AN5115
Application note

Migrating from ST25TAxxx/xxx-x to ST25TAxxxB/xxxB-x

Introduction

The ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x are NFC devices with an optional general purpose output.

The ST25TAxxxB/xxxB-x is an update of the ST25TAxxx/xxx-x, including an additional TruST25™ digital signature feature and alignments to the NFC forum specification.

The purpose of this document is to explain how to migrate from the ST25TAxxx/xxx-x to the new ST25TAxxxB/xxxB-x tag.

The new digital signature feature is not discussed in this document.

Table 1. Applicable products

Type	Part number			
	ST25TAxxx	**ST25TAxx-x**	**ST25TAxxxB**	**ST25TAxxxB-x**
NFC Forum Type 4A tag	ST25TA512 ST25TA02K	-	ST25TA512B ST25TA02KB	-
NFC Forum Type 4A tag with general purpose output	-	ST25TA02K-D ST25TA02K-P	-	ST25TA02KB-D ST25TA02KB-P

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1 Acronyms and notational conventions

Table 2. List of acronyms

Acronym	Definition
CC	Capability container file as defined by the NFC Forum
CCLEN	Length of the CC file in bytes
CCRD	Read access condition to the NDEF file (offset 0x000D in the CC file)
CCWR	Write access condition to the NDEF file (offset 0x000E in the CC file)
FLEN	Length of the NDEF file in bytes
Le	Parameter expressing the number of bytes requested in a (Extended)ReadBinary command
MLe	Maximum value allowed for the Le parameter (0x40 on a ST25TA512/512B, 0xFF otherwise)
NDEF	NFC data exchange format defined by the NFC Forum
NFC	Near field communication standard defined by the NFC Forum
P1P2	Start address parameter of (Extended)ReadBinary command
NLEN	Length of the NDEF message (stored in the NDEF file) in bytes.
SLEN	Length of the file currently selected (NDEF, CC or SYS) in bytes
SYS	System file: used to store ST proprietary data
SYSLEN	Length of the system file in bytes

1.1 Conventions

The following conventions and notations apply in this document unless stated otherwise.

1.1.1 Product family denomination

Product families are abbreviated as follows:

- ST25TAxxx/xxx-x refers to the deprecated family of products: ST25TA512, ST25TA02K, ST25TA02K-D and ST25TA02K-P
- ST25TAxxxB/xxxB-x refers to the new family of products: ST25TA512B, ST25TA02KB, ST25TA02KB-D and ST25TA02KB-P

1.1.2 Binary number representation

Binary numbers are represented by strings of 0 and 1 digits, with the most significant bit (MSB) on the left, the least significant bit (LSB) on the right, and a ‘b’ suffix added at the end.

Example: 11110101b

1.1.3 Hexadecimal number representation

Hexadecimal numbers are represented by strings of numbers from 0 to 9 and letters from A to F, and a ‘0x’ prefix added at the beginning. The most significant byte (MSB) is shown on the left and the least significant byte (LSB) on the right.

Example: 0xF5

1.1.4 Decimal number representation

Decimal numbers are represented without any trailing character.

Example: 245

2 ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x product feature comparison

Table 3 lists the features of ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x products. For full details, please refer to the ST25TAxxx/xxx-x *[1]*, *[2]*, *[3]*, *[4]* and ST25TAxxxB/xxxB-x *[5]* product datasheets.

