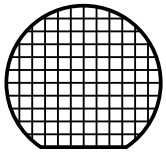
# SRTAG16K

## NFC Forum Type 4 Tag IC with 16-Kbit EEPROM

**Datasheet - production data**



Wafer (SB12I)

## Description

The SRTAG16K device is a dynamic NFC/RFID tag IC. It embeds an EEPROM memory. It can be operated from a 13.56 MHz RFID reader or an NFC phone.

The RF protocol is compatible with ISO/IEC 14443 Type A and NFC Forum Type 4 Tag.

## Features

### Contactless interface

- NFC Forum Type 4 Tag
- ISO/IEC 14443 Type A
- 106 Kbps data rate
- Internal tuning capacitance: 25 pF

### Memory

- 2-Kbyte (16-kbit) EEPROM
- Support of NDEF data structure
- Data retention: 200 years
- Endurance: 1 million erase-write cycles
- Read up to 246 bytes in a single command
- Write up to 246 bytes in a single command
- 7 bytes unique identifier (UID)
- 128 bits passwords protection



This is information on a product in full production. www.st.com

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# 1 Functional description

The SRTAG16K device is a dynamic NFC/RFID tag that can be accessed from the RF interface. The RF interface is based on the ISO/IEC 14443 Type A standard. The SRTAG16K is compatible with the NFC Forum Type 4 Tag specifications and supports all corresponding commands.

*Figure 1* displays the block diagram of the SRTAG16K device.

**Figure 1. SRTAG16K block diagram**

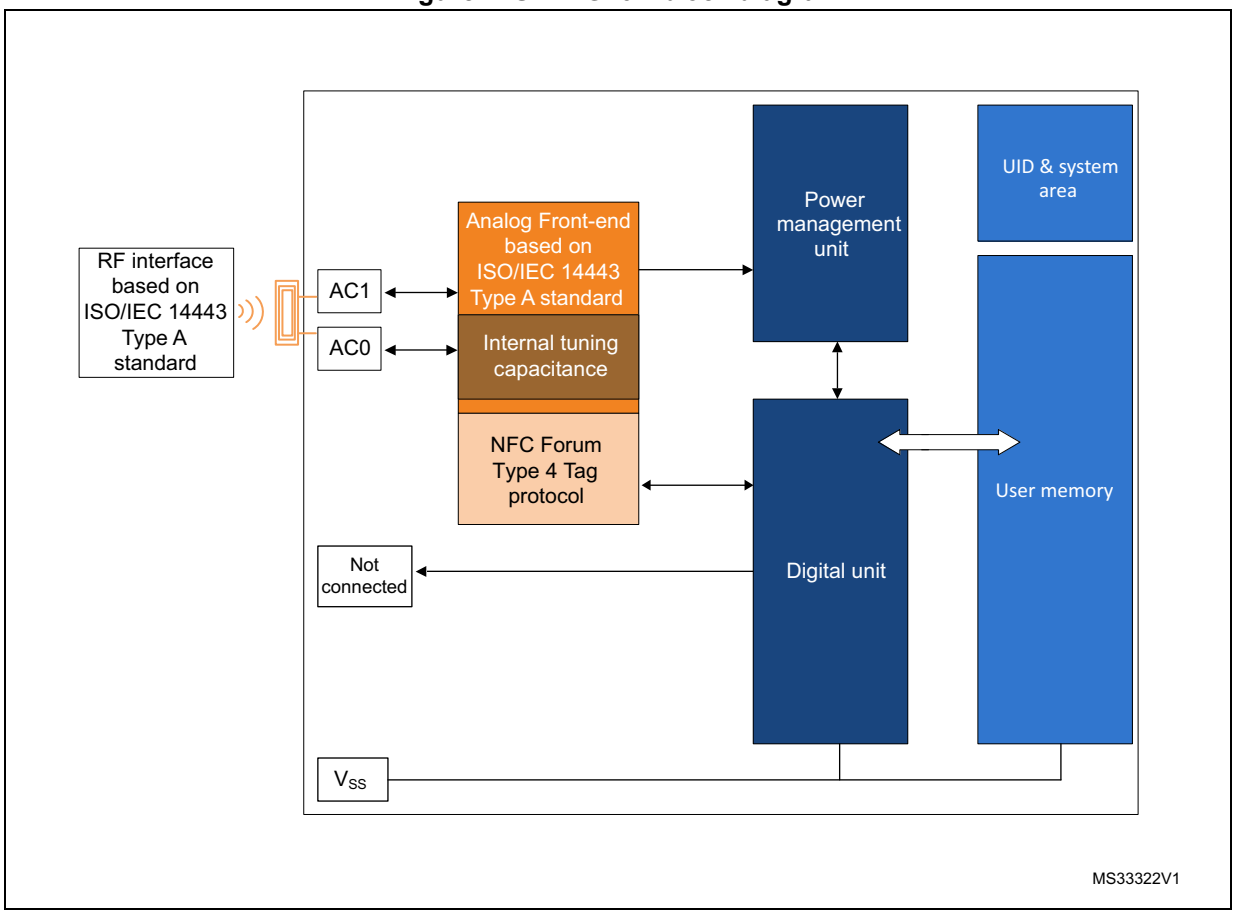


**Table 1. Signal names**

| Signal name | Function | Direction |
|---|---|---|
| AC0, AC1 | Antenna coils | - |

## 1.1 Functional modes

The SRTAG16K has just one functional mode (see *Table 2*).

**Table 2. Functional mode**

| Mode | Supply source | Comments |
|---|---|---|
| Tag mode | RF field only | The interface is connected |

### 1.1.1 Tag mode

The SRTAG16K is supplied by the RF field and can communicate with an RF host (RFID reader or an NFC phone). The User memory can only be accessed by the RF commands.

# 2 Signal descriptions

## 2.1 Antenna coil (AC0, AC1)

These inputs are used to connect the device to an external coil exclusively. It is advised not to connect any other DC or AC path to AC0 or AC1.

When correctly tuned, the coil is used to access the device using NFC Forum Type 4 commands.

# 3 SRTAG16K memory management

## 3.1 Memory structure

The SRTAG16K supports the NDEF Tag Application as defined in the NFC Forum Type 4 Tag. The SRTAG16K is composed of three files:

- One Capability Container file
- One NDEF file
- One System file: this is an ST-proprietary file

The System file contains some information on the configuration of the SRTAG16K device. The CC file gives some information about the SRTAG16K itself and the NDEF file. The NDEF file contains the User data.

### 3.1.1 File identifier

The file identifier is the value used in the Select command to select a file.

**Table 3. File identifier**

| File identifier | Meaning |
|---|---|
| 0xE101 | System file |
| 0xE103 | CC file |
| 0x0001 | NDEF file |

### 3.1.2 CC file layout

The CC file gives some information about the SRTAG16K and the NDEF file. This file is a read-only file for the RF host and cannot be modified by issuing a write command.

The T field, Read Access and Write Access fields can be changed by the RF host by issuing a specific process (refer to *Section 7: Functional procedures*).

