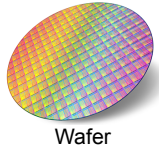


## NFC Type 5 / RFID tag IC with 4-Kbit EEPROM and protection



Wafer

**Product status link**[ST25TV04K-P](#)

### Features

#### Contactless interface

- Based on ISO/IEC 15693
- NFC Forum Type 5 tag certified by the NFC Forum
- Supports all ISO/IEC 15693 modulations, coding, subcarrier modes and data rates
- Custom Fast read access up to 53 Kbit/s
- Single and multiple block reads (Same for Extended commands)
- Single and multiple block writes (Same for Extended commands) (up to 4)
- Internal tuning capacitance: 28.5 pF
- Kill capability for privacy protection

#### Memory

- 4 Kbits of EEPROM
- RF interface accesses blocks of four bytes
- Typical write time: 5 ms for one block
- Data retention: 40 years
- Write cycles endurance:
  - 1 million at 25 °C
  - 600k at 85 °C

#### Data protection

- User memory: one to four configurable areas, protectable in read and/or write by three 64-bit passwords
- System configuration: protected in write by a 64-bit password

#### Energy harvesting

- Analog output pin to power external components

#### GPO

- Interruption pin configurable on multiple RF events (field change, memory write, activity, user set/reset/pulse)

#### Temperature range

- From - 40 to 85 °C

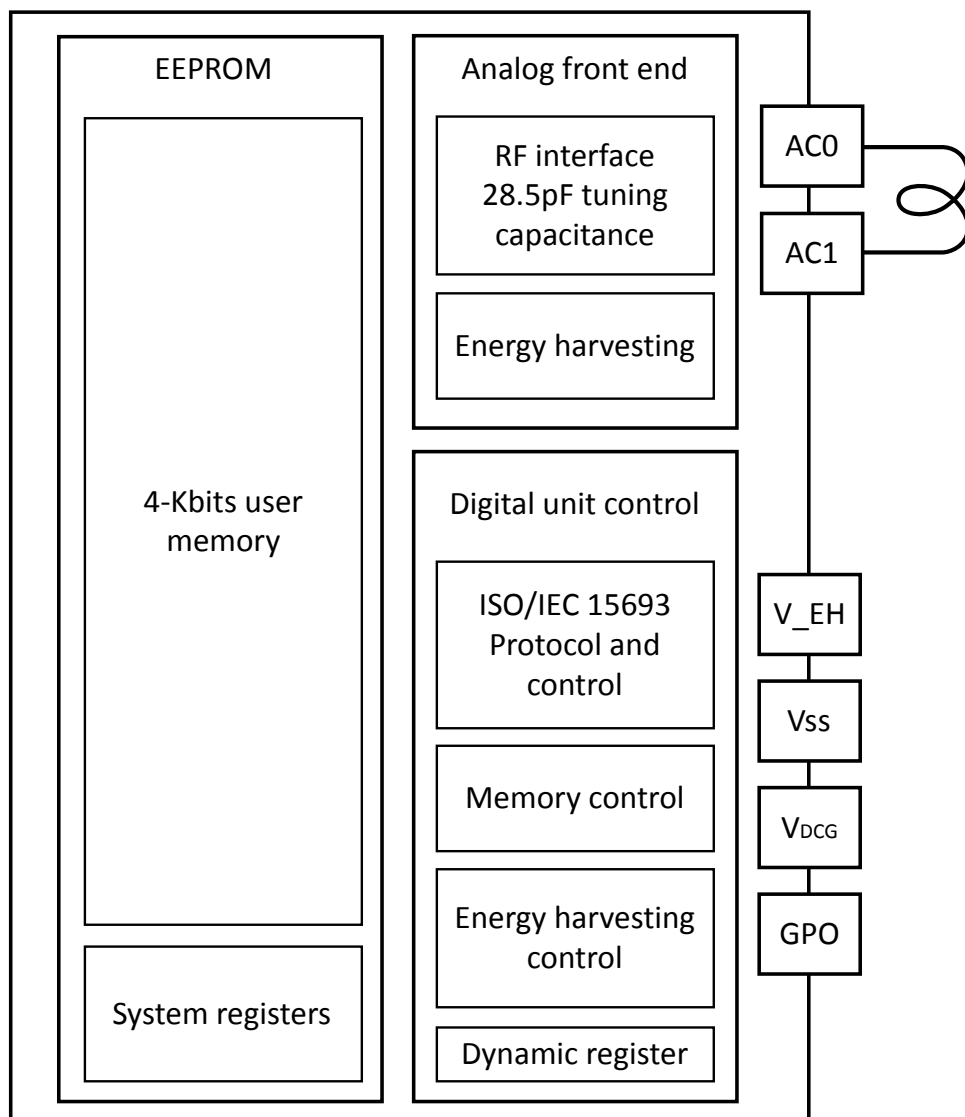
# 1 Description

The **ST25TV04K-P** device is a NFC and RFID tags, with 4 Kbits of electrically erasable programmable memory (EEPROM). This device acts as a contactless memory accessed through a RF link, following ISO/IEC 15693 or NFC forum type 5 recommendations, and powered by the received carrier electromagnetic wave.

The GPO pin of the **ST25TV04K-P** provides data informing the contact world about incoming events, like RF field detection, RF activity in progress or can be directly controlled by an RF reader. An energy harvesting feature is also proposed when external conditions make it possible.

## 1.1 ST25TV04K-P block diagram

Figure 1. ST25TV04K-P block diagram



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## 2 Signal descriptions

### 2.1 Antenna coil (AC0, AC1)

These inputs are used exclusively to connect the [ST25TV04K-P](#) devices to an external coil. It is advised not to connect any other DC or AC path to AC0 or AC1.

When correctly tuned, the coil is used to power and access the device using the ISO/IEC 15693 and ISO 18000-3 mode 1 protocols.

### 2.2 Ground (V<sub>SS</sub>)

V<sub>SS</sub> is the reference for the V<sub>DCG</sub> supply voltages and V\_EH analog output voltage.

### 2.3 Process control (V<sub>DCG</sub>, GPO)

#### 2.3.1 Driver supply voltage (V<sub>DCG</sub>)

This pin can be connected to an external DC supply voltage. It only supplies the GPO driver block. [ST25TV04K-P](#) cannot be powered by V<sub>DCG</sub>. If V<sub>DCG</sub> is left floating, no information is available on GPO pin.

#### 2.3.2 General purpose output (GPO)

The [ST25TV04K-P](#) features a configurable output GPO pin used to provide RF activity information to an external device.

[ST25TV04K-P](#) offers a GPO CMOS output, which requires to connect V<sub>DCG</sub> pin to an external power supply. The interrupt consists in setting the state to a high level or outputting a positive pulse on the GPO pin.

GPO pin is a configurable output signal, and can mix several interruption modes. By default, the GPO register sets the interruption mode as a RF field change detector. It is able to raise various events like RF activity or memory write completion. It can authorize the RF side to directly drive GPO pin using the manage GPO command to set the output state or emit a single pulse (for example, to wake up an application.). See Section GPO for details.

### 2.4 Energy harvesting analog output (V\_EH)

This analog output pin is used to deliver the analog voltage V\_EH available when the energy harvesting mode is enabled and if the RF field strength is sufficient. When the energy harvesting mode is disabled or the RF field strength is not sufficient, V\_EH pin is in High-Z state (See Section xx Energy Harvesting (EH) for details).

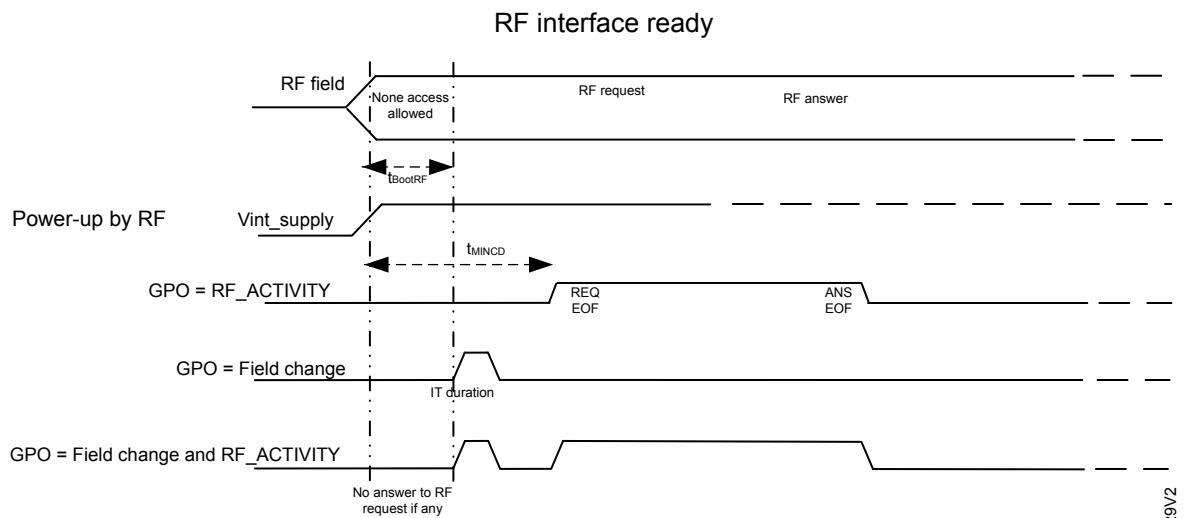
Energy harvesting voltage output is not regulated.

### 3 Power management

#### 3.1 Device set

To ensure a proper boot of the RF circuitry, the RF field must be turned ON without any modulation for a minimum period of time  $t_{BootRF}$ . Before this time, ST25TV04K-P ignores all received RF commands. (See Figure 2. ST25TV04K-P RF power-up sequence).

**Figure 2. ST25TV04K-P RF power-up sequence**



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#### 3.2 Device reset

To ensure a proper reset of the RF circuitry, the RF field must be turned off (100% modulation) for a minimum  $t_{RF\_OFF}$  period of time.

The RF access can be definitely disabled by setting the appropriate value in the KILL register.

## 4 Memory management

### 4.1 Memory organization overview

The ST25TV04K-P memory is divided in three main memory areas:

- User memory
- System configuration area
- Dynamic register

The ST25TV04K-P user memory can be divided into 4 flexible user areas. Each area can be individually read - and/or - write-protected with one out of three specific 64-bit password.

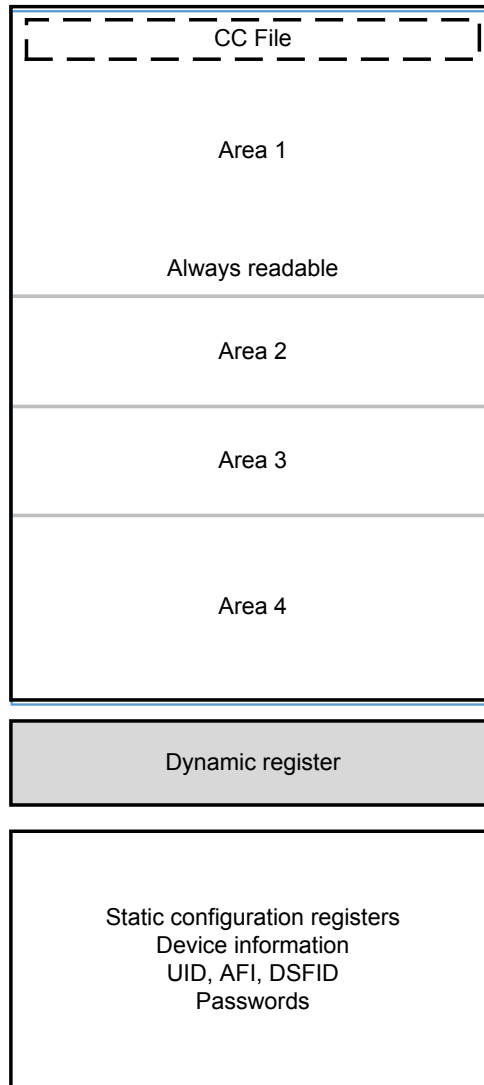
The ST25TV04K-P system configuration area contains registers to configure all ST25TV04K-P features, which can be tuned by user. Its access is protected by a 64 bit configuration password.

The ST25TV04K-P dynamic registers provide a dynamic activity status on RF field and energy harvesting and allow temporary activation and deactivation of energy harvesting.

This system configuration area also includes read only device information such as IC reference, memory size, as well as a 64-bit block that is used to store the 64-bit unique identifier (UID), and the AFI (default 00h) and DSFID (default 00h) registers. The UID is compliant with the ISO 15693 description, and its value is used during the anticollision sequence (Inventory). The UID value is written by ST on the production line. The AFI register stores the application family identifier. The DSFID register stores the data storage family identifier used in the anticollision algorithm.

The system configuration area includes four additional 64-bit blocks that store three RF user area access passwords and a RF configuration password.

Figure 3. Memory organization



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## 4.2 User memory

User memory is addressed as blocks of 4 bytes, starting at address 0.

All the blocks of the user memory are initialized to 00h in the factory.

Table 1 shows how memory is seen from RF interface.

**Table 1. User memory as seen by RF**

RF command (block addressing)	User memory			
	RF block (00)00h			
Read Single Block	Byte	Byte	Byte	Byte
Read Multiple Blocks	0003h	0002h	0001h	0000h
Fast Read Single Block	RF block (00)01h			
Fast Read Multiple Blocks	Byte	Byte	Byte	Byte
Write Single Block	0007h	0006h	0005h	0004h
Write Multiple Blocks	RF block (00)02h			
Ext. Read Single Block	Byte	Byte	Byte	Byte
Ext. Read Multiple Blocks	0011h	0010h	0009h	0008h
Fast Ext. Read Single Block	....			
Fast Ext. Read Multi. Blocks	RF block (00)7Fh			
Ext. Write Single Block	Byte	Byte	Byte	Byte
Ext. Write Multiple Blocks	01FFh	01FEh	01FDh	01FCh

#### 4.2.1 User memory areas

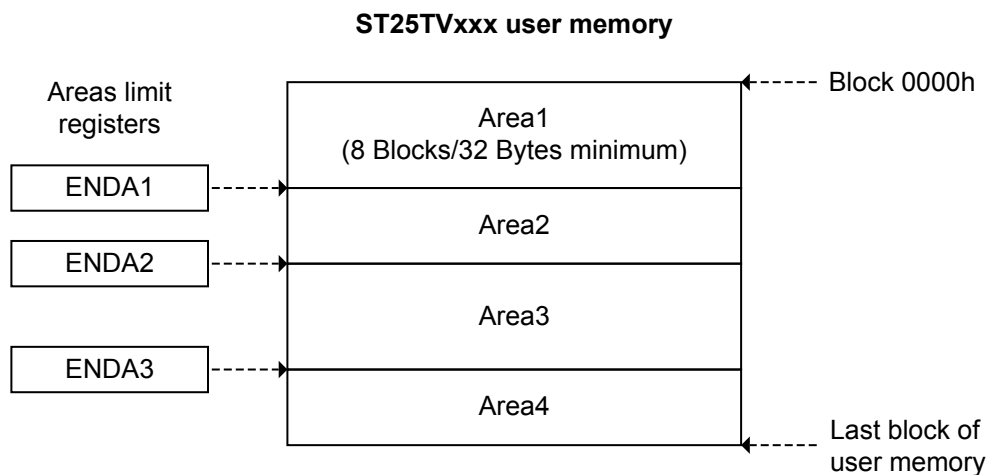
The user memory can be split into different areas, each one with a distinct access privilege.

RF read and write commands are legal only within a same zone:

- A multiple read or a multiple write command is not executed and returns the error code 0Fh if addresses cross the area borders.

Each user memory area is defined by its ending block address ENDA<sub>i</sub>. The starting block address is defined by the end of the preceding area.

There are three ENDA<sub>i</sub> registers in the configuration system memory, used to define the end block addresses of Area 1, Area 2 and Area 3. The end of Area 4 is always the last block of memory and is not configurable.

**Figure 4. ST25TV04K-P user memory areas**


On factory delivery all ENDA<sub>i</sub> are set to maximum value, only Area1 exists and includes the full user memory.

A granularity of 8 Blocks (32 Bytes) is offered to code area ending points.

An area's end limit is coded as followed in ENDA<sub>i</sub> registers:

- Last block address of area =  $8 \times \text{ENDA}_i + 7 \Rightarrow \text{ENDA}_i = \text{int}(\text{Last Area}_i \text{ block address} / 8)$
- As a consequence,  $\text{ENDA}_1 = 0$  means size of Area 1 is 8 blocks (32 Bytes).

**Table 2. Maximum user memory block addresses and ENDA<sub>i</sub> value**

Device	Last user memory block address seen by RF	Maximum ENDA <sub>i</sub> value
ST25TV04K-P	007Fh	0Fh

**Table 3. Areas and limit calculation from ENDA<sub>i</sub> registers**

Area	Seen from RF interface
Area 1	Block 0000h
	...
	Block $(\text{ENDA}_1 * 8) + 7$
Area 2	Block $(\text{ENDA}_1 + 1) * 8$
	...
	Block $(\text{ENDA}_2 * 8) + 7$
Area 3	Block $(\text{ENDA}_2 + 1) * 8$
	...
	Block $(\text{ENDA}_3 * 8) + 7$
Area 4	Block $(\text{ENDA}_3 + 1) * 8$
	...
	Last memory Block

Organization of user memory in areas have the following characteristics:

- At least one area exists (Area1), starting at Block address 0000h and finishing at ENDA<sub>1</sub>, with  $\text{ENDA}_1 = \text{ENDA}_2 = \text{ENDA}_3 = \text{End of user memory}$  (factory setting).
- Two Areas could be defined by setting  $\text{ENDA}_1 < \text{ENDA}_2 = \text{ENDA}_3 = \text{End of user memory}$ .
- Three Areas may be defined by setting  $\text{ENDA}_1 < \text{ENDA}_2 < \text{ENDA}_3 = \text{End of user memory}$ .
- A maximum of four areas may be defined by setting  $\text{ENDA}_1 < \text{ENDA}_2 < \text{ENDA}_3 < \text{End of user memory}$ .
- Area 1 specificities
  - Start of Area1 is always Block address 0000h.
  - Area1 minimum size is 8 Blocks (32 Bytes) when  $\text{ENDA}_1 = 00\text{h}$ .
  - Area1 is always readable.
- The last area always finishes on the last user memory Block address (ENDA<sub>4</sub> doesn't exist).
- All areas are contiguous: end of Area(n) + one Block address is always start of Area(n+1).

### Area size programming

RF user must first open the configuration security session to write ENDA<sub>i</sub> registers.

When programming an ENDA<sub>i</sub> register, the following rule must be respected:

- $\text{ENDA}_{i-1} < \text{ENDA}_i \leq \text{ENDA}_{i+1} = 0\text{Fh}$  (End of user memory).

This means that prior to programming any ENDA<sub>i</sub> register, its successor (ENDA<sub>i+1</sub>) must first be programmed to the last Block of memory:

- Successful ENDA<sub>3</sub> programming condition:  $\text{ENDA}_2 < \text{ENDA}_3 \leq \text{End of user memory}$ .
- Successful ENDA<sub>2</sub> programming condition:  $\text{ENDA}_1 < \text{ENDA}_2 \leq \text{ENDA}_3 = \text{End of user memory}$ .
- Successful ENDA<sub>1</sub> programming condition:  $\text{ENDA}_1 \leq \text{ENDA}_2 = \text{ENDA}_3 = \text{End of user memory}$ .

If this rule is not respected, an error 0Fh is returned, and programming is not done.

In order to respect this rule, the following procedure is recommended when programming Areas size (even for changing only one Area size):



1. Ends of Areas 3 and 2 must first be set to the end of memory while respecting the following order:
  - a. If ENDA3  $\neq$  end of user memory, then set ENDA3 = end of memory; else, do not write ENDA3.
  - b. If ENDA2  $\neq$  end of user memory, then set ENDA2 = end of memory; else, do not write ENDA2.
2. Then, desired area limits can be set respecting the following order:
  - a. Set new ENDA1 value.
  - b. Set new ENDA2 value, with ENDA2 > ENDA1
  - c. Set new ENDA3 value, with ENDA3 > ENDA2

Example of successive user memory area setting:

1. Initial state, 2 Areas are defined:
  - a. ENDA1 = 05h (Last block of Area 1:  $(05h \times 8) + 7 = 002Fh$ )
  - b. ENDA2 = 0Fh (Last block of Area 2:  $(0Fh \times 8) + 7 = 007Fh$ )
  - c. ENDA3 = 0Fh (No Area 3)
    - Area 1 from Block 0000h to 002Fh (48 Blocks)
    - Area 2 from Block 0030h to 007Fh (80 Blocks)
    - There is no Area 3.
    - There is no Area 4.
2. Split of user memory in four areas:
  - a. ENDA3 is not updated as it is already set to end of memory.
  - b. ENDA2 is not updated as it is already set to end of memory.
  - c. Set ENDA1 = 03h (Last block of Area 1:  $(03h \times 8) + 7 = 001Fh$ )
  - d. Set ENDA2 = 07h (Last block of Area 1:  $(07h \times 8) + 7 = 003Fh$ )
  - e. Set ENDA3 = 0Bh (Last block of Area 1:  $(0Bh \times 8) + 7 = 005Fh$ )
    - Area1 from Block 0000h to 001Fh (32 Blocks)
    - Area2 from Block 0020h to 003Fh (32 Blocks)
    - Area3 from Block 0030h to 005Fh (32 Blocks)
    - Area4 from Block 0060h to 007Fh (32 Blocks).
3. Return to a split in two equal areas:
  - a. Set ENDA3 = 0Fh
  - b. Set ENDA2 = 0Fh
  - c. Set ENDA1 = 07h (Last block of Area 1:  $(07h \times 8) + 7 = 003Fh$ )
    - Area1 from Block 0000h to 003Fh (64 Blocks)
    - Area2 from Block 0400h to 007Fh (64 Blocks)
    - There is no Area3.
    - There is no Area4.

Programming ENDA3 to 0Fh in step 2.a would have resulted in into an error, since rule  $ENDAi-1 < ENDAi$  would not been respected (END A2 = ENDA3 in that case).

### Registers for user memory area configuration

**Table 4. ENDA1 access**

RF	
Command	Type
Read configuration (cmd code A0h) @05h	R always
Write configuration (cmd code A1h) @05h	W if RF configuration security session is open and configuration not locked

**Table 5. ENDA1**

Bit	Name	Function	Factory Value
b7-b0	ENDA1	End Area 1 = $8 \times \text{ENDA1} + 7$ when expressed in blocks (RF) End Area 1 = $32 \times \text{ENDA1} + 31$ when expressed in bytes (I <sup>2</sup> C)	0Fh

Note: Refer to Table 10. System configuration memory map for the ENDA1 register.

**Table 6. ENDA2 access**

RF	
Command	Type
Read configuration (cmd code A0h) @07h	R always
Write configuration (cmd code A1h) @07h	W if RF configuration security session is open and configuration not locked

**Table 7. ENDA2**

Bit	Name	Function	Factory Value
b7-b0	ENDA2	End Area 2 = $8 \times \text{ENDA2} + 7$ when expressed in blocks (RF)	0Fh

Note: Refer to Table 10. System configuration memory map for the ENDA2 register.

**Table 8. ENDA3 access**

RF	
Command	Type
Read configuration (cmd code A0h) @09h	R always
Write configuration (cmd code A1h) @09h	W if RF configuration security session is open and configuration not locked

**Table 9. ENDA3**

Bit	Name	Function	Factory Value
b7-b0	ENDA3	End Area 3 = $8 \times \text{ENDA3} + 7$ when expressed in blocks (RF)	0Fh

Note: Refer to Table 10. System configuration memory map for the ENDA3 register.

### 4.3 System configuration area

In addition to EEPROM user memory, includes a set of registers located in the system configuration area memory (EEPROM nonvolatile registers). Those registers are set during device configuration (i.e.: area extension), or by the application (i.e.: area protection). Registers content is read during the boot sequence and define basic [ST25TV04K-P](#) behavior.

The registers located in the system configuration area can be accessed via dedicated Read Configuration and Write Configuration commands, with a pointer acting as the register address.

The configuration security session must first be open, by presenting a valid configuration password, to grant write access to system configuration registers.

Table 1 shows the complete map of the system configuration area.

**Table 10. System configuration memory map**

RF access		Static Register	
Address	Type	Name	Function
00h	RW <sup>(1)</sup>	Table 38. GPO	Enable/disable ITs on GPO
01h	RW <sup>(1)</sup>	Table 40. IT_TIME	Interruption pulse duration
02h	RW <sup>(1)</sup>	Table 42. EH_MODE	Energy harvesting default strategy after Power ON
03h	RW <sup>(1)</sup>	Table 13. KILL	Tag kill
04h	RW <sup>(1)</sup>	Table 15. A1SS	Area1 access protection
05h	RW <sup>(1)</sup>	Table 5. ENDA1	Area 1 ending point
06h	RW <sup>(1)</sup>	Table 17. A2SS	Area2 access protection
07h	RW <sup>(1)</sup>	Table 7. ENDA2	Area 2 ending point
08h	RW <sup>(1)</sup>	Table 19. A3SS	Area3 access protection
09h	RW <sup>(1)</sup>	Table 9. ENDA3	Area 3 ending point
0Ah	RW <sup>(1)</sup>	Table 21. A4SS	Area4 access protection
N/A	RW <sup>(2) (3)</sup>	Table 23. LOCK_CCFILE	Blocks 0 and 1 RF Write protection
0Fh	RW <sup>(1)</sup>	Table 25. LOCK_CFG	Protect Write to system configuration registers
N/A	WO <sup>(4)</sup>	Table 47. LOCK_DSFDID	DSFDID lock status
NA	WO <sup>(5)</sup>	Table 49. LOCK_AFI	AFI lock status
N/A	RW <sup>(4)</sup>	Table 51. DSFDID	DSFDID value
N/A	RW <sup>(5)</sup>	Table 53. AFI	AFI value
N/A	RO	Table 55. MEM_SIZE	Memory size value in blocks, 2 bytes
	RO	Table 57. BLK_SIZE	Block size value in bytes
N/A	RO	Table 59. IC_REF	IC reference value
NA	RO	Table 61. UID	Unique identifier, 8 bytes
N/A	WO <sup>(6)</sup>	Table 27. PWD_0	Configuration security session password, 8 bytes
N/A	WO <sup>(6)</sup>	Table 29. PWD_1	User security session password 1, 8 bytes
N/A	WO <sup>(6)</sup>	Table 31. PWD_2	User security session password 2, 8 bytes
N/A	WO <sup>(6)</sup>	Table 33. PWD_3	User security session password 3, 8 bytes

1. Write access is granted if RF configuration security session is open and configuration is not locked (LOCK\_CFG register equals to 0).
2. Write access to bit 0 if Block 00h is not already locked and to bit 1 if Block 01h is not already locked.
3. LOCK\_CCFILE content is only readable through reading the Block Security Status of blocks 00h and 001h (see User memory protection)
4. Write access if DSFDID is not locked
5. Write access if AFI is not locked.
6. Write access only if corresponding security session is open.

