HF Reader System Series 6000

S6500/S6550 Configuration and Host Protocol

Reference Guide

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Edition Two – April 2002

This is the second edition of this manual. It describes the S6500/S6550 Configuration and Host Protocol (Firmware version 03-10).

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Read This First

About This Manual

This reference guide describes the **configuration and control commands** to adapt the S6500/S6550 Long Range Reader to the application requirements and the **Reader/Host Protocol** (ISO Protocol). It is designed for use by TI partners who are engineers experienced with Radio Frequency Identification Devices (RFID) and software development.

Numerical Representations

The following figure formats are used:

0...9:	decimal figures
0x00...0xFF:	hexadecimal figures
b0...1	binary figures

Hexadecimal values in brackets "[ ]" mark a control byte (command).

If bits within one byte contain the character "-", this means that these bits are reserved for future extensions or for internal testing and manufacturing functions. Bits containing the character "-" have a default value of zero (0). These bits must not be changed, as this may cause faulty operation of the Reader.

Conventions

The following pictograms and designations are used in this document:

Note:

Indicates conditions that must be met or procedures that must be followed to ensure proper functioning.

Terms and Abbreviations

The terms and abbreviations used in this manual can be found in the Terms and Abbreviations Manual, document number 11-03-21-002. This manual can be found in the document center on our homepage:

http://www.ti-rfid.com

If You Need Assistance

For more information, please contact the sales office or distributor nearest you. This contact information can be found on our web site at:

http://www.ti-rfid.com

Program Libraries

For support of programming application software and integration of the S6500/S6550 Long Range Reader into a system, two program libraries are available:

- Program Library FEISC, which supports reader functionality, is described in document number 11-06-21-062.
- Program Library FECOM, which supports the serial interface, is described in document number 11-06-21-063.

These reference guides, as well as the program libraries themselves, can be found on our homepage at:

http://www.ti-rfid.com

Document Overview Page

CHAPTER 1

Introduction

Topic Page

1.1 The S6500/S6550 Long Range Reader

The S6500/S6550 Long Range Readers are members of the HF Reader System Series 6000, working at a frequency of 13.56 MHz. This system comprises a reader, antenna and transponder (for example: Smart Label) and is used for wireless identification of a variety of objects.

The Reader is equipped with a bi-directional, asynchronous interface (RS232, RS485), and is able to communicate with Tag-it HF, Tag-it HF-I and other ISO 15693 compliant transponders.

1.2 Reader and Host Data Transmission

Four different ways of data transmission between S6500/S6550 Readers and a host (terminal or PC) are possible. ISO Host Commands (named according to standard ISO Host Commands) and Buffered Read Mode are used for data exchange between transponder and host, whereas Configuration Commands and Control Commands serve to adapt Reader parameters to individual applications. The following chart shows which form of data transmission is supported by which interface:

Data Transmission Support

	Asynchronous Interface (RS232 / RS485)
Configuration Commands	√
Reader Control Commands	√
ISO 15693 Host Commands	√
Buffered Read Mode	√
Scan Mode	√

1.3 Configuration Commands, Control Commands and ISO Host Commands

This form of data transmission is used for Reader configuration, Reader diagnosis and sending of ISO Host Commands via the asynchronous interface.

Reader configuration parameters are stored in the Reader memory. The current Reader configuration is stored in the Reader's EEPROM in the event of a Reader power down. After power-up, the Reader reads the configuration from the EEPROM.

Reader control diagnosis and ISO Host Commands are immediately processed and the Reader response contains command status or data information.

<table>
<tr><th colspan="2">Host (Terminal / PC / etc.)</th><th colspan="2">Reader</th></tr>
<tr><td colspan="2" rowspan="2">Parameter / Control Command →</td><td colspan="2">Parameter received and stored / Control Command processed</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td rowspan="2"></td><td>←</td><td>Status / Data</td><td rowspan="2">Error Status</td></tr>
<tr><td colspan="2">←</td></tr>
</table>

1.4 Buffered Read Mode

Buffered Read Mode is a high-level operating mode for detection of transponders that are within range of the Reader. This mode of operation is particularly designed for applications using transponders to identify objects. Buffered Read Mode processes all transponder read data and filter operations to make the user interface transparent to transponder data and to minimize data transfers between Reader and host. Three commands are used for control of Buffered Read Mode.

In this operating mode, the Reader automatically selects transponders that are within the detection range of the Reader and reads the data requested. Sampled transponder data is stored in a FIFO data buffer.

Sampled transponder data can be read with the [0x21] Read Buffer command. This command always reads the first available datasets from the data buffer. However data already read must be deleted with the [0x32] Clear Data Buffer command before the next datasets in the data buffer can be accessed with the read command.

If Buffered Read Mode is enabled in the CFG10 General System Parameters configuration block, the Reader immediately starts sampling transponder data after power-up. Buffered Read Mode can be reinitialized with the [0x33] Initialize Buffer command.

If Buffered Read Mode is turned on, the Reader answers every valid message with a data or status protocol message. This answer includes the control byte that has been received by the Reader.

Host (Terminal / PC / ....)		Reader	
Read data	→	Transponder data in data buffer?	
		Yes	No
	←	Status / data protocol	Status = no valid data
	←		
Clear data	→	Transponder data read?	
		Yes	No
	←	OK status	Status = no valid data
	←		

Note:

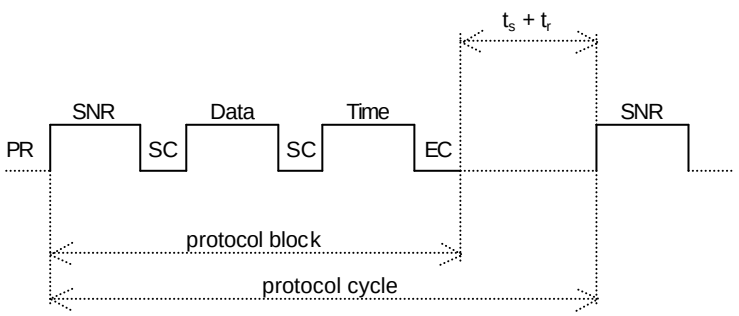
Buffered Read Mode is only available if Scan Mode is disabled.

Buffered Read Mode supports read operations only.

1.5 Scan Mode

In this operation-mode the reader self-initializes and sends out data to the host as soon as a transponder is within the detection range and valid data can be read.

When turned to Scan Mode, the contents of the message block (Serial number, Data Block) can be adapted to each user application. The data will be output depending on configuration according to the following scheme, the order of which cannot be changed.



PR:	Com-Prefix (optional)	ts:	locking time reception
SNR:	Serial number (fixed)	tr:	time to the next new transponder reading
Data:	Data Blocks (freely programmable)		
SC	Separation character		
EC	End character		
Time	internal system time		

The reader starts the output of the protocol block as soon as all required data has been read correctly from the transponder. If the reader is unable to read all data of a protocol block completely and without faults, no data is output. For example, should the address of the data block be invalid, the serial number of the transponder will not be outputted.

Notes:

If configuration protocols are to be sent to the reader while Scan Mode is active, no transponder should be within the detection range of the reader during this time.

Only read operations are available with Scan Mode.

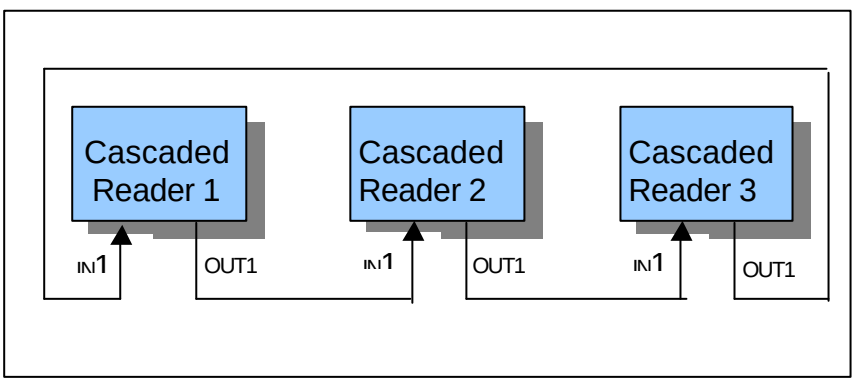
Scan Mode is only available if Buffered Read Mode is disabled.

1.6 Cascaded Reader Synchronization

To enable more than one reader to be used in close proximity, RF operations executed by the readers must be synchronized to prevent unwanted interference.

This is achieved by means of cascaded control

In combination with Buffered Read Mode, Cascaded Synchronization allows maximum speed of operation. In this case each reader passes control to the next after it has completed its task. This is effectively a round-robin control, but is much faster than single host control since it is controlled at a reader level.



To set up Cascaded Synchronization, Buffered Read Mode must be enabled in configuration block CFG10: General System Parameters and Cascaded Synchronization must be selected in the SYNC setting in configuration block CFG11: Buffered Read Mode. The reader that should trigger the synchronization chain must be configured as MASTER in the SYNC setting in configuration block CFG11: Buffered Read Mode.

In Cascaded Synchronization mode the signal input IN1 and the signal output OUT1 are reserved for synchronization cable connections. Please note that the signal input and the signal output are isolated and must be supplied with an external DC voltage.

Note:

Cascaded Synchronization will only be available in Buffered Read Mode.

CHAPTER 2

Asynchronous Interface

Topic **Page**

2.1 Data Format and Protocol Frames

The Reader can be configured via the asynchronous interface and data may be written to transponders or read from them. Communication between Reader and host (terminal, PC, etc.) is performed with a fixed protocol. This protocol is intended for data bus use and has a corresponding bus address.

During data transfer via asynchronous interface, the Reader supplies the required data or a status byte. The reply contains the control byte transmitted.

There is no reply from the Reader if there is a protocol frame failure in the communication from Host to Reader.

All bytes will be transferred with the most significant byte (MSB) first.

2.2 Protocol Frame

Host ® Reader

1	2	3	4...n-2	n-1	n
LENGTH = n	COM-ADR	CONTROL BYTE	PROTOCOL DATA	MSB CRC16	LSB CRC16

Host ¬ Reader

1	2	3	4	(5...n-2)	n-1	n
LENGTH = n	COM-ADR	CONTROL BYTE	STATUS	(PROTOCOL DATA)	MSB CRC16	LSB CRC16

LENGTH
Number of protocol bytes 1- n (5 - 255) including length byte and checksum

COM-ADR
0 to 253: address of device in bus mode

Notes:

Any point-to-point Reader can be addressed by COM-ADR 255 and will reply with its own configured address.

COM-ADR 254 has a special feature for RS485 bus applications. All Readers will process commands received and only the Reader with COM-ADR 0 will send a response to the host.

STATUS / PROTOCOL DATA
Includes the status message or protocol data from, or to, the Reader.

Note:

For the index of Status Bytes, please see Appendix D.

CRC16
Cyclic redundancy check of protocol bytes from 1 to n-2, as specified by CCITT-CRC16 (reverse direction)
Polynomial: $x^{16} + x^{12} + x^5 + 1$
Start Value: 0xFFFF

Data Format

Start bits: 1

Data bits: 8

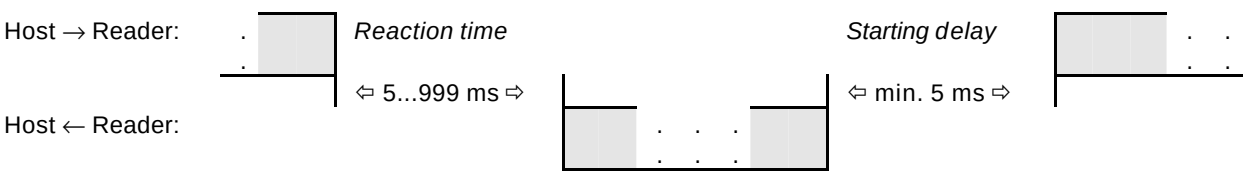
Stop bits: 1

Parity: Even (default), Odd, None

2.3 Timing conditions

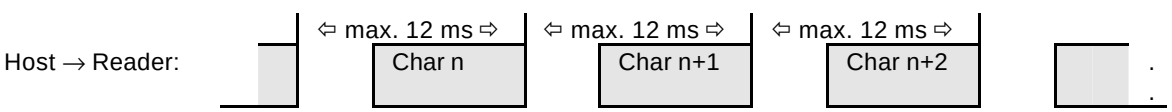
Starting Delay

Before sending a protocol start signal (length byte), there must be a minimum 5 ms delay.



2.4 Data timeout

Within a protocol, characters must follow each other in intervals of 12 ms maximum.



2.5 CRC16 Calculation Algorithm

Polynomial: $x^{16} + x^{12} + x^5 + 1$ ⇒ CRC_POLYNOM = 0x8408;

Start Value: 0xFFFF ⇒ CRC_PRESET = 0xFFFF;

C-Example:

```
unsigned internal CRC = CRC_PRESET;

 for (i = 0; i < cnt; i++) /* cnt = number of protocol bytes without CRC */
{
        crc ^= DATA[i];
        for (j = 0; j < 8; j++)
        {
                if (crc & 0x0001)
                        crc = (crc >> 1) ^ CRC_POLYNOM;
                else
                        crc = (crc >> 1);
        }
}
```

CHAPTER 3

Configuration Parameters

Topic **Page**

3.1 Structure

The configuration memory of the Reader is organized in configuration blocks of 16 bytes each. These are divided into 14-byte configuration parameters and a 2-byte CRC16 checksum. Each of these configuration blocks takes a number (from CFG 0 through CFG n). Not all configuration blocks are available to the user as they are reserved for system level parameter or future use.