**Table 4. CC file layout for 1 NDEF file**

| File offset | Meaning | Value | Comments |
|---|---|---|---|
| 0x0000 | Number of bytes of CC file | 0x000F | 15 bytes |
| 0x0002 | Mapping version(1) | 0x20 or 0x10 | V 2.0 or V 1.0 |
| 0x0003 | Maximum number of bytes that can be read | 0x00F6 | 246 bytes |
| 0x0005 | Maximum number of bytes that can be written | 0x00F6 | 246 bytes |
| 0x0007 | NDEF file control TLV | 0x04 (2) | T field |
| 0x0008 | | 0x06 | L field |
| 0x0009 | | 0x0001 | FileID |
| 0x000B | | 0x0800 | Maximum NDEF file size |
| 0x000D | | 0x00 (2) | Read access |
| 0x000E | | 0x00 (2) | Write access |

1. According to the reader.
2. Delivery state.

### 3.1.3 NDEF file layout

The NDEF file contains the NDEF message which contains the User data. The RF host host can read and write data inside the file. The first two bytes named NDEF Message Length define the size of the NDEF message. The NDEF Message Length shall be managed by the application and the SRTAG16K device does not check if its value is relevant vs the data written by the RF host. The SRTAG16K device uses the NDEF Message Length, e. g. the standard read can be processed only inside the NDEF message; otherwise, the SRTAG16K device returns an error code. For more details about the read command, refer to *Section 5.6.7: ReadBinary command*.

**Table 5. NDEF file layout**

| File offset | Byte 0 | Byte 1 | Byte 2 | Byte 3 |
|---|---|---|---|---|
| 0x0000 | NDEF message length | | User data | User data |
| 0x0004 | User data | User data | User data | User data |
| ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... |
| ... | ... | ... | ... | ... |
| 0x07FF | ... | ... | ... | User data |

### 3.1.4 System file layout

The system file specifies the configuration of the SRTAG16K. *Table 6* lists the different fields.

**Table 6. Field list**

| File offset | Field name | Number of bytes | Read access | Write access | Delivery state (1) |
|---|---|---|---|---|---|
| 0x0000 | Length system file | 2 | RF | - | 0x0012 |
| 0x0002 | ST reserved | 1 | RF | none | 0x01 |
| 0x0003 | ST reserved | 1 | RF | none | 0x00 |
| 0x0004 | ST reserved | 1 | RF | none | 0x11 |
| 0x0005 | ST reserved | 1 | RF | none | 0x00 |
| 0x0006 | ST reserved | 1 | RF | none | 0x01 |
| 0x0007 | NDEF File number (RFU) | 1 | RF | none | 0x00 |
| 0x0008 | UID | 7 | RF | none | 0x02C5 xx xx xx xx xx(2) |
| 0x000F | Memory Size | 2 | RF | none | 0x07FF |
| 0x0011 | Product Code | 1 | RF | none | 0xC5 |

1. The delivery state for all passwords = 0x00000000000000000000000000000000.
2. x values are defined by ST to insure UID unicity.

## 3.2 Read and write access rights to the memory

An NDEF file can be locked for read or write accesses. It is also protected by a 128-bit password that the host shall present before accessing the NDEF file. There are two 128-bit passwords, one for the read access and the other one for the write access.

An NDEF file can be permanently locked for read or write accesses. Thus, the host cannot access the NDEF file.

The read password shall be sent to the SRTAG16K device before reading a read-locked NDEF file.

The write password shall be present on the SRTAG16K device before writing a write-locked NDEF file. The write password shall be sent to change the read or write access. The read or write access right is defined for the NDEF file.

### 3.2.1 State of the Read and Write access rights

Two bytes in the CC file are used to define the Read and Write access rights to the NDEF file. For more details, refer to *Section 3.1.2: CC file layout*.

**Table 7. Read access right**

| Value | Meaning |
|---|---|
| 0x00 | Read access without any security |
| 0x80 | Locked (1) |
| 0xFE | Read not authorized |

1. The read password shall be sent before reading in the NDEF file.

**Table 8. Write access right**

| Value | Meaning |
|---|---|
| 0x00 | Write access without any security |
| 0x80 | Locked (1) |
| 0xFF | Write not authorized |

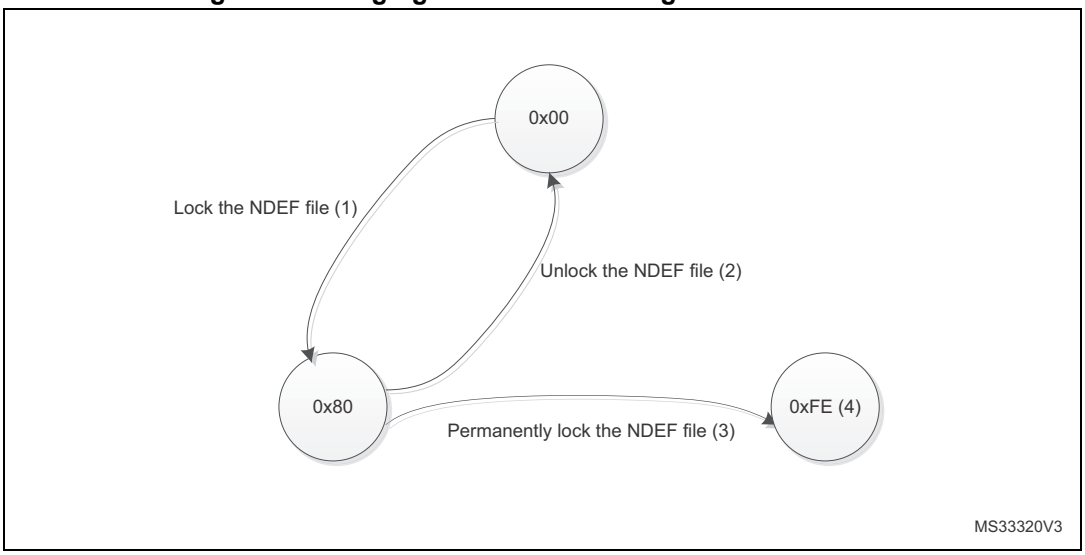
1. The write password shall be sent before writing in the NDEF file.

The state 0xFF and 0xFE cannot be changed by using the Read or Write passwords.

### 3.2.2 Changing the read access right to NDEF files

The state diagram on *Figure 2* shows how to change the access right to read an NDEF file.

