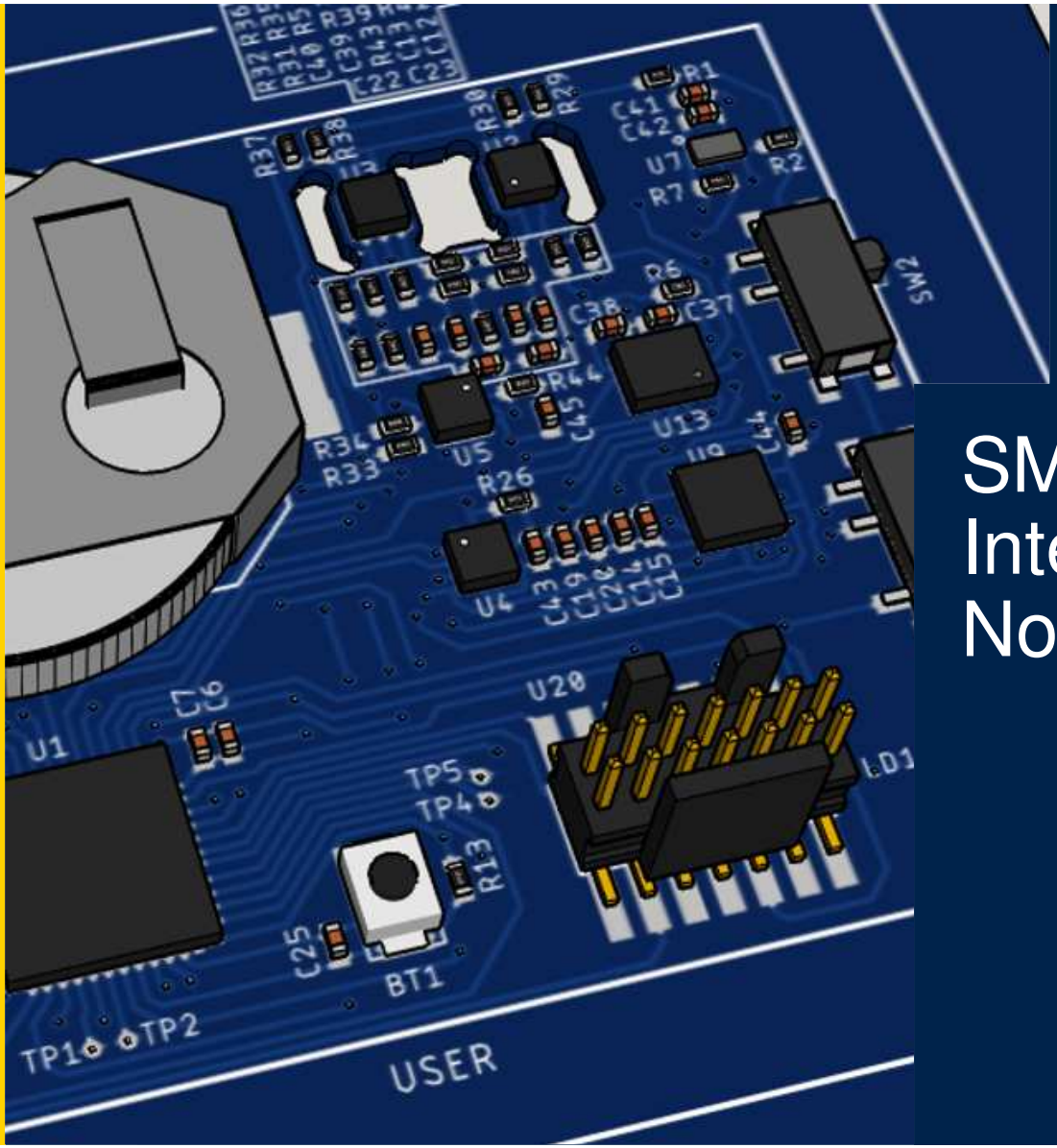

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SMARTAG2
Intelligent NFC Sensor Node for Asset Tracking

What is Asset Tracking?

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Asset tracking
Applications and segmentation

IoT Tag & Tracker		Luxury goods	Personal devices	Pet tracking	People tracking	
Outdoor real-time monitoring		Containers	Fleet management	Livestock monitoring	Tractor	Mobility sharing
Indoor localization & Warehouse logistics		RTLS*	Mobile assets	Pallet	Smart parcels	Employee Safety
Good guarantee		Cold chain	Food tracing	Medical		
Disposable		Letters	Packages	Parcels		

*RTLS = Real Time Localization System

Asset tracking – Needs per applications

ST offering for asset tracking

Processing | Sensing & Actuating | Security | Connectivity | Power & Energy Management | Signal Conditioning & Protection

Components and evaluation platforms for all asset tracking use-cases

NFC & RFID

NFC Sensor Tag
FP-SNS-SMARTAG2

Bluetooth

SensorTile.box
FP-ATR-BLE1

Sub 1GHz | NFC

STEVAL-ASTRA1B
FP-ATR-ASTRA1B

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DSH-ASSETRACKING

- **DSH-ASSETRACKING**
  - Intuitive web interface
  - Collection, visualization and analysis of asset tracking position
  - Data from motion and environmental from
  - Compatible ST devices:
    - NFC Sensor Tag
    - Sensor Tile
    - Astra

End to end
ST sensors development kits to cloud application

STEVAL-SMARTAG2 with
FP-SNS-SMARTAG2 firmware

STEVAL-MKSBOX1V1
with FP-ATR-BLE1 firmware

STEVAL-ASTRA1 with
FP-ATR-ASTRA1 firmware

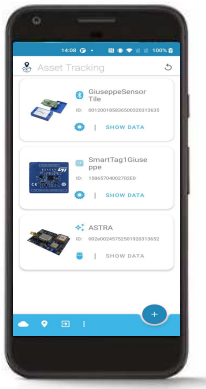
NFC

Bluetooth

NFC

LoRa

ST Asset Tracking app



LoRa Network Server

Laptop with DSH-ASSETRACKING dashboard on browser

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NFC as a compelling technology for Asset Tracking and Data Logging

- Data does not need to be constantly uploaded to the cloud.
- Much lower power consumption vs. other active wireless technology such as BLE.
- Easy deployment as NFC is available in almost all smartphones in use today.

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What is NFC?

RFID technologies at a glance

RFID	LF	HF	UHF
Coupling mode	Inductive	Inductive	Electro-magnetic backscatter
Operating frequency	125kHz – 134kHz	13.56MHz	860MHz – 960MHz
Antenna	Coil	Coil	Dipole
Max operating distance	up to 1m	Vicinity: up to 1m Proximity: up to 10cm	~10m
Regulation	Worldwide harmonized	Worldwide harmonized	Different regulations per country
Standards	ISO14223 ISO18000-2	ISO14443 A/B ISO15693 ISO18092 ISO18000-3 **NFC Forum**	ISO18000-6 B/C EPC Class 1 Gen 2 **RAIN RFID**
Environmental influences	Small influence on operating distance Works in metal and industrial environment	Small influence on operating distance Works in metal and industrial environment	Influence on operating distance by reflection and absorption (metal and liquids)
Applications	Animal tagging	Product identification Public transport / Libraries Access control / Payment	Pallets and container ID Retail / Logistics Authentication
ST solutions		**X**	

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NFC technology at a glance

An interactive technology enabling engagement with IoT devices

- Near Field Communication, a **short range** wireless technology
  - Operating at **13.56MHz**
  - Based on the RFID HF standard (ISO14443 & ISO15693)
- **Interactive** and **zero power**, enabling convenient connection to the Internet of Things

➔ **NFC-enabled mobile phone can engage with items by a simple tap**

- NFC is developed by the NFC Forum
  - **Interoperability** between devices
  - **Standardized** use cases (web link, Bluetooth handover,…)
- Fast growing deployment in Mobile phone
  - In 2022, more than 75% phones to come with NFC
  - NFC is used for Mobile payment (EMVco) like ApplePay
  - Apple added in 2017 support of NFC reader mode from iOS11 onward and support of NFC writer mode from iOS13 in September 2019

