



# RFID Selection Guide



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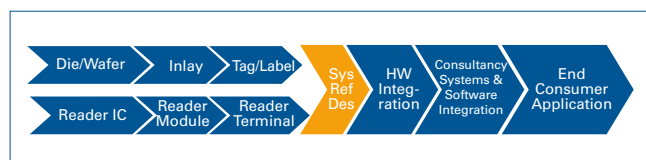
## FOREWORD

The increasing flow of goods globally, more and more demanding requirements for traceability, and the necessity for more efficient production processes call for an information system with which packages or products can be clearly and reliably identified and accompanied by specific data. RFID offers these capabilities. As a result, an increasing number of companies are relying on this technology, which is already being used in billions of applications including those for car immobilisers, tickets for buses and stadia or for building access control. These applications have one thing in common, that is that they are supported by an overall concept for various hardware components and software. EBV, with its considerable product portfolio and an extensive network of partners, can fulfill an important role here. The EBV specialists can assist in determining the potential of RFID especially for small and medium-sized businesses by helping with the selection of the correct components and work with the users to develop a tailored system solution. EBV's international presence in EMEA is important in this respect, as it enables the selection of the right products and partners even beyond national borders. Our RFID specialists receive on-going training and, where necessary, have access to the expertise of our partners, component manufacturers and systems vendors. We are intermediaries for the necessary RFID technology and required expertise as well as being system providers with comprehensive solutions. These capabilities benefit small and large corporations alike.

We want to make the introduction of RFID technology that much easier. Only then can the full potential of RFID technology be reached.

*Christian Krieber*

*Vertical Segment Manager for RFID – Europe*



Together with our supplier and partner network, EBV is able to offer a comprehensive solution for our customers. On top of supplying the right hardware, we can offer the support of our partners if special software or system integration is needed. For our customers this means to have a single point of contact, starting from the design-in phase up to the roll-out of a product or installation. EBV is RFID.

## ABOUT EBV ELEKTRONIK

EBV Elektronik, an Avnet (NYSE: AVT) company, was founded in 1969 and is the leading specialist in European semiconductor distribution. EBV maintains its successful strategy of personal commitment to customers and excellent services. 220 Technical Sales Specialists provide a strong focus on a selected group of long-term manufacturing partners. 110 continuously trained Application Specialists offer extensive application know-how and design expertise. Warehouse operations, complete logistics solutions and value-added services such as programming, taping & reeling and laser marking are fulfilled by Avnet Logistics, EBV's logistical backbone and Europe's largest service centre. EBV operates from 59 offices in 27 countries throughout EMEA (Europe – Middle East – Africa). For more information about EBV Elektronik, please visit [www.ebv.com](http://www.ebv.com).

Interested in more product highlights and market updates from EBV Elektronik? Subscribe for our newsletter at [www.ebv.com/newsletter](http://www.ebv.com/newsletter).

## WHAT IS RFID?

First of all, RFID is the abbreviation for Radio Frequency Identification. An RFID system serves to identify

- People (access control)
- Objects (logistics)
- Places (transport systems)
- Transactions (payment systems)

RFID essentially performs the same tasks as the widespread barcode or magnetic strip, but offers several advantages as a successor technology:

- No direct line of sight required
- Read/Write functionality
- Different memory sizes / technologies available
- Security features available
- Multiple tags can be read simultaneously
- Works in harsh environment

## HOW DOES RFID WORK?

RFID technology is based on the transfer of data by means of electromagnetic fields – in other words, by radio. Information about an object is stored on a data carrier, known as a transponder or tag, which is attached to the object. This transponder consists of an antenna and a chip containing the individual object data. This information can either be

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www.ebv.com/rfid

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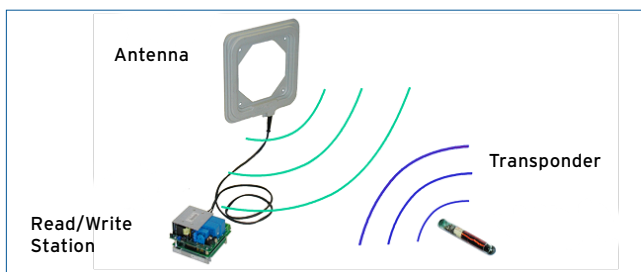
object-related data or simply a unique serial number that creates the connection to the actual data in a database. As with the barcode, the data carrier is attached to the object and allows the information to be read at any time or altered as desired. To do this, the tag communicates with the read/write station, commonly known as the reader.

## ACTIVE/PASSIVE

There are generally two types of transponders: active and passive.

**Active transponders** have their own power supply in the form of a battery. This enables them to transmit at higher power levels and thus be read or written at greater distances (up to and over 100 m). As a result, these tags are relatively large and, due to the technology, more expensive than passive transponders.

**Passive transponders** obtain their energy from the electromagnetic field of the reading device. This means that they do not require their own power supply, which makes these transponders very small and economical.



## THE RIGHT FREQUENCY FOR EVERY APPLICATION

As well as their technology – active or passive – RFID systems also differ in terms of the frequency range in which they operate. There are three well established frequencies worldwide.

**Low frequency (LF): <135 kHz**

**High frequency (HF): 13.56 MHz**

**Ultra high frequency (UHF): 850...960 MHz**

The type of application determines the frequency range.

## THE RIGHT HARDWARE FOR EVERY APPLICATION

Hardware requirements differ from application to application. Apart from factors such as price, size and antenna type, there are other decisions to be made such as whether to develop a

reader in-house based on a reader IC or to buy ready-made modules or even ready-made readers.

**Whatever the application, EBV can supply the appropriate hardware.**



The selected frequency range also has a decisive influence on the appearance of the actual data carriers – the transponders.

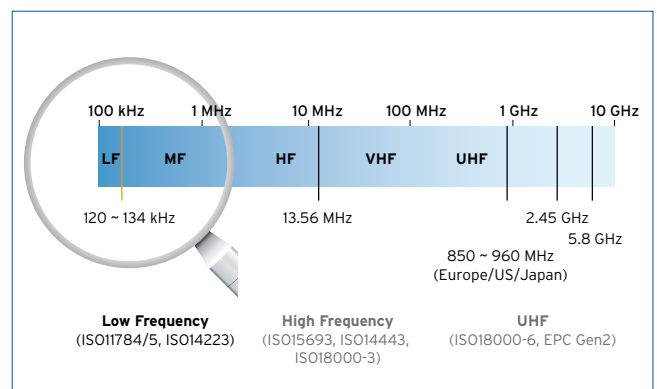
### Common formats are:

- Glass
- Coin-shaped
- Rod
- Cards
- Key fobs
- Labels
- Inlays
- IC housings



## LOW FREQUENCY SYSTEMS

These systems are particularly well-suited to industrial use. The tags generally consist of wire coils and are embedded in a stable glass or plastic housing.

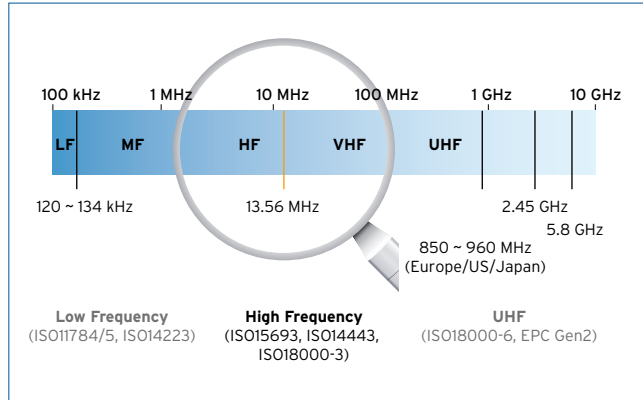


### Characteristics

- Well-defined magnetic field
- Works well near metal
- Able to read through materials
- Unaffected by water
- Low data rates
- Tags are more expensive than those for higher frequencies

## HIGH FREQUENCY SYSTEMS

These systems are characterised by greater ranges and higher reading speeds. Due to the higher data rate, tags with more storage and/or security functions are used here. The design of these transponders is relatively simple and they are therefore cheap to produce.

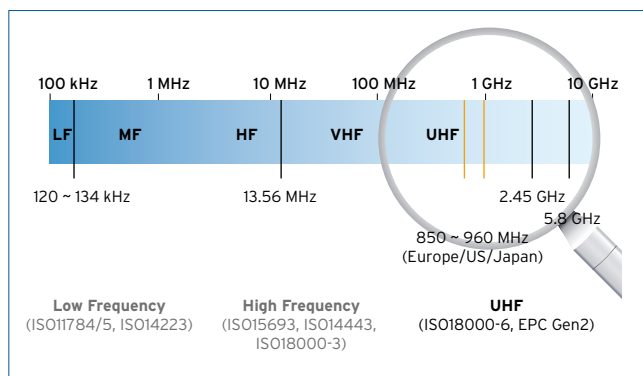


### Characteristics

- Well-defined magnetic field
- Signal passes through most materials, with the exception of metals – some attenuation occurs
- Capable of simultaneous reading of multiple tags
- Tags are mainly in label/ticket (flat) format

## UHF SYSTEMS

UHF systems are primarily used in warehousing and goods tracking, as they enable very high data transfer rates and long ranges of up to six metres. Due to the low amount of space required for the dipole antenna, this technology is also ideal for tracking circuit boards. Formats in a miniature IC housing can be attached directly to the PCB.



### Characteristics

- Longer reading distances
- High data rates
- Signals do not pass through materials as well as they do at lower frequencies
- Reflections can extend the read range, but make the reading zone less well defined (ghost readings from labels thought to be out of range)
- Different frequencies and power limits around the world

## Summary

Frequency	LF 120 ~ 134 kHz	HF 13.56 MHz	UHF 850 ~ 960 MHz
Read Range	0.5 ~ 1 m	< 1 m	> 3 m
Cost	Relatively expensive	Less expensive	Least expensive
Penetration of Materials	Excellent ← → Poor		
Affected by Water?	No	To some extent	Yes
Antenna	Coil	Coil	Dipole, Slot
Data Rate	Slower ← → Faster		
Reading Multiple Tags	Poor	Good	Very Good
Applications	Immobilisers, industrial-identification	"Pharma", libraries brand protection, tickets, payments, passports	Pallet/case tracking, tolls baggage tracking, PCB tracking

## IMPORTANT POINTS WHEN SELECTING

### Reading Distance

- Proximity (<10 cm)
- Vicinity (<1 m)
- Long Range (>1 m)

### Material

- The higher the frequency, the higher the influence of the material (water)
- Metal environment?

### Memory

- UID (serial number)
- R/W (Read/Write)
- OTP (One Time Programmable)
- Multipage (several independent pages)
- Segmentation/File Structure

### Frequency

- 125/134 kHz (ISO11784/85)
- 13.56 MHz (ISO15693, ISO14443)
- 868/915 MHz (EPC)

### Security

- Plain communication
- Password protected read or write
- Mutual authentication
- Encrypted communication
- Mutual authentication with encrypted communication and password protected read/write for different sectors

### Project scale

- Quantity/Price of reader
- Quantity/Price of tag

**Dimensions**

- Max. size of the reader
- Max. size of the antenna
- Max. size of the tag

**General requirements**

- Robustness of the tag
- Anti-collision requirements
- Material of the tag (glass tube, label, coin, ...)
- Temperature
- Power consumption of the system
- Experience in HF design
- Use Reader from the shelf or develop own reader

**Benefit Optimisation/Process Consideration**

The full advantages of RFID can be realised when the application, manufacturing process and the supply chain are considered as a whole.