**Figure 2. Changing the read access right to an NDEF file**

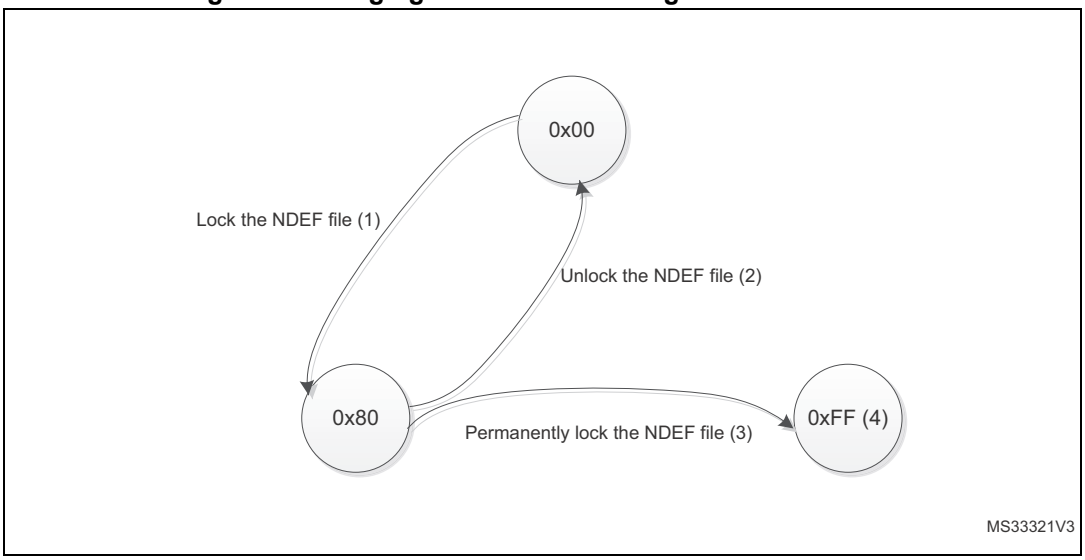



1. See the procedure to lock the read access (*Section 7.4: Locking an NDEF file*).
2. See the procedure to unlock the read access (*Section 7.5: Unlocking an NDEF file*).
3. See the procedure to permanently lock the read access (*Section 7.6: Reaching the read-only state for an NDEF file*).
4. Proprietary state, not defined by NFC Forum Type 4 Tag.

### 3.2.3 Changing the write access right to NDEF files

The state diagram on *Figure 3* shows how to change the write access right to an NDEF file.

**Figure 3. Changing the write access right to an NDEF file**




1. See the procedure to lock the write access.
2. See the procedure to unlock the write access.
3. See the procedure to permanently lock the write access (*Section 7.6: Reaching the read-only state for an NDEF file*).
4. Proprietary state, not defined by NFC Forum Type 4 Tag.

## 3.3 Access right life time

The access right life time is validated while the NDEF file is selected or until the end of the RF session. Once the read or write access right is granted, the host can send one or more ReadBinary or UpdateBinary commands.

At the end of a session or when the host selects another file, the read and write access rights are initialized.

## 3.4 NDEF file passwords

The NDEF file passwords protect the read or write access from an RF interface from/to an NDEF file.

Two NDEF file passwords are available for each NDEF file:

- Read password
- Write password

The length of a password is 128 bits (16 bytes).

# 4 Communication mechanism

This chapter describes the principle of communication between an RF host and the SRTAG16K device.

## 4.1 Master and slave

The SRTAG16K acts as a slave device on the RF channel and therefore waits for a command from the RF host before sending its response.

The RF host shall generate the RF field and the RF commands.

# 5 RF command sets

This section describes the SRTAG16K command sets that can be issued by the RF host.

There are three command families:

- the NFC Forum Type 4 Tag command set
- the ISO/IEC 7816-4 command set
- the proprietary command set

The NFC Forum Type 4 Tag command set and the ISO/IEC 7816-4 command set use the I-Block format. For more details about the I-Block format, refer to *Section 5.2: I-Block format*.

Two other command formats exist:

- the commands using the R-Block format
- the commands using the S-Block format

For more details about these formats, refer to the corresponding sections: *Section 5.3: R-Block format* and *Section 5.4: S-Block format*.

This section gives a brief description of the RF host commands. The format of these command sets is the I-Block format.

*Table 9* lists the RF command sets.

**Table 9. RF command sets**

| Family command set | Command name | Class byte | Instruction code | Brief description |
|---|---|---|---|---|
| NFC Forum Type 4 Tag | NDEF Tag Application Select | 0x00 | 0xA4 | NDEF Tag Application Select |
| | CC select | 0x00 | 0xA4 | Select the CC file |
| | NDEF select | 0x00 | 0xA4 | Select the NDEF file |
| | System select | 0x00 | 0xA4 | Select the system file |
| | ReadBinary | 0x00 | 0xB0 | Read data from file |
| | UpdateBinary | 0x00 | 0xD6 | Write or erase data to a NDEF file |
| ISO/IEC 7816-4 | Verify | 0x00 | 0x20 | Checks the right access of a NDEF file or sends a password |
| | ChangeReferenceData | 0x00 | 0x24 | Change a Read or write password |
| | EnableVerificationRequirement | 0x00 | 0x28 | Activate the password security |
| | DisableVerificationRequirement | 0x00 | 0x26 | Disable the password security |
| ST Proprietary | EnablePermanentState | 0xA2 | 0x28 | Enables the Read Only or Write Only security state |
| ST Proprietary | ExtendedReadBinary | 0xA2 | 0xB0 | Read data from file |

## 5.1 Structure of the command sets

The exchange of data between the RF host and the SRTAG16K uses three kinds of data formats, called blocks:

- I-Block: to exchange the command and the response
- R-Block: to exchange positive or negative acknowledgment
- S-Block: to use either the Deselect command or the Frame Waiting eXtension (WTX) command or response

This section describes the structure of the I-Block, R-block and S-Block. This format is used for the application command set.

## 5.2 I-Block format

The I-Block is used to exchange data between the RF host and the SRTAG16K. It is composed of three fields. *Table 10* details the I-Block format.

**Table 10. I-Block format**

| Name | SoD | | Payload | EoD |
|---|---|---|---|---|
| | PCB | DID | 0 | CRC |
| Length | 1 byte | 1 byte | 1 to 251 bytes | 2 bytes |
| PCB field | | | | |
| DID field (optional) | | | | |
| RF host to SRTAG16K: C-APDU<br>SRTAG16K to RF host: R-APDU | | | | |
| 2 CRC bytes | | | | |

**Table 11. PCB field of the I-Block format**

| | b7-b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| | 0b00 | 0 | 0 | X | 0 | 1 | X |
| I-Block | | | | | | | |
| RFU | | | | | | | |
| Must be set to 0 | | | | | | | |
| DID field, if bit is set | | | | | | | |
| Must be set to 0 | | | | | | | |
| Must be set to 1 | | | | | | | |
| Block number | | | | | | | |

When the RF host sends a command to the SRTAG16K the format of the payload is the C-APDU.

When the SRTAG16K sends a command to the RF host, the format of the payload is the R-APDU.

### 5.2.1 C-APDU: payload format of a command

The C-APDU format is used by the RF host to send a command to the SRTAG16K. *Table 12* describes its format.

**Table 12. C-APDU format**

| Name | Payload field | | | | | | |
|---|---|---|---|---|---|---|---|
| | CLA | INS | P1 | P2 | LC | Data | Le |
| Length | 1 byte | 1 byte | 1 byte | 1 byte | 1 byte | Lc byte | 1 byte |
| Class byte<br>0x00: standard command<br>0xA2: ST command | | | | | | | |
| Instruction byte | | | | | | | |
| Param Byte 1 | | | | | | | |
| Param Byte 2 | | | | | | | |
| Number of bytes of the Data field | | | | | | | |
| Data bytes | | | | | | | |
| Number of bytes to be read in the SRTAG16K memory | | | | | | | |

### 5.2.2 R-APDU: payload format of a response

the SRTAG16K uses the I-Block format to reply to a command which used the I-Block format. This format is described in *Table 13*.