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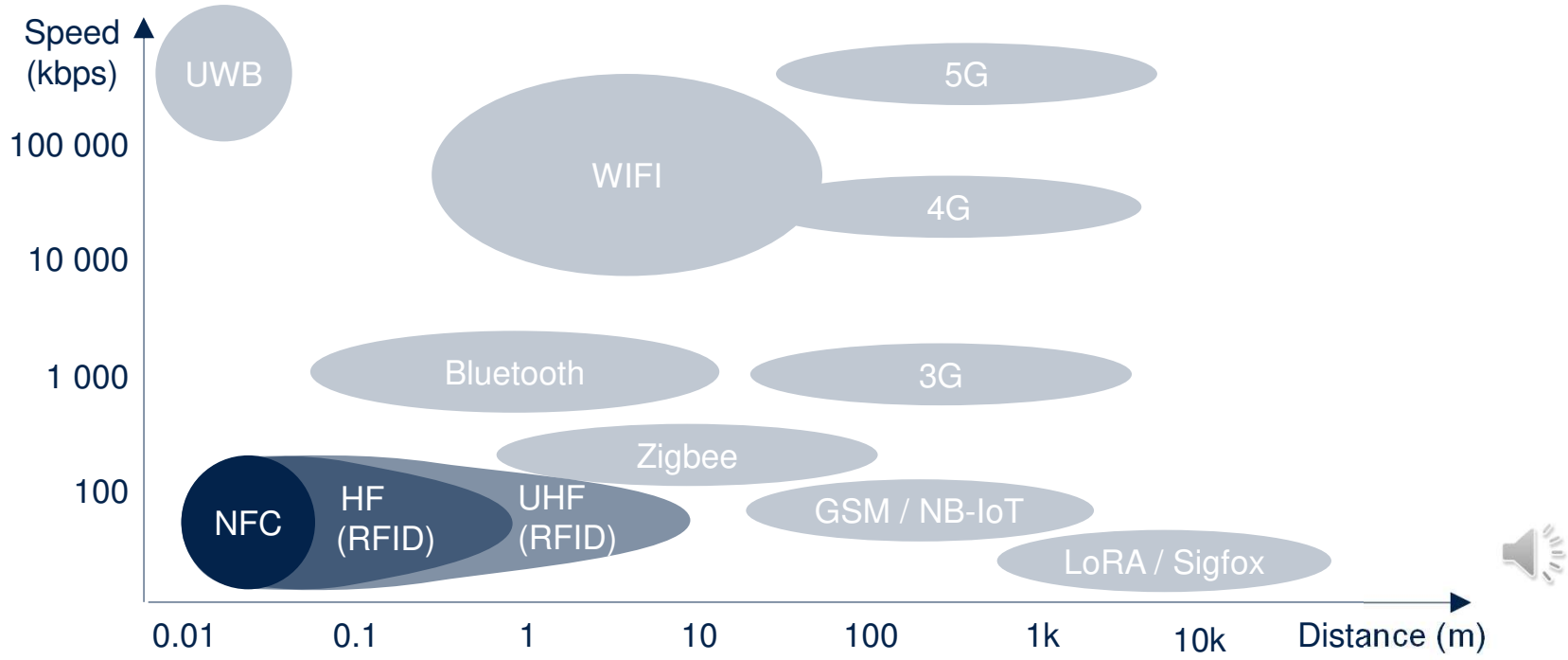
NFC in the wireless spectrum

**NFC is unique in the wireless spectrum: Short distance,
Low data-rate & Zero power consumption for the application**



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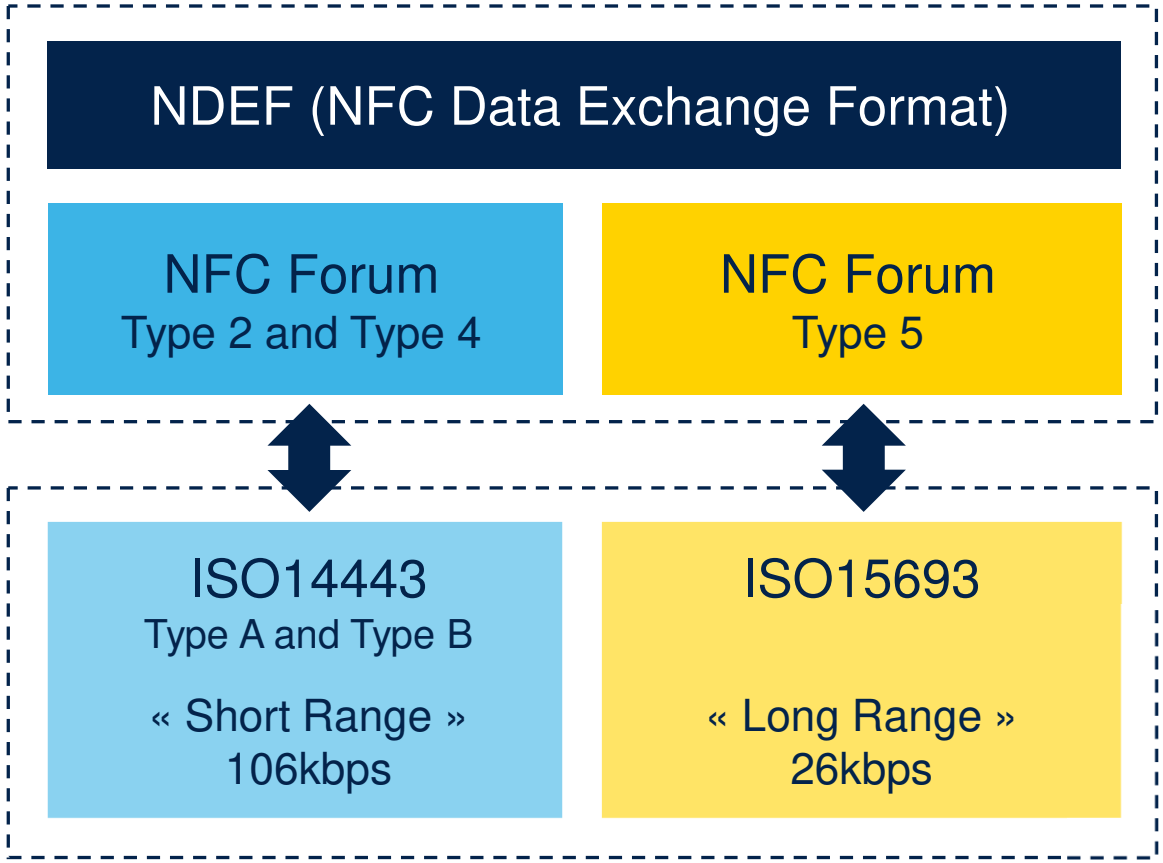
NFC Forum standards

NFC specification
→ **Upper layer SW**

RFID HF ISO standards
→ **HW / SW protocol**



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Typical NFC / RFID range

NFC Phones

ISO14443 (106kb/s) — Up to 5cm (2in.)

ISO15693 (26kb/s) — Up to 7cm (3in.)

RFID Readers

ISO14443 (106kb/s) — Up to 10cm (4in.)

ISO15693 (26kb/s) — Up to 1m (3ft)

- ISO14443 (NFC Forum Type 2 & Type 4) is called « **short range** » standard while with higher RF speed
- **ISO15693 (NFC Forum Type 5) is called « long range » standard**

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ST25 products family

Consumer engagement, Asset tracking, Ticketing, Brand protection, Access control, Gaming… www.st.com/st25t

Tags

NFC phone / RFID Reader

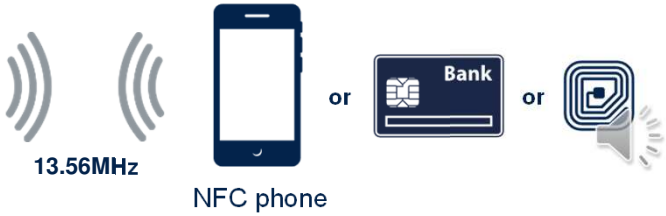
Industrial, Lighting, Metering, Motor control, Consumer, Appliance, Healthcare… www.st.com/st25d

Dynamic tags

NFC phone / RFID Reader

POS & mPOS terminals, Automotive, Access control, Gaming, Reader+Tag… www.st.com/st25r

Readers



NFC phone

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ST25 NFC / RFID portfolio one-stop-shop for tags and readers