Structure of the configuration blocks in Reader configuration memory and Reader EEPROM (CFG) is:

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Contents	PARAMETER														CRC16	

Parameters are stored in two different configuration memory locations:

Reader RAM
or
Backup EEPROM (used for storing power down parameters)

Multiple configuration memory locations can be addressed by the value of the CFG-ADR parameter as described in chapter 4, Reader Configuration Protocols.

CFG-ADR

CFGn memory address of required configuration block
LOC specifies location of configuration block
MODE specifies one or all configuration blocks

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Function	LOC	MODE	CFGn: address of configuration block					

The EEPROM configuration blocks are protected by a 16-bit CRC checksum. Examination of these checksums is executed after each reset of the Reader. If a faulty checksum is detected, the Reader goes into the "EE-Init-Mode" error status and sets the faulty configuration block to its default value.

While EE-Init-Mode is active, LED1 and LED2 blink alternately (see 3.2.2 Dedicated Input / Output Functions) and the Reader answers external commands with the status "0x10 EEPROM Failure". The "EE-Init-Mode" can be exited via a new reset (cold start or [0x63] CPU Reset command). If after this the checksums of all data records are correct, the Reader shifts to its configured operation mode.

Notes:

Malfunctions may occur if parameters are configured without their range being specified or if parameters have been changed to unspecified values.

A firmware update resets the EEPROM to default settings and the Reader goes into the “EE-Init-Mode” error status.

3.2 Reader Parameters

Note:

If bits within one byte contain the character "-", this means that these bits are reserved for future extensions or for internal testing and manufacturing functions. Bits containing the character "-" have a default value of zero (0). These bits must not be changed, as this may cause faulty operation of the Reader.

3.2.1 CFG1: General Inputs / Outputs

The parameters of the CFG1 configuration block contain the input and output settings.

Byte	0	1	2	3	4	5	6
Contents	I/O-MODE		FLASH-RATE		IN-ACTIVE	-	REL-TIME MSB
Default	0xA800		0xFC00		0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	REL-TIME LSB	OUT2-TIME		-	-	-	-
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

I/O-MODE

Defines status of the signal emitters (OUT1, OUT2 and REL) during I/O mode.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Function	REL mode		OUT2 mode		OUT1 mode		-	-	-	-	-	-	-	-	-	-

Mode	Function	
b 0 0	UNCHANGED	No effect on status of signal emitter
b 0 1	ON	Signal emitter on
b 1 0	OFF	Signal emitter off
b 1 1	FLASH	Signal emitter alternating on

FLASH-RATE

Allocates an individual flash frequency to each output.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Function	REL frq		OUT2 frq		OUT1 frq		-	-	-	-	-	-	-	-	-	-

frq	Frequency
b 1 1	1 Hz
b 1 0	2 Hz
b 0 1	4 Hz
b 0 0	8 Hz

INACTIVE

Determines if input is activated by a closed or open contact

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	IN2	IN1

Bit = 0 ⇒ closed contact - activates input
Bit = 1 ⇒ open contact - activates input

REL-TIME

Defines relay holding time. If the Reader receives a valid transponder response, the relay is activated for the time of the value set in REL-TIME. If REL-TIME is zero, this function is disabled.

If relay is on in idle mode, the relay will be deactivated for REL-TIME.

If flash mode is enabled, the relay will be activated.

Range: 0x00 ... 0xFFFF (* 100ms) = 100ms ... 65535s.

OUT2-TIME

Defines holding time. If the Reader receives a valid transponder response, Output2 is activated for the time of the value set in OUT2-TIME. If OUT2-TIME is zero the function is disabled.

If OUT2 is high in idle mode, OUT2 will be low for OUT2-TIME.

If the flash mode is enabled, the output goes low.

Range: 0x00 ... 0xFFFF (* 100ms) = 100ms ... 65535s.

3.2.2 Dedicated Input / Output Functions

If synchronization is used within the Buffered Read Mode, the input IN1 and the output OUT1 are reserved for the external trigger.

In Scan Mode, IN2 is reserved for the trigger, if the trigger is enabled in the configuration of CFG12: Scan Mode. Input IN2 can now be used to start the scan.

LEDs used for system monitoring.

LED	Color	Dedicated Function
1	Green	1 second blink. Alternate blink with LED2 after EEPROM error.
2	Red	RF interface has error-free communication with a transponder. Alternate blink with LED1 after EEPROM error.
3	Red	Asynchronous interface is sending data to host.
4	Red	RF interface is re-reading Tag-it transponders in Buffered Read or Scan Mode.
5	Red	Reader is initializing after power-up or a **[0x63] CPU Reset** command. Error in RF final stage. See chapter 5.11 **[0x6E] Reader Diagnostic** for details.

Notes:

LED1 (green) and LED2 (red) blink alternately if an EEPROM read error occurred after power-up or a CPU Reset command. A firmware update sets the EEPROM to its initial state and LED1 and LED2 also blink alternately. See chapter 5.5 Start Flash Loader for details.

An error in the RF final stage is shown by LED5 blinking. A detailed error code is returned from the Reader with each asynchronous communication. See Appendix D for details.

3.2.3 CFG2: Com-Interface

The parameters of the CFG2 configuration block contain the data communication settings.

Byte	0	1	2	3	4	5	6
Contents	COM-ADR	-	BAUD	TRANS-FORM	FLASH-LOADER-BAUD	-	COM-TIMEOUT
Default	0x00 0x00	0x00	0x08 38400 Baud	0x01 e,8,1	0x08 38400 Baud	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	COM-TIMEOUT	-	-	-	-	-	-
Default	0x64 *10 sec.*	0x00	0x00	0x00	0x00	0x00	0x00

COM-ADR

Bus address of the Reader (0 .. 255) for communication via asynchronous interface, particularly for RS485 interface applications.

Notes:

Reader may be addressed at any time via COM-ADR 255 in send protocol. It then answers with the configured address.

With COM-ADR 0 at power-up and after a [0x63] CPU Reset command, Reader reads the settings of switches DIP1 ... DIP3 as bus address.

Changing of this parameter only becomes effective after writing or saving this configuration block to EEPROM and a Reader reset.

BAUD

Defines baud rate of asynchronous interface.

BAUD	Baud Rate
0x06	9600 baud
0x07	19200 baud
0x08	38400 baud
0x09	57600 baud
0x0A	115200 baud

Notes:

Changing this parameter only becomes effective after writing/saving this configuration block to EEPROM and Reader reset.

Validity checking is done by writing this parameter to Reader. If an error occurs, Reader answers with STATUS = {0x11}.

TRANS-FORM

Defines parameters for asynchronous interface data transmission format.

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	S	D	P	

P: Parity

P	Parity
b00	none
b01	even
b10	odd

D: Data Bits

D	Data Bits
b0	8

S: Stop Bits

S	Stop Bits
b0	1

Notes:

Changing this parameter only becomes effective after writing/saving this configuration block to EEPROM and Reader reset.

Validity checking is done by writing this parameter to Reader. If an error occurs, Reader answers with STATUS = {0x11}.

FLASH-LOADER-BAUD

Defines baud rate for flash loader – see chapter 5.5 [0x55] Start Flash Loader.

BAUD	Baud Rate
0x06	9600 baud
0x07	19200 baud
0x08	38400 baud

Note:

Validity checking is done by writing this parameter to Reader. If an error occurs, Reader answers with STATUS = {0x11}.

COM-TIMEOUT

Defines maximum response duration for transponder commands.

	Max. Response Duration
COM-TIMEOUT	1 ... 65535 * 100 ms

Note:

COM-TIMEOUT has no effect with Reader Configuration Protocols and Reader Control Protocols.

3.2.4 CFG3: RF Interface I

The CFG3 configuration block parameters contain global transponder driver and Reader settings.

Byte	0	1	2	3	4	5	6
Contents	TAG-DRV		RF-POWER	-	FSK-RX-CHN	RF-C-IND	-
Default	0x000A		0x90	0x00	0x01	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	-	-	-	-	-	-	-
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

TAG-DRV

Defines transponder types operated by Reader.

Byte	0								1							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Driver	-	-	-	-	-	-	-	-	-	-	-	-	D	-	B	-

B: Driver for Tag-it HF

B	
b0	inactive
b1	active

D: Driver for Tag-it HF-I as well as other ISO 15693 compliant transponders

D	
b0	inactive
b1	active

In principle, only those transponder drivers used in the current application should be active. Reader reaction time for transponder read/write operations is reduced and danger of parasitic transponder access is thus minimized.

RF-POWER

Defines RF output power.

Bit	7	6	5	4	3	2	1	0
Function	MUL	-	LEVEL					

MUL

Selects multiplier for LEVEL

MUL	
b1	RF-POWER = LEVEL * ¼W

LEVEL

Level of RF output power

LEVEL	RF-POWER (MUL = 1)
2	0.50 W
3	0.75 W
4	1.00 W
...	...
39	9.75 W
40	10.0 W
41	10.25 W

Notes:

A monitor continuously checks RF hardware. If an error occurs the Reader answers every command with the 0x84 error code.

Changing RF-POWER only becomes effective after writing/saving configuration block CFG3 to EEPROM and Reader reset.

If the configured RF power is above 4W for the S6500 Reader, an additional 0.8K/W heat sink is necessary.

FSK-RX-CHN

Selects the receive antenna.

FSK-RX-CHN	Antenna Type
0x00	Only complementary antenna
0x01	Only basic antenna
0x02	Both antennas

Note:

If both a basic and a complementary antenna are used, FSK-RX-CHN must be set to [0x02]

RF-C-IND

RF-C-IND	
b0	enabled
b1	disabled

The RF output power is continuously controlled. If the Impedance of the antenna is outside of the range 30 to 80 Ohm an RF Error will be indicated by the status LEDs and the reader diagnostic. This RF Error indication can be disabled.

Note:

If the impedance value of the antenna is outside the range of 20 to 100 Ohms, the RF power regulation is stopped and a RF Error is indicated independent of the setting of RF-C-IND.

3.2.5 CFG5: RF- Interface III

The parameters of the CFG5 configuration block contains transponder interface timing settings.

Byte	0	1	2	3	4	5	6
Contents	-	-	-	-	-	-	RF-MOD
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x14

Byte	7	8	9	10	11	12	13
Contents	-	-	-	-	-	-	-
Default	0x16	0x10	0x00	0x00	0x00	0x00	0x00

RF-MOD:
RF Modulation.
A value of RF-MOD = 0x14 corresponds to 20% modulation.
A range of 10%–30% (0x0A – 0x1E) is adjustable.

3.3 Transponder Parameters

3.3.1 CFG8: General Transponder Parameters

The CFG8 configuration block parameters contain general transponder settings.

Byte	0	1	2	3	4	5	6
Contents	-	-	-	-	ISO-MODE	ISO-AFI	ISO-OPTION
Default	0x00	0x00	0x00	0x00	0x0F	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	ISO-CMD-OPTION	-	-	-	-	-	-
Default	0x03	0x00	0x00	0x00	0x00	0x00	0x00

ISO-MODE (only ISO 15693 transponders)

Bit	7	6	5	4	3	2	1	0
Function	-	-	AFI	NO-TS	DATA-RATE	SUB-CARRIER	MOD	FAST

FAST

FAST	
b0	Normal Mode (1 / 256)
b1	Fast Mode (1 / 4)

MOD

MOD	
b0	100% (This option increases modulation bandwidth)
b1	10%

SUB-CARRIER

SUB-CARRIER	
b0	ASK (one subcarrier)
b1	FSK (two subcarriers)

Note:

In FSK mode the number of timeslots (NO-TS) should be 16, only if one transponder is in the field, the number of timeslot may be set to 1 to speed up the communication in FSK mode.

DATA-RATE

DATA-RATE	
b0	Low
b1	High

NO-TS

NO-TS	
b0	16 timeslots
b1	1 timeslot

Note:

In combination with FSK, only 16 timeslots should be used.

AFI

AFI	
b0	Disabled
b1	Enabled

ISO-AFI

Application Family Identifier to select a transponder

ISO-OPTION: (only ISO transponder driver)

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	WR-OPTION		-	-

WR-OPTION

WR-OPTION	
b00	automatically set
b10	Tag Option = 0
b11	Tag Option = 1

Note:

If WR-OPTION is automatically set, the reader sets the WR-OPTION to 1, if the ISO-Host Command is in non-addressed mode.

ISO-CMD-OPTION (only ISO tag driver)

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	BREAK	

BREAK

BREAK	
b10	Break timeslot at “NO TAG” Break is always 100% modulated (EOF) (This option speeds up anticollision process, but increases modulation bandwidth)
b11	Complete timeslot length at “NO TAG”

3.4 System Parameters

3.4.1 CFG10: General System Parameters

The CFG10 configuration block parameters contain general system settings.