Table 3. Feature comparison summary

Feature	ST25TAxxx/xxx-x	ST25TAxxxB/xxxB-x
Contactless interface	NFC Forum Type 4 Tag, certified by the NFC Forum	
	ISO/IEC 14443 Type A	
	106 kbps data rate	
	Internal tuning capacitance: 50 pF	
Memory	64 bytes (512) or 256 bytes (02K/02K-D/02K-P) EEPROM	
	Supports NDEF data structure	
	NA	NDEF message length coherency check
	Data retention: 200 years	
	Endurance : 1 million erase-write cycles	
	Range of ReadBinary command restricted to the message read	Range of ReadBinary and ExtendedReadBinary commands not restricted (only a valid start offset in the file read is needed)
	Range of ExtendedReadBinary command restricted to the NDEF file	
	Le=0 not supported by Read commands	Le=0 supported by Read commands
	Reads up to 255 bytes in a single command	Reads up to 256 bytes in a single command
	Writes up to 54 bytes in a single command	
	Chaining capability	
	128-bit password protection	
	Protection status readable from the CC file	Protection status read with the Verify command
	20-bit event counter with anti-tearing	
Product identification and protection	7-byte unique identifier (UID)	
	Product codes : 0xE5/0xE2/0xF2/0xA2	Product codes : 0xE4/0xE3/0xF3/0xA3
	NA	TruST25^{TM} digital signature

Table 3. Feature comparison summary (continued)

Feature	ST25TAxxx/xxx-x	ST25TAxxxB/xxxB-x
Package	Sawn and bumped wafer, 120 +/- 10 µm	
	NA	Sawn and bumped wafer, 75 +/- 10 µm
	UFDFPN5 (02K-D/P only)	
	UFDFPN8 (02K-D/P only)	NA
Digital output	Configurable general purpose output (02K-D/P only)	
	Driven by an open drain transistor (02K-D)	
	CMOS output buffer enabling no DC consumption (02K-P)	

3 Hardware considerations

ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x products are available in 120 µm thick wafers (sawn and bumped).

Only ST25TAxxxB/xxxB-x products are available in 75 µm thick wafers (sawn and bumped).

ST25TA02K-D/P and ST25TA02KB-D/P products are available in UFDFPN5 packages.

Only ST25TA02K-D/P products are available in UFDFPN8 packages.

ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x products are pin-to-pin compatible when using the same package.

Table 4. ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x product package availability

Product	Package			
	Wafer 75µm	Wafer 120 µm	UFDFPN5	UFDFPN8
ST25TA512	-	X	-	-
ST25TA512B	X	X	-	-
ST25TA02K	-	X	-	-
ST25TA02KB	X	X	-	-
ST25TA02K-D	-	X	X	X
ST25TA02KB-D	X	X	X	-
ST25TA02K-P	-	X	X	X
ST25TA02KB-P	X	X	X	-

The internal tuning capacitances of ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x products are identical. Migrating from ST25TAxxx/xxx-x to ST25TAxxxB/xxxB-x products doesn’t require modification of the antenna design.

4 NDEF message length coherency check

The NDEF file contains the NDEF message that contains the user data. The RF host can read and write data inside the file. The NDEF message starts at offset 0x0002 in the NDEF file. The first two bytes named NDEF Message Length (NLEN) define the size of the NDEF message as depicted in *Table 5*.

The NDEF Message Length shall be managed by the application, and there should be a coherency between its value and the actual size of the message written by the RF host to the NDEF file. Such check of the user data size at write time is not available on ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices.

Table 5. NDEF file layout

File offset	Byte 0	Byte 1	Byte 2	Byte 3
0x0000	NLEN : NDEF Message Length		User data	User data
0x0004	User data	User data	User data	User data
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
FLEN(1) (2)- 4	…	…	…	User data

1. FLEN=0x0040 on ST25TA512 and ST25TA512B
2. FLEN=0x0100 on ST25TA02K, ST25TA02KB, ST25TA02K-D/P and ST25TA02KB-D/P

However on ST25TAxxxB/xxxB-x devices, if the NDEF file length (FLEN) is not coherent with the NDEF Message Length value stored in the file (i.e. NLEN>FLEN-2), the tag handles it as an invalid case and returns 0x0000 for the byte values at offsets 0x0000 and 0x0001 in the response to a ReadBinary or ExtendedReadBinary command.
The coherency between NDEF Message length and NDEF file length values is not checked on ST25TAxxx/xxx-x devices.

5 ExtendedReadBinary and ReadBinary commands

5.1 ExtendedReadBinary command

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, the only file supported by the ExtendedReadBinary command is the NDEF file. An error is obtained when this command is used with the System or CC file selected.

