AN4054
Application note

Comparison of RF addressing modes of low-density and high-density ISO/IEC 15693 devices

Introduction

This application note highlights the key differences of RF addressing modes between the products of the ISO/IEC 15693 STMicroelectronics family, which is composed of the dual interface EEPROM products (M24LRx) and the long range contactless products (LRix).

The memory size is a key point and has an impact on some specific parameters of the RF (Radio frequency) commands.

Dual interface memory M24LRx overview

M24LRx devices are a dual-interface EEPROM. They feature an I^2C interface. They are also a contactless memory powered by the received carrier electromagnetic wave. Thus, its internal memory can be addressed by either an I^2C bus or the RF interface.

The M24LRx products are compliant to the ISO/IEC 15693 recommendation for radio-frequency power and signal interface.

Long range contactless tag LRxK overview

LRxK devices are contactless memory powered by the received carrier electromagnetic wave with an EEPROM. They are compliant with the ISO/IEC 15693 specification.

Table 1 lists the products concerned by this application note.

Table 1. Applicable products

Type	Applicable products
Dual Interface EEPROM	M24LR04E-R, M24LR64-R, M24LR64E-R, M24LR16E-R
RFID & RF Memory ICs	LRi1K, LRi2K, LRiS2K, LRiS64K

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1 Comparison between low-density and high-density devices

This chapter highlights the differences of RF addressing modes between the ISO/IEC 15693 family products.

1.1 Overview

The STMicroelectronics ISO/IEC 15693 family can be split as shown in *Table 2*. The M24LRx products can be accessed either by the I^2C or the RF interface, and the LRix products can be addressed only by the RF interface.

The M24LR64-R, M24LR64E-R, M24LR16E-R and LRiS64k devices have an extended memory and some RF commands shall be updated. Details are given in *Chapter 1.4: Memory mapping of ISO/IEC 15693 products*.

Table 2. Low-density and high-density devices

Access type	Low-density	High-density
RF and I^2C access	M24LR04E-R	M24LR64-R
		M24LR64E-R
		M24LR16E-R
RF access	LRi1K	LRiS64K
	LRi2K	
	LRiS2K	

1.2 IC reference of ISO/IEC 15693 products

The IC reference (IC ref) is a byte that identifies an STMicroelectronics product. Each product of the ISO/IEC 15693 family has its own and can be retrieved by issuing the GetSystemInfo RF command.

Table 3 lists the different IC references of the ISO/IEC 15693 family products.

Table 3. IC references of the ISO/IEC 15693 family products

	LRi1K	LRi2K	LRiS2K	LRiS64K	M24LR04E-R	M24LR16E-R	M24LR64E-R	M24LR64-R
IC ref	0b010000xx	0b001000xx	0b001010xx	0x44	0x5A	0x4E	0x5E	0x2C

1.3 How to identify the ISO/IEC 15693 products

There are two ways to identify the STMicroelectronics ISO/IEC 15693 products:

- Analyze the product code field of the UID.
- Analyze the IC reference value of the GetSystemInfo response.

1.3.1 Using the Inventory command

The user can identify the STMicroelectronics ISO/IEC 15693 product by issuing an inventory command and analyzing the product code field of the UID.

The UID of the STMicroelectronics ISO/IEC 15693 product is defined as shown in *Table 4*.

Table 4. UID of the STMicroelectronics ISO/IEC 15693 product

UID	Byte 7	Byte 6	Byte 5	Byte 4 to 0
Value	0xE0	0x02 (1)	Product code field (2)	IC manufacture code

1. Manufacture code 0x02 for STMicroelectronics.
2. the product code field is defined in *Table 5*.

The product code field (only the first 6 bits are relevant) is defined in the STMicroelectronics ISO/IEC 15693 as shown in *Table 5*.