## 4.4 Dynamic configuration

ST25TV04K-P has dynamic register that allow temporary modification of the energy harvesting behaviour and report RF field presence and energy harvesting state. Dynamic register is volatile and not restored to its previous values after POR.

Dynamic register can be accessed via dedicated (fast) read dynamic configuration and (fast) write dynamic configuration commands, with a pointer acting as the register address. No password is needed to access dynamic registers.

**Table 11. Dynamic register memory map**

RF access		Static Register	
Address	Type	Name	Function
02h	RW	Table 44. EH_CTRL_Dyn	Energy harvesting default strategy after Power ON

## 5 ST25TV04K-P specific features

ST25TV04K-P offers the data protection feature, both user memory and system configuration, and a kill mode. It also offers a GPO pin, which indicates incoming event to the contact side, like RF field changes, RF activity in progress, RF writing completion or RF user state or pulse. Finally, it offers an energy harvesting element to deliver  $\mu\text{W}$  of power when external conditions make it possible.

Those features can be programmed by setting registers of the ST25TV04K-P. ST25TV04K-P can be partially customized using configuration registers located in the EEPROM system area.

These registers are dedicated to:

- Data memory organization and protection ENDA<sub>i</sub>, AiSS, LOCK\_CCFILE.
- Kill mode, KILL
- The device's structure LOCK\_CFG
- General purpose output: GPO, IT\_TIME
- Energy harvesting: EH\_MODE

A set of additional registers allows to identify and customize the product (DSFID, AFI, IC\_REF, etc.).

Dedicated commands read configuration and write configuration must be used to access the configuration registers. Update is only possible when the access right has been granted by presenting the configuration password (PWD\_0), and if the system configuration was not previously locked (LOCK\_CFG=1).

After any valid write access to the configuration registers, the new configuration is immediately applied.

A dynamic register allow to dynamically control energy harvesting. This dynamic configuration register updated by the application recovers its default static value after a power-on reset (POR).

Read or write accesses to the dynamic register is associated to the dedicated commands, read dynamic configuration, write dynamic configuration.

### 5.1 KILL feature

#### 5.1.1 KILL register

**Table 12. KILL access**

Command	Type
Read configuration (cmd code A0h) @03h	R always
Write configuration (cmd code A1h) @03h	W if RF configuration security session is open and configuration not locked

**Table 13. KILL**

Bit	Name	Function	Factory value
b0	KILL_ERROR	0: RF commands executed 1: ST25TV04K-P is killed but still answers commands with error 0Fh	0b
b1	KILL_MUTE	0: RF communication enabled 1: ST25TV04K-P is killed and doesn't answer to any command	0b
b7-b2	RFU	-	00000b

*Note:* Refer to Table 10. System configuration memory map for the KILL register.

### 5.1.2 KILL mode description

KILL register allow the user to definitely kill the ST25TV04K-P tag.

KILL register is composed of two bits (see Table 13. KILL): KILL\_ERROR and KILL\_MUTE. For a normal usage of RF interface, bits KILL\_MUTE and KILL\_ERROR must be set to 0.

Three working modes are offered for ST25TV04K-P:

- Kill mute mode:
  - When KILL\_MUTE is set to 1, ST25TV04K-P is killed. It can't be read or write and stay mute to any request. Kill mute mode is definitive.
- Kill error mode:
  - When KILL\_MUTE is set to 0 and KILL\_ERROR is set to 1, RF commands are interpreted but not executed. In case of a valid command, ST25TV04K-P responds after t1 with the error code 0Fh. Inventory and stay quiet commands are not answered. Kill error mode is definitive
- Normal mode:
  - In normal usage, KILL\_MUTE and KILL\_ERROR are set to 0, ST25TV04K-P processes the request and respond accordingly.

## 5.2 Data protection

ST25TV04K-P provides a special data protection mechanism based on passwords that unlock security sessions. User memory can be protected for read and/or write access and system configuration can be protected from write access.

### 5.2.1 Data protection registers

**Table 14. A1SS access**

Command	Type
Read configuration (cmd code A0h) @04h	R always
Write configuration (cmd code A1h) @04h	W if RF configuration security session is open and configuration not locked

**Table 15. A1SS**

Bit	Name	Function	Factory Value
b1-b0	PWD_CTRL_A1	00: Area 1 user security session can't be open by password 01: Area 1 user security session is open by PWD_1 10: Area 1 user security session is open by PWD_2 11: Area 1 user security session is open by PWD_3	00b
b3-b2	RW_PROTECTION_A1	00: Area 1 access: Read always allowed / Write always allowed 01: Area 1 access: Read always allowed, Write allowed if user security session is open 10: Area 1 access: Read always allowed, Write allowed if user security session is open 11: Area 1 access: Read always allowed, Write always forbidden	00b
b7-b4	RFU	-	0000b

*Note:* Refer to Table 10. System configuration memory map for the A1SS register.

**Table 16. A2SS access**

Command	Type
Read configuration (cmd code A0h) @06h	R always

Command	Type
Write configuration (cmd code A1h) @06h	W if RF configuration security session is open and configuration not locked

**Table 17. A2SS**

Bit	Name	Function	Factory Value
b1-b0	PWD_CTRL_A2	00: Area 2 user security session can't be open by password 01: Area 2 user security session is open by PWD_1 10: Area 2 user security session is open by PWD_2 11: Area 2 user security session is open by PWD_3	00b
b3-b2	RW_PROTECTION_A2	00: Area 2 access: Read always allowed, Write always allowed 01: Area 2 access: Read always allowed, Write allowed if user security session is open 10: Area 2 access: Read allowed if user security session is open, Write allowed if RF user security session is open 11: Area 2 access: Read allowed if user security session is open, Write always forbidden.	00b
b7-b4	RFU	-	0000b

*Note:* Refer to [Table 10. System configuration memory map for the A2SS register.](#)

**Table 18. A3SS access**

Command	Type
Read configuration (cmd code A0h) @08h	R always
Write configuration (cmd code A1h) @08h	W if RF configuration security session is open and configuration not locked

**Table 19. A3SS**

Bit	Name	Function	Factory Value
b1-b0	PWD_CTRL_A3	00: Area 3 user security session can't be open by password 01: Area 3 user security session is open by PWD_1 10: Area 3 user security session is open by PWD_2 11: Area 3 user security session is open by PWD_3	00b
b3-b2	RW_PROTECTION_A3	00: Area 3 access: Read always allowed / Write always allowed 01: Area 3 access: Read always allowed, Write allowed if user security session is open 10: Area 3 access: Read allowed if user security session is open, Write allowed if user security session is open 11: Area 3 access: Read allowed if user security session is open, Write always forbidden.	00b
b7-b4	RFU	-	0000b

*Note:* Refer to [Table 10. System configuration memory map for the A3SS register.](#)



**Table 20. A4SS access**

Command	Type
Read configuration (cmd code A0h) @0Ah	R always
Write configuration (cmd code A1h) @0Ah	W if RF configuration security session is open and configuration not locked

**Table 21. A4SS**

Bit	Name	Function	Factory Value
b1-b0	PWD_CTRL_A4	00: Area 4 user security session can't be open by password 01: Area 4 user security session is open by PWD_1 10: Area 4 user security session is open by PWD_2 11: Area 4 user security session is open by PWD_3	00b
b3-b2	RW_PROTECTION_A4	00: Area 4 access: Read always allowed, Write always allowed 01: Area 4 access: Read always allowed, Write allowed if user security session is open 10: Area 4 access: Read allowed if user security session is open, Write allowed if user security session is open 11: Area 4 access: Read allowed if user security session is open, Write always forbidden	00b
b7-b4	RFU	-	0000b

*Note:* Refer to [Table 10. System configuration memory map](#) for the A4SS register.

**Table 22. LOCK\_CCFILE access**

Command	Type
Lock Block (cmd code 22h) @00h/01h	R always      b0: W if Block 00h is not already locked. b1: W if Block 01h is not already locked.
Ext Lock Block (cmd code 32h) @00h/01h	
Read Block (cmd code 20h) @00h/01h	
Fast Read Block <sup>(1)</sup> (cmd code C0h) @00h/01h	
Ext Read Block <sup>(1)</sup> (cmd code 30h) @00h/01h	
Fast Ext Read Block <sup>(1)</sup> (cmd code C4h) @00h/01h	
Read Multi Block <sup>(1)</sup> (cmd code 23h) @00h/01h	
Ext Read Multi Block <sup>(1)</sup> (cmd code 33h) @00h/01h	
Fast Read Multi Block <sup>(1)</sup> (cmd code C3h) @00h/01h	
Fast Ext Read Multi Block <sup>(1)</sup> (cmd code C5h) @00h/01h	
Get Multi Block SS (cmd code 2Ch) @00h/01h	
Ext Get Multi Block SS (cmd code 3Ch) @00h/01h	

1. With option flag set to 1.

**Table 23. LOCK\_CCFILE**

Bit	Name	Function	Factory Value
b0	LCKBCK0	0: Block @ 00h is not write locked 1: Block @ 00h is write locked	0b
b1	LCKBCK1	0: Block @ 01h is not write locked 1: Block @ 01h is write locked	0b
b7-b2	RFU	-	000000b

Note: Refer to Table 10. System configuration memory map for the LOCK\_CCFILE register.

**Table 24. LOCK\_CFG access**

Command	Type
Read configuration (cmd code A0h) @0Fh	R always
Write configuration (cmd code A1h) @0Fh	W if RF configuration security session is open and configuration not locked

**Table 25. LOCK\_CFG**

Bit	Name	Function	Factory Value
b0	LCK_CFG	0: Configuration is unlocked 1: Configuration is locked	0b
b7-b1	RFU	-	0000000b

Note: Refer to Table 10. System configuration memory map for the LOCK\_CFG register.

**Table 26. PWD\_0 access**

Command	Type
Present Password (cmd code B3h)	WO if configuration security session is open
Write Password (cmd code B1h)	

**Table 27. PWD\_0**

Bit	Name	Function	Factory Value
b7-b0	PWD_0	Byte 0 (LSB) of password for configuration security session	00h
b7-b0		Byte 1 of password for configuration security session	00h
b7-b0		Byte 2 of password for configuration security session	00h
b7-b0		Byte 3 of password for configuration security session	00h
b7-b0		Byte 4 of password for configuration security session	00h
b7-b0		Byte 5 of password for configuration security session	00h
b7-b0		Byte 6 of password for configuration security session	00h
b7-b0		Byte 7 (MSB) of password for configuration security session	00h

Note: Refer to Table 10. System configuration memory map for the PWD\_0 register.

**Table 28. PWD\_1 access**

Command	Type
Present Password (cmd code B3h) Write Password (cmd code B1h)	WO if configuration security session is open with password 1

**Table 29. PWD\_1**

Bit	Name	Function	Factory Value
b7-b0	RF_PWD_1	Byte 0 (LSB) of password 1 for user security session	00h
b7-b0		Byte 1 of password 1 for user security session	00h
b7-b0		Byte 2 of password 1 for user security session	00h
b7-b0		Byte 3 of password 1 for user security session	00h
b7-b0		Byte 4 of password 1 for user security session	00h
b7-b0		Byte 5 of password 1 for user security session	00h
b7-b0		Byte 6 of password 1 for user security session	00h
b7-b0		Byte 7 (MSB) of password 1 for user security session	00h

Note: Refer to [Table 10. System configuration memory map](#) for the PWD\_1 register.

**Table 30. PWD\_1 access**

Command	Type
Present Password (cmd code B3h) Write Password (cmd code B1h)	WO if configuration security session is open with password 2

**Table 31. PWD\_2**

Bit	Name	Function	Factory Value
b7-b0	PWD_2	Byte 0 (LSB) of password 2 for user security session	00h
b7-b0		Byte 1 of password 2 for user security session	00h
b7-b0		Byte 2 of password 2 for user security session	00h
b7-b0		Byte 3 of password 2 for user security session	00h
b7-b0		Byte 4 of password 2 for user security session	00h
b7-b0		Byte 5 of password 2 for user security session	00h
b7-b0		Byte 6 of password 2 for user security session	00h
b7-b0		Byte 7 (MSB) of password 2 for user security session	00h

Note: Refer to [Table 10. System configuration memory map](#) for the PWD\_2 register.

**Table 32. PWD\_1 access**

Command	Type
Present Password (cmd code B3h) Write Password (cmd code B1h)	WO if configuration security session is open with password 3

**Table 33. PWD\_3**

Bit	Name	Function	Factory Value
b7-b0	PWD_3	Byte 0 (LSB) of password 3 for user security session	00h
b7-b0		Byte 1 of password 3 for user security session	00h
b7-b0		Byte 2 of password 3 for user security session	00h
b7-b0		Byte 3 of password 3 for user security session	00h
b7-b0		Byte 4 of password 3 for user security session	00h
b7-b0		Byte 5 of password 3 for user security session	00h
b7-b0		Byte 6 of password 3 for user security session	00h
b7-b0		Byte 7 (MSB) of password 3 for user security session	00h

*Note:* Refer to [Table 10. System configuration memory map for the PWD\\_3 register.](#)

## 5.2.2 Passwords and security sessions

ST25TV04K-P provides protection of user memory and system configuration registers. user and host can access those protected data by opening security sessions with the help of passwords. Access rights is more restricted when security sessions are closed, and less restricted when security sessions are open.

There is two types of security sessions, as shown in Table 34. Security session type:

**Table 34. Security session type**

Security session	Open by presenting	Right granted when security session is open, and until it is closed
user	password 1, 2 or 3 (PWD_1, PWD_2, PWD_3)	User access to protected user memory as defined in A <sub>i</sub> SS registers User write access to password 1, 2 or 3
configuration	password 0 (PWD_0)	User write access to configuration registers User write access to password 0

1. Password number must be the same as the one selected for protection.
2. Write access to the password number corresponding to the password number presented.

All passwords are 64-bits long, and default factory passwords value is 0000000000000000h.

The ST25TV04K-P passwords management is organized around dedicated set of commands to access the dedicated registers in system configuration area.

The dedicated password commands are:

- "Write Password": command (code B1h): see Section 6.4.28 Write password.
- "Present Password": command (code B3h): see Section 6.4.29 Present password.

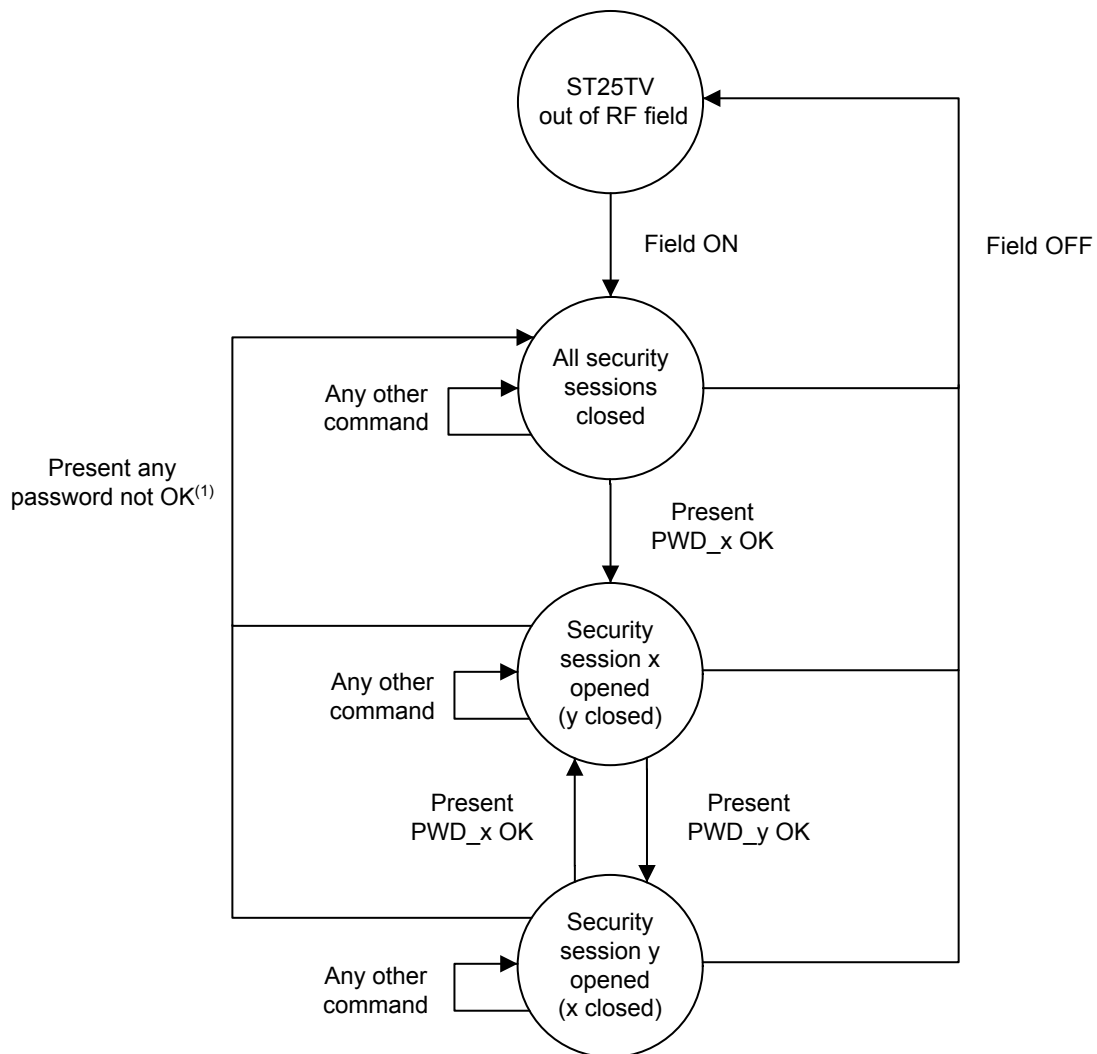
User possible actions for security sessions are:

- **Open user security session:** "Present Password" command, with password number 1, 2 or 3 and the valid corresponding password
- **Write password:** "Present Password" command, with password number (0, 1, 2 or 3) and the current valid corresponding password. Then "Write Password" command, with same password number (0, 1, 2 or 3) and the new corresponding password.
- **Close user security session:** "Present Password" command, with a different password number than the one used to open session or any wrong password. Or remove tag from RF field (POR).
- Presenting a password with an invalid password number doesn't close the session.
- **Open configuration security session:** "Present Password" command, with password number 0 and the valid password 0.
- **Close configuration security session:** "Present Password" command, with a password number different than 0, or password number 0 and wrong password 0. Or remove tag from field (POR).
- Presenting a password with an invalid password number doesn't close the session.

Opening any new security session (user or configuration) automatically close the previously open one (even if it fails).

**Caution:** To make the application more robust, it is recommended to use addressed or selected mode during write password operations to get the traceability of which tags/UID have been programmed

Figure 5. Security sessions management



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1. Presenting a password with an invalid password number doesn't close the session.

### 5.2.3 User memory protection

On factory delivery, areas are not protected.

Each area can be individually protected in read and/or write access.

Area 1 is always readable.

Furthermore, blocks 0 and 1 can be independently write locked.

Each memory area of the ST25TV04K-P can be individually protected by one out of three available passwords (password 1, 2 or 3), and each area can also have individual Read/Write access conditions.

For each area, an AiSS register is used to:

- Select the password that unlock the user security session for this area
- Select the protection against read and write operations for this area

(See Table 15. A1SS, Table 17. A2SS, Table 19. A3SS and Table 21. A4SS for details about available read and write protections).

**Note:** Setting 00b in PWD\_CTRL\_A<sub>i</sub> field means that user security session cannot be open by any password for the corresponding area.

When updating AiSS registers, the new protection value is effective immediately after the register write completion.

- blocks 0 and 1 are exceptions to this protection mechanism:
  - Blocks 0 and 1 can be individually write locked by issuing a (Ext) Lock Single Block command. Once locked, they cannot be unlock. LOCK\_CCFILE register is automatically updated when using (Ext) Lock Single Block command.
  - User needs no password to lock blocks 0 and/or 1.
  - Locking blocks 0 and/or 1 is possible even if the configuration is locked (LOCK\_CFG=1).
  - Locking blocks 0 and/or 1 is possible even if the area is write locked.
  - Unlocking area1 (through A1SS register) does not unlock blocks 0 and 1 if they have been locked though (Ext) Lock Block command.
  - Once locked, the user cannot unlock blocks 0 and/or 1.

*Note:* When areas size are modified (ENDAi registers), AiSS registers are not modified.

#### **Retrieve the security status of a user memory block or byte**

User can read a block security status by issuing following commands:

- (Ext) Get Multiple Blocks Security Status command
- (Ext) (Fast) Read Single Block with option flag set to 1
- (Ext) (Fast) Read Multiple Blocks with option flag set to 1

responds with a Block security status containing a Lock\_bit flag as specified in ISO 15693 standard. This lock\_bit flag is set to 1 if block is locked against write.

Lock\_bit flag value may vary if corresponding user security session is open or closed.

### **5.2.4 System memory protection**

By default, the system memory is write protected.

To enable write access to system configuration registers, user must open the configuration security session (by presenting a valid password 0) and system configuration must not be locked (LOCK\_CFG=00h).

By default, user can read all system configuration registers, except all passwords, LOCK\_CCFILE, LOCK\_DSFID and LOCK\_AFI.

Configuration lock:

- Write access to system configuration registers can be locked by writing 01h in the LOCK\_CFG register.
- User cannot unlock system configuration if LOCK\_CFG=01h, even after opening configuration security session (Lock is definitive).
- When system configuration is locked (LOCK\_CFG=01h), it is still possible to change passwords (0 to 3).

Device identification registers:

- AFI and DFSID registers can be independently locked by user, issuing respectively a lock AFI and a lock DSFID command. Lock is definitive: once locked, AFI and DSFID registers cannot be unlocked. System configuration locking mechanism (LOCK\_CFG=01h) does not lock AFI and DSFID registers.
- Other device identification registers (MEM\_SIZE, BLK\_SIZE, IC\_REF, UID) are read only registers.

## **5.3 GPO**

GPO signal is used to alert external device of RF events or ST25TV04K-P processes activity. Several causes could be used to request a host interruption. RF user can also directly drive GPO pin level using a dedicated RF command.

### **5.3.1 Interrupt capabilities on RF events**

ST25TV04K-P supports multi interruption mode and can report several events occurring through RF interface.

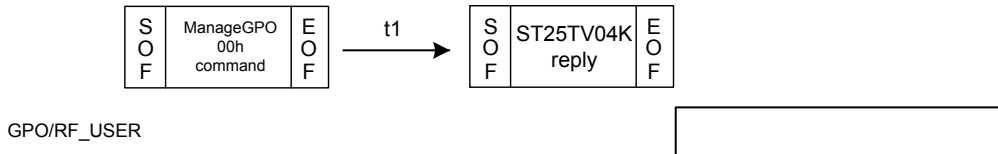
Supported RF events is listed hereafter:

**RF\_USER:**

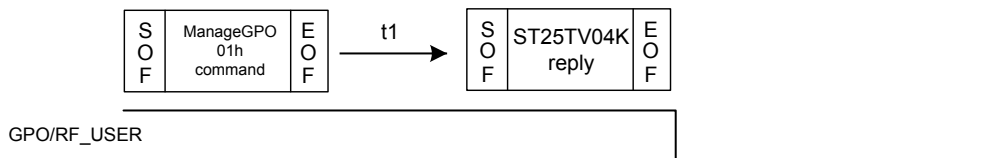
- GPO output level is controlled by Manage GPO command (set or reset)
- When RF\_USER is activated, GPO level is changed after EOF of ST25TV04K-P response to a manage GPO set or reset command (see xxxx).
- RF\_USER is prevalent over all other GPO events when set by manage GPO command.

**Figure 6. RF\_USER chronogram**

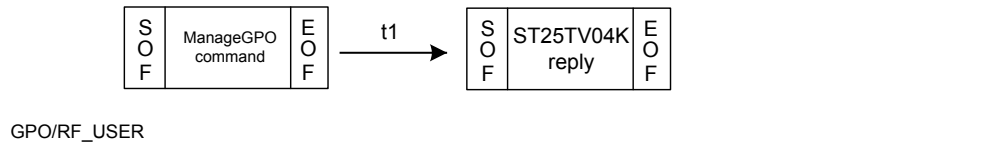
1) VCD sends a ManageGPO command with value 00h (set GPO) and ST25TVxxx replies. GPO/RF\_USER is pulled high after ST25TVxxx response.



