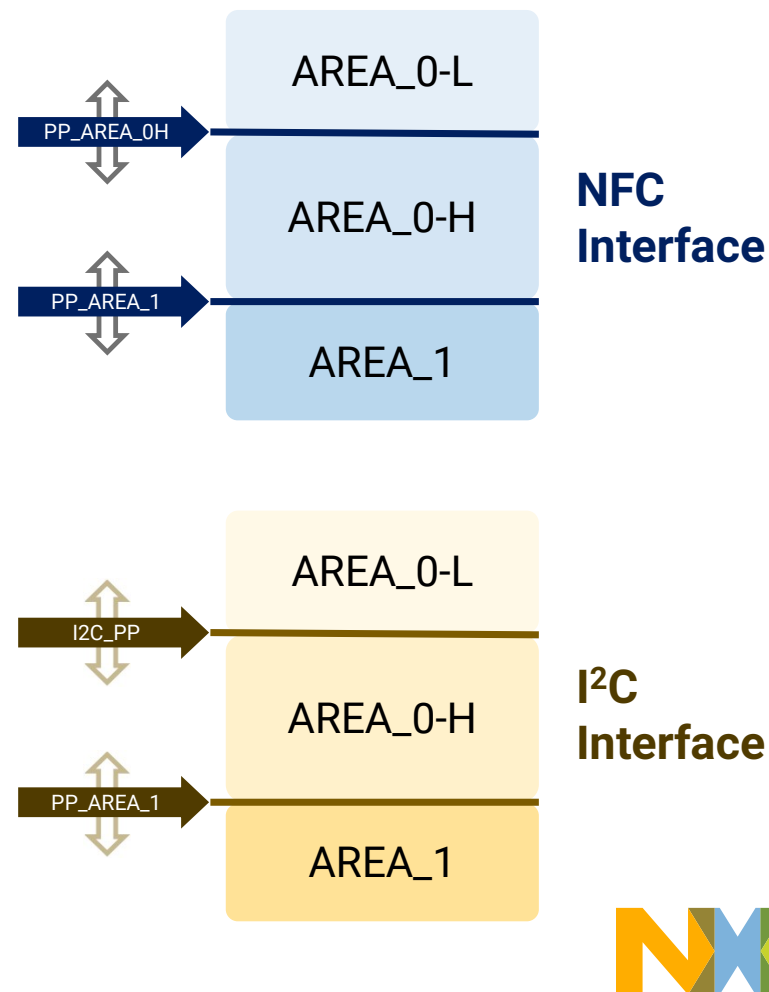


# NTAG 5 link

## Protected user memory areas

Differences with NTAG 5 Switch:

- Pages L and H can be defined independently from I2C and RF perspective.
- AREA\_1 remains the same as for NFC perspective.
- If PP\_AREA\_1 points outside user EEPROM, AREA\_0-H ends at the end of user memory
- Adjustable security level up to AES mutual authentication\*
- SRAM access protection available



# NTAG 5 link SRAM memory

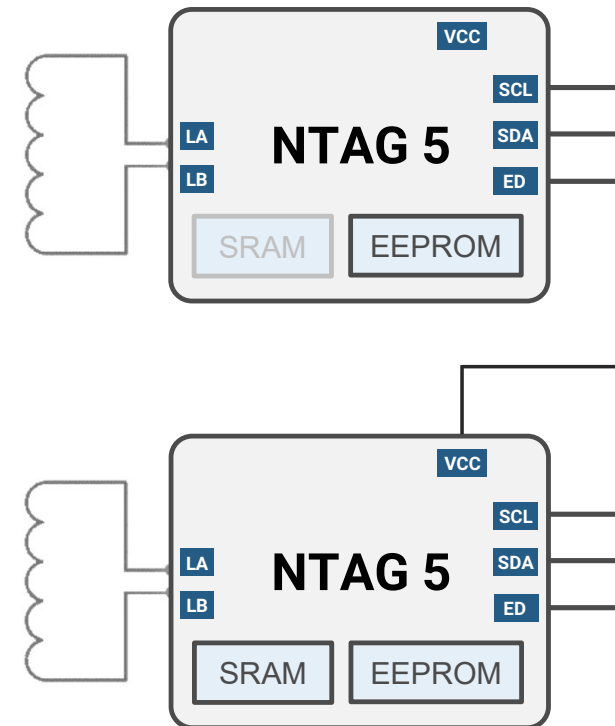
- SRAM of 256 bytes volatile memory with unlimited write endurance.
- SRAM is only available if the chip is powered via the Vcc pin.
- If the chip is not powered through Vcc pin it behaves as a standard Type 5 tag with EEPROM memory.

From NFC interface:

- SRAM is used for:
  - **SRAM mirroring**
  - **Pass-through mode**
  - **I<sup>2</sup>C master\***

From I<sup>2</sup>C Interface:

- SRAM is always accessible



# NTAG 5 link

## SRAM mirroring

- The SRAM can be mirrored into the user memory
  - Behaves like an overlay. Each read/write operation from RF is not executed on the underlying EEPROM, but on the SRAM.
  - EEPROM content is not influenced.
- Use case:
  - Dynamic update of pairing information (write a new key every second)
- Hints:
  - The mirroring is effective for both RF and I<sup>2</sup>C side.
  - From I<sup>2</sup>C perspective it is also still accessible through fixed SRAM addresses (2000h-203Fh)
  - Not compatible with pass-through mode

**EEPROM structure (SRAM Mirroring active)**

Block Address		Byte 0	Byte 1	Byte 2	Byte 3	
NFC	I <sup>2</sup> C					
00h	0000h					
01h	0001h					
02h	0002h	SRAM Mirrored				
03h	0003h					
:	:	:	:	:	:	
3Fh	003Fh					
40h	0040h					
:	:	:	Normal			:
1FEh	01FEh	EEPROM				
1FFh	N/A	Counter				

# NTAG 5 link

## Pass-through mode

- Pass through mode transfers data from RF to I<sup>2</sup>C interface and vice versa using the 256-byte SRAM saving EEPROM cycles. Available for NTAG 5 link and boost models.
- Data flow from one side to the other is synchronized using interruption signal and register settings.