Table 5. Product code vs the ISO/IEC 15693 product

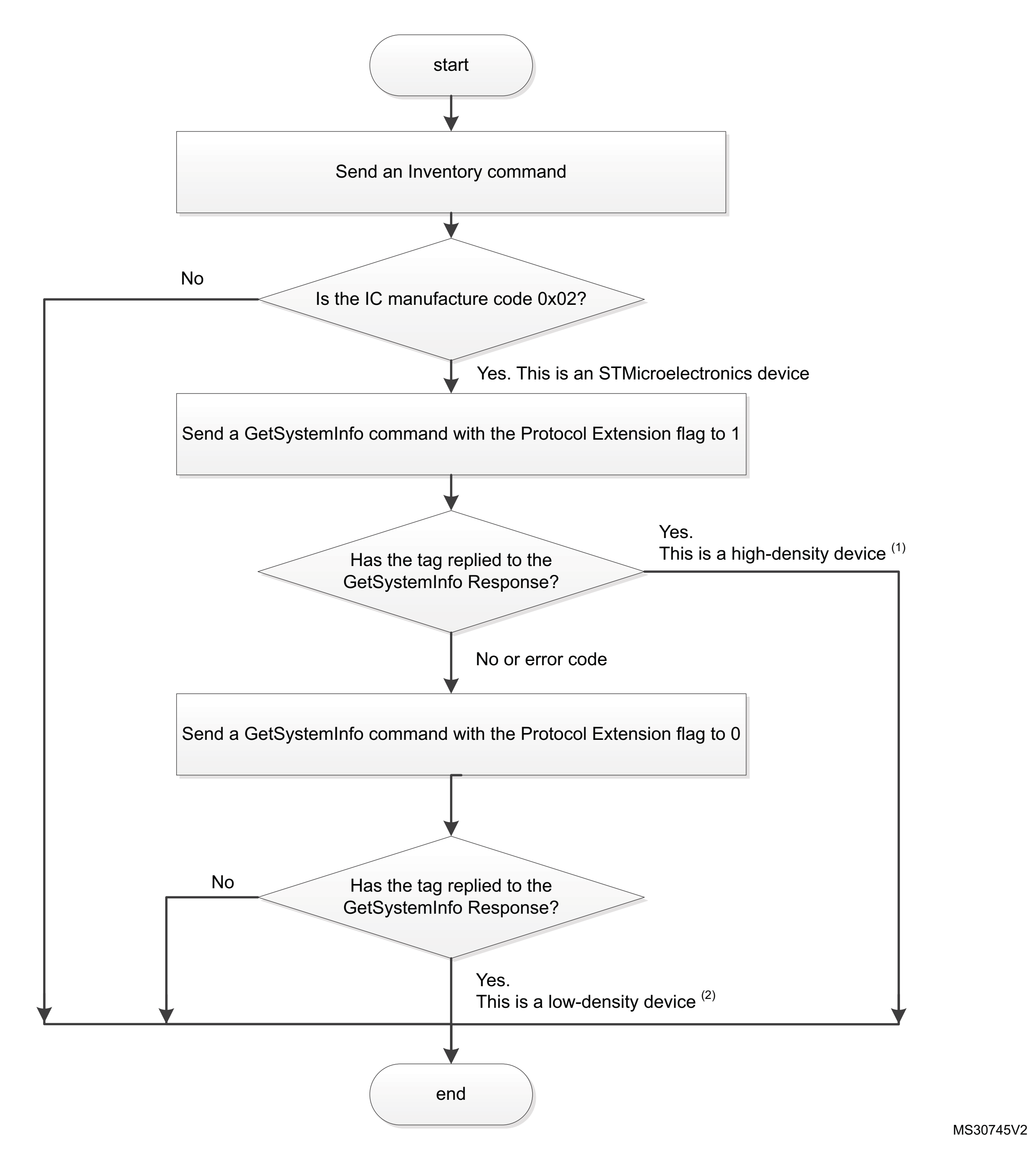
Product	LRI1k	LRI2k	LRis2K	LRiS64k	M24LR04-E-R	M24LR16-E-R	M24LR64E-R	M24LR64-R
Product code field	0b0100 00xx	0b0010 00xx	0b0010 10xx	0b0100 01xx	0b0101 11xx	0b0100 11xx	0b0101 11xx	0b0010 11xx

1.3.2 Using the GetSystemInfo command

Figure 1 is an example using the GetSystemInfo command to identify the STMicroelectronics ISO/IEC 15693 product:

1. Issue a GetSystemInfo with the Protocol Extension flag set to 1, and identify the STMicroelectronics product by analyzing the IC reference field, as defined in *Table 3*.
2. Issue a GetSystemInfo with the Protocol Extension flag set to 0.

Figure 1. Flow diagram



1. The RF host shall use the extended format for the addressing mode (see *Table 7*).
2. The RF host shall use the standard format for the addressing mode (see *Table 7*).

1.4 Memory mapping of ISO/IEC 15693 products

Table 6 lists the key parameters of the memory mapping of LRix and M24LRx devices.

Table 6. Memory mapping of LRix and M24LRx devices

Device	LRi1K	LRi2K	LRiS2K	LRiS64K	M24LR04E-R	M24LR16E-R	M24LR64x-R
Memory size	1 Kbit	2 Kbits	2 Kbits	64 Kbits	4 Kbits	16 Kbits	64 Kbits
Block size	32 bits	32 bits	32 bits	32 bits	32 bits	32 bits	32 bits
Number of blocks	0x1F	0x3F	0x3F	0x7FF	0x3F	0x1FF	0x7FF

The ISO/IEC 15693 specification defines the read or write command with a block number coded on 1 byte.

The high-density products of the ISO/IEC 15693 family require a block number coding on 2 bytes. It is the extended addressing mode.