Byte	0	1	2	3	4	5	6
Contents	SYS-MODE	-	-	-	-	-	-
Default	0x04	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	-	-	-	-	-	-	-
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

SYS-MODE

This register enables different operation modes of the Reader.

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ACOLL	OP-Mode	

OP-Mode	Function
b00	ISO-Host Mode
b01	Buffered Read Mode
b10	Scanner Mode

OP-Mode:

ISO-Host Mode:
This bit combination activates the ISO Host Mode. If the ISO Host Mode is enabled the ISO Host commands will be available.

Buffered Read Mode:
This bit combination activates the Buffered Read Mode. If the Buffered Read Mode is enabled there are no ISO Host commands available.

Scanner Mode:
This bit combination activates the Scanner Mode. In the Scanner Mode the reader sends the transponder data automatically after its detection. If the Scanner Mode is enabled there are no ISO Host commands available.

Note:

Changing of OP-Mode only becomes effective after writing/saving configuration block CFG10 to EEPROM and reset of the reader.

ACOLL

This bit activates Anticollision Mode. In Anticollision Mode, the Reader automatically sets transponder-specific communication parameters.

ACOLL-SEL	Function
b0	disabled (default)
b1	enabled

Note:

If Anticollision Mode is switched off, the Reader does not run any anticollision procedures for transponders inside the antenna field. See description of CFG13: Anticollision configuration parameters. Changing this parameter only becomes effective after writing/saving this configuration block to EEPROM and Reader reset.
If Anticollision Mode is switched off, no Quiet will be sent to the transponder.

3.4.2 CFG11: Buffered Read Mode

The CFG11 configuration block parameters contain Buffered Read Mode settings. To enable Buffered Read Mode, the OP-Mode bits in the SYS-MODE register of the CFG10: General Systems Parameters configuration block must be set. It may be useful to enable Anticollision Select Mode if there are a large or unknown number of transponders within the antenna field.

Byte	0	1	2	3	4	5	6
Contents	TR-DATA	DB-ADR	DB-N	TR-ID	VALID-TIME		READ
Default	0x01	0x00	0x01	0x80	0x000A		0x80

Byte	7	8	9	10	11	12	13
Contents	SYNC	SYNC-TIMEOUT		-	-	-	-
Default	0x00	0x03E8		0x00	0x00	0x00	0x00

TR-DATA

Selects data types for read operation.

Bit	7	6	5	4	3	2	1	0
Function	-	-	TIMER	-	-	-	DB	SNR

SNR = Serial Number

SNR	Function
b0	no serial number will be stored
b1	serial number will be stored

DB = Data Block

Data Block	Function
b0	no data block will be stored
b1	data block will be stored

TIMER = internal system timer
(see chapter 4.5 **[0x85] Set System Timer** for details)

TIMER	Function
b0	no internal system timer
b1	internal system timer will be active

Notes:

Changing TR-DATA only becomes effective after writing/saving configuration CFG11 to EEPROM and Reader reset.

The internal system timer is not a real time clock (RTC) and therefore accuracy cannot be guaranteed.

DB-ADR
Address of first data block. Range: 0x00...0x1F.

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	DB-ADR				

Note:

Changing of DB-ADR only becomes effective after writing/saving configuration block CFG11 to EEPROM and Reader reset.

DB-N
Number of data blocks. Range: 0x01...0x0F.

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	DB-N			

Note:

Changing of DB-N only becomes effective after writing/saving configuration block CFG11 to EEPROM and Reader reset.

TR-ID
The TR-ID register sets the parameters for transponder identification.

Bit	7	6	5	4	3	2	1	0
Function	ID-SOURCE	-	-	DB-ADR				

Notes:

Changing this parameter only becomes effective after writing / saving this configuration block to EEPROM and Reader reset.

A Validity check is performed by writing this parameter to Reader. If an error occurs, Reader answers with STATUS = {0x11}.

DB-ADR

Sets address of data block for transponder identification. If ID-SOURCE selects the serial number as data source, DB-ADR will be ignored in Buffered Read Mode.

ID-SOURCE

Sets data source for transponder identification.

ID-SOURCE	Function
b0	Data block
b1	Serial no.

Notes:

Changing of TR-ID only becomes effective after writing/saving configuration block CFG11 to EEPROM and Reader reset.

Address ID-DB-ADR must be in selected data blocks range:
TR-ADR ≤ ID-DB-ADR ≤ TR-ADR + TR-N – 1.

ID-TR-ADR is used as serial number for Tag-it transponders if SNR is not selected in TR-DATA configuration parameter.

VALID-TIME

Period of time before a transponder can be read a second time.

	Time Range
VALID-TIME	0...65535 x 100 ms

Note:

Changing VALID-TIME only becomes effective after writing/saving configuration block CFG11 to EEPROM and Reader reset.

READ

Defines whether a transponder read error will cause repeated reads of missing data blocks until VALID-TIME is over. This setting is useful for catching transponders being read badly due to noise, movement, positioning, etc.

Bit	7	6	5	4	3	2	1	0
Function	RE-SCAN	-	-	-	RE-READ			

RE-READ

Number of repeated reads of data blocks if read error occurs. RE-READ = 0 means the reader forces one read but no second read in case of error during the first read.

RE-SCAN

A transponder can leave the antenna field before all data blocks are read. With RE-SCAN enabled the Reader tries to read the missing data blocks until VALID-TIME for this transponder has passed.

RE-SCAN	Function
b0	No re-scans are processed
b1	Re-scans are processed

SYNC:

Selects the synchronization parameters.

Bit:	7	6	5	4	3	2	1	0
Function	RFOFF	-	-	-	-	MASTER	MODE	

MODE:

MODE	Function
b00	Synchronization OFF
b01	Cascaded Synchronization

MASTER:

MASTER	Function
b0	Slave
b1	Master

RFOFF:

RFOFF	Function
b0	After the reader has completed its task of RF Communication and passes the control to the next reader the RF-field will not be switched off, only the task will stopped.
b1	After the reader has completed its task of RF Communication and passes the RF Communication to the next reader the RF-field will be switched off.

Note:

One reader in the synchronization chain must be configured as MASTER to start the synchronization.

Changing of SYNC only becomes effective after writing/saving this configuration block to EEPROM and Reader reset.

SYNC-TIMEOUT:
Timeout between two synchronization pulses.

	Time Range
SYNC-TIMEOUT	0...65535 x 1 ms

Note:

If a SYNC-TIMEOUT occurred the reader switches the synchronization off until the next synchronization pulse will be detected.

3.4.3 CFG 12: Scan Mode

The parameters of the CFG12 configuration block contains scan mode settings. To enable scan mode the SCAN-MODE bit in the SYS-MODE register of the configuration block CFG10:General System Parameter must be set.

Byte	0	1	2	3	4	5	6
Contents	SCANNER -MODE	-	-	SCAN-DATA	DB-ADR	DB-N	SCAN-LOCK-TIME
Default	0x02	0x00	0x00	0x01	0x00	0x01	0x00

Byte	7	8	9	10	11	12	13
Contents	SCAN-LOCK-TIME	-	DB-USE	SEP-CHAR	SEP-USR	END-CHAR	END-USR
Default	0x64 10s	0x00	0x02 ASCII	0x20 Comma	0x00	0x01 CR+LF	0x00

SCANNER-MODE:
defines the mode of the scanner.

Bit:	7	6	5	4	3	2	1	0
Function	Trigger	-	-	-	-	mode		

Mode:

Bit combination	Mode
b000	Single Read
b010	Continuous Read

Single Read: (active for read duration – stops after good read)

When transponders have been decoded, the reader will stop the scan. The reader must be triggered again to read other transponders.

Continuous Read:

The reader will detect as many transponders as it can decode regardless whether they are the same or not. This mode is mainly used for demonstration and diagnostic. Between two reads the reader automatically forces a RF-Reset.

Trigger:

Trigger	Mode
b0	**Trigger disabled:** The reader scans all the time. However, this mode increase the current consumption
b1	**Trigger enabled:** The reader starts the scan, if the trigger is enabled The digital input IN2 can be used for the trigger signal to start the scan.

SCAN-DATA:

selects the data types to be sent in the Scanner Mode.

Bit:	7	6	5	4	3	2	1	0
Function	-	COM-Prefix	TIME	-	-	-	DB	SNR

If either bit 0..1 (SNR, DB) is not set, the scan-mode remains switched off.

SNR = Serial Number.

Setting of this bit activates the output of the serial number.

SNR	Mode
b0	Output of the serial number inactive
b1	Output of the serial number active

DB = Data Block

Setting of this bit activates the output of a specified data field

DB	Mode
b0	Output of a data field inactive
b1	Output of a data field active

TIME = internal system timer (see chapter 4.5 [0x85] Set System Timer for details).

Setting of this bit activates the output of the internal system timer

TIME	Mode
b0	Output of internal system timer inactive
b1	Output of internal system timer active

COM Prefix

When this option is on, the reader will transmit the COM-ADR before each data set.

COM Prefix	Mode
b0	COM-ADR of the reader will not transmit
b1	COM-ADR of the reader will transmit

SCAN-LOCK-TIME: (1 ... 65535 * 100 ms = 100 ms ... 6553.5 sec)
The Scan Lock Time defines the minimum period of time during which the transponder stays locked after having read a protocol for a further operation. As soon as this period of time is over, the transponder will be called again, unless the reader has not detected another transponder in the meantime.

Notes:

The time until the output of the next protocol-block is prolonged by the time that is necessary to read the data completely again, because the reader begins to read the data from the transponder again only after the expiration of the "SCAN-LOCK-TIME".

The "SCAN-LOCK-TIME" will only become effective, if it is selected to exceed the sum of times that the reader requires to read the data of the transponder.

DB-ADR:
Address of first Data Block. Range: 0x00...0xFF.

DB-N:
Number of Data Blocks to be read from the transponder, starting at DB-ADR. Maximum DB-N is 32.

DB-USE:
Defines the data format of the data.

Bit:	7	6	5	4	3	2	1	0
Function	-	-	-	-	DB-FORMAT			

DB-FORMAT for Transmit

Bit combination	Transmit as
b0 0 0 0	binary / unformatted
b0 0 1 0	ASCII

SEP-CHAR:
selects the separation character between two data types for the send data (only one bit can be set).

Bit:	7	6	5	4	3	2	1	0
Function	USER	‘ ‘	‘,‘	‘;’	TAB	CR	LF	CR+LF

CR+LF = 0x0D and 0x0A.
CR = 0x0D
LF = 0x0A
TAB = 0x07
‘;’ = 0x3B
‘,’ = 0x2C
‘ ‘ = 0x20
USER = user defined separation character in SEP-USR

SEP-USR:
user defined separation character.

END-CHAR:
selects the end character between two data types for the send data (only one bit can be set).

Bit:	7	6	5	4	3	2	1	0
Function	USER	‘ ‘	‘,‘	‘;’	TAB	CR	LF	CR+LF

CR+LF = 0x0D and 0x0A.
CR = 0x0D
LF = 0x0A
TAB = 0x07
‘;’ = 0x3B
‘,’ = 0x2C
‘ ‘ = 0x20
USER = user defined separation character in END-USR

END-USR:
user defined end character.

3.4.4 CFG13: Anticollision

The CFG13 configuration block parameters contain anticollision settings. To enable Anticollision Mode, ACOLL bit in the SYS-MODE register of the CFG10: General System Parameters configuration block must be set.

Byte	0	1	2	3	4	5	6
Contents	-	-	-	-	-	-	-
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Byte	7	8	9	10	11	12	13
Contents	-	-	-	-	ONT	-	-
Default	0x00	0x00	0x00	0x00	0x00	0x00	0x00

ONT

Defines which transponder will send to the host.

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	-	-	ONT

ONT	Function
b0	All transponders in field will sent to host. Reader performs an RF Reset before any command reads a serial number.
b1	Only newly-selected transponders will sent to host

3.4.5 Buffered Read Mode Examples

Example No. 1:

Only one transponder at any one time in antenna field. Transponder needs one second to pass antenna. Antenna field is homogeneous with no RF holes. Application data is inside data blocks 1 and 2. Internal system time is necessary to determine when transponder passes antenna.

CFG10:General System Parameters

Byte	0	1	2	3	4	5	6
Contents	SYS-MODE	-	-	-	-	-	-
Settings	0x01	0x00	0x00	0x00	0x00	0x00	0x00
Byte	7	8	9	10	11	12	13
Contents	-	-	-	-	-	-	-
Settings	0x00	0x00	0x00	0x00	0x00	0x00	0x00

CFG11:Buffered Read Mode

Byte	0	1	2	3	4	5	6
Contents	TR-DATA	DB-ADR	DB-N	TR-ID	VALID-TIME		READ
Settings	0x22	0x01	0x02	0x01	0x0014		0x00
Byte	7	8	9	10	11	12	13
Contents	SYNC	SYNC-TIMEOUT		-	-	-	-
Settings	0x00	0x00	0x00	0x00	0x00	0x00	0x00

CFG13: Anticollision

Byte	0	1	2	3	4	5	6
Contents	-	-	-	-	-	-	-
Settings	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Byte	7	8	9	10	11	12	13
Contents	-	-	-	-	ONT	-	-
Settings	0x00	0x00	0x00	0x00	0x01	0x00	0x00

CFG10: General System Parameters

Buffered Read mode is enabled

Anticollision Mode is disabled

CFG11: Buffered Read Mode

Data blocks 1 & 2 with time information

Data block 1 is used to identify the transponders

Each transponder has to pass the antenna in 2 seconds

CFG13: Anticollision (disabled)

Example No. 2:

There are an uncertain number of transponders at any one time inside antenna field. Transponders require two seconds to pass antenna. Antenna field has RF holes. Application data is inside data blocks 1 and 2.