2) VCD sends a ManageGPO command with value 01h (reset GPO) and ST25TVxxx replies. GPO/RF\_USER is pulled low after ST25TVxxx response.



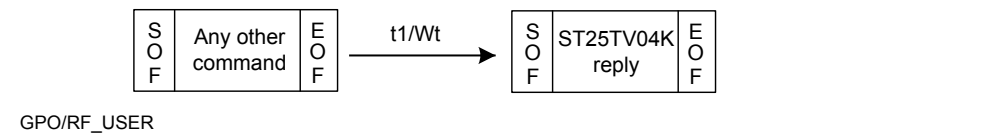
3) VCD sends a ManageGPO command (any value) and ST25TVxxx replies with error. GPO/RF\_USER remains low.



4) VCD sends a ManageGPO command (any value) and ST25TVxxx stays quiet (command not for this VICC, or quiet state). GPO/RF\_USER remains low.



5) VCD sends any command other than ManageGPO command and ST25TVxxx replies. GPO/RF\_USER remains low.



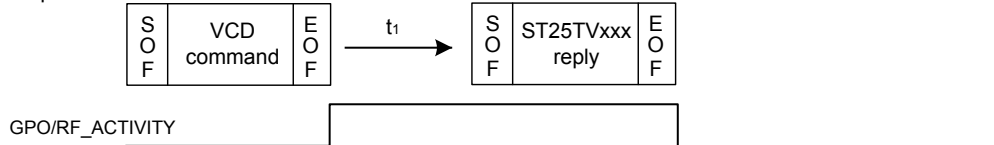


**RF\_ACTIVITY:**

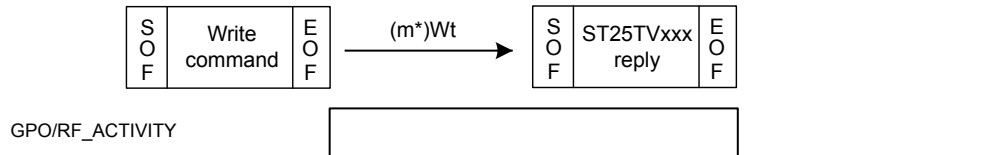
- GPO output level reflects the RF activity.
- When RF\_ACTIVITY is activated, a GPO output level change from RF command EOF to ST25TV04K-P response EOF.

**Figure 7. RF\_ACTIVITY chronogram**

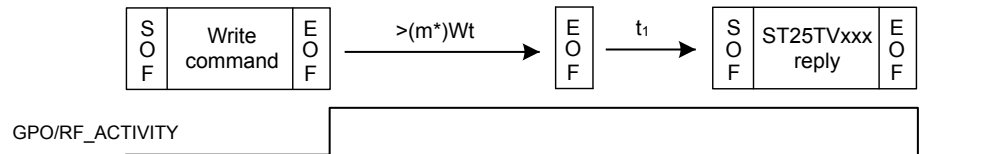
1) VCD sends a command and ST25TVxxx replies. GPO/RF\_ACTIVITY is released after ST25TVxxx response.



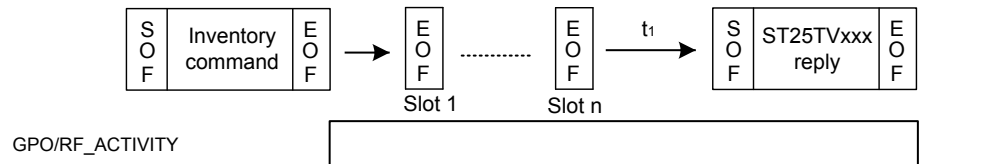
2) VCD sends a write command and ST25TVxxx replies after write completed. GPO/RF\_ACTIVITY is released after ST25TVxxx response.



3) VCD sends a write command with option flag set to 1, and ST25TVxxx replies after receiving EOF. GPO/RF\_ACTIVITY is released after ST25TVxxx response.



4) VCD sends an Inventory 16 slots command, and ST25TVxxx replies in it's slot. GPO/RF\_ACTIVITY is released after ST25TVxxx response.



5) VCD sends a command and ST25TVxxx stays quiet (Stay Quiet command, command not for this VICC, or quiet state). GPO/RF\_ACTIVITY remains low.

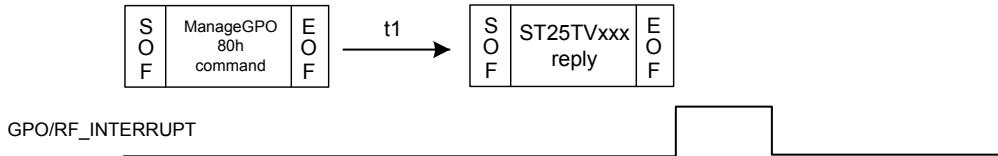


**RF\_INTERRUPT:**

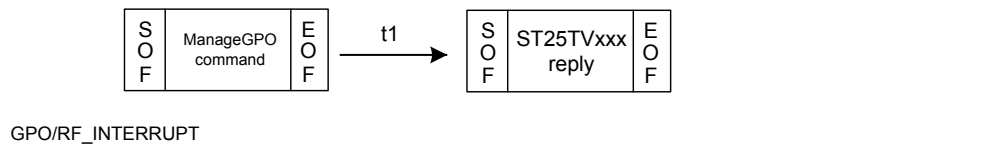
- A pulse is emitted on GPO by Manage GPO command (interrupt).
- When RF\_INTERRUPT is activated, a pulse of duration IT\_TIME is emitted after EOF of ST25TV04K-P response to a manage GPO interrupt command (see xxxx).

**Figure 8. RF\_INTERRUPT chronogram**

1) VCD sends a ManageGPO command with value 80h (GPO emit pulse) and ST25TVxx replies. GPO/RF\_INTERRUPT generates a pulse of during IT\_TIME after ST25TVxxx response.



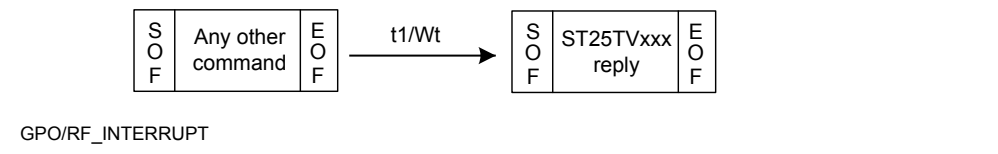
2) VCD sends a ManageGPO command (any value) and ST25TVxxx replies with error. GPO/RF\_INTERRUPT remains low.



3) VCD sends a ManageGPO command (any value) and ST25TVxxx stays quiet (command not for this VICC, or quiet state). GPO/RF\_INTERRUPT low.



4) VCD sends any command other than ManageGPO command and ST25TVxxx replies. GPO/RF\_INTERRUPT remains low.



**FIELD\_CHANGE:**

- A pulse is emitted on GPO to signal a change in RF field state.
- When FIELD\_CHANGE is activated, and when RF field appear, GPO emits a pulse of duration IT\_TIME.
- If ST25TV04K-P is configured in KILL\_MUTE mode, field change are not reported on GPO, even if FIELD\_CHANGE event is activated, as shown in Table 35. FIELD\_CHANGE KILL mode.

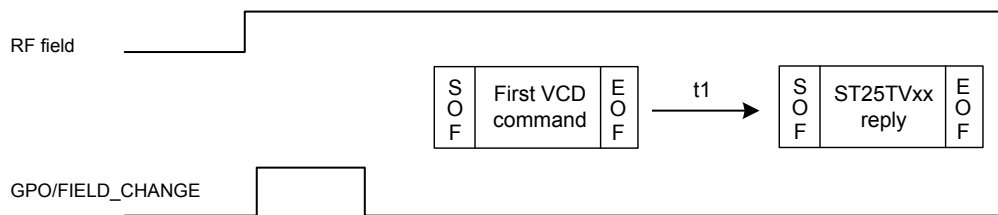
**Table 35. FIELD\_CHANGE KILL mode**

KILL_ERROR	KILL_MUTE	GPO behaviour in KILL mode
0	0	A pulse is emitted on GPO if RF field appears <sup>(1)</sup>
1	0	
X	1	GPO is tied low if VDCG is powered, High-Z otherwise
X	1	

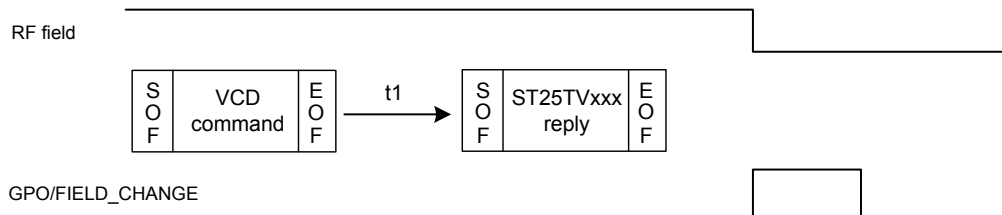
1. assuming that GPO output is enabled (GPO\_EN = 1) and VDCG is powered.

**Figure 9. FIELD\_CHANGE chronogram**

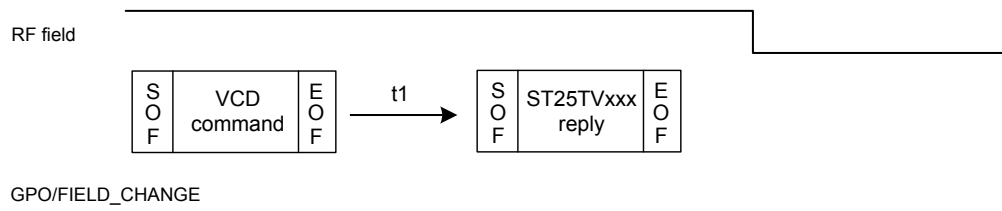
1) RF field appears. GPO/FIELD\_CHANGE generates a pulse during IT\_TIME.



2) RF field disappears and ST25TVxxx is powered through VCC. GPO/FIELD\_CHANGE generates a pulse during IT\_TIME.



3) RF field disappears and ST25TV is not powered through VCC. GPO/FIELD\_CHANGE doesn't generates any pulse.

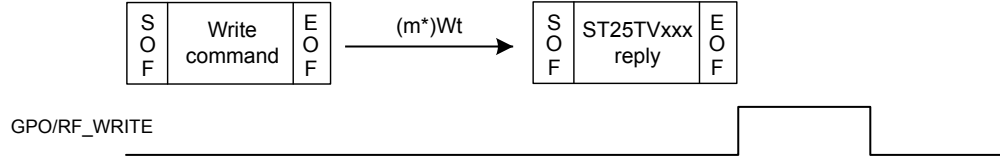


**RF\_WRITE:**

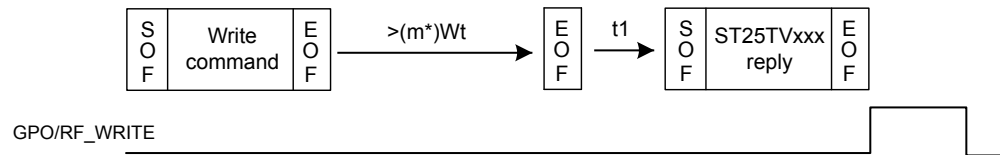
- When RF\_WRITE is activated, a pulse of duration IT\_TIME is emitted at completion of a valid RF write operation in EEPROM (after EOF of ST25TV04K-P response).
- Following commands trigger the RF\_WRITE interrupt after a valid write operation in EEPROM:
  - Write single block
  - Extended write single block
  - Write multiple block
  - Extended write multiple block
  - Lock block
  - Extended lock block
  - Write AFI
  - Lock AFI
  - Write DSFID
  - Lock DSFID
  - Write configuration
  - Write password
- Note that writing in dynamic register does not trigger RF\_WRITE interrupt (no write operation in EEPROM).

**Figure 10. RF\_WRITE chronogram**

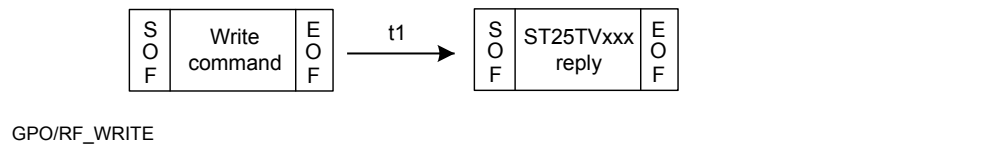
1) VCD sends a write command and ST25TVxx replies after write completed. GPO/RF\_WRITE generates a pulse during IT\_TIME after ST25TVxxx response.



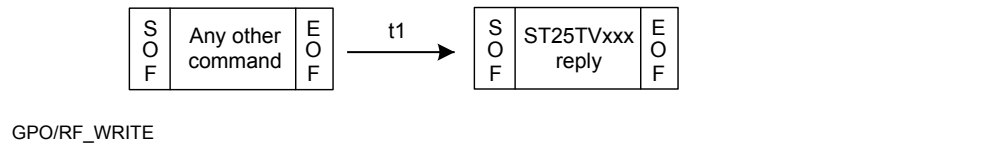
2) VCD sends a write command with option flag set to 1, and ST25TVxx replies after receiving EOF. GPO/RF\_WRITE generates a pulse during IT\_TIME after ST25TVxxx response.



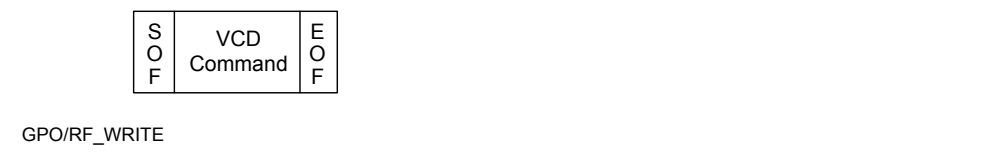
3) VCD sends a write command and ST25TVxxx replies with error. GPO/RF\_WRITE remains low.



4) VCD sends any other command than a write command. GPO/RF\_WRITE remains low.



5) VCD sends any command and ST25TVxxx stays quiet (command not for this VICC, or quiet state). GPO/RF\_ACTIVITY remains low.



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### 5.3.2 GPO and power supply

When RF field is present and  $V_{DGC}$  is powered, GPO is acting as configured in GPO and IT\_TIME registers. When the RF field disappears, the GPO state is reset and the output level is set tied low if  $V_{DGC}$  is powered or high-Z otherwise.

**Table 36. GPO interrupt capabilities in function of RF field**

RF field on	RF field off
GPO state is function of RF events <sup>(1)</sup>	GPO is tied low if $V_{DGC}$ is powered, High-Z otherwise

1.  $V_{DGC}$  is powered.

### 5.3.3 GPO registers

Two static registers in system configuration are dedicated to this feature.

**Table 37. GPO access**

Command	Type
Read Configuration (cmd code A0h) @00h Write Configuration (cmd code A1h) @00h	R always, W if RF configuration security session is open and configuration not locked

**Table 38. GPO**

Bit	Name	Function	Factory Value
b0	RF_USER_EN	0: disabled 1: GPO output level is controlled by Manage GPO Command (set/reset)	0b
b1	RF_ACTIVITY_EN	0: disabled 1: GPO output level changes from RF command EOF to response EOF.	0b
b2	RF_INTERRUPT_EN	0: disabled 1: GPO output level is controlled by Manage GPO Command (pulse).	0b
b3	FIELD_CHANGE_EN	0: disabled 1: A pulse is emitted on GPO, when RF field appears or disappears.	1b
b4	RFU	-	0b
b5	RFU	-	0b
b6	RF_WRITE_EN	0: disabled 1: A pulse is emitted on GPO at completion of valid RF write operation in EEPROM.	0b
b7	GPO_EN	0: GPO output is disabled. 1: GPO output is enabled. GPO outputs enabled interrupts.	1b

**Note:** Refer to [Table 10. System configuration memory map for the GPO register.](#)

- Enables the interruption source, and enable GPO output.
- Several interruption sources can be enabled simultaneously.
- The updated value is valid for the next command (except for the RF\_WRITE interrupt, which is valid right after EOF of the Write Configuration command if enabled through RF).
- The GPO\_EN bit (b7) allows to disable GPO output .
- RF configuration security session (present RF password 0) must be open in order to write the GPO register.

**Table 39. IT\_TIME access**

Command	Type
Read Configuration (cmd code A0h) @01h Write Configuration (cmd code A1h) @01h	R always, W if RF configuration security session is open and configuration not locked

**Table 40. IT\_TIME**

Bit	Name	Function	Factory Value
b2-b0	IT_TIME	Pulse duration = 301 us - IT_TIME x 37.65 us ± 2 us	011b
b7-b3	RFU	-	00000b

**Note:** Refer to [Table 10. System configuration memory map for the IT\\_TIME register.](#)

- Defines interrupt pulse duration on GPO pin for the flowing events: RF\_INTERRUPT, FIELD\_CHANGE, RF\_WRITE.

- See Eq. (1) for interrupt duration calculation.
- RF configuration security session (present RF password 0) must be open in order to write IT\_TIME register.

### 5.3.4 Configuring GPO

Both GPO and interruption pulse duration can be configured. One or more interrupts can be enabled at same time.

RF user can use Read Configuration and Write Configuration commands to set accordingly the GPO and IT\_TIME registers, after presenting a valid RF configuration password to open RF configuration security session.

Enabling or disabling GPO output: GPO output can be enabled or disabled at power up time by writing in GPO\_EN bit 7 of GPO register (if write access is granted).

Interruption pulse duration configuration:

- Interrupt pulse duration is configured by writing pulse duration value in IT\_TIME register.
- Pulse duration is calculated with the following equation

IT pulse duration equation:

$$IT_{pulse\ duration} = 301\mu s - IT\_TIME \times 37.65\mu s \pm 2\mu s \quad (1)$$

## 5.4 Energy harvesting (EH)

### 5.4.1 Energy harvesting registers

**Table 41. EH\_MODE access**

Command	Type
Read configuration (cmd code A0h) @02h Write configuration (cmd code A1h) @02h	R always, W if RF configuration security session is open and configuration not locked

**Table 42. EH\_MODE**

Bit	Name	Function	Factory Value
b0	EH_MODE	0: EH forced after boot 1: EH on demand only	1b
b7-b1	RFU	-	0000000b

*Note:* Refer to Table 10. System configuration memory map for the EH\_MODE register.

**Table 43. EH\_CTRL\_Dyn access**

Command	Type
Read dynamic configuration (cmd code ADh) @02h Fast read dynamic configuration (cmd code CDh) @02h Write dynamic configuration (cmd code AEh) @02h Fast write dynamic configuration (cmd code CEh) @02h	b0: R always, W always b1 - b7: RO

**Table 44. EH\_CTRL\_Dyn**

Bit	Name	Function	Factory Value
b0	EH_EN	0: Disable EH feature 1: Enable EH feature	0b
b1	EH_ON	0: EH feature is disabled 1: EH feature is enabled	0b
b2	FIELD_ON	0: RF field is not detected 1: RF field is present and ST25DVxxx may communicate in RF	Depending of power source
b3	RFU	-	0b
b7-b4	RFU	-	0b

**Note:** Refer to [Table 11. Dynamic register memory map](#) for the EH\_CTRL\_Dyn register.

### 5.4.2 Energy harvesting feature description

The usage of energy harvesting element can be defined in configuration register EH\_MODE. When the energy harvesting mode is disabled or the RF field strength is not sufficient, the energy harvesting analog voltage output V\_EH is in High-Z state.

EH\_MODE static register is used to define the energy harvesting default strategy after boot.

At boot EH\_EN (in EH\_CTRL\_Dyn register) is set depending EH\_MODE value as shown in table below:

**Table 45. Energy harvesting at power-up**

EH_MODE	EH_EN (at boot)	Energy harvesting at power-up
0	1	EH enabled after boot (when possible)
1	0	EH disabled initially, EH delivered on demand (when possible)

Writing "0" in EH\_MODE at any time after boot automatically set EH\_EN bit to 1, and thus activate energy harvesting.

Writing "1" in EH\_MODE at any time after boot not modify EH\_EN bit (until next reboot) and thus not modify energy harvesting current state.

EH\_CTRL\_Dyn allows to activate or deactivate on the fly the energy harvesting (EH\_EN) and bring information on actual state of EH and state of power supplies :

- EH\_ON set reflects the EH\_EN bit value
- FIELD\_ON is set in presence of a RF field

During boot, EH is not delivered to avoid alteration in device configuration.

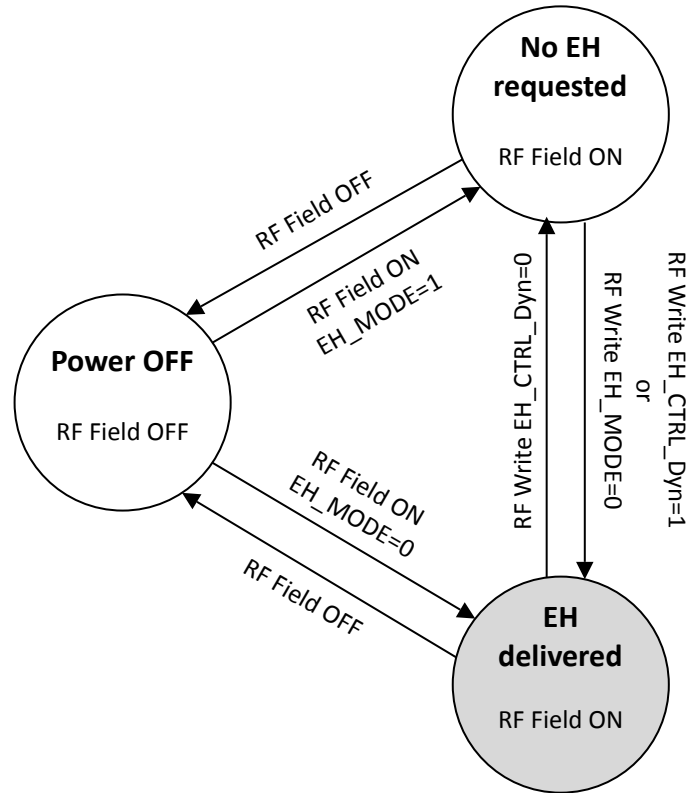
**Caution:** Communication is not guaranteed during EH delivery. Refer to the application note AN4913 (Energy harvesting delivery impact on ST25DVxxx behaviour during RF communication).

Energy harvesting can provide power even if ST25TV04K-P is in KILL\_MUTE or KILL\_ERROR mode. In all these cases, ST25TV04K-P deliver power on V\_EH pin if RF field is present. Energy harvesting voltage output is not regulated.



5.4.3 EH delivery state diagram

Figure 11. EH delivery state diagram

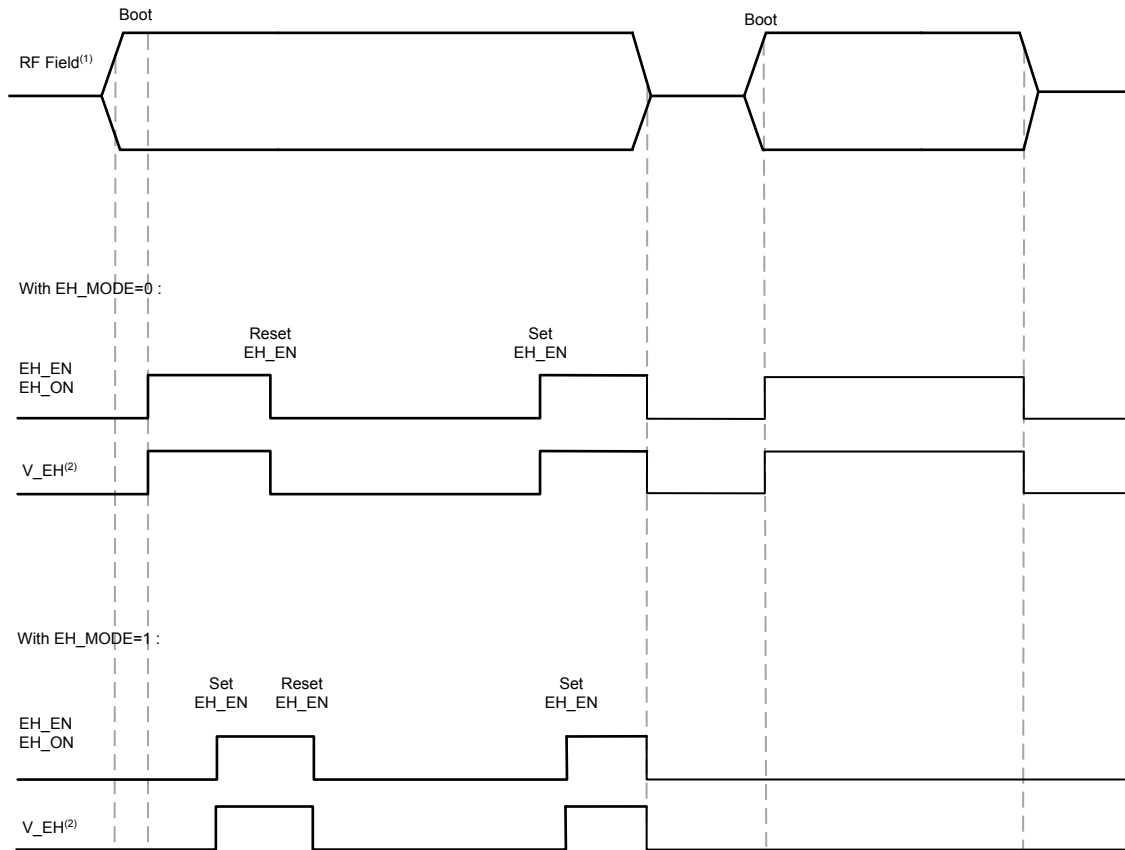


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*Note:* Power is delivered on V\_EH only if harvested energy is sufficient to supply ST25TV04K-P and leave over power. Grey color indicates the states where power is delivered on V\_EH pin.

