

# USING SKYETEK PROTOCOL V2 HF TAG COMMANDS

VERSION 042213



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## 1 About this Document

This Application Note describes how the SkyeTek Protocol is used to communicate with RFID tags, transponders, and smart labels at 13.56 MHz (HF).

Read the [SkyeTek Protocol V2 Guide](#) document before using this Application Note (*Using SkyeTek Protocol V2 HF Tag Commands*).

### 1.1 Revision History

Revision	Author	Change
100112	Ryan Smith	Changed Formatting, Added command examples.
042213	Josh Peifer	Fixed error in inventory command example

Table 1-1: Revision History

## 2 Definition of Terms

3DES	Triple Data Encryption Standard
AES	Advanced Encryption Standard
API	Application Programming Interface
DES	Data Encryption Standard
GPIO	General Purpose Input/Output
HID	Human Interface Device
HMAC	Hash-based message authentication code
I <sup>2</sup> C	Inter-integrated Circuit
LSB	Least Significant Bit
MD5	Message-Digest Algorithm
MSB	Most Significant Bit
NC	No Connect
PRNG	Pseudo-Random Number Generator
RoHS	Reduction of Hazardous Substances
SHA	Secure Hash Algorithm
SPI	Serial Programming Interface
SSEL	Slave Select
STP V3	SkyeTek Protocol Version 3
TTL	Transistor-transistor Logic



## 3 Tag Commands

### 3.1 Select Tag

The Select Tag command gets the unique Tag ID (TID) of the tag(s) present in the reader's field. By setting different flag bits, different modes of operation can be selected, such as "Loop Mode," "Anti-Collision," etc.

#### Loop Mode

SkyeTek RFID readers operate under host control or in stand-alone mode - "Loop Mode"

LOOP\_F is only relevant for Select Tag Commands.

LOOP\_F = 0 The reader will execute the Select Tag command one time only. The reader will send a pass or fail Response.

Loop\_F = 1 The reader will enter "Loop Mode" and respond with Response Code 0x1C to indicate "Loop Mode activated." Upon entering Loop Mode, the reader will begin to continuously seek for a valid tag. During Loop Mode, the reader will not send any Response if no tag is detected. The reader will only give a response if a tag is successfully detected. Since the commands are executed very rapidly within the reader, a continuous stream of responses from the reader can be expected when tag(s) are successfully detected.

Note: for any command besides Select Tag, the Response will be 0x82 to indicate "Flags don't match command."

#### Anti-Collision

SkyeTek RFID readers allow identification, reading, and writing of multiple RFID tags simultaneously. RF\_F, INV\_F, and LOOP\_F control how the reader handles Tag Commands.

INV\_F is only relevant in a Select Tag command Request.

INV\_F=0 the reader will identify and respond with only the first Tag ID that is detected, even if more than one is present; the reader will not inventory all the tags that are activated within the reader's antenna field.

INV\_F=1 the reader will inventory all tags that are activated within the reader's antenna field. The Tag ID for each tag detected will be reported to the host as a separate Response.

The reader sends a "Stay Quiet" command to each tag identified. For LOOP\_F=0 and RF\_F=0, the "Stay Quiet" command is of no consequence. For LOOP\_F=1 or RF\_F=1, the "Stay Quiet" command will cause each tag that enters the field to stay quiet after identification (so they don't interfere with new tags entering the field) until the RF field is turned off.

For many applications, optimal performance of the anti-collision feature is seen when INV\_F=1, RF\_F=1 and LOOP\_F=1 in the Select Tag Request.



## The “Selected State”

All tag types supported by SkyeModule RFID readers have a unique Tag ID (TID). Most tag types supported by SkyeModule RFID readers have what is called a “Selected State.” When several successive Read / Write operations are expected to target a single tag, then the Selected State can speed transaction time by eliminating need for sending the TID along with each Read and/or Write request.

A tag remains in the Selected State until a different tag is put into the Selected State, or until the tag leaves the field (loses power). Make sure to use the RF\_F=1 when using the Selected State because the tag will exit the Selected State after when RF power is removed (i.e. at the end of a command with RF\_F=0).

With the SkyeTek Protocol, use the Select Tag command with TID\_F=1 and the RF\_F = 1 in order to put a specific tag into the Selected State. The Request must also contain the Tag ID of the tag that needs to be put in the Selected State.

### 3.2 Read Tag

This command is used for Reading Single/Multiple blocks of data from the Tag Memory. In order to perform a read operation, the Tag ID must be provided in the request, or else the tag should be in the Selected State.

