TEXAS INSTRUMENTS

Series 2000 Reader System
ASCII Protocol

Reference Guide

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This is the first edition of this manual, it describes the ASCII software protocol that can be used with the TIRIS Series 2000 Readers (RI-STU-MBxA, RI-STU-251B), and the Series 2000 Control Module (RI-CTL-MBxA).

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Read This First

About This Guide

This manual describes the ASCII protocol that can be used for communication between the TIRIS Series 2000 readers (RI-STU-MBxA, RI-STU-251B) and Series 2000 control module (RI-CTL-MBxA) with RFM (we will refer to this as the reader from this point on) and a host system (we will refer to this as a PC from this point on). It describes the commands that can be used, together with their effect, and provides examples of each of these commands.

Conventions

WARNING:

A WARNING IS USED WHERE CARE MUST BE TAKEN, OR A CERTAIN PROCEDURE MUST BE FOLLOWED IN ORDER TO PREVENT INJURY OR HARM TO YOUR HEALTH.

CAUTION:

This indicates information on conditions which must be met, or a procedure which must be followed, which if not heeded could cause permanent damage to the equipment or software.

Note:

Indicates conditions which must be met, or procedures which must be followed, to ensure proper functioning of the equipment or software.

Information:

Indicates information which makes usage of the equipment or software easier

If You Need Assistance

Application Centers are located in Europe, North and South America, the Far East and Australia to provide direct engineering support. For more information, please contact your nearest TIRIS Sales and Application Center. The contact addresses can be found on our home page:

http://www.tiris.com

Document Overview

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Introduction

This chapter will introduce you to the ASCII protocol. It explains the environment in which the protocol is used, system modes, functions, and how the different types of transponder used by TIRIS systems are identified.

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1.1   Product Description

This is a simple protocol that you can use to send ASCII character commands to the reader. It is possible to use a standard terminal emulator program to send ASCII commands. The ASCII protocol can only be used with RS232 or RS422.

1.1.1   Microcomputer Reset

TIRIS readers and control modules are equipped with a reset circuit which resets them after power-up and if a supply voltage break-down occurs. A built-in watch-dog function secures re-initialization should a microcomputer malfunction happen. After each initialization the ASCII character STX (STX = 2_{dec}), together with **carriage return** and **line feed** are transmitted via the serial interface. Any characters which may be transmitted before the STX character are random characters caused by power-on of the interface circuit and are not relevant.

1.1.2   Transmit Function

The reader can operate in four different modes. In EXECUTE mode the reader triggers a single command. In NORMAL, LINE and GATE modes (GATE mode is only possible in K0) the read function is continuously triggered by the reader or control unit. The time between two readout cycles depends on the data processing time and the duty cycle pause. While the RF Module is in the transmitting phase, the red ACTIVE LED is activated.

1.2   Transponder Detection (RO, R/W or MPT)

The TIRIS readers and control modules are able to distinguish between three transponder types, they are:

Read Only =	RO
Read/Write =	R/W
Multipage =	MPT

A character reflecting the transponder type is transmitted to the Computer (PC) within the serial protocol. The characters are: R for Read Only, W for Read/Write, and M for Multipage Transponders.

Examples:

Serial Protocol	*Comment*
`1R 0000 0000000120672337<CR><LF>`	RO detected in NORMAL mode (K1)
`R 0000 0000000130655388<CR><LF>`	RO detected in NORMAL mode (K0)
`LW 0000 0000000013444555<CR><LF>`	R/W detected in LINE mode (K0)
`L1W 0000 0000000013264565<CR><LF>`	R/W detected in LINE mode (K1)
`X1R 0000AFC234567ABC<CR><LF>`	RO detected in EXECUTE mode (hexadecimal output format)
`L10M 05 1234 1234123434567653<CR><LF>`	MPT detected in LINE mode
`X10M 11 FFFFFFFFFFFFFFFF<CR><LF>`	MPT detected in EXECUTE mode (hexadecimal output format)

1.3   Data Handling

1.3.1   Data Check

A data check is always performed on the data signal received from the transponder.

Three different reading status are possible when attempting to read a transponder:

- Identification correctly received

- Invalid Identification

- No Identification detected (no read)

After addressing MPTs, however, the TIRIS reader sends out different protocols as described in sections 3.1 and 3.2.

In all cases the following is true:

If the identification number is correct, the green **O.K.** LED is activated.

If a transponder protocol could not be detected, or only a start byte could be detected the green **O.K.** LED will not be activated.

In LINE or EXECUTE mode the ASCII character ' I ' will be sent to the PC if at least the start byte of a transponder protocol could be detected.

Examples:

Serial Protocol	*Comment*
`LW 0000 0000000023450607<CR><LF>`	TIRIS reader in LINE mode read correct R/W ID
`L10M 05 1234 1234123434567653<CR><LF>`	MPT detected in LINE mode
`XR 0000 5674895692567054<CR><LF>`	TIRIS reader in EXECUTE read correct RO ID
`LI<CR><LF>`	Reader in LINE mode (invalid ID)
`XI<CR><LF>`	Reader in EXECUTE mode (invalid ID)
`L<CR><LF>`	Reader in LINE mode (no read)
`X<CR><LF>`	Reader in EXECUTE mode (no read)

Note:
In a noisy environment, it could occur that the invalid ID character is generated, even when there is no transponder within the reading area.

1.3.2   Data Buffer

In NORMAL mode (see 2.4.8 and 2.5.3), a correctly received identification number is transmitted via the serial interface only if it is different to the previously received transponder identification. The comparison includes the transponder type (RO, R/W or MPT), read page (if an MPT was read) and the identification number.

For this purpose the last transponder information received is stored in an identification data buffer, located in the microcomputer RAM, and each correctly received information together with its transponder type (RO, R/W and MPT (if in Multipage Transponder mode)) are compared to the content of this buffer. The buffer is cleared by a microcomputer reset or by the PC command CLEAR (2.3.3).

1.3.3   Data Conversion

TIRIS Read Only transponders can be split into two groups with regard to their numbering system. These two groups are Animal Code numbers (according to ISO 11784/11785) described in section 1.3.3.2 and Industrial (non-Animal) numbers described in section 1.3.3.1.

Read/Write and Multipage Transponders are not affected by the ISO 11784/11785 and are therefore only for use with the Industrial numbering.

1.3.3.1   TIRIS Industrial Format

In the default decimal output format, when the most significant bit of the RO Transponder ID is 0 or for a R/W or Multipage Transponder, the 12 most significant bits of the 64-bit identification number are converted into a 4-digit decimal application code (0000 to 4095). The least significant 52 bits of the identification number are converted into a 16-digit decimal identification code (0000000000000000 to 4503599627370495).