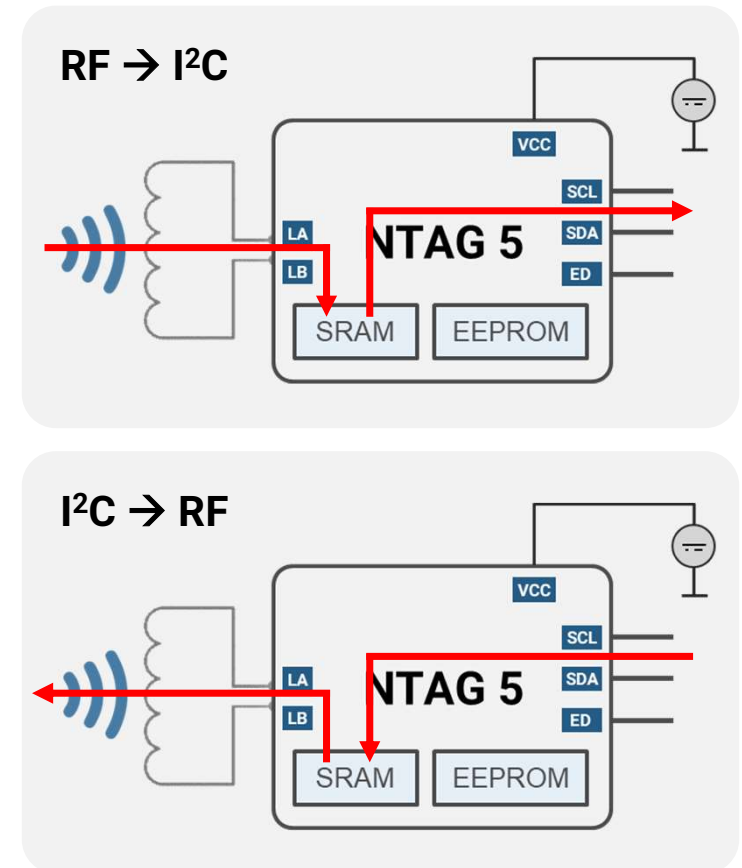
### Use cases:

#### **RF → I<sup>2</sup>C** data exchange:

- Mobile device writes data into the microcontroller
- Update microcontroller FW from NFC interface

#### **I<sup>2</sup>C → RF** data exchange:

- Download of data into mobile device (e.g. large amount of logging data, error descriptions...)

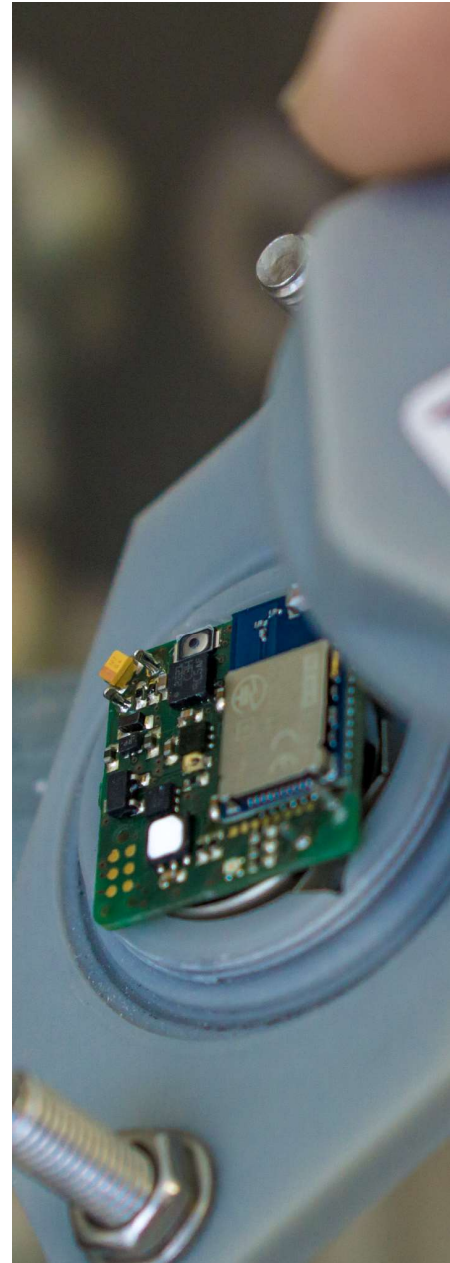
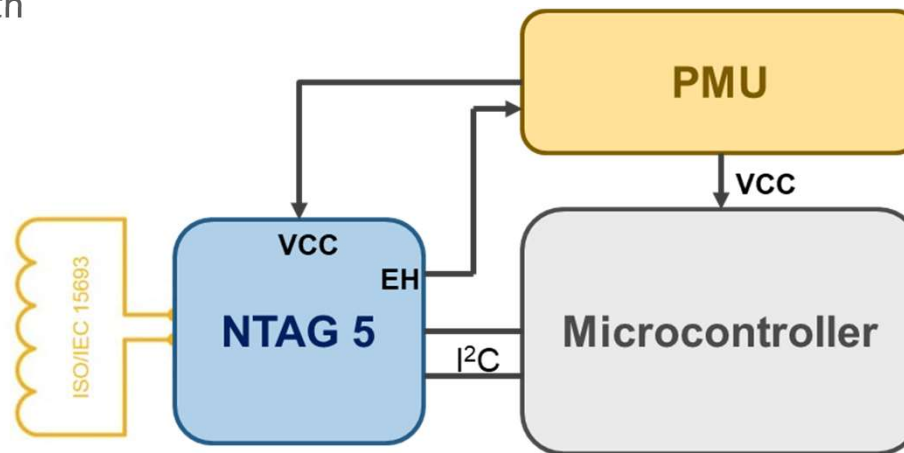




# NTAG 5 link

## Energy Harvesting

- Allows the user to supply external low-power devices with energy harvested from NFC field generated by an NFC device.
- Output voltage can be configured:
  - 1.8 V
  - 2.4 V
  - 3.0 V
- Two modes of operation:
  - Optimized for low field strength (default)
  - Optimized for high field strength
- Up to 30mW output power