Tags				Dynamic Tags			NFC / HF Readers					
ST25TA	**ST25TB**	**ST25TN**	**ST25TV**	**M24SR**	**ST25DV-I2C EVO ***	**ST25DV-PWM**	**ST25R95 [2]**	**ST25R3911B ST25R3912**	**ST25R3914 ST25R3915**	**ST25R3916B ST25R3917B ST25R3918**	**ST25R3920**	
ISO14443-A 106kbps NFC Type 4	ISO14443-B 106Kbps	ISO14443-A 106kbps NFC Type 2	ISO15693 up to 53Kbps NFC Type 5	ISO14443-A 106kbps NFC Type 4	ISO15693 up to 53kbps NFC Type 5	ISO15693 up to 53kbps NFC Type 5	ISO14443-A/B ISO15693	ISO14443-A/B Felica ISO15693 ISO18092	ISO14443-A/B Felica ISO15693 ISO18092	ISO14443-A/B Felica ISO15693 ISO18092	ISO14443-A/B Felica ISO15693 ISO18092	
EEPROM 512b-64Kb 200-year retention 1M cycles	EEPROM 512b-04Kb 40-year retention 1M cycles	EEPROM 512b-1.6Kb 40-year retention 100k cycles	EEPROM 512b-64Kb 60-year retention 100k cycles	EEPROM 2Kb-64Kb 200-year retention 1M cycles	256B Buffer EEPROM 4Kb-64Kb 40-year retention 1M cycles	EEPROM 2Kb 40-year retention 100k cycles	Reader/Writer Card Emulation	Reader/Writer P2P EMVco & PBOC	Reader/Writer P2P AEC-Q100	Reader/Writer P2P Card Emulation EMVco & PBOC	Reader/Writer P2P Card Emulation AEC-Q100	
TruST25 digital signature 128b password 20b counter UID RF Field Detect	32b counter Lock OTP bits UID	Augmented NDEF TruST25 digital signature 24b UTC UID	Augmented NDEF TruST25 digital signature 64b password 24b UTC UID Tamper Detect	128b password RF disable RF Detect UID	Fast X-fer Mode 64b password E-Harvesting RF Detect UID	TruST25 digital signature 64b password UID		VHBR Auto Antenna Tuning Dynamic Power Out Multi-antenna	Auto Antenna Tuning Dynamic Power Out Multi-antenna	Active wave shaping v2 Auto Antenna Tuning Dynamic Power Out Multi-antenna	Active wave shaping Auto Antenna Tuning Dynamic Power Out Multi-antenna	
				I2C 1MHz 2.4V-5.5V	I2C 1MHz Write 16B page 1.8V-5.5V	2x PWM 488-31.25 kHz 1.8V-5.5V	SPI 2Mbps UART 2.7V-5.5V 0.23W	SPI 6Mbps 2.4V-5.5V 1.4W – 1W	SPI 6Mbps 2.4V-5.5V 1W	SPI 10Mbps I2C 3.4Mbps 2.4V-5.5V 1.6W – 0.5W		
SBN12 / SBN075 / FPN5	SBN12	SBN12 / SBN075 / FPN5	SBN12 / SBN075 / FPN5	SO8 / TSSOP8 / FPN8 / SBN12	SO8 / TSSOP8 / FPN8 / FPN12 / WLCSP10	SO8 / TSSOP8	32-pin QFN	WF 32-pin QFN / 32-pin QFN / WLCSP-30 / Wafer	WF 32-pin QFN / 32-pin QFN	WF 32-pin QFN / WLCSP-36	WF 32-pin QFN	

*: successor of M24LR and ST25DV-I2C

[2]: same as former CR95HF / ST95HF

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NFC Sensor Node

SMARTAG1 vs. SMARTAG2

	
MCU: STM32L0	MCU:STM32L4+ or (STM32L071)
30mm x 30mm Antenna	45mm x 75mm Antenna
ST25DV	ST25DVKC
Security None	Security ST-SAFE Optional
None	Wireless Charging Optional
None	IMU
None	MultiSpectral Sensor
None	Tilt Detection
Humidity Sensor	None

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ST25DVKC

ST25DVKC chip belongs to ST25 NFC / RFID Tags & Readers family

- **ST25DVKC main features**
  - NFC Forum Tag Type 5 certified / ISO15693 RF interface
  - Two-wire, slave I²C up to 1MHz interface (I²C fast mode) - 1.8V to 5.5V
  - Improved I2C write time in EEPROM
  - Up to 64kbit EEPROM memory
  - Multiple 64-bit passwords for data protection
  - 40 years data retention & 1Mcycles erase/write
  - 9 Interrupts modes, configurable on dedicated GPO pin (MCU wake-up, …)
  - Energy harvesting through RF
  - Fast Transfer Mode, thanks to 256 Bytes buffer
  - Extended temperature range, industrial grade 8
  - 8 pin or 12 pin package versions
- ST25DVKC is the natural evolution of ST25DV or M24LR series

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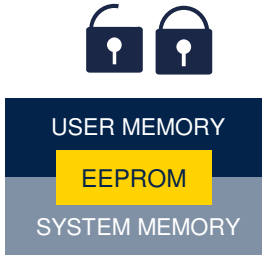
ST25DVKC
Data protection

- User and System memory data protection thanks to a password
  - Password size 64-bit → 1.8 10^{19} combinations

Access from RF

- 3x passwords
- Each memory area can be individually protected by 1 out of 3 available passwords.
- Each area can have a Read / Write access conditions set (area 1 always readable).



Access from I2C

- 1x password
- Each memory area can be individually protected by 1 available password.
- Each area can have a Read / Write access conditions set (area 1 always readable).

+ 1x configuration password to access configuration bytes in system memory (specific from RF, but same password as memory access password from I2C)

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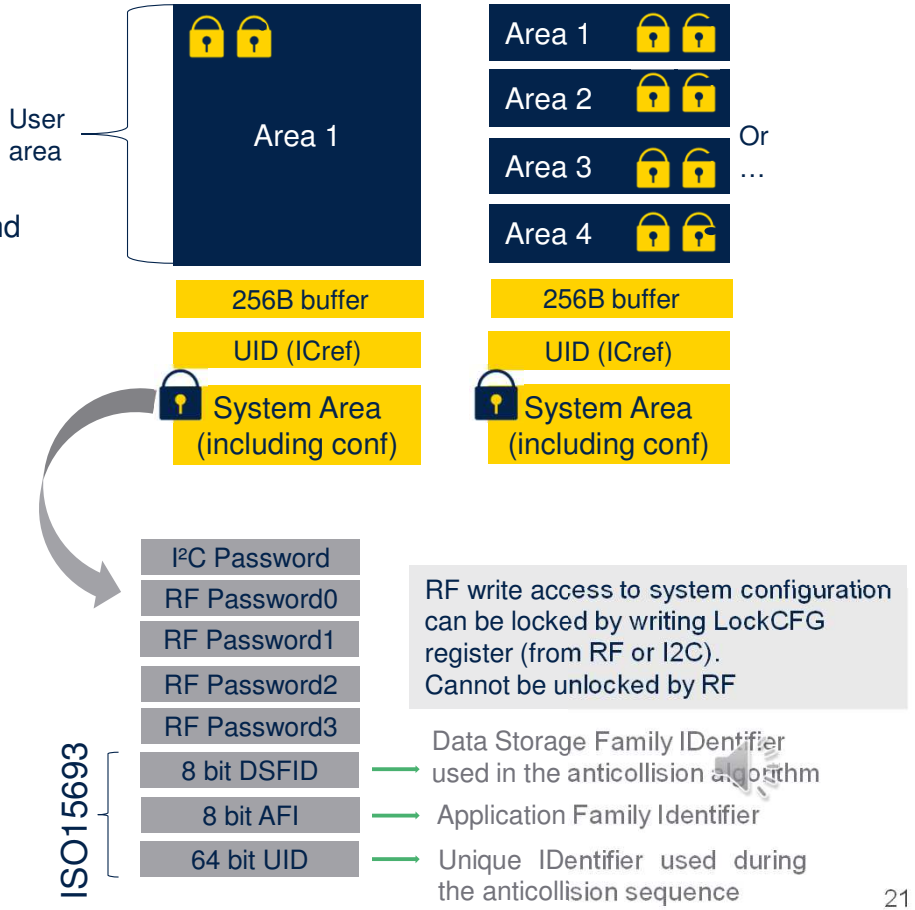
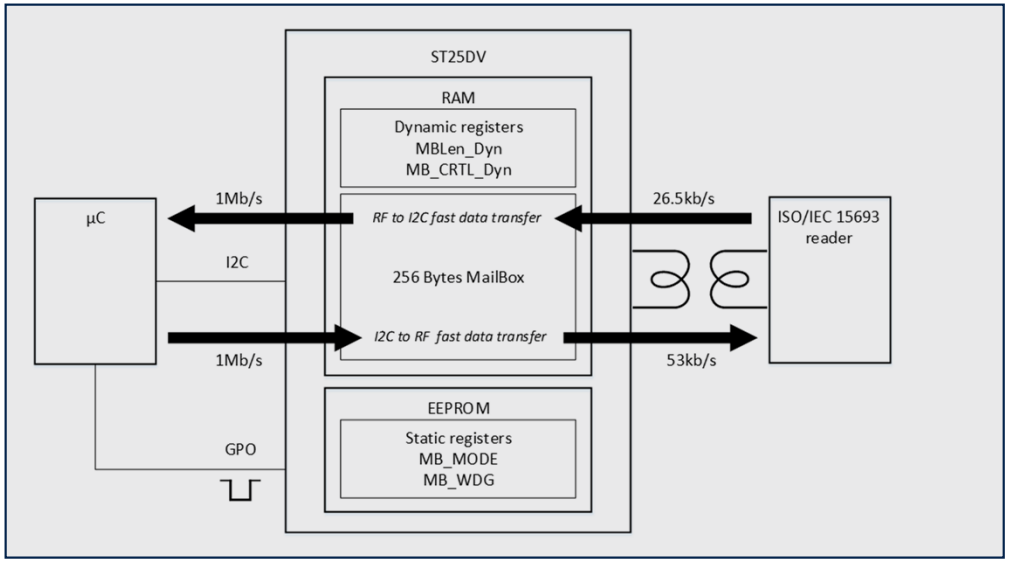
ST25DVKC
Memory mapping & password management

- High EEPROM density
  - 4k-bit / 16k-bit / 64k-bit
- User EEPROM area configurable in flexible areas (up to 4, granularity 32 bytes)
  - Each area is individually read-/write- protected by password command ➔ **64-bit password**
- System EEPROM area
  - Access protected by **64-bit password** (Write)
- Specific block used to store a **64-bit UID**
  - Unique Identifier accessible from I²C (read only)
  - Its value is written by ST on the production line
  - used during the anticollision sequence (Inventory)
- 256 Bytes buffer
  - Dedicated Fast Transfer mode
  - Need Vcc ON to be accessible
  - When enabled, write access to user memory (EEPROM) is disabled
- 5 additional **64-bit** blocks that stores:
  - 1 I²C password (only accessible from I²C)
  - 1 RF configuration password (access from RF),
  - 3 RF area access password codes (access from RF)



ST25DVKC
Fast transfer mode

- Fast Transfer Mode Overview
  - Fast data transfer between µC and RF reader, ensured through 256 bytes buffer
  - RF link up to 53Kb/s (26.5kb/s in write) / I2C link up to 1Mb/s
  - Interruption on GPO pin to wake µC on message read and/or message write.
  - Status register to inform RF reader or µC of current message status.
  - Programmable watchdog to automatically release the system.