Indicator for an Industrial string in K0 Line mode:
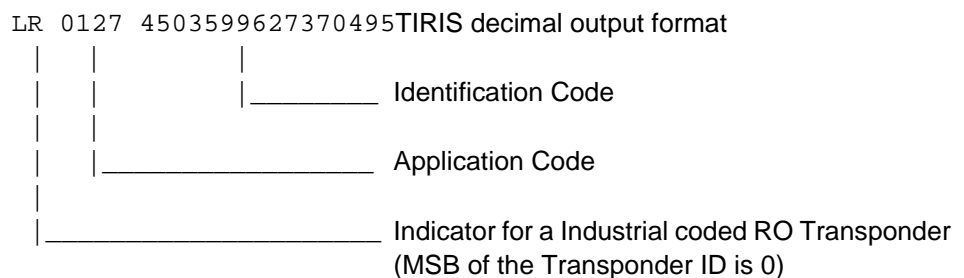
```
LR 0127 4503599627370495TIRIS decimal output format
   |    |            |
   |    |            |_____ Identification Code
   |    |
   |    |_____ Application Code
   |
   |_____ Indicator for a Industrial coded RO Transponder
                           (MSB of the Transponder ID is 0)
```

For information about changing the output format to hexadecimal, see section 2.3.2 "FORMAT command".

1.3.3.2   TIRIS Animal Format

In decimal output format and when the most significant bit of a RO Transponder ID is 1 (Animal coded Transponder ID), the 64 bits of the ID are split into five fields, described by means of an ID example below. An 'A' is always sent within the response string to indicate "Animal", instead of the 'R' to indicate a RO Transponder using the Industrial numbering.

Example:

Transponder number: 2048 0274603029037288$_{Dec}$ Or   8000F9C0000000E8$_{Hex}$

8 0 0 0 F 9 C 0 0 0 0 0 0 0 0 E 8

1000 0000 0000 0000 1111 1001 1100 0000 0000 0000 0000 0000 0000 0000 0000 1110 1000

MSB   LSB
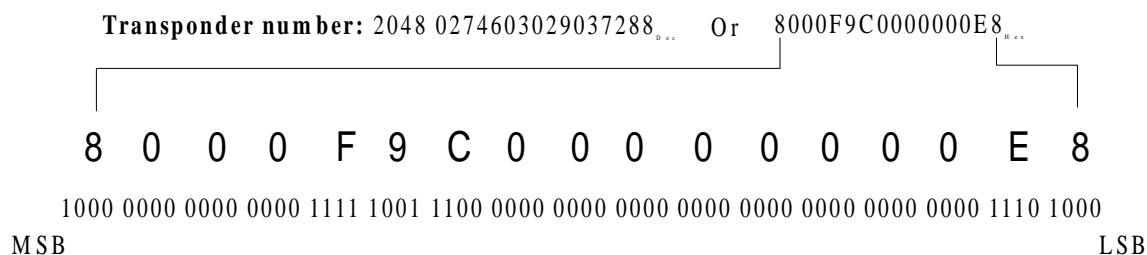
The ID Split according to ISO 11784 is:

1 Bit	14 Bits	1 Bit	10 Bits	38 Bits
1	00000000000000	0	1111110011	00000000000000000000000000000011101000

MSB   LSB

Animal coded Trp. Flag

Reserved

Additional Data Flag

ISO 3166 numeric-3 Country Code

National Identification Code

1111110011$_{Bin}$ 00000000000000000000000000000011101000$_{Bin}$
OR   OR
3E7$_{Hex}$ 0000000E8$_{Hex}$
OR   OR
999$_{Dec}$ 232$_{Dec}$

These codes are transferred in ASCII format via the serial interface using the example output format:
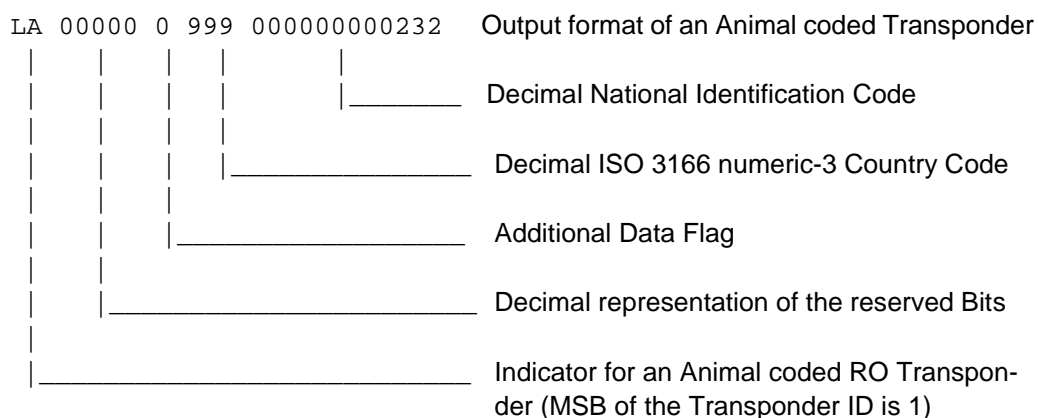
```
LA 00000 0 999 000000000232     Output format of an Animal coded Transponder
   |     |   |       |_____ Decimal National Identification Code
   |     |   |
   |     |   |_____ Decimal ISO 3166 numeric-3 Country Code
   |     |
   |     |_____ Additional Data Flag
   |
   |_____ Decimal representation of the reserved Bits
   |
   |_____ Indicator for an Animal coded RO Transpon-
                             der (MSB of the Transponder ID is 1)
```
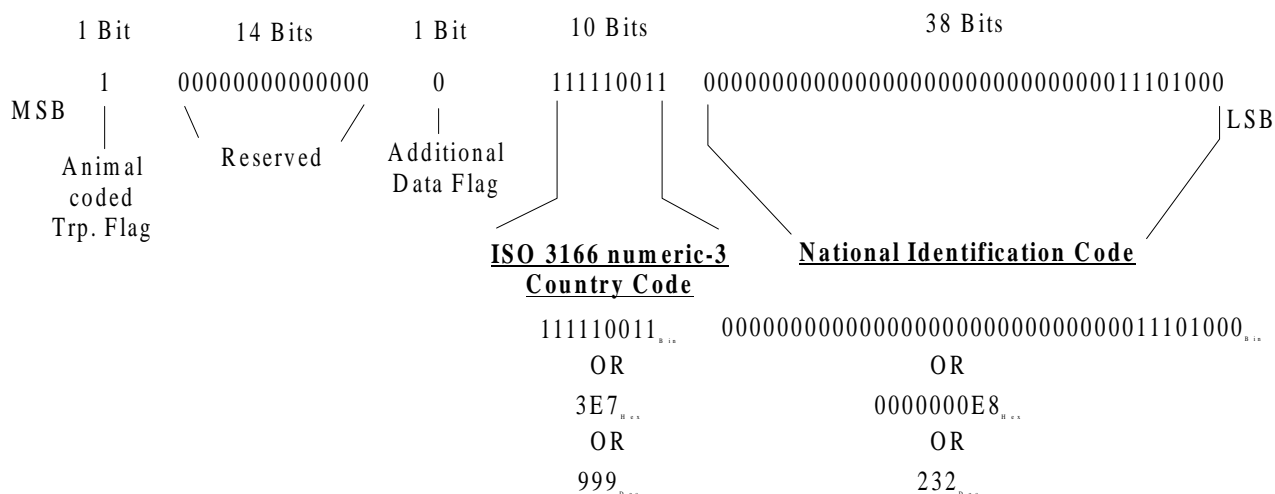
For information about changing the output format to hexadecimal, see section 2.3.2 "FORMAT command".