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, the allowed range for the start address (P1P2) of an ExtendedReadBinary command is the whole NDEF file (i.e. [0:FLEN - 1]). Start address beyond the NDEF message (i.e. P1P2 ≥ NLEN+2) are allowed if they do not exceed FLEN - 1.

Using ExtendedReadBinary command with a valid start address, and Le=0:

- on ST25TAxxx/xxx-x devices, an error is obtained
- on ST25TAxxxB/xxxB-x devices, the success status with data at offsets [P1P2:FLEN-1] is obtained

Note: In the later case, the whole NDEF file (256 bytes when a ST25TA02KB/KB-D/KB-P is used) can be read with a single ExtendedReadBinary command using P1P2=Le=0

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, an ExtendedReadBinary command with an end address beyond the NDEF message (i.e. P1P2+Le>NLEN+2) and within the NDEF file (i.e. P1P2 + Le ≤ FLEN) are allowed.

Using ExtendedReadBinary command with a valid start address, and an end address exceeding the size of the NDEF file (i.e. P1P2 + Le > FLEN):

- on ST25TAxxx/xxx-x devices, an error is obtained
- on ST25TAxxxB/xxxB-x devices, the success status with data at offsets [P1P2:FLEN - 1] is obtained

Note: In the later case, the amount of data responded (FLEN - P1P2) is less than requested (Le)

Different behaviors between ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices on ExtendedReadBinary use cases are highlighted by grayed cells in *Table 6*.

Table 6. Comparison of SW1SW2 status for ExtendedReadBinary command

File	Use cases	ST25TAxxx/xxx-x	ST25TAxxxB/xxxB-x
NDEF	P1P2+Le(1) ≤ NLEN + 2	0x9000	
	Le > MLe(2)	0x6A80	
	P1P2 ≥ FLEN	0x6A86	
	P1P2 ≥ NLEN + 2	0x9000	
	Le = 0	0x6A80	0x9000(3)
	P1P2 + Le > FLEN	0x6282(4)	
	P1P2 + Le > NLEN + 2	0x9000	

Table 6. Comparison of SW1SW2 status for ExtendedReadBinary command (continued)

File	Use cases	ST25TAxxx/xxx-x	ST25TAxxxB/xxxB-x
CC	P1P2+Le(1) ≤ CCLEN	0x6E00(5)	
	Le > MLe(2)		
	P1P2 ≥ CCLEN		
	Le = 0		
	P1P2 + Le > CCLEN		
SYS	P1P2 + Le(1) ≤ SYSLEN		
	Le > MLe(2)		
	P1P2 ≥ SYSLEN		
	Le = 0		
	P1P2 + Le > SYSLEN		

1. Le > 0
2. Le > MLe may occur on ST25TA512 and ST25TA512B devices only.
3. Data bytes at offsets [P1P2 : FLEN – 1] are responded
4. Error code 0x6282 occurs on ST25TAxxx/xxx-x devices only.
5. ExtendedReadBinary command not supported with CC file or SYS file selected.

5.2 ReadBinary command

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, the ReadBinary command can be used on any of the NDEF, CC and SYS files. Let SLEN be the length of the selected file (FLEN/CCLEN/SYSLEN for the NDEF/CC/SYS files respectively).

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, the allowed range for the start address (P1P2) of a ReadBinary command is the whole file selected (i.e. [0 : SLEN - 1]).