CFG10: General System Parameters

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Contents	SYS-MODE	-	-	-	-	-	-
Settings	0x05	0x00	0x00	0x00	0x00	0x00	0x00
Byte	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Contents	-	-	-	-	-	-	-
Settings	0x00	0x00	0x00	0x00	0x00	0x00	0x00

CFG11: Buffered Read Mode

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Contents	TR-DATA	DB-ADR	DB-N	TR-ID	VALID-TIME		READ
Settings	0x02	0x01	0x02	0x01	0x0028		0x80
Byte	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Contents	SYNC	SYNC-TIMEOUT		-	-	-	-
Settings	0x00	0x00	0x00	0x00	0x00	0x00	0x00

CFG13: Anticollision

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Contents	-	-	-	-	-	-	-
Settings	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Byte	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Contents	-	-	-	-	ONT	-	-
Settings	0x00	0x00	0x00	0x00	0x01	0x00	0x00

CFG10: General System Parameters

Buffered Read mode is enabled

Anticollision Mode is enabled

CFG11: Buffered Read Mode

Data blocks 1 & 2 with time information are read from transponders

Data block 1 is used to identify transponders

Each transponder must pass antenna within 4 seconds

If a transponder has read errors, Reader tries to read this transponder again for 4 seconds

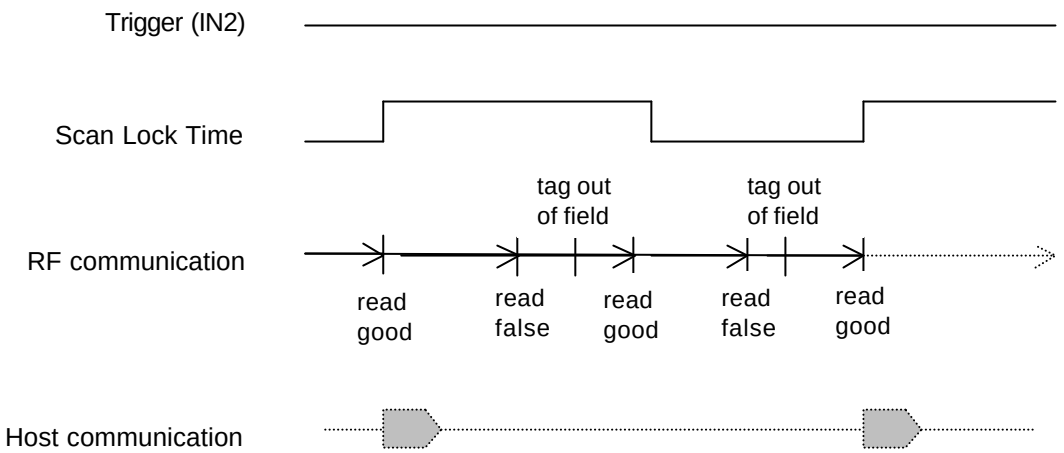
CFG13: Anticollision

Transponders are read with anticollision procedure

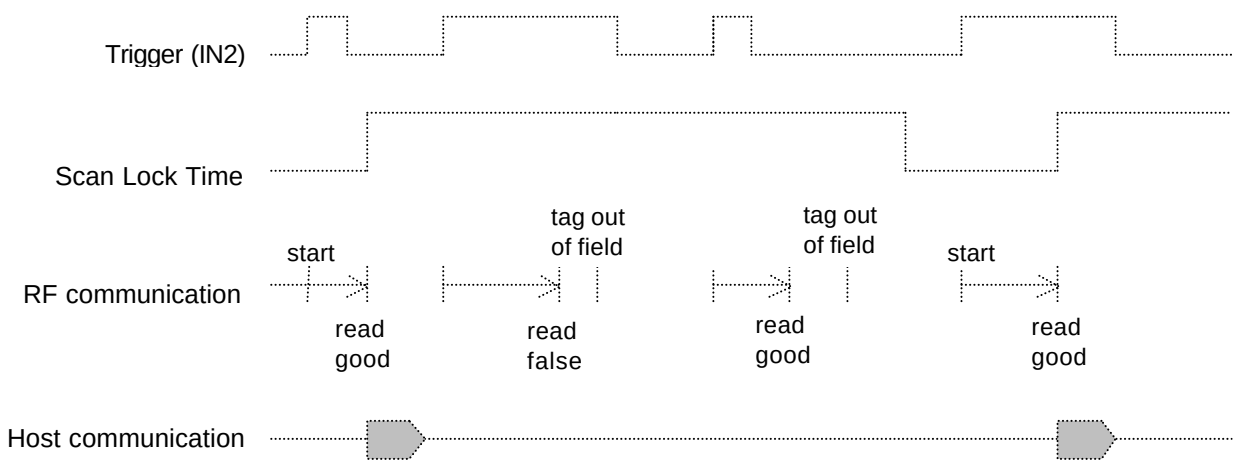
3.4.6 Scan Read Mode Examples

The diagrams below show the function of the four different settings for the Scan-Mode. The examples refer to only one transponder in the antenna field.

Single Read, Trigger disable

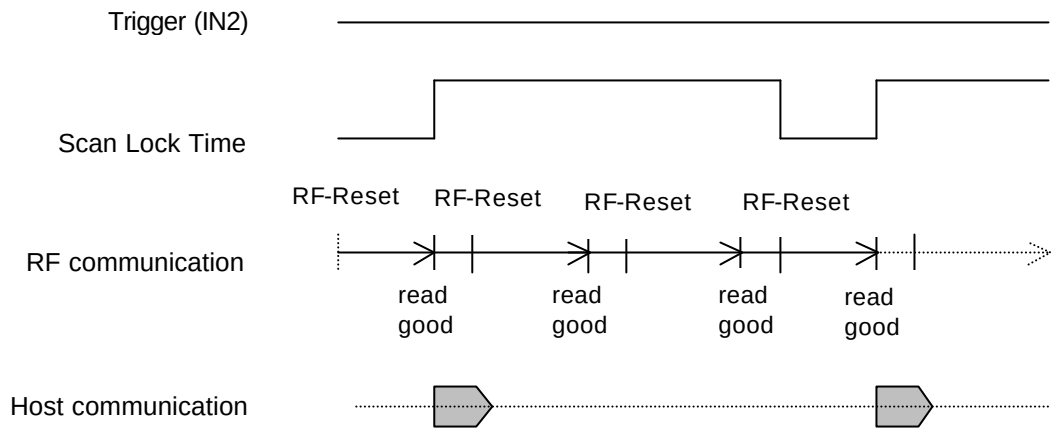


Single Read, Trigger enable

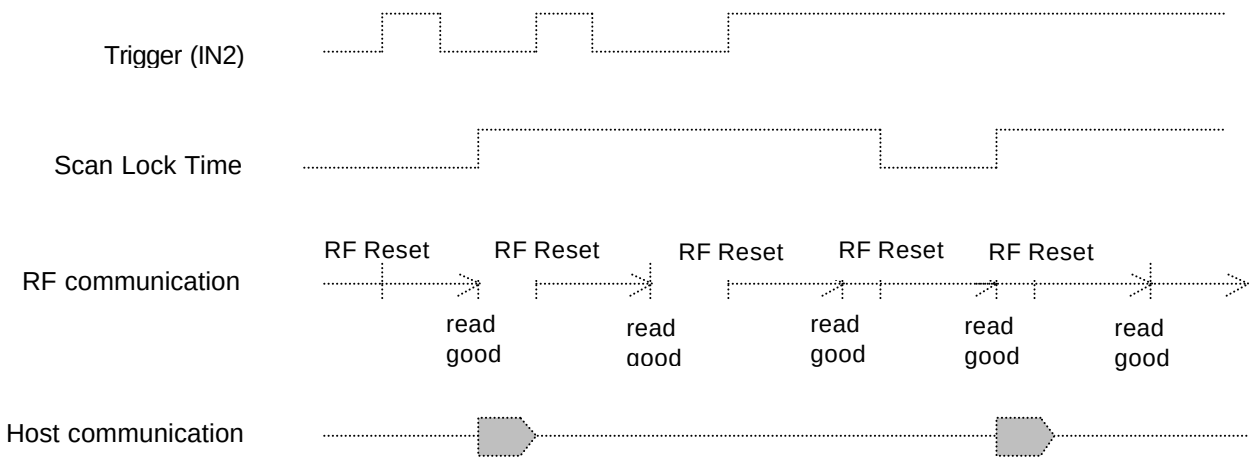


In single mode the reader only sends data to the host, if new transponders were detected or the transponders have left and re-entered the antenna field for the scan-lock-time.

Continuous Read, Trigger disable



Continuous Read, Trigger enable



In continuous mode the reader sends data to the host, if new transponders were detected or the scan lock time for the transponders are over.

CHAPTER 4

Reader Configuration Protocols

Topic **Page**

4.1 [0x80] Read Configuration

Reader configuration protocols allow the Reader to be adapted to a wide range of individual application conditions.

By using Read Configuration, the actual configuration of the Reader can be detected. To do so, configuration is read in blocks of 14 bytes each and addressed by the CFGn bits in the CFG-ADR byte.

Host ® Reader

1	2	3	4	5-6
6	COM-ADR	[0x80]	CFG-ADR	CRC16

Host ¬ Reader

1	2	3	4	5...18	19-20
20	COM-ADR	[0x80]	STATUS	CFG-REC	CRC16

CFG-ADR

Bit	7	6	5	4	3	2	1	0
Function	LOC	-	CFGn: Address of Configuration Block					

CFGn memory address of required configuration block
LOC specifies location of configuration block

LOC	Block Location
b0	RAM
b1	EEPROM

CFG-REC
14 bytes configuration block read from address CFGn in CFG-ADR.

Note:

A read from reserved configuration blocks will cause a 0x15 error code.

4.2 [0x81] Write Configuration

The Write Configuration command changes the configuration of the Reader. To do so, configuration memory is written to with 14-byte long blocks and addressed by CFGn in the CFG-ADR byte. The parameters description can be found in the chapter on Configuration Parameters.

Host ® Reader

1	2	3	4	5...18	19-20
20	COM-ADR	[0x81]	CFG-ADR	CFG-REC	CRC16

Host ¬ Reader

1	2	3	4	5-6
6	COM-ADR	[0x81]	STATUS	CRC16

CFG-ADR

Bit	7	6	5	4	3	2	1	0
Function	LOC	-	CFGn: Address of Configuration Block					

CFGn memory address of required configuration block
LOC specifies location of configuration block

LOC	Block Location
b0	RAM
b1	EEPROM

CFG-REC
14-byte configuration block stored in Reader configuration memory at address CFGn.

Note:

A write to reserved configuration blocks will cause a 0x16 error code.

4.3 [0x82] Save Configuration to EEPROM

This command causes the configuration block (CFG-ADR) in RAM configuration memory to be stored in Reader EEPROM configuration memory.

Host ® Reader

1	2	3	4	5-6
6	COM-ADR	[0x82]	CFG-ADR	CRC16

Host ¬ Reader

1	2	3	4	5-6
6	COM-ADR	[0x82]	STATUS	CRC16

CFG-ADR

Bit	7	6	5	4	3	2	1	0
Function	-	MODE	CFGn: Address of Configuration Block					

CFGn: memory address of required configuration block

MODE: specifies one or all configuration blocks

MODE	Mode
b0	Configuration block specified by CFGn
b1	All configuration blocks

Note:

A Save Configuration to EEPROM command with reserved configuration blocks will cause a 0x16 error code.

4.4 [0x83] Set Default Configuration

The Set Default Configuration command allows each configuration block to be reset to manufacturer's values.

Host ® Reader

1	2	3	4	5-6
6	COM-ADR	[0x83]	CFG-ADR	CRC16

Host ¬ Reader

1	2	3	4	5-6
6	COM-ADR	[0x83]	STATUS	CRC16

CFG-ADR

Bit	7	6	5	4	3	2	1	0
Function	LOC	MODE	CFGn: Address of Configuration Block					

CFGn memory address of required configuration block

LOC specifies location of configuration block

LOC	Block Location
b0	RAM
b1	RAM and EEPROM

MODE specifies one or all configuration blocks

MODE	Mode
b0	Configuration block specified by CFGn
b1	All configuration blocks

Notes:

To store RAM configuration on power down use 4.3 [0x82] Save Configuration to EEPROM.

A Set to Default Configuration command with reserved configuration blocks will cause a 0x16 error code.

4.5 [0x85] Set System Timer

The Set System Timer command sets the internal CPU system timer. The current internal system time is stored in each dataset after transponder select, read or write command.

Host ® Reader

1	2	3	4-7	8,9
9	COM-ADR	[0x85]	TIMER	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x85]	STATUS	CRC16

TIMER

Byte	4	5	6-7
Time	h	min	ms

h: Hours in the range of 0 to 23
min: Minutes in the range of 0 to 59
ms: Milliseconds since last minute in the range of 0 to 59999

Note:

The internal system timer is not a real time clock (RTC) and therefore accuracy cannot be guaranteed.