Prerequisites

Vcc ON supply must be active to use the 256 Bytes buffer system

Put message is only possible when buffer is empty and enabled

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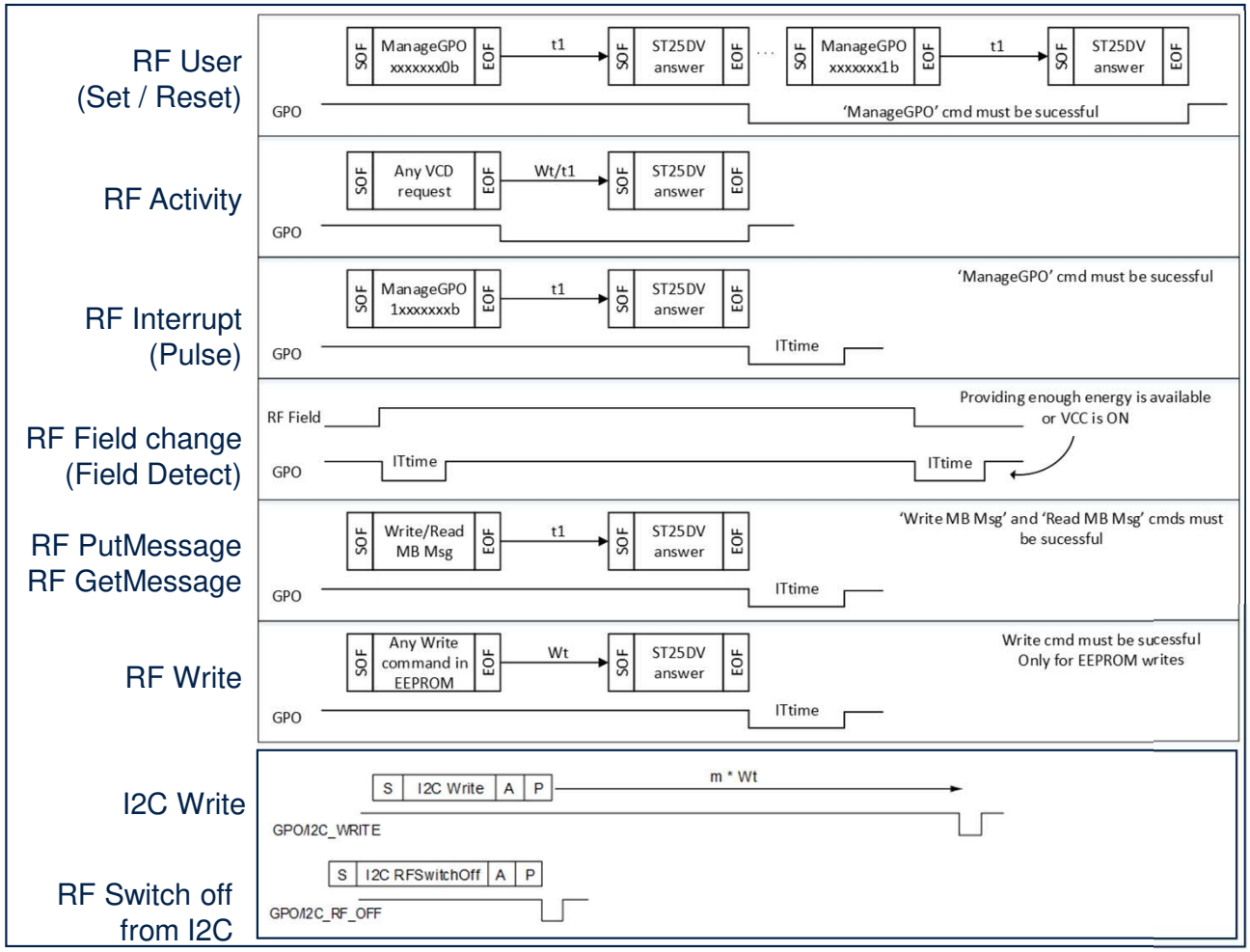
ST25DVKC
GPO interruptions

- GPO interruptions chronograms



Open drain version.
CMOS version signal is inverted.

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ST25DVKC
I2C interface

- I²C (Inter-Integrated Circuit) is typically used for connecting ST25DVKC to a micro-controller. It features:
  - Slave I²C serial interface supports 1MHz protocol (I²C fast mode)
  - Single supply voltage: 1.8V to 5.5V
  - Configurable I2C address
  - Random and sequential read modes
  - Automatic address increment
  - Byte and multiple-byte write modes (up to 256 bytes, 16-byte pages internally)
  - No roll over, no cross-zone border

- I²C uses only two lines
  - Serial Clock (SCL)
    - Input signal used to strobe all data in and out of the device
  - Serial Data (SDA), Open drain
    - Bidirectional signal is used to transfer data in or out of the device
    - Pull-up resistor must be connected from SDA to Vcc

Write time comparison on ST25DV products (ms)

Nb Bytes to write	ST25DV	ST25DVKC
64	81	21
256	325	86
512	651	172
1024	1303	343

Write time divided by 4

Thanks to 16-Byte page I2C access, write time is equivalent on 16Kb standard EEPROMs

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ST25DVKC
Energy harvesting for battery less design

- The ST25DVKC offers Energy Harvesting mode to power external components
  - Part of the non necessary RF power received by the ST25DVKC on the AC0-AC1 RF input is delivered through the V_EH pin in order to supply external devices.

- The ***analog output pin*** will be able to deliver the analog voltage ***V_EH*** whenever the RF field strength is sufficient
  - Delivery of Harvest Energy (**up to a few tens µW**) on V_EH pin depends on the value of the EH_enable bit located in the dynamic register EH_Dyn
  - Harvest Energy is available at host as soon as surplus energy is available (just limited by RF communication needs)
  - Available Energy depends on antenna, Reader's modulation rate, load and whether RF communication is simultaneously required

Energy harvesting from NFC RF field

NFC connectivity

Up to a few mA with NFC reader

ST one-stop-shop with low power MCU and sensors

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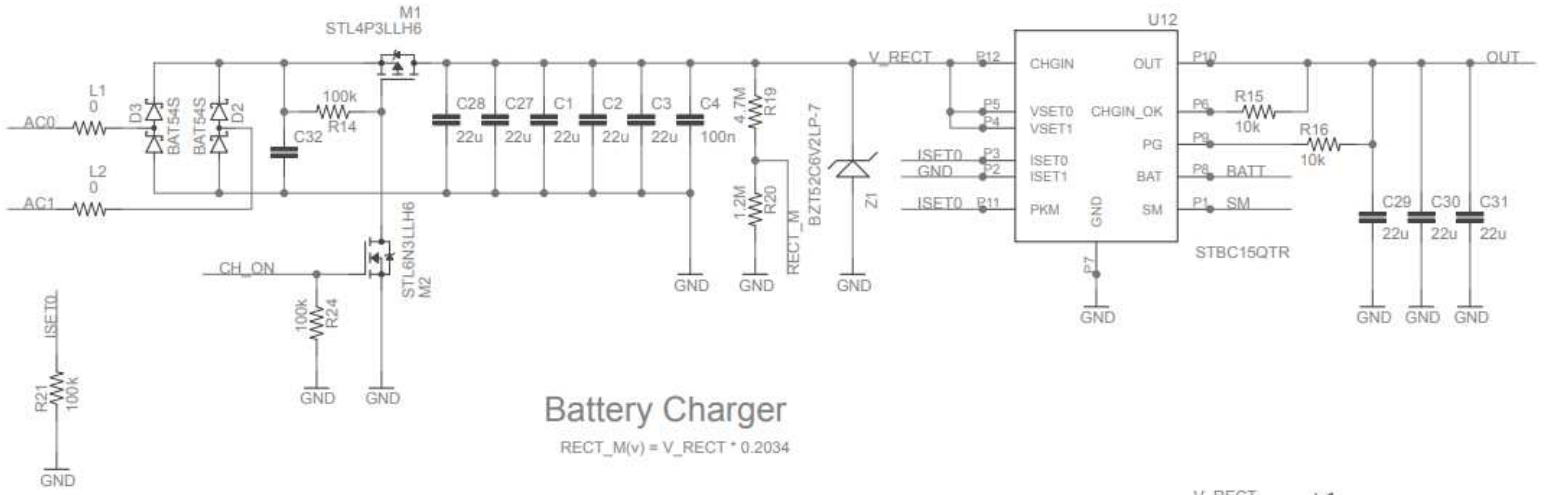
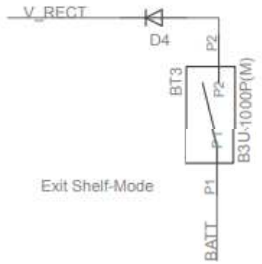
NFC Wireless Charging Circuit