**Table 13. R-APDU format**

| Name | Payload field | | |
|---|---|---|---|
| | Data (optional) | SW1 | SW2 |
| Length | Le byte | 1 byte | 1 byte |
| Data | | | |
| Status byte 1 | | | |
| Status byte 2 | | | |

## 5.3 R-Block format

The R-Block is used to convey positive or negative acknowledgment between the RF host and the SRTAG16K.

**Table 14. R-Block format**

| PCB | CRC |
|---|---|
| R(ACK) without the DID field: 0xA2 or 0xA3<br>R(ACK) with the DID field: 0xAA or 0xAB<br>R(NAK) without the DID field: 0xB2 0xB3<br>R(NAK) with the DID field: 0xBA 0xBB | 2 CRC bytes |

There are two kinds of R-Blocks:

- R(ACK): the acknowledgement block sent by the RF host or by the SRTAG16K
- R(NAK): the non-acknowledgement block sent by the RF host or by the SRTAG16K

**Table 15. R-Block detailed format**

| | b7-b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| | 0b10 | 1 | X | X | 0 | 0 | X |
| R-Block | | | | | | | |
| RFU | | | | | | | |
| 0: NAK<br>1: ACK | | | | | | | |
| 0: DID field is not present<br>1: DID field is present | | | | | | | |
| Must be set to 0 | | | | | | | |
| RFU | | | | | | | |
| Block number | | | | | | | |

## 5.4 S-Block format

The S-Block is used to exchange control information between a reader and a contactless tag.

**Table 16. S-Block format**

| NFC frame | SoD | | | EoD |
|---|---|---|---|---|
| | PCB | DID | Payload | CRC |
| Length | 1 byte | 1 byte | 1 to 255 bytes | 2 bytes |
| 0xC2: for S(DES) when the DID field is not present<br>0xCA: for S(DES) when the DID field is present<br>0xF2: for S(WTX) when the DID field is not present<br>0xFA: for S(WTX) when the DID field is present | | | | |
| DID field (optional) | | | | |
| WTX field (1) | | | | |
| 2 CRC bytes | | | | |

1. This field is present when b5-b4 bits are set to 0b11 (S-Block is a WTX). see *Table 17: S-Block detailed format*.

There are two requests using the S-Block format:

- S(DES): the deselect command
- S(WTX): the Waiting Frame eXtension command or response.

**Table 17. S-Block detailed format**

| | b7-b6 | b5-b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|
| | 0b11 | X | X | 0 | 1 | 0 |
| S-Block | | | | | | |
| 0b00: Deselect<br>0b11: WTX | | | | | | |
| 0: DID field is not present<br>1: DID field is present | | | | | | |
| - | | | | | | |
| RFU | | | | | | |
| RFU | | | | | | |

*Note: After receiving the deselect command, the session is released and SRTAG16K enters the Standby power mode.*

*In response to a RATS command, SRTAG16K returns FWI parameter (default frame waiting time used); when SRTAG16K needs more time for a command execution, it requests a frame waiting time extension by responding 0xF2 0xWTX (Request waiting time = FWI * WTX). If the reader accepts SRTAG16K request, it acknowledges by sending the command 0xF2 0xWTX. The frame waiting time becomes FWI * WTX for the current command only.*

## 5.5 CRC of the RF frame

The two CRC bytes check the data transmission between the RF host and the SRTAG16K. For the RF frame, the CRC is computed on all the data bits in the frame, excluding parity bits, SOF and EOF, and the CRC itself.

The CRC is as defined in ISO/IEC 13239. The initial register content shall be 0x6363 and the register content shall not be inverted after calculation.

## 5.6 NFC Forum Type 4 Tag protocol

### 5.6.1 Commands set

**Table 18. Command set overview**

| Command name | Brief description |
|---|---|
| NDEF Tag Application Select | Select the NDEF Tag Application |
| Capability Container Select | Select the capability container (CC) file using the Select command |
| NDEF Select | Select the NDEF file |
| System File Select | Select the system file |
| ReadBinary | Read data from a file |
| UpdateBinary | Write new data to a file |

### 5.6.2 Status and error codes

This section lists the status and the error code of the SRTAG16K.

**Table 19. Status code of the SRTAG16K**

| | SW1 | SW2 | Comment |
|---|---|---|---|
| Value | 0x90 | 0x00 | Command completed successfully |

**Table 20. Error code of the SRTAG16K**

| | SW1 | SW2 | Comment |
|---|---|---|---|
| **Length** | **1 byte** | **1 byte** | |
| Value | 0x62 | 0x80 | File overflow (Le error) |
| Value | 0x62 | 0x82 | End of file or record reached before reading Le bytes |
| Value | 0x63 | 0x00 | Password is required |
| Value | 0x63 | 0xCX | Password is incorrect, X further retries allowed (X can take value 0,1, 2) |
| Value | 0x65 | 0x81 | Unsuccessful updating |
| Value | 0x67 | 0x00 | Wrong length |
| Value | 0x69 | 0x81 | Cmd is incompatible with the file structure |
| Value | 0x69 | 0x82 | Security status not satisfied |
| Value | 0x69 | 0x84 | Reference data not usable |
| Value | 0x6A | 0x80 | Incorrect parameters Le or Lc |
| Value | 0x6A | 0x82 | File or application not found |

Table 20. Error code of the SRTAG16K (continued)

| | SW1 | SW2 | Comment |
|---|---|---|---|
| **Length** | **1 byte** | **1 byte** | |
| Value | 0x6A | 0x84 | File overflow (Lc error) |
| Value | 0x6A | 0x86 | Incorrect P1 or P2 values |
| Value | 0x6D | 0x00 | INS field not supported |
| Value | 0x6E | 0x00 | Class not supported |

### 5.6.3 NDEF Tag Application Select command

the RF host shall send this command to activate the NDEF Tag Application.

To activate the NDEF Tag Application, the RF host sends the Select command (see *Table 21*) in addition to the sequence defined in the NFC Forum digital protocol.

*Table 21* defines the C-APDU of the Select command to select the NDEF Tag Application (called NDEF Tag Application Select).

**Table 21. C-APDU of the NDEF Tag Application Select command**

| Name | CLA | INS | P1 | P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|---|
| Value | 0x00 | 0xA4 | 0x04 | 0x00 | 0x07 | 0xD27600 00850101 | 0x00 |
| Class byte | | | | | | | |
| Select instruction code | | | | | | | |
| P1 field | | | | | | | |
| P2 field | | | | | | | |
| Number of bytes of data | | | | | | | |
| Application ID | | | | | | | |
| Le field | | | | | | | |

*Table 22* defines the R-APDU of the NDEF Tag Application Select command.

**Table 22. R-APDU of the NDEF Tag Application Select command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed |
| Value | - | 0x6A | 0x82 | NDEF Tag Application not found |
| Value | - | 0x6D | 0x00 | Class not supported |

### 5.6.4 Capability Container Select command

The RF host uses the Capability Container Select procedure to select the capability container (CC) file.