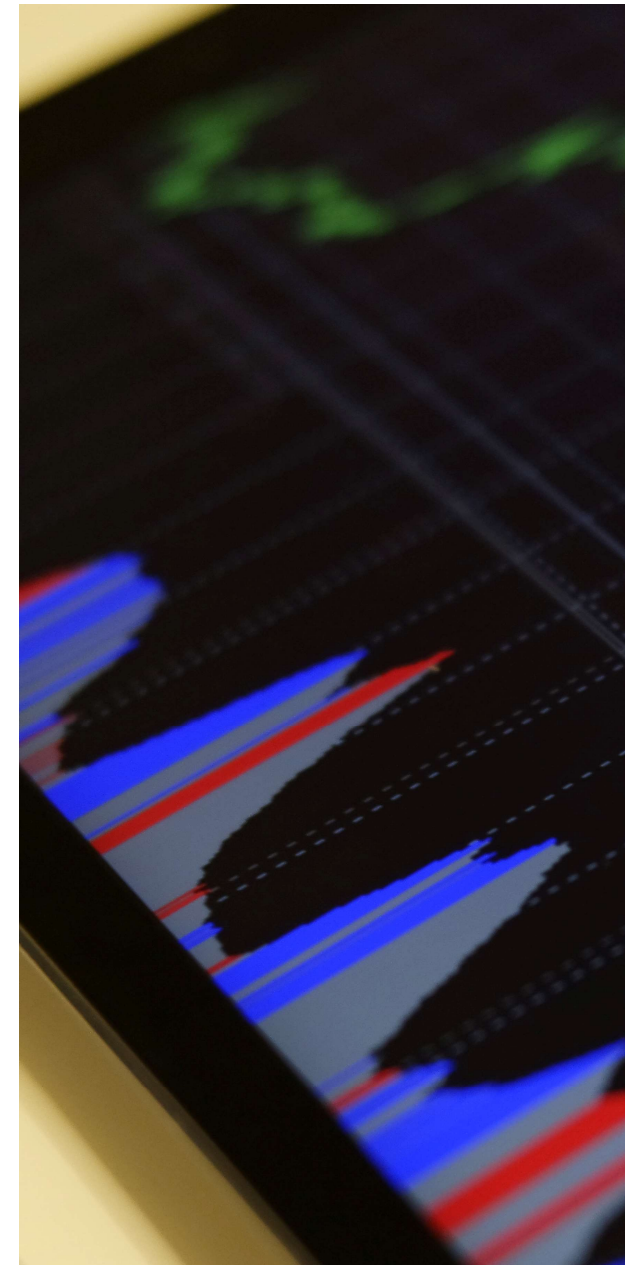
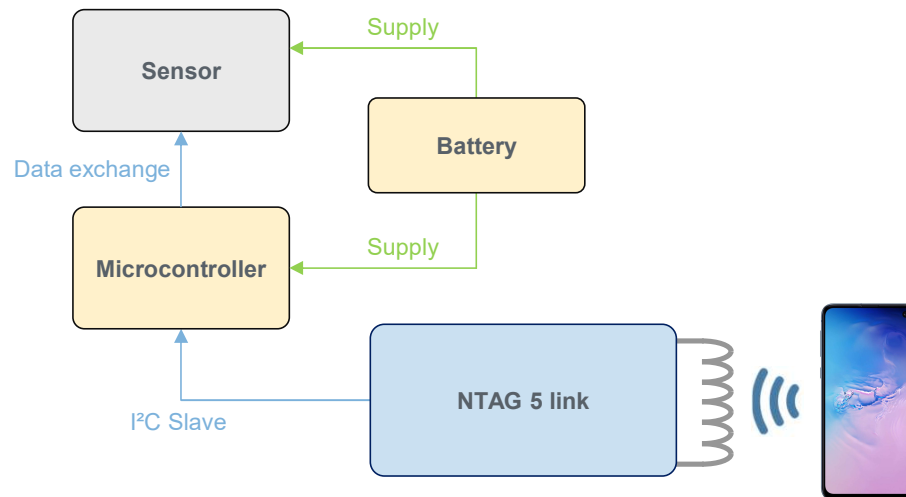


# NTAG 5 link

## Benefits

### Constant monitoring of sensors

- Save front-panel space
- Device can be fully sealed → NFC communication possible through plastic, glass...
- Together with consumer mobile phone cost efficient IoT solution