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STBC15 Ultra Low Power Battery Charger

QFN12 1.7 x 2.0

Flip-chip12

Features

- Charges thin film battery with CC-CV algorithm
- L version suitable for Li-Ion batteries
- Charging current up to 40 mA (selectable by dedicated pins)
- 250 nA battery leakage current
- Reverse current protection from battery to supply input
- Programmable floating voltage with 0.5% accuracy
- Battery overcurrent protection
- Battery over-discharge protection switch totally disconnects battery for cell durability
- Shelf-mode supported, no battery mechanical switch needed
- Power-Good open-drain output
- Valid source open drain output
- Peak mode input to avoid over-discharge false triggering
- Available packages:
  - QFN12 1.7 x 2.0 mm, thickness 0.55 mm max.
  - Flip-chip12 1.1 x 1.4 mm, 300 µm pitch

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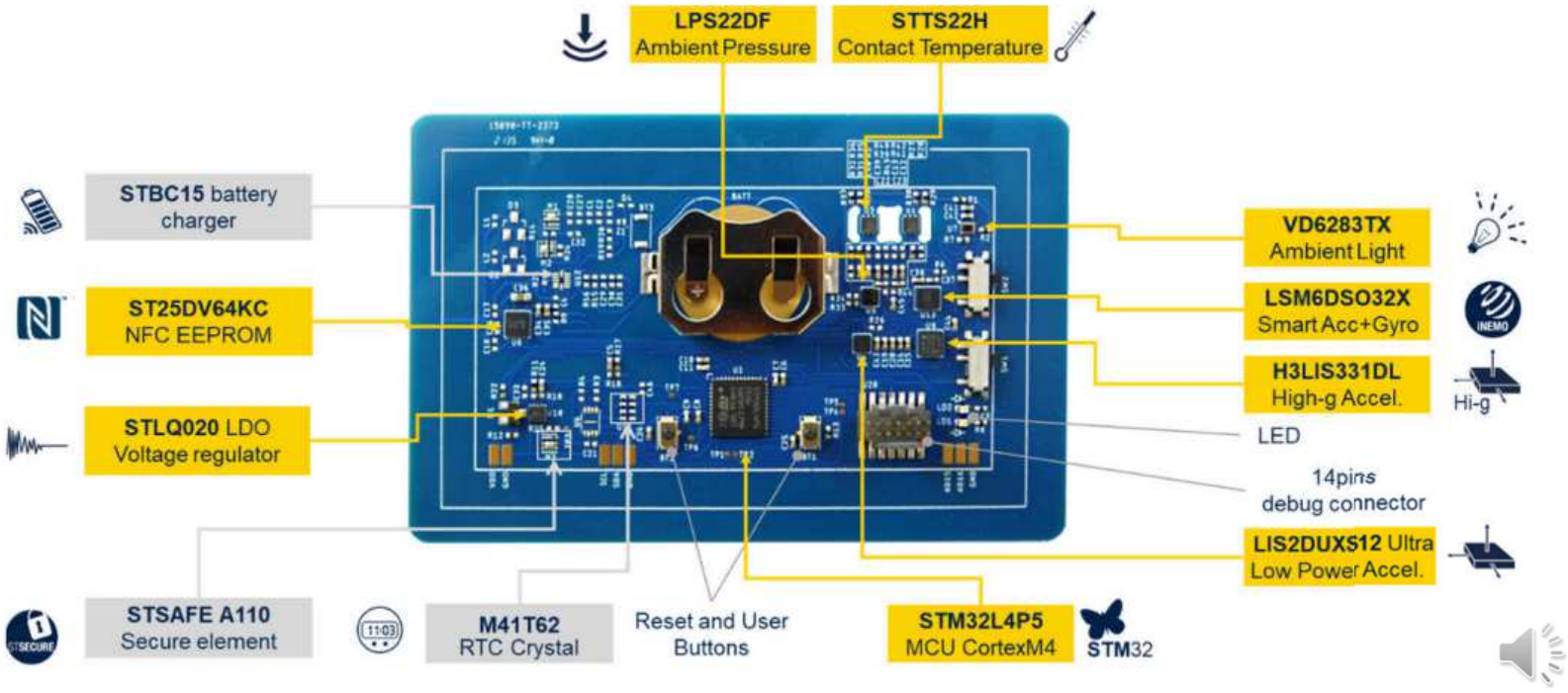
Components used in SMARTAG2



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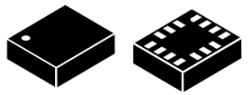
LSM6DSO32X

Ultra-low Power iNEMO inertial modules with Machine Learning Core and Finite State Machine



2.5 x 3 x 0.86mm

HIGHLIGHTS

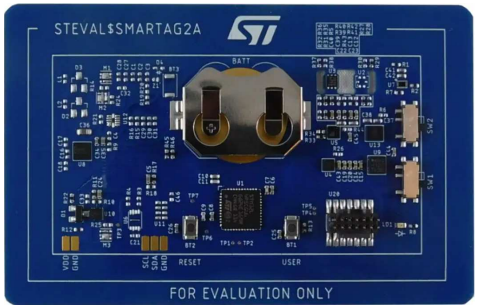
- **Event-detection interrupts** enable efficient and reliable **motion tracking and contextual awareness, implementing hardware recognition** of free-fall events, 6D orientation, click and double-click sensing, activity or inactivity, stationary/motion detection and wakeup events
- Up to **9 kbytes of FIFO** with compression and dynamic allocation of significant data allows overall power saving of the system
- **Embedded features** (Machine Learning Core, programmable Finite State Machine)

KEY FEATURES

- Accelerometer Full Scale up to **±32g**
- Ultra-low power consumption
  - **0.55mA (accel + gyro) in high performance mode**
  - **9.5µA (accel) in ultra low power mode @ 52Hz**
- **70 µg/√Hz Acceleration** noise density in high-performance mode @ 2g
- **3.8 mdps/√Hz Rate noise density** in high-performance mode
- SPI / I²C & MIPI I3C serial interface with main processor data synchronization

TARGET APPLICATIONS

Wireless Sensor Node (IoT) | Wearables Gesture detection | Hard fall detection | Optical Image and Lens Stabilization | Asset Trackers



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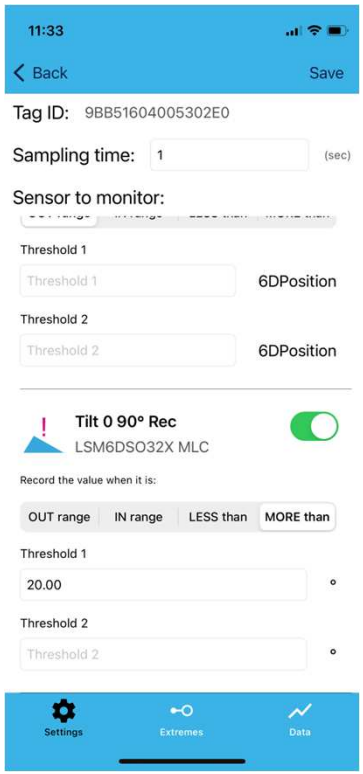
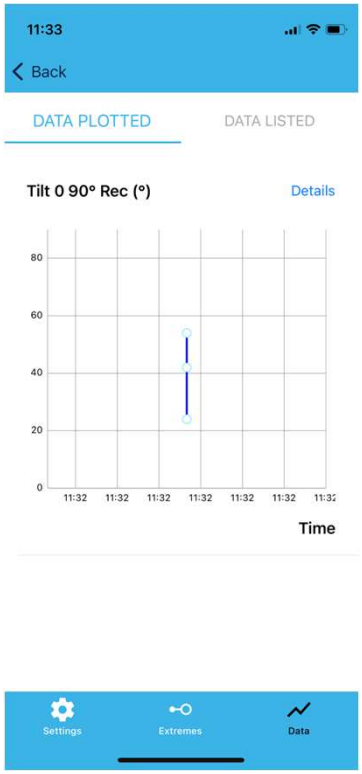
Detecting Tilts





LIS2DUXS12

Ultra Low Power Accelerometer with Qvar, anti-aliasing, finite state machine and machine learning core