The CC file is selected when this command returns "command completed" in the R-APDU. *Table 23* defines the C-APDU of the Select command to select the CC file (called Capability Container Select).

**Table 23. C-APDU of the Capability Container Select command**

| Name | CLA | INS | P1 | P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|---|
| Value | 0x00 | 0xA4 | 0x00 | 0x0C | 0x02 | 0xE103 | - |
| Class byte | | | | | | | |
| Select instruction code | | | | | | | |
| P1 field | | | | | | | |
| P2 field | | | | | | | |
| Number of bytes of data | | | | | | | |
| CC file ID | | | | | | | |
| - | | | | | | | |

*Table 24* defines the R-APDU of the CC Select command.

**Table 24. R-APDU of the Capability Container Select command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6D | 0x00 | Class not supported |

### 5.6.5 NDEF Select command

The RF host uses the NDEF Select command to select the NDEF file.

The NDEF file is selected when this command returns "command completed" in the R-APDU. *Table 25* defines the C-APDU of the Select command to select the NDEF file (called NDEF Select).

**Table 25. C-APDU of the NDEF Select command**

| Name | CLA | INS | P1 | P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|---|
| Value | 0x00 | 0xA4 | 0x00 | 0x0C | 0x02 | 0x000X | - |
| Class byte | | | | | | | |
| Select instruction code | | | | | | | |
| P1 field | | | | | | | |
| P2 field | | | | | | | |
| Number of bytes of data | | | | | | | |
| 0x0001: first NDEF file | | | | | | | |
| - | | | | | | | |

*Table 26* defines the R-APDU of the NDEF Select command.

**Table 26. R-APDU of the NDEF Select command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed |
| Value | - | 0x6A | 0x82 | File or application not found |

### 5.6.6 System File Select command

The RF host uses this command to select the system file.

The System file is selected when this command returns "command completed" in the R-APDU.

*Table 27* defines the C-APDU of the command to select the System file (called System Select).

**Table 27. C-APDU of the System File Select command**

| Name | CLA | INS | P1 | P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|---|
| | 0x00 | 0xA4 | 0x00 | 0x0C | 0x02 | 0xE101 | - |
| Class byte | | | | | | | |
| Select instruction code | | | | | | | |
| P1 field | | | | | | | |
| P2 field | | | | | | | |
| Number of bytes of data | | | | | | | |
| System file ID | | | | | | | |
| - | | | | | | | |

*Table 28* defines the R-APDU of the System File Select command.

**Table 28. R-APDU of the System File Select command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed |
| Value | - | 0x6A | 0x82 | Capability container not found, no data is returned |

### 5.6.7 ReadBinary command

On receiving the ReadBinary command, the SRTAG16K reads the requested memory field and sends back its value in the R-APDU response.

Before sending a ReadBinary command, a file shall be selected by using a Select command.

The Response of the ReadBinary command is successful when the data to be read is within the selected file [(a)]; in other words, when the sum of P1-P2 and Le fields is equal to or lower than the selected file length.

*Table 29* defines the ReadBinary command.

**Table 29. C-APDU of the ReadBinary command**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| | 0x00 | 0xB0 | 2 bytes | - | - | 1 byte |
| Class byte | | | | | | |
| Read instruction code | | | | | | |
| Offset in the file selected | | | | | | |
| - | | | | | | |
| - | | | | | | |
| Number of bytes to read between 0x01 ≤ Le ≤ max(Selected File length, 0xF6) | | | | | | |

*Table 30* defines the R-APDU of the ReadBinary command.

**Table 30. R-APDU of the ReadBinary command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | Content read | 0x90 | 0x00 | Command completed |
| Value | - | 0x67 | 0x00 | Wrong length |
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6E | 0x00 | Class not supported |

a. For more details about CC file, refer to *Section 3.1.2: CC file layout*.
For more details about NDEF file, refer to *Section 3.1.3: NDEF file layout*.
For more details about System file, refer to *Section 3.1.4: System file layout*.

### 5.6.8 UpdateBinary command

On receiving the UpdateBinary command, the SRTAG16K writes the data field into the selected file and sends back a status in the R-APDU response.

Before sending an UpdateBinary command, a file shall be selected by issuing a Select command.

*Table 31* defines the UpdateBinary command.

**Table 31. C-APDU of the UpdateBinary command**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| | 0x00 | 0xD6 | 2 bytes | 1 byte | Lc bytes | - |
| Class byte | | | | | | |
| Write instruction code | | | | | | |
| Offset in the file selected | | | | | | |
| Number of bytes of data (0x01 ≤ Lc ≤ 0xF6) | | | | | | |
| Data to write in the SRTAG16K memory | | | | | | |
| - | | | | | | |

*Table 32* defines the R-APDU of the UpdateBinary command.

**Table 32. R-APDU of the UpdateBinary command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed |
| Value | - | 0x65 | 0x81 | Unsuccessful updating |
| Value | - | 0x67 | 0x00 | Wrong length |
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6E | 0x00 | Class not supported |

*Note: For further return codes and definitions, refer to Status and error codes.*

## 5.7 ISO/IEC 7816-4 commands

The ISO/IEC 7816-4 command set offers some extended features such as the protection of the NDEF file. This command set is used to manage the right access of the NDEF file.

### 5.7.1 Verify command

The Verify command has two functions:

1. Check if a password is required to access to the NDEF file (the LC field = 0x00).
2. Check that the password embedded in the Verify command allows the access to the memory (the Lc field = 0x10 and the password is present).

When the Lc field if equal to 0x00, the verify command returns a success code (0x90 00) provided that the access to the NDEF file does not require a password. When the access to the NDEF file is protected, the response to the Verify command returns an error code (0x63 00).

When the Lc field equals 0x10, on receiving the Verify command, the SRTAG16K compares the requested password with the data contained in the request and reports whether the operation has been successful in the response.

Before sending this command, an NDEF file shall be selected by issuing the NDEF Select command. Thus, this command checks the right access condition of the last NDEF file selected.

After a successful command, an access is granted for the whole NDEF file.

*Table 33* defines the Verify command.

**Table 33. Verify command format**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| | 0x00 | 0x20 | 2 bytes | 1 byte | Lc bytes | - |
| Class byte | | | | | | |
| Instruction code | | | | | | |
| Password identification<br>0x0001: Read NDEF password transmit<br>0x0002: Write NDEF password transmit<br>Other: RFU | | | | | | |
| 0x00: the password is not present<br>0x10: the password is present in the data field | | | | | | |
| Password | | | | | | |
| - | | | | | | |

*Table 34* defines the R-APDU of the Verify command.

**Table 34. R-APDU of the Verify command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed, the password is correct |
| Value | - | 0x69 | 0x85 | The conditions of use are not satisfied (e.g. no NDEF file was selected) |
| Value | - | 0x69 | 0x81 | Cmd incompatible with file structure |
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x80 | Incorrect parameter in cmd data field |
| Value | - | 0x63 | 0x00 | A password is required |
| Value | - | 0x63 | 0xCX (1) | The password transmitted is incorrect and X encodes the number of further allowed retries. |
| Value | - | 0x6E | 0x00 | Class not supported |

1. At each session, the RF host can check a password 3 times.

## 5.7.2 Change Reference Data command

The Change Reference Data command replaces the read or write password related to the NDEF files previously selected. It can be performed only if the security status satisfies the security attributes for this command.