1.4   Handshake Mode

Data transmission from the TIRIS reader can be influenced by an external device (computer or printer) using the X_{on}/X_{off} handshake mode to prevent a communication buffer overflow. Transmission of the ASCII character X_{off} ($X_{off} = 19_{dec}$) to the Reader interrupts the data flow, but carries on reading until the internal transmission buffer is full at which time it disables the read function.

This option can be switched off during a configuration session.

Sending X_{on} ($X_{on} = 17_{dec}$) to the TIRIS reader terminates the X_{off} state and returns the system to the function that it was in before X_{off} was sent to it.

Commands

This chapter describes the commands that can be sent to the reader or control module from the controlling computer and the modes that the reader or control module can work in.

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2.1   Introduction

If a PC is connected to the interface, the transmitted application and identification codes can be stored, converted to other formats, displayed on the PC monitor or transferred to other equipment. In addition the PC can control the operation of the TIRIS reader by sending special command characters to it. All the commands that can be sent from the PC to the TIRIS reader are described in the following sections. The TIRIS reader accepts both upper and lower case command characters. In order to provide a uniform style, all examples we have given use upper-case command character.

2.2   Reader Mode Commands

All TIRIS transponder types fall into one of two groups of transponders: Multipage Transponders (MPTs) and 64-bit transponders (ROs and R/Ws). Since both of these transponder groups need different protocols, the TIRIS reader must be able to operate in two different modes.

2.2.1   64-bit Transponder Mode or K0 Mode

The commands (and responses) that can be used with 64-bit transponders in the K0 mode are described in section 2.4.

2.2.2   Multipage Transponder Mode or K1 Mode

The commands (and their responses) that can be used with multipage transponders in the K1 mode are described in section 2.5.

Note:

The GATE mode for multipage transponders is not supported in K1 mode.

2.3   General Commands

The commands that can be used in both modes (K0 and K1) are described in this section (2.3.1 to 2.3.8) these commands are listed in Table 1.

Table 1: General Commands

Character	Command	Section
B	READOUT BUFFER Command	2.3.4
C	CLEAR Command	2.3.3
F	FORMAT Command	2.3.2
H	COMBINED Command SET OUTPUTS/GET I/O STATUS	2.3.7
J	I/O Status Command	2.3.5
V	VERSION Command	2.3.1
Y	SET OUTPUTS Command	2.3.6
Z	SET CHARGE PERIOD	2.3.8

2.3.1 Version Command

The ASCII character **V** induces the TIRIS reader to transmit the version number of the software followed by **carriage return** and **line feed**.

Example:

> *PC --> Reader:*

```
V
```

> *Reader --> PC:*

```
S2500 - REV 1.1x<CR><LF>
```

2.3.2 FORMAT Command

Sending the ASCII character **F** to the TIRIS reader causes a change of the output format of page and identification number from decimal to hexadecimal format.

The character **F**, **carriage return** and **line feed** will be transmitted by the TIRIS reader when the command is accepted. Each identification following this command is done in hexadecimal format until the ESCAPE command is received.

It is now possible to set the hexadecimal format as the default format, using the TIRIS Reader Manager.

Note:

Only the responses from the TIRIS reader to the PC are influenced by the FORMAT command. The command format from the PC to the TIRIS reader must always be in hexadecimal format.

The FORMAT command can be used in the same way for both TIRIS reader modes (K0 and K1).

Example:	**Comment**
PC --> Reader:	
`F`	Initiates Format - command
Reader --> PC:	
`F<CR><LF>`	All further identifications are transmitted in hexadecimal format
Reader --> PC:	
`X1R FFFFFFFFFFFFFFFF<CR><LF>`K1 mode	
`XR FFFFFFFFFFFFFFFF<CR><LF>`K0 mode	
`L10M 05 ABCFED672889AD38<CR><LF>`K1 mode	
`R 0123456789ABCDEF<CR><LF>`K0 mode	

2.3.3   CLEAR Command

Regardless of the current transponder mode, the ASCII character **C** erases the identification buffer used in NORMAL mode and sets the ID counter used in GATE mode to zero. When this task has been performed, the TIRIS reader sends back the ASCII character **C**, **carriage return** and **line feed**.

The CLEAR command can be used in the same way for both TIRIS reader modes.

| **Example:** | **Comment** |

PC --> Reader:

C   Initiates Clear - command

Reader --> PC:

C<CR><LF>

2.3.4   READOUT BUFFER Command

The ASCII character **B** causes the TIRIS reader to transmit the ASCII character B and the content of the buffer (used in NORMAL mode, see section 1.3.2) followed by **carriage return** and **line feed** to the PC. If the buffer is empty, the TIRIS reader sends back the ASCII character **B**, **carriage return** and **line feed**.

| **Example: (ID is buffered)** | **Comment** |

PC --> Reader:

B   Initiates Readout Buffer - command

Reader --> PC:

B10M 01 0000 0000000000000001<CR><LF>

Example: (no ID is buffered)

PC --> Reader:

B

Reader --> PC:

B<CR><LF>

2.3.5   I/O STATUS Command

The ASCII character **J** causes the TIRIS reader to transmit the current status of the four lower I/O and the four higher I/O lines. The result of this function depends on the configuration of the I/O port lines. During the manufacturing process, the TIRIS reader is configured so that I/O lines 0 to 3 are set to input while I/O lines 4 to 7 are set to output. This configuration can be changed using the TIRIS Reader Manager, the new setting is then used as default.

When the TIRIS reader receives the command character **J** it echoes it back to the PC together with two ASCII characters which represent the status of the input and output lines (hexadecimally coded) followed by **carriage return** and **line feed**.

The first character after the **J** represents the status of the I/O lines 0 to 3. Table 2 shows the relationship between the character and the status of the lines.

Table 2: Input Line Status

Returned Character	Status of I/O 3	Status of I/O 2	Status of I/O 1	Status of I/O 0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

1 = Logical high, 0= Logical low

The second character after J represents the status of the I/O lines 4 to 7. Table 3 shows the relationship between the character and the status of the lines:

Table 3: Input Line Status

Returned Character	Status of I/O 3	Status of I/O 2	Status of I/O 1	Status of I/O 0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	1
7	0	1	1	1
8	1	0	0	0
9	1	0	1	0
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

Example:	**Comment**

PC --> Reader:

`J`   Command character

Reader --> PC:

`J2A<CR><LF>`   Input lines: I/O 0 = 0

                                                               I/O 1 = 1

                                                               I/O 2 = 0

                                                               I/O 3 = 0

                                     Output lines: I/O 4 = 0

                                                               I/O 5 = 1

                                                               I/O 6 = 0

                                                               I/O 7 = 1

2.3.6   SET OUTPUTS Command

The ASCII character **Y** followed by an ASCII character in the range **0** to **F** causes the TIRIS reader to switch four output lines. The way that this works depends on the configuration of the I/O port lines. During the manufacturing process, the TIRIS reader is configured so that I/O lines 0 to 3 are set to input while I/O lines 4 to 7 are set to output and all the output lines are set to 1. This default configuration can be changed to a customer specific configuration.

In order for this command to function correctly, a configuration that sets one of the I/O groups to output is required. This command reads the configuration information and sets the output level (0 or 1) of the I/Os which are configured to outputs.