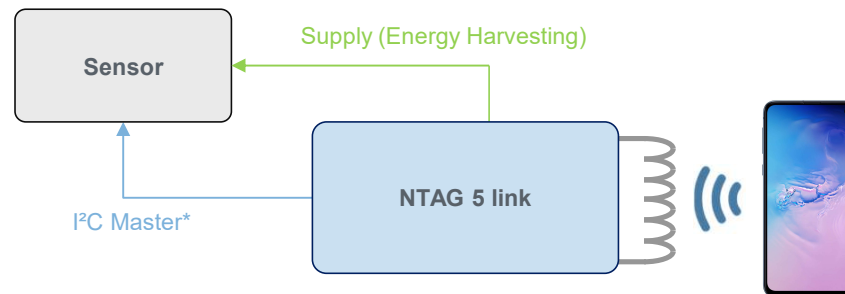


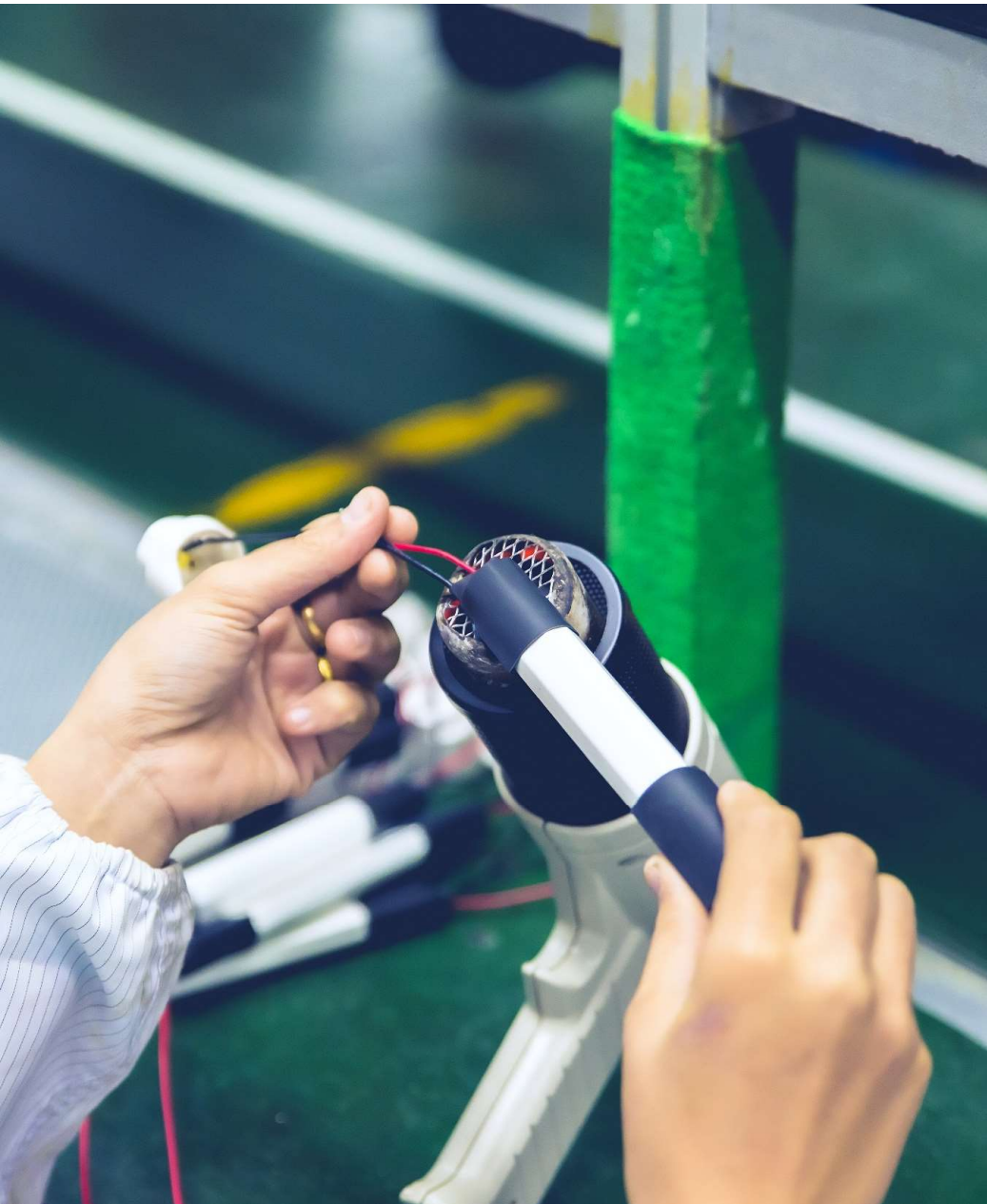
# NTAG 5 link

## Benefits

### Ad-hoc read out of sensors

- Overall BOM reduction:
  - No Battery needed
  - No MCU needed → data process in app or cloud
- Especially for devices where power is an issue
- Device can be fully sealed



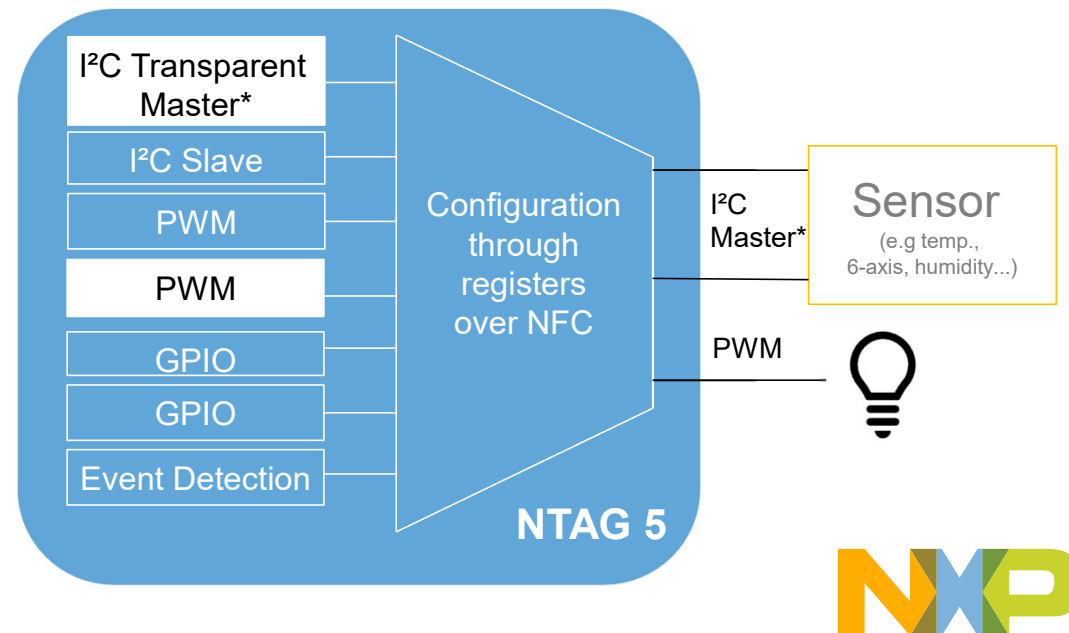


# NTAG 5 link

## Target applications

### Sensor communication

- Read/write to sensor through NFC and I<sup>2</sup>C master\*
- No MCU needed for communication to the sensor
- LED brightness changed through PWM indicating the communication



\* only NTP5332 supports I<sup>2</sup>C master

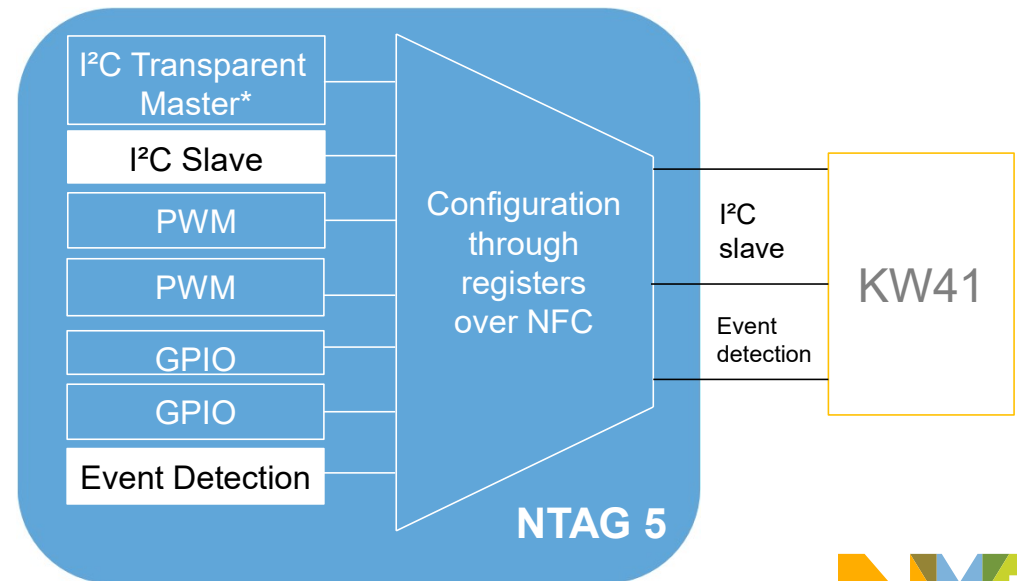




## NTAG 5 link Target applications

### NFC commissioning

- I<sup>2</sup>C slave interface to a BT/Zigbee  $\mu$ C for pairing protocol
- Event detection pin to wake up the circuit in the event of NFC field