Before sending this command, the verify command with the correct NDEF write password shall be issued. Thus, this command changes the reference data of the NDEF file.

*Table 35* defines the Change Reference Data command.

**Table 35. Change reference data command format**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| | 0x00 | 0x24 | 2 bytes | 1 byte | Lc bytes | - |
| Class byte | | | | | | |
| Instruction code | | | | | | |
| Password identification<br>0x0001: Read password transmit<br>0x0002: Write password transmit<br>Other: RFU | | | | | | |
| 0x10: the password is present in the data field | | | | | | |
| NDEF file Password | | | | | | |
| - | | | | | | |

*Table 36* defines the R-APDU of the Change Reference Data command.

**Table 36. R-APDU of the Change Reference Data command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | 0 | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed, the access right has been changed |
| Value | - | 0x69 | 0x81 | Cmd is incompatible with the file structure |
| Value | - | 0x65 | 0x81 | Unsuccessful updating |
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x80 | CC file or System file selected |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6A | 0x86 | Incorrect P1 or P2 values |
| Value | - | 0x6E | 0x00 | Class not supported |

### 5.7.3 Enable Verification Requirement command

The Enable Verification Requirement command activates the protection by password of the NDEF file. When this command is successful, the read or write access to the NDEF file is protected by a 128-bit password. It can be performed only if the security status satisfies the security attributes for this command.

This command can update the right access of the NDEF file by writing into the EEPROM. In this case, the response timing will be around 5 ms.

Before sending this command, the verify command with the correct NDEF write password shall be issued. Thus, this command changes the access right of the NDEF file.

*Table 37* defines the Enable Verification requirement command.

**Table 37. Enable Verification Requirement command format**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| | 0x00 | 0x28 | 2 bytes | - | - | - |
| Class byte | | | | | | |
| Instruction code | | | | | | |
| New security attributes<br>0x0001: Enable the read protection of the NDEF file<br>0x0002: Enable the write protection of the NDEF file<br>Other: RFU | | | | | | |
| - | | | | | | |
| - | | | | | | |
| - | | | | | | |

The last five bits identify the password sent in the Verify command.

*Table 38* defines the R-APDU of the Enable Verification Requirement command.

**Table 38. R-APDU of the Enable Verification Requirement command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | 0 | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed, the password is correct |
| Value | - | 0x69 | 0x81 | Cmd is incompatible with the file structure |
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x80 | CC file or System file selected |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6A | 0x86 | Incorrect P1 or P2 values |

### 5.7.4 Disable Verification Requirement command

The Disable Requirement command deactivates the protection by password of the NDEF file. When this command is successful, the read or write access to the NDEF file is granted without security requirements. It can be performed only if the security status satisfies the security attributes for this command.

Before sending this command, the verify command with the correct NDEF write password shall be issued. Thus, this command changes the access right of the NDEF file.

This command can update the right access of the NDEF file by writing into the EEPROM. In this case, the response timing will be around 6 ms.

*Table 39* defines the Disable Verification Requirement command.

**Table 39. Disable Verification Requirement command format**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| | 0x00 | 0x26 | 2 bytes | - | - | - |
| Class byte | | | | | | |
| Instruction code | | | | | | |
| New security attributes<br>0x0001: Disable the read protection of the NDEF file<br>0x0002: Disable the write protection of the NDEF file<br>Other: RFU | | | | | | |
| - | | | | | | |
| - | | | | | | |
| - | | | | | | |

*Table 40* defines the R-APDU of the Disable Verification Requirement command.

**Table 40. R-APDU of the Disable Verification Requirement command**

| | Data | SW1 | SW2 | Comment |
|---|---|---|---|---|
| Length | 0 | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed, the password is correct |
| Value | - | 0x69 | 0x81 | Cmd is incompatible with the file structure |
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x80 | CC file or System file selected |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6A | 0x86 | Incorrect P1 or P2 values |
| Value | - | 0x6E | 0x00 | Class not supported |
| Value | - | 0x65 | 0x81 | Update failed |

## 5.8 ST Proprietary command set

The RF host can be issued with the command set described in this chapter.

### 5.8.1 ExtendedReadBinary command

On receiving the ExtendedReadBinary command, the SRTAG16K reads the requested memory field and sends back its value in the R-APDU response.

Before sending an ExtendedReadBinary command, a file shall be selected by issuing an NDEF select command.

The response of the ExtendedReadBinary command will be successful even if the data to be read is beyond the NDEF message. The command returns an error code if the data to be read goes beyond the end of the file.

**Table 41. C-APDU of the ExtendedReadBinary command**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| Length | 0xA2 | 0xB0 | 2 bytes | - | - | 1 byte |
| ST Class byte | | | | | | |
| Read instruction code | | | | | | |
| Offset in the file selected | | | | | | |
| - | | | | | | |
| - | | | | | | |
| - | | | | | | |
| Number of bytes to read between 0x01 ≤ Le ≤ 0xF6 | | | | | | |

*Table 42* defines the R-APDU of the read binary command.

**Table 42. R-APDU of the ExtendedReadBinary command**

| | Data | SW1 | SW2 | comment |
|---|---|---|---|---|
| Length | Le bytes | 1 byte | 1 byte | - |
| Value | Content read | 0x90 | 0x00 | Command completed |
| Value | - | 0x67 | 0x00 | Wrong length |
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6A | 0x86 | Incorrect P1 or P2 values |
| Value | - | 0x6E | 0x00 | Class not supported |

### 5.8.2 EnablePermanentState command

The command configures the NDEF file to the ReadOnly or to the WriteOnly State.

This command can update the right access to the NDEF file by writing into the EEPROM. In this case, the response timing will be around 6 ms.

*Table 43* defines the EnablePermanentState requirement command.

**Table 43. EnablePermanentState command format**

| Name | CLA | INS | P1 & P2 | Lc | Data | Le |
|---|---|---|---|---|---|---|
| Length | 0xA2 | 0x28 | 2 bytes | - | - | - |
| Class byte | | | | | | |
| Instruction code | | | | | | |
| New security attributes<br>0x0001: Enable the read protection of the NDEF file<br>0x0002: Enable the write protection of the NDEF file<br>Other: RFU | | | | | | |
| - | | | | | | |
| - | | | | | | |
| - | | | | | | |
| - | | | | | | |

*Table 44* defines the R-APDU of the EnablePermanentState command.

**Table 44. R-APDU table of the EnablePermanentState command**

| | Data | SW1 | SW2 | comment |
|---|---|---|---|---|
| Length | - | 1 byte | 1 byte | - |
| Value | - | 0x90 | 0x00 | Command completed |
| Value | - | 0x65 | 0x81 | Update failed |
| Value | - | 0x67 | 0x00 | Wrong length |

Table 44. R-APDU table of the EnablePermanentState command (continued)

| | Data | SW1 | SW2 | comment |
|---|---|---|---|---|
| Value | - | 0x69 | 0x82 | Security status not satisfied |
| Value | - | 0x6A | 0x80 | CC file or System file selected |
| Value | - | 0x6A | 0x82 | File or application not found |
| Value | - | 0x6A | 0x86 | Incorrect P1 or P2 values |
| Value | - | 0x6E | 0x00 | Class not supported |

## 5.9 Specific RF command set

This section describes the command set that can be issued only by the RF host.