### 5.4.4 EH delivery sequence

Figure 12. ST25TV04K-P energy harvesting delivery sequence



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1. We suppose that the captured RF power is sufficient to trig EH delivery.
2. V\_EH = 1 means some  $\mu\text{W}$  are available on V\_EH pin.  
V\_EH = 0 means V\_EH pin is in high-Z.

## 5.5 Device parameter registers

**Table 46. LOCK\_DSFD access**

Command	Type
Lock DSFD (cmd code 2Ah)	WO if DSFD not locked

**Table 47. LOCK\_DSFD**

Bit	Name	Function	Factory Value
b0	LOCK_DSFD	0: DSFD is not locked 1: DSFD is locked	0b
b7-b1	RFU	-	0000000b

*Note:* Refer to [Table 10. System configuration memory map](#) for the LOCK\_DSFD register.

**Table 48. LOCK\_AFI access**

Command	Type
Lock AFI (cmd code 28h)	WO if DSFD not locked

**Table 49. LOCK\_AFI**

Bit	Name	Function	Factory Value
b0	LOCK_AFI	0: AFI is not locked 1: AFI is locked	0b
b7-b1	RFU	-	0000000b

*Note:* Refer to [Table 10. System configuration memory map](#) for the LOCK\_AFI register.

**Table 50. DSFD access**

Command	Type
Inventory (cmd code 01h) Get system info (cmd code 2Bh) Ext get system info (cmd code 3Bh) Write DSFD (cmd code 28h)	R always, W if DSFD not locked

**Table 51. DSFD**

Bit	Name	Function	Factory Value
b7-b0	DSFD	ISO/IEC 15693 data storage format identifier	00h

*Note:* Refer to [Table 10. System configuration memory map](#) for the DSFD register.

**Table 52. AFI access**

Command	Type
Inventory (cmd code 01h) Get system info (cmd code 2Bh) Ext get system info (cmd code 3Bh) Write AFI (cmd code 27h)	R always, W if AFI not locked

**Table 53. AFI**

Bit	Name	Function	Factory Value
b7-b0	AFI	ISO/IEC 15693 application family identifier	00h

Note: Refer to [Table 10. System configuration memory map](#) for the AFI register.

**Table 54. MEM\_SIZE access**

Command	Type
Ext get system info (cmd code 3Bh)	RO

**Table 55. MEM\_SIZE**

Bit	Name	Function	Factory Value
b7-b0	MEM_SIZE	LSB byte of the memory size expressed in blocks	7Fh
b7-b0		MSB byte of the memory size expressed in blocks	00h

Note: Refer to [Table 10. System configuration memory map](#) for the MEM\_SIZE register.

**Table 56. \_BLK\_SIZE access**

Command	Type
Ext get system info (cmd code 3Bh)	RO

**Table 57. BLK\_SIZE**

Bit	Name	Function	Factory Value
b7-b0	BLK_SIZE	user memory block size	03h

Note: Refer to [Table 10. System configuration memory map](#) for the BLK\_SIZE register.

**Table 58. IC\_REF access**

Command	Type
Get system info (cmd code 2Bh) Ext get system info (cmd code 3Bh)	RO

**Table 59. IC\_REF**

Bit	Name	Function	Factory Value
b7-b0	IC_REF	ISO/IEC 15693 IC reference	35h

Note: Refer to Table 10. System configuration memory map for the IC\_REF register.

**Table 60. UID access**

Command	Type
Inventory (cmd code 01h)	RO
Get system info (cmd code 2Bh)	
Ext get system info (cmd code 3Bh)	

**Table 61. UID**

Bit	Name	Function	Factory Value
b7-b0	UID	ISO/IEC 15693 UID byte 0 (LSB)	IC manufacturer serial number
b7-b0		ISO/IEC 15693 UID byte 1	
b7-b0		ISO/IEC 15693 UID byte 2	
b7-b0		ISO/IEC 15693 UID byte 3	
b7-b0		ISO/IEC 15693 UID byte 4	
b7-b0		ISO/IEC 15693 UID byte 5: ST Product code	35h
b7-b0		ISO/IEC 15693 UID byte 6: IC Mfg code	02h
b7-b0		ISO/IEC 15693 UID byte 7 (MSB)	E0h

Note: Refer to Table 10. System configuration memory map for the UID register.

## 6 RF operations

Contactless exchanges are performed as specified by ISO/IEC 15693 or NFC Forum Type 5. The **ST25TV04K-P** communicates via the 13.56 MHz carrier electromagnetic wave on which incoming data are demodulated from the received signal amplitude modulation (ASK: amplitude shift keying). The received ASK wave is 10% or 100% modulated with a data rate of 1.6 Kbit/s using the 1/256 pulse coding mode or a data rate of 26 Kbit/s using the 1/4 pulse coding mode.

Outgoing data are generated by the **ST25TV04K-P** load variation using Manchester coding with one or two subcarrier frequencies at 423 kHz and 484 kHz. Data are transferred from the **ST25TV04K-P** at 6.6 Kbit/s in low data rate mode and 26 Kbit/s in high data rate mode. The **ST25TV04K-P** supports the 53 Kbit/s in high data rate mode in one sub-carrier frequency at 423 kHz.

The **ST25TV04K-P** follows ISO/IEC 15693 or NFC Forum Type 5 recommendation for radio-frequency power and signal interface and for anticollision and transmission protocol.

### 6.1 RF communication

#### 6.1.1 Access to a ISO/IEC 15693 device

The dialogue between the “reader” and the **ST25TV04K-P** takes place as follows:

- Activation of the **ST25TV04K-P** by the operating field of the reader,
- Transmission of a command by the reader (**ST25TV04K-P** detects carrier amplitude modulation)
- Transmission of a response by the **ST25TV04K-P** using load modulation

These operations use the power transfer and communication signal interface described below (see power transfer, frequency and operating field). This technique is called RTF (reader talk first).

#### Operating field

The **ST25TV04K-P** operates continuously between the minimum and maximum values of the electromagnetic field H defined in [Table 196. RF characteristics](#). The Reader has to generate a field within these limits.

#### Power transfer

Power is transferred to the **ST25TV04K-P** by radio frequency at 13.56 MHz via coupling antennas in the **ST25TV04K-P** and the reader. The operating field of the reader is transformed on the **ST25TV04K-P** antenna to an AC voltage which is rectified, filtered and internally regulated. During communications, the amplitude modulation (ASK) on this received signal is demodulated by the ASK demodulator.

#### Frequency

The ISO 15693 standard defines the carrier frequency ( $f_C$ ) of the operating field as 13.56 MHz  $\pm$  7 kHz.

### 6.2 RF protocol description

#### 6.2.1 Protocol description

The transmission protocol (or simply “the protocol”) defines the mechanism used to exchange instructions and data between the VCD (vicinity coupling device) and the VICC (vicinity integrated circuit card) in both directions. It is based on the concept of “VCD talks first”. The **ST25TV04K-P** acts as the VICC.

This means that a **ST25TV04K-P** does not start transmitting unless it has received and properly decoded an instruction sent by the VCD. The protocol is based on an exchange of:

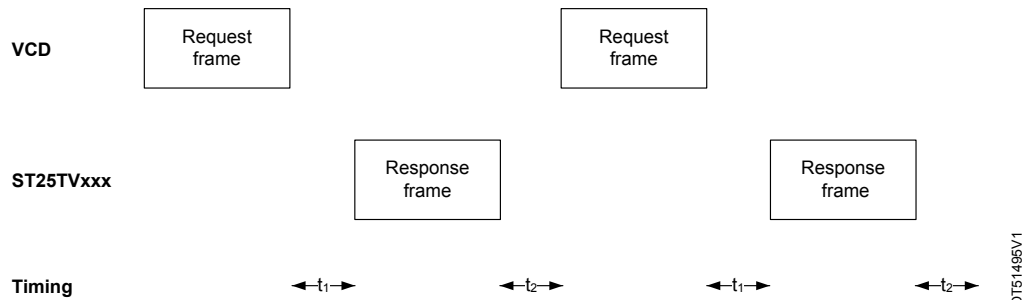
- A request from the VCD to the **ST25TV04K-P**
- A response from the **ST25TV04K-P** to the VCD

Each request and each response are contained in a frame. The frames are delimited by a start of frame (SOF) and end of frame (EOF).

The protocol is bit-oriented. The number of bits transmitted in a frame is a multiple of eight (8), that is an integer number of bytes.

A single-byte field is transmitted least significant bit (LSBit) first. A multiple-byte field is transmitted least significant byte (LSByte) first and each byte is transmitted least significant bit (LSBit) first.

**Figure 13. ST25TV04K-P protocol timing**



### 6.2.2 ST25TV04K-P states referring to protocol

The ST25TV04K-P can be in one of four states:

- Power-off
- Ready
- Quiet
- Selected

Transitions between these states are specified in Figure 14. ST25TV04K-P state transition diagram and Table 62. Response depending on Request\_flags.

#### Power-off state

The ST25TV04K-P is in the power-off state when it does not receive enough energy from the VCD.

#### Ready state

The ST25TV04K-P is in the ready state when it receives enough energy from the VCD. When in the ready state, the ST25TV04K answers any request where the Select\_flag is not set.

#### Quiet state

When in the quiet state, the ST25TV04K-P answers any request with the Address\_flag set, except for inventory requests.

#### Selected state

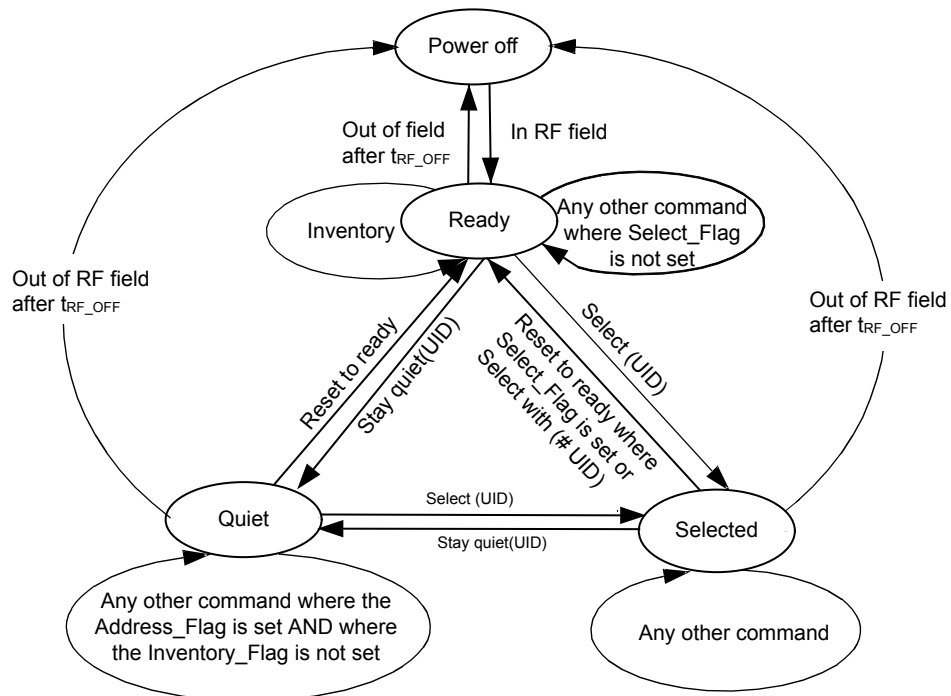
In the selected state, the ST25TV04K-P answers any request in all modes (see Section 6.2.3 Modes):

- Request in select mode with the Select\_flag set
- Request in addressed mode if the UID matches
- Request in non-addressed mode as it is the mode for general requests

**Table 62. Response depending on Request\_flags**

Flags	Address_flag		Select_flag	
	1 Addressed	0 Non addressed	1 Selected	0 Non selected
ST25TV04K-P in ready or selected state (Devices in quiet state do not answer)	-	X	-	X
ST25TV04K-P in selected state	-	X	X	-
ST25TV04K-P in ready, quiet or selected state (the device which matches the UID)	X	-	-	X
Error (03h) or no response (command dependent)	X	-	X	-

**Figure 14. ST25TV04K-P state transition diagram**



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- The **ST25TV04K-P** returns to the power-off state if the tag is out of the field for at least  $t_{RF\_OFF}$ . The intention of the state transition method is that only one **ST25TV04K-P** should be in the Selected state at a time.  
When the **Select\_flag** is set to 1, the request shall "not" contain a unique ID.  
When the **address\_flag** is set to 0, the request shall "not" contain a unique ID.

### 6.2.3 Modes

The term "mode" refers to the mechanism used in a request to specify the set of **ST25TV04K-P** devices that shall execute the request.

#### Addressed mode

When the **Address\_flag** is set to 1 (addressed mode), the request contains the unique ID (UID) of the addressed **ST25TV04K-P**.

Any **ST25TV04K-P** that receives a request with the **Address\_flag** set to 1 compares the received unique ID to its own. If it matches, then the **ST25TV04K-P** executes the request (if possible) and returns a response to the VCD as specified in the command description.



If the UID does not match, then it remains silent.

#### Non-addressed mode (general request)

When the Address\_flag is cleared to 0 (non-addressed mode), the request does not contain a unique ID.

#### Select mode

When the Select\_flag is set to 1 (select mode), the request does not contain a unique ID. The ST25TV04K-P in the selected state that receives a request with the Select\_flag set to 1 executes it and returns a response to the VCD as specified in the command description.

Only the ST25TV04K-P in the selected state answers a request where the Select\_flag is set to 1.

The system design ensures that only one ST25TV04K-P can be in the select state at a time.

### 6.2.4 Request format

The request consists of:

- an SOF
- flags
- a command code
- parameters and data
- a CRC
- an EOF

**Table 63. General request format**

SOF	Request_flags	Command code	Parameters	Data	2 byte CRC	EOF
-----	---------------	--------------	------------	------	------------	-----

### 6.2.5 Request flags

In a request, the “flags” field specifies the actions to be performed by the ST25TV04K-P and whether corresponding fields are present or not.

The flags field consists of eight bits. Bit 3 (Inventory\_flag) of the request flag defines the contents of the four MSBs (bits 5 to 8). When bit 3 is reset (0), bits 5 to 8 define the ST25TV04K-P selection criteria. When bit 3 is set (1), bits 5 to 8 define the ST25TV04K-P inventory parameters.

**Table 64. Definition of request flags 1 to 4**

Bit No	Flag	Level	Description
Bit 1	Subcarrier_flag <sup>(1)</sup>	0	A single subcarrier frequency is used by the ST25TV04K-P
		1	Two subcarriers are used by the ST25TV04K-P
Bit 2	Data_rate_flag <sup>(2)</sup>	0	Low data rate is used
		1	High data rate is used
Bit 3	Inventory_flag	0	The meaning of flags 5 to 8 is described in Table 2
		1	The meaning of flags 5 to 8 is described in Table 3
Bit 4	Protocol_extension_flag	0	No Protocol format extension
		1	Protocol format extension. Reserved for future use.

1. Subcarrier\_flag refers to the ST25TV04K-to-VCD communication.

2. Data\_rate\_flag refers to the ST25TV04K-to-VCD communication.

**Table 65. Request flags 5 to 8 when inventory\_flag, Bit 3 = 0**

Bit nb	Flag	Level	Description
Bit 5	Select flag <sup>(1)</sup>	0	The request is executed by any ST25TV04K-P according to the setting of Address_flag
		1	The request is executed only by the ST25TV04K-P in selected state
Bit 6	Address flag	0	The request is not addressed. UID field is not present. The request is executed by all ST25TV04K-P devices.
		1	The request is addressed. UID field is present. The request is executed only by the ST25TV04K-P whose UID matches the UID specified in the request.
Bit 7	Option flag	0	Option not activated.
		1	Option activated.
Bit 8	RFU	0	-

1. If the Select\_flag is set to 1, the Address\_flag is set to 0 and the UID field is not present in the request.

**Table 66. Request flags 5 to 8 when inventory\_flag, Bit 3 = 1**

Bit nb	Flag	Level	Description
Bit 5	AFI flag	0	AFI field is not present
		1	AFI field is present
Bit 6	Nb_slots flag	0	16 slots
		1	1 slot
Bit 7	Option flag	0	-
Bit 8	RFU	0	-

## 6.2.6

### Response format

The response consists of:

- an SOF
- flags
- parameters and data
- a CRC
- an EOF

**Table 67. General response format**

SOF	Response_flags	Parameters	Data	2 byte CRC	EOF
-----	----------------	------------	------	------------	-----

### 6.2.7 Response flags

In a response, the flags indicate how actions have been performed by the ST25TV04K and whether corresponding fields are present or not. The response flags consist of eight bits.

**Table 68. Definitions of response flags 1 to 8**

Bit Nb	Flag	Level	Description
Bit 1	Error_flag	0	No error
		1	Error detected. Error code is in the "Error" field.
Bit 2	RFU	0	-
Bit 3	RFU	0	-
Bit 4	Extension flag	0	No extension
Bit 5	RFU	0	-
Bit 6	RFU	0	-
Bit 7	RFU	0	-
Bit 8	RFU	0	-

### 6.2.8 Response and error code

If the Error\_flag is set by the ST25TV04K-P in the response, the error code field is present and provides information about the error that occurred.

Error codes not specified in Table 69 are reserved for future use.

**Table 69. Response error code definition**

Error code	Meaning
01h	Command is not supported.
02h	Command is not recognized (format error).
03h	The option is not supported.
0Fh	Error with no information given.
10h	The specified block is not available.
11h	The specified block is already locked and thus cannot be locked again.
12h	The specified block is locked and its contents cannot be changed.
13h	The specified block was not successfully programmed.
14h	The specified block was not successfully locked.
15h	The specified block is protected in read.
No response	It might indicate illegal programming

### 6.3 Timing definition

#### t<sub>1</sub>: ST25TV04K-P response delay

Upon detection of the rising edge of the EOF received from the VCD, the ST25TV04K-P waits for a t<sub>1nom</sub> time before transmitting its response to a VCD request or switching to the next slot during an inventory process. Values of t<sub>1</sub> are given in Table 70. Timing values.

#### t<sub>2</sub>: VCD new request delay

t<sub>2</sub> is the time after which the VCD may send an EOF to switch to the next slot when one or more ST25TV04K-P responses have been received during an Inventory command. It starts from the reception of the EOF from the ST25TV04K-P devices.

The EOF sent by the VCD may be either 10% or 100% modulated regardless of the modulation index used for transmitting the VCD request to the ST25TV04K-P.

t<sub>2</sub> is also the time after which the VCD may send a new request to the ST25TV04K-P, as described in Figure 13. ST25TV04K-P protocol timing.

Values of t<sub>2</sub> are given in Table 70. Timing values.

#### t<sub>3</sub>: VCD new request delay when no response is received from the ST25TV04K-P

t<sub>3</sub> is the time after which the VCD may send an EOF to switch to the next slot when no ST25TV04K-P response has been received.

The EOF sent by the VCD may be either 10% or 100% modulated regardless of the modulation index used for transmitting the VCD request to the ST25TV04K-P.

From the time the VCD has generated the rising edge of an EOF:

- If this EOF is 100% modulated, the VCD waits for a time at least equal to t<sub>3min</sub> for 100% modulation before sending a new EOF.
- If this EOF is 10% modulated, the VCD waits for a time at least equal to t<sub>3min</sub> for 10% modulation before sending a new EOF.

**Table 70. Timing values**

-	Minimum (min) values		Nominal (nom) values	Maximum (max) values
	100% modulation	10% modulation		
t <sub>1</sub>	4320 / f <sub>c</sub> = 318.6 μs		4352 / f <sub>c</sub> = 320.9 μs	4384 / f <sub>c</sub> = 323.3 μs <sup>(1)</sup>
t <sub>2</sub>	4192 / f <sub>c</sub> = 309.2 μs		No t <sub>nom</sub>	No t <sub>max</sub>
t <sub>3</sub>	t <sub>1max</sub> <sup>(2)</sup> + t <sub>SOF</sub> <sup>(3)</sup>	t <sub>1max</sub> <sup>(2)</sup> + t <sub>NRT</sub> <sup>(4)</sup> + t <sub>2min</sub>	No t <sub>nom</sub>	No t <sub>max</sub>

1. VCD request is not interpreted during the first milliseconds following the field rising.
2. t<sub>1max</sub> does not apply for write-alike requests. Timing conditions for write-alike requests are defined in the command description.
3. t<sub>SOF</sub> is the time taken by the ST25TV04K to transmit an SOF to the VCD. t<sub>SOF</sub> depends on the current data rate: high data rate or low data rate.
4. t<sub>NRT</sub> is the nominal response time of the ST25TV04K. t<sub>NRT</sub> depends on VICC to ST25TV04K data rate and subcarrier modulation mode.

Note: The tolerance of specific timing is ± 32/f<sub>C</sub>.

## 6.4 RF Commands

### 6.4.1 RF command code list

The **ST25TV04K-P** supports the following legacy and extended RF command set:

- **Inventory**, used to perform the anticollision sequence.
- **Stay Quiet**, used to put the **ST25TV04K-P** in quiet mode, where it does not respond to any inventory command.
- **Select**, used to select the **ST25TV04K-P**. After this command, the **ST25TV04K-P** processes all read/write commands with `Select_flag` set.
- **Reset To Ready**, used to put the **ST25TV04K-P** in the ready state.
- **Read Single Block** and **Extended Read Single Block**, used to output the 32 bit of the selected block and its locking status.
- **Write Single Block** and **Extended Write Single Block**, used to write and verify the new content for an update of a 32 bit block, provided that it is not in a locked memory area.
- **Read Multiple Blocks** and **Extended Read Multiple Block**, used to read the selected blocks in a unique area, and send back their value.
- **Write Multiple Blocks** and **Extended Write Multiple Block**, used to write and verify the new content for an update of up to 4 blocks located in the same memory area, which was not previously locked for writing.
- **Write AFI**, used to write the 8-bit value in the AFI register.
- **Lock AFI**, used to lock the AFI register.
- **Write DSFID**, used to write the 8-bit value in the DSFID register.
- **Lock DSFID**, used to lock the DSFID register.
- **Get System information**, used to provide the standard system information values.
- **Extended Get System Information**, used to provide the extended system information values.
- **Write Password**, used to update the 64 bit of the selected areas or configuration password, but only after presenting the current one.
- **Lock Block** and **Extended Lock block**, used to write the CC file blocks security status bits (Protect the CC File content against writing).
- **Present Password**, enables the user to present a password to open a security session.
- **Fast Read Single Block** and **Fast Extended Read Single Block**, used to output the 32 bits of the selected block and its locking status at doubled data rate.
- **Fast Read Multiple Blocks** and **Fast Extended Read Multiple Blocks**, used to read the selected blocks in a single area and send back their value at doubled data rate.
- **Read Configuration**, used to read static configuration registers.
- **Write Configuration**, used to write static configuration registers.
- **Get multiple block security status** and **Extended Get multiple block security status** used to send the security status of the selected block.
- **Read Dynamic Configuration**, used to read dynamic register.
- **Write Dynamic Configuration**, used to write dynamic register.
- **Fast Read Dynamic Configuration**, used to read dynamic register, at double data rate.
- **Fast Write Dynamic Configuration**, used to write dynamic register, with answer at double data rate.
- **Manage GPO**, used to drive GPO output value when corresponding GPO mode is enabled.

### 6.4.2 Command codes list

The ST25TV04K-P supports the commands described in this section. Their codes are given in Table 71. Command codes.

**Table 71. Command codes**

Command code standard	Function	Command code custom	Function
01h	Inventory	A0h	Read configuration
02h	Stay quiet	A1h	Write configuration request format
20h	Read single block	B1h	Write password
21h	Write single block	B3h	Present password
22h	Lock block	C0h	Fast read single block
23h	Read multiple blocks	C3h	Fast read multiple blocks
24h	Write multiple blocks	C4h	Fast extended read single block
25h	Select	C5h	Fast extended read multiple block
26h	Reset to ready	CDh	Fast read dynamic configuration
27h	Write AFI	CEh	Fast write dynamic configuration
28h	Lock AFI	-	-
29h	Write DSFID	-	-
2Ah	Lock DSFID	-	-
2Bh	Get system info	-	-
2Ch	Get multiple block security status	-	-
30h	Extended read single block	-	-
31h	Extended write single block	-	-
32h	Extended lock block	-	-
33h	Extended read multiple blocks	-	-
34h	Extended write multiple blocks	-	-
3Bh	Extended get system info	-	-
3Ch	Extended get multiple block security status	-	-

### 6.4.3 General command rules

In case of a valid command, the following paragraphs describe the expected behavior for each command.

But in case of an invalid command, in a general manner, the ST25TV04K-P behaves as follows:

1. If flag usage is incorrect, the error code 03h is issued only if the right UID is used in the command, otherwise no response is issued.
2. The error code 02h is issued if the custom command is used with the manufacturer code different from the ST one

### 6.4.4 Inventory

Upon receiving the inventory request, the ST25TV04K-P runs the anticollision sequence. The Inventory\_flag is set to 1. The meaning of flags 5 to 8 is shown in Table 66. Request flags 5 to 8 when inventory\_flag, Bit 3 = 1.

The request contains:

- the flags
- the Inventory command code (001)
- the AFI if the AFI flag is set
- the mask length

- the mask value if mask length is different from 0
- the CRC

The **ST25TV04K-P** does not generate any answer in case of error.

**Table 72. Inventory request format**

Request SOF	Request_flags	Inventory	Optional AFI	Mask length	Mask value	CRC16	Request EOF
-	8 bits	01h	8 bits	8 bits	0 - 64 bits	16 bits	-

The response contains:

- the flags
- the unique ID

**Table 73. Inventory response format**

Response SOF	Response_flags	DSFID	UID	CRC16	Response EOF
-	8 bits	8 bits	64 bits	16 bits	-

During an Inventory process, if the VCD does not receive an RF **ST25TV04K-P** response, it waits for a time  $t_3$  before sending an EOF to switch to the next slot.  $t_3$  starts from the rising edge of the request EOF sent by the VCD.