2 x 2 x 0.74mm

HIGHLIGHTS

- Tap / Double-tap recognition / Wake up detection / Free fall detection / 6D/4D orientation and Activity / Inactivity
- Pedometer
- Embedded machine learning core (MLC)
- Programmable finite state machine (FSM)
- Integrated analog hub / Qvar sensing channel

KEY FEATURES

- Acceleration range: ±2/±4/±8/±16 g
- Enhanced flexibility with embedded FIFO up to 128 samples
- Low current consumption
  - 2.7µA at 1.6Hz (ultra-low power mode)
  - 6.2µA at 50Hz with Anti-Alias Filter (lower power mode)
  - 10.8µA with Anti-Alias Filter (high performance mode)
- I3C interface option

TARGET APPLICATIONS

Game controllers | Smart Watch | Wrist Bands | True Wireless Stereo (TWS) | Asset Trackers | Motion-activated user interface

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H3LIS331DL

Low power High-g 3-axis accelerometer

LGA-16 3x3x1 mm3

HIGHLIGHTS

- High-performance 3-axis linear accelerometer with digital I²C/SPI serial interface
- Accurately detect potential concussions in high-impact sports
- Reliable crash detection

KEY FEATURES

- ±100g/±200g/±400g dynamically selectable full scales
- Ultra-low power consumption down to 10 µA in low-power mode, 330 µA in normal mode, 1 µA in power down mode
- 16-bit data output – I2C/SPI digital output interface
- BW (max) 500Hz; Output data rate: 0.5Hz to 1kHz
- Sleep-to-wakeup function, Programmable interrupts
- 10000 g high-shock survivability

TARGET APPLICATIONS

Shock detection

Concussion detection

Impact recognition and logging

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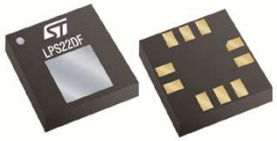
LPS22DF



HLGA-10L
2.0 x 2.0 x 0.73 mm

Low-power, High-precision, Absolute digital output barometer

HIGHLIGHTS

- **Greater than 20% reduction in power** vs previous generation
- Better Absolute Pressure Accuracy
- **Supports 1.08V digital interface**
- Fully factory calibrated
- E911 compliant

KEY FEATURES

- 260 to 1260 hPa absolute pressure range
- Current consumption down to 1.7 µA
- Absolute pressure accuracy 0.5 hPa
- Low noise 0.34 Pa
- High performance TCO 0.45 Pa/°C
- Embedded temperature compensation
- Unique Full-molded package

TARGET APPLICATIONS

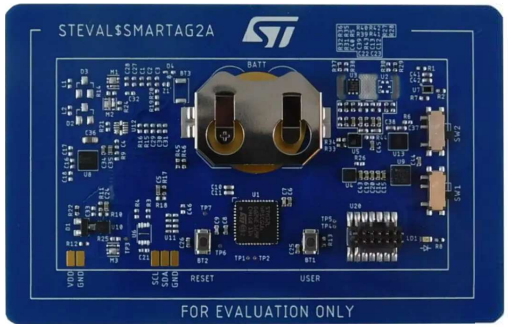
GPS applications

Altimeters and barometers

Sport Watches and Wearables

Drones

Vacuum cleaners Floor type / Bag level



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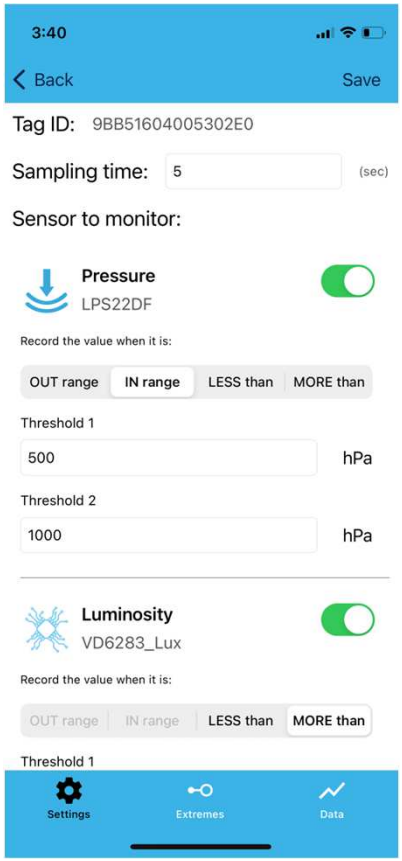
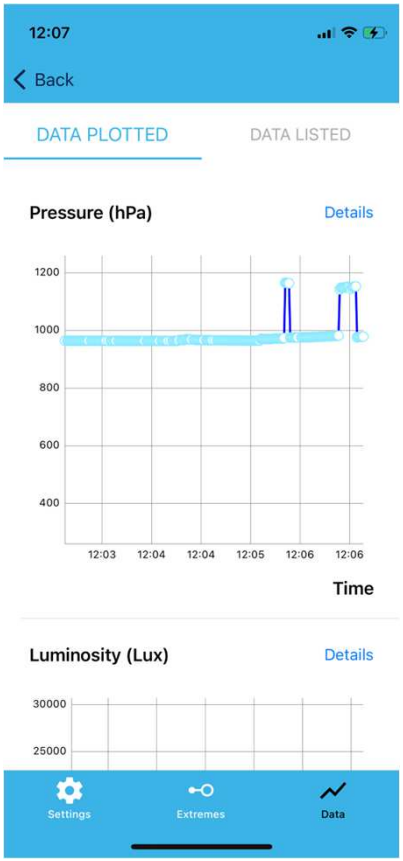
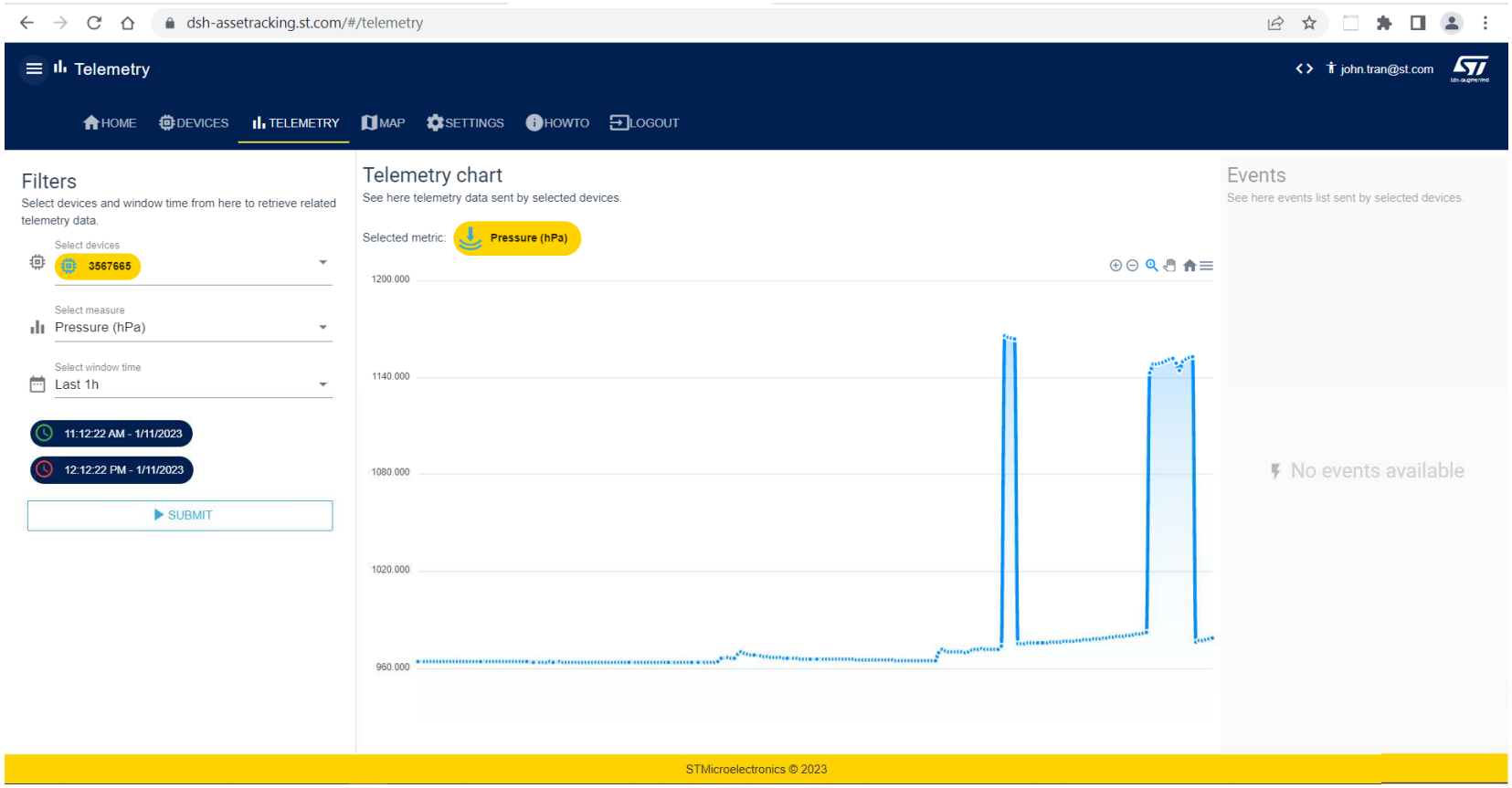
Measuring ambient pressure