One of the unique differentiators for RFID in comparison to other identification technologies, is the ability to send

and receive data, in a so-called downstream and upstream process. Products can therefore be identified from the raw materials stage to complete manufacture, quality assurance, registration in the warehouse and delivery to the customer right through to servicing. This truly unlocks the full potential of RFID.

**Typical Applications for RFID**

- PCB tracking
- Process automation
- Pharmaceutical / medical
- Vending machines
- E-metering
- Service / maintenance
- POS terminals
- Product authentication / brand protection
- Access to buildings / machines
- Immobiliser systems
- Wireless payment / loyalty programmes
- Logistics

**ATMEL'S RFID AND AUTHENTICATION ICs – FLEXIBILITY FOR ALL KINDS OF APPLICATIONS**

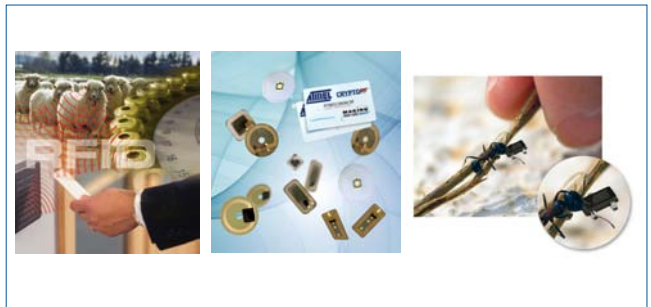


Atmel, through continuous innovation, presents a product scope that includes all semiconductors required for complete

RFID or authentication systems, ranging from low-cost standard identification ICs up to highly sophisticated devices for maximum security requirements. Easy handling, perfect device matching and extensive application support facilitate fast and seamless design-in. Various frequencies and security levels enable flexibility for all kinds of applications.

With its IDIC®, CryptoRF® and CryptoAuthentication™ products Atmel provides flexible, scalable RFID and authentication security system solutions for brand protection, access control,

electronic purse, ticketing, loyalty cards, copy protection, anti-counterfeiting, product authentication, animal identification, etc. Atmel's RFID and authentication products are available as wafers (sawn or unsawn), as NOA3 micromodules, with gold or Ni-gold bumps, as transponder finished tags or in various IC packages.



**LF TAGS**

LF Tags (100...150 kHz)					
	TK5551 <sup>1</sup>	ATA5558	ATA5570	ATA5577M1 <sup>2</sup> ATA5577M2 <sup>2</sup>	ATA5575M1 <sup>2</sup> ATA5575M2 <sup>2</sup>
Type	R/W	R/W	R/W	R/W	OTP
User memory (bit)	224	1024	224	224	128
System memory (bit)	40	320	96	128	8
Write protection	Blockwise	Blockwise	Blockwise	Blockwise	1 lock bit
ISO11784/11785	FDX-B	FDX-B	FDX-B	FDX-B	FDX-B <sup>8</sup>
Capacitor on chip	-	0 pF, 80 pF and 210 pF	0	0 <sup>4</sup> , 75 <sup>4</sup> , 130 <sup>4</sup> , 250 or 330 pF trimmed +/- 3%	250 or 330 pF trimmed +/- 3%
Megapads	-	400 x 200 μm <sup>5</sup>	-	400 x 200 μm <sup>6</sup>	400 x 200 μm <sup>7</sup>
Anti-collision function	AOR (Answer on Request)	Deterministic	AOR (Answer on Request)	AOR (Answer on Request)	-
Transponder part no.	TK5551M-PP	ATA555815-PP	-	ATA5577M1330-PP <sup>3</sup>	-
Sensor	-	-	Resistor interface 1 bit	-	-

<sup>1</sup> Only available as transponder · <sup>2</sup> Successor of T5554, T5557, and ATA5567 · <sup>3</sup> Planned · <sup>4</sup> On request for M1 version · <sup>5</sup> Available for 80 and 210 pF version with 25 μm gold bumps · <sup>6</sup> Available for M2 version with 25 μm gold bumps · <sup>7</sup> On request with 25 μm gold bumps · <sup>8</sup> ATA5575M2 version

## READER ICs

Part Number	Frequency	Description	Vcc [V]
U2270B	100...150 kHz	ISO 11784/85 LF RFID reader	4.5...16
AT88RF1354	13.56 MHz	ISO 14443 type B HF RFID reader	3.0...5.5

## HF TAGs (13.56 MHz)

Part Number	AT88RF04 (new), AT88SC0808CRF, AT88SC1616CRF, AT88SC3216CRF, AT88SC6416CRF
Memory size	4 kBit to 64 kBit
Write endurance	100K cycles
Data retention	10 years
Number of zones	4 to 16
Configuration memory	256 bytes
ISO	14443 Type B
Frequency	13.56 MHz
Baud rate	106 Kbit/s
Anticollision	Timeslot
Operating distance	Up to 10 cm
Read/Write password	Yes
Encrypted password	Yes
Symmetric dynamic	4 x 64 bit keys
Stream encryption	Yes
R/W encrypted checksum	Yes
Unique serial number	32 bit, fixed and additional, user programmable
Write protection	Zone or byte
Access keys	Yes
Encryption algorithm	64 bit key
Standard packages	Die, Tag (MX1, MY1), Module (MR1)
Temperature	-45...+85 °C
Tools	Eval./devel. kit

## CRYPTOCOMPANION™ (HOST-SIDE SECURITY IC, 2-WIRE INTERFACE)

Part Number	Description	I/O	Temperature	Vcc
AT88SC018	Host-side security IC for CryptoMemory and CryptoRF	TWI1	-40...+85 °C	3.0...5.5

1TWI = I<sup>2</sup>C-compatible

## CRYPTOAUTHENTICATION™ (CLIENT AND HOST-SIDE SECURITY IC, 1-WIRE INTERFACE)

Part Number	Description	Crypto Algorithm	Package	UID	I/O*	Temperature	Vcc
AT88SA102S	Universal authentication IC	SHA-256	SOT23 or SO8	48-bit	1 wire	-40...+85 °C	2.5...5.5
AT88SA100S	Battery authentication IC	SHA-256	SOT23 or SO8	48-bit	1 wire	-40...+85 °C	2.5...5.5
AT88SA10HS	Authentication host IC	SHA-256	SOT23 or SO8	48-bit	1 wire	-40...+85 °C	2.5...5.5

\* Contact based 1-wire interface for GPIO usage

## DESIGN/DEMO KITS

### ATA2270-EK1

This LF demonstration kit provides a completely self-contained means to begin using RFID systems. It includes an LCD and control buttons to enable interaction with the RFID system and supports the e5530/TK5530, T5551/TK5551, ATA5567(T5557), ATA5570, ATA5575, ATA5577, ATA5558 IDICs and U2270 from Atmel. Source code and reference designs are also included. This kit is supported by all the standard AVR development tools such as AVR Studio®, STK500, JTAGICE mkII, etc. A GUI for a PC can control the board in several modes.

### AT88CK201STK

An all Atmel HF component secure RFID starter kit for prototyping and developing secure RFID applications. It features industry's lowest BOM count and small footprint reader reference design. It supports CryptoRF AT88RF04 and AT88SCxxxCRF. It introduces versatility through modularity where the Bamboo reader module can plug directly onto a USB flash drive-like controller microbase as well as onto the 10-pin header common to most Atmel microcontroller starter and evaluation kits. With use of available Bamboo adapter kit, the bamboo module can plug to virtually any development system. Complete documentation, software, and reference design is downloadable from [www.atmel.com/cryptokits](http://www.atmel.com/cryptokits).

### AT88CK109STK3

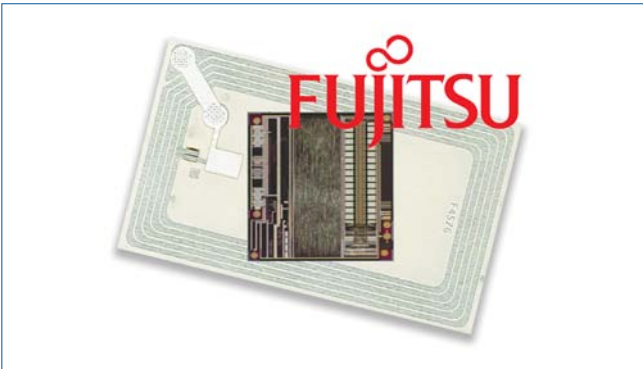
The AT88CK109STK3 starter kit is a development kit for the AT88SA100, AT88SA102, and AT8810HS CryptoAuthentication devices that gives developers a tool they can use to develop applications for protection of confidential files, encrypting downloads, performing a two factor logon, product authentication, or the prevention of software piracy. The development kit includes an AT88Microbase board with a convenient USB interface allowing the user to connect to a personal computer and the AT88CK109BK3 daughter board included in the kit that interfaces to the AT88Microbase via a 10-pin header. The daughter board has two 3-pin SOT23 sockets for either client or client-host development. The AT88CK109STK3 software developed on the PC can also serve as the base for code to be ported to an embedded microcontroller. [www.atmel.com/cryptokits](http://www.atmel.com/cryptokits).

## FUJITSU SEMICONDUCTOR RFID PRODUCTS



Fujitsu offers HF and UHF RFID products with embedded FRAM (Ferroelectric Random Access Memory) based on Fujitsu's cutting-edge technologies.

Compared to conventional E<sup>2</sup>PROM/Flash-based RFID chips, the FerVID Family enables the same high speed data transfer rate for both reading and writing over long distances. The write endurance, specified to 10 billion cycles, is far higher than that of conventional RFID tags, thus saving cost and time in applications. The products are ISO/IEC15693, ISO/IEC 18000-3 or EPCglobal Class 1 Generation 2 compliant. Fujitsu offers wafers, sawn wafers or packaged chips. Derivatives with combined contactless and contact-based SPI interface are available. Find out more: <http://emea.fujitsu.com/fseu/fram>



### Applications

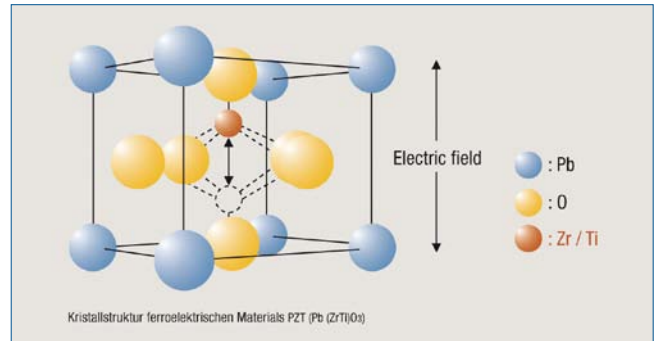
Fujitsu's RFID products with 2 kbytes of FRAM, are ideally suited to many applications and markets including:

- Logistics, supply chain management
- Passenger tickets, subscription cards
- Factory automation
- Access control
- Medical and food industry applications



### What is FRAM?

FRAM (Ferroelectric Random Access Memory) is a non-volatile memory that uses ferroelectric film as a capacitor for storing data. Possessing characteristics of both ROM and RAM devices, FRAM features high speed access, high endurance in write mode, low power consumption, non-volatility, and excellent tamper resistance. It is therefore ideal for use in RFID products, where high security and low power consumption are important.