4.6 [0x86] Get System Timer

The Get System Timer command reads the internal CPU system timer.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x86]	CRC16

Host ¬ Reader

1	2	3	4	5-8	9,10
10	COM-ADR	[0x86]	STATUS	TIMER	CRC16

TIMER

Byte	5	6	7-8
Timer	h	min	ms

h: Hours in the range of 0 to 23
min: Minutes in the range of 0 to 59
ms: Milliseconds since last minute in the range of 0 to 59999

Note:

The internal system timer is not a real time clock (RTC) and therefore accuracy cannot be guaranteed.

CHAPTER 5

Reader Control Protocols

Topic **Page**

5.1 [0x31] Read Data Buffer Info

The Read Data Buffer Info command reads the current data buffer parameters.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x31]	CRC16

Host ¬ Reader

1	2	3	4	5,6	7,8
12	COM-ADR	[0x31]	STATUS	TAB-SIZE	TAB-START

9,10	11,12
TAB-LEN	CRC16

TAB-SIZE
Maximum count of transponder datasets in data buffer.

TAB-START
Address of first dataset in data buffer.

TAB-LEN
Number of transponder datasets reserved in data buffer.

Notes:

Additional information about the data table status is transferred if STATUS = {0x00, 0x84, 0x90, 0x93}.

The data structure can be inconsistent, if some transponders have left the antenna field before all requested data blocks could be read. However TAB-LEN does not contain the number of valid datasets in the data buffer.

5.2 [0x32] Clear Data Buffer

The Clear Data Buffer command clears datasets from the data buffer that were transferred with the [0x21] Read Buffer command.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x32]	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x32]	STATUS	CRC16

Note:

This command can make the data structure inconsistent. Datasets containing no valid data are possible.

5.3 [0x33] Initialize Buffer

The Initialize Buffer command clears the data buffer to an initial state whether the datasets in the buffer were read or not.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x33]	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x33]	STATUS	CRC16

5.4 [0x52] Baud Rate Detection

This protocol is used to determine the current baud rate of the Reader's asynchronous interface.

Host ® Reader

1	2	3	4	5,6
6	COM-ADR	[0x52]	0x00	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x52]	0x00	CRC16

Note:

The return protocol will only be sent if the inquiry is executed with baud rate and current Reader parity.

5.5 [0x55] Start Flash Loader

This protocol starts the Flash Loader inside the Reader. Use the MEMTOOL Windows program to process the firmware update.

Host ® Reader

1	2	3	4,5
5	0x00	[0x55]	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	0x00	[0x55]	0x00	CRC16

Note:

Command only available if the COM-ADR of the Reader is set to '0'. Baud rate for flash loader is set in CFG2: Com-Interface configuration block.

5.6 [0x63] CPU Reset

This protocol initiates reset of Reader CPU.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x63]	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x63]	STATUS	CRC16

5.7 [0x65] Get Software Version

Determines software version of Reader, its type and types of transponders supported.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x65]	CRC16

Host ¬ Reader

1	2	3	4	5...6	7
13	COM-ADR	[0x65]	STATUS	SW-REV	D-REV

8	9	10-11	12,13
HW-TYPE	SW-TYPE	TR-TYPE	CRC16

SW-REV

Revision status of the firmware

Byte	5		6
Bit	7 .. 4	3 .. 0	7 .. 0
Function	decoder firmware	main controller firmware	

D-REV

Revision status of the development firmware. DREV is set to '0' in customized firmware revisions.

HW-TYPE

Type of Reader hardware

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	S65xx	FSK	ASK	CHN

CHN

CHN	Function
b0	one RX channel
b1	two RX channels

ASK / FSK

ASK / FSK	Function
b0	ASK/FSK not available
b1	ASK / FSK available

SW-TYPE

Type of Reader firmware

SW-TYPE	Type of Reader
41	S6500/S6550

TR-TYPE

Displays transponders supported by the software.

Bit	15	14	13	12	11	10	9	8
Function	-	-	-	-	-	-	-	-

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	Tag-it HF-I (ISO15693)	-	Tag-it HF	-

5.8 [0x69] RF Reset

The Reader antenna RF field can be switched off for t_{rf} = 15 ms by this command. All transponders within the Reader antenna field will be reset to their base setting.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x69]	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x69]	STATUS	CRC16

Notes:

After RF Reset, the Reader is not able to receive a new transponder before expiration of t_{rf} .

After RF Reset, any transponder located within the field must be re-selected.

When Buffered Read Mode is switched off, RF Reset initializes the data table.

Response to this command will be sent after RF Reset is completed.

5.9 [0x6A] RF ON/OFF

The RF ON/OFF command switches the RF field of the Reader antenna ON or OFF.

Host ® Reader

1	2	3	4	5,6
6	COM-ADR	[0x6A]	RF	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x6A]	STATUS	CRC16

RF

RF	RF Field of Reader antenna
0x00	OFF
0x01	ON

Notes:

When Buffered Read Mode is switched off, the RF ON command initializes the data table.

An active Buffered Read Mode is paused if RF power is switched off and resumed when RF power is switched on.

5.10 [0x6D] Get Noise Level

The Get Noise Level command reads current Reader noise levels.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x6D]	CRC16

Host ¬ Reader

1	2	3	4	5-10	11,12
12	COM-ADR	[0x6D]	STATUS	NOISE-LEVEL	CRC16

NOISE-LEVEL

Byte	5,6	7,8	9,10
NOISE-LEVEL	min. NL	avg. NL	max. NL

min. NL: Minimum noise level in mV
avg. NL: Average noise level in mV
max. NL: Maximum noise level in mV

5.11 [0x6E] Reader Diagnostic

The Reader Diagnostic command performs hardware diagnostics on the Reader.

Host ® Reader

1	2	3	4	5,6
6	COM-ADR	[0x6E]	MODE	CRC16

Host ¬ Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0x6E]	STATUS	DATA	CRC16

MODE

Reader Diagnostic Modes

MODE	Description
0x01	Read detailed information for STATUS = 0x84
0x02	Status of RF final stage

DATA

Response data for Reader Diagnostic Modes

MODE = 0x01

5
FLAGS

FLAGS

Bit	7	6	5	4	3	2	1	0
Function	TEMP-ALARM	-	TEMP-WARN	CONT-ROL	|Z| >	|Z| <	NOISE	RF-HW

Error Conditions:

Error	Set condition	Clear condition	RF Power	LED 5
RF-HW	no RF hardware / error during the initialization of RF power	CPU reset	OFF	ON
NOISE	noise ≥ 1000 mV	noise < max level	ON	ON
|Z| <	absolute impedance value << 50 Ohm	tune antenna	ON	ON
|Z| >	absolute impedance value >> 50 Ohm	tune antenna	ON	ON
CONTROL	RF-Power out of control range	tune antenna / check cable	ON	ON
TEMP-WARN	temp ≥ warning level ≥100°C	temp < warning level	ON, decrement	ON
TEMP-ALARM	temp ≥ alarm level ≥120°C	temp < alarm level	OFF	ON

Note:

Values are valid when bit is set (b1).

MODE = 0x02

5	6	7
RF-POWER	RF-MOD	TEMP

RF-POWER
actual RF output power [*0.1W]

RF-MOD
actual RF modulation [%]

TEMP
temperature of RF final stage [°C]

5.12 [0x71] Set Output

The Set Output command allows temporary limited or unlimited activation of Reader outputs.

Each output assumes the state defined by the OS (Output State) byte for the period of time determined in the protocol. Flash frequency is defined by the OSF byte. With this protocol, outputs can be switched on or off for the period of time indicated. If the Reader receives a Set Output command, all times active until that moment are overwritten by the new times in the protocol if these are greater then zero.

Host ® Reader

1	2	3	4...5	6,7
13	COM-ADR	[0x71]	OS	OSF

8,9	10,11	12,13
-	OUT-TIME	CRC16

Host ¬ Reader

1	2	3	4	5,6
6	COM-ADR	[0x71]	STATUS	CRC16

OS
The OS (Output State) word defines status of signal emitters (OUT1, OUT2 and REL) during the time defined in OUT-TIME. The signal emitters may be selected singly or in a group.

Bit	15	14	13	12	11	10	9	8
Function	REL mode		OUT2 mode		OUT1 mode		-	-

7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	-

Mode	Function	
b 0 0	UNCHANGED	OUT-TIME has no effect on status of signal emitter
b 0 1	ON	Signal emitter for OUT-TIME = active
b 1 0	OFF	Signal emitter for OUT-TIME = inactive
b 1 1	FLASH	Signal emitter for OUT-TIME = with alternating OSF

Note:
If reader synchronization is used, the output OUT1 is not available for common use.

OSF

The OSF (Output State Flash) word allows allocation of an individual flash frequency to each output.

Bit	15	14	13	12	11	10	9	8
Function	REL frq		OUT2 frq		OUT1 frq		-	-

7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	-

frq	Frequency
b 1 1	1 Hz
b 1 0	2 Hz
b 0 1	4 Hz
b 0 0	8 Hz

OUT-TIME

The values defined by OUT-TIME activate the outputs (OUT1, OUT2, REL) can be temporary or unlimited period of time.
The time values 0 and 65535 (0xFFFF) (see following table) are exceptions.

Time range	0	1...65534 x 100 ms (100 ms...1:49:13 h)	65535 (0xFFFF)
OUT-TIME	Status unchanged	Output for "time" active	Continuously active

Notes:

In order to reset an unlimited time period, OUT-TIME = 1 has to be sent to the Reader. This changes the idle status after 100 ms.

Continuous activation is set after reset or power failure.

5.13 Set Output Examples

Example No. 1:

OUT1 alternates at 4 Hz for 500 ms.

OUT2 is activated for 500 ms.

REL is unchanged

OS	OSF	OUT-TIME
0x1C00	0x0400	0x0005

Example No. 2:
The relay is activated for 1000 ms without affecting other signal emitters.

OS	OSF	OUT-TIME
0x4000	0x0000	0x000A

5.14 [0x74] Get Input

This protocol allows current status of the IN1 ... IN2 and DIP1 ... DIP4 digital inputs to be read at any time.

Host ® Reader

1	2	3	4,5
5	COM-ADR	[0x74]	CRC16

Host ¬ Reader

1	2	3	4	5	6,7
7	COM-ADR	[0x74]	STATUS	INPUTS	CRC16

INPUTS

Bit	7	6	5	4	3	2	1	0
Function	DIP4	DIP3	DIP2	DIP1	-	-	IN2	IN1

1 ⇒ digital input = active (see 3.2.1 CFG1: General Inputs/Outputs)

Notes:
If reader synchronization is used, input IN1 is not available for common use.

If the trigger is enabled in Scan mode, input IN2 is not available for common use.

CHAPTER 6

ISO Host Command Protocols

Topic **Page**

6.1 Description

The following table shows an overview of which ISO commands can be used to access which type of transponder.

	Transponder Types	
	Tag-it HF	Tag-it HF-I (ISO 15693)
Host commands for ISO15693 Mandatory and Optional Commands	√	√
Inventory	√	√
Stay Quiet		√
Lock Multiple Blocks	√	√
Read Multiple Blocks	√	√
Write Multiple Blocks	√	√
Select		√
Reset to Ready		√
Write AFI		√
Lock AFI		√
Write DSFID		√
Lock DSFID		√
Get System Information	√	√
Get Multiple Block Security Status		√
Host commands for ISO15693 Custom and Proprietary Commands		√
ISO15693 Transparent Command		√

6.2 [0xB0] Host commands for ISO15693 Mandatory and Optional Commands

These commands send ISO 15693 defined RF commands to the transponder.

Host ® Reader

1	2	3	4...n-2	n-1,n
n	COM-ADR	[0xB0]	REQUEST-DATA	CRC16

Host ¬ Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xB0]	STATUS	RESPONSE-DATA	CRC16

REQUEST-DATA
Command specific request

RESPONSE-DATA
Command specific response

Notes:

Data is only transferred if STATUS = {0x00, 0x83, 0x84, 0x90, 0x93, 0x94, 0x95}.

This command is not available if Buffered Read Mode is switched on.

6.2.1 [0x01] Inventory

This command reads the serial number (UID) and DSFID of all transponders inside the antenna field. If the reader has detected a new transponder, the transponder will be automatically set in the quiet state by the reader. In this state the transponder doesn't send back a response for the next command.

The transponder sends back a response every time:

- if the transponder has left the antenna and reentered the antenna field
  or
- a [0x69] RF Reset command was send to the reader
  or
- if the ONT bit in the ONT register of the CFG13: Anticollision configuration block is not set.
- if anticollision is set OFF in CFG 10: General System Parameter.

REQUEST-DATA

4	5
0x01	MODE

RESPONSE-DATA

5	6	7	8...15
DATA-SETS	TR-TYPE	DSFID	UID
	Repeated DATA-SETS times		

MODE

Bit	7	6	5	4	3	2	1	0
Function	MORE	-	-	-	-	-	-	-

MORE

MORE	
b0	new Inventory requested
b1	more data requested

DATA-SETS
Number of transponder datasets to be transferred in this Reader response.