Table 7 lists the ISO/IEC 15693 products and their addressing mode.

Table 7. Addressing mode of LRix and M24LRx devices

Device	LRi1K	LRi2K	LRiS2K	LRiS64K	M24LR04E-R	M24LR16E-R	M24LR64x-R
Addressing mode	standard	standard	standard	extended	standard	extended	extended

As an example, the next two tables define the write single block command for low- and high-density devices, and show the difference between the two density families.

Table 8 describes the format of the write single block RF command for low-density products. The block number parameter is coded on 8 bits or 1 byte.

Table 8. Write single block request format for low-density products

SOF	Request_ flags	Write single block	UID [(1)]	Block number	Data	CRC16	EOF
	8 bits	0x21	64 bits	8 bits	32 bits	16 bits	

1. Gray color means that the field is optional.

Table 9 is the write single block RF command for high-density products. The block number parameter is coded on 16 bits or 2 bytes.

Table 9. Write single block request format for high-density products

SOF	Request_ flags	Write single block	UID [(1)]	Block number	Data	CRC16	EOF
	8 bits	0x21	64 bits	16 bits	32 bits	16 bits	

1. Gray color means that the field is optional.

Table 10 lists all RF commands for:

- low-density products which require using 1 byte to define the block number parameter,
- high-density products which require using 2 bytes to define the block number parameter.

Table 10. RF command for low-density products using 1 byte and high-density products using 2 bytes

Number of bytes to code the block number of the following RF command	Low-density products	High-density products
Read single block	1 byte	2 bytes
Write single block	1 byte	2 bytes
Read multiple blocks	1 byte	2 bytes
Get multiple security blocks status	1 byte	2 bytes
Fast read single block	1 byte	2 bytes
Fast read multiple blocks	1 byte	2 bytes

1.5 Request_flags management

1.5.1 Request_flags description

Request_flags is the first byte of all RF commands and contains some information on the formats of the RF commands. The forth bit of this Request_flags is the Protocol Extension bit and it is used to define the number of bytes of the block number parameter.

For more information about the Request_flags, please refer to ISO/IEC 15693 STMicroelectronics product datasheet.

Table 11 shows an RF command frame for low-density products. The Protocol Extension flag is set to 0 for all RF commands. The block number is coded on 1 byte.

Table 11. RF command frame for low-density products

Block name	Request_flags								Command code	Data	Block number	Data
				0					1 byte	…	1 byte	…

Table 12 shows an RF read/write frame for high-density products. The Protocol Extension flag is set to 1 for read and write commands. In this case, the block number is coded on 2 bytes.

Table 12. RF command with block number parameter frame for high-density products

Block name	Request flags								Command code	Data	Block number	Data
				1					1 byte	…	2 bytes	…

1.5.2 Protocol Extension bit of Request_flags management

Table 13 describes the Protocol Extension bit of the Request_flags byte according to the product type.

Table 13. Request_flags functions according to the product types

Function	Low-density product	High-density product	
		LRiS64K, M24LR64x-R	M24LR16E-R
Read single block	0	1	1
Write single block	0	1	1
Read multiple blocks	0	1	1
Get system Info	0	1	-
Get multiple blocks security status	0	1	1
Lock sector [1]	0	1	1
Fast read single block	0	0	0
Fast read multiple blocks	0	0	0
Other commands	0	0	0

1. This command is not available for LRi1k, LRi2k and LRiS2k products.

Note: '0' means that the flag is reset.
'1' means that the flag is set.
'-' means that it shall be managed by the application.

Appendix A Acronym and notational conventions

A.1 List of acronyms

Table 14. List of acronyms

Acronym	Definition
EEPROM	Electrically-Erasable Programmable Read-Only Memory
EOF	End of frame
I^2C	Inter-integrated circuit
IC	Integrated circuit
IC ref	Integrated circuit reference
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission
LRi	Long range interface
M24LR64-R	Dual interface EEPROM (I^2C and RF) with 64 Kbits memory size
M24LR16-E	Dual interface EEPROM (I^2C and RF) with 16 Kbits memory size and energy harvesting feature
RF	Radio frequency
RFID	Radio frequency identification
SOF	Start of frame
UID	Unique identifier

A.2 Notational conventions

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

A.2.1 Binary number representation

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

Example: 0b11110101

A.2.2 Hexadecimal number representation

Hexadecimal numbers are represented by numbers 0 to 9, characters A - 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

A.2.3 Decimal number representation

Decimal numbers are represented as is, without any trailing character.

Example: 245

Revision history

Table 15. Document revision history

Date	Revision	Changes
02-Mar-2012	1	Initial release.
22-Oct-2012	2	Added *Section 1.3: How to identify the ISO/IEC 15693 products*.
23-Nov-2012	3	Updated *Figure 1: Flow diagram* and added 2 notes below.