

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

## Commands and Options

# Reference Guide



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<b>Preface</b> .....	<b>5</b>
<b>1 Tag-it™ HF-I Standard Transponder Chip/Inlays Implemented Commands</b> .....	<b>7</b>
<b>2 Memory Architecture</b> .....	<b>7</b>
2.1 User Memory .....	7
2.2 Additional Blocks .....	7
<b>3 UID Coding</b> .....	<b>8</b>
<b>4 Fast Simultaneous Identification (FastSID)</b> .....	<b>8</b>
<b>5 Transponder to Reader Interruption Conditions</b> .....	<b>10</b>
<b>6 Error Codes and Priorities</b> .....	<b>10</b>
<b>Appendix A Terms and Abbreviations</b> .....	<b>10</b>

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## List of Figures

1	Tag-it HF-I Standard Memory Structure .....	7
2	FastSID Mode Concept .....	9
3	FastSID Mode Details .....	9

## List of Tables

1	Tag-it HF-I Standard Transponder Chip/Inlays Implemented Commands .....	7
2	UID Numbering Scheme .....	8
3	UID Coding .....	8
4	General Error Conditions .....	10
5	Command-Specific Error Conditions .....	10

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## ***Read This First***

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### **Edition Four – September 2011**

This is the fourth edition of this manual; it describes the commands and 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 and 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 who want to integrate the extended commands and additional features of the Tag-it HF-I standard transponder chip/inlays into a 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**

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**NOTE:** Notes indicate 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 commands and the corresponding request modes of these commands as implemented in TI's ISO/IEC 15693 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 ISO/IEC 15693-3.

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

REQUEST	REQUEST CODE	REQUEST MODE <sup>(1)</sup>				
		INVENTORY	ADDRESSED	NON-ADDRESSED	AFI	OPTIONAL FLAG
<b>ISO 15693 Mandatory and Optional Commands</b>						
Inventory	0x01	✓	–	–	✓	0/–
Stay Quiet	0x02	–	✓	–	–	0/–
Read_Single_Block	0x20	–	✓	✓	–	–/1
Write_Single_Block	0x21	–	✓	✓	–	–/1
Lock_Block	0x22	–	✓	✓	–	–/1

<sup>(1)</sup> ✓ = Implemented, – = Not applicable

## 2 Memory Architecture

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

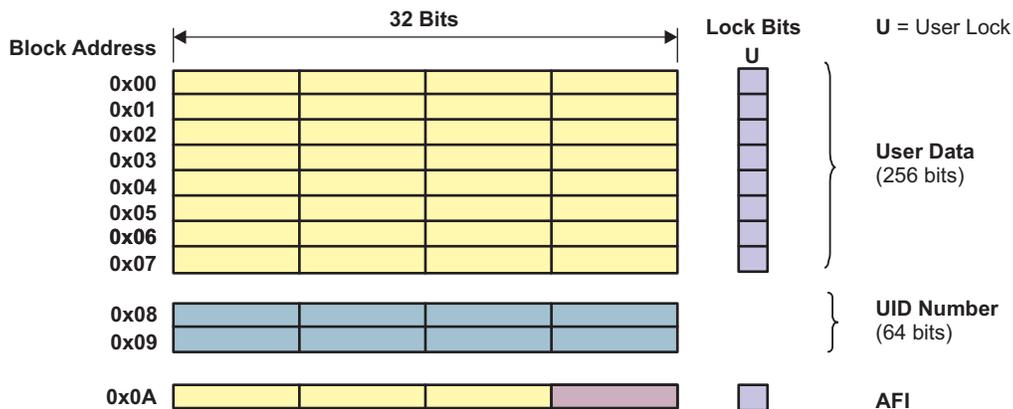
### 2.1 User Memory

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

### 2.2 Additional Blocks

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

Each user block has a lock function, allowing individual block locking.



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

### 3 UID Coding

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

**Table 2. UID Numbering Scheme**

UID CODING					
b63 ... b56	b55 ... b48	b47 ... b41	b40 ... b21	b20 ... b16	b15 ... b0
E0	07	b'xxxx nnn <sup>(1)</sup>	TI internal numbering		

<sup>(1)</sup> xxxx = 4-bit product ID, nnn = 3-bit product configuration

**Table 3. 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

### 4 Fast Simultaneous Identification (FastSID)

To differentiate between the ISO/IEC15693-defined Inventory mode and the TI-defined Inventory mode, the term FastSID is used. FastSID refers to TI's patented "Fast Simultaneous IDENTIFICATION" concept.

The main advantages of FastSID are:

The "Quiet" command is 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 that do not support FastSID) 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 is controlled by the Reader. All Request and Response Formats that are defined in "Inventory Command", as well as the defined timings, are 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 manufacturers 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 or not FastSID is applicable; that is, whether or not each transponder is Tag-it HF-I Standard.