DSH-AssetTracking Telemetry



STTS22H

Integrated Ultra-Low Power, High Accuracy Digital Temperature Sensor

HIGHLIGHTS

- band gap temperature sensor coupled with an A/D converter, signal processing logic and an I²C/SMBus 3.0 interface all in a single ASIC.
- factory calibrated and requires no additional calibration efforts on the customer side.
- 100% tested on a production setup that is NIST traceable and verified with equipment that is calibrated in accordance with the IATF 16949:2016 standard

Key features

- Operating temperature -40 °C to +125 °C
- Accuracy (typical):
  - ±0.25°C [-10°C : +60°C], ±0.7°C [-40°C : +125°C]
- Accuracy (max):
  - ±0.5°C [-10°C : +60°C] , ±1.0°C [-40°C : +125°C]
- Supply voltage: 1.5V to 3.6 V
- One-shot mode for power saving (1.75 µA)
- 2 x 2 x 0.50 mm 6-lead UDFN package with exposed pad down

TARGET APPLICATIONS


Industrial asset tracking


Equipment monitoring


Healthcare devices


Appliances


Sport Watches and Wearables

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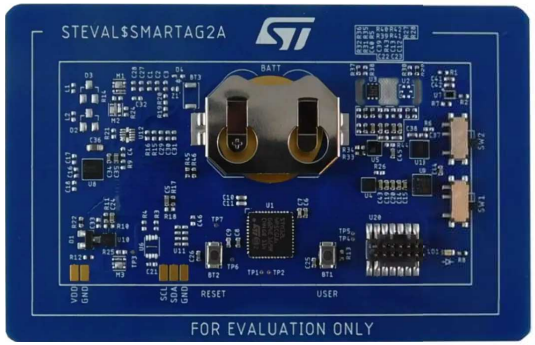
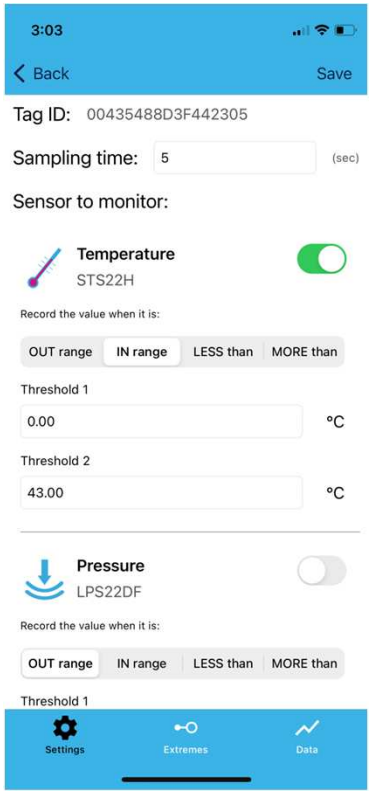
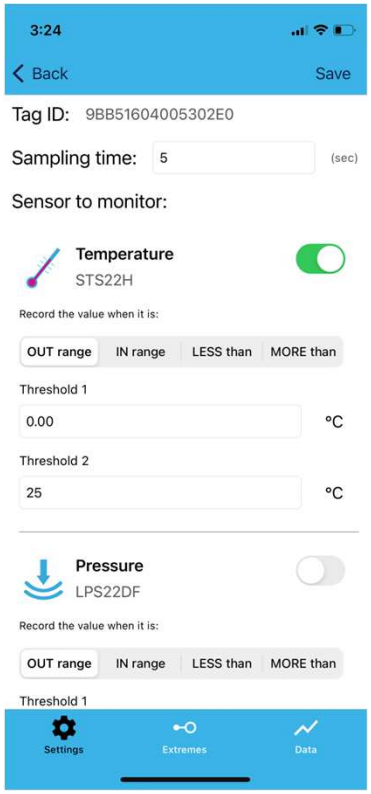
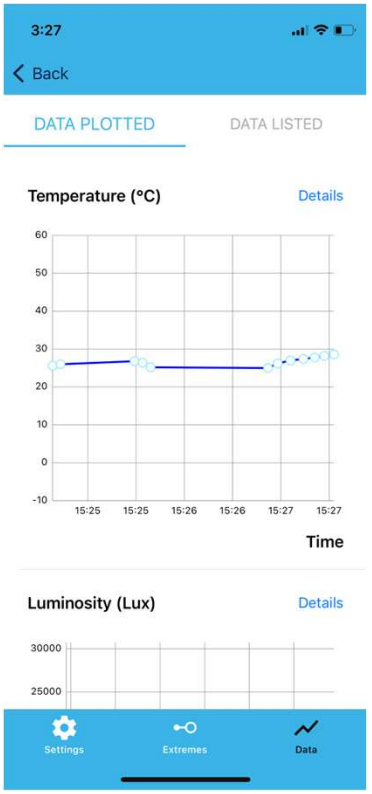
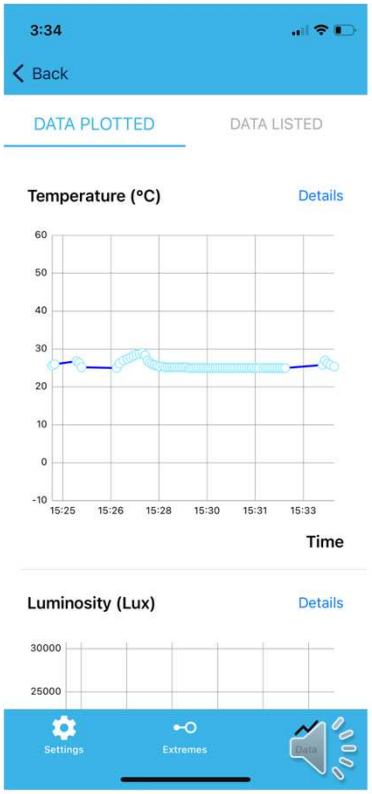


Detecting Temperature Changes









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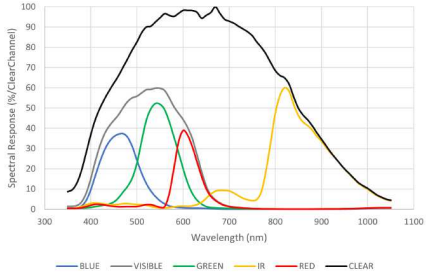
VD6283 | Product overview

6-channel ambient light sensor with advanced light flicker extraction

1.83 x 1.0 x 0.55mm
Smallest on the market

Lux and CCT Color sensor

- 6 channels from 400 to 1100nm: **R, G, B, IR, Visible and Clear**
- **Lux information** from 7mLux to 30kLux (large dynamic range)
- **CCT accurate information** to enable light type detection
- **Excellent sensitivity** in low light conditions
- **Low power**, single 1.8V supply
- 120° Optical FoV



Light Flicker extractor

- Only sensor in the market with **true flicker extraction engine**
- For all frequencies from 100Hz up to 2kHz (square or sinewave)
- Can work **simultaneously** with ALS
- Excellent accuracy (<3%) through FFT
- Multiple light sources management

Available now!

Order code: **VD6283TX45/1**

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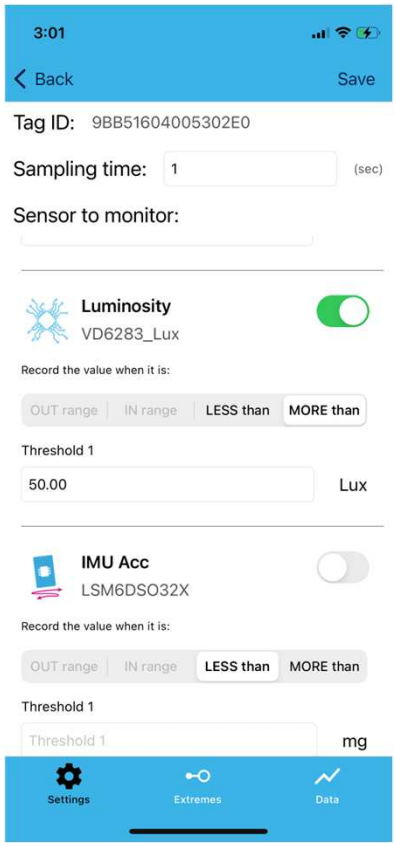
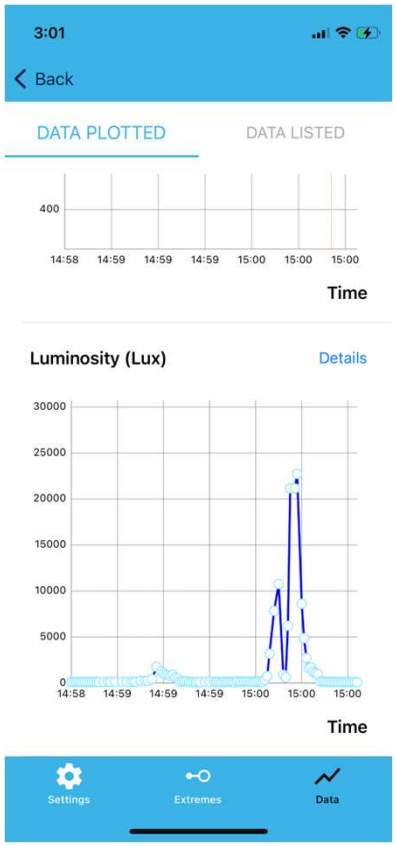
Measuring Ambient Light