### 5.9.1 Anticollision command set

*Table 45* lists the commands that can be issued only by the RF host. The format of these commands is described in the NFC Forum Digital Protocol specification.

Table 45. Commands issues by the RF host

| Family command set | Command name | Instruction code |
|---|---|---|
| NFC-A technology | ALL_REQ | 0x52 (1) |
| | SENS_REQ | 0x26 (1) |
| | SDD_REQ | 0x93 or 0x95 or 0x97 |
| | SEL_REQ | 0x93 or 0x95 or 0x97 |
| | SLP_REQ | 0x50 |

1. Code on 7 bits.

### 5.9.2 RATS command and ATS response

RATS command and ATS response are used for NFC Forum Type 4A Tag Platform Device Activation (as defined in NFC Forum Digital Protocol specification).

*Table 46* details the RATS command. This command shall be sent after the anticollision process.

**Table 46. RATS command**

| Name | INS | Param | | CRC |
|---|---|---|---|---|
| Byte field | 0xE0 | 1 byte | | 2 bytes |
| Bit field | | b7-b4 | b3-b0 | |
| Instruction code | | | | |
| FSDI | | | | |
| DID (0 ≤ DID ≤ 14) | | | | |
| 2 CRC bytes | | | | |

The FSDI field codes the FSD that defines the maximum size that an RF host is able to receive. *Table 47* gives the conversion from FDSI to FSD.

**Table 47. Conversion from FDSI to FSD**

| FSDI | 0x0 | 0x1 | 0x2 | 0x3 | 0x4 | 0x5 | 0x6 | 0x7 | 0x8 | 0x9h-0xE | 0xF |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FSD | 16 | 24 | 32 | 40 | 48 | 64 | 96 | 128 | 256 | RFU | 256 |

The DID field defines the value of the addressed SRTAG16K.

**Table 48. ATS response**

| Name | TL | T0 | TA(1) | TB(1) | | TC(1) | CRC |
|---|---|---|---|---|---|---|---|
| Byte field | 0x05 | 0x78 | 1 byte | 1 byte | | 0x02 | 2 bytes |
| Bit field | | | | b8-b5 | b4-b1 | | |
| Length of the ATS response | | | | | | | |
| FSCI = 256 bytes | | | | | | | |
| The maximum ascending data rate is 106 kbps<br>The maximum descending data rate is 106 kbps | | | | | | | |
| FWI field (155 ms when TB = 0x90) | | | | | | | |
| SFGI field (302 µs when TB = 0x90) | | | | | | | |
| The DID is supported | | | | | | | |
| 2 CRC bytes | | | | | | | |

The FSCI codes the FSC which stands for the maximum frame size that the SRTAG16K is able to receive. The SRTAG16K is able to receive up to 256 bytes of command. If the RF host sends a command with more than 256 bytes, the SRTAG16K will not be able to treat the command and will not reply.

The FWI which stands for the Frame Waiting time Integer codes the FWT. This time corresponds to the maximum duration while an RF host shall send before sending the next command.

The SFGI which stands for the Start-up Frame Guard Time is the minimum time that the reader shall wait after receiving the response of the SRTAG16K.

### 5.9.3 PPS command & response

PPS (Protocol and Parameter Selection) command and response are defined in ISO/IEC 14443-4, in the Protocol Activation of PICC Type A.

The PPS command allows to change the data rates of the ascending (RF host to SRTAG16K) and descending (SRTAG16K to RF host) data rates.

**Table 49. PPS command**

| | Name | INS | | PPS0 | PPS1 | | | CRC |
|---|---|---|---|---|---|---|---|---|
| - | Byte field | 0xDX | | 0x11 | 1 byte | | | 2 bytes |
| | Bit field | b7-b4 | b3-b0 | | 0b0000 | b3-b2 | b1-b0 | |
| INS | Instruction code | | | | | | | |
| | DID | | | | | | | |
| | PPS1 is present | | | | | | | |
| PPS1 | RFU | | | | | | | |
| | Descending data rate | | | | | | | |
| | Ascending data rate | | | | | | | |
| | 2 CRC bytes | | | | | | | |

The ascending and descending data rates shall be coded as described in *Table 50*.

**Table 50. Ascending and descending data rate coding**

| Value | 0b00 | 0b01 | 0b10 | 0b11 |
|---|---|---|---|---|
| Data rate | 106 kbps | RFU | RFU | RFU |

When the SRTAG16K is able to change both data rates, it returns the following response. The data rate of this response is 106 kbps; then, the SRTAG16K changes the ascending and descending data rates.

*Table 51* gives the details of the PPS response.

**Table 51. PPS response**

| Name | INS | - | PPS0 |
|---|---|---|---|
| Byte field | 0xDX | - | 0x11 |
| Bit field | b8-b5 | b4-b1 | |
| Response code | | | |
| DID field | | | |
| 2 CRC bytes | | | |

# 6 RF device operation

## 6.1 Anticollision and Device Activation command set for the RF interface

The SRTAG16K device supports the command set defined in the NFC-A Technology and the Type 4A Tag Platform chapters of the NFC Digital Protocol V1.0 specification.

## 6.2 Open an RFsession

Once the RF host has terminated the anticollision procedure and retrieve the ATS response, it shall send the SelectApplication command. The SRTAG16K will open an RF session. At this point, the RF host can send the applicative command set.

## 6.3 Close an RFsession

The RF host can close the RF session by issuing one of these methods:

- send an S(DES) command
- turn off the RF field

## 6.4 Applicative command set

The applicative command set is composed of the following command sets:

- the NFC Forum Type 4 Tag command set
- the ISO/IEC 7816-4 command set
- the proprietary command set

# 7 Functional procedures

This section describes some procedure to access the memory or manage its protection.

## 7.1 Selection of an NDEF message

The RF host shall use this procedure to detect the NDEF message inside an SRTAG16K.

The NDEF detection procedure is as follows:

1. Open an RF session
2. Send the SelectNDEFTagApplication command
3. Select the CC file
4. Read the CC file
5. Select the NDEF file.

## 7.2 Reading of an NDEF message

The RF host executes the NDEF read procedure to read the NDEF file.

1. Detect successfully the NDEF file using the NDEF detection procedure
2. Check that the read access without any security is granted for the NDEF file from the information provided by the CC file
3. Select the NDEF file
4. Read the NDEF file.

## 7.3 Reading a locked NDEF file

The RF host executes this procedure to read an NDEF file which has been locked previously.

1. Select the NDEF Tag Application
2. Select the NDEF file
3. Verify the Read password by using the Verify command
4. Read the data in the NDEF file.

## 7.4 Locking an NDEF file

The RF host executes this procedure to protect an NDEF file.