### 3.3 Write Tag

This command is used for Writing Single/Multiple blocks of data to the Tag Memory. In order to perform a write operation, the Tag ID must be provided in the request, or the tag should have been put in the Selected State.

### 3.4 Lock Tag

Lock tag is done using the Write Tag command with the Lock Flag (LOCK\_F) set. There should be no data sent when locking a tag, only the address and number of blocks to lock. This is used for locking the tag blocks to prevent changing the data present in those blocks. The blocks can still be read after they have been locked, but cannot be written to.



## 4 Command Examples

### 4.1 Get the Tag ID of a Single Tag Present in the Reader Field

Use the Select Tag command (Command Byte = 0x14) with INV\_F=0 in order to obtain the Tag ID of a single tag present in the reader field. This option is used in applications with only one tag in the field at any given time, or in applications that should ignore the situation when there is more than one tag in the field simultaneously.

#### 4.1.1 Get the TID of Any Tag in the Field (Auto-Detect)

The tag type in the request is Auto-Detect. The response received gives the tag type immediately following the Response code and is followed by the Tag ID.

##### ASCII Mode

Request:

	Flags	Command	Tag Type	
<CR>	00	14	00	<CR>

Send the Select Tag command with the tag type set to Auto-Detect, for example 00.

Response :

	Response Code	Tag Type	Data (TID)	
<LF>	14	01	E00401500570A910	<CR><LF>

In this example, a tag of type ISO15693 is detected.

##### Binary Mode

Request:

	Message Length	Flags	Command	Tag Type	CRC
<STX>	0x05	0x20	0x14	0x00	0x8E14

Response:

	Message Length	Response Code	Tag Type	Data (TID)	CRC
<STX>	0x0C	0x14	0x0C	0xE00401500570A910	0x4D59

In this example, a tag of type ISO15693 is detected.



#### 4.1.2 Get the Unique TID of a Specific Type of Tag

The request is similar to the previous example, except in this case the tag type is set to 01, namely or ISO15693 instead of Auto-Detect.

Since the tag type is already known, the response does not contain the Tag Type field.

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	
<CR>	00	14	01	<CR>

The Tag Type field is set to 01, for example, the reader must detect a tag of type ISO15693.

Response:

	Response Code	Data (TID)	
<LF>	14	E00401500570A910	<CR><LF>

##### Example 2: Binary Mode

Request:

	Message Length	Flags	Command	Tag Type	CRC
<STX>	0x05	0x20	0x14	0x01	0x8E14

The Tag Type field is set to 01, for example, the reader must detect a tag of type ISO-15693.

Response:

	Message Length	Response Code	Data (TID)	CRC
<STX>	0x0B	0x14	0xE00401500570A910	0x5D04

## 4.2 Get the Tag ID(s) of All Tags Present in the Reader Field

Use the Select Tag command with INV\_F=1 in order to obtain the Tag IDs of every tag present in the reader field. This option used in applications with multiple tags in the field simultaneously. This option activates the “anti-collision sequence” of the specified tag type.

Due to their multi-protocol support, all SkyeModule RFID readers can be installed in applications where tags of different types are used within the same system. During a Select Tag command, the host can specify the Tag Type as Auto-Detect. In this case, the reader will be able to get the TID for any or all tags near the reader.





#### 4.2.1 Get the IDs of All the Tags in the Field

As the Request had the Tag Type set to Auto-Detect, the response contains the Tag Type along with the Tag IDs. When there are no more tags in the field to detect, the reader responds with response code 94. Note that this case is for LOOP\_F=0.

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	
<CR>	02	14	00	<CR>

Note that the Inventory flag is set, for example, INV\_F = 1.

Response:

	Response Code	Tag Type	Data (TID)	
<LF>	14	01	E007000001645E37	<CR><LF>
<LF>	14	01	E007000001546531	<CR><LF>
<LF>	14	01	E007000001544132	<CR><LF>
<LF>	14	02	0100000033B1DF8E	<CR><LF>
<LF>	14	02	01000000025DCAD2	<CR><LF>

This shows that multiple tags of type ISO-15693 and I-Code SL1 are detected.

<LF>	94	<CR><LF>
------	----	----------

Last response indicates that no more tags are detected.



#### 4.2.2 Get the Tag ID(s) of All the Tags of a Specific Type in the Field

The Request has the Tag Type set to a particular type and not Auto-Detect. In this case, the reader will respond with the Tag IDs of only the type specified that are present in the field. When there are no more tags in the field to detect, the reader responds with response code 94. Note this case if for LOOP\_F=0.