Using ReadBinary command with the NDEF file selected, and a start address beyond the NDEF message (i.e. P1P2 ≥ NLEN + 2):

- on ST25TAxxx/xxx-x devices, an error is obtained
- on ST25TAxxxB/xxxB-x devices, the success status with data is obtained if the start address remains in the NDEF file (P1P2<FLEN)

Using ReadBinary command with the NDEF file selected, and an end address beyond the NDEF message (i.e. P1P2 + Le > NLEN + 2) and within the NDEF file (i.e. P1P2 + Le ≤ FLEN):

- on ST25TAxxx/xxx-x devices, an error is obtained
- on ST25TAxxxB/xxxB-x devices, the success status with data is obtained

Using ReadBinary command with a valid start address, and Le = 0:

- on ST25TAxxx/xxx-x devices, an error is obtained
- on ST25TAxxxB/xxxB-x devices, the success status with data at offsets [P1P2 : SLEN - 1] is obtained

Note: In the later case, the whole selected file can be read with a single ReadBinary command using P1P2 = Le = 0

Using ReadBinary command with a valid start address, and an end address exceeding the size of the selected file (i.e. P1P2 + Le > SLEN):

- on ST25TAxxx/xxx-x devices, an error is obtained
- on ST25TAxxxB/xxxB-x devices, the success status with data at offsets [P1P2 : SLEN - 1] is obtained

Note: In the later case, the amount of data responded (SLEN - P1P2) is less than requested (Le)

On ST25TAxxxB/xxxB-x devices, the behavior of the ReadBinary and ExtendedReadBinary is identical on the NDEF file (ExtendedReadBinary is not supported when CC or SYS file is selected).

Different behaviors between ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices on ReadBinary use cases are highlighted by grayed cells in *Table 7*.

Table 7. Comparison of SW1SW2 status for ReadBinary command

File	Use cases	ST25TAxxx/xxx-x	ST25TAxxxB/xxxB-x
NDEF	P1P2 + Le(1) ≤ NLEN+2	0x9000	
	Le > MLe(2)	0x6A80	
	P1P2 ≥ FLEN	0x6A86	
	P1P2 ≥ NLEN+2	0x6282(3)	0x9000
	Le = 0	0x6A80	0x9000(4)
	P1P2 + Le > FLEN	0x6282(3)	
	P1P2 + Le > NLEN + 2		0x9000
CC	P1P2 + Le(1) ≤ CCLEN	0x9000	
	Le > MLe(2)	0x6A80	
	P1P2 ≥ CCLEN	0x6A86	
	Le = 0	0x6A80	0x9000(4)
	P1P2 + Le > CCLEN	0x6282(3)	
SYS	P1P2 + Le(1) ≤ SYSLEN	0x9000	
	Le > MLe(2)	0x6A80	
	P1P2 ≥ SYSLEN	0x6A86	
	Le = 0	0x6A80	0x9000(4)
	P1P2 + Le > SYSLEN	0x6282(3)	

1. Le > 0
2. Le > MLe may occur on ST25TA512 and ST25TA512B devices only.
3. Error code 0x6282 occurs on ST25TAxxx/xxx-x devices only.
4. Bytes at offsets [P1P2 : SLEN – 1] are obtained.

6 Status of access rights to the NDEF file

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, three protection modes are defined for each of the read and write access rights to the NDEF file:

- UNPROTECTED (the access is granted without a security constraint)
- PROTECTED (the access is granted if a correct password is presented, and denied otherwise)
- FORBIDDEN (the access is permanently forbidden)

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, the read or write protection mode is identified by the R-APDU value responded to a Verify command.

The bytes at offsets 0x000D and 0x000E in the CC file are named CCRD and CCWR. As defined in *[7]*, they are used to identify the read and write access conditions for the NDEF message.

On ST25TAxxx/xxx-x devices, the read/write protection mode can be uniquely identified by the value of CCRD/CCWR byte respectively.

However on ST25TAxxxB/xxxB-x devices, the CCRD/CCWR bytes cannot be used to identify the read/write protection mode respectively. The reason is that as an access condition value may correspond to several protection mode values on these devices.

The differences in CCRD and CCWR values between the ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices are highlighted by the grayed cells in *Table 8* and *Table 9*.

