Texas Instruments

Tag-it™ HF-I Standard Transponder Chip/Inlays

Commands and Options

Reference Guide

TI-RFid
A TEXAS INSTRUMENTS TECHNOLOGY

November 2005

SCBU002

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Literature Number: SCBU002
November 2005

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Read This First

Edition Three – November 2005

This is the third edition of this manual; it describes the Commands as well as additional features/options that can be used with the Tag-it HF-I Standard Transponder Chip/Inlays.

About This Guide

This guide describes the Commands that can be used with the Tag-it HF-I Standard Transponder Chip/Inlays as well as additional features/options that can be used with the Tag-it HF-I Standard Transponder Chip/Inlays. It is designed for use by TI partners who are engineers experienced with Radio Frequency Identification Devices (RFID) and software development and wants to integrate the extended commands and additional features of the Tag-it HF-I Standard Transponder Chip/Inlays into an own reader. This reference guide should be used in conjunction with the ISO15693 standard, which specifies the standard protocol, commands, and other parameters required to initialize communication between the transponder and the reader.

Conventions

Note: Indicates conditions that must be met or must be followed, to ensure proper functioning

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1 Tag-it™ HF-I Standard Transponder Chip/Inlays Implemented Commands

Table 1 shows the list of implemented commands and the corresponding request modes of these commands as implemented in TI's ISO/IEC15693 compliant Tag-it HF-I Standard Transponder Chip/Inlays. The request mode defines the set of transponders that shall answer to the request.

The syntax of the ISO defined commands can be found in the ISO/IEC 15693-3.

Table 1. Tag-it HF-I Standard Transponder Chip/Inlays Implemented Commands

REQUEST		REQUEST MODE(1)				
	REQUEST CODE	INVENTORY	ADDRESSED	NON-ADDRESSED	AFI	OPT. FLAG
ISO 15693 Mandatory and Optional Commands						
Inventory	0x01	ü	–	–	ü	0/–
Stay Quiet	0x02	–	ü	–	–	0/–
Read_Single_Block	0x20	–	ü	ü	–	–/1
Write_Single_Block	0x21	–	ü	ü	–	–/1
Lock_Block	0x22	–	ü	ü	–	–/1

(1) ü = Implemented, – = Not applicable

2 Factory Lock Bit

How to program the User Lock bit of a block is described in ISO/IEC 15693-3.

For TI's Tag-it HF-I standard transponder chip/inlays a second bit per block is designated for the Factory Lock capability of every block, so that every block of the transponder's memory can be factory locked during production.

Bit 2 of the Block Security Status byte, defined in ISO/IEC 15693-3, is used to store the Factory Lock Status of the blocks.

Table 2. Lock Bit Definition

BLOCK SECURITY STATUS BYTE (ISO/IEC 15693-3)				
BIT NO.	FLAG NAME	STATE	DESCRIPTION	
1	User lock bit	0	Not user locked	ISO
		1	User locked	ISO
2	Factory lock bit	0	Not factory locked	TI
		1	Factory locked	TI
3–8	RFU	0	Set to 0	ISO

3 Memory Architecture

The physical memory structure is byte oriented and is organized in blocks of fixed size (see Figure 1).

3.1 User Memory

The available user memory size is 8 blocks of 32 bits each (Block 0x00 to 0x07). This results in a capacity of 256 Bits available user memory.

3.2 Additional Blocks

- Two blocks (Block address 0x08 and 0x09) for the 64 bits unique identification code (UID), programmed and factory locked at IC manufacturing.
- One block (Block address 0x0A) 32 bits which includes the 8 bits Application Family Identifier (AFI) in the LSB.

Each user block has two Lock Bits for Factory Lock (FLB) and User Lock (ULB) function, allowing individual block locking.

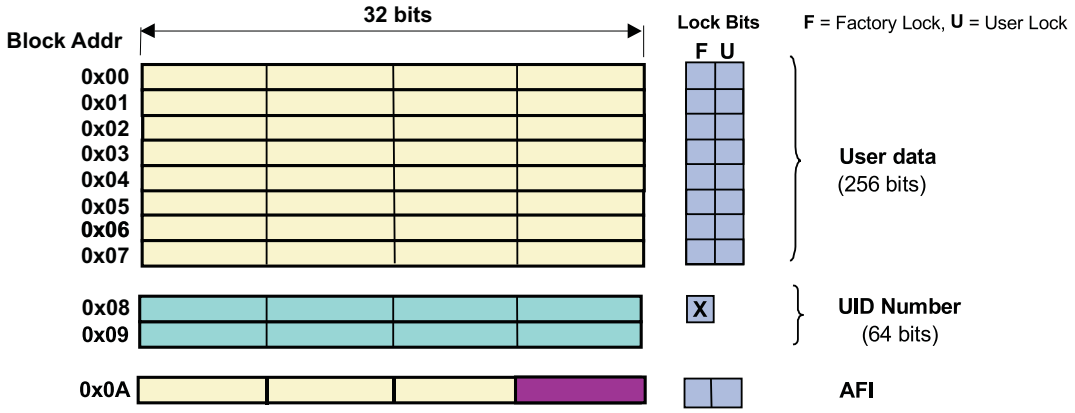

Figure 1. Tag-it HF-I Standard Memory Structure

4 UID Coding

The UID is programmed at wafer probe test. The coding of the UID is different for the individual product configurations.