Note: Use your phone flashlight to get maximum reading.


dsh-assetracking.st.com/#/telemetry
Telemetry
john.tran@st.com
HOME
DEVICES
TELEMETRY
MAP
SETTINGS
HOWTO
LOGOUT
Filters
Select devices and window time from here to retrieve related telemetry data.
Select devices
3567665
Select measure
LUX
Select window time
Last 1h
11:22:22 AM - 1/11/2023
12:22:22 PM - 1/11/2023
SUBMIT
Selected metric:
LUX
3200.000
2400.000
1600.000
800.000
0.000
12:03:00
12:03:20
12:03:40
12:04:00
12:04:20
12:04:40
12:05:00
12:05:20
12:05:40
12:06:00
12:06:20
12:06:40
Events
See here events list sent by selected devices.
No events available
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STSAFE-A110 Overview

Secure solution for brand protection & connected devices

Optimized and certified

Provisioning services

Seamless integration

- Strong authentication
- Secure channel establishment (TLS)
- Signature verification
- Decrement counter
- Secure data storage
- Amazon AWS JIT and Microsoft Azure DPS device enrollment
- WPC 1.3 Qi authentication compliant
- Based on CC EAL5+ platform

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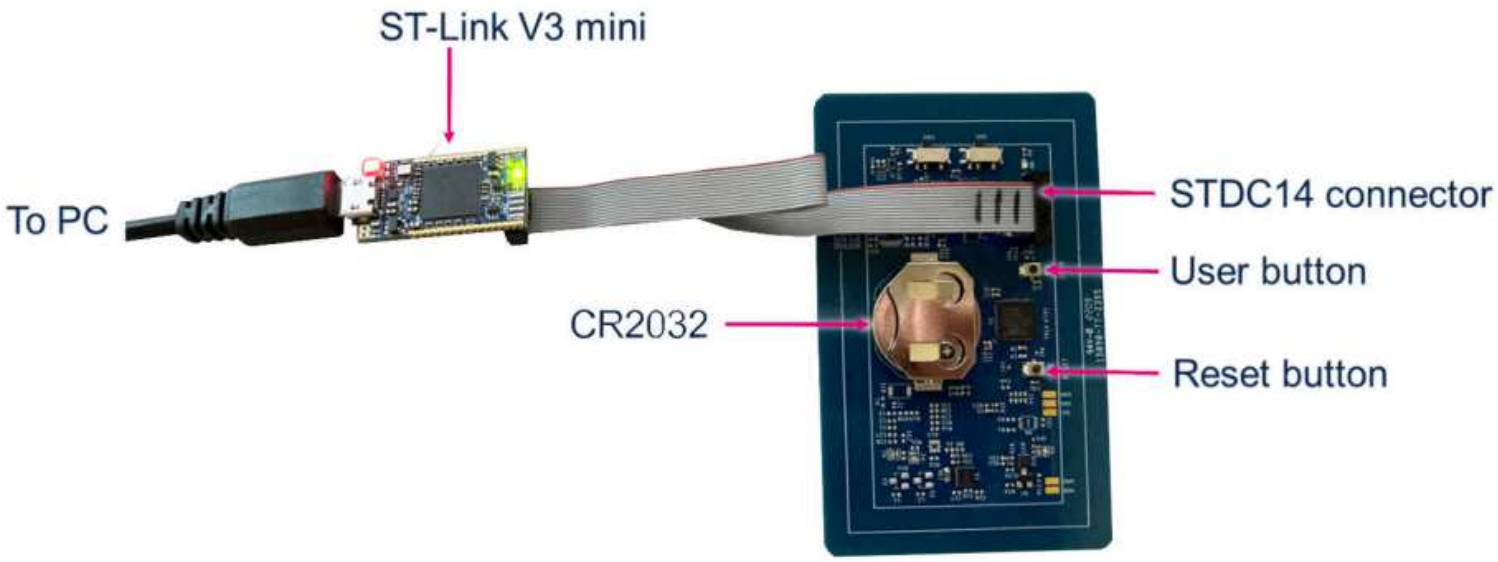
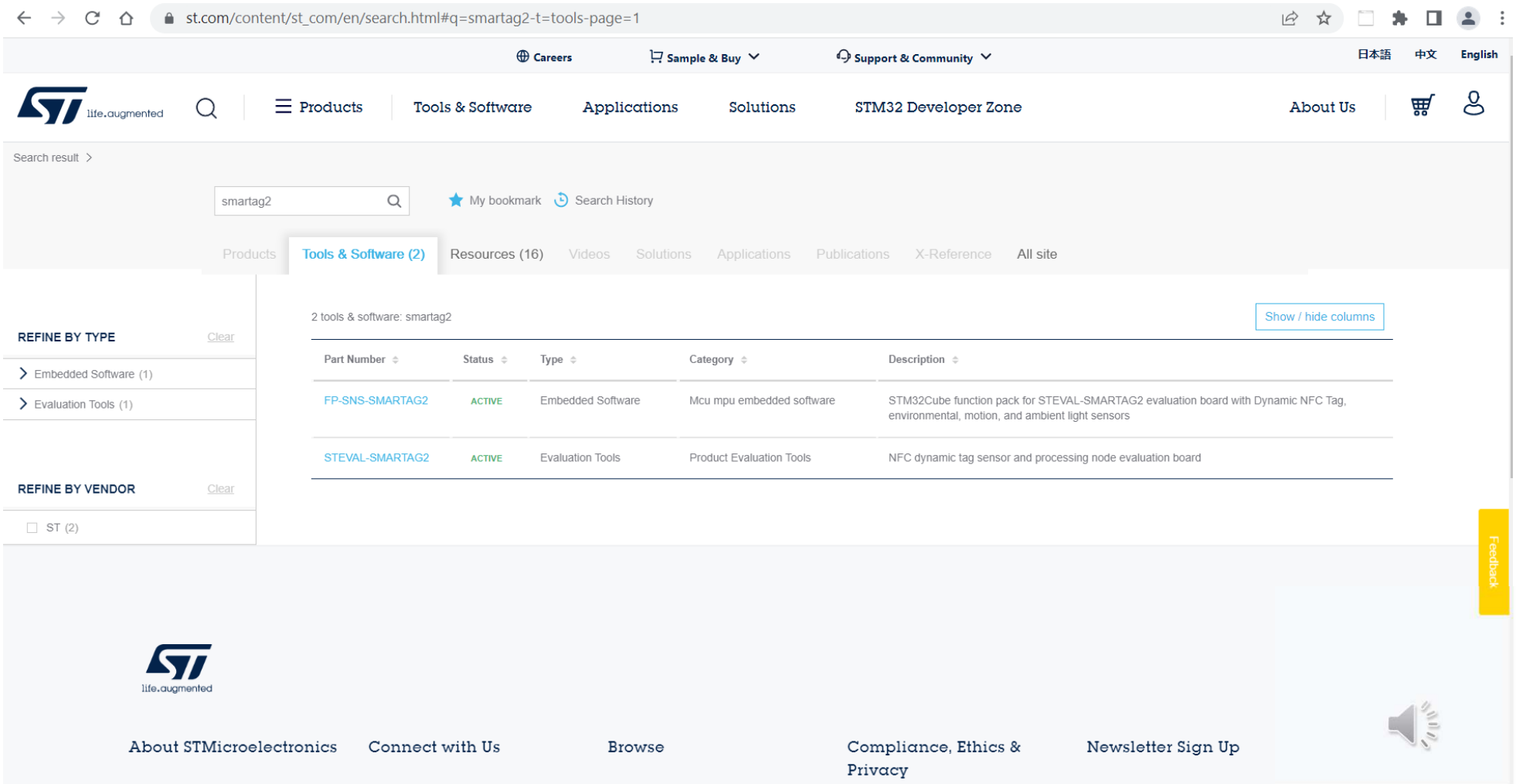
Few last things

Updating SMARTAG2 f/w or debugging

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Clear
Embedded Software (1)
Evaluation Tools (1)
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ST (2)
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Status
Type
Category
Description
FP-SNS-SMARTAG2
ACTIVE
Embedded Software
Mcu mpu embedded software
STM32Cube function pack for STEVAL-SMARTAG2 evaluation board with Dynamic NFC Tag, environmental, motion, and ambient light sensors
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Thank you