### What is Ferroelectric Material?

PZT (Pb(ZrTi)O<sub>3</sub>) material which has a perovskite-type structure (ABO<sub>3</sub>), is commonly used as a typical ferroelectric material. When an electric field is applied the Zr/Ti atom shifts up or down, and this polarisation remains when the electric field is removed. It is this property that provides non-volatility and keeps the power required for data storage very low.

Fujitsu is a pioneer in this innovative technology. With more than 10 years of experience in developing and manufacturing FRAM products, it has now shipped more than 300 million FRAM devices. The industry is embracing it as a mature technology.

## FRAM AND RFID

FRAM RFID chips can provide the following advantages, which could not be provided by commonly used E<sup>2</sup>PROM-based RFID chips.

### Range

Low power consumption can improve the operating range. The power delivered to the load must provide certain threshold voltage and power for the circuits to function. Because of the low power consumption nature of FRAM, the operating range could be improved within given field strength or power density.

### Speed and High Capacity

FRAM memories can be written as fast as they can be read out. I.e. FRAM write access is about 25 times faster than E<sup>2</sup>PROM write access. Speed and range are coupled. Given the bandwidth limitations and anti-collision schemes, low power consumption tags offer better data rate in exchange of speed of identification. FRAM is best fit for this purpose. Furthermore, the high speed access and low power consumption allows the design of high capacity RFID chips.

### Almost Unlimited Read-Write Times

With read-write endurance of  $1e^{10}$ , FRAM is more durable and suitable for applications that require frequent writing. This is an important feature for RFID based production line control, where tags will be re-used many times.

### Gamma Radiation Hardness

Unlike E<sup>2</sup>PROM, Ferroelectric Memories do not lose their content due to radiation exposure. Therefore FRAM based RFID tags are ideally suited for medical applications or applications in the food industry where sterilisation is performed by irradiation. FRAM data is protected against 50 kGy gamma ray sterilisation.

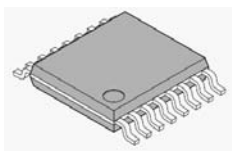
Item	MB89R118C (HF)	MB97R8030 (UHF)
	Wafer	Wafer
	sawn wafer	sawn wafer
		Package, 11-pin (SPI)
Memory capacity	2048 bytes	2048 bytes
User memory area	2000 bytes	1664 bytes
System memory area		(Including reserved, EPC, and TID): 384 bytes
Memory structure	8 byte/block, 256 blocks	32 byte/block, 52 blocks
Operating frequency	13.56 MHz ±7 kHz	860...960 MHz
Standards	ISO/IEC 15693* ISO/IEC 18000-3 (Mode 1)*	EPCglobal Class 1 Generation 2 (C1G2) Ver. 1.2.0
Modulation type	10%ASK, 100%ASK	DSB-ASK, SSB-ASK, PR-ASK
Ambient operating temperature	-20...+85 °C	-20...+85 °C
Ambient storage temperature	-40...+85 °C	-40...+85 °C
Input capacitance	24 pF	
Power consumption	150 µW	
Data retention period	10 years at 70 °C	10 years at 70 °C
Data endurance	10 <sup>10</sup> cycles	10 <sup>10</sup> cycles
Data integrity	16-bit CRC per block parity bit for each byte	16-bit CRC
Anticollision	30 tags per second 40 tags per second (using ASK 100%)	yes, EPCglobal C1G2 Ver. 1.2.0, compliant
Data Rx rate reader/writer→tag	26.48 Kbit/s 52,96 kbits/sec with Fast commands	26.7...128 kbps
Data Tx rate tag→reader/writer	26.48 Kbit/s 52,96 Kbit/s with Fast commands	40...640 kbps
Examples of data reading <sup>*1</sup>	1525 ms (2048 bytes)	-
Examples of data writing <sup>*2</sup>	1413 ms (2000 bytes)	-
UID/TID	64 bits	256 bits
Others	· 8 bytes/block configuration · Reading up to 256 blocks using custom lump commands · EAS command (Electronic Article Surveillance)	· Optional SPI interface · Permalock command
SPI interface	-	3.3 V ±0.3 V (required for SPI access only)
Package	-	16-pin TSSOP (FPT-16P-M08) (11-pins functional)
SPI clock	-	2 MHz

\* partly not supported

<sup>\*1</sup>: Read with the Read Multiple Blocks command (UID contained)

<sup>\*2</sup>: Write with the Write Multiple Blocks command (UID contained)

16-pin plastic TSSOP



(FPT-16P-M08)

Lead pitch	0.65 mm
Package width x package length	4.40 x 4.96 mm <sup>2</sup>
Lead shape	Gullwing
Sealing method	Plastic mould
Mounting height	1.20 mm Max.
Weight	0.06 g



## NXP – RFID



NXP Semiconductors is a world leading supplier of ICs into the identification markets. The markets NXP focuses on are Secure Transactions, Secure ID, Tagging and Authentication. Together with EBV as a strong partner NXP is targeting the following applications:

- PCB tracking & authentication of electronic goods
- Medical equipment
- Brand protection
- Prepaid metering
- Access control, POS terminals and cash machines
- Vending machines
- Industrial PCs/controls logical access

NXP, through its sustainable strategy into the ID markets, provides leading-edge semiconductors in RF performance, speed, level of security and cost for both readers as well as labels, cards, tickets and tags.

- NXP ICs for tags, cards, tickets and labels:
  - Hitag
  - ICODE
  - Mifare & Desfire
  - UCODE

And the contact and contactless reader ICs:

- RC family
- PN family
- TDA family

To support the evaluation and design-in of the NXP products, demokits are readily available:

### HITAG Proximity Reader Kit - HTRM301

This demokit is based on the HITAG reader IC, HTRC110. It includes:

- HITAG reader
- Antenna 17.5 x 17.5 cm<sup>2</sup>
- CD with HITAG Demo SW
- Power supply
- Serial connector
- Transponders: HITAG1, HITAG2, HITAG S and HITAG μ (5 pcs of each)



### HF Proximity Reader Kit - CLRD701

This demokit is based on the NXP CLRC632. It includes:

- Pegoda Mifare and ICODE reader
- Mifare & Desfire Software
- Fully Compliant to ISO14443 A & ISO15693
- ICODE Software
- USB Cable to connect to PC



### UCODE Reader Kit – UCEV101

This demokit supports the UCODE product family and includes:

- UCODE long range reader
- Fully compliant to ISO 18000-6B & EPC Global Class Gen 2
- Supports commands of UCODE G2X, such as EAS, Read Protect, Calibrate and the extended 512-bit user Memory (G2XM)
- CD with UCODE Demo SW
- Power supply
- Serial connector and UHF antenna
- Labels: UCODE XL and UCODE XM



#### NXP HITAG™ Reader ICs

Product Features	HTRC110 HITAG™ Reader ICs
Modulation type	100% ASK
Dimensions [mm]	6.2 x 8.75 x 1.45
Interface	CMOS
Supply voltage [V]	5 ±10%
Antenna driver current [mA]	200 continuous
Clock osc. frequency [MHz]	4...16
Operating temperature [°C]	-40...+85
Power down current [μA typ.]	7
Supported Products	
HITAG™ 1	yes
HITAG™ 2	yes
HITAG™ S	yes
HITAG™ μ	yes
Security	
HITAG™ 1 data encryption	-
HITAG™ 2 data encryption	-
HITAG™ S data encryption	-
Package	
S014, tube	HTRC110 01T/02EE
S014, reel	HTRC110 01T/03EE

**NXP Smart Label and Tag ICs**

Product Features	HITAG™ 1	HITAG™ 2	HITAG™ S	HITAG™ μ	HITAG™ μ Advanced HITAG™ μ Advanced+	HITAG™ RO64	"ICODE SLI-S ICODE SLI-SY"
<b>Total Memory</b>							
Size [bit]	2048	256	256, 2048	128	512, 1760	64	2048
Write endurance [cycles]	100 000	100 000	100 000	100 000	100 000	100 000	100 000
Data retention [yrs]	10	10	10	10	10	10	10/40 <sup>(6)</sup>
Organisation	64 blocks x 4 bytes	8 blocks x 4 bytes	64 blocks x 4 bytes	4 blocks x 4 bytes	16 blocks x 4 bytes, 55 blocks x 4 bytes	2 blocks x 4 bytes	16 pages each 4 blocks x 4 bytes
<b>RF-Interface</b>							
According to	HITAG 1	HITAG 2, ISO 11784/85	HITAG 1+, ISO 11784/85	ISO 11784/85	ISO 11784/85	ISO 11784/85	ISO 15693, ISO 18000, EPC <sup>(4)</sup>
Frequency	100...150 kHz	100...150 kHz	100...150 kHz	100...150 kHz	100...150 kHz	100...150 kHz	13.56 MHz
Baudrate [Kbit/s]	up to 4	up to 4	up to 8	up to 8	up to 8	up to 8	up to 53
Anticollision	yes, collision detection	-	yes, collision detection	-	yes, collision detection	-	acc. ISO 15693, ISO 18000, EPC <sup>(4)</sup>
Operating distance [m]	up to 1.5	up to 1.5	up to 2.0	up to 2.0	up to 2.0	up to 2.0	up to 2.0 <sup>(5)</sup>
<b>Security</b>							
Unique serial number [byte]	4	4	4	4	4	4	8
Write protection	blockwise	blockwise	blockwise, multi user mode	blockwise	blockwise	-	blockwise
Access keys	32-bit	48-bit	48-bit	32-bit	32-bit	-	32-bit
Access conditions	Encrypted mutual authentication or plain	Encrypted mutual authentication or plain	Encrypted mutual authentication or plain	Plain, password	Plain, password	-	Plain, password pagewise configurable password protection read/write
Encryption algorithm	yes	yes	yes, for authentication only	-	-	-	-
<b>Special Features</b>							
EAS	-	-	-	-	-	-	yes (Plain, Password)
AFI	-	-	-	-	-	-	yes
EPC	-	-	-	-	-	-	yes
TTF modes	-	yes	yes	yes	yes	yes	-
Destroy command	-	-	-	-	-	-	yes
Privacy command	-	-	-	-	-	-	yes
<b>Packaging</b>							
Sawn wafer	HT1ICS3002W/V9F	HT2ICS2002W/V9F	-	-	-	-	-
Sawn wafer (Au-Bumped)	-	-	HTSICHxx01EW/V4	HTMS1001FUG/AM <sup>(1)</sup> HTMS8001FUG/AM <sup>(2)</sup>	HTMS1x01FUG/AM <sup>(1)</sup> HTMS8x01FUG/AM <sup>(2)</sup>	HTCIC6402FUG/AM <sup>(1)</sup> HTCIC6403FUG/AM <sup>(2)</sup>	SL2 ICS5301EW/V7 SL2 ICS5401EW/V7 <sup>(3)</sup> SL2 ICS5311EW/V7 <sup>(6)</sup>
Other packages	MOA2	MOA2, SOT 385-1	FCP2, HVSON2, MOA2	FCP2, HVSON2, SOT-1122	FCP2, HVSON2, SOT-1122	-	FCP2, MOA2