TR-TYPE
Transponder type (See Appendix A).

DSFID (ISO transponders only)
Data Storage Family Identifier. If not used, this value will return {0x00}.

UID
Read only serial number of the transponder.

Notes:

If the STATUS byte of the protocol frame has the value {0x94}, more serial numbers can be read out of the Reader with MORE = {b1}.

Reader Configuration CFG13:
If ONT = {b1}, only the serial numbers of those transponders are read which arrived in the antenna field since the last Inventory command.

If ONT = {b0}, an RF Reset is performed to read the serial numbers of all transponders inside the antenna field.

6.2.2 [0x02] Stay Quiet

This command sets the addressed transponder to the Quiet State.

REQUEST-DATA

4	5	6-13
0x02	MODE	UID

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b001	addressed

UID
Read only serial number of the transponder.

Note:

This command is only available for ISO transponders.

6.2.3 [0x22] Lock Multiple Blocks

This command locks one or more data blocks.

REQUEST-DATA

4	5	(6-13)	6 / (14)	7 / (15)
0x22	MODE	UID	DB-ADR	DB-N

RESPONSE-DATA (STATUS = {0x03})

5
DB-ADR-E

RESPONSE-DATA (STATUS = {0x95})

5	6
ISO-ERROR	DB-ADR-E

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	non-addressed
b001	addressed
b010	selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

DB-ADR
First block number to be locked. First block can have any value between 0 and 255.

DB-N
Number of data blocks to be locked, starting at DB-ADR. Maximum DB-N number is 32.

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

DB-ADR-E
Block number where the error occurred.

6.2.4 [0x23] Read Multiple Blocks

This command reads one or more data blocks.

REQUEST-DATA

4	5	(6-13)	6 / (14)	7 / (15)
0x23	MODE	UID	DB-ADR	DB-N

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

RESPONSE-DATA

5	6	7	8-n
DB-N	DB-SIZE	SEC-STATUS	DB
		Repeated DB-N times	

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	SEC	ADR		

ADR

ADR	
b000	Non-addressed
b001	Addressed
b010	Selected

SEC

SEC	
b0	SEC-STATUS always = {0x00}
b1	Security status of following data block in SEC-STATUS

MORE

MORE	
b0	New Command requested
b1	More data requested

UID
Read only serial number of the transponder. UID is only required in addressed mode.

DB-ADR
First block number to be read. First block can have any value between 0 and 255.

DB-N
Number of data blocks to be read from the transponder, starting at DB-ADR. Maximum number of DB-N is 32.

ISO-ERROR (ISO transponders only)
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

DB-SIZE
Number of bytes of one data block.

SEC-STATUS
Block security status of following data block. If not used, this value will return {0x00}.

SEC-STATUS	
b00000000	unlocked
b00000001	user locked
b00000010	factory locked

DB
Requested data block. The block size is defined by DB-SIZE.

Notes:

A read from one block uses a Read Single Block command to the transponder.

Only one transponder can be read in the non-addressed mode.

Tag-it HF transponders cannot be read in Selected mode.

6.2.5 [0x24] Write Multiple Blocks

This command writes one or more data blocks.

REQUEST-DATA

4	5	(6-13)	6 / (14)	7 / (15)	8 / (16)	9-n / (17-n)
0x24	MODE	UID	DB-ADR	DB-N	DB-SIZE	DB
						Repeated DB-N times

RESPONSE-DATA (STATUS = {0x03})

5
DB-ADR-E

RESPONSE-DATA (STATUS = {0x95})

5	6
ISO-ERROR	DB-ADR-E

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	non-addressed
b001	addressed
b010	selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

DB-ADR
Address of first data block to be written to transponder. First block can have any value between 0 and 255.

DB-N
Number of data blocks to be written to transponder, starting at DB-ADR. Maximum number of DB-N is 32

DB-SIZE
Number of bytes in one data block.

DB
Data block to be written to transponder. Required block size is defined by DB-SIZE.

ISO-ERROR (ISO transponders only)
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

DB-ADR-E
Block number where the error occurred.

Notes:

Write to One Block uses a Write Single Block command to the transponder.

For Tag-it HF-I Transponders the 'Write_2_Blocks command" will be used if the block address starts with an even-numbered address. For other ISO transponders multiple Write Single Block commands are issued to the transponder.

For Tag-it HF transponders, the Write Multiple Blocks command cannot be performed in the selected mode.

6.2.6 [0x25] Select

This command sets one transponder to Select State. Only one ISO transponder can be selected at any one time. A transponder already selected will automatically be set to Ready State.

REQUEST-DATA

4	5	6-13
0x25	MODE	UID

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b001	addressed

UID
Read only serial number of the transponder.

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for ISO transponders.

6.2.7 [0x26] Reset to Ready

This command sets a transponder to Ready State.

REQUEST-DATA

4	5	(6-13)
0x26	MODE	UID

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	Non-addressed
b001	Addressed
b010	Selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for ISO transponders.

6.2.8 [0x27] Write AFI

This command writes a new AFI code to one or more transponders.

REQUEST-DATA

4	5	(6-13)	6 / (14)
0x27	MODE	UID	AFI

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	non-addressed
b001	addressed
b010	selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

AFI
Application Family Identifier of transponder.

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for ISO transponders.

6.2.9 [0x28] Lock AFI

This command locks the AFI register in one or more transponders.

REQUEST-DATA

4	5	(6-13)
0x28	MODE	UID

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	Non-addressed
b001	Addressed
b010	Selected

UID

Read only serial number of the transponder. UID is only required in addressed mode.

ISO-ERROR

ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for ISO transponders.

6.2.10 [0x29] Write DSFID

This command writes the DSFID to one or more transponders.

REQUEST-DATA

4	5	(6-13)	6 / (14)
0x29	MODE	UID	DSFID

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	non-addressed
b001	addressed
b010	selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

DSFID
Data Storage Format Identifier of transponder.

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for ISO transponders.

6.2.11 [0x2A] Lock DSFID

This command locks the DSFID register in one or more transponders.

REQUEST-DATA

4	5	(6-13)
0x2A	MODE	UID

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	non-addressed
b001	addressed
b010	selected

UID

Read only serial number of the transponder. UID is only required in addressed mode.

ISO-ERROR

ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for ISO transponders.

6.2.12 [0x2B] Get System Information

This command reads system information from a transponder.

REQUEST-DATA

4	5	(6-13)
0x2B	MODE	UID

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

RESPONSE-DATA

5	6-13	14	15-16	17		
DSFID	UID	AFI	MEM-SIZE	IC-REF	⇐	ISO Transponder
'0'	Only LS 32bits valid	Manufacturer Code	MEM Size	Chip Version	⇐	Tag-it HF

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	Non-addressed
b001	Addressed
b010	Selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

DSFID
Data Storage Format Identifier of transponder.

AFI
Application Family Identifier. If not supported by transponder, this value will return {0x00}.

MEM-SIZE
Memory size of the transponder. If not supported by the transponder, this value will return {0x0000}.

Byte	15		16
Bit	7 .. 4	3 .. 0	7 .. 0
Content	Reserved	Block size in bytes	Number of blocks

IC-REF
Transponder IC reference. If not supported by transponder, this value will return {0x00}.

6.2.13 [0x2C] Get Multiple Block Security Status

This command reads the public block security status from a transponder.

REQUEST-DATA

4	5	(6-13)	6 / (14)	7 / (15)
0x2C	MODE	UID	DB-ADR	DB-N

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

RESPONSE-DATA

5	6
DB-N	SEC-STATUS
	Repeated DB-N times

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	non-addressed
b001	addressed
b010	selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

DB-ADR
First block number from which security status is requested. First block number can be any value between 0 and 255.

DB-N
Number of security status bytes to be read starting at DB-ADR. Maximum number of DB-N is 32

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

SEC-STATUS
Block security status.

SEC-STATUS	
b00000000	unlocked
b00000001	user locked
b00000010	factory locked

Note:

This command is only available for ISO transponders.

6.2.14 [0xA3] Inventory Read Multiple Blocks

This command reads the serial number (UID), DSFID and one or more data blocks of all transponders inside the antenna field. If the reader has detected a new transponder, the transponder will be automatically set in the quiet state by the reader. In this state the transponder does not send back a response for the next command.

The transponder sends back a response every time:

- if the transponder has left the antenna and re-entered the antenna field or
- a [0x69] RF Reset command was send to the reader or
- if the ONT bit in the ONT register of the CFG13: Anticollision configuration block is not set

if anticollision is set OFF in CFG 10: General System Parameter.

REQUEST-DATA

4	5	6	7
0xA3	MODE	DB-ADR	DB-N

RESPONSE-DATA

5	6	7	8-15	16	17-n
DATA-SETS	DB-SIZE	DSFID	UID	SEC-STATUS	DB
				Repeated DB-N times	
	Repeated DATA-SETS times				

MODE

Bit	7	6	5	4	3	2	1	0
Function	MORE	-	-	-	SEC	-	-	-

SEC

SEC	
b0	SEC-STATUS always = {0x00}
b1	Security status of following data block in SEC-STATUS

MORE

MORE	
b0	New command requested
b1	More data requested

DB-ADR
First block number to be read. First Block number can have any value between 0 and 255.

DB-N
Number of data blocks to be read from transponder, starting at DB-ADR. Maximum number of DB-N is 32.

DATA-SETS
Number of transponder datasets to be transferred in this Reader response.

DB-SIZE
Number of bytes of one data block.

DSFID
Data Storage Format Identifier of the transponder.

UID
Read only serial number of the transponder.

SEC-STATUS
Block security status of following data block. If not used, this value will return {0x00}.

SEC-STATUS	
b00000000	unlocked
b00000001	user locked
b00000010	factory locked

DB
Requested data block. Block size is defined by DB-SIZE.

Note:

This command is only available for Tag-it HF-I transponders.

6.2.15 [0xAB] Inventory Get System Information

This command reads the serial number (UID), DSFID and system information from all transponders inside the antenna field. If the reader has detected a new transponder,

the transponder will be automatically set in the quiet state by the reader. In this state the transponder does not send back a response for the next command.

The transponder sends back a response every time:

- if the transponder has left the antenna and reentered the antenna field
  or
- a [0x69] RF Reset command was send to the reader
  or
- if the ONT bit in the ONT register of the CFG13: Anticollision configuration block is not set

if anticollision is set OFF in CFG 10: General System Parameter.

REQUEST-DATA

4	5
0xAB	MODE

RESPONSE-DATA

5	6	7-14	15	16-17	18
DATA-SETS	DSFID	UID	AFI	MEM-SIZE	IC-REF
	Repeated DATA-SETS times				

MODE

Bit	7	6	5	4	3	2	1	0
Function	MORE	-	-	-	-	-	-	-

MORE

MORE	
b0	new Command requested
b1	more data requested

DATA-SETS
Number of transponder datasets to be transferred in this Reader response.

DSFID
Data Storage Format Identifier of the transponder.

UID
Read only serial number of the transponder. UID is only required in addressed mode.

AFI
Application Family Identifier. If not supported by transponder, this value will return {0x00}.

MEM-SIZE
Memory size of the transponder. If not supported by transponder, this value will return {0x0000}.

Byte	15		16
Bit	7 .. 4	3 .. 0	7 .. 0
Content	Reserved	Block size in bytes	Number of blocks

IC-REF
IC reference of the transponder. If not supported by transponder, this value will return {0x00}.

Note:

This command is only available for Tag-it HF-I transponders.

6.2.16 [0xAC] Inventory Get Multiple Block Security Status

This command reads the serial number (UID), DSFID and the public block security status from all transponders inside the antenna field. If the reader has detected a new transponder, the transponder will be automatically set in the quiet state by the reader. In this state the transponder doesn't send back a response for the next command.

The transponder sends back a response every time:

- if the transponder has left the antenna and reentered the antenna field
  or
- a [0x69] RF Reset command was send to the reader
  or
- if the ONT bit in the ONT register of the CFG13: Anticollision configuration block is not set

if anticollision is set OFF in CFG 10: General System Parameter.

REQUEST-DATA

4	5	6	7
0xAC	MODE	DB-ADR	DB-N

RESPONSE-DATA

5	6	7-14	15-n
DATA-SETS	DSFID	UID	SEC-STATUS
	Repeated DATA-SETS times		

MODE

Bit	7	6	5	4	3	2	1	0
Function	MORE	-	-	-	-	-	-	-

MORE

MORE	
b0	New Command requested
b1	More data requested

DB-ADR
First block number to be read. First block number can have any value between 0 and 255.

DB-N
Number of data blocks to be read from the transponder, starting at DB-ADR. Maximum number of DB-N is 32.

DATA-SETS
Number of transponder datasets to be transferred in this Reader response.

DSFID
Data Storage Format Identifier of the transponder.

UID
Read only serial number of the transponder. UID is only required in addressed mode.

SEC-STATUS
Block security status.

SEC-STATUS	
b00000000	unlocked
b00000001	user locked
b00000010	factory locked

Note:

This command is only available for Tag-it HF-I transponders.

6.3 [0xB1] Host commands for ISO15693 Custom and Proprietary Commands

These commands send defined custom commands to the transponder.