If both groups of I/O lines are configured to output, only I/O lines 4 to 7 are set by the SET OUTPUTS command. When both groups of I/O lines are configured to outputs you need to use the COMBINED command (described in section 2.3.7).

If both groups of I/O lines are configured to input, the command will not have any effect.

The relationship between the number (0 to F) and the setting of the output lines is given in table 3.

Table 4: Output Line Settings

ASCII Character	Status of I/O 7	Status of I/O 6	Status of I/O 5	Status of I/O 4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1

Table 4: Output Line Settings

ASCII Character	Status of I/O 7	Status of I/O 6	Status of I/O 5	Status of I/O 4
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

1 = Logical high, 0= Logical low

Once the TIRIS reader has received the command character **Y** it echoes it to the PC in order to indicate that the TIRIS reader is ready to receive a parameter (range: 0 to F) specifying the logic output level. Once the command has been executed the TIRIS reader sends **carriage return** and **line feed** back to the PC.

Note:

In order to prevent the TIRIS reader from damage please take care not to exceed the Electrical Characteristics, given in the relevant manual.

Example:	**Comment**
PC --> Reader:	
Y	Command character
Reader --> PC:	
Y	
PC --> Reader:	
1	Output lines: I/O 4 = 1
	I/O 5 = 0
	I/O 6 = 0
	I/O 7 = 0
Reader --> PC:	
<CR><LF>	

2.3.7   COMBINED Commands - SET OUTPUT & GET I/O Status

This command combines and extends the I/O STATUS command (2.3.5) and SET OUTPUTS command (2.3.6). Once the TIRIS reader has received the command character **H** it echoes it to the PC in order to indicate that the TIRIS reader is ready to receive further parameters specifying the operation to the I/O ports.

The following parameter (ASCII character) can either be:

I	to specify get the status of input ports, followed by:
port specifier	in the range of 0...4 (Table 4 lists the ports specified)

or

O	to specify that outputs are to be set, followed by
port specifier	in the range of 0...3 (Table 4 lists the ports specified)
logical operation	in the range of 0...4 (Table 5 describes the logical operations)
port value	two ASCII characters (Table 6 shows the port values)

If neither **I** or **O** follows the H command, or if the port specifier and the values for the logical operation are out of their range, **carriage return** and **line feed** are returned, and no action is performed. Table 5 shows the assignment for the ports.

Table 5: Port Specifier for H Command

Port Specifier (ASCII Character)	Description
0	Open Collector Outputs
1	I/O Port 0...7
2	I/O Port 0...3
3	I/O Port 4...7
4	IN 0/1

Table 6 shows the possible logical operations to write to an output. The port value is either written directly to the output or the port status is read and a logical operation is performed with the port value, the result of this operation is written back to the port.

Table 6: Logical Operation for H Command

Logical Operation (ASCII Character)	Description
0	Port value is written directly to the output
1	Read status ANDed with port value
2	Read status ORed with port value
3	Read status XORed with port value
4	Read status is inverted (the port value is in this case meaningless)

Table 7 shows the value or status of the specified port.

Table 7: Port Value

Status or Port Value	Description
00 to 03	Open Collector Outputs
00 to FF	I/O Port 0 to 7
00 to 0F	I/O Port 0 to 3
00 to 0F	Port 4 to 7
00 to 03 (only status)	IN 0/1

Example 1	*Comment*

PC --> Reader:

H

Reader --> PC:

H

PC --> Reader:

I2	Get Input status of port lines 0...3

Reader --> PC:

03<CR><LF>	Return Port status 0...3; in this example I/O lines 0&1 of the I/O port 0...3 are set to 1 I/O lines 2&3 of the I/O port 0...3 are set to 0

Example 2	*Comment*

PC --> Reader:

H	Assuming, Open Collector outputs were previously set to OC0=0 and OC1=1

Reader --> PC:

H

PC --> Reader:

O0400	Invert current output settings of the Open Collector outputs. They are now set to OC0=1 and OC1=0

Reader --> PC:

<CR><LF>

Example 3	**Comment**

PC --> Reader:

H	Assuming, I/O port lines 0...7 are configured to Output and previously set to 'A5'

Reader --> PC:

H

PC --> Reader:

O133F	Set outputs 0...7 Logical operation: XOR Prior output status: A5 Port value: 3F

```
I/O 7              I/O 0      status
      1 0 1 0 0 1 0 1
XOR   0 0 1 1 1 1 1 1  port value
      1 0 0 1 1 0 1 0  new output status
```

Reader --> PC:

`<CR><LF>`

Note:

The result of the logical operation depends on the configuration of the I/O 0...7. The TIRIS reader is preconfigured to:

      I/O 0...3   INPUT

      I/O 4...7   OUTPUT   all set to 1

This configuration can be changed, using the TIRIS Reader Manager.

2.3.8   SET CHARGE PERIOD Command

The charge-up period to charge-up a transponder can be set in steps of 1 ms in the range: 15 ms to 255 ms.

The ASCII character **Z** and two further ASCII characters (in the range of **0** to **9** and **A** to **F**) specify the charge period. This hexadecimal number is translated into an actual time (for example: 32 = 50 ms, 64 = 100 ms and C8 = 200 ms), which will cause the TIRIS reader to change the charge period. This new charge period is valid until the TIRIS reader is either reset or powered-up again. The default charge period can be set using the configuration utility software, but the charge period can still be modified using this command.

If you try to set the charge period at less than 15 ms, the current charge period will not be changed.

Note:

Changing the charge period has a great influence on the synchronization with other readers.

All Readers which should be synchronized must be configured with the same charge period.

The TIRIS reader is preconfigured to 50 ms charge period.

Example	**Comment**
PC --> Reader:	
`Z`	
Reader --> PC:	
`Z`	
PC --> Reader:	
`20`	Set charge period to 32 ms
	$20_{hex} = 32_{dec}$
Reader --> PC:	
`<CR><LF>`	

2.4   64-Bit Transponder - K0 Mode

The commands that can be used in the K0 mode for use with 64-bit transponders are described in this section (2.4.1 to 2.4.9) these commands are listed in Table 8.

Table 8: 64-bit Transponder Commands

Character	Command	Section
Esc	NORMAL Mode/ESCAPE	2.4.1
G	GATE Mode	2.4.2
L	LINE Function	2.4.7
N	NUMBER Command	2.4.6
P	PROGRAM Command	2.4.9
R	RAM FILL Command	2.4.5
S	STORE Command	2.4.3
U	ANTENNA Commands	2.4.10
X	EXECUTE Command	2.4.1
?	READ MEMORY Command	2.4.4

2.4.1   EXECUTE Command

The ASCII character **X** switches the TIRIS reader to a single readout mode and triggers a single readout sequence. After the readout the TIRIS reader is in an idle loop, waiting for the next command.

When an identification number is received and it is a valid number, the TIRIS reader transmits the ASCII character **X**, the **transponder type character**, **space**, **4-digit application code**, **space**, **16-digit identification code**, **carriage return** and **line feed** to the PC. If the system does not read an identification number, the ASCII character **X** (**XI** if the identification was not valid), **carriage return** and **line feed** are transmitted.