# NTAG 5 link

## Use cases – Internet of Things



Read out sensor information  
with and without an MCU



Draw power from the NFC  
reader to supply sensors



Secure sensor  
interaction



Verify authenticity  
of the device

Relevant features:

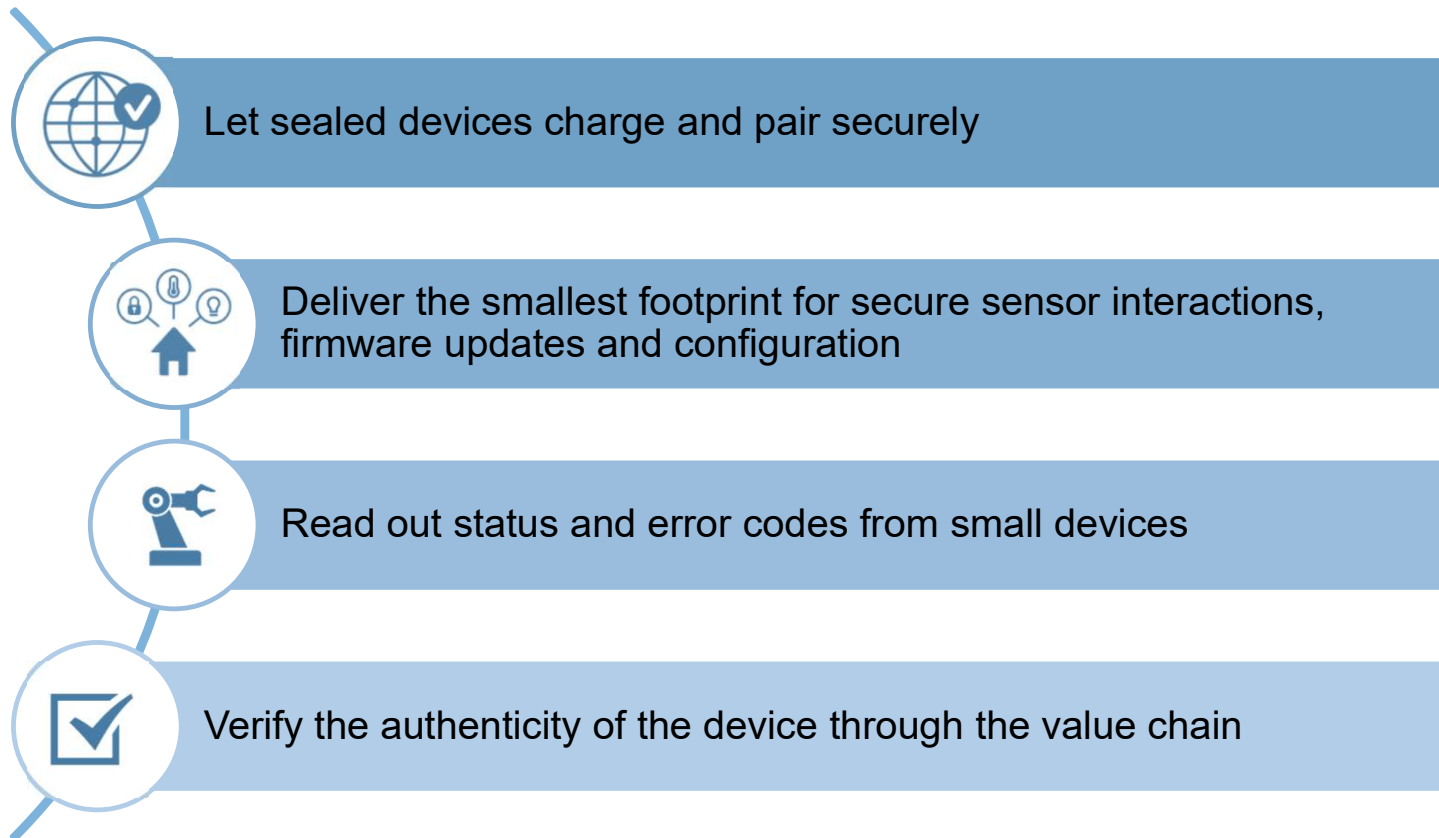
- I<sup>2</sup>C master interface\*
- Energy harvesting
- NFC Forum Tag 5 Type tag
- AES mutual authentication\*
- Originality check of the product by reprogrammable ECC signature

# NTAG 5 boost



# NTAG 5 boost

## NFC Forum Compliant I<sup>2</sup>C Bridge for Tiny Devices





# NTAG 5 boost

## NFC Forum Compliant I<sup>2</sup>C Bridge for Tiny Devices

### Main features

RF Interface & protocols	NFC Forum Type 5 Tag Active Load Modulation for extra range and tiny antenna footprint
Memory	2048 Bytes user memory 256 byte SRAM
Wired Interface	I <sup>2</sup> C slave (up to 400 kHz) or I <sup>2</sup> C transparent master channel or Pulse Width Modulation/GPIO Event detection or PWM output Stand-by current < <b>10 µA @ RT</b> Hard power down current < <b>0.25µA @ RT</b> 1.62 V to 5.5 V supply
Security	<b>AES</b> 128 bit mutual authentication or 32-bit or 64-bit password protection from NFC perspective 32-bit password from I <sup>2</sup> C perspective 3 configurable user memory areas ECC based reprogrammable originality signature NFC and I <sup>2</sup> C disable
Temperature range	-40°C to +85°C