1. Select the NDEF Tag Application
2. Check the right access provided by the CC file
3. Select the NDEF file
4. Transmit the NDEF file Write password by using the Verify command
5. Lock the NDEF file by sending the Enable verification command.

## 7.5 Unlocking an NDEF file

The RF host executes this procedure to read an NDEF file which has been locked previously.

1. Select the NDEF Tag Application
2. Select the NDEF file
3. Verify the NDEF file Write password by using the Verify command
4. Unlock the NDEF file by sending the Disable verification command.

## 7.6 Reaching the read-only state for an NDEF file

The RF host executes this procedure to read an NDEF file which has been locked previously.

1. Select the NDEF Tag Application
2. Select the NDEF file
3. Transmit the NDEF file Write password by using the Verify command
4. Select the NDEF file
5. Send an EnablePermanentState command as the Write access right of the previous Select NDEF file.

## 7.7 Changing an NDEF password procedure

The RF host could use this procedure to change one NDEF password. it can be a Read or Write password.

1. Select the NDEF Tag Application
2. Select the NDEF file
3. Transmit the NDEF file Write password by using the Verify command
4. Change the password by sending a ChangeReferenceData command.

## 7.8 Changing a File type Procedure

The RF host executes this procedure to change the File Type of a file for which all access rights were previously granted.

1. Select the NDEF Tag Application
2. Select the File to be modified
3. Set the File Length to 0x00 using the UpdateBinary command
4. Send an UpdateFileType command with the New file Type as data.

# 8 UID: Unique identifier

The SRTAG16K is uniquely identified by a 7 bytes unique identifier (UID). The UID is a read-only code and comprises:

- The IC manufacturer code on 1 byte (0x02 for STMicroelectronics).
- The Product code on 1 byte.
- A device number on 5 bytes.

*Table 52* describes the UID format.

**Table 52. UID format**

| | 0x02 | 0xC5 | 5 bytes |
|---|---|---|---|
| IC manufacturer code | | | |
| SRTAG16K product code | | | |
| Device number | | | |

# 9 Maximum rating

Stressing the device above the rating listed in *Table 53* may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect the device reliability.

**Table 53. Absolute maximum ratings**

| Symbol | Parameter | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $T_A$ | Ambient operating temperature | | -40 | 85 | °C |
| $T_{STG}$, $h_{STG}$, $t_{STG}$ | Storage conditions | Sawn wafer on UV tape | 15 | 25 | °C |
| | | | | 6 (1) | months |
| | | | kept in its original packing form | | |
| $T_{STG}$ | Storage temperature | Sawn Bumped Wafer (kept in its antistatic bag) | 15 | 25 | °C |
| | Storage time | | | 6 | months |
| $I_{CC}$ (2) | RF supply current AC0 - AC1 | | - | 100 | mA |
| $V_{MAX\_1}$ (2) | RF input voltage amplitude between AC0 and AC1, GND pad left floating | VAC0-VAC1 | - | 10 | V |
| $V_{MAX\_2}$ (2) | AC voltage between AC0 and GND, or AC1 and GND | VAC0-GND or VAC1-GND | -0.5 | 4.5 | V |
| $V_{ESD}$ | Electrostatic discharge voltage (human body model) (3) | AC0-AC1 | - | 1000 | V |
| $V_{ESD}$ | Electrostatic discharge voltage (Machine model) | | - | 200 | V |

1. Counted from ST shipment date.
2. Based on characterization, not tested in production. Maximum absorbed power = 100 mW @ 7.5 A/m
3. AEC-Q100-002 (compliant with JEDEC Std JESD22-A114A, C1 = 100 pF, R1 = 1500 Ω, R2 = 500 Ω)

# 10 RF electrical parameters

This section summarizes the operating and measurement conditions, and the DC and AC characteristics of the device in RF mode.

The parameters in the DC and AC characteristics tables that follow are derived from tests performed under the Measurement Conditions summarized in the relevant tables. Designers should check that the operating conditions in their circuit match the measurement conditions when relying on the quoted parameters.

**Table 54. Default operating conditions**

| Symbol | Parameter | Min. | Max. | Unit |
|---|---|---|---|---|
| $T_A$ | Ambient operating temperature | –40 | 85 | °C |

**Table 55. RF characteristics (1)**

| Symbol | Parameter | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $f_C$ | External RF signal frequency | | 13.553 | 13.56 | 13.567 | MHz |
| H_ISO | Operating field according to ISO | $T_A$ = 0 °C to 50 °C | 1500 | - | 7500 | mA/m |
| H_Extended | Operating field in extended temperature range | $T_A$ = -40 °C to 85 °C | 1500 | - | 7500 | mA/m |
| $MI_{CARRIER}$ | 100% carrier modulation index | MI=(A-B)/(A+B) | 90 | - | 100 | % |
| $t_1$ | Pause A length | - | $28/f_C$ | - | $40.5/f_C$ | µs |
| $t_2$ | Pause A low time | - | $7/f_C$ | - | t1 | µs |
| $t_3$ | Pause A rise time | - | 1.5xt4 | - | $16/f_C$ | µs |
| $t_4$ | Pause A rise time section | - | 0 | - | $6/f_C$ | µs |
| $t_{MIN\ CD}$ | Minimum time from carrier generation to first data | From H-field min | - | - | 5 | ms |
| $W_t$ | RF write time (including internal Verify) for one page | - | - | 6 | - | ms |
| $C_{TUN}$ | Internal tuning capacitor in SO8 (2) | $f_C$ = 13.56 MHz | 22.5 | 25 | 27.5 | pF |
| $t_{RF\_OFF}$ | RF OFF time | Chip reset | - | - | 5 | ms |

1. All timing characterizations were performed on a reference antenna with the following characteristics:
   External size: 75 mm x 48 mm
   Number of turns: 6
   Width of conductor: 0.6 mm
   Space between two conductors: 0.6 mm
   Value of the tuning capacitor in SO8: 25 pF (SRTAG16K)
   Value of the coil: 5 µH
   Tuning frequency: 14.2 MHz.
2. Characterized only, at room temperature only, measured at VAC0-VAC1 = 2 V peak to peak at 13.56 MHz.

# 11 Part numbering

**Table 56. Ordering information scheme for packaged devices**

Example: SRTAG 16K - SB12I /2

**Device type**

SRTAG = Short range tag

**Memory size**

16K = memory size in Kbits

**Device feature**

**Package**

SB12I = 120 µm ± 15 µm bumped and sawn inkless wafer on 8-inch frame

**Device grade**

(No parameter for SB12I)

**Option**

(No parameter for SB12I)

**Capacitance**

/2 = 25 pF

*Note: Parts marked as "ES", "E" or accompanied by an Engineering Sample notification letter, are not yet qualified and therefore not yet ready to be used in production and any consequences deriving from such usage will not be at ST charge. In no event, ST will be liable for any customer usage of these engineering samples in production. ST Quality has to be contacted prior to any decision to use these Engineering samples to run qualification activity.*

# 12 Revision history

Table 57. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 07-Nov-2013 | 1 | Initial release. |
| 30-Jan-2015 | 2 | Replaced “Datasheet preliminary data” to “Datasheet production data”<br>Added note after *Table 56: Ordering information scheme for packaged devices* |