Table 8. Read protection modes

Mode	Verify(1) R-APDU	CCRD		Meaning
		ST25TAxxx ST25TAxxx-x	ST25TAxxxB ST25TAxxxB-x	
READ UNPROTECTED	0x9000	0x00	0x00	Read access without any security
READ PROTECTED	0x6300	0x80	0x00	Read access protected by password
READ FORBIDDEN	0x6984	0xFE	0x00	Read access permanently forbidden

1. Verify command parameters: Lc = 0x00, P1P2 = 0x0001

Table 9. Write protection modes

Mode	Verify(1) R-APDU	CCWR		Meaning
		ST25TAxxx ST25TAxxx-x	ST25TAxxxB ST25TAxxxB-x	
WRITE UNPROTECTED	0x9000	0x00	0x00	Write access without any security

Table 9. Write protection modes (continued)

Mode	Verify(1) R-APDU	CCWR		Meaning
		ST25TAxxx ST25TAxxx-x	ST25TAxxxB ST25TAxxxB-x	
WRITE PROTECTED	0x6300	0x80	0xFF	Write access protected by password
WRITE FORBIDDEN	0x6984	0xFF	0xFF	Write access permanently forbidden

1. Verify command parameters: Lc = 0x00, P1P2 = 0x0002

On ST25TAxxxB/xxxB-x devices, an additional error code (0x6985) is available for the ExtendedReadBinary, ReadBinary and UpdateBinary commands in cases of forbidden access to the NDEF file. This difference between the ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices is highlighted by the grayed cells in *Table 10* and *Table 11*.

Table 10. Return status of ReadBinary and ExtendedReadBinary commands

Use case	R-APDU	
	ST25TAxxx/xxx-x	ST25TAxxxB/xxxB-x
READ GRANTED(1)	Data + 0x9000	
READ DENIED(2)	0x6982	
READ FORBIDDEN	0x6982	0x6985

1. READ UNPROTECTED or READ PROTECTED with presentation of correct read password.
2. READ PROTECTED without presentation of correct read password.

Table 11. Return status of UpdateBinary command

Use case	R-APDU	
	ST25TAxxx/xxx-x	ST25TAxxxB/xxxB-x
WRITE GRANTED(1)	0x9000	
WRITE DENIED(2)	0x6982	
WRITE FORBIDDEN	0x6982	0x6985

1. WRITE UNPROTECTED or WRITE PROTECTED with presentation of correct write password
2. WRITE PROTECTED without presentation of correct write password

7 Product identification and protection

7.1 Product codes and IC Reference

On ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x devices, the product code is the second byte of the UID, and the IC reference code is the byte at offset 0x0011 in the System file.

The grayed cells in Table 12 highlight the differences of codification between the ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x products.

Table 12. Codification of ST25TAxxx/xxx-x and ST25TAxxxB/xxxB-x products

Product	IC reference	Product code
ST25TA512	0xE5	0xE5
ST25TA512B	0xE5	0xE4
ST25TA02K	0xE2	0xE2
ST25TA02KB	0xE2	0xE3
ST25TA02K-D	0xF2	0xF2
ST25TA02KB-D	0xF2	0xF3
ST25TA02K-P	0xA2	0xA2
ST25TA02KB-P	0xA2	0xA3

7.2 TruST25™ digital signature feature

The ST25TAxxxB/xxxB-x devices support the TruST25™ digital signature feature, which allows the user to verify the authenticity of the device, based on a unique digital signature. TruST25™ solution encompasses secure industrialization processes and tools deployed by STMicroelectronics to generate, store and check the signature in the device.

Implementation details can be found in AN5101 *[6]*. Contact your STMicroelectronics sales office to get this documentation.

8 Reference documents

Table 13. Reference documents

Reference	Revision	Title
[1]	Last revision	ST25TA512 datasheet, STMicroelectronics
[2]		ST25TA02K datasheet, STMicroelectronics
[3]		ST25TA02K-D datasheet, STMicroelectronics
[4]		ST25TA02K-P datasheet, STMicroelectronics
[5]		ST25TAXXXB datasheet, STMicroelectronics
[6]		AN5101 application note, STMicroelectronics
[7]		NFC Forum Type 4 Tag specification, NFC Forum

9 Revision history

Table 14. Document revision history

Date	Revision	Changes
24-Jan-2018	1	Initial release