(1) 210 pF ±3%

(2) 280 pF ±5%

(3) HC: high capacitance (97 pF)

(4) HF EPC Class 1: EPCglobal/Auto-ID Center Specification

(5) based on ECC regulations

(6) ICODE SLI-SY

ICODE SLI	ICODE SLI-L	ICODE UID-OTP	ICODE UID	ICODE EPC	UCODE HSL	UCODE EPC Gen2	UCODE G2XL	UCODE G2XM	
Total Memory									
1024	512	192	192	136	2048	512	368	880	
100 000	100 000	-	10 000	-	100 000	100 000	100 000	100 000	
10	10	5	5	5	10	10	50	50	
32 blocks x 4 bytes	4 pages each 4 blocks x 4 bytes	24 blocks x 1 byte	24 blocks x 1 byte	17 blocks x 1 byte	64 blocks x 4 bytes	32 blocks x 2 bytes	23 blocks x 2 bytes	55 blocks x 4 bytes	
RF-Interface									
ISO 15693, ISO 18000	ISO 15693, ISO 18000	EPC <sup>(4)</sup>	EPC <sup>(4)</sup>	EPC <sup>(4)</sup>	ISO18000-6B	EPC Class 1 Gen2	EPC Class 1 Gen2	EPC Class 1 Gen2	
13.56 MHz	13.56 MHz	13.56 MHz	13.56 MHz	13.56 MHz	UHF/2.4 GHz	860...960 MHz	840...960 MHz	840...960 MHz	
up to 53	up to 53	up to 53	up to 53	up to 53	up to 40	up to 640	up to 640	up to 640	
acc. ISO 15693, ISO 18000	acc. ISO 15693, ISO 18000	acc. EPC <sup>(4)</sup>	acc. EPC <sup>(4)</sup>	acc. EPC <sup>(4)</sup>	binary tree	slotted ALOHA	slotted ALOHA	slotted ALOHA	
up to 1.5	up to 2.0 <sup>(5)</sup>	up to 1.5	up to 1.5	up to 1.5	up to 7	up to 7	up to 10	up to 10	
Security									
8	8	5	5	-	8	TID: 64-bit incl. 32-bit serial number <sup>1)</sup>	TID: 64-bit incl. 32-bit serial number	TID: 64-bit incl. 32-bit serial number	
blockwise	blockwise	OTP	-	OTP	bitwise	blockwise	blockwise	blockwise	
-	-	-	-	-	-	32-bit	32-bit	32-bit	
-	-	-	-	-	-	Plain, write password	Plain, read/write password	Plain, read/write password	
-	-	-	-	-	-	-	-	-	
Special Features									
yes	yes (Plain, Password)	-	-	-	-	yes	yes	yes	
yes	yes	-	-	-	yes	-	-	-	
-	-	yes	yes	yes	-	96-bit	240-bit	240-bit	
-	-	-	-	-	-	-	-	-	
-	yes	yes	yes	yes	-	yes	yes	yes	
-	yes	-	-	-	-	-	yes, read protect	yes, read protect	
Packaging									
-	-	-	-	-	-	-	-	-	
SL2 ICS2001DW/VID	SL2 ICS5001EW/V7 SL2 ICS5101EW/V7 <sup>(3)</sup>	SL2 ICS1201DW/V1	SL2 ICS1101DW/V1	SL2 ICS1001DW/V1	SL3ICS3001FW/V4	SL3ICS1001FW/V7AJ	SL3ICS1202FUG/V7AF	SL3ICS1202FUG/V7AF	
FCP2, MOA2, FCS2-AI, FCS2-Cu	FCP2, MOA2	-	-	-	TSSOP8	FCP2, TSSOP8	FCS2-AI, FCS2-Cu, SOT-1122, TSSOP8	FCS2-AI, FCS2-Cu, SOT-1122, TSSOP8	

ISO 7816 / ISO 14443

**NXP MIFARE™ Smart Card ICs**

Product Features	MIFARE Ultralight™	MIFARE Ultralight™ C	MIFARE Classic™ 1K	MIFARE Classic™ 4K	MIFARE Plus™ S 2 K
	MFO IC U1X	MFO IC U2X	MF1 IC S50	MF1 IC S70	MF1 SPlus 60
Memory					
E <sup>2</sup> PROM size [byte]	64	192	1024	4096	2048
OTP area [bit]	32	32	-	-	-
Write endurance [cycles]	10 000	10 000	100 000	100 000	200 000
Data retention [yrs]	5	5	10	10	10
Organisation	16 pages x 4 byte	48 pages x 4 byte	16 sectors x 64 byte	32 sectors x 64 byte 8 sectors x 256 byte	32 sectors x 64 byte
<b>RF-Interface</b>					
Acc. to ISO 14443A	yes - up to layer 3	yes - up to layer 3	yes - up to layer 3	yes - up to layer 3	yes - up to layer 4
Frequency [MHz]	13.56	13.56	13.56	13.56	13.56
Baudrate [Kbit/s]	106	106	106	106	106 ... 848
Anticollision	bit-wise	bit-wise	bit-wise	bit-wise	bit-wise
Operating distance [mm]	up to 100	up to 100	up to 100	Up to 100	Up to 100
Security					
Unique serial number [byte]	7, cascaded	7, cascaded	4	4	4 or 7, optional random ID
Random number generator	-	yes	yes	yes	yes
Access keys	-	1 key	2 keys per sector	2 keys per sector	CRYPTO1 or AES keys per sector
Access conditions	per page	per page	per sector	per sector	per sector
MIFARE Classic™ Security (Crypto1)	-	-	supported	supported	supported in security level 1&2
DES & DES3 Security	-	authentication	-	-	-
AES 128 Security	-	-	-	-	CMACing
Anti-tear supported by chip	-	-	for value blocks	for value blocks	for AES keys, sector trailers and configuration
<b>Special Features</b>					
Multi-application	-	-	supports MAD*	supports MAD2**	supports MAD2**
Special functionalities	-	-	-	-	Multi-sector authentication
Purse functionality	-	16-bit counter	Value block format	Value block format	-
<b>Packaging</b>					
Sawn wafer	-	-	MF1ICS5005W/V9D	MF1ICS7001W/V9D	-
Sawn wafer (Au-Bumped)	MFOICU1X01W/V1D	MFOICU2001DUD (17 pF) MFOICU2101DUD (50 pF)	MF1ICS5005W/V1D	MF1ICS7001W/V1D	7B UID MF1SPLUS6001DUD/02 4B UID MF1SPLUS6011DUD/02
MOA2 module	-	-	MF1MOA2S50/D/3 ICN8	-	-
MOA4 module	-	MF1MOU2001DA4 (17 pF) MF1MOU2101DA4 (50 pF)	MF1MOA4S50/D	MF1MOA4S70/D	7B UID MF1SPLUS6001DA4/02 4B UID MF1SPLUS6011DA4/02
FCP2 module	MF0FCP2U1X/DH	-	-	-	-
PDM1.1 module	-	-	-	-	-

\*MAD: MIFARE Application Directory

\*\*MAD2: MAD Extension for 4 kbyte E<sup>2</sup>PROM size

\*\*\*MAD3: MAD2 Extension for DESFire

	MIFARE Plus™ S 4K	MIFARE Plus™ X 2K	MIFARE Plus™ X 4K	MIFARE DESFire™ EV1 2K	MIFARE DESFire™ EV1 4K	MIFARE DESFire™ EV1 8K
	MF1 SPlus 80	MF1 Plus 60	MF1 Plus 80	MF3 IC D21	MF3 IC D41	MF3 IC D81
	4096	4096	4096	2048	4096	8192
	-	-	-	-	-	-
	200 000	200 000	200 000	500 000	500 000	500 000
	10	10	10	10	10	10
	32 sectors x 64 byte 8 sectors x 256 byte	32 sectors x 64 byte 8 sectors x 256 byte	32 sectors x 64 byte 8 sectors x 256 byte	flexible file system	flexible file system	flexible file system
<b>RF-Interface</b>						
	yes - up to layer 4	yes - up to layer 4	yes - up to layer 4	yes - up to layer 4	yes - up to layer 4	yes - up to layer 4
	13.56	13.56	13.56	13.56	13.56	13.56
	106 ... 848	106...848	106...848	106...848	106...848	106...848
	bit-wise	bit-wise	bit-wise	bit-wise	bit-wise	bit-wise
	Up to 100	Up to 100	Up to 100	up to 100	up to 100	up to 100
	4 or 7, optional random ID	4 or 7, optional random ID	4 or 7, optional random ID	7, cascaded	7, cascaded	7, cascaded
	yes	yes	yes	yes	yes	yes
	CRYPTO1 or AES keys per sector	CRYPTO1 or AES keys per sector	CRYPTO1 or AES keys per sector	14 keys per application	14 keys per application	14 keys per application
	per sector	per sector	per sector	per file	per file	per file
	supported in security level 1&2	supported in security level 1&2	supported in security level 1&2	-	-	-
	-	-	-	CMACing/encipherment	CMACing/encipherment	CMACing/encipherment
	CMACing	CMACing/encipherment	CMACing/encipherment	CMACing/encipherment	CMACing/encipherment	CMACing/encipherment
	for AES keys, sector trailers and configuration	for AES keys, sector trailers and configuration	for AES keys, sector trailers and configuration	yes	yes	yes
<b>Special Features</b>						
	supports MAD2**	supports MAD2**	supports MAD2**	28 applications, MAD3***	28 applications, MAD3***	28 applications, MAD3***
	Multi-sector authentication	Multi-sector authentication, Proximity check, full virtual card support	Multi-sector authentication, Proximity check, full virtual card support	-	-	-
	-	Value block format	Value block format	Value file	Value file	Value file
<b>Packaging</b>						
	-	-	-	-	-	-
	7B UID MFISPLUS8001DUD/02 4B UID MFISPLUS8011DUD/02	7B UID MF1PLUS6001DUD/02 4B UID MF1PLUS6011DUD/02	7B UID MF1PLUS8001DUD/02 4B UID MF1PLUS8011DUD/02	MF3ICD2101DUD/01	MF3ICD4101DUD/01	MF3ICD8101DUD/01
	-	-	-	-	-	-
	7B UID MFISPLUS8001DA4/02 4B UID MFISPLUS8011DA4/02	7B UID MF1PLUS6001DA4/02 4B UID MF1PLUS6011DA4/02	7B UID MF1PLUS8001DA4/02 4B UID MF1PLUS8011DA4/02	MF3MOD2101DA4/01	MF3MOD4101DA4/01	MF3MOD8101DA4/01
	-	-	-	-	-	-
	-	-	-	-	-	-