Examples: Comment

Reader --> PC:

```
XR 4095 4503599627370495<CR><LF>   RO type correctly read
XW 2095 3453577809046784<CR><LF>   R/W type correctly read
X<CR><LF>                          No read
XI<CR><LF>                         Invalid identification
```

2.4.2   GATE Mode

In the GATE mode each correct identification number is compared with the identifications stored in the identification memory. If the identification number is new, it is then stored in the identification memory.

The ASCII character **G** activates a continuous readout mode. The TIRIS reader confirms with the ASCII character **G**, **carriage return** and **line feed**. Each time that a new identification is stored in the identification memory the ASCII character **G**, the **transponder type character**, **spac**e, the **actual memory count number**, **space**, **application code**, **space**, **identification code**, **carriage return** and **line feed** are transmitted via the interface.

When the identification is stored in location 909, the warning *** MEMORY FULL**, **carriage return** and **line feed** are also transmitted to the PC. After the warning the GATE mode is still active but no more identifications are transmitted to the PC.

When GATE mode is selected the K command is disabled as it is not possible to have GATE mode in Multipage transponder mode.

Example:

PC --> Reader:
```
G
```

Reader --> PC:
```
G<CR><LF>
GR 001 4095 4503599627370495<CR><LF>


GM 400 3033 1324364758692037<CR><LF>


GW 909 2047 2345678901234567<CR><LF>
* MEMORY FULL<CR><LF>
```

2.4.3   STORE Command

The ASCII character **S** causes transmission of all stored identification numbers from the memory to the PC together with the memory location where the identification number is stored. Each transmitted line consists of the **transponder type character**, **space**, the **memory location**, **space**, **application code**, **space**, **identification code**, **carriage return** and **line feed**. For hexadecimal format refer to the description of the FORMAT command earlier in this section.

When the transmission has been completed the TIRIS reader transmits the ASCII character **S**, **carriage return** and **line feed**. As described in section 1.4, the transmission of this data can be influenced by X_{on}/X_{off} (if enabled).

Example: (three ID's are stored)

PC --> Reader:
```
S
```

Reader --> PC:
```
R 001 4095 4503599627370495<CR><LF>
W 002 0000 0000000000000001<CR><LF>
M 003 0000 0000000000212121<CR><LF>
S<CR><LF>
```

2.4.4   READ MEMORY Command

The ASCII character **?** causes the TIRIS reader to confirm the character ?. Entering the memory location (three characters are necessary) then causes the TIRIS reader to transmit **space**, the **memory location**, **space**, the **16 digit identification code**, the **transponder type information** (the last two digits), **carriage return** and **line feed**.

Example:

PC --> Reader:

```
?
```

Reader --> PC:

```
?
```

PC --> Reader:

```
38D                             Only in hexadecimal
```

Reader --> PC: (memory location $909_{dec} = 38D_{hex}$)

```
<space>38D 0123456789ABCDEF00<CR><LF>Only in hexadecimal
```

As previously said, the last two digits (17 and 18) contain the transponder type information. In fact digit 18 carries the information as digit 17 is always 0. The information is carried as follows:

	Digit 17	Digit 18	
BINARY:	0000	0000	RO
	0000	0001	R/W
	0000	0010	MPT

Note:

The TIRIS reader acknowledges receipt of the Read Memory command by echoing the command character to indicate that it is ready to receive further data.

2.4.5   RAM FILL Command

The PC can check the memory by filling it with a pattern and then reading the memory to see if this pattern is in each of the memory locations.

Note:

This memory test overwrites all the existing memory contents. This means that all prior ID numbers stored in the memory are lost and the ID counter will be set to $909_{dec} = 38D_{hex}$.

The ASCII character **R** and two ASCII characters (in the range **0** to **9** and **A** to **F**) which specify an 8 bit test pattern in hexadecimal format causes the identification memory locations to be loaded with this pattern. All three characters are confirmed separately to the PC. After the identification memory is filled, the TIRIS reader transmits the ASCII character **R**, **carriage return** and **line feed**. It is now possible to check whether all cells are correctly filled by using the STORE command.

Example:	**Comment**

PC --> Reader: (pattern = 01011010BIN = 5A$_{hex}$):

| R | RAM FILL command |

Reader --> PC:

| R | RAM FILL command confirmed |

PC --> Reader:

| 5 | First HEX character of 5A$_{hex}$ = 01011010$_{bin}$ |

Reader --> PC:

| 5 | First HEX character confirmed |

PC --> Reader:

| A | Second HEX character of 5A$_{hex}$ = 01011010$_{bin}$ |

Reader --> PC:

| AR<CR><LF> | Second HEX character and RAM FILL execution confirmed |

2.4.6   NUMBER Command

The number of stored identifications can be checked by the PC sending the ASCII character **N** to the TIRIS reader. It causes the TIRIS reader to transmit the ASCII character **N**, **space**, the **number of identifications** stored in the memory in hexadecimal format, **carriage return** and **line feed** via the interface.

Example:

PC --> Reader:

N

Reader --> PC: (909$_{dec}$ =38D$_{hex}$ identifications stored)

N 38D<CR><LF>

2.4.7   LINE Function

The ASCII character **L** switches the TIRIS reader into a special continuous readout mode. In this mode each correct identification causes the direct transmission of the ASCII character **L**, the **transponder type characte**r, **space**, **application code, space**, **identification code**, **carriage return** and **line feed** without buffer comparison.

If no identification is received or if the identification is not valid, the ASCII character **L** together with an optional **I**, **carriage return** and **line feed** are transmitted.

Example:

PC --> Reader:

L

Reader --> PC:

`LR 4095 4503599627370495<CR><LF>`	RO type correctly read
`LR 4095 4503599627370495<CR><LF>`	RO type correctly read
`LI<CR><LF>`	Invalid identification
`LI<CR><LF>`	Invalid identification
`LW 2095 3453577809046784<CR><LF>`	R/W type correctly read

.

.

2.4.8   NORMAL Mode/ESCAPE

The NORMAL readout function provides a continuous readout of transponders at high speed. In this mode each valid ID code and the transponder type, that is read in is compared to the identification which is already in the buffer. If the identification is new it overwrites the buffer and is then transmitted to the PC. The transfer consists of the **transponder type character**, **space**, **application code**, **space**, **identification code**, **carriage return** and **line feed**.

The ASCII character **Esc** (Esc = 27_{dec}) activates the NORMAL readout function. The ASCII character **E**, **carriage return** and **line feed** are returned by the TIRIS reader.

The NORMAL mode can be terminated by the commands EXECUTE, LINE or GATE. These commands are all described in this section.

Example: **Comment**

PC --> Reader:

`<Esc>`	Esc = 27_{dec}

Reader --> PC:

`E<CR><LF>`	
`R 4095 4503599627370495<CR><LF>`	RO type correctly read

2.4.9   PROGRAM Command

In order to program a Read/Write transponder the PC must first send the character **P** to the TIRIS reader and then when the character is echoed, the PC must transmit the 16 hexadecimal characters which specify the identification number to be programmed into the transponder. As soon as the TIRIS reader has received the sixteenth character it calculates a Block Check Character (BCC). The transponder is then charged-up, and the identification data including the BCC and some additional data are sent to the transponder.

Once the programming cycle is completed, the transponder sends the newly programmed number back to the TIRIS reader for comparison. After comparison the TIRIS reader sends a status character (**0**, **1** or **2**) **carriage return** and **line feed** back

to the PC. The meaning of the status characters is:

0 - The transponder has been correctly programmed.