Host ® Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xB1]	MFR	REQUEST-DATA	CRC16

Host ¬ Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xB1]	STATUS	RESPONSE-DATA	CRC16

MFR

Manufacturer code

MFR	
0x07	Texas Instruments

REQUEST-DATA

Manufacturer-specific request

RESPONSE-DATA

Manufacturer-specific response

Notes:

Data is only transferred if STATUS = {0x00, 0x83, 0x84, 0x90, 0x93, 0x94, 0x95}.

This command is not available if Buffered Read Mode is switched on.

6.3.1 [0xA2] Write 2 Blocks

This command writes two data blocks. The first block should always have an even address (e.g. 0 or 2).

REQUEST-DATA

5	6	(7-14)	7 / (15)	8 / (16)	9-12 / (17-20)	13-16 / (21-24)
0xA2	MODE	UID	DB-ADR	DB-SIZE	even DB	odd DB

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	Non-addressed
b001	Addressed
b010	Selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

DB-ADR
First block number to be written (second block will be written to the succeeding block number).

DB-SIZE
Number of bytes in one data block.

DB
Block data to be written to the transponder.

ISO-ERROR
Transponder response ISO error code. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for Tag-it HF-I transponders.

6.3.2 [0xA3] Lock 2 Blocks

This command locks two data blocks. The first block should always have an even address (e.g. 0 or 2).

REQUEST-DATA

5	6	(7-14)	7 / (15)
0xA3	MODE	UID	DB-ADR

RESPONSE-DATA (STATUS = {0x95})

5
ISO-ERROR

MODE

Bit	7	6	5	4	3	2	1	0
Function	-	-	-	-	-	ADR		

ADR

ADR	
b000	non-addressed
b001	addressed
b010	selected

UID
Read only serial number of the transponder. UID is only required in addressed mode.

DB-ADR
First block number to be locked (second block that will be locked is the succeeding block).

ISO-ERROR
ISO error code of transponder response. This byte is only available if STATUS = {0x95}.

Note:

This command is only available for Tag-it HF-I transponders.

6.4 [0xBF] ISO15693 Transparent Command

These commands send user-transparent commands to the transponder.

Host ® Reader

1	2	3	4	5-6
n	COM-ADR	[0xBF]	MODE	RSP-LENGTH

MODE 1+2	7-8	9...n-2	n-1,n
	CMD-RSP-DELAY	REQUEST-DATA	CRC16

MODE 3+4	7-8	9 – 10	11 ... n-2	n-1,n
	CMD-RSP-DELAY	EOF-PULSE-DELAY	REQUEST-DATA	CRC16

Host ¬ Reader

1	2	3	4	5...n-2	n-1,n
n	COM-ADR	[0xBF]	STATUS	RESPONSE-DATA	CRC16

MODE
Request Options

1 = Read request
Response is sampled corresponding to CMD-RES-DELAY

2 = Write request with “0” Option
Reader tries to sample the response after CMD-RES-DELAY + a multiple of 302µs. If there is no response within 20ms, the command sends back the “no transponder” [0x01] status.

3 = Write request with “1” Option
Reader tries to sample the response after CMD-RES-DELAY. If there is no response, the Reader sends an EOF after EOF-PULSE-DELAY and tries to sample the response after CMD-RES_DELAY.

4 = Inventory request
Reader tries to sample the response after CMD-RES-DELAY.
If the ISO15693 “Nb_slot_flag” Flag is:

“0”
Reader sends an EOF after EOF-PULSE-DELAY and tries again to sample the response in the next timeslot (after CMD-RES_DELAY). This is carried out 16 times. In this case the RSP-LENGTH defines the response length in one timeslot. Transponder responses with other response lengths will by ignored. If there is a CRC error in one of the timeslots, the protocol status is set to 0x02 [CRC error]. The user must calculate which transponder data contains the CRC error.

“1”
Reader sends back the data received.

RSP-LENGTH
Length of transponder response in bits without SOF and EOF. If the Error flag in the transponder response is set, the length of the sample data is 4 bytes.

CMD-RSP-DELAY
Response delay for transponder response (ISO15693: t1)
e.g. ISO15693 average value: {0x021F} * 590ns = 320.9µs

EOF-PULSE-DELAY
EOF Pulse delay is used in write operations with the ISO15693 “1” write option to define the EOF response delay for transponder response (ISO15693: t1) e.g. ISO15693 maximum value: {0x846A} * 590ns = 20ms.

REQUEST-DATA
Complete transponder request without SOF, CRC16 and EOF

Note:

The read and write option FLAGS in REQUEST-DATA must correspond to the MODE Byte in the request protocol. Reader always forces command as specified by MODE Byte in request protocol.

RESPONSE-DATA
Complete transponder response without SOF and EOF. A CRC16 check is made inside the Reader. The transponder CRC16 is transferred with the response data.

Notes:

Data is only transferred if STATUS = {0x00, 0x02, 0x83, 0x84, 0x94}.

Response data always contains the number of data bytes defined in RSP-LENGTH.

This command is only available for ISO transponders.

This command is not available if Buffered Read Mode or Scan Mode is switched on.

CHAPTER 7

Buffered Read Mode Protocols

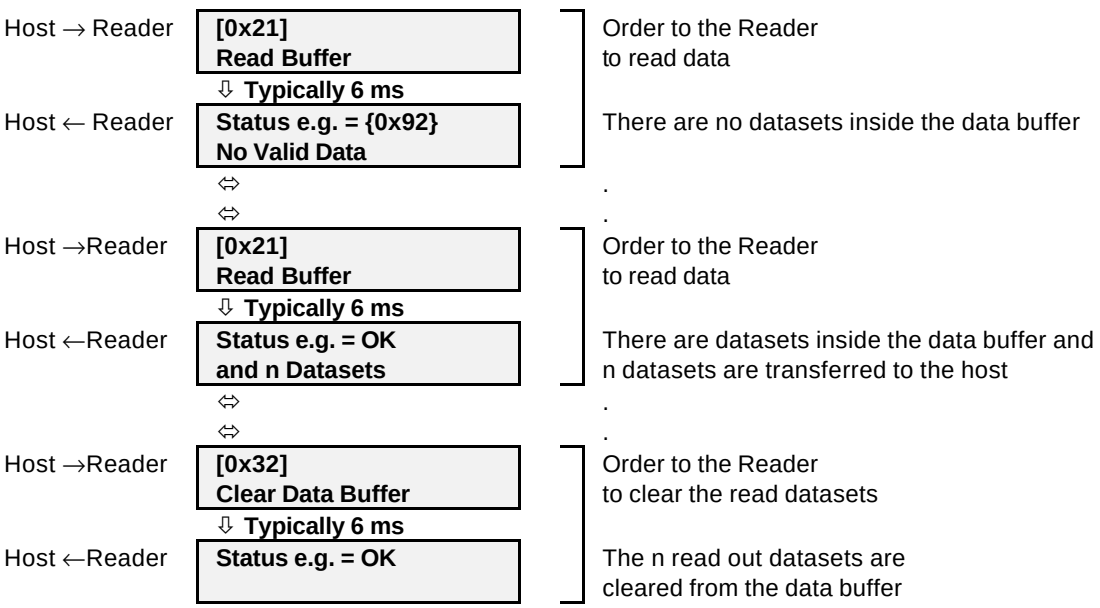
Topic **Page**

7.1 The Buffered Read Mode Procedure

By using Buffered Read Mode, the Reader itself reads data from every transponder inside the antenna field. This mode must be enabled in the CFG10: General System Parameters configuration block and configured in the CFG11: Buffered Read Mode configuration block.

The transponder datasets sampled are stored in a FIFO data buffer inside the Reader. Buffered Read Mode runs independently of any host commands and is immediately started after power-up or a [0x63] CPU Reset command.

To read sampled transponder datasets, only two commands are necessary. The figure below shows the principle of the Buffered Read Mode procedure:



⇩ Host waits for an answer from Reader

⇔ Host is able to do other jobs e.g. communicate with other Readers

Additional information about data buffer capacity can be determined with the [0x31] Read Data Buffer Info command.

Note:

Buffered Read Mode is currently only available for Tag-it HF transponders.

7.2 Transponder Access in the Buffered Read Mode

Buffered Read Mode only reads data blocks from transponders in the antenna field. The anticollision procedure can be configured in the CFG13: Anticollision configuration block and enabled in the CFG10: General System Parameters configuration block.

In Buffered Read Mode, all transponder types enabled in the CFG3: RF-Interface configuration block are used.

7.3 [0x21] Read Buffer

The Read Buffer command reads a specified number of datasets from the data buffer.

Host ® Reader

1	2	3	4	5,6
6	COM-ADR	[0x21]	DATA-SETS	CRC16

Host ¬ Reader

1	2	3	4	(5)	(6)
6 / (n)	COM-ADR	[0x21]	STATUS	TR-DATA	DATA-SETS

(7...n-2)	5-6 / (n-1,n)
DATA	CRC16

DATA-SETS
Number of datasets to be transferred from the data buffer. If the data buffer does not contain the requested number of datasets, the Reader responds with al available datasets and an error occurs. The Reader will reduce the number of datasets if the maximum number of 256 bytes for the answer protocol is exceeded.

TR-DATA
Selects data types for read operation.

Bit	7	6	5	4	3	2	1	0
Function	-		TIMER	-	-	-	DB	SNR

SNR = Serial Number

DB = Data Block

TIMER = internal system timer (see chapter 4.5 [0x85] Set System Timer for details)

DATA

Requested number of datasets from the data buffer. Only selected data will be transferred to the host. See chapter 3.4.2 CFG11: Buffered Read Mode for details. Each dataset has the following structure:

Data Type			DATA	
Serial Number	Byte no.	**1**	**2-9**	
		TR-TYP	SNR	
Data Blocks	Byte no.	**1**	**2**	**3-6 ... 3-66**
		DB-ADR	DB-N	DB
Timer	Byte no.	**1-4**		
		TIMER		

Notes:

This command reads the same datasets until they are cleared with the [0x32] Clear Data Buffer command.

This command is only available in Buffered Read Mode.

Data is only transferred if STATUS = {0x00, 0x83, 0x84, 0x90, 0x93, 0x94}.

APPENDIX A

Transponder Type Codes

Value	Transponder type
0x01	Tag-it HF
0x03	Tag-it HF-I or other ISO 15693 compliant transponders

APPENDIX B

Asynchronous Interface Timing

Reaction times of the asynchronous interface depend on:

- Amount of data to be read or written
- Type and amount of transponders supported by Reader
- Position of transponder at time of request
- Local electromagnetic interference, if present
- Success or failure of request

	Min.	Typical	Max.	Unit
EE-Parameter change **1 Block (16 Bytes)** **All (16) Blocks**	5	22 340	300 600	ms ms
RF Reset		15		ms
Host Commands for ISO 15693 Mandatory and Optional Commands	5	See note 1)	See note 2)	ms
Host Commands for ISO 15693 Custom and Proprietary Commands	5	See note 1)	See note 2)	ms
ISO 15693 Transparent Command	5	See note 1)	See note 2)	ms

Note:

1) See Appendix C for details.

2) As configured in CFG2: Com-Interface, COM-TIMEOUT.

APPENDIX C

ISO Host Command Timing

Reaction times for ISO Host Commands depend on:

- Number of transponders in antenna field (duration of anticollision process)
- Amount of data to be read or written
- Types of transponders supported by Reader
- Position of transponder at time of requirement
- Local electromagnetic interference, if present

	Typical	Unit
	Tag-it HF	
Inventory with 1 Transponder:		
1 timeslot	-	ms
16 timeslots	50	ms
Read Multiple Blocks:		
1 Block, non-addressed	13	ms
1 Block, addressed	18	ms
4 Blocks, non-addressed	44	ms
4 Blocks, addressed	66	ms
Write Multiple Blocks (1 Block, non-addressed):	27	ms
Write Multiple Blocks (1 Block, addressed):	33	ms
Write Multiple Blocks (4 Blocks, non-addressed):	104	ms
Write Multiple Blocks (4 Blocks, addressed):	126	ms

Time Behavior for Tag-it HF-I Transponders

All times apply to the following parameters: ISO-MODE = 0x0F (see chapter CFG8: General Transponder Parameters)

Fast Mode (1 / 4)