NXP Contactless Reader Systems						
Product Features	Reader ICs					
	MF RC500	MF RC530	MF RC531	CL RC632	SL RC400	MF RC522
Product Family Name	"Micore I" family					"Micore I" family
Operating distance typ. [mm]	100	100	100	100	100	
Antenna	-	-	-	-	-	-
FIFO depth [byte]	64	64	64	64	64	64
Host interface	8-bit parallel	8-bit parallel	SPI 8-bit parallel	SPI 8-bit parallel	SPI 8-bit parallel	SPI, I <sup>2</sup> C, RS232
RF Interface						
Analog interface	fully integrated	fully integrated	fully integrated	fully integrated	fully integrated	fully integrated
Carrier frequency [MHz]	13.56	13.56	13.56	13.56	13.56	13.56
Modulation	100% ASK	100% ASK	10% & 100% ASK	10% & 100% ASK	10% & 100% ASK	10% & 100% ASK
Baudrate ISO 14443 [Kbit/s]	106	106/212/424	106/212/424	106/212/424		106/212/424/848
Baudrate ISO 15693 [Kbit/s]	-	-	-	1.66/26.5/53	1.66/26.5/53	-
Baudrate ISO 18000-6-B and	-	-	-	-	-	-
EPC class 1 Gen2	-	-	-	-	-	-
Standards & Protocols						
NFC Reader	yes	yes	yes	yes	yes	yes
ISO 14443 A	yes	yes	yes	yes	-	yes
ISO 14443 B	-	-	yes	yes	-	-
ISO 15693	-	-	-	yes	yes	-
MIFARE classic protocol	yes	yes	yes	yes		yes
ICODE 1 protocol	-	-	-	yes	yes	-
EPC protocol	-	-	-	yes	yes	-
ISO 18000-6B	-	-	-	-	-	-
Security Features						
MIFARE classic™	yes	yes	yes	yes	-	yes
Exception sensors	V, f	V, f	V, f	V, f	V, f	V, f
Additional Product Information						
Supply voltage digital [V]	5	3.3 or 5	3.3 or 5	3.3 or 5	5	2.5...3.6
Supply voltage analog [V]	5	5	5	5	5	2.5...3.6
Power down mode current, typ. [µA]	2	2	2	2	2	1
Wake up time [µs]	1000	1000	1000	1000	1000	1000
Temperature range [°C]	-25...+85	-25...+85	-25...+85	-25...+85	-25...+85	-25...+85
Package	S032	S032	S032	S032	S032	HVQFN32
Approvals						
EMC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Software support	yes	yes	yes	yes	yes	yes

Evaluation Systems						
MF RC 523	MF EV700	SL EV400	CL RD 701	MF EV710	MF EV852	
"Micore I I" family	"Pegoda"		10 x "Pegoda"			
	75	75	75	75	75	
-	yes	yes	yes	yes	Yes	
64	n.a.	n.a.	n.a.	n.a.	n.a.	
SPI, I <sup>2</sup> C, RS232	USB	USB	USB	USB; Ethernet, JTag (with additional connection board)	USB; Ethernet, JTag (with additional connection board)	
RF Interface						
fully integrated	CL RC632	SL RC400	CL RC 632	RC523	RX852	
13.56	13.56	13.56	13.56	13.56	13.56	
10% & 100% ASK	10% & 100% ASK	10% & 100% ASK	10% & 100% ASK	10% & 100% ASK	10% & 100% ASK	
106/212/424/848	106/212/424	-	106/212/424	106/212/424/848	106/212/424/848	
-	1.66/26.5/53	1.66/26.5/53	1.66/26.5/53	-	-	
-	-	-	-	-	-	
-	-	-	-	-	-	
Standards & Protocols						
yes	yes	yes	yes	yes	yes	
yes	yes	-	yes	yes	yes	
yes	yes	-	yes	yes	yes	
-	yes	yes	yes	-	-	
yes	yes	-	yes	yes	yes	
-	yes	yes	yes	-	-	
-	yes	yes	yes	-	-	
-	-	-	-	-	-	
Security Features						
yes	yes	-	yes	yes	Yes	
V, f	-	-	-			
Additional Product Information						
2.5...3.6	5	5	5	5	5	
2.5...3.6	-	-	-	-	-	
1	n.a.	n.a.	n.a.	n.a.	n.a.	
1000	n.a.	n.a.	n.a.	n.a.	n.a.	
-25...+85	0...+70	0...+70	0...+70	0...+70	0...+70	
HVQFN32	-	-	-	-	-	
Approvals						
n.a.	CE, FCC	CE, FCC	CE, FCC	CE, FCC	CE, FCC	
yes	yes	yes	yes	yes	yes	

ISO/IEC 18092 / ISO/IEC 14443

NXP NFC devices						
	NFC Transceivers		NFC Controllers			
Product features	PN511	PN512	PN531	PN532	PN533	PN544
Operating distance typ [mm]	Up to 100 depending on mode, coil...	Up to 100 depending on mode, coil...	Up to 100 depending on mode, coil...	Up to 100 depending on mode, coil...	Up to 100 depending on mode, coil...	Up to 100 depending on mode, coil...
Interfaces						
Serial interface [Mbits/s]	up to 1.228	up to 1.228	up to 1.228	up to 1.228	up to 1.228	460 800 bit/s
I <sup>2</sup> C interface [bits/s]	400 K/3.4 M	400 K/3.4 M	400 K	400 K	-	400 K/3.4 M
SPI interface [Mbits/s]	up to 5	up to 5	up to 5	up to 5	-	8
8 bits parallel interface	yes (with HVQFN40)	yes (with HVQFN40)	-	-	-	-
USB 2.0 (full speed) interface	no	no	yes	-	yes	-
CL FIFO depth [bytes]	64	64	64	64	64	N/A
Serial/SPI FIFO [bytes]	-	-	180	180	180	N/A
SWP interface	-	-	-	-	-	yes
S <sup>2</sup> C interface	yes	yes	yes	yes	yes	yes
CPU	no	no	80C51	80C51	80C51	HT80C51MX
RAM/ROM/E <sup>2</sup> PROM [bytes]	-	-	1 K/32 K	1 K/40 K	1.2 K/44 K	5 K/128 K/52 K
RF interface						
Carrier frequency [MHz]	13.56	13.56	13.56	13.56	13.56	13.56
Analog interface	fully integrated	fully integrated	fully integrated	fully integrated	fully integrated	fully integrated
Standard and Protocols						
ISO 18092 peer-to-peer (active/passive)	yes	yes	yes	yes	yes	yes
ISO 14443-A reader/writer	yes	yes	yes	yes	yes	yes
ISO 14443-B reader/writer	no	yes	no	yes	yes	yes
Felica reader/writer	yes	yes	yes	yes	yes	yes
ISO 15693 reader/writer	no	no	no	no	no	yes
Card emulation	FeliCa RF, ISO 14443-A, MIFARE	FeliCa RF, ISO 14443-A, MIFARE	FeliCa RF, ISO 14443-A, MIFARE	FeliCa RF, ISO 14443-A, MIFARE	FeliCa RF, ISO 14443-A, MIFARE	FeliCa RF, ISO 14443-A-B-B', MIFARE
Baudrate [kBit/s]	106/212/424	106/212/424	106/212/424	106/212/424	106/212/424	106/212/424/848
Security features						
MIFARE classic	yes	yes	yes	yes	yes	yes
Interface to smart card controller	S <sup>2</sup> C	S <sup>2</sup> C	S <sup>2</sup> C	S <sup>2</sup> C	S <sup>2</sup> C	S <sup>2</sup> C/SWP
Additional Product information						
Embedded firmware	no	no	yes	yes	yes	yes
Middleware	HAL, NFC forum reference implementation	HAL, NFC forum reference implementation	HAL, NFC forum reference implementation	HAL, NFC forum reference implementation	HAL, NFC forum reference implementation	HAL, NFC forum reference implementation
Integrated LDO voltage regulator	no	no	no	yes	no	yes
Low battery mode	no	no	no	yes	no	yes
Battery off mode	no	no	no	no	no	yes
Supply voltage [V]	2.5...3.6	2.5...3.6	2.5...4.0	2.7...5.5	2.5...3.6	2.3...5.5
Min. host interface voltage[V]	1.6	1.6	1.6	1.6	1.6	1.65...1.95
USB bus power supply [V]	-	-	4.2...5.5	-	4.2...5.5	-
Supply voltage for secure device integrated	no	no	yes	yes	yes	S <sup>2</sup> C/SWP
Power down mode typ. [uA]	5	5	10	5	12	3
Power down mode with RF level detector on [uA]	10	10	30	25	30	50
Transmitter supply current typ. [mA]	60	60	60	60	60	60
Temperature range [°C]	-25...+85	-25...+85	-25...+85	-25...+85	-25...+85	-25...+85
Package thickness	0.85 mm	0.85 mm	0.85 mm	0.85 mm	0.85 mm	0.8 mm
Package size	5 x 5 or 6 x 6 mm <sup>2</sup>	5 x 5 or 6 x 6 mm <sup>2</sup>	6 x 6 mm <sup>2</sup>	6 x 6 mm <sup>2</sup>	6 x 6 mm <sup>2</sup>	4.5 x 4.5 mm <sup>2</sup>
Package type	HVQFN32 or HVQFN40	HVQFN32 or HVQFN40	HVQFN40	HVQFN40	HVQFN40	TFBGA64
Design-in kit	OM5561	OM5571	OM5555	OM5581	OM5588	OM5596

Transceiver: RF front-end Controller: RF front-end + microcontroller on single die



ISO 7816 / ISO 14443

**NXP MIFARE™ SAMs for Reader Systems**

Product Features	MIFARE SAM MF3 IC D40 SAM	MIFARE SAM AV1 MF3 IC D81 SAM	MIFARE SAM AV2	MF RX852
<b>Memory</b>				
E <sup>2</sup> PROM size [byte]	72 K	72 K	81 K	81 K
OTP area [bit]	-	-	-	-
Write endurance [cycles]	100 K	100 K	100 K	100 K
Data retention [yrs]	10	10	10	10
Organsation	128 key entries	128 key entries	128 key entries	128 key entries
<b>RF-Interface</b>				
Acc. to ISO 14443A	ISO 7816, T=1	ISO 7816, T=1	ISO 7816, T=1	ISO 7816, T=1
Frequency [MHz]	1...10	1...10	1...10	1...10
Baudrate [Kbit/s]	9.6...1000	9.6...1500	9.6...1500	9.6...1500
Anticollision	-	-	-	yes
Operating distance [mm]	-	-	-	RC523/80 mm
<b>Security</b>				
Unique serial number [byte]	7	7	7	7
Random number generator	yes	yes	yes	yes
Access keys	128 key entries	128 key entries	128 key entries	128 key entries
Access conditions	per key entry	per key entry	per key entry	per key entry
MIFARE classic security	supported	supported	supported	supported
DES & DES3 security	MACing/encipherment	MACing/encipherment	MACing/encipherment	MACing/encipherment
AES 128 security	-	MACing/encipherment	MACing/encipherment	MACing/encipherment
PKI	-	-	MACing/encipherment	-
RSA	-	-	MACing/encipherment	-
<b>Packaging</b>				
PCMI.1 module	P5DF072EV2/TOPD2050	P5DF072EV2/TOPD4090	P5DF081	-
HVQFN package	-	HVQFN32: P5DF072EHN/ TOPD4090	HVQFN32	HVQFN48