1 - The identification received from the transponder is different to the identification transmitted.

2 - The TIRIS reader did not receive any identification from the transponder for comparison.

Because the programming cycle is longer than the normal reading cycle, the TIRIS reader during programming could interfere with other Readers in the area, even if they have been synchronized.

The distance over which the transponder can be programmed is less than the reading distance. This is due to the higher power consumption of the transponder's IC during programming. If the transponder is not sufficiently charged-up, the programming will not take place.

Example: **Comment**

PC --> Reader:

```
P
```

Reader --> PC:

```
P
```

PC --> Reader:

```
FEDCBA9876543210
```
The hexadecimal number that must be programmed into the transponder

Reader --> PC:

```
0<CR><LF>
```
Successful programming

or

```
1<CR><LF>
```
Received identification is different to transmitted identification

or

```
2<CR><LF>
```
No read

Note:

If more than one transponder are in the field of the antenna it could happen that they are all programmed with the same number. If this happens and more than one transponder return the same identification at the same time (or the transmission is corrupted) the TIRIS reader will indicate that the programming failed even though at least one transponder was correctly programmed.

2.4.10   ANTENNA Commands

The ASCII character **U** and a subsequent character **0** to **2** enable you to address a specific receive only antenna to be used

Note:

This command is only applicable to the S2000 reader with RFM-104B.

The following modes can be specified:

> 1 = ANTENNA 1
>
> 2 = ANTENNA 2
>
> 0 = TOGGLE MODE

If the character **U** is followed by a character other than **0**,**1** or **2**, the entire command will be ignored. Both command characters will separately be echoed by the reader. The command acknowledgment is completed with the transmission of **carriage return** and **line feed**.

Note:

The antenna addressing can be changed any time during continuous reading (NORMAL mode (2.4.8), LINE mode (2.4.7) and GATE mode (2.4.2)).

2.4.10.1 ANTENNA 1 Mode

The ASCII character **U** and the character **1** cause receive antenna 1 to be connected. In this mode each correct identification read by antenna 1 is directly transferred to the PC.

Example:	**Comment**
PC --> Reader:	
U	initiates Antenna mode - command
Reader --> PC:	
U	
PC --> Reader:	
1	switch to antenna 1
Reader --> PC:	
1<CR><LF>	

2.4.10.2 ANTENNA 2 Mode

Switching to antenna 2 requires the command **U2** instead of **U1**. Apart from the antenna specifier (the number 2 to specify antenna 2) the response format of the reader is exactly the same as described in 2.4.10.1.

2.4.10.3 TOGGLE Mode

The ASCII character **U** and the character **0** switch the reader into a special antenna toggle mode. In this mode, both receive antennas (antenna 1 and antenna 2) are used consecutively. Thus, two reading cycles are carried out compared to the AN-TENNA 1 mode or ANTENNA 2 mode. The protocol sent out by the reader corresponds to the ANTENNA 1 mode (2.4.10.1) and ANTENNA 2 mode (2.4.10.2).

Note:

When the reader is operating in the TOGGLE mode, the response to the Programming command (2.4.9) is only checked at antenna 1.

Example:	**Comment**
PC --> Reader:	
U	initiates Antenna mode - command
Reader --> PC:	
U	
PC --> Reader:	
0	select antenna toggle mode
Reader --> PC:	
0<CR><LF>	

2.5   Multipage Transponder - K1 Mode

The commands that can be used in the K1 mode for use with MPTs are described in sections 2.5.1 to 2.5.5 these commands are:

Table 9: Multipage Transponder Commands

Character	Command	Section
Esc	NORMAL Mode/ESCAPE	2.5.3
L *	LINE Function	2.5.2
O	LOCK PAGE Command	2.5.5
P	PROGRAM Command	2.5.4
U	ANTENNA Commands	2.5.6
X*	EXECUTE Command	2.5.1

*   =   If the second character in the Execute and Line commands is **M**, the reader or control module is switched to Multiplexer mode (2.5.2.1 or 2.5.2.2).

In order to address an MPT it is necessary to switch the TIRIS reader into the Multipage Transponder mode (K1 mode). The Multipage Transponder mode causes the TIRIS reader on the one hand to generate a protocol including additional information specifying the MPT page as well as information concerning the desired command (PC --> TIRIS reader), and on the other hand to provide a status information (TIRIS reader --> PC) to inform you which command was actually carried out in the transponder.

The ASCII character **K** and a subsequent character **1** enable you to switch into the Multipage Transponder mode. If character **K** is followed by a character other than **1** (MPT mode) or **0** (64-bit Transponder mode), the TIRIS reader will ignore the entire command. Both command characters will be separately echoed by the TIRIS reader. The command acknowledgment is completed with the transmission of **carriage return** and **line feed**.

Note:

If the TIRIS reader is switched from the Multipage Transponder mode (K1) into the 64-bit Transponder mode (K0), continuous read-out functions NORMAL and LINE MODE keep running (for example: Line mode (K1) ---> Line mode (K0)).

If the TIRIS reader is switched from the 64-bit Transponder mode (K0) into the Multipage Transponder mode (K1) and continuous read-out functions were active, the TIRIS reader will ask for additional two characters to specify the page of the MPT to be read, and then continue to run in the previous read mode.

Example (switching from 64-bit transponder functions to MPT functions):

PC --> Reader:

K   Initiates Change mode - command

Reader --> PC:

K

PC --> Reader:

1

Reader --> PC:

1 <CR><LF>   Command acknowledgment

When the command is acknowledged the TIRIS reader has been switched into the Multipage Transponder mode and is now ready to accept further command characters as described in sections 2.5.1 to 2.5.5.

Note:

RO and R/W transponders can also be read when the TIRIS reader is operating in the MPT mode. If a RO or R/W is read when the TIRIS reader is in K1 (MPT) mode, an additional character (antenna character) is transferred via the serial port immediately before the transponder type character (R or W).

2.5.1   EXECUTE Command

If the command **X** is immediately followed by a page number (in the range **01** to **11**) the system reads the specified page as described in section 2.5.1.1. If the command **X** is immediately followed by the letter **M** the system is switched into Multiplexer mode as described in section 2.5.1.2.

2.5.1.1   Execute Command

The ASCII character **X** and a subsequent two digit page information, specifying the corresponding MPT page (**01** to **11**$_{hex}$) to be read, switch the TIRIS reader to a single readout mode and trigger one readout sequence. This command can also be used to stop (terminate) the continuous read modes (LINE or NORMAL). After receiving the character **X** the TIRIS reader echoes **X** and waits for the page specification. After receiving the page specification the TIRIS reader proceeds with the EXECUTE command.

If no valid identification number could be received, the TIRIS reader transmits the **antenna number**, an optional ' **11** ' (invalid), **carriage return** with **line feed**.

If an MPT transponder was read, the MULTIPAGE TRANSPONDER PROTOCOL, that is: **antenna number**, **status information**, the **transponder type character** (**M**), **space**, **transponder page read**, **space**, **application code**, **space**, **identification code**, **carriage return** and **line feed**, will be transmitted to the PC.