- If the VCD sends a 100% modulated EOF, the minimum value of  $t_3$  is:  
 $t_{3min} = 4384/f_C (323.3\mu s) + t_{SOF}$
- If the VCD sends a 10% modulated EOF, the minimum value of  $t_3$  is:  
 $t_{3min} = 4384/f_C (323.3\mu s) + t_{NRT} + t_{2min}$

where:

- $t_{SOF}$  is the time required by the **ST25TV04K-P** to transmit an SOF to the VCD,
- $t_{NRT}$  is the nominal response time of the **ST25TV04K-P**.

$t_{NRT}$  and  $t_{SOF}$  are dependent on the **ST25TV04K-P**-to-VCD data rate and subcarrier modulation mode.

*Note:* In case of error, no response is sent by **ST25TV04K-P**.

#### 6.4.5 Stay quiet

On receiving the stay quiet command, the **ST25TV04K-P** enters the quiet state if no error occurs, and does "not" send back a response. There is 'no' response to the stay quiet command even if an error occurs.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

When in the quiet state:

- the **ST25TV04K-P** does not process any request if the Inventory\_flag is set,
- the **ST25TV04K-P** processes any addressed request.

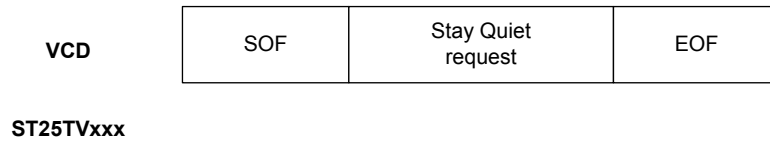
The **ST25TV04K-P** exits the quiet state when:

- it is reset (power-off),
- receiving a select request. It then goes to the selected state,
- receiving a reset to ready request. It then goes to the ready state.

**Table 74. Stay quiet request format**

Request SOF	Request flags	Stay Quiet	UID	CRC16	Request EOF
-	8 bits	02h	64 bits	16 bits	-

The stay quiet command must always be executed in addressed mode (Select\_flag is reset to 0 and Address\_flag is set to 1).

**Figure 15. Stay quiet frame exchange between VCD and ST25TV04K-P**


DT51496V2

### 6.4.6 Read single block

On receiving the read single block command, the **ST25TV04K-P** reads the requested block and sends back its 32-bit value in the response. The `Option_flag` is supported, when set response include the block security status. The `Inventory_flag` must be set to 0. Block number is coded on 1 Byte and only first 256 blocks of **ST25TV04K-P** can be addressed using this command.

**Table 75. Read single block request format**

Request SOF	Request_flags	Read single block	UID <sup>(1)</sup>	Block number	CRC16	Request EOF
-	8 bits	20h	64 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)
- Block number (from LSB byte to MSB byte)

**Table 76. Read single block response format when Error\_flag is "not" set**

Response SOF	Response_flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits	32 bits	16 bits	-

1. This field is optional.

Response parameters:

- Block security status if `Option_flag` is set (see [Table 77. Block security status](#))
- Four bytes of block data

**Table 77. Block security status**

b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use. All at 0.							0: Current block not locked 1: Current block locked

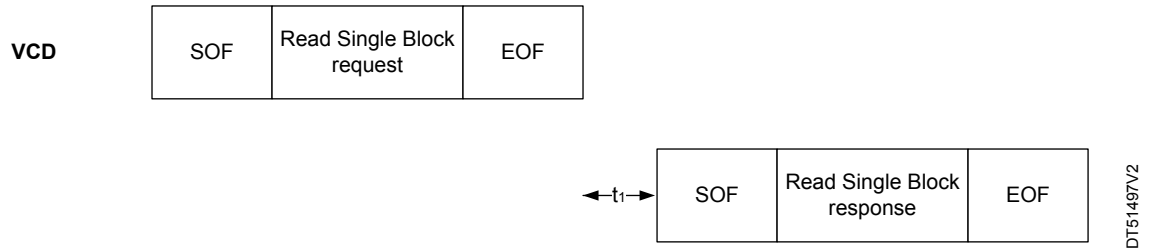
**Table 78. Read single block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:



- Error code as Error\_flag is set
  - 03h: command option not supported
  - 0Fh: error with no information
  - 10h: the specified block is not available
  - 15h: the specified block is read-protected

**Figure 16. Read single block frame exchange between VCD and ST25TV04K-P**


### 6.4.7 Extended read single block

On receiving the extended read single block command, the **ST25TV04K-P** reads the requested block and sends back its 32-bit value in the response.

The Inventory\_flag must be set to 0.

When the Option\_flag is set, the response includes the block security status.

Block number is coded on 2 bytes so all memory blocks of **ST25TV04K-P** can be addressed using this command.

**Table 79. Extended read single block request format**

Request SOF	Request_flags	Extended read single block	UID <sup>(1)</sup>	Block number	CRC16	Request EOF
-	8 bits	30h	64 bits	16 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)
- Block number (from LSB byte to MSB byte)

**Table 80. Extended read single block response format when Error\_flag is "not" set**

Response SOF	Response_flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits	32 bits	16 bits	-

1. This field is optional.

Response parameters:

- Block security status if Option\_flag is set (see [Table 77. Block security status](#))
- Four bytes of block data

**Table 81. Block security status**

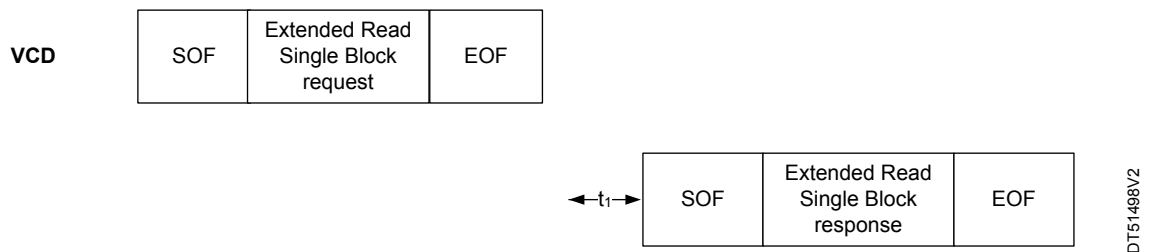
b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use.							0: Current block not locked
All at 0.							1: Current block locked

**Table 82. Extended read single block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set
  - 03h: command option not supported or no response
  - 0Fh: error with no information
  - 10h: the specified block is not available
  - 15h: the specified block is read-protected

**Figure 17. Extended read single block frame exchange between VCD and ST25TV04K-P**


### 6.4.8 Write single block

On receiving the write single block command, the **ST25TV04K-P** writes the data contained in the request to the targeted block and reports whether the write operation was successful in the response. When the Option\_flag is set, wait for EOF to respond.

The Inventory\_flag must be set to 0.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the **ST25TV04K-P** may not program correctly the data into the memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  ( $N$  is an integer).

Block number is coded on 1 Byte and only first 256 blocks of **ST25TV04K-P** can be addressed using this command.

**Table 83. Write single block request format**

Request SOF	Request_flags	Write Single Block	UID <sup>(1)</sup>	Block number	Data	CRC16	Request EOF
-	8 bits	21h	64 bits	8 bits	32 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)
- Block number
- Data

**Table 84. Write single block response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- No parameter. The response is sent back after the writing cycle.

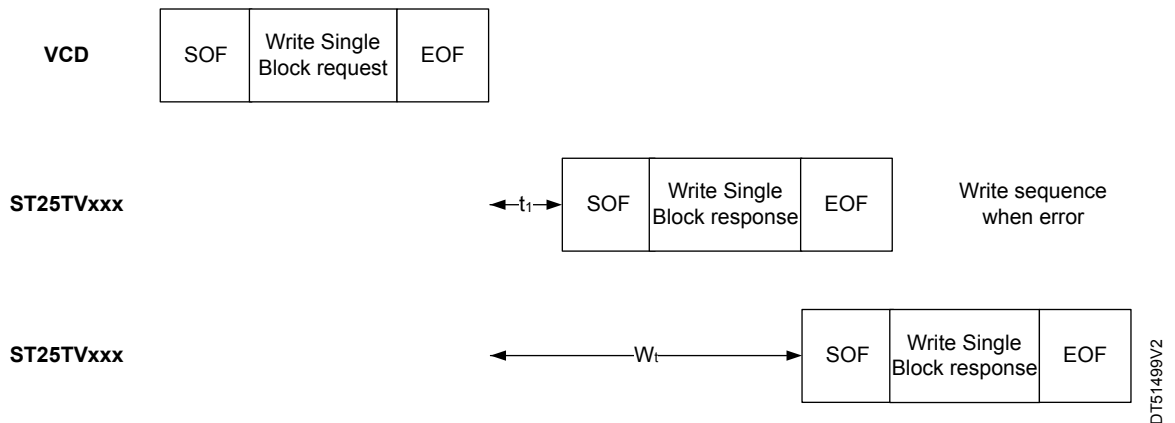
**Table 85. Write single block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set<sup>(1)</sup>
  - 03h: command option not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 12h: the specified block is locked or protected and its contents cannot be changed
  - 13h: the specified block was not successfully programmed

1. For more details, see [Figure 3. Memory organization](#)

**Figure 18. Write single block frame exchange between VCD and ST25TV04K-P**


### 6.4.9 Extended write single block

On receiving the extended write single command, the [ST25TV04K-P](#) writes the data contained in the request to the targeted block and reports whether the write operation was successful in the response. When the Option\_flag is set, wait for EOF to respond.

The Inventory\_flag must be set to 0.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the [ST25TV04K-P](#) may not program correctly the data into the memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  (N is an integer).

Block number is coded on 1 Byte and only first 256 blocks of [ST25TV04K-P](#) can be addressed using this command.

**Table 86. Extended write single request format**

Request SOF	Request_flags	Extended write single block	UID <sup>(1)</sup>	Block number	Data	CRC16	Request EOF
-	8 bits	31h	64 bits	16 bits	32 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)

- Block number (from LSB byte to MSB byte)
- Data (from LSB byte to MSB byte)

**Table 87. Extended write single response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- No parameter. The response is sent back after the writing cycle.

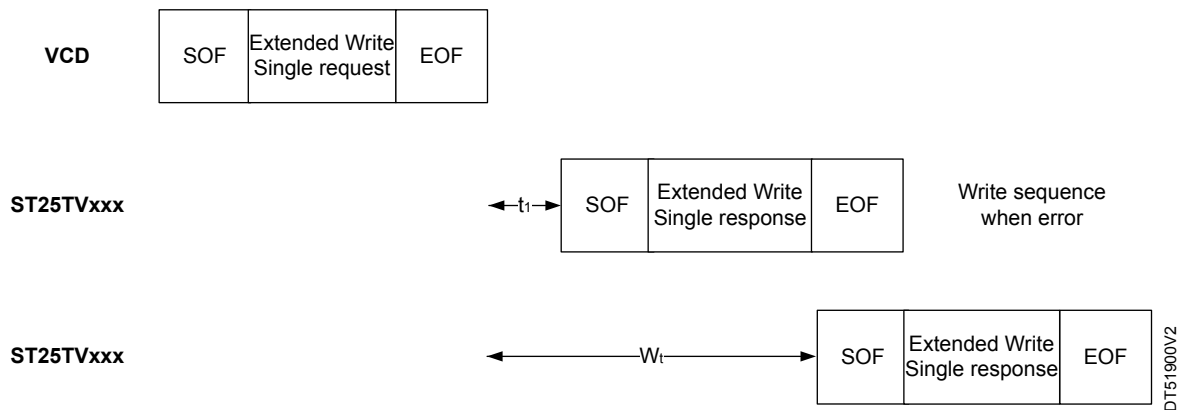
**Table 88. Extended write single response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: command option not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 12h: the specified block is locked and its contents cannot be changed
  - 13h: the specified block was not successfully programmed

**Figure 19. Extended write single frame exchange between VCD and ST25TV04K-P**



### 6.4.10 Lock block

On receiving the Lock block request, the ST25TV04K-P locks the single block value permanently and protects its content against new writing.

This command is only applicable for the blocks 0 and 1 which may include a CC file.

For a global protection of a area, update accordingly the RFAiSS bits in the system area. The Option\_flag is supported, when set wait for EOF to respond.

The Inventory\_flag must be set to 0.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the ST25TV04K-P may not lock correctly the single block value in memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  (N is an integer).

**Table 89. Lock block request format**

Request SOF	Request_flags	Lock block	UID <sup>(1)</sup>	block number	CRC16	Request EOF
-	8 bits	22h	64 bits	8 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request Flags
- UID (optional)
- Block number (only value 00h or 01h) are allowed to protect the CCfile in case of NDEF usage.

**Table 90. Lock block response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

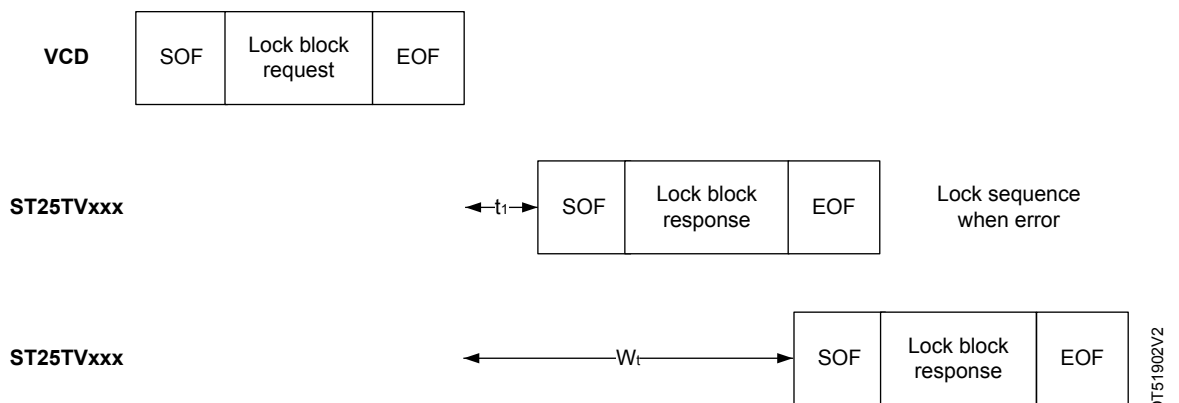
- No parameter

**Table 91. Lock single block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set
  - 03h: command option not supported
  - 10h: block not available
  - 11h: the specified block is already locked and thus cannot be locked again
  - 14h: the specified block was not successfully locked

**Figure 20. Lock single block frame exchange between VCD and ST25TV04K-P**


### 6.4.11 Extended lock block

On receiving the extended lock block request, the **ST25TV04K-P** locks the single block value permanently and protects its content against new writing.

This command is only applicable for the blocks 0 and 1 which may include a CC file.

For a global protection of a area, update accordingly the AiSS bits in the system area. When the Option\_flag is set, wait for EOF to respond.

The Inventory\_flag must be set to 0.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the ST25TV04K-P may not lock correctly the single block value in memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  (N is an integer).

**Table 92. Extended lock block request format**

Request SOF	Request_flags	Extended lock block	UID <sup>(1)</sup>	block number	CRC16	Request EOF
-	8 bits	32h	64 bits	16 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request Flags
- UID (optional)
- Only block number 0 and 1 are allowed to protect the CCFfile in case of NDEF (from LSB byte to MSB byte).

**Table 93. Extended lock block response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

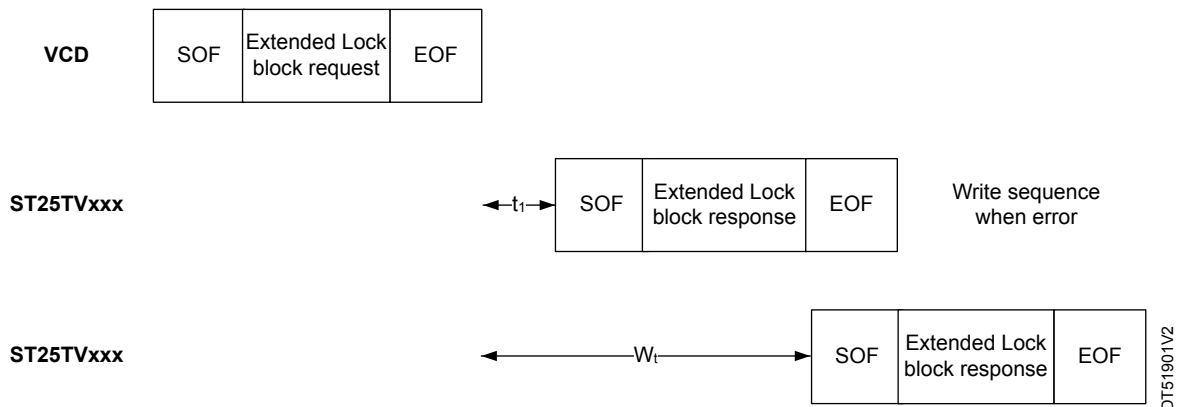
- No parameter

**Table 94. Extended lock block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set
  - 03h: command option not supported
  - 10h: block not available
  - 11h: the specified block is already locked and thus cannot be locked again
  - 14h: the specified block was not successfully locked

**Figure 21. Extended lock block frame exchange between VCD and ST25TV04K-P**


### 6.4.12 Read multiple blocks

When receiving the read multiple block command, the **ST25TV04K-P** reads the selected blocks and sends back their value in multiples of 32 bits in the response. The blocks are numbered from 00h to FFh in the request and the value is minus one (-1) in the field. For example, if the “Number of blocks” field contains the value 06h, seven blocks are read. The maximum number of blocks is fixed at 256 assuming that they are all located in the same area. If the number of blocks overlaps areas or overlaps the end of user memory, the **ST25TV04K-P** returns an error code. When the Option\_flag is set, the response returns the lock security status.

The Inventory\_flag must be set to 0.

Block number is coded on 1-Byte and only first 256 blocks of **ST25TV04K-P** can be addressed using this command.

**Table 95. Read multiple block request format**

Request SOF	Request_flags	Read multiple block	UID <sup>(1)</sup>	First block number	Number of blocks	CRC16	Request EOF
-	8 bits	23h	64 bits	8 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)
- First block number
- Number of blocks

**Table 96. Read multiple block response format when Error\_flag is "not" set**

Response SOF	Response_flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits <sup>(2)</sup>	32 bits <sup>(2)</sup>	16 bits	-

1. This field is optional.

2. Repeated as needed.

Response parameters:

- Block security status if Option\_flag is set (see [Table 97. Block security status](#))
- N blocks of data

**Table 97. Block security status**

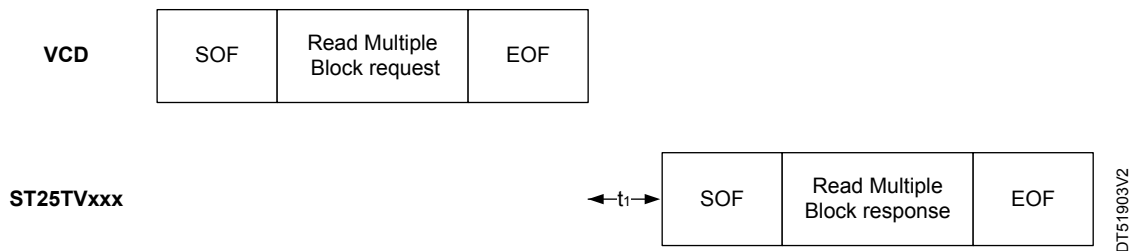
b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use. All at 0.						0: Current block not locked 1: Current block locked	

**Table 98. Read multiple block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 15h: the specified block is read-protected

**Figure 22. Read multiple block frame exchange between VCD and ST25TV04K-P**


### 6.4.13 Extended read multiple blocks

When receiving the extended read multiple block command, the **ST25TV04K-P** reads the selected blocks and sends back their value in multiples of 32 bits in the response. The blocks are numbered from 00h to last block of memory in the request and the value is minus one (-1) in the field. For example, if the “Number of blocks” field contains the value 06h, seven blocks are read. The maximum number of blocks is fixed at 2047 assuming that they are all located in the same area. If the number of blocks overlaps areas or overlaps the end of user memory, the **ST25TV04K-P** returns an error code. When the Option\_flag is set, the response returns the block security status.

The Inventory\_flag must be set to 0.

Block number is coded on 2-Bytes so all memory blocks of **ST25TV04K-P** can be addressed using this command.

**Table 99. Extended read multiple block request format**

Request SOF	Request_flags	Extended read multiple block	UID <sup>(1)</sup>	First block number	Number of blocks	CRC16	Request EOF
-	8 bits	33h	64 bits	16 bits	16 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)
- First block number (from LSB byte to MSB byte)
- Number of blocks (from LSB byte to MSB byte)



**Table 100. Extended read multiple block response format when Error\_flag is "not" set**

Response SOF	Response_ flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits <sup>(2)</sup>	32 bits <sup>(2)</sup>	16 bits	-

1. This field is optional.
2. Repeated as needed.

Response parameters:

- Block security status if Option\_flag is set (see Table 101. Block security status)
- N blocks of data

**Table 101. Block security status**

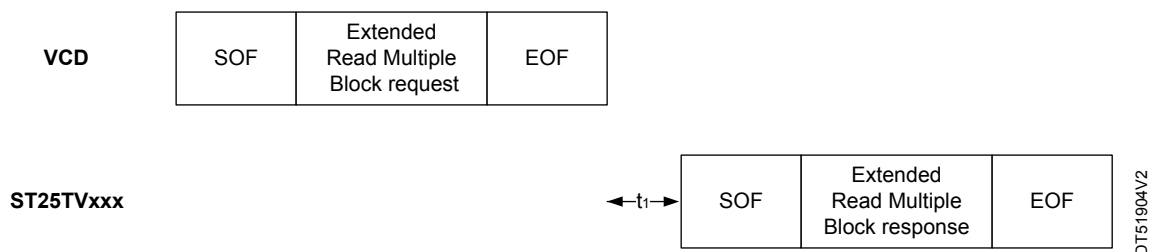
b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use.							0: Current block not locked
All at 0							1: Current block locked

**Table 102. Extended read multiple block response format when Error\_flag is set**

Response SOF	Response_ flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 15h: the specified block is read-protected

**Figure 23. Extended read multiple block frame exchange between VCD and ST25TV04K-P**


#### 6.4.14 Write multiple blocks

On receiving the write multiple block command, the **ST25TV04K-P** writes the data contained in the request to the requested blocks, and reports whether the write operation were successful in the response. **ST25TV04K-P** supports up to 4 blocks, data field must be coherent with the number of blocks to program.

If some blocks overlaps areas, or overlap end of user memory the **ST25TV04K-P** returns an error code and none of the blocks are programmed.

When the Option\_flag is set, wait for EOF to respond. During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the **ST25TV04K-P** may not program correctly the data into the memory. The  $W_t$  time is equal to  $t_{1nom} + m \times 302 \mu s < 20 \text{ ms}$ . (m is an integer, it is function of Nb number of blocks to be programmed).

The Inventory\_flag must be set to 0.

Block number is coded on 1 Byte and only first 256 blocks of ST25TV04K-P can be addressed using this command.

**Table 103. Write multiple block request format**

Request SOF	Request_flags	Write Multiple Block	UID <sup>(1)</sup>	First Block number	Number of block <sup>(2)</sup>	Data	CRC16	Request EOF
-	8 bits	24h	64 bits	8 bits	8 bits	Block length <sup>(3)</sup>	16 bits	-

1. *This field is optional.*
2. *The number of blocks in the request is one less than the number of blocks that the VICC shall write.*
3. *Repeated as needed*

Request parameters:

- Request flags
- UID (optional)
- First Block number
- Number of blocks
- Data

**Table 104. Write multiple block response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

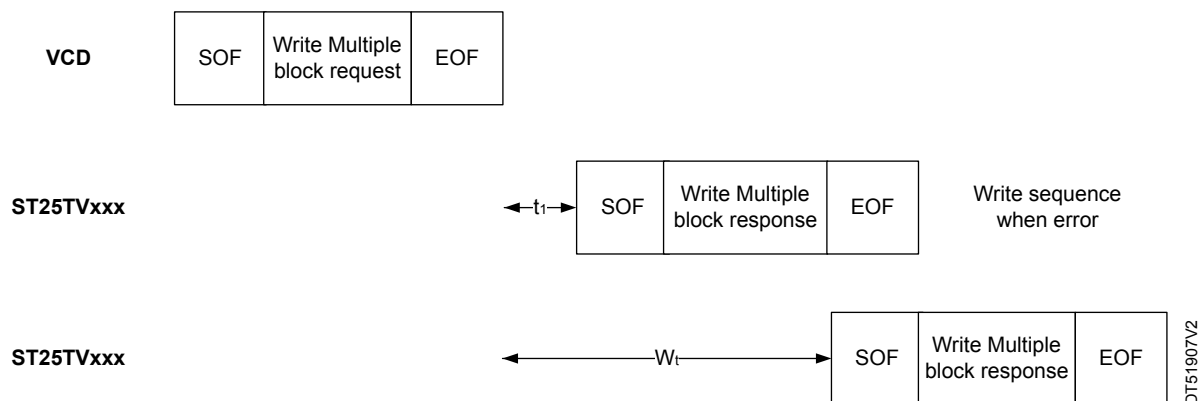
- No parameter. The response is sent back after the writing cycle.

**Table 105. Write multiple block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 12h: the specified block is locked and its contents cannot be changed
  - 13h: the specified block was not successfully programmed

**Figure 24. Write multiple block frame exchange between VCD and ST25TV04K-P**


### 6.4.15 Extended write multiple blocks

On receiving the extended write multiple block command, the **ST25TV04K-P** writes the data contained in the request to the targeted blocks and reports whether the write operation were successful in the response. **ST25TV04K-P** supports up to four blocks, data field must be coherent with number of blocks to program.