### Wired Interface Details

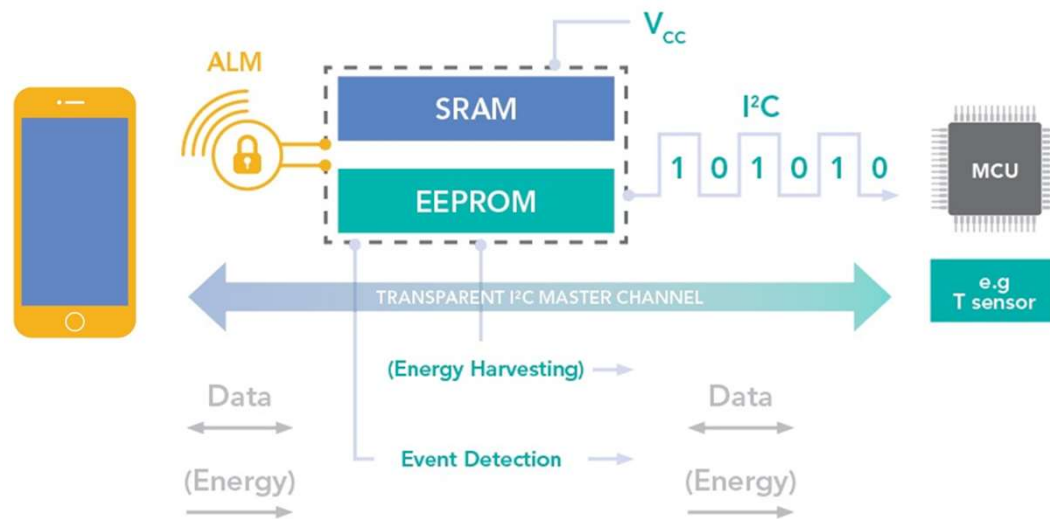
GPIO / PWM	I <sup>2</sup> C lines maybe used as GPIO's or PWM lines
Event Detection	Multiple events can be used as trigger to the host, or use ED pin as PWM channel in parallel to I <sup>2</sup> C
Transparent I <sup>2</sup> C master channel	Attach and power any I <sup>2</sup> C slave-like sensor or external memory without MCU
I <sup>2</sup> C slave	Standardized passthrough synchronization in addition to procedure from NTAG I <sup>2</sup> C <i>Plus</i> passthrough mode

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# NTAG 5 boost

## NFC Forum Compliant I<sup>2</sup>C Bridge for Tiny Devices

- NTAG 5 boost is the most complete chip of the NTAG 5 family.
- It incorporates the same characteristics of NTAG 5 link, while adding Active Load Modulation (ALM) feature to deliver robust and reliable communication with NFC phones, bringing a new level of convenience to tiny devices.



**Consumer**



**Industrial**



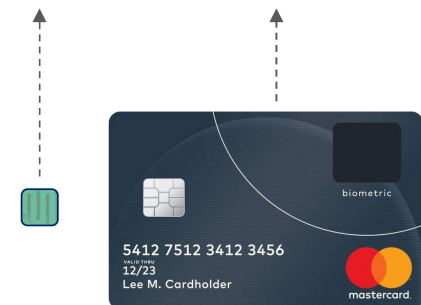
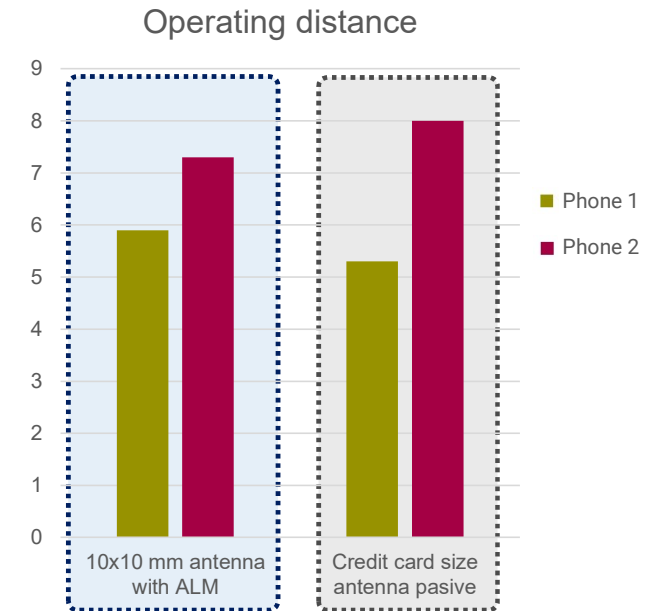
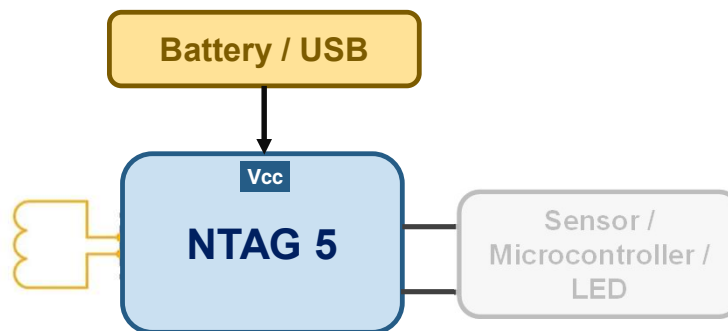
**IoT**



# NTAG 5 boost

## Active Load Modulation

- Allows the user to build a compact antenna with a smaller footprint without compromising the read range.
- NTAG 5 boost in active mode should be powered using a battery or an external power supply (e.g. USB)
- Energy efficient design:
  - Hard power-down < 0.25  $\mu\text{A}$
  - Stand-by current < 10  $\mu\text{A}$



Antenna size ratio comparison

# NTAG 5 boost

## Use cases – Internet of Things



Smallest footprint  
Antenna



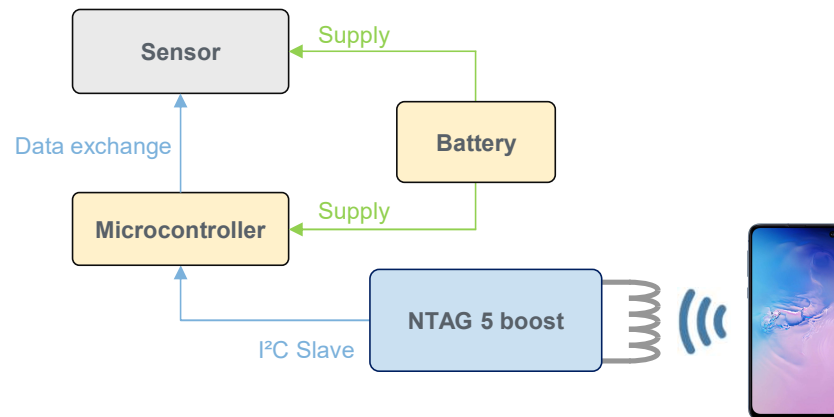
Read out sensor  
information without  
MCU