If a RO or R/W was read, the TIRIS reader will transmit the 64-Bit PROTOCOL, that is: **antenna number**, **transponder type character** (**R**, **W**), **space**, **application code**, **space**, **identification code**, **carriage return** and **line feed**.

Note:

Page specification 00 does not refer to an addressed page number 00, but just causes the TIRIS reader to send a charge-up signal. This causes a simple read-out of the first page (01) of an MPT, or a readout of a RO or R/W. Therefore if you only want to read page 01 of an MPT you achieve a faster reading cycle time by specifying page 00.

Example: **Comment**

PC --> Reader:

X   Initiates Execute - command

Reader --> PC:

X

PC --> Reader:

01   Page information in hexadecimal format

Reader --> PC: Only one of the following responses is possible:

10M 01 4095 4503599627370495<CR><LF> Correct MPT identification in decimal format

10M 01 FFFFFFFFFFFFFFFF<CR><LF> Correct MPT identification in hexadecimal format

1R 4095 4503599627370495<CR><LF>RO was read in decimal format

1W FFFFFFFFFFFFFFFF<CR><LF>R/W was read in hexadecimal format

1<CR><LF>   No read

1I<CR><LF>   Invalid identification

For further descriptions of possible command response formats see Chapter 3: "Possible Reading Responses".

2.5.1.2   Execute Command with TX/RX Multiplexer Support

Note:

This command should only be used if you have the Remote Antenna RFM (RI-RFM-008B) and the Multiplexer Module (RI-MOD-TX8A) included in your system.

If the character immediately following **X** is **M**, the system is switched into the Transmit/ Receive Multiplexer mode. Following the **M** character four further parameters (characters) are required. They specify (in the order they are transmitted to the reader):

• the number of Transmit Multiplex Antennas (TX_Ant)

• the number of Receive Multiplex Antennas (RX_Ant)

• the page information to read a Multipage Transponder (two digits; most significant digit of the page first).

The range for TX_Ant and RX_Ant is 1 to 4. If the Multiplexer parameter are out of range, the Execute command is executed with the default one Transmit Antenna and one Receive Antenna.

Examples:

1. The command sequence **'X01**' reads page 1 of a Multipage Transponder without switching the TX/RX control outputs.

2. The command sequence '**XM4201**' reads page 1 of a Multipage Transponder, switching the control output lines for a 4 Channel Transmit Multiplexer and a 2 Channel Receive Multiplexer.

A typical Multiplexer read sequence selects the Transmit Antennas from 1 to TX_ANT then the Receive Antennas are selected from 1 to RX_ANT with a successive transponder read.

The multiplexer sequence depends on how many transmit and receive antennas are specified, but the sequence is always: The first TX antenna is selected, then in series the RX antennas (1, 2, 3 or 4), then the next TX antenna is selected, followed once again by the RX antennas. Then the next TX antenna and so on.

Example:		**Comment**
XM2407		Read page 7 of a multipage transponder using 2 TX and 4 RX antennas.
Sequence =	TX Antenna 1	Read page 7
	RX Antenna 1	Page 7 ID
	RX Antenna 2	Page 7 ID
	RX Antenna 3	Page 7 ID
	RX Antenna 4	Page 7 ID
	TX Antenna 2	Read page 07
	RX Antenna 1	Page 7 ID
	RX Antenna 2	Page 7 ID
	RX Antenna 3	Page 7 ID
	RX Antenna 4	Page 7 ID
XM2209		Read page 9 of a multipage transponder using 2 TX and 2 RX antennas.
Sequence =	TX Antenna 1	Read page 9
	RX Antenna 1	Page 9 ID
	RX Antenna 2	Page 9 ID
	TX Antenna 2	Read page 9
	RX Antenna 1	Page 9 ID
	RX Antenna 2	Page 9 ID

In order for the multiplexer to work correctly the I/O lines must be configured to be outputs (the default status).

Table 10: Multiplexer I/O Lines 6 & 7 Configuration

RX_Ant	External RX Mux.	
	I/O 6	I/O 7
1	0	0
2	1	0
3	0	1
4	1	1

The TX Multiplexer Channel is controlled with I/O line 4 and 5 according to the table below.

Table 11: Multiplexer I/O Lines4 & 5 Configuration

TX_Ant	External RX Mux.	
	I/O 4	I/O 5
1	0	0
2	1	0
3	0	1
4	1	1

The response data format is defined as follows:

Read Status	K1 Mode	
	Current Protocol	Protocol for TX/RX Mux
RO,R/W Trp.	`Xrx iiii iiiiiiiiiiiiiiii`	`Xtrx iiii iiiiiiiiiiiiiiii`
MPT	`Xrsx pp iiii iiiiiiiiiiiiiiii`	`Xtrsx pp iiii iiiiiiiiiiiiiiii`
incomplete ID	`XrI`	`XtrI`
no read	`Xr`	`Xtr`

Legend:

        X is the leading character to define the read mode

        pp =   Page of an MPT

        i   =   Transponder ID

        x   =   Transponder Type

        r   =   Receive antenna

        t   =   Transmit antenna

        s   =   read/programming status

Note:

The receive multiplexer is only supported by TIRIS readers which include the RFM 104B. To ensure that other TIRIS readers function correctly, the Rx Antenna specifier must be set to 1.

2.5.2   LINE Function

If the command L is immediately followed by a page number (in the range **01** to **11**) the system continuously reads the specified page as described in section 2.5.2.1. If the command L is immediately followed by the letter **M** the system is switched into Multiplexer mode as described in section 2.5.2.2.

2.5.2.1   Line Function

The ASCII character **L** and an additional two digit page specification (**01** to **11**$_{hex}$) switch the TIRIS reader into a special continuous readout mode.

The TIRIS reader acknowledges the command by returning the character L. When the page number is received by the TIRIS reader it is acknowledged by **carriage return** and **line feed**.

In this mode each correct identification number is transferred directly to the interface without any buffer comparison. In addition the ASCII character **L**, the a**ntenna number**, **read status information** (only for MPT) and the **transponder type** are transmitted in front of each identification number. If no identification is received or if the identification is not valid, the ASCII character L together with the number of the connected antenna and an optional I, **carriage return** and **line feed** will be transmitted to the PC.

Note:

Page specification 00 does not refer to an addressed page number 00.

Example:	**Comment**
PC --> Reader:	
`L`	Initiates Line mode - command
Reader --> PC:	
`L`	
PC --> Reader:	
`01`	Page information in hexadecimal format
Reader --> PC:	
`<CR><LF>`	
`L10M 01 4095 4503599627370495<CR><LF>`	Correct MPT identification in decimal format
`L10M 01 4095 4503599627370495<CR><LF>`	Correct MPT identification in decimal format
`L10M 01 4095 4503599627370495<CR><LF>`	Correct MPT identification in decimal format
`L1<CR><LF>`	No read
`L1I<CR><LF>`	Invalid identification

`L1I<CR><LF>`	Invalid identification
`L1R 4095 4503599627370495<CR><LF>`	Correct RO identification
`L1R 4095 4503599627370495<CR><LF>`	Correct RO identification
`L1<CR><LF>`	No read
`L1I<CR><LF>`	Invalid identification
`L1I<CR><LF>`	Invalid identification
`L1W 2095 2394293797780071<CR><LF>`	Correct R/W identification

For further descriptions of possible command response formats see Chapter 3: "Possible Reading Responses".