If some blocks overlaps areas, or overlap end of user memory the **ST25TV04K-P** returns an error code and none of the blocks are programmed.

When the Option\_flag is set, wait for EOF to respond. During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the **ST25TV04K-P** may not program correctly the data into the memory. The  $W_t$  time is equal to  $t_{1nom} + m \times 302 \mu s < 20 \text{ ms}$  ( $m$  is an integer function of  $N_b$  number of blocks to be programmed).

The Inventory\_flag must be set to 0.

Block number is coded on 2-Bytes so all memory blocks of **ST25TV04K-P** can be addressed using this command.

**Table 106. Extended write multiple block request format**

Request SOF	Request_flags	Extended write multiple block	UID <sup>(1)</sup>	First Block number	Number of block <sup>(2)</sup>	Data	CRC16	Request EOF
-	8 bits	34h	64 bits	16 bits	16 bits	Block length <sup>(3)</sup>	16 bits	-

- This field is optional.*
- The number of blocks in the request is one less than the number of blocks that the VICC shall write.*
- Repeated as needed*

Request parameters:

- Request flags
- UID (optional)
- First block number (from LSB byte to MSB byte)
- Number of block (from LSB byte to MSB byte)
- Data (from first to last blocks, from LSB bytes to MSB bytes)

**Table 107. Extended write multiple block response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

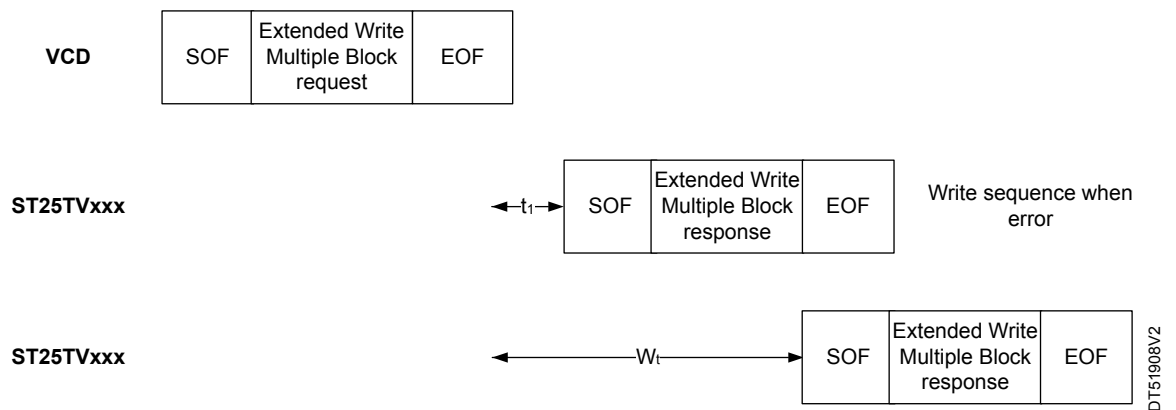
- No parameter. The response is sent back after the writing cycle.

**Table 108. Extended write multiple block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 12h: the specified block is locked and its contents cannot be changed
  - 13h: the specified block was not successfully programmed

**Figure 25. Extended write multiple block frame exchange between VCD and ST25TV04K-P**


### 6.4.16

#### Select

When receiving the select command:

- If the UID is equal to its own UID, the **ST25TV04K-P** enters or stays in the selected state and sends a response.
- If the UID does not match its own UID, the selected **ST25TV04K-P** returns to the ready state and does not send a response.

The **ST25TV04K-P** answers an error code only if the UID is equal to its own UID. If not, no response is generated. If an error occurs, the **ST25TV04K-P** remains in its current state.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 109. Select request format**

Request SOF	Request_flags	Select	UID	CRC16	Request EOF
-	8 bits	25h	64 bits	16 bits	-

Request parameter:

- UID

**Table 110. Select block response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- No parameter

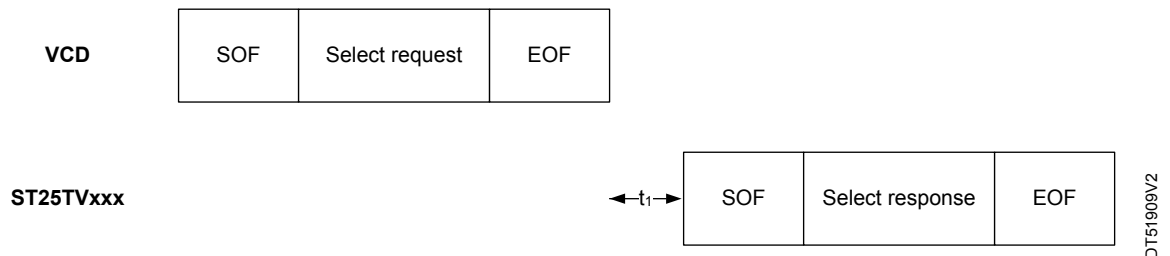
**Table 111. Select response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: the option is not supported
  - 0Fh: error with no information given

**Figure 26. Select frame exchange between VCD and ST25TV04K-P**



### 6.4.17 Reset to ready

On receiving a reset to ready command, the **ST25TV04K-P** returns to the Ready state if no error occurs. In the addressed mode, the **ST25TV04K-P** answers an error code only if the UID is equal to its own UID. If not, no response is generated.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 112. Reset to ready request format**

Request SOF	Request_flags	Reset to ready	UID <sup>(1)</sup>	CRC16	Request EOF
-	8 bits	26h	64 bits	16 bits	-

1. This field is optional.

Request parameter:

- UID (optional)

**Table 113. Reset to Ready response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- No parameter

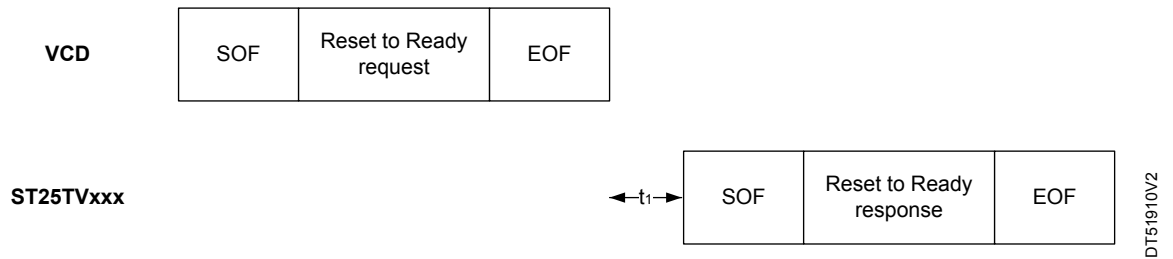
**Table 114. Reset to ready response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: the option is not supported
  - 0Fh: error with no information given

**Figure 27. Reset to ready frame exchange between VCD and ST25TV04K-P**



### 6.4.18 Write AFI

On receiving the write AFI request, the **ST25TV04K-P** programs the 8-bit AFI value to its memory. When the Option\_flag is set, wait for EOF to respond.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the **ST25TV04K-P** may not write correctly the AFI value into the memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  (N is an integer).

The Inventory\_flag must be set to 0.

**Table 115. Write AFI request format**

Request SOF	Request_flags	Write AFI	UID <sup>(1)</sup>	AFI	CRC16	Request EOF
-	8 bits	27h	64 bits	8 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)
- AFI

**Table 116. Write AFI response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

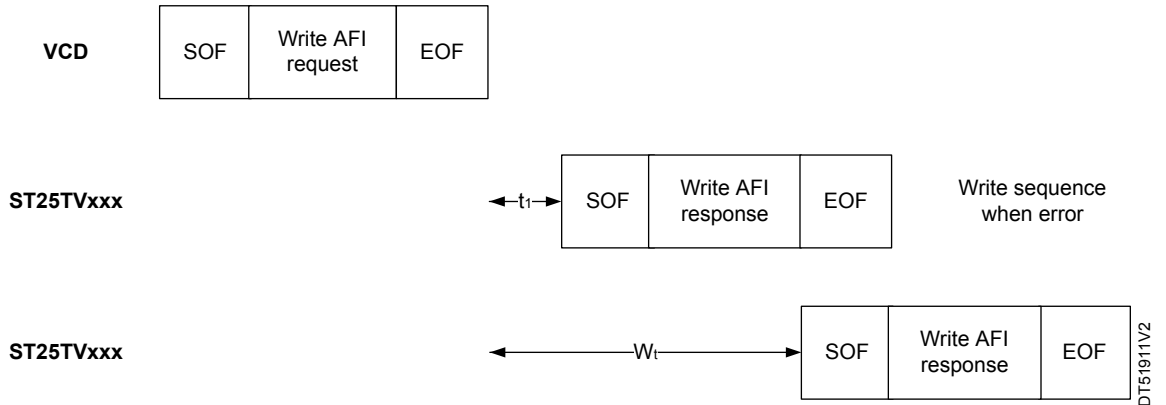
- No parameter

**Table 117. Write AFI response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 12h: the specified block is locked and its contents cannot be changed
  - 13h: the specified block was not successfully programmed

**Figure 28. Write AFI frame exchange between VCD and ST25TV04K-P**


#### 6.4.19

#### Lock AFI

On receiving the lock AFI request, the ST25TV04K-P locks the AFI value permanently. When the Option\_flag is set, wait for EOF to respond.

The Inventory\_flag must be set to 0.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the ST25TV04K-P may not lock correctly the AFI value in memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  (N is an integer).

**Table 118. Lock AFI request format**

Request SOF	Request_flags	Lock AFI	UID <sup>(1)</sup>	CRC16	Request EOF
-	8 bits	28h	64 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request Flags
- UID (optional)

**Table 119. Lock AFI response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- No parameter

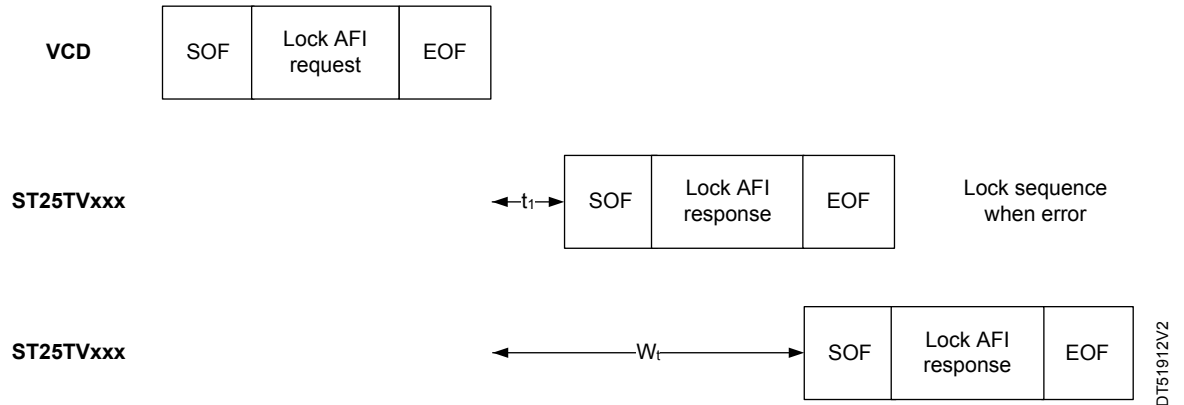
**Table 120. Lock AFI response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 11h: the specified block is already locked and thus cannot be locked again
  - 14h: the specified block was not successfully locked

**Figure 29. Lock AFI frame exchange between VCD and ST25TV04K-P**



#### 6.4.20

#### Write DSFID

On receiving the write DSFID request, the **ST25TV04K-P** programs the 8-bit DSFID value to its memory. When the Option\_flag is set, wait for EOF to respond.

The Inventory\_flag must be set to 0.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the **ST25TV04K-P** may not write correctly the DSFID value in memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  ( $N$  is an integer).

**Table 121. Write DSFID request format**

Request SOF	Request_flags	Write DSFID	UID <sup>(1)</sup>	DSFID	CRC16	Request EOF
-	8 bits	29h	64 bits	8 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)
- DSFID

**Table 122. Write DSFID response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- No parameter

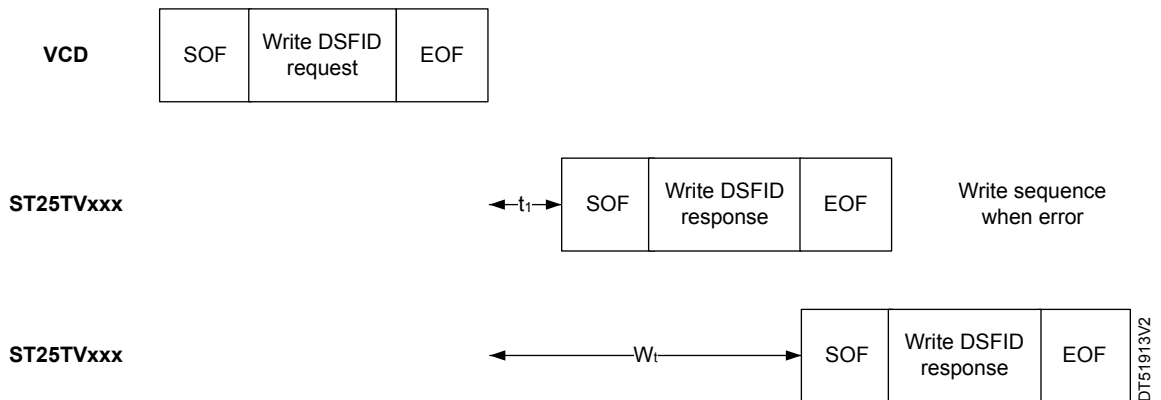


**Table 123. Write DSFID response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 12h: the specified block is locked and its contents cannot be changed
  - 13h: the specified block was not successfully programmed

**Figure 30. Write DSFID frame exchange between VCD and ST25TV04K-P**


### 6.4.21

#### Lock DSFID

On receiving the lock DSFID request, the ST25TV04K-P locks the DSFID value permanently. When the Option\_flag is set, wait for EOF to respond.

The Inventory\_flag must be set to 0.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the ST25TV04K-P may not lock correctly the DSFID value in memory. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  ( $N$  is an integer).

**Table 124. Lock DSFID request format**

Request SOF	Request_flags	Lock DSFID	UID <sup>(1)</sup>	CRC16	Request EOF
-	8 bits	2Ah	64 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)

**Table 125. Lock DSFID response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

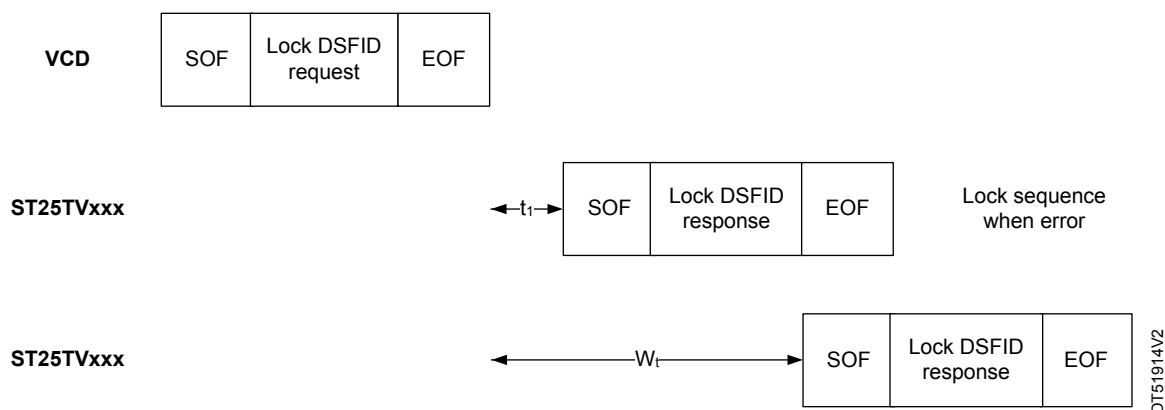
- No parameter.

**Table 126. Lock DSFID response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 11h: the specified block is already locked and thus cannot be locked again
  - 14h: the specified block was not successfully locked

**Figure 31. Lock DSFID frame exchange between VCD and ST25TV04K-P**


### 6.4.22 Get system info

When receiving the get system info command, the **ST25TV04K-P** sends back its information data in the response. The Option\_flag is not supported. The Get System Info can be issued in both Addressed and Non Addressed modes.

The Inventory\_flag must be set to 0.

**Table 127. Get system info request format**

Request SOF	Request_flags	Get System Info	UID <sup>(1)</sup>	CRC16	Request EOF
-	8 bits	2Bh	64 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)

**Table 128. Get system info response format Error\_flag is "not" set**

Response SOF	Response_flags	Information flags	UID	DSFID	AFI	Mem size	IC ref.	CRC16	Response EOF
-	00h	0Fh	64bits	8 bits	8 bits	037Fh	35h	16 bits	-

Response parameters:

- Information flags set to 0Bh. DSFID, AFI, and IC reference fields are present.

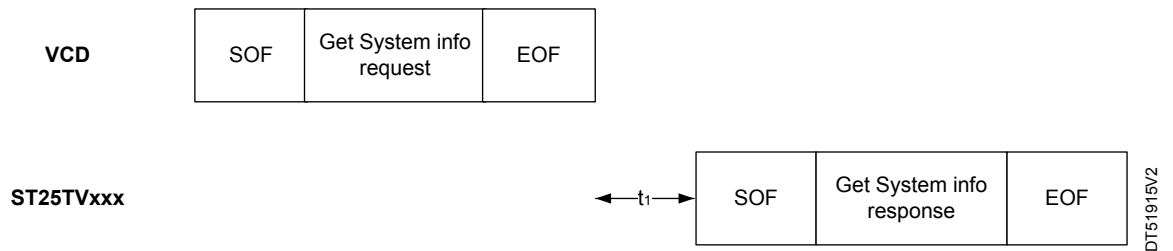
- UID code on 64 bits
- DSFID value
- AFI value
- IC reference: the 8 bits are significant.

**Table 129. Get system info response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	01h	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: Option not supported
  - 0Fh: error with no information given

**Figure 32. Get system info frame exchange between VCD and ST25TV04K-P**


### 6.4.23 Extended get system info

When receiving the extended get system info command, the **ST25TV04K-P** sends back its information data in the response. The Option\_flag is not supported. The extended get system info can be issued in both addressed and non addressed modes.

The Inventory\_flag must be set to 0.

**Table 130. Extended get system info request format**

Request SOF	Request_flags	Extended get system info	Parameter request field	UID <sup>(1)</sup>	CRC16	Request EOF
-	8 bits	3Bh	8 bits	64 bits	16 bits	-

1. This field is optional.

- Request flags
- Request parameters
- UID (optional)

**Table 131. Parameter request list**

Bit	Flag name	Value	Description
b1	DSFID	0	No request of DSFID
		1	Request of DSFID
b2	AFI	0	No request of AFI
		1	Request of AFI
b3	VICC memory size	0	No request of data field on VICCmemory size
		1	Request of data field on VICCmemory size
b4	IC reference	0	No request of Information on IC reference
		1	Request of Information on IC reference
b5	MOI	1	Information on MOI always returned in response flag
b6	VICC Command list	0	No request of Data field of all supported commands
		1	Request of Data field of all supported commands
b7	CSI Information	0	No request of CSI list
		1	Request of CSI list
b8	Extended Get System Info parameter Field	0	One byte length of Extended Get System Info parameter field

**Table 132. Extended get system info response format when Error\_flag is "not" set**

Response SOF	Response_flags	Information flags	UID	DSFID <sup>(1)</sup> <sup>(2)</sup>	AFI <sup>(1)(2)</sup>	Other Field <sup>(1)(2)</sup>	CRC16	Response EOF
-	00h	8 bits <sup>(1)</sup>	64 bits	8 bits	8 bits	up to 64 bits <sup>(3)</sup>	16 bits	-

1. See [Table 133](#).
2. This field is optional.
3. Number of bytes is function of parameter list selected.

Response parameters:

- Information flag defining which fields are present
- UID code on 64 bits
- DSFID value (if requested in Parameters request field)
- AFI value (if requested in Parameters request field)
- Other fields:
  - VICC memory size (if requested in parameters request field)
  - ICRRef(if requested in parameters request field)
  - VICC command list (if requested in parameters request field)

**Table 133. Response information flag**

Bit	Flag name	Value	Description
b1	DSFID	0	DSFID field is not present
		1	DSFID field is present
b2	AFI	0	AFI field is not present
		1	AFI field is present
b3	VICC memory size	0	Data field on VICC memory size is not present.
		1	Data field on VICC memory size is present.
b4	IC reference	0	Information on IC reference field is not present.
		1	Information on IC reference field is present.
b5	MOI	0	1 byte addressing
1	Data field of all supported commands is present	b6	VICCcommand list
b7	CSI information	0	CSI list is not present
b8	Info flag field	0	One byte length of info flag field

**Table 134. Response other field: ST25TV04K-P VICC memory size**

MSB			LSB		
24	22	21	17	16	01
RFU		Block size in byte		Number of blocks	
0h		03h		007Fh	

**Table 135. Response other field: ST25TV04K-P IC Ref**

1 Byte	
ICRef	
35h	

**Table 136. Response other field: ST25TV04K-P VICC command list**

MSB				LSB			
32	25	24	17	16	09	08	01
Byte 4		Byte 3		Byte 2		Byte 1	
00h		3Fh		3Fh		FFh	

**Table 137. Response other field: ST25TV04K-P VICC command list byte 1**

Bit	Meaning if bit is set	Comment
b1	Read single block is supported	-
b2	Write single block is supported	-
b3	Lock single block is supported	-
b4	Read multiple block is supported	-
b5	Write multiple block is supported	-
b6	Select is supported	Including select state
b7	Reset to ready is supported	-
b8	Get multiple block security status is supported	-

**Table 138. Response other field: ST25TV04K-P VICC command list byte 2**

Bit	Meaning if bit is set	Comment
b1	Write AFI is supported	-
b2	Lock AFI is supported	-
b3	Write DSFID is supported	-
b4	Lock DSFID is supported	-
b5	Get system information is supported	-
b6	Custom commands are supported	-
b7	RFU	0 shall be returned
b8	RFU	0 shall be returned

**Table 139. Response other field: ST25TV04K-P VICC command list byte 3**

Bit	Meaning if bit is set	Comment
b1	Extended read single block is supported	-
b2	Extended write single block is supported	-
b3	Extended lock single block is supported	-
b4	Extended read multiple block is supported	-
b5	Extended write multiple block is supported	-
b6	Extended Get Multiple Security Status is supported	-
b7	RFU	0 shall be returned
b8	RFU	0 shall be returned

**Table 140. Response other field: ST25TV04K-P VICC command list byte 4**

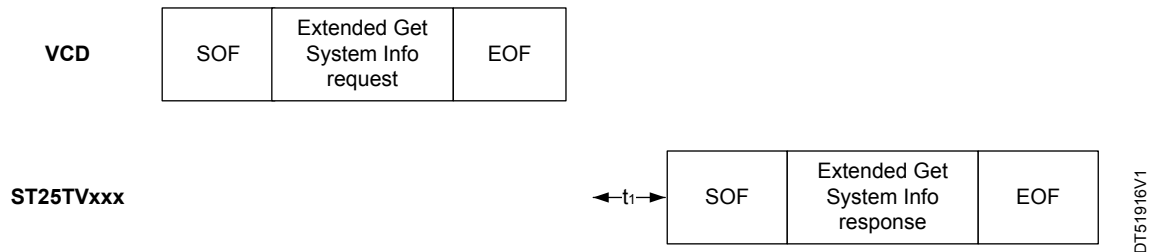
Bit	Meaning if bit is set	Comment
b1	Read buffer is supported	Means response buffer is supported
b2	Select secure state is supported	Means VCD or mutual authentication are supported
b3	Final response always includes crypto result	Means that flag b3 is set in the final response
b4	AuthComm crypto format is supported	-
b5	SecureComm crypto format is supported	-
b6	KeyUpdate is supported	-
b7	Challenge is supported	-
b8	If set to 1 a further byte is transmitted	0 shall be returned

**Table 141. Extended get system info response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	01h	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: Option not supported
  - 0Fh: error with no information given

**Figure 33. Extended get system info frame exchange between VCD and ST25TV04K-P**


#### 6.4.24

#### Get multiple block security status

When receiving the get multiple block security status command, the **ST25TV04K-P** sends back its security status for each address block: 0 when block is writable else 1 when block is locked for writing. The blocks security status are defined by the area security status (and by LCK\_CCFILE register for blocks 0 and 1). The blocks are numbered from 00h up to the maximum memory block number in the request, and the value is minus one (-1) in the field. For example, a value of "06" in the "Number of blocks" field requests returns the security status of seven blocks. This command does not respond an error if number of blocks overlap areas or overlaps the end of user memory.