ISO 7816

**NXP Contact Smart Card Reader ICs**

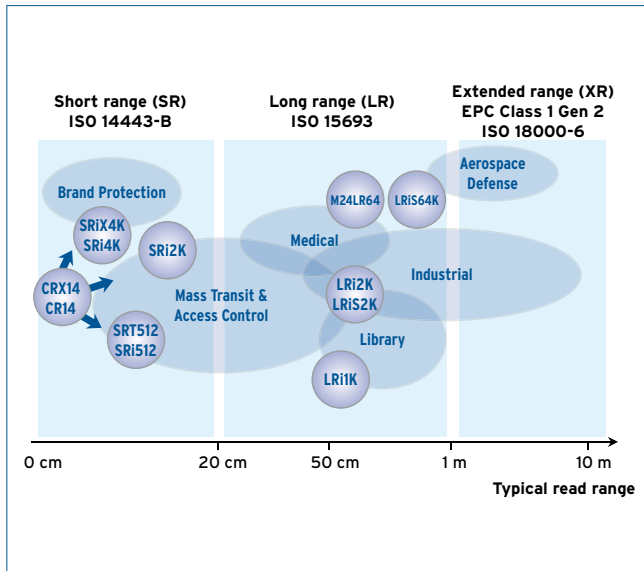
Product Features	Analog Interface						Analog & UART	Analog & UART & CPU
	TDA8020	TDA8023	TDA8024	TDA8025	TDA8026	TDA8034	TDA8007B	TDA8029
Analog interfaces	2	1	1	1	5	1	2	1
ISO 7816 UART	no	no	no	no	no	no	yes	yes
ISO 7816 dedicated timers	no	no	no	no	no	no	yes	yes
µC-core	-	-	-	-	no	-	no	80C51RB+
ROM[kbyte] / RAM[byte]	-	-	-	-	-	-	-	16/768
Flexible sequencer programming	no	yes	no	no	yes	no	no	no
Host interface	I <sup>2</sup> C	I <sup>2</sup> C	I/O lines	I/O lines	I+C	I/O lines	8 bit parallel	serial or I <sup>2</sup> C
ESD protection on ISO pads [kV]	6	6	6	6	6	6	6	6
Auxiliary protected lines for C4 and C8 contacts	0	2	2	2	2 (on slot 1)	2	2x2	0
Vcc card power supply [V]	3 & 5	1.8 & 3 & 5	3 & 5	1.2 & 1.8 & 3	1.8 & 3 & 5	1.8 & 3 & 5	1.8 & 3 & 5	1.8 & 3 & 5
Card supply current @ 5 V V <sub>cc</sub> [mA]	2x55	55	80	-	55	65	55	65
Card supply current @ 3 V V <sub>cc</sub> [mA]	2x50	55	65	65	55	65	55	50
Card supply current @ 1.8 V V <sub>cc</sub> [mA]	-	35	-	65	35	65	35	30
Card supply voltage @ 1.2 V V <sub>cc</sub> [mA]	-	-	-	30	-	-	-	-
Card clock frequency max. [MHz]	20	20	26	26	20	26	26	20
Card activation time max. [µs]	135	135	225	240	135	3500	135	225
Card deactivation time max. [µs]	110	110	100	100	100	250	100	100
<b>Protocol Support</b>								
Synchronous card management	-	yes	-	-	yes	-	yes	yes
Asynchronous protocol T=0 and T=1	yes	yes	yes	yes	yes	yes	yes	yes
<b>Security Features</b>								
Voltage supervisor and over current detection	yes	yes	yes	yes	yes	yes	yes	yes
Current protection on VCC, I/O, RST, CLK	yes	yes	yes	yes	yes	yes	yes	yes
<b>Additional Product Information</b>								
Power supply interface VDDI (V)	-	1.5...6.5	-	1.6...3.3	-	1.6...3.6	-	-
Power supply (V)	2.5...6.5	2.7...6.5	2.7...6.5	3.6...5.5	2.7...5.5	2.7...5.5	2.7...6.0	2.7...6.0
Power down current max (µA)	150	2	-	100	25	12	350	20
Temperature range (°C)	-25/+85	-40/+85	-40/+85	-25/+85	-25/+85	-25/+85	-40/+85	-25/+85
Package	LQFP32	TSSOP28	S028 & TSSOP28	HVQFN32	TFBGA64	HVQFN24 & S016	LQFP48	LQFP32
Software libraries (EMV 4.2)	-	-	-	-	-	-	yes	yes
NDS compliance	-	-	yes	yes	-	yes	-	yes
EMV compliance	EMV 4.2	EMV 4.2	EMV 4.2	-	EMV 4.2	EMV 4.2	EMV 4.2	EMV 4.2

## STMICROELECTRONICS



ST provides a wide range of radio-frequency identification (RFID) chips to match different target applications such as access control, brand protection, anti-counterfeiting, anti-theft, industrial asset tracking, libraries, logistics, textile apparel, supply chain management and retail.

ST's RFID portfolio is based on the right technology and the best quality and reliability, enhanced by its leadership in automotive E<sup>2</sup>PROM. The whole process of design, development, production and testing is managed by ST. This ensures high-volume production for a long-term partnership. Our interoperable, standard-compliant RFID memories and complete solutions provide strategic independence to our partners and are available through a wide distribution network.



## HF, SHORT-RANGE RFID ICs AND RFID COUPLERS



STMicroelectronics offers a wide range of reader ICs and tag ICs for contactless short-range applications such as transport, industrial identification and anti-counterfeiting.

These short-range applications use low-cost transponders embedded in plastic cards or paper tickets produced by partners. Transaction security is ensured by an optional state-of-the-art anti-clone algorithm. The products comply with the ISO 14443-B standard, 13.56 MHz carrier frequency.

### Common features

- ISO 14443-2 type B fully compliant
- ISO 14443-3 type B frame format compliant
- 13.56 MHz carrier frequency, 847 kHz sub-carrier and 106 Kbit/s data transfer rate
- ASK data modulation for reader-to-card and BPSK coding for card-to-reader
- 64-bit unique ID and two binary counters
- Internal tuning capacitor
- Anti-collision

Reader ICs		
Part Number	CR14	CRX14
Operating frequency	13.56 MHz	13.56 MHz
Supported protocol	ISO14443-B	ISO14443-B
Operating voltage	4.5...5.5 V	4.5...5.5 V
Operating distance	up to 10 cm	up to 10 cm
Data rate (Kbit/s)	106	106
Communication interface	I <sup>2</sup> C 400 kHz	I <sup>2</sup> C 400 kHz
Operating temperature	-20...+85 °C	-20...+85 °C
Embedded security	no	Proprietary anti-clone function
Package	SO16	SO16
Packing/delivery	Tube, tape and reel	Tube, tape and reel

HF, Short range tag ICs (ISO14443)					
Part Number	SRI512	SRT512	SRI2K	SRI4K	SRIx4K
RF interface					
Operating frequency	13.56 MHz	13.56 MHz	13.56 MHz	13.56 MHz	13.56 MHz
Supported protocol	ISO14443-B	ISO14443-B	ISO14443-B	ISO14443-B	ISO14443-B
Operating distance	up to 10 cm	up to 10 cm	up to 10 cm	up to 10 cm	up to 10 cm
Data rate (Kbit/s)	106	106	106	106	106
Anti-collision	yes	yes	yes	yes	yes
Memory					
UID (bit)	64	64	64	64	64
Chip ID (bit)	8	8	8	8	8
E <sup>2</sup> PROM Memory (bit)	288	448	1824	3872	3872
OTP memory (bit)	160	0	160	160	160
Counters w/ anti-tearing	2 x 32-bit	2 x 32-bit	2 x 32-bit	2 x 32-bit	2 x 32-bit
Organisation	16 x 32 bits	16 x 32 bits	64 x 32 bits	128 x 32 bits	128 x 32 bits
Data retention	40-year	40-year	40-year	40-year	40-year
Endurance	1 Million erase write cycles	1 Million erase write cycles	1 Million erase write cycles	1 Million erase write cycles	1 Million erase write cycles
Specific functions					
Proprietary anti-clone	no	no	no	no	yes
Block lock	yes	yes	yes	yes	yes
Other information					
Internal tuning capacitor	64 pF	64 pF	64 pF	64 pF	64 pF
Operating temperature	-20...+85 °C	-20...+85 °C	-20...+85 °C	-20...+85 °C	-20...+85 °C
Package	wafer, bumped die	wafer, bumped die	wafer, bumped die	wafer, bumped die	wafer, bumped die

## HF, LONG-RANGE RFID ICs



Long-range RFID applications operate within one meter from the reader and typically involve a large number of tag transponders (100+), requiring reliable anti-collision mechanisms and full interoperability. The products comply with ISO 15693 standard.

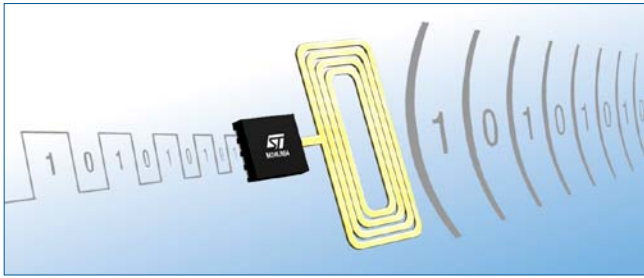
### Common features

- ISO 15693 compliant
- 13.56 MHz carrier frequency
- ASK data modulation for reader-to-card and Manchester coding for card-to-reader
- Internal tuning capacitor
- Anti-collision
- 64-bit unique ID
- Electronic article surveillance (EAS) capable through AFI
- Kill command
- Supports 53-Kbit/s data transfer rate