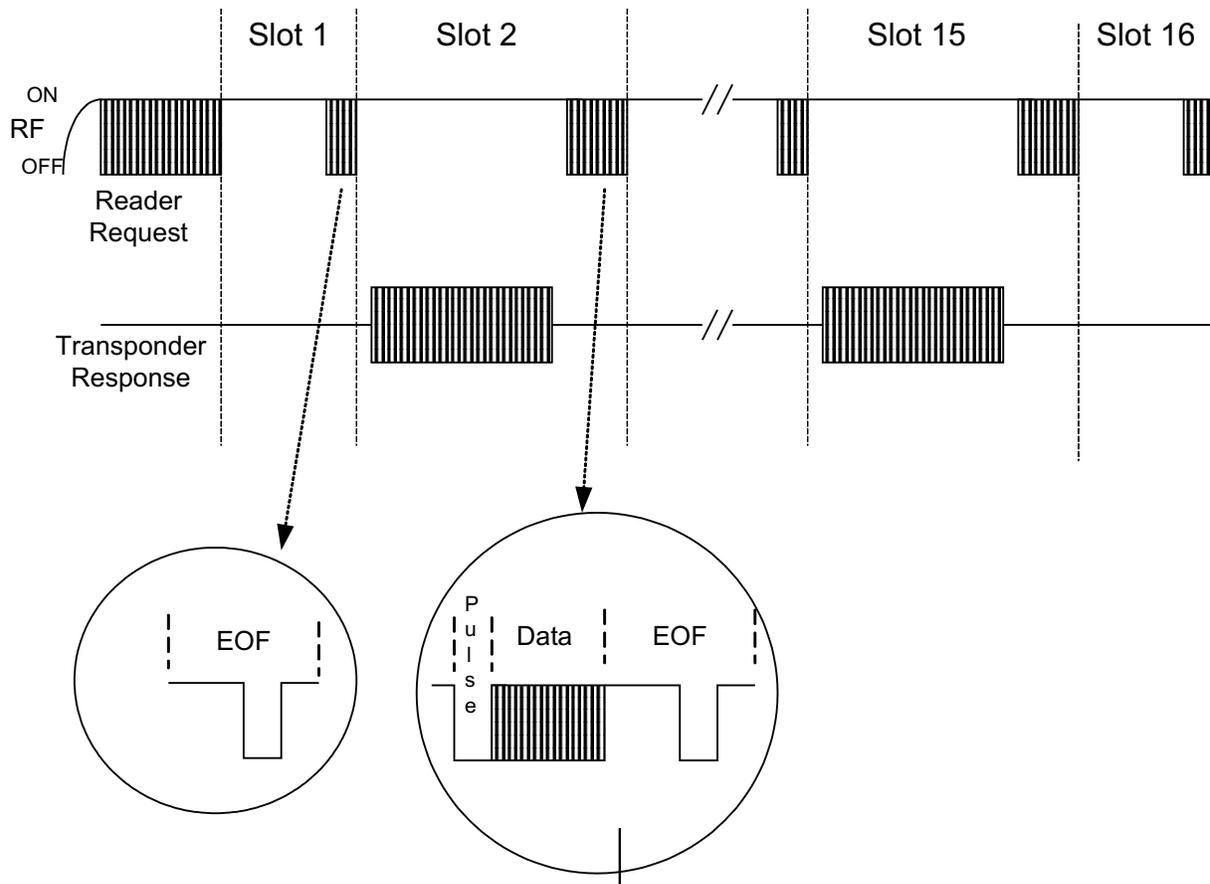
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**NOTE:** FastSID is designed to be used in the 1 out of 4 mode. The use in 1 out of 256 mode is possible but not ISO compliant because of the defined system timings in ISO/IEC15693.

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

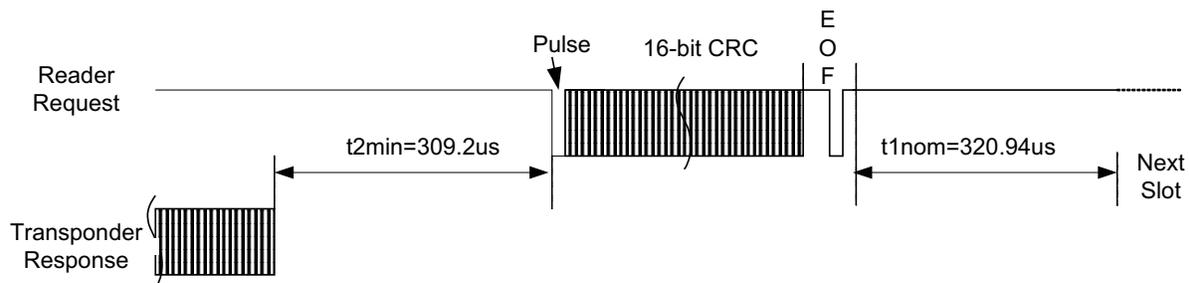
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FastSID is based on the Pulse Slotted concept as defined in ISO/IEC15693 with the following modifications:



**Figure 2. FastSID Mode Concept**

- The Quiet command for a Transponder is not addressed at the end of the Inventory cycle. Instead, a 16-bit request is sent to the Transponder within the response time slot, which is interpreted by the Transponder as a "Quiet" Request.
- If a valid Transponder response is received within a time slot, in the same time slot and after the validated response, the Reader sends:
  1. SID\_Pulse
  2. 16-bit CRC of the tag's response
  3. EOF to switch to the next time slot



**Figure 3. FastSID Mode Details**

## 5 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 interrupts 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.

## 6 Error Codes and Priorities

In addition to the implementation of the commands and the error code definitions that are described in ISO/IEC 15693, general error conditions and command-specific error conditions are defined. The response and error codes are shown in [Table 4 General Error Conditions](#) and [Table 5 Command-Specific Error Conditions](#). General error conditions have higher priority than command-specific error codes.

**Table 4. 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 (wrong number of bits)	No response
Command Option_Flag not supported (except for Inventory and Stay Quiet commands)	03

**Table 5. 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* ([SCBU014](#)) (11-03-21-002)

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