Table 3. UID Numbering Scheme

UID CODING					
b63 … b56	**b55 … b48**	**b47 … b41**(1)	**b40 … b21**	**b20 … b16**	**b15 … b0**
E0	07	b'xxxx nnn	TI Internal Numbering		

(1) xxxx := 4 bit product ID and nnn := 3 bit product config

Table 4. UID Coding

PRODUCT VERSION	PRODUCT ID/CONFIG
Tag-it HF-I Plus Inlay	b'0000 000
Tag-it HF-I Plus Chip	b'1000 000
Tag-it HF-I Standard Chip / Inlays	b'1100 000
Tag-it HF-I Pro Chip / Inlays	b'1100 010

5 Fast Simultaneous Identification (FastSID)

To differentiate between the ISO/IEC15693 defined Inventory mode and the TI defined Inventory mode, the term FastSID will be introduced.

FastSID defines TI's patented "Fast Simultaneous IDENTIFICATION" concept.

The main advantages of the FastSID concept are:

The "Quiet" command will be transmitted within the time slot where the Transponder responds and not at the end of the Inventory cycle.

Instead of sending the 64-bit UID to address and set the Transponder "Quiet" (plus command and frame overhead), only 16-bits will be sent to the Transponder. The 16 bit represents the calculated CRC of the data of the last Response (without SOF/EOF) all tags having the same sub-address (4bit) but different CRC will not be set "Quiet".

Based on the system timing definition in ISO/IEC15693 the concept is fully ISO/IEC15693 compliant. If a mixed population of Transponders is used in Inventory mode (with Transponders which do not support FastID) the concept does not interfere with the executed Inventory process.

The advantage of this concept is a higher detection speed for the inventory mode executed in FastSID mode.

The FastSID mode can be seen as an extension of the "Inventory Command" to improve the system performance.

The execution of the FastSID will be controlled by the Reader. All Request and Response Formats as already defined in "Inventory Command" as well as the defined timings will be used for the execution of the FastSID. The additional information transmitted within the timeslots can only be interpreted by TI's Tag-it HF-I Standard Transponder Chip/Inlays, but does not interfere Transponders of other manufacturer’s in the field. It is possible for the reader, based on the received manufacturer's code (part of the UID), to decide "on the Fly" whether FastSID is applicable (Tag-it HF-I Standard) or not.

Note: The concept is designed to be used in the 1 out of 4 mode. The use in 1 out of 256 mode is possible but not ISO compliant because of the defined system timings in ISO/IEC15693.

To keep the ISO compatibility in both modes, 1 out of 4 and 1 out of 256, the 16 bit response shall always be send in 1 out of 4 mode.

The concept of the Fast SID is based on the Pulse Slotted concept as defined in ISO/IEC15693 with the following modifications:

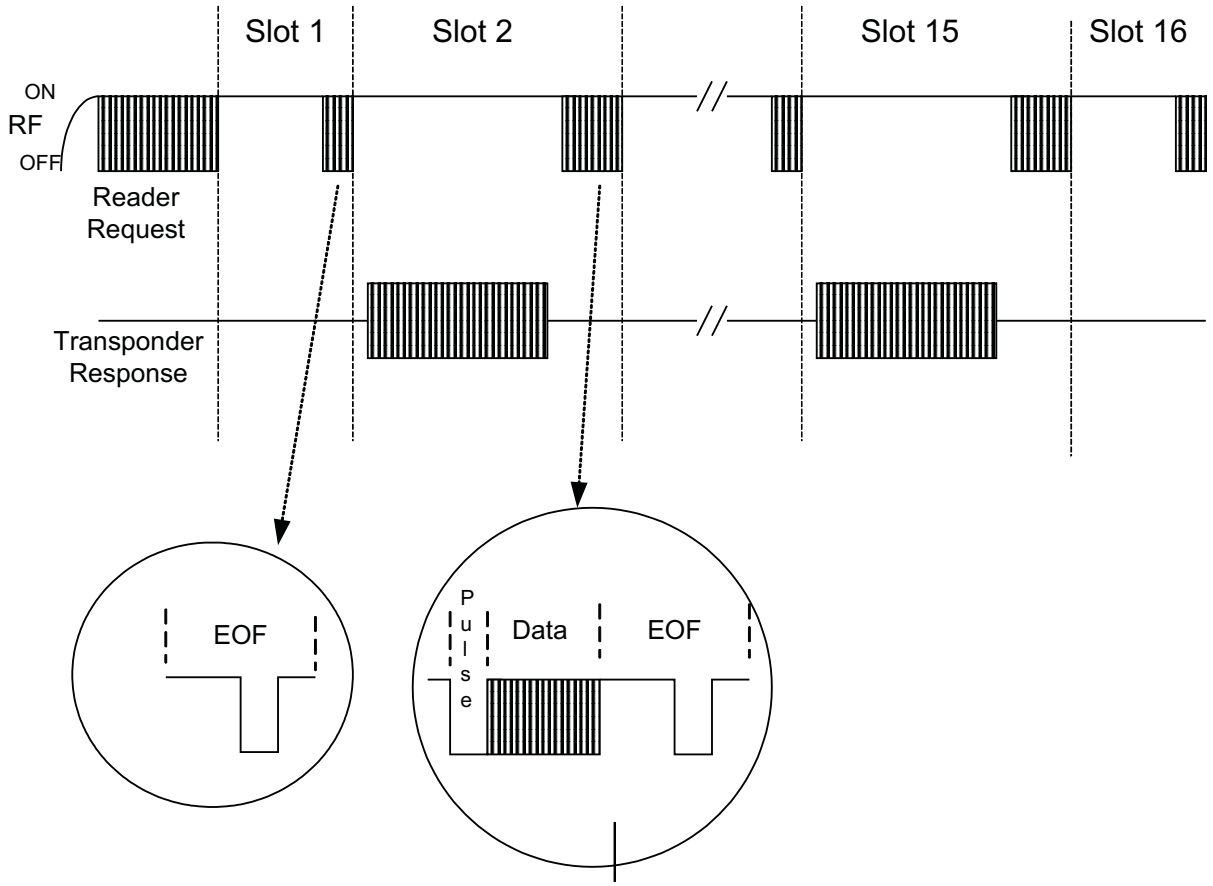

Figure 2. FastSID Mode Concept

- The Quiet command for a Transponder will not be addressed at the end of the Inventory cycle. Instead, a 16-bit request will be sent to the Transponder within the response time slot, which will be interpreted by the Transponder as a "Quiet" Request.
- If a valid Transponder response was received within a time slot the Reader will send within the slot and after the validated response a:
  - "SID_Pulse" followed by
  - the 16 bit CRC of the tag's response followed by an
  - EOF to switch to the next time slot.

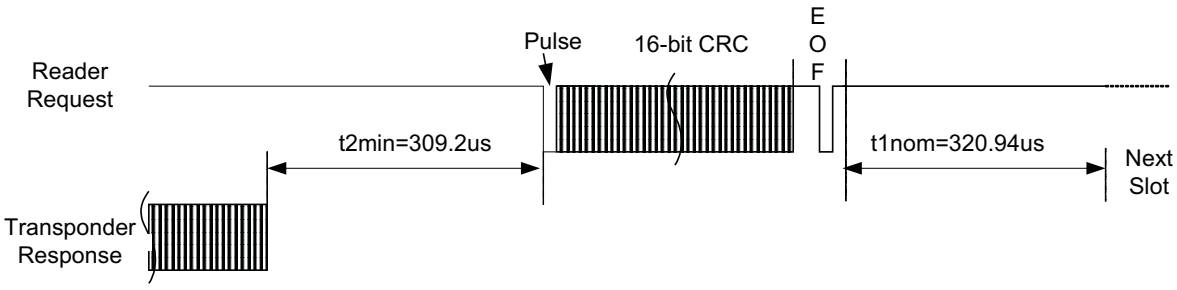

Figure 3. FastSID Mode Details

6 Transponder to Reader Interruption Conditions

The conditions for the Transponder to Reader response interruption are:

The Transponder to Reader communication can be interrupted any time with 100% modulated EOF.

If in Inventory mode the responding tag shall interrupt the response transmission if the reader applies a 100% modulated EOF. The same EOF is used by all transponders in the field as the EOF to switch to the next inventory slot.

7 Error Codes and Priorities

Additional to the implementation of the commands and error code definitions as described in the ISO/IEC 15693 Standard, general error conditions and command specific error conditions are defined. The response and error codes are defined in Table 5: General error conditions and Table 6: Command specific error conditions. General error conditions have higher priority than command specific error codes.

Table 5. General Error Conditions

ERROR CONDITION	RESPONSE ERROR CODE
CRC Mismatch	No response
Protocol Extension_Flag = 1	No response
Select_Flag = 1	No response
RFU Flag = 1	No response
Address_Flag = 1 and UID mismatch	No response
Command is not supported	No response
Format Error (i.e., wrong number of bits)	No response
Command Option_Flag not supported (Except for Inventory and Stay Quiet command)	03

Table 6. Command-Specific Error Conditions

COMMAND	ERROR CONDITION	RESPONSE ERROR CODE
Inventory	AFI Flag = 1 and AFI not match	No response
	Command Option Flag not supported	
	Invalid mask length or mask value	
Read Single Block	Invalid block address	10
	No read access	B0
Write Single Block	Invalid block address	10
	Block already locked	12
	Block not successfully programmed	13
Lock Block	Invalid block address	10
	Block already locked	11
	Block not successfully locked	14

Appendix A Terms and Abbreviations

A list of the abbreviations and terms used in the various TI manuals can be found in a separate manual:

TI-RFid™ Product Manual Terms & Abbreviations

Literature number SCBU014 (11-03-21-002)

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