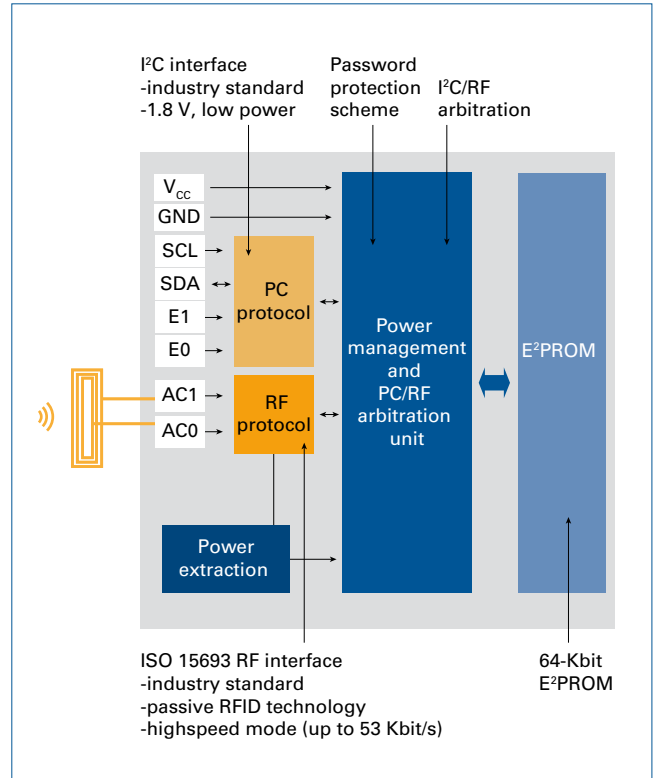
HF, Long range tag ICs (ISO15693)					
	Part Number	LR11K	LRi2K	LRIS2K	LRIS64K
RF interface	Operating frequency	13.56 MHz	13.56 MHz	13.56 MHz	13.56 MHz
	Supported protocol	ISO15693	ISO15693	ISO15693	ISO15693
	Operating distance	up to 1.5 m	up to 1.5 m	up to 1.5 m	up to 1.5 m
	Data rate (Kbit/s)	up to 53	up to 53	up to 53	up to 53
	Anti-collision	yes	yes	yes	yes
Memory	E <sup>2</sup> PROM Memory Size (bit)	1024	2048	2048	65536
	UID (bit)	64	64	64	64
	AFI, DSFID	yes	yes	yes	yes
	Organisation	32 blocks x 32 bit	64 blocks x 32 bit	64 blocks x 32 bit	64 blocks x 1024 bit
	Data retention	40-year	40-year	40-year	40-year
	Endurance	1 Million erase write cycles	1 Million erase write cycles	1 Million erase write cycles	1 Million erase write cycles
	Specific functions				
	EAS for Library	yes, using AFI	yes, using AFI	yes, using AFI	yes, using AFI
	Kill function	yes	yes	yes	no
	Password protection	no	no	yes, 32-bit	yes, 32-bit
Block lock	yes	yes	yes	yes	
Other information	Internal tuning capacitor	21 pF	21 pF, 23.5 pF, 28.5 pF, 97 pF	21 pF, 23.5 pF, 28.5 pF, 97 pF	27.5 pF
	Operating temperature	-20...+85 °C	-20...+85 °C	-20...+85 °C	-20...+85 °C
	Package	sawn bumped wafer	wafer, sawn bumped wafer, UDFPN8	sawn bumped wafer	sawn bumped wafer
	Availability	sampling in Q4 2010	in production	sampling in Q4 2010	sampling in Q4 2010

## M24LR64-R

### Read and write parameters from inside (I<sup>2</sup>C) and outside (RF) the application





The innovative family of Dual Interface E<sup>2</sup>PROM provides new features and capabilities. The E<sup>2</sup>PROM memory bank can be accessed either by a standard I<sup>2</sup>C interface or by an ISO 15693 RF interface. In addition, the family features a 32-bit password protection mechanism. The ISO 15693 RF interface is based on a passive RFID technology that does not require a battery or power to operate, as it gets both the energy and the data stream from the RF reader. This enables on-board energy savings and provides easy and convenient remote access to electronic product parameters.



Dual Interface E <sup>2</sup> PROM (I <sup>2</sup> C / ISO15693)	
Part Number	M24LR64
RF interface	
Operating frequency	13.56 MHz
Supported protocol	ISO15693
Operating distance	up to 1.5 m
Data rate (Kbit/s)	up to 53
Anti-collision	yes
Serial Interface	
Operating frequency	400 kHz
Supported protocol	I <sup>2</sup> C
Operating voltage	1.8...5.5 V
Memory	
E <sup>2</sup> PROM memory size (bit)	65536
UID (bit)	64
AFI, DSFID	yes
Organisation	64 blocks x 1024-bit
Data retention	40-year
Endurance	1 Million erase write cycles
Specific functions	
I <sup>2</sup> C-RF arbitration unit	yes
EAS for Library	yes, using AFI
Kill function	no
Password protection	yes
Block lock	yes
Other information	
Internal tuning capacitor	27.5 pF
Operating temperature	-40...+85 °C
Package	Sawn wafer, SO8, TSSOP8, UDFPN8
Availability	In production



Dual Interface E <sup>2</sup> PROM - tools summary		
		
Purpose	Evaluation, proof-of-concept	Development, advanced evaluation
RF operating distance	Up to 8 cm*	Up to 40 cm*
RF and I <sup>2</sup> C communication speed	<b>Slow</b> read 64 Kbit: 1'24" write 64 Kbit: 5'34"	<b>Fast</b> read 64 Kbit: 0'08" write 64 Kbit: 0'31"
RF capabilities	1 tag at a time	multi-tag capability
Software	Windows dll source code	Windows SDK for free (other platforms SDK with charge) <i>FEIG download access code available</i>
Ordering information	STARTKIT-M24LR-A	DEVKIT-M24LR-A

## TEXAS INSTRUMENTS – RFID SYSTEMS PRODUCT SPECIFICATIONS



### Overview

Texas Instruments Radio Frequency Identification Systems is an industry leader in RFID technology, and the world's largest integrated manufacturer of TI-RFid™ tags, TI-RFid smart labels, and TI-RFid reader systems. With more than 1 billion RFID tags manufactured, TI-RFid technology is used in a broad range of RFID applications worldwide. TI is an active member of many standards bodies, ISO, ISO/IEC, ECMA International, ETSI, and several national standardisation bodies working to drive the adoption of global standards for RFID technology.

### Applications

Partner with TI, the technology leader in application-specific RFID solutions, for turnkey end-to-end formulae to employ

RFID in specific tracking models such as re-cycling, waste management and high value asset tracking – to name a few. The integration of TI-RFid products into proven application models, in conjunction with third-party Developers' Network partners gives customers the ability to adapt an end-to-end RFID asset tracking solutions for their business, without costly mistakes or development time. TI's RFID Application Solutions are state-of-the-art design and system models for unique vertical business needs that result in lower overall system cost and faster, more efficient roll-outs. Learn more at [www.ti.com/rfid-applications](http://www.ti.com/rfid-applications).



LF Reader Types					
Part Number	TMS3705A1DRG4	RI-RFM-003B	RI-RFM-007B	RI-RFM-008B	RI-ACC-008B
Type	IC (SO 16)	Mini RFM module	High performance RFM	Remote antenna RFM	Antenna tuning board
Typical read range*	up to 20 cm	up to 60 cm	up to 200 cm	up to 200 cm	up to 200 cm
Interface	I/O	I/O	I/O**	I/O**	Antenna terminals
Operating frequency	134.2 kHz	134.2 kHz	134.2 kHz	134.2 kHz	134.2 kHz
Operating voltage	4.5...5.5 V <sub>DC</sub>	5 V <sub>DC</sub>	7...24 V <sub>DC</sub>	7...24 V <sub>DC</sub>	
Part Number	RI-CTL-MB2B	RI-CTL-MB6B	RI-STU-MRD1	RI-STU-251B	
Type	Digital contr. module	Digital contr. module	Reader module	Reader/writer	
Typical read range*			up to 30 cm	up to 200 cm	
Interface	RS232, USB	RS422/485, USB	(RS232, TTL level)	RS232/422/485	
Operating frequency			134.2 kHz	134.2 kHz	
Operating voltage	7...25 V <sub>DC</sub>	7...25 V <sub>DC</sub>	5 V <sub>DC</sub>	10...24 V <sub>DC</sub>	

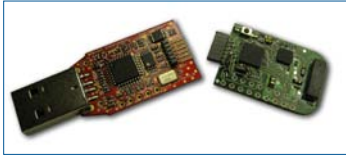
\*\* Modules RI-CTL-MB2B/RI-CTL-MB6B have to be combined with RFM modules - RI-RFM-007B, RI-RFM-008B

LF Antenna Types					
Part Number	RI-ANT-S01C, RI-ANT-S02C	RI-ANT-P02A	RI-ANT-G01E	RI-ANT-G02E	RI-ANT-G04E
Type	Stick	Stick	Gate	Gate	Gate
Inductance	27 µH	116 µH	27 µH	27 µH	26 µH
Dimensions	140 ± 2 x 21 ± 2 (dia.) mm <sup>2</sup>	133 ± 1 x 21.3 ± 1 (dia.) mm <sup>2</sup>	715 x 270 x 25 mm <sup>3</sup>	200 x 200 x 25 mm <sup>3</sup>	1018 x 518 x 47 mm <sup>3</sup>
Operating temperature	-30...+70 °C	-30...+70 °C	-30...+60 °C	-30...+60 °C	-30...+60 °C
Protection class	IP66	IP65	IP65	IP65	IP44

LF Transponders					
Part Number	RI-TRP-R9BK, RI-TRP-W9WK, RI-TRP-M9WK	RI-TRP-RR3P, RI-TRP-WR3P, RI-TRP-REHP, RI-TRP-WEHP	RI-INL-RR2B, RI-TRP-WR2B, RI-INL-DR2B, RI-TRP-RE2B/WE2B	RI-INL-R9QM, RI-INL-W9QM	RI-TRP-R9VS, RI-TRP-W9VS
Type	12 mm Wedge	23 mm Glass	32 mm Glass	24 mm Disk	Mount-on-Metal
Memory types available	R/O (64 bit), R/W (80 bit), Multi (32 bit UID, 208 bit R/W)	R/O (64 bit), R/W (80 bit)	R/O (64 bit), R/W (80 bit), MPT (1360 bit)	R/O (64 bit), R/W (80 bit)	R/O (64 bit), R/W (80 bit)
Typical read range*	up to 20 cm	up to 60 cm	up to 100 cm	up to 50 cm	up to 120 cm
Operating frequency	134.2 kHz	134.2 kHz	134.2 kHz	134.2 kHz	134.2 kHz
Dimensions	12 x 6 x 3 mm <sup>3</sup>	3.85 x 23.1 mm <sup>2</sup>	3.85 x 31.2 mm <sup>2</sup>	24 mm dia.	102 x 36 x 16.5 mm <sup>3</sup>
Protection class	IP68	Hermetically sealed	Hermetically sealed		IP67
Case material	Plastic compound	Glass	Glass		PP
Part Number	RI-TRP-R9QL, RI-TRP-W9QL	RI-TRP-R9UR, RI-TRP-W9UR	RI-TRP-RFOB, RI-TRP-WFOB	RI-TRP-R4FF, RI-TRP-W4FF	RI-TRP-R9TD, RI-TRP-W9TD
Type	30 mm Disk	85 mm Disk	Keyring Tag	Card	120 mm Cylindrical
Memory types available	R/O (64 bit), R/W (80 bit)	R/O (64 bit), R/W (80 bit)	R/O (64 bit), R/W (80 bit)	R/O (64 bit), R/W (80 bit)	R/O (64 bit), R/W (80 bit)
Typical read range*	up to 60 cm	up to 150 cm	up to 60 cm	up to 100 cm	up to 200 cm
Operating frequency	134.2 kHz	134.2 kHz	134.2 kHz	134.2 kHz	134.2 kHz
Dimensions	29.4 x 8.4 mm <sup>2</sup>	85.5 x 5.5 mm <sup>2</sup>	10.5 x 37.5 mm <sup>2</sup>	85.5 x 54 x 1.3 mm <sup>3</sup>	21 x 121 mm <sup>2</sup>
Protection class	IP67	IP53	Hermetically sealed	ISO 7810	IP67
Case material	POM	ASA	ABS, glass	PVC	PEI

\* Dependent on the configuration used, the RF regulation in country of use and the environmental condition

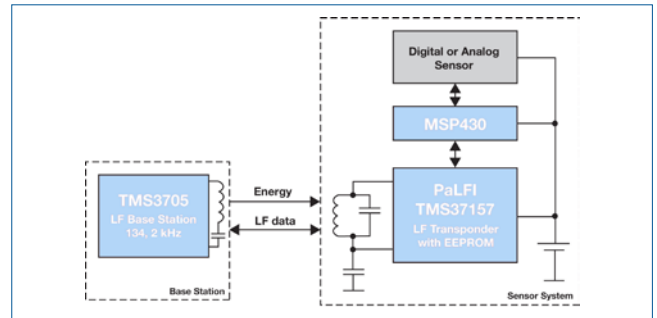
## PaLFI – PASSIVE LOW FREQUENCY INTERFACE



Developers in medical, industrial and consumer applications continuously strive to increase wireless functionality to enhance the convenience of products.