2.5.2.2   Line Function with TX/RX Multiplexer Support

Note:

This command should only be used if you have a Multiplexer Module (RI-MOD-TX8A) included in your system.

If the character immediately following **L** is **M**, the system is switched into the Transmit/ Receive Multiplexer mode. Following the **M** character four further parameters (characters) are required. They specify (in the order they are transmitted to the reader):

- · the number of Transmit Multiplex Antennas (TX_Ant)
- · the number of Receive Multiplex Antennas (RX_Ant)
- · the page information to read a Multipage Transponder (two digits; most significant digit of the page first).

The range for TX_Ant and RX_Ant is 1 to 4. If the Multiplexer parameter are out of range, the Line mode is executed with the default one Transmit Antenna and one Receive Antenna.

Examples:

1. The command sequence '**L01**' reads page 1 of a Multipage Transponder continuously without switching the TX/RX control outputs.

2. The command sequence '**LM4201**' continuously reads page 1 of a Multipage Transponder, switching the control output lines for a 4 Channel Transmit Multiplexer and a 2 Channel Receive Multiplexer.

A typical Multiplexer read sequence selects the Transmit Antennas from 1 to TX_ANT then the Receive Antennas are selected from 1 to RX_ANT with a successive transponder read.

In order for the multiplexer to work correctly the I/O lines must be configured to be outputs (the default status).

Table 12: Multiplexer I/O Lines 6 & 7 Configuration

RX_Ant	External RX Mux.	
	I/O 6	I/O 7
1	0	0
2	1	0
3	0	1
4	1	1

The TX Multiplexer Channel is controlled with I/O line 4 and 5 according to the table below.

Table 13: Multiplexer I/O Lines4 & 5 Configuration

TX_Ant	External RX Mux.	
	I/O 4	I/O 5
1	0	0
2	1	0
3	0	1
4	1	1

The response data format is defined as follows:

Read Status	K1 Mode	
	Current Protocol	Protocol for TX/RX Mux
RO,R/W Trp.	`Lrx iiii iiiiiiiiiiiiiiii`	`Ltrx iiii iiiiiiiiiiiiiiii`
MPT	`Lrsx pp iiii iiiiiiiiiiiiiiii`	`Ltrsx pp iiii iiiiiiiiiiiiiiii`
incomplete ID	`LrI`	`LtrI`
no read	`Lr`	`Ltr`

Legend:

L is the leading character to define the read mode

pp = Page of an MPT

i   =   Transponder ID

x   =   Transponder Type

r   =   Receive antenna

t   =   Transmit antenna

s   =   read/programming status

Note:

The receive multiplexer is only supported by TIRIS readers which include an RFM 104B. To ensure that other TIRIS readers function correctly, the Rx Antenna specifier must be set to 1.

2.5.3   NORMAL Mode

The NORMAL readout function provides a continuous readout of a certain transponder page at high speed. The transmission of a page including its identification via the serial interface will only be carried out if it is not equal to the last received transponder type (RO, R/W and MPT), transponder page and identification. For this purpose the last page received, together with its identification number is stored in an identification buffer, located in the microcomputer RAM, and each correctly received page, identification number and the transponder type (RO, R/W, MPT) is compared to the content of this buffer.

The NORMAL mode can also be used to terminate the LINE mode and to switch to decimal display if the FORMAT command was previously used.

ASCII character **Esc** (Esc=27$_{dec}$) together with a page specification (**01** to **11**$_{hex}$) cause the TIRIS reader to switch into the NORMAL mode. The ASCII character **E**, **carriage return** and **line feed** are returned by the TIRIS reader in order to acknowledge the PC command.

Each received identification that is different to the identification stored in the buffer will be transmitted to the PC:

If an MPT was read: **antenna number**, **read status**, **transponder type character** (**M**), **space**, **page**, **space**. **application code, space, identification code**, **carriage return** and **line feed**.

If a RO or R/W was read, the TIRIS reader will transmit the 64-bit PROTOCOL, that is: **antenna number**, **transponder type character** (**R**, **W**), **space**, **application code**, **space**, **identification code**, **carriage return** and **line feed**.

The NORMAL mode can be terminated by the commands EXECUTE (2.4.1) or LINE (2.4.7).

Note:

Page specification 00 does not refer to an addressed page number 00.

Example:	**Comment**
PC --> Reader:	
`<Esc>`	Initiates Normal mode - command, `Esc=27`$_{dec}$
Reader --> PC:	
`E`	
PC --> Reader:	
`05`	Page information in hexadecimal `format`
Reader --> PC:	
`<CR><LF>`	
`10M 05 0000 11237906738429913<CR><LF>`	
`1R 1024 1111111100101010<CR><LF>`	

For further descriptions of possible command response formats see Chapter 3: "Possible Reading Responses".

2.5.4   PROGRAM Command

In order to program an MPT, the ASCII character **P**, two characters page information (**01** to **11**$_{hex}$), and an additional **16 hexadecimal characters** specifying the identification number to be programmed (written) into the specified page must be sent to the TIRIS reader. After receiving the last character from the PC a Block Check Character (BCC) is calculated and the entire protocol is sent to the MPT. At the end of the programming cycle, the TIRIS reader receives both the identification number and the read address information (actual page and programming status) back from the transponder, to check whether the transponder was programmed successfully. Depending on the comparison, the TIRIS reader transmits the followings characters:

antenna number, **programming status**, **transponder type**, **space**, **page**, **space**, **application code**, **space**, **identification number**, **carriage return** and **line feed**

or

antenna number, **status information 2**, **carriage return** and **line feed** if no transponder protocol could be detected.

Programming distance is less than the reading distance, this is because of the higher energy required by the transponder for programming. This requires a better coupling between reader unit and transponder. If the transponder is not charged sufficiently, programming will not be carried out.

Example:	**Comment**
PC --> Reader:	
P	Initiates Program - command
Reader --> PC:	
P	
PC --> Reader:	
05	Page information in hexadecimal format
432FFA6B22228FFA	Identification number to be programmed in page 05$_{hex}$
Reader --> PC:	
10M 05 1074 4497462691794938<CR><LF>	Successful programming of page 05$_{dec}$ (432FFA6B22228FFA$_{hex}$= 1074 4497462691794938$_{dec}$)
12<CR><LF>	If programming has failed

Note:

If more than one MPT is in the field of the antenna, all of the transponders might be programmed with the same number. If more than one MPT send back their identification number at the same time and/or if the transmission is corrupted, the TIRIS reader will indicate that programming has failed, even though the transponder was programmed correctly.

For a more precise overview of possible responses refer to Chapter 3: "Possible Programming Responses in MPT mode".

2.5.5   LOCK PAGE Command

The LOCK Page command enables you to make a certain page of an MPT inaccessible to programming. ASCII character **O** initiates the LOCK page procedure. The TI-RIS reader echoes the character as an acknowledgment and is now ready to accept the page to be locked (**01** to **11**$_{hex}$). The following two response formats from the TI-RIS reader are possible after trying to lock a transponder page:

> **Antenna number**, **status**, **transponder type**, **space**, **page**, **space**, **application code**, **space**, **identification number**, **carriage return** and **line feed** if a transponder protocol could be received