Verify authenticity  
of the device

### Relevant feature

- Active Load Modulation
- I<sup>2</sup>C master interface
- NFC Forum Tag 5 Type tag
- Adjustable security levels up to mutual AES authentication
- Originality check of the product by reprogrammable ECC signature



# Summary



# Introduction

## NTAG 5 Product family

### NTAG 5 switch

- NFC Forum compliant Type 5 tag
- ISO/IEC 15693 compliant
- 512 bytes user memory
- Configurable wired interfaces:
  - PWM / GPIO
  - NFC Field detection
- Energy harvesting with output up to 30mW
- 3 configurable user memory areas
  - 32/64-bit password protection
- ECC reprogrammable originality Signature
- Low power consumption
  - < 6  $\mu$ A Standby
  - < 0.25  $\mu$ A Hard power down

### NTAG 5 link

- NFC Forum compliant Type 5 tag
- ISO/IEC 15693 compliant
- 2048 bytes user memory
- 256 bytes SRAM
- Configurable wired interfaces:
  - I<sup>2</sup>C master and slave\*
  - PWM / GPIO
  - NFC Field detection
- Energy harvesting with output up to 30mW
- 3 configurable user memory areas
  - 32/64-bit password protection
  - 128-bit AES mutual authentication\*
- ECC reprogrammable originality Signature
- NFC Silence
- Low power consumption
  - < 6  $\mu$ A Standby
  - < 0.25  $\mu$ A Hard power down

### NTAG 5 boost

- NFC Forum compliant Type 5 tag
- ISO/IEC 15693 compliant
- Active Load Modulation feature for performance boost
- 2048 bytes user memory
- 256 bytes SRAM
- Configurable wired interfaces:
  - I<sup>2</sup>C master and slave
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  - NFC Field detection
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  - < 10  $\mu$ A Standby
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# Introduction

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# Introduction

## NTAG 5 Product family

### NTAG 5 switch

- NFC Forum compliant Type 5 tag
- ISO/IEC 15693 compliant
- 512 bytes user memory
- Configurable wired interfaces:
  - PWM / GPIO
  - NFC Field detection
- Energy harvesting with output up to 30mW
- 3 configurable user memory areas
  - 32/64-bit password protection
- ECC reprogrammable originality Signature
- Low power consumption
  - < 6  $\mu$ A Standby
  - < 0.25  $\mu$ A Hard power down

### NTAG 5 link

- NFC Forum compliant Type 5 tag
- ISO/IEC 15693 compliant
- 2048 bytes user memory
- 256 bytes SRAM
- Configurable wired interfaces:
  - I<sup>2</sup>C master and slave\*
  - PWM / GPIO
  - NFC Field detection
- Energy harvesting with output up to 30mW
- 3 configurable user memory areas
  - 32/64-bit password protection
  - 128-bit AES mutual authentication\*
- ECC reprogrammable originality Signature
- NFC Silence
- Low power consumption
  - < 6  $\mu$ A Standby
  - < 0.25  $\mu$ A Hard power down

### NTAG 5 boost

- NFC Forum compliant Type 5 tag
- ISO/IEC 15693 compliant
- Active Load Modulation feature for performance boost
- 2048 bytes user memory
- 256 bytes SRAM
- Configurable wired interfaces:
  - I<sup>2</sup>C master and slave
  - PWM / GPIO
  - NFC Field detection
- Energy harvesting with output up to 30mW
- 3 configurable user memory areas
  - 32/64-bit password protection
  - 128-bit AES mutual authentication
- ECC reprogrammable originality Signature
- NFC Silence
- Low power consumption
  - < 10  $\mu$ A Standby
  - < 0.25  $\mu$ A Hard power down



# Introduction

## NTAG 5 comparison with other NFC tags

Feature	NTAG 21xF	NTAG I <sup>2</sup> C plus	NTAG 5 switch	NTAG 5 link	NTAG 5 boost
NFC interface	ISO/IEC14443	ISO/IEC14443	ISO/IEC15693	ISO/IEC15693	ISO/IEC15693
Max. speed - NFC/I <sup>2</sup> C	106 kbps/-	106 kbps/400 kHz	53 kbps/-	53 kbps/400 kHz	53 kbps/400 kHz
Memory size	144 or 888 bytes	888 or 1912 bytes 64 bytes SRAM	512 bytes	2048 bytes 256 bytes SRAM	2048 bytes 256 bytes SRAM
Memory protection from NFC perspective	Read only locking and 32-bit PWD	Read only locking and 32-bit PWD	Read only locking and 32- or 64-bit PWD	Read only locking and 32- or 64-bit PWD or AES mutual auth.	Read only locking and 32/ 64-bit PWD or AES mutual auth.
Memory protection from connected host	-	Password protected area	-	32-bit PWD	32-bit PWD
Memory areas	2	2	3	3	3
Originality Signature	fixed	fixed	re-programmable	re-programmable	re-programmable
GPO/Event detection	Only NFC field	NFC field and interface arbitration	Yes	Yes	Yes
Energy harvesting	-	Yes up to 15 mW	Regulated up to 30 mW	Regulated up to 30 mW	When used as passive regulated up to 30 mW
GPIO + PWM	-	-	yes	yes	yes
I <sup>2</sup> C interface	-	slave	-	slave / master	slave / master
Pass-through	-	proprietary	-	proprietary and standardized	proprietary and standardized
Standby / Hard-power-down	-	-	6µA/0.25µA	6µA/0.25µA	10µA/0.25µA
Active load modulation	-	-	-	-	Yes, when V <sub>CC</sub> supplied