The number of blocks is coded on 1-Byte and only first 256 blocks of **ST25TV04K-P** can be addressed using this command.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 142. Get multiple block security status request format**

Request SOF	Request_flags	Get multiple block security status	UID <sup>(1)</sup>	First block number	Number of blocks	CRC16	Request EOF
-	8 bits	2Ch	64 bits	8 bits	8 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)
- First block number
- Number of blocks

**Table 143. Get multiple block security status response format when Error\_flag is "not" set**

Response SOF	Response_flags	Block security status	CRC16	Response EOF
-	8 bits	8 bits <sup>(1)</sup>	16 bits	-

1. Repeated as needed.

Response parameters:

- Block security status

**Table 144. Block security status**

b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use All at 0							0: Current block not locked 1: Current block locked

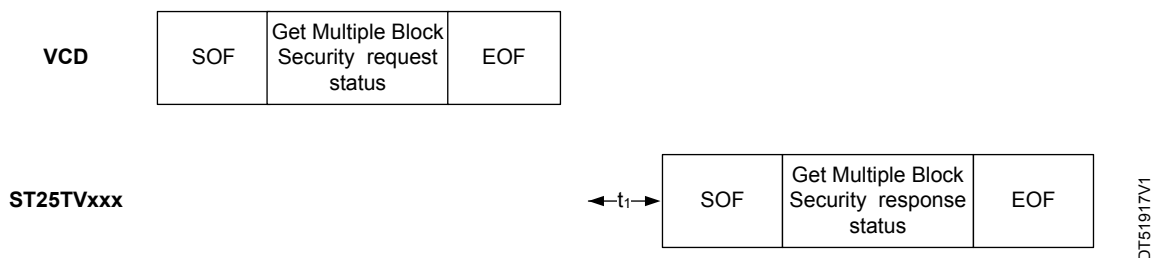
**Table 145. Get multiple block security status response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: the option is not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available

**Figure 34. Get multiple block security status frame exchange between VCD and ST25TV04K-P**



### 6.4.25 Extended get multiple block security status

When receiving the extended get multiple block security sStatus command, the **ST25TV04K-P** sends back the security status for each address block: 0 when the block is writable else 1 when block is locked for writing. The block security statuses are defined by the area security status. The blocks are numbered from 00h up to the maximum memory block number in the request, and the value is minus one (-1) in the field. For example, a value of '06' in the "Number of blocks" field requests to return the security status of seven blocks.

This command does not respond an error if number of blocks overlap areas or overlaps the end of user memory. The number of blocks is coded on 2 Bytes so all memory blocks of **ST25TV04K-P** can be addressed using this command.



The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 146. Extended get multiple block security status request format**

Request SOF	Request_flags	Extended get multiple block security status	UID <sup>(1)</sup>	First block number	Number of blocks	CRC16	Request EOF
-	8 bits	3Ch	64 bits	16 bits	16 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)
- First block number (from LSB byte to MSB byte)
- Number of blocks (from LSB byte to MSB byte)

**Table 147. Extended get multiple block security status response format when Error\_flags "not" set**

Response SOF	Response_flags	Block security status	CRC16	Response EOF
-	8 bits	8 bits <sup>(1)</sup>	16 bits	-

1. Repeated as needed.

Response parameters:

Block security status

**Table 148. Block security status**

b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use							0: Current block not locked
All at 0							1: Current block locked

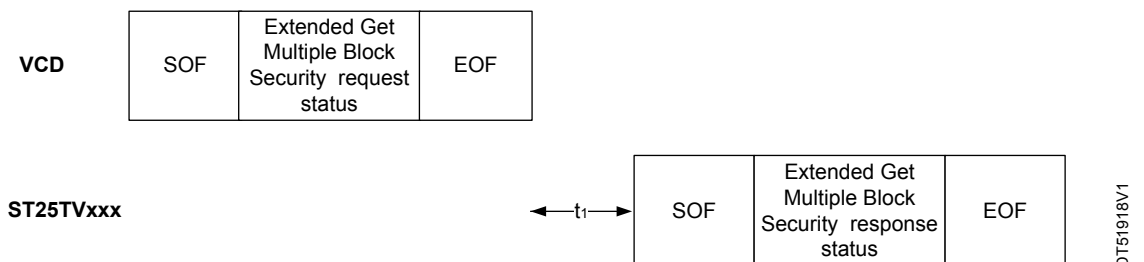
**Table 149. Extended get multiple block security status response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 03h: the option is not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available

**Figure 35. Extended get multiple block security status frame exchange between VCD and ST25TV04K-P**



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### 6.4.26 Read configuration

On receiving the read configuration command, the ST25TV04K-P reads the static system configuration register at the pointer address and sends back its 8-bit value in the response.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 150. Read configuration request format**

Request SOF	Request_flags	Read configuration	IC Mfg code	UID <sup>(1)</sup>	Pointer	CRC16	Request EOF
-	8 bits	A0h	02h	64 bits	8 bits	16 bits	-

1. This field is optional.

**Note:** Please refer to [Section 4.3 System configuration area](#) for details on register addresses.

Request parameters:

- System configuration register pointer
- UID (optional)

**Table 151. Read configuration response format when Error\_flag is "not" set**

Response SOF	Response_flags	Register value	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameters:

- One byte of data: system configuration register

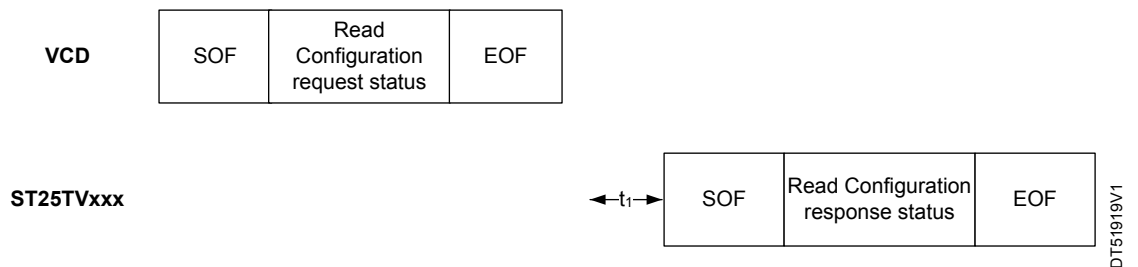
**Table 152. Read configuration response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set
  - 02h: command not recognized
  - 03h: the option is not supported
  - 10h: block not available
  - 0Fh: error with no information given

**Figure 36. Read configuration frame exchange between VCD and ST25TV04K-P**



### 6.4.27 Write configuration

The write configuration command is used to write static system configuration register. The write configuration must be preceded by a valid presentation of the RF configuration password (00) to open the RF configuration security session.

On receiving the write configuration command, the ST25TV04K-P writes the data contained in the request to the system configuration register at the Pointer address and reports whether the write operation was successful in the response or not.

When the Option\_flag is set, wait for EOF to respond. The Inventory\_flag is not supported.

During the RF write cycle  $W_t$ , there should be no modulation (neither 100% nor 10%), otherwise the ST25TV04K-P may not program correctly the data into the configuration byte. The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  (N is an integer).

**Table 153. Write configuration request format**

Request SOF	Request_flags	Write configuration	IC Mfg code	UID <sup>(1)</sup>	Pointer	Register Value <sup>(2)</sup>	CRC16	Request EOF
-	8 bits	A1h	02h	64 bits	8 bits	8 bits	16 bits	-

1. This field is optional.
2. Before updating the register value, check the meaning of each bit in previous sections.

Request parameters:

- Request flags
- Register pointer
- Register value
- UID (optional)

**Table 154. Write configuration response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

*Note:* Refer to [Section 4.3 System configuration area](#) for details on register addresses.

Response parameter:

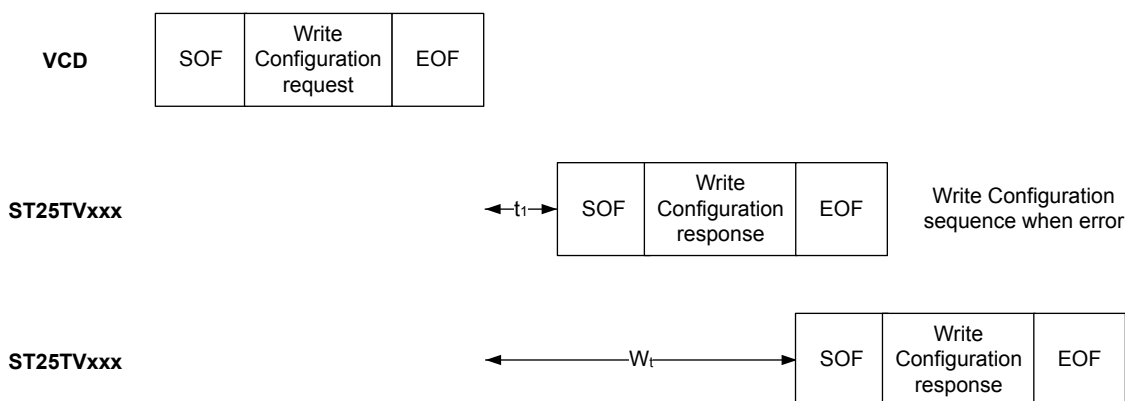
- No parameter. The response is sent back after the writing cycle.

**Table 155. Write configuration response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option is not supported
  - 0Fh: error with no information given
  - 10h: block not available
  - 12h: block already locked, content can't change
  - 13h: the specified block was not successfully programmed

**Figure 37. Write configuration frame exchange between VCD and ST25TV04K-P**


### 6.4.28 Write password

On receiving the write password command, the **ST25TV04K-P** uses the data contained in the request to write the password and reports whether the operation was successful in the response. It is possible to modify a password value only after issuing a valid present password command (of the same password number). When the `Option_flag` is set, wait for EOF to respond. Refer to [Section 5.2 Data protection](#) for details on password management.

The `Inventory_flag` must be set to 0.

During the RF write cycle time,  $W_t$ , there must be no modulation at all (neither 100% nor 10%), otherwise the **ST25TV04K-P** may not correctly program the data into the memory.

The  $W_t$  time is equal to  $t_{1nom} + N \times 302 \mu s$  ( $N$  is an integer). After a successful write, the new value of the selected password is automatically activated. It is not required to present the new password value until the **ST25TV04K-P** power-down.

**Caution:** To make the application more robust, it is recommended to use addressed or selected mode during write password operations to get the traceability of which tags/UID have been programmed.

**Table 156. Write password request format**

Request SOF	Request_flags	Write password	IC Mfg code	UID <sup>(1)</sup>	Password number	Data	CRC16	Request EOF
-	8 bits	B1h	02h	64 bits	8 bits	64 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)
- Password number:
  - 00h = PWD\_0 configuration password
  - 01h = PWD\_1
  - 02h = PWD\_2
  - 03h = PWD\_3
  - other = Error
- Data

**Table 157. Write password response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- no parameter.

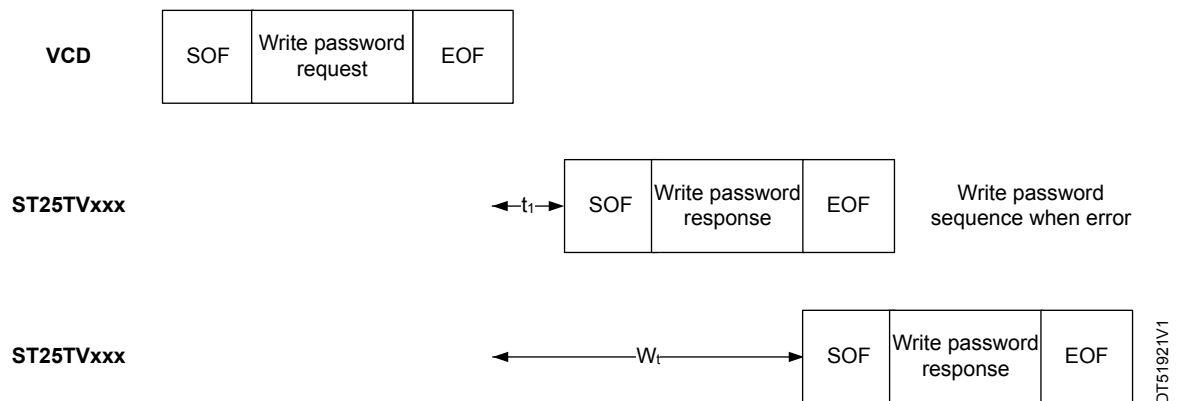
**Table 158. Write password response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 10h: the password number is incorrect
  - 12h: update right not granted, Present Password command not previously executed successfully
  - 13h: the specified block was not successfully programmed

**Figure 38. Write password frame exchange between VCD and ST25TV04K-P**



### 6.4.29 Present password

On receiving the present password command, the ST25TV04K-P compares the requested password with the data contained in the request and reports if the operation has been successful in the response. Refer to [Section 5.2 Data protection](#) for details on password management. After a successful command, the security session associated to the password is open as described in [Section 5.2 Data protection](#).

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 159. Present password request format**

Request SOF	Request_flags	Present password	IC Mfg code	UID (1)	Password number	Password	CRC16	Request EOF
-	8 bits	B3h	02h	64 bits	8 bits	64 bits	16 bits	-

1. This field is optional.

Request parameter:

- Request flags
- UID (optional)
- Password number (00h = Password configuration, 0x01 = PWD\_1, 0x02 = PWD\_2, 0x03 = PWD\_3, other = Error)
- Password

**Table 160. Present password response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

- No parameter. The response is sent back after the write cycle.

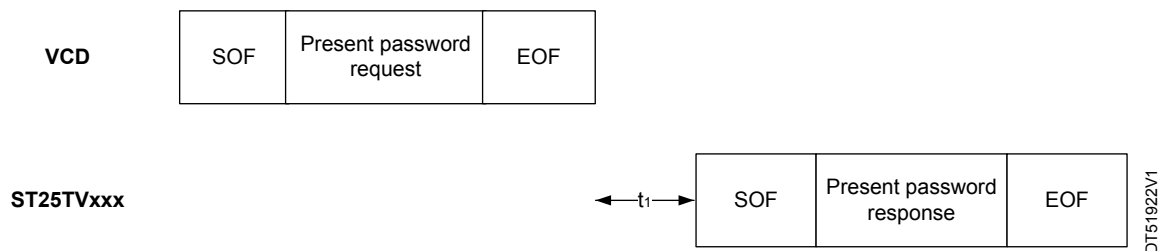
**Table 161. Present password response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 0Fh: the present password is incorrect
  - 10h: the password number is incorrect

**Figure 39. Present password frame exchange between VCD and ST25TV04K-P**



### 6.4.30 Fast read single block

On receiving the fast read single block command, the ST25TV04K-P reads the requested block and sends back its 32-bit value in the response. When the Option\_flag is set, the response includes the block security Status. The data rate of the response is multiplied by 2.

The subcarrier\_flag should be set to 0, otherwise the ST25TV04K-P answers with an error code.

The Inventory\_flag must be set to 0.

Block number is coded on 1 Byte and only first 256 blocks of ST25TV04K-P can be addressed using this command.

**Table 162. Fast read single block request format**

Request SOF	Request_flags	Fast read single block	IC Mfg code	UID <sup>(1)</sup>	Block number	CRC16	Request EOF
-	8 bits	C0h	02h	64 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)
- Block number

**Table 163. Fast read single block response format when Error\_flag is "not" set**

Response SOF	Response_flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits	32 bits	16 bits	-

1. This field is optional.

Response parameters:

- Block security status if Option\_flag is set (see Table 164. Block security status)
- Four bytes of block data

**Table 164. Block security status**

b7	b6	b5	b4	b3	b2	b1	b0
Reserved for future use All at 0							0: Current Block not locked 1: Current Block locked

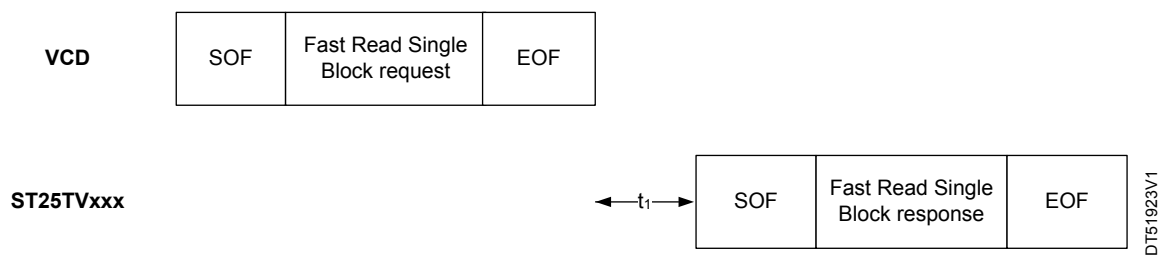
**Table 165. Fast read single block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 15h: the specified block is read-protected

**Figure 40. Fast read single block frame exchange between VCD and ST25TV04K-P**



### 6.4.31 Fast extended read single block

On receiving the fast extended read single block command, the ST25TV04K-P reads the requested block and sends back its 32-bit value in the response. When the Option\_flag is set, the response includes the block security status. The data rate of the response is multiplied by 2.

The subcarrier\_flag should be set to 0, otherwise the ST25TV04K-P answers with an error code.

The Inventory\_flag must be set to 0.

Block number is coded on 2 Bytes so all memory blocks of ST25TV04K-P can be addressed using this command

**Table 166. Fast extended read single block request format**

Request SOF	Request_flags	Fast extended read single block	IC Mfg code	UID <sup>(1)</sup>	Block number	CRC16	Request EOF
-	8 bits	C4h	02h	64 bits	16 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (optional)
- Block number (from LSB byte to MSB byte)

**Table 167. Fast extended read single block response format when Error\_flag is "not" set**

Response SOF	Response_flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits	32 bits	16 bits	-

1. This field is optional.

Response parameters:

- Block security status if Option\_flag is set (see Table 164. Block security status)
- Four bytes of block data

**Table 168. Block security status**

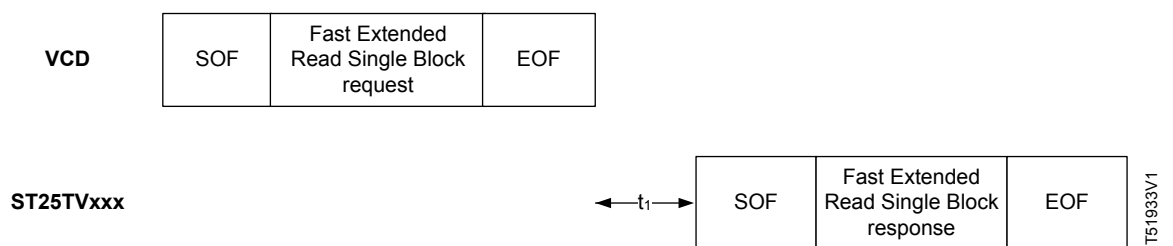
b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use							0: Current Block not locked
All at 0							1: Current Block locked

**Table 169. Fast extended read single block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 0Fh: error with no information given
  - 10h: the specified block is not available
  - 15h: the specified block is read-protected

**Figure 41. Fast extended read single block frame exchange between VCD and ST25TV04K-P**


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### 6.4.32 Fast read multiple blocks

On receiving the fast read multiple blocks command, the **ST25TV04K-P** reads the selected blocks and sends back their value in multiples of 32 bits in the response. The blocks are numbered from 00h up to the last block of user memory in the request, and the value is minus one (-1) in the field. For example, if the "Number of blocks" field contains the value 06h, seven blocks are read. The maximum number of blocks is fixed to 256 assuming that they are all located in the same area. If the number of blocks overlaps area or overlap the end of user memory, the **ST25TV04K-P** returns an error code.

The `Inventory_flag` must be set to 0.

When the `Option_flag` is set, the response includes the block security status. The data rate of the response is multiplied by 2.

The `subcarrier_flag` should be set to 0, otherwise the **ST25TV04K-P** answers with an error code.

Block number is coded on 1 Byte and only first 256 blocks of **ST25TV04K-P** can be addressed using this command.

**Table 170. Fast read multiple block request format**

Request SOF	Request_flags	Fast read multiple block	IC Mfg code	UID <sup>(1)</sup>	First block number	Number of blocks	CRC16	Request EOF
-	8 bits	C3h	02h	64 bits	8 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flag
- UID (Optional)
- First block number (from LSB byte to MSB byte)
- Number of blocks (from LSB byte to MSB byte)

**Table 171. Fast read multiple block response format when `Error_flag` is "not" set**

Response SOF	Response_flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits <sup>(2)</sup>	32 bits <sup>(2)</sup>	16 bits	-

1. This field is optional.

2. Repeated as needed.

Response parameters:

- Block security status if `Option_flag` is set (see [Table 172. Block security status if `Option\_flag` is set](#))
- N block of data

**Table 172. Block security status if `Option_flag` is set**

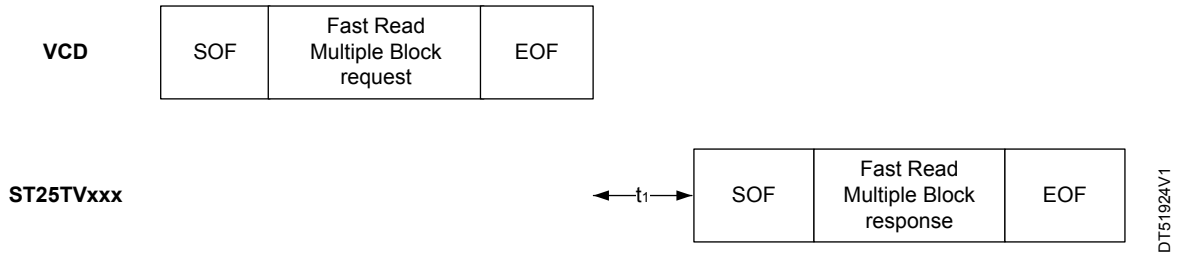
b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use All at 0							0: Current not locked 1: Current locked

**Table 173. Fast read multiple block response format when `Error_flag` is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 0Fh: error with no information given
  - 03h: the option is not supported
  - 10h: block address not available
  - 15h: block read-protected

**Figure 42. Fast read multiple block frame exchange between VCD and ST25TV04K-P**


### 6.4.33 Fast extended read multiple block

On receiving the fast extended read multiple block command, the **ST25TV04K-P** reads the selected blocks and sends back their value in multiples of 32 bits in the response. The blocks are numbered from 00h to up to the last block of memory in the request and the value is minus one (–1) in the field. For example, if the “Number of blocks” field contains the value 06h, seven blocks are read. The maximum number of blocks is fixed to 2047 assuming that they are all located in the same area. If the number of blocks overlaps several areas or overlaps the end of user memory, the **ST25TV04K-P** returns an error code.

When the Option\_flag is set, the response includes the Block Security Status. The data rate of the response is multiplied by 2.

The subcarrier\_flag should be set to 0, otherwise the **ST25TV04K-P** answers with an error code.

The Inventory\_flag must be set to 0.

Block number is coded on 2 Bytes so all memory blocks of **ST25TV04K-P** can be addressed using this command.

**Table 174. Fast extended read multiple block request format**

Request SOF	Request_flags	Fast extended read multiple block	IC Mfg code	UID <sup>(1)</sup>	First block number	Block Number	CRC16	Request EOF
-	8 bits	C5h	02h	64 bits	16 bits	16 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flag
- UID (Optional)
- First block number (from LSB byte to MSB byte)
- Number of blocks (from LSB byte to MSB byte)

**Table 175. Fast extended read multiple block response format when Error\_flag is “not” set**

Response SOF	Response_flags	Block security status <sup>(1)</sup>	Data	CRC16	Response EOF
-	8 bits	8 bits <sup>(2)</sup>	32 bits Table 176	16 bits	-

1. This field is optional.

2. Repeated as needed.

Response parameters:

- Block security status if Option\_flag is set (see Table 176. Block security status if Option\_flag is set)
- N block of data

**Table 176. Block security status if Option\_flag is set**

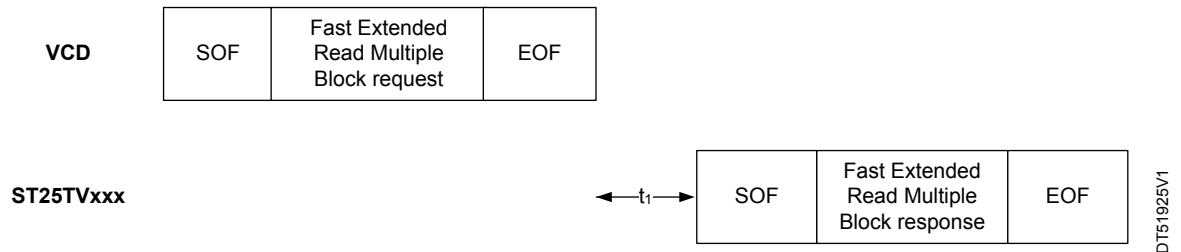
b <sub>7</sub>	b <sub>6</sub>	b <sub>5</sub>	b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>0</sub>
Reserved for future use All at 0							0: Current not locked 1: Current locked

**Table 177. Fast read multiple block response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: the option is not supported
  - 0Fh: error with no information given
  - 10h: block address not available
  - 15h: block read-protected

**Figure 43. Fast extended read multiple block frame exchange between VCD and ST25TV04K-P**


### 6.4.34 Manage GPO

On receiving the manage GPO command. Depending on the command argument, the ST25TV04K-P force the GPO output level if RF\_USER interrupt is enabled, or send a pulse on GPO output if RF\_INTERRUPT is enabled. If neither RF\_USER nor RF\_INTERRUPT was enabled, the command is not executed and ST25TV04K-P responds an Error code "0F".

The IT duration is defined by IT\_TIME register and occurs just after the command response.

For the ST25TV04K-P, a set means that the GPO pin is driven to a high level ( $V_{DCCG}$ ) and a reset pulls the GPO pin to a low level ( $V_{SS}$ ).

The IT corresponds to a transmission of a positive pulse on the GPO pin.

Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 178. Manage GPO request format**

Request SOF	Request_flags	Manage GPO	IC Mfg code	UID <sup>(1)</sup>	GPO VAL <sup>(2)</sup>	CRC16	Request EOF
-	8 bits	A9h	02h	64 bits	8 bits	16 bits	-

1. This field is optional.
2. See Table 179

**Table 179. GPOVAL**

GPOVAL	IT	GPO pin state
0xxxxx0b	RF_USER enabled	GPO pin set to logic One ( $V_{DCC}$ )
0xxxxx1b	RF_USER enabled	GPO pin reset to logic zero
1xxxxxxb	RF_INTERRUPT enabled	GPO Pin drives a positive pulse
	Any other conditions	GPO pin reset to logic zero

Request parameters:

- Request flag
- UID (optional)
- Data: Define static or dynamic interrupt

**Table 180. Manage GPO response format when Error\_flag is 'not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameter:

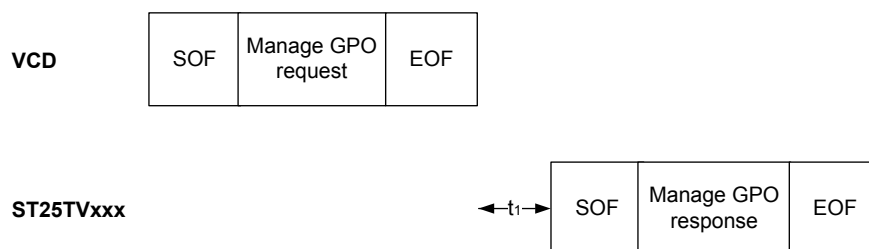
- No parameter. The response is sent back after the write cycle.

**Table 181. Manage GPO response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 13h: the specified block was not successfully programmed (this error is generated if the ManageCPO GPOVAL value is not in line with the GPO interrupts setting as specified in [Table 179. GPOVAL](#))

**Figure 44. Manage GPO frame exchange between VCD and ST25TV04K-P**


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### 6.4.35 Read dynamic configuration

On receiving the read dynamic configuration command, the [ST25TV04K-P](#) reads the dynamic register address indicated by the pointer and sends back its 8-bit value in the response.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 182. Read dynamic configuration request format**

Request SOF	Request_flags	Read dynamic configuration	IC Mfg code	UID <sup>(1)</sup>	Pointer address	CRS16	Request EOF
-	8 bits	ADh	02h	64 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- UID (Optional)

**Table 183. Read dynamic configuration response format when Error\_flag is "not" set**

Response SOF	Response_flags	Data	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameters:

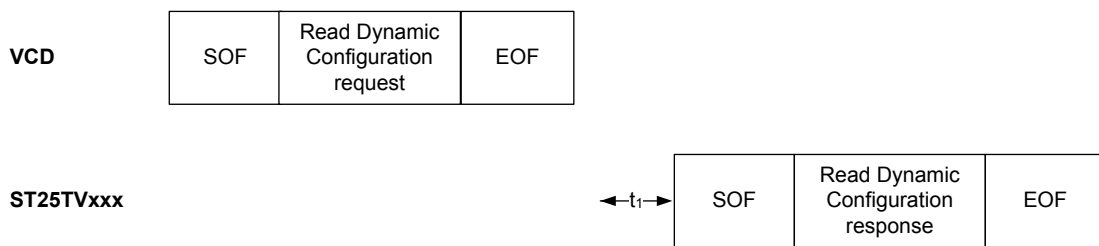
- One byte of data

**Table 184. Read dynamic configuration response format when Error\_flag is set**

Response SOF	Response_flags	error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 0Fh: error given with no information
  - 10h: block not available

**Figure 45. Read dynamic configuration frame exchange between VCD and ST25TV04K-P**


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### 6.4.36 Write dynamic configuration

On receiving the write dynamic configuration command, the **ST25TV04K-P** updates the dynamic register addressed by the pointer.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

**Table 185. Write dynamic configuration request format**

Request SOF	Request_flags	Write dynamic configuration	IC Mfg code	UID <sup>(1)</sup>	Pointer address	Register value	CRC16	Request EOF
-	8 bits	A Eh	02h	64 bits	8 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flags
- UID (Optional)
- Pointer address
- Register value

**Table 186. Write dynamic configuration response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameters:

- No parameter. The response is sent back after  $t_1$ .

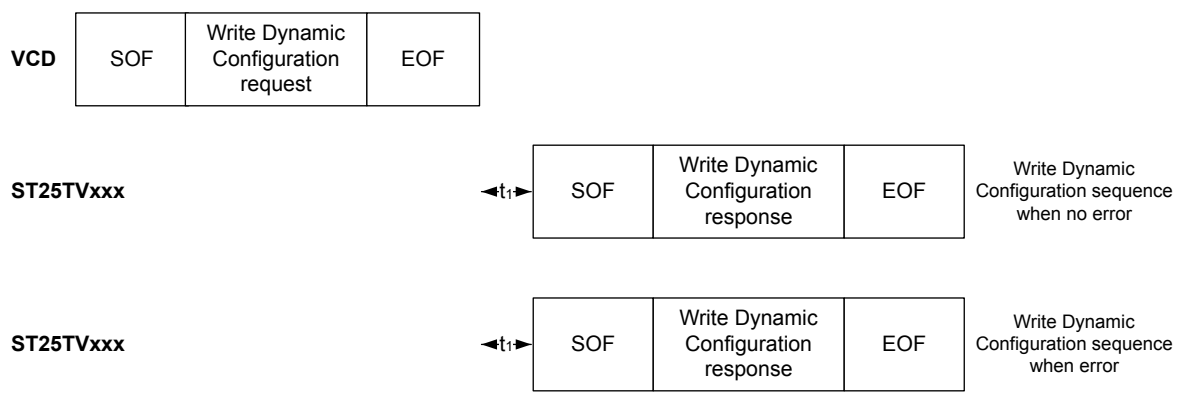
**Table 187. Write dynamic configuration response format when Error\_flag is set**

Response SOF	Response_flags	error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 0Fh: error with no information given
  - 10h: block not available

**Figure 46. Write dynamic configuration frame exchange between VCD and ST25TV04K-P**



### 6.4.37 Fast read dynamic configuration

On receiving the fast read dynamic configuration command, the ST25TV04K-P reads the dynamic register address by the pointer and sends back its 8-bit value in the response.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

The subcarrier\_flag should be set to 0, otherwise the ST25DVxxx answers with an error code.

The data rate of the response is multiplied by two compared to read dynamic configuration command.

**Table 188. Fast read dynamic configuration request format**

Request SOF	Request_flags	Fast read dynamic configuration	IC Mfg code	UID <sup>(1)</sup>	Pointer address	CRC16	Request EOF
-	8 bits	CDh	02h	64 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flag
- UID (optional)

**Table 189. Fast read dynamic configuration response format when Error\_flag is "not" set**

Response SOF	Response_flags	Data	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameters:

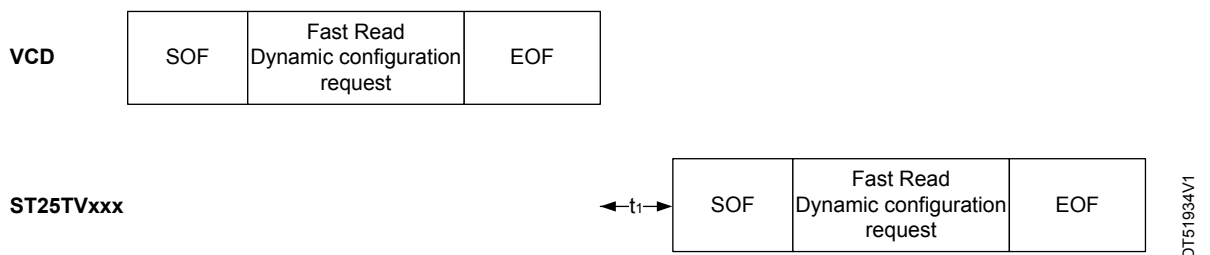
- One byte of data

**Table 190. Fast read dynamic configuration response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 0Fh: error with no information given
  - 10h: block not available

**Figure 47. Fast read dynamic configuration frame exchange between VCD and ST25TV04K-P**


### 6.4.38 Fast write dynamic configuration

On receiving the fast write dynamic configuration command, the **ST25TV04K-P** updates the dynamic register addressed by the pointer.

The Option\_flag is not supported. The Inventory\_flag must be set to 0.

The data rate of the response is multiplied by 2 compared to write dynamic configuration command.

**Table 191. Fast write dynamic configuration request format**

Request SOF	Request_flags	Fast write dynamic configuration	IC Mfg code	UID <sup>1</sup>	Pointer address	Register Value	CRC16	Request EOF
-	8 bits	CEh	02h	64 bits	8 bits	8 bits	16 bits	-

1. This field is optional.

Request parameters:

- Request flag
- UID (optional)
- Pointer address
- Register value

**Table 192. Fast write dynamic configuration response format when Error\_flag is "not" set**

Response SOF	Response_flags	CRC16	Response EOF
-	8 bits	16 bits	-

Response parameters:

- No parameter. The response is sent back after  $t_1$ .

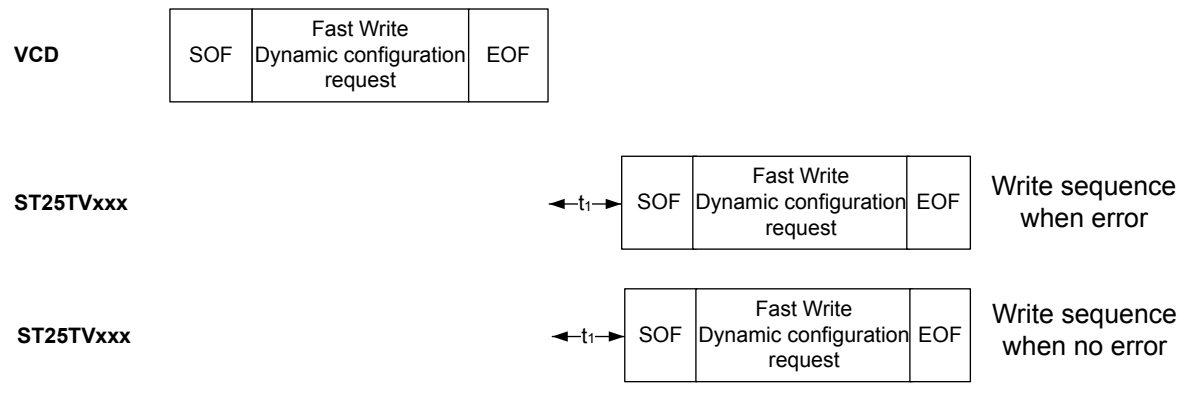
**Table 193. Fast write dynamic configuration response format when Error\_flag is set**

Response SOF	Response_flags	Error code	CRC16	Response EOF
-	8 bits	8 bits	16 bits	-

Response parameter:

- Error code as Error\_flag is set:
  - 02h: command not recognized
  - 03h: command option not supported
  - 0Fh: error with no information given
  - 10h: block not available

**Figure 48. Fast write dynamic configuration frame exchange between VCD and ST25TV04K-P**



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## 7 Unique identifier (UID)

The **ST25TV04K-P** is uniquely identified by a 64-bit unique identifier (UID). This UID complies with ISO/IEC 15963 and ISO/IEC 7816-6. The UID is a read-only code and comprises:

- eight MSBs with a value of E0h,
- the IC manufacturer code “ST 02h” on 8 bits (ISO/IEC 7816-6/AM1),
- a unique serial number on 48 bits.

**Table 194. UID format**

MSB				LSB			
63	56	55	48	47	40	40	0
0xE0		0x02		ST product code <sup>(1)</sup>		Unique serial number	

1. See [Table 61](#) for ST product code value definition.

With the UID, each **ST25TV04K-P** can be addressed uniquely and individually during the anticollision loop and for one-to-one exchanges between a VCD and an **ST25TV04K-P**.

## 8 Device parameters

### 8.1 Maximum ratings

Stressing the device above the rating listed in [Table 195](#) 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. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 195. Absolute maximum ratings**

Symbol	Parameter	Min.	Max.	Unit
$T_A$	Ambient operating temperature	- 40	85	°C
$T_{STG}$	Storage temperature	15	25	°C
$t_{STG}$	Retain	-	9 <sup>(1)</sup>	months
$V_{MAX\_1}$ <sup>(2)</sup>	RF input voltage amplitude, peak to peak between AC0 and AC1, $V_{SS}$ pin left floating	-	11	V
$V_{ESD}$	Electrostatic discharge voltage <sup>(3)</sup> (human body model)	-	2000	V

1. Counted from ST production date.
2. Evaluated by characterization, not tested in production.
3. ANSI/ESDA/JEDEC JS-001-2012,  $C = 100\text{ pF}$ ,  $R = 1500\ \Omega$ ,  $R2 = 500\ \Omega$

## 8.2 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 196. RF characteristics**

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$f_{CC}$	External RF signal frequency	-	13.553	13.56	13.567	MHz
H_ISO	Operational field according to ISO <sup>(1)</sup>	$T_A = -40\text{ °C to }85\text{ °C}$	150	-	5000	mA/m
MI <sub>CARRIER</sub>	10% carrier modulation index $MI = (A - B) / (A + B)$ <sup>(1)</sup>	$150\text{ mA/m} > H\_ISO > 1000\text{ mA/m}$	10	-	30	%
	100% carrier modulation index <sup>(1)</sup>	$MI = (A - B) / (A + B)$	95	-	100	
t <sub>MINCD</sub>	Minimum time from carrier generation to first data <sup>(1)</sup>	From H-field min	-	-	1	ms
f <sub>SH</sub>	Subcarrier frequency high <sup>(1)</sup>	$f_{CC}/32$	-	423.75	-	kHz
f <sub>SL</sub>	Subcarrier frequency low <sup>(1)</sup>	$f_{CC}/28$	-	484.28	-	
t <sub>1</sub>	Time for ST25TV04K-P response <sup>(1)</sup>	$4352/f_C$	318.6	320.9	323.3	μs
t <sub>2</sub>	Time between commands <sup>(1)</sup>	$4192/f_C$	309	311.5	314	
t <sub>3</sub>	Time between commands <sup>(1)</sup>	$4384/f_C$	323.3	-	-	
W <sub>t_Block</sub>	RF user memory write time (including internal Verify) <sup>(1) (2)</sup>	1 block	-	5.2	-	ms
		4 blocks	-	19.7	-	
W <sub>t_Byte</sub>	RF system memory write time (including internal Verify) <sup>(2)</sup>	1 byte	-	4.9	-	
C <sub>TUN</sub>	Internal tuning capacitor in SO8 <sup>(3)</sup>	$f = 13.56\text{ MHz}$	26.5	28.5	30.5	pF
V <sub>BACK</sub>	Backscattered level as defined by ISO test <sup>(1)</sup>	-	10	-	-	mV
V <sub>MIN_1</sub> <sup>(1)</sup>	RF input voltage amplitude between AC0 and AC1, V <sub>AC0</sub> -V <sub>AC1</sub> peak to peak <sup>(1)</sup>	Inventory and Read operations	-	4.8	-	V
		Write operations	-	5.25	-	
t <sub>BootRF</sub>	<sup>(1)</sup>	Set up time	-	0.6	-	ms
t <sub>RF_OFF</sub>	RF OFF time <sup>(1)</sup>	Chip reset	2	-	-	

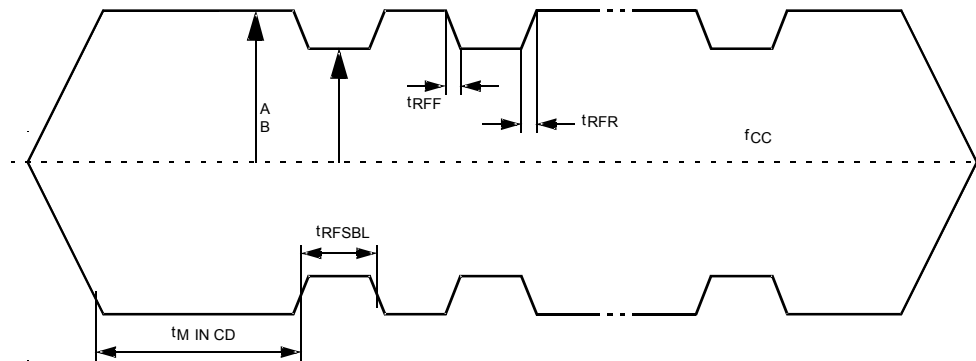
1. Evaluated by characterization, not tested in production.
2. For VCD request coded in 1 out of 4 and ST25TV04K-P response in high data rate, single sub carrier.
3. Evaluated by characterization at 25°C– Tested in production at 25°C by correlating industrial tester measure with characterization results.

**Table 197. Operating conditions**

Symbol	Parameter	Min.	Max.	Unit
T <sub>A</sub>	Ambient operating temperature	- 40	85	°C

Figure 1 shows an ASK modulated signal from the VCD to the ST25TV04K-P. The test conditions for the AC/DC parameters are:

- Close coupling condition with tester antenna (1 mm)
- ST25TV04K-P performance measured at the tag antenna
- ST25TV04K-P synchronous timing, transmit and receive

**Figure 49. ASK modulated signal**


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### 8.3 GPO characteristics

This section summarizes the operating and measurement conditions of the GPO feature. The parameters in the DC and AC characteristic tables that follow are derived from tests performed under the measurement conditions summarized in the relevant tables.

**Table 198. GPO DC characteristics up to 85°C**

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$V_{OL\_GPO}$	Output low voltage	$V_{DCG} = 1.8\text{ V}, I_{OL} = 0.5\text{ mA}$	-	-	0.4	V
		$V_{DCG} = 3.3\text{ V}, I_{OL} = 0.5\text{ mA}$	-	-	0.4	
		$V_{DCG} = 5.5\text{ V}, I_{OL} = 0.5\text{ mA}$	-	-	0.4	
$V_{OH\_GPO}$	Output high voltage	$V_{DCG} = 1.8\text{ V}, I_{OH} = -0.5\text{ mA}$	$V_{DCG} - 0.4$	-	-	V
		$V_{DCG} = 3.3\text{ V}, I_{OH} = -0.5\text{ mA}$	$V_{DCG} - 0.4$	-	-	
		$V_{DCG} = 5.5\text{ V}, I_{OH} = -0.5\text{ mA}$	$V_{DCG} - 0.4$	-	-	
$I_{LI\_VDCG}$	Input leakage ( $V_{DGC}$ )	$V_{DGC} = 5.5\text{ V}$	-	-	0.1	$\mu\text{A}$

**Table 199. GPO AC characteristics**

Symbol	Parameter	Condition	Min	Max	Unit
$t_r\_GPO$	Output rise time	$C_L = 30\text{ pF}, V_{DCG} = 1.8\text{ V to }5.5\text{ V}$	-	50	ns
$t_f\_GPO$	Output fall time	$C_L = 30\text{ pF}, V_{DCG} = 1.8\text{ V to }5.5\text{ V}$	-	50	

## 9 Ordering information

**Table 200. Ordering information scheme**

Example:	ST25TV	04K	P	E	6	G	3
<b>Device type</b>							
ST25TV = NFC/RFID tag based on ISO15693 and NFC T5T							
<b>Memory size</b>							
04K = 4 Kbit							
<b>Interface</b>							
P = P-CMOS GPO							
<b>Features</b>							
E = Energy harvesting							
<b>Device grade</b>							
6 = Industrial: device tested with standard test flow over - 40 to 85 °C							
<b>Package</b>							
G = 120um +/- 15 um bumped sawn wafer							
<b>Capacitance</b>							
3 = 28.5 pF							

**Note:** *Parts marked as “ES” or “E” are not yet qualified and therefore not approved for use in production. ST is not responsible for any consequences resulting from such use. In no event will ST be liable for the customer using any of these engineering samples in production. ST’s Quality department must be contacted prior to any decision to use these engineering samples to run a qualification activity.*

## Appendix A Bit representation and coding for fast commands

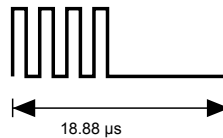
Data bits are encoded using Manchester coding, according to the following schemes. For the low data rate, same subcarrier frequency or frequencies is/are used. In this case, the number of pulses is multiplied by 4 and all times increase by this factor. For the fast commands using one subcarrier, all pulse numbers and times are divided by two.

### A.1 Bit coding using one subcarrier

#### A.1.1 High data rate

For the fast commands, a logic 0 starts with four pulses at 423.75 kHz ( $f_C / 32$ ) followed by an unmodulated time of 9.44  $\mu\text{s}$ , as shown in Figure 50.

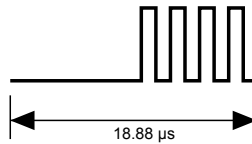
**Figure 50. Logic 0, high data rate, fast commands**



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For the fast commands, a logic 1 starts with an unmodulated time of 9.44  $\mu\text{s}$  followed by four pulses of 423.75 kHz ( $f_C / 32$ ), as shown in Figure 51.

**Figure 51. Logic 1, high data rate, fast commands**

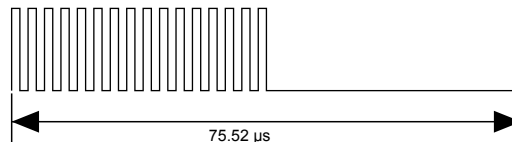


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#### A.1.2 Low data rate

For the fast commands, a logic 0 starts with 16 pulses at 423.75 kHz ( $f_C / 32$ ) followed by an unmodulated time of 37.76  $\mu\text{s}$ , as shown in Figure 52.

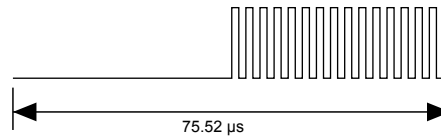
**Figure 52. Logic 0, low data rate, fast commands**



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For the fast commands, a logic 1 starts with an unmodulated time of 37.76  $\mu\text{s}$  followed by 16 pulses at 423.75 kHz ( $f_C / 32$ ), as shown in Figure 53.

Figure 53. Logic 1, low data rate, fast commands



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Note: For fast commands, bit coding using two subcarriers is not supported.

## A.2 VICC to VCD frames

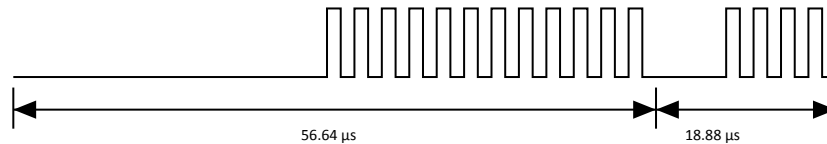
Frames are delimited by an SOF and an EOF. They are implemented using code violation. Unused options are reserved for future use. For the low data rate, the same subcarrier frequency or frequencies is/are used. In this case, the number of pulses is multiplied by 4. For the fast commands using one subcarrier, all pulse numbers and times are divided by two.

## A.3 SOF when using one subcarrier

### A.3.1 High data rate

For the fast commands, the SOF comprises an unmodulated time of 28.32  $\mu\text{s}$ , followed by 12 pulses at 423.75 kHz ( $f_C / 32$ ), and a logic 1 that consists of an unmodulated time of 9.44  $\mu\text{s}$  followed by four pulses at 423.75 kHz, as shown in Figure 54.

Figure 54. Start of frame, high data rate, one subcarrier, fast commands

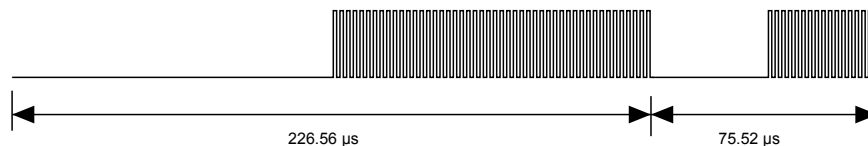


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### A.3.2 Low data rate

For the fast commands, the SOF comprises an unmodulated time of 113.28  $\mu\text{s}$ , followed by 48 pulses at 423.75 kHz ( $f_C / 32$ ), and a logic 1 that includes an unmodulated time of 37.76  $\mu\text{s}$  followed by 16 pulses at 423.75 kHz, as shown in Figure 55.

Figure 55. Start of frame, low data rate, one subcarrier, fast commands



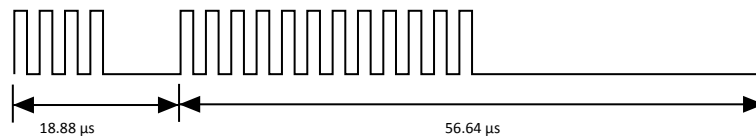
DT12081bV1

## A.4 EOF when using one subcarrier

### A.4.1 High data rate

For the Fast commands, the EOF comprises a logic 0 that includes four pulses at 423.75 kHz and an unmodulated time of 9.44  $\mu\text{s}$ , followed by 12 pulses at 423.75 kHz ( $f_C / 32$ ) and an unmodulated time of 37.76  $\mu\text{s}$ , as shown in Figure 56.

Figure 56. End of frame, high data rate, one subcarrier, fast commands

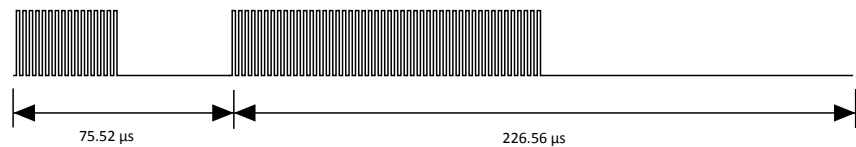


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### A.4.2 Low data rate

For the fast commands, the EOF comprises a logic 0 that includes 16 pulses at 423.75 kHz and an unmodulated time of 37.76  $\mu\text{s}$ , followed by 48 pulses at 423.75 kHz ( $f_C / 32$ ) and an unmodulated time of 113.28  $\mu\text{s}$ , as shown in Figure 57.

Figure 57. End of frame, low data rate, one subcarrier, fast commands



DT12087bV1

**Note:** For SOF and EOF in fast commands, bit coding using two subcarriers is not supported.



## Revision history

**Table 201. Document revision history**

Date	Revision	Changes
21-Mar-2019	1	Initial release.
03-Jan-2023	2	Updated: <ul style="list-style-type: none"><li>• Section Features, Section 1 Description, Section 6.1.1 Access to a ISO/IEC 15693 device</li><li>• Figure 2. ST25TV04K-P RF power-up sequence, Figure 3. Memory organization</li><li>• note 2 in Table 1, Table 196. RF characteristics</li></ul>

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