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	
<CR>	02	14	01	<CR>

The Tag Type field is set to 01, for example, the reader must detect a tag of type ISO-15693.

Response:

	Response Code	Data (TID)	
<LF>	14	E0 07 00 00 01 64 5E 37	<CR><LF>
<LF>	14	E0 07 00 00 01 54 65 31	<CR><LF>
<LF>	14	E0 07 00 00 01 54 41 32	<CR><LF>
<LF>	94		<CR><LF>

Last response indicates that no more tags were detected.



### 4.3 Get the TID of a (Single) Tag in the Field Continuously

In this case, the Loop Flag is set in the Request, for example LOOP\_F = 1. When the loop flag is set in a Request, the reader will respond with 1C as the Response code to indicate that Loop Mode has been activated. After that, the reader will send a response every time it successfully detects a tag.

#### 4.3.1 Get the TID of any tag present in the field continuously

In this case, the Tag Type is Auto-Detect with the loop flag set and not in inventory mode, for example, INV\_F = 0 and LOOP\_F = 1. The Tag ID of any tag and of any type detected by the reader is sent to the host.

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	
<CR>	01	14	00	<CR>

Response:

	Response Code	
<LF>	1C	<CR><LF>

This response indicates that Loop mode has been activated.

	Response Code	Tag Type	Data (TID)	
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>

As soon as a tag (type ISO-15693) is introduced into the reader's field, it is detected and the reader continues to send its ID to the host as long as the tag is in the field. If another tag is detected, then the ID of that tag is sent.

<LF>	14	02	01 00 00 00 02 D5 C2 AD	<CR><LF>
<LF>	14	02	01 00 00 00 02 D5 C2 AD	<CR><LF>

This shows that a new tag of type I-Code SL1 is detected. Now the I-Code SL1 tag leaves and a new tag enters the field again.

<LF>	14	0A	04 A6 8D 11 12 7A 00	<CR><LF>
<LF>	14	0A	04 A6 8D 11 12 7A 00	<CR><LF>

This shows that a Mifare Ultralight tag is detected.

In order to cancel or de-activate Loop mode, the host must send one or more bytes to the reader.



Request:

	Flags	Command	Tag Type	
<CR>	00	14	00	<CR>

Response:

	Response Code	
<LF>	9C	<CR><LF>

The command that is sent is discarded and the reader exits loop mode, which is indicated by the 9C response code.

#### 4.3.2 Get the TID of a Single Tag of a Specific Type Present in the Field Continuously

In this case again, the loop flag is set and the Tag Type is set to a particular type and not Auto-Detect.

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	
<CR>	01	14	01	<CR>

The tag type has been set to ISO-15693.

Response:

	Response Code	
<LF>	1C	<CR><LF>

This response indicates that Loop mode has been activated.

	Response Code	Tag Type	Data (TID)	
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>

As soon as a tag is introduced into the reader's field, it is detected and the reader continues to send its ID to the host as long as the tag is in the field. Once the tag leaves the field, the reader stops sending responses.

If another tag is detected, then the ID of that tag will be sent.

<LF>	14	01	E0 07 00 00 01 6A D1 0E	<CR><LF>
<LF>	14	01	E0 07 00 00 01 6A D1 0E	<CR><LF>

This shows that a new ISO-15693 tag is detected.



In order to cancel or de-activate Loop mode, the host must send one or more bytes to the reader.

Request:

	Flags	Command	Tag Type	
<CR>	00	14	01	<CR>

Response:

	Response Code	
<LF>	9C	<CR><LF>

The command that is sent is discarded and the reader exits loop mode which is indicated by the 9C response code.

#### 4.4 Get the Tag IDs of all the tags in the field continuously

In this example the loop and inventory flags are both set in the Request, for example, INV\_F = 1 and LOOP\_F = 1. When the loop flag is set in the Request, the reader responds with 1C as the response code to indicate that Loop Mode has been activated.

For every Tag detected, the Reader responds only once with the Tag ID so long as the tags are in the field. If a tag leaves the field and comes back, the reader responds again with its Tag ID.

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	
<CR>	03	14	00	<CR>

The tag type has been set to Auto-Detect.

Response:

	Response Code	
<LF>	1C	<CR><LF>

When a tag enters the reader's field, its ID is reported once.