The PaLFI (Passive Low Frequency Interface device) TMS37157 combines a low frequency wireless interface with an SPI interface which ensures ultra-stable communication within a very well-defined activation/communication zone and can wirelessly supply an ultra-low-power MSP430 microcontroller (MCU) with energy to operate without a battery. For example, PaLFI has the ability to remotely communicate with and

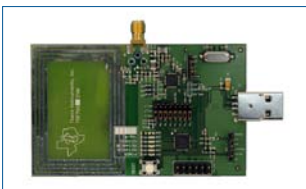
power implantable medical devices, making procedures less invasive. Among numerous other potential applications, the device is also being used for production chain or container tracking and end of line configuration of electronic equipment and measurement instruments.



PaLFI - Passive Low Frequency Interface

Part Number	TMS37157
Communication interfaces	SPI, RFID, direct microcontroller access via RFID
Operating frequency	134.2 kHz
Wired communication interface	3-wire SPI
Operating voltage	2...3.6 V <sub>DC</sub>
Current consumption	Active mode max. 150 µA Power down mode 60 nA
Battery charge current	max. 2 mA
Memory	32-bit unique serial number 968-bit E <sup>2</sup> PROM user memory 8-bit selective address
Operating temperature	-40...+85 °C
Storage temperature	-40...+125 °C
Package	16 Pin VQFN, (4 x 4 mm <sup>2</sup> )
Packing/delivery	Tape-on Reel, 3000 per reel

## TRF7960 READERS



The TRF7960/7961 is a high-frequency (13.56 MHz) multi-standard RFID reader IC product family. It supports ISO/IEC 14443A/B, ISO15693, ISO/IEC18000-3 standard with

completely integrated protocol handling. Separate internal High-PSRR power supplies for Analog, Digital, and PA sections provide noise isolation for superior read range and reliability. Dual receiver inputs with AM and PM demodulation to minimise communication holes and receiver AM and PM RSSI. An EVM as also a reference design and source code for a TRF7960/ TRF7961 plus a MSP430 MCU solution is available for easy evaluation.

HF Reader ICs

Part Number	TRF7960	TRF7961
Operating frequency	13.56 MHz	13.56 MHz
Supported protocols	ISO 15693 ISO 18000-3 (Mode 1) ISO 14443A & B	ISO 15693 ISO 18000-3 (Mode 1)
Operating voltage	2.7...5.5 V <sub>DC</sub>	2.7...5.5 V <sub>DC</sub>
Current consumption	Transmit: 200 mW @ 120 mA, typ. 100 mW @ 70 mA, typ. Active (RX only): 10 mA, typ. Stand-by: 120 µA Power down: <1 µA	Transmit: 200 mW @ 120 mA, typ. 100 mW @ 70 mA, typ. Active (RX only): 10 mA, typ. Stand-by: 120 µA Power down: <1 µA
Transmitter power	Adjustable power, 100 mW or 200 mW at 5 V <sub>DC</sub>	Adjustable power, 100 mW or 200 mW at 5 V <sub>DC</sub>
Transmitter modulation	ASK, adjustable 8% to 30% OOK	ASK, adjustable 8% to 30% OOK
Communication interface	Parallel 8-bit or 4-wire SPI	Parallel 8-bit or 4-wire SPI
Operating temperature	-40...+110 °C	-40...+110 °C
Storage temperature	-55...+150 °C	-55...+150 °C
Package	32 Pin QFN, (5 x 5 mm <sup>2</sup> )	32 Pin QFN, (5 x 5 mm <sup>2</sup> )
Packing/delivery	Tape-on reel, 250 or 3000 per reel	Tape-on reel, 250 or 3000 per reel

### HF Packaged Transponders

Part Number	RF-HDT-DVBE	RF-HDT-DVBB	RI-TH1-CB1A
Type	22 mm coin over-moulded	22 mm coin over-moulded	Vicinity card
Available memory	256 bits organised in 8 x 32-bit blocks	2k bits organised in 64 x 32-bit blocks	2k bits organised in 64 x 32-bit blocks
Operating frequency	13.56 MHz ± 300 kHz	13.56 MHz ± 300 kHz	13.56 MHz ± 200 kHz
Dimensions	∅ 22 ± 0.2 x 3 ± 0.2 mm <sup>2</sup>	∅ 22 ± 0.2 x 3 ± 0.2 mm <sup>2</sup>	85.6 x 54 x 0.76 mm <sup>3</sup> (according ISO 7810)
Case material	PPS, black	PPS, black	PVC (Polyvinylchloride), white

### Tag-it™ INLAYS



The Texas Instruments (TI) Tag-it HF-I family of transponder inlays consists of 13.56 MHz high-frequency (HF) transponders that are compliant with ISO/IEC 15693 and ISO/IEC 18000-3 global open standards.

These products are available in six different antenna shapes with frequency offset for integration into paper, PVC or other substrates. Tag-it HF-I transponder inlays are manufactured with TI's patented laser-tuning process to provide consistent read performance. Prior to delivery, the transponders undergo complete functional and parametric testing to provide the high quality customers expect from TI. The Tag-it HF-I family of transponders is available with 2 kbit and 256 bit memory.

### Tag-it™ HF-I Family Die

Part number	RF-HDT-AJLE-G1	RF-HDT-WNME-MO	RF-HDT-AJLS-G1
HF-I family	Standard	Standard	Pro
Die supported standards	ISO/IEC 15693; ISO/IEC 18000-3 (Mode 1)	ISO/IEC 15693; ISO/IEC 18000-3 (Mode 1)	ISO/IEC 15693; ISO/IEC 18000-3 (Mode 1)
Available memory	256 bits organised in 8 x 32-bit blocks	256 bits organised in 8 x 32-bit blocks	256 bits organised in 8 x 32-bit blocks
Die thickness	150 µm	710...740 µm	150 µm
Wafer processing	Bumped, sawn, grinded, inked		Bumped, sawn, grinded, inked
Bump material	Gold (AU)		Gold (AU)

### Tag-it™ HF-I Plus Transponders Inlay

Part Number	RI-I11-112A-03 (square)	RI-I11-112B-03 (square)	RI-I02-112A-03 (rectangle-lg)	RI-I02-112B-03 (rectangle-lg)	RI-I03-112A-03 (rectangle-mini)	RI-I15-112B-03 (rectangle-med)	RI-I16-112A-03 (circular)	RI-I17-112A-03 (CD/DVD)
Supported standards	ISO 15693, ISO/IEC 18000-3 (Mode 1)							
Available memory	2 Kbits organised in 64 x 32-bit blocks							
Factory programmed	64 bits							
Resource frequency	13.86 MHz	14.4 MHz	13.86 MHz	14.4 MHz	13.86 MHz	14.1 MHz	13.7 MHz	13.8 MHz
Frequency offset for lamination material	Paper	PVC	Paper	PVC	Paper/PVC	PVC	Paper/PVC	Paper/PVC
Antenna size (mm)	45 x 45	45 x 45	45 x 76	45 x 76	22.5 x 38	34 x 65	∅ 24.2	∅ 32.5
Foil width (mm)	48 ± 0.5							
Delivery	Single row tape with 48-mm foil width wound on cardboard reel							

### Tag-it™ HF-I Pro Transponder Inlays Features - Password Write/Password Kill Functionality

Part Number	RI-I11-114A-S1 (square)	RI-I11-114B-S1 (square)	RI-I02-114A-S1 (rectangle-lg)	RI-I02-114B-S1 (rectangle-lg)	RI-I03-114A-S1 (rectangle-mini)	RI-I16-114A-S1 (circular)	RI-I17-114A-S1 (CD/DVD)
Supported standards	ISO 15693, ISO/IEC 18000-3 (Mode 1)						
Available memory	256 bits organised in 8 x 32-bit blocks						
Factory programmed	64 bits						
Resource frequency	13.86 MHz	14.4 MHz	13.86 MHz	14.4 MHz	13.86 MHz	13.7 MHz	13.8 MHz
Frequency offset for lamination material	Paper	PVC	Paper	PVC	Paper/PVC	Paper/PVC	Paper/PVC
Antenna size (mm)	45 x 45	45 x 45	45 x 76	45 x 76	22.5 x 38	∅ 24.2	∅ 32.5
Foil width (mm)	48 ± 0.5						
Delivery	Single row tape with 48-mm foil width wound on cardboard reel						

### Tag-it™ HF-I Standard Transponder Inlays

Part Number	RI-I11-114A-01 (square)	RI-I11-114B-01 (square)	RI-I02-114A-01 (rectangle-lg)	RI-I02-114B-01 (rectangle-lg)	RI-I03-114-01 (rectangle-mini)	RI-I16-114A-01 (circular)	RI-I17-114A-01 (CD/DVD)
Supported standards	ISO/IEC 15693; ISO/IEC 18000-3 (Mode 1)						
Available memory	256 bits organised in 8 x 32-bit blocks						
Factory programmed	64 bits						
Resource frequency	13.86 MHz	14.2 MHz	13.86 MHz	14.4 MHz	13.86 MHz	13.7 MHz	13.8 MHz
Frequency offset for lamination material	Paper	PVC	Paper	PVC	Paper/PVC	Paper/PVC	Paper/PVC
Antenna size (mm)	45 x 45	45 x 45	45 x 76	45 x 76	22.5 x 38	∅ 24.2	∅ 32.5
Foil width (mm)	48 ± 0.5						
Delivery	Single row tape with 48-mm foil width wound on cardboard reel						

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