High Data Rate

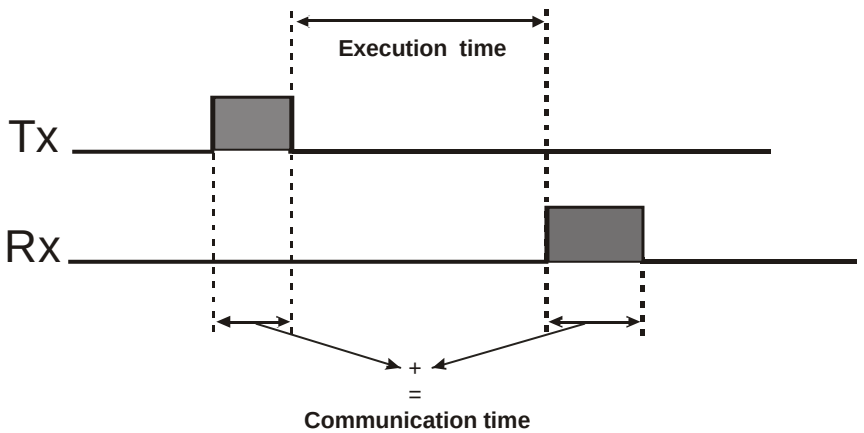
AFI disabled

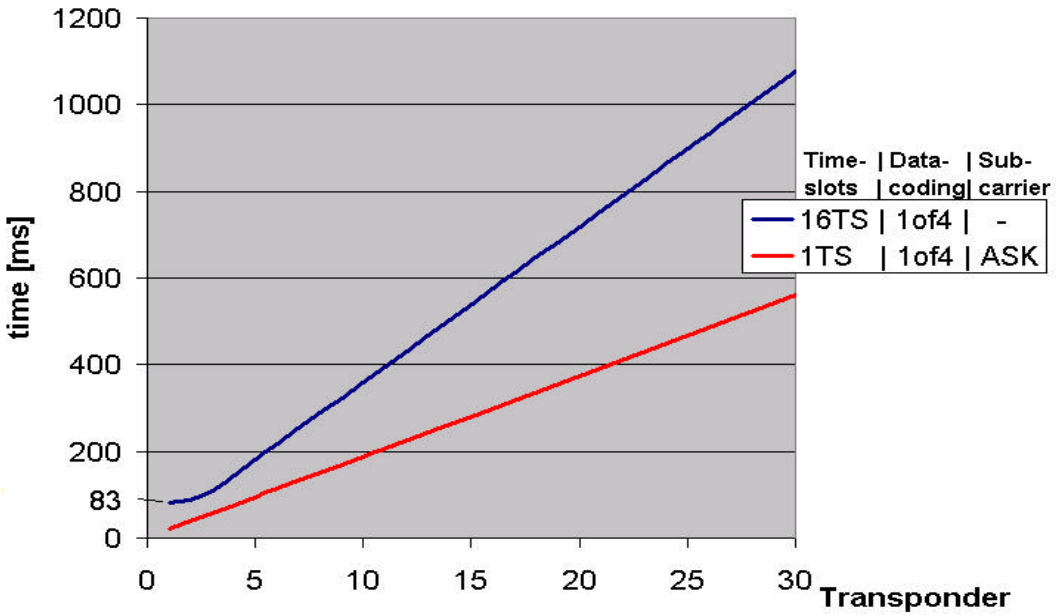
The modulation and the subcarrier have a hardly measurable influence of the reaction time.

Time Behavior for [0x01] Inventory

The following diagrams show the average value of timing behavior, dependent on the number of transponders. For certain UID's the real timing can by higher or lower as show below.

The timing is measured inclusive of the communication time at 115Kbaud. A modified Baud rate will slightly increase the timing but the Inventory timing is mostly determined by the anticollision so the communication time can be neglected.





The measurement scenario for the average values is a worst case scenario where the transponders are static and close to the antenna. The results will be better if the transponders are moving or at different distances to the antenna.

The 1 timeslot configuration is possible only by using the ASK (i.e. one subcarrier) configuration.

The diagram for 1 timeslot stops at approximately 30 transponders. The reason for this is that in the measurement scenario (transponders close to the antenna), the execution time will quickly rise with more than 30 transponders. If more than about 30 transponders are present, it is advisable to use the 16 timeslot configuration. Switching the value from the 1 timeslot configuration to the 16 timeslots configuration depends on the application. The value of 30 transponders is a average value. It is possible to increase or decrease this value in certain applications.

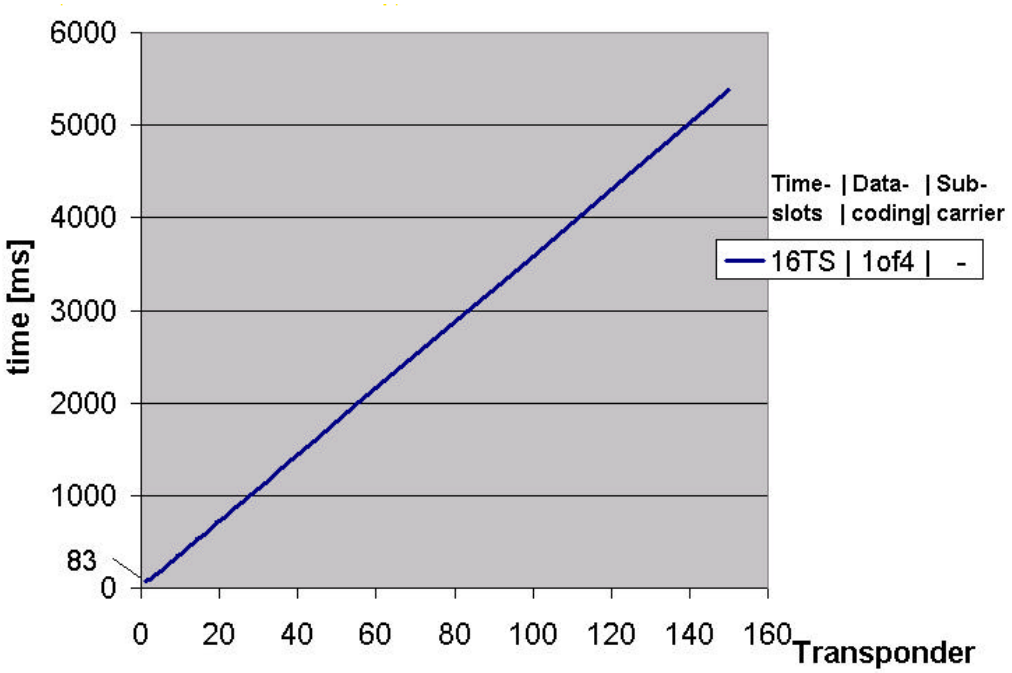
This may be increased if the application meets the following criteria:

- Small size of the transponders in relation to the reader antenna
- Transponders at different distances from the antenna

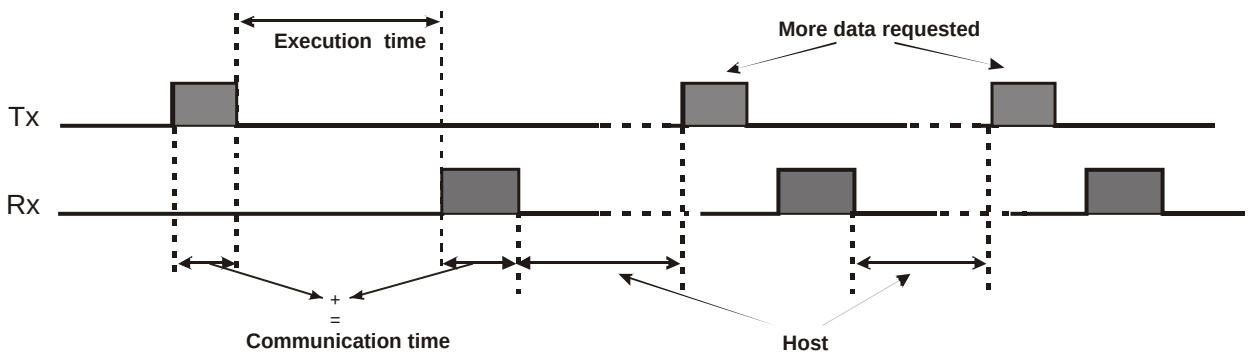
This should be decreased if the application meets the following criteria:

- Large size of the transponders in relation to the reader antenna
- Transponders at the same distance from the antenna
- Transponders very close to the antenna

The timing diagram with 16 timeslots and 1 to 150 transponders shows the timing of the inventory including the communication time. The timing will be achieved in buffered read mode.



Please consider that the timing of the inventory command [0xB0 0x01] is influenced by the “More Bit”. The “More Bit” is set if the number of transponders exceeds 24. If the “More bit” is set in the response of the reader to the inventory command, the communication time is influenced by the speed of the host system.



functions		Execution time (ms)		Communication time at 115 kBaud (ms)	
		addressed	selected	addressed	selected
Stay Quiet		5.6	-	2.1	
Select		7	-	2.1	
Reset to Ready		7	5.3	2.1	1.3
Get System Information		11.5	9	3.3	2.5
Get multiple block security status	1 block	11.5	8.5	2.5	1.7
	2 block	12	9	3	1.75
	8 block	14	11	3.15	2.4
	32 block	22	19	5.4	4.65

Read	Tag-it HF-I					
	Execution time (ms)				Communication time at 115 kBaud (ms)	
	without security-block		with security-block			
	addressed	selected	addressed	selected	addressed	selected
1 block 4Byte	13	10	13	10	3	2.2
2 block 8Byte	14	12	15	12	3.5	2.6
8 block 32 Byte	22	20	26	22	6.3	5.5
32 block 128 Byte	54	52	65	62	18.7	17.9

Write	Tag-it HF-I							
	WR-Option = 1							
	Execution time (ms)				Communication time at 115 kBaud (ms)			
	write Data Block		lock Data Block		write Data Block		lock Data Block	
	addressed	selected	addressed	selected	addressed	selected	addressed	selected
1 block 4Byte	35	31	33	30	2.7	2	2.5	1.7
2 block 8Byte	64	59	61	56	3.1	2.3	2.5	1.7
8 block 32 Byte	245	223	118	108	5.4	4.6	2.5	1.7
32 block 128 Byte	965	878	921	835	14.6	14.6	2.5	1.7

Write AFI	30	27		2.15	1.4	
Lock AFI	29	26		2.15	1.2	
Write DSFID	30	27		2.15	1.4	
Lock DSFID	29	26		2.15	1.2	

APPENDIX D

Status Bytes

Hex value	General
0x00	**OK:** Data / parameters have been read or stored without error. Control command has been executed.

Hex value	Transponder Status
0x01	**No Transponder:** No transponder is located within detection field of Reader. Transponder in detection field has been switched to Quiet Mode. Communication between Reader and transponder has been interrupted and Reader is unable to read transponder.
0x02	**Data False:** CRC16 data error in received data.
0x03	**Write Error:** Negative Validity check of written data. Attempt to write to a read-only storage area. Transponder and Reader antenna too far apart. Attempt to read in an electrically noisy environment.
0x04	**Address Error:** Required data outside logical or physical transponder address area. Address above maximum transponder address space. Address beyond configured address space of transponder.
0x05	**Wrong transponder type:** Command not applicable to transponder. Special command not applicable to transponder.
0x06	**Read Error:** Negative Validity check of data read Transponder and Reader antenna too far apart Attempt to read in an electrically noisy environment.

Hex-value	Parameter Status
0x10	**EEPROM-Failure:** Reader EEPROM cannot be written to. A faulty parameters checksum has been detected before writing into EEPROM.
0x11	**Parameter Range Error:** Value range of parameters exceeded.
0x15	**Read Protect:** Configuration block reserved for future use.
0x16	**Write Protect:** Configuration block reserved for future use.

Hex Value	Interface Status
0x80	**Unknown Command:** Reader does not support selected function.
0x81	**Length Error:** Selected function has wrong number of parameters.
0x82	**Command not available:** A ISO Host command was sent to the reader in the Buffered Read or Scan Mode. A Buffered Read Mode protocol was sent to the reader in the standard mode. The command with More bit does not correspond with the last command.
0x83	**RF communication error:** This error indicates that there is an error in communication between the transponder and the reader. Reason for this can be: Timeout for transponder communication. The collision handling algorithm was not continued until no collision is detected. Reason for the break: there are more transponders in the field than timeslots.
0x84	**RF Error:** Detailed status information can be read with [0x6E] Reader Diagnostic command. RF hardware defective. RF final stage temperature too high. RF power may be decreased or switched off. Antenna configuration not correct. Check antenna cables and antenna tuning. RF power has no value configured. Electrical environment too noisy.
0x85	**Synchronization Error:** A timeout for the synchronization input was detected and the reader is running with synchronization mode switched off.

Hex Value	Buffer Status
0x90	**Data Buffer Overrun:** Data buffer overrun occurred. Oldest data in data buffer will be overwritten in Buffered Read Mode.
0x92	**No Valid Data:** No valid data in Buffered Read Mode. No transponder in antenna field. VALID-TIME not yet finished for transponders in antenna field.
0x93	**Data Buffer Overflow:** A data buffer overflow occurred.
0x94	**More Data:** More transponder datasets requested than response protocol is capable of transferring at same time.
0x95	**ISO Error:** Additional error code for ISO transponders, sent with response data.

APPENDIX E

Control Bytes

Control Byte	Description
[0x21]	Read Buffer
[0x31]	Read Data Buffer Info
[0x32]	Clear Data Buffer
[0x33]	Initialize Buffer
[0x52]	Baud Rate Detection
[0x55]	Start Flash Loader
[0x63]	CPU Reset
[0x65]	Get Software Version
[0x69]	RF Reset
[0x6A]	RF ON/OFF
[0x6D]	Get Noise Level
[0x6E]	Reader Diagnostic
[0x71]	Set Output
[0x74]	Get Input
[0x80]	Read Configuration
[0x81]	Write Configuration
[0x82]	Save Configuration to EEPROM
[0x83]	Set Default Configuration
[0x85]	Set System Timer
[0x86]	Get System Timer
[0xB0]	Host commands for ISO15693 Mandatory and Optional Commands
[0xB1]	Host commands for ISO15693 Custom and Proprietary Commands
[0xBF]	ISO15693 Transparent Command