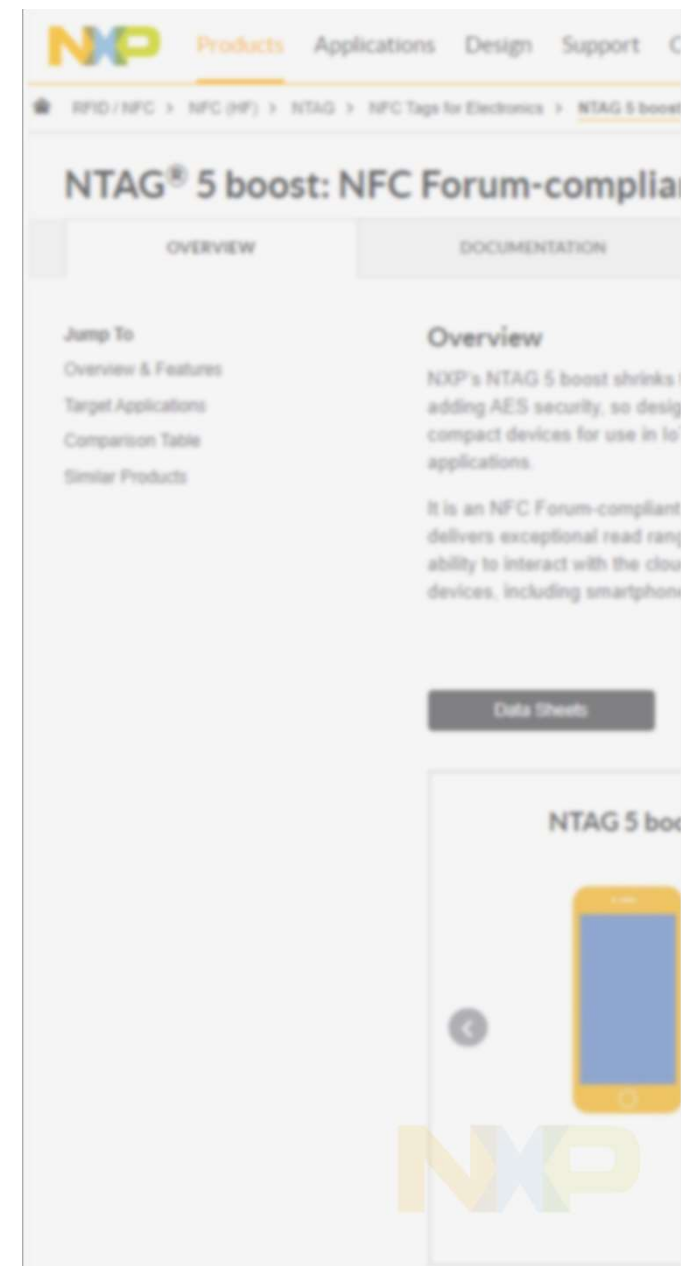
**More support**

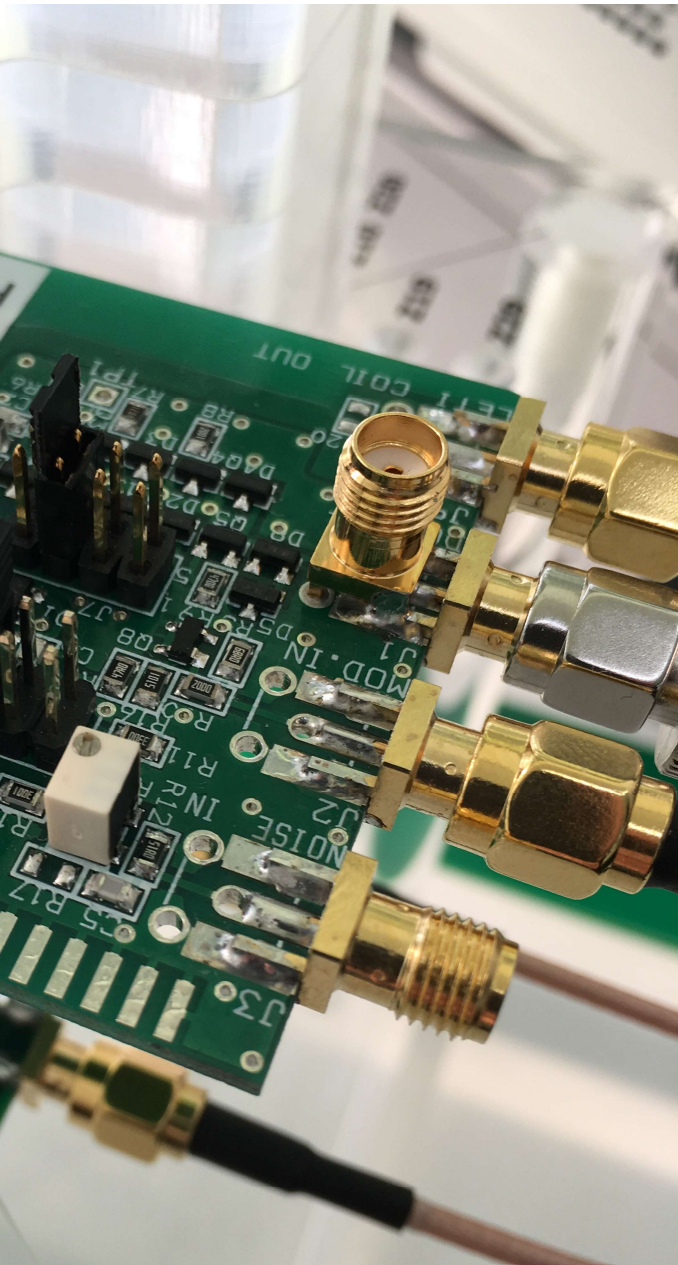


# More support

## Relevant resources regarding NTAG 5 family

- NTAG 5 switch website  
<https://www.nxp.com/products/rfid-nfc/nfc-hf/ntag/nfc-tags-for-electronics/ntag-5-switch-nfc-forum-compliant-pwm-gpio-bridge-for-lighting-and-gaming:NTAG5-SWITCH>
- NTAG 5 link website  
<https://www.nxp.com/products/rfid-nfc/nfc-hf/ntag/nfc-tags-for-electronics/ntag-5-link-nfc-forum-compliant-ic-bridge-for-iot-on-demand:NTAG5-LINK>
- NTAG 5 boost website  
<https://www.nxp.com/products/rfid-nfc/nfc-hf/ntag/nfc-tags-for-electronics/ntag-5-boost-nfc-forum-compliant-ic-bridge-for-tiny-devices:NTAG5-BOOST>
- NTAG 5 development kit  
<http://www.nxp.com/products/rfid-nfc/nfc-hf/ntag/ntag-5-development-kit:OM23510ARD>
- NXP Tech community  
<https://www.nxp.com/support/support:SUPPORTHOME>





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# NTAG 5 Product family presentation

## Product introduction

Pablo Fuentes (Speaker)

Angela Gemio (Host)

Time for  
**Q & A**







# NTAG 5 Product family presentation

## Product introduction

**Thank you for your kind attention!**

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[www.themobileknowledge.com/content/knowledge-catalog-0](http://www.themobileknowledge.com/content/knowledge-catalog-0)





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We help companies leverage  
the secure IoT revolution