	Response Code	Tag Type	Data (TID)	
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>
<LF>	14	01	E0 07 00 00 01 6A 3D 21	<CR><LF>

Two tags of type ISO-15693 were detected. When a new tag enters the reader's field, its ID is reported once. There are two new tags, for example, four tags in the field.



	Response Code	Tag Type	Data (TID)	
<LF>	14	02	01 00 00 00 05 CA 5D E2	<CR><LF>
<LF>	14	03	01 32 1F A7	<CR><LF>

As new tags enter the field, their IDs are reported back to the host. If a tag leaves the field and is brought back, then its ID is reported once

	Response Code	Tag Type	Data (TID)	
<LF>	14	01	E0 07 00 00 01 64 5E 37	<CR><LF>

In order to cancel or de-activate this mode, the host must send one or more bytes to the reader.

Request:

	Flags	Command	Tag Type	
<CR>	00	14	00	<CR>

Response:

	Response Code	
<LF>	9C	<CR><LF>

The command that is sent is discarded, and the reader exits loop mode which is indicated by the 9C response code.

#### 4.5 Putting a tag into “Selected State”

In this example a tag is put into the “Selected State,” to eliminate the need to send the Tag ID along with each subsequent Read/Write request. This can be done by sending a Select Tag command with TID\_F=1 and the specific tag’s ID in the TID field. If the ID provided by the host matches the ID of the tag in the field, then the reader responds with the Select Tag Passed response code 14 or it returns a Select Tag Failed response code 94.

To prevent a tag from losing power and leaving the Selected State make sure that the RF field is left On, for example, RF\_F=1.

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	TID	
<CR>	48	14	01	E0040150056FC5C6	<CR>

Response:

	Response Code	
<LF>	14	<CR><LF>

The response 14 indicates that the tag has been put into the selected state.



## 4.6 Reading a tags memory

After the previous command the tag is in the selected state. The RF flag keeps the carrier frequency on and power to the tag so for subsequent commands we need not include the TID flag or field. Now a tags memory is read starting at block 0.

### 4.6.1 Reading a single block of data

#### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	Starting Block	Num of Blocks	
<CR>	08	24	01	00	01	<CR>

Response:

	Response Code	Data	
<LF>	24	00000000	<CR><LF>

The tag responds with the command code indicating a success followed by the block of data requested.

### 4.6.2 Reading multiple blocks of data

#### Example 2: ASCII Mode

Request:

	Flags	Command	Tag Type	Starting Block	Num of Blocks	
<CR>	08	24	01	00	02	<CR>

Response:

	Response Code	Data	
<LF>	24	0000000000000000	<CR><LF>

In this example two blocks of data have been read and the results returned. Notice that a single block of data for an ISO15693 tag corresponds to 4 bytes. The number of bytes of data per block varies with tag however SkyeProtocol V2 handles this number for you returning the whole block of data.

## 4.7 Writing to a tags memory

The previous read command returned 0's in the first block of data indicating that no information has been written to the tag yet. We can write data to this block assuming that the block has not been locked. The following example writes one block of data to the tags memory starting at address 0x00.



#### 4.7.1 Writing a single block of data

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	Start Block	Num Blocks	Data	
<CR>	08	44	01	00	01	11223344	<CR>

Response:

	Response Code	
<LF>	44	<CR><LF>

The tag responds with the command code indicating a success. Reading block 0x00 of the tag now shows '11223344' instead of the '00000000' previously read.

#### 4.7.2 Writing multiple blocks of data

##### Example 1: ASCII Mode

Request:

	Flags	Command	Tag Type	Start Block	Num Blocks	Data	
<CR>	08	44	01	00	02	1122334455667788	<CR>

Response:

	Response Code	
<LF>	44	<CR><LF>

The tag responds with the command code indicating a success. Block 1 now contains '11223344' and block 2 contains '55667788'.

## 4.8 Locking a section of memory

After writing some data to a tag it may be desirable to write protect this data so that it cannot be changed intentionally or by accident. If a tag supports this functionality a block can be locked by initiating a write command on the tag while having the lock flag set. No data should be passed to the tag during the lock function as it will be discarded. The following example shows how to lock 1 block of memory at address 0x00.





**Example 1: ASCII Mode**

Request:

	Flags	Command	Tag Type	Start Block	Num Blocks	
<CR>	0C	44	01	00	01	<CR>

Response:

	Response Code	
<LF>	44	<CR><LF>

The tag responds with the command code indicating a success. Reading block 0x00 of the tag still shows '11223344' however further attempts to write to block 0 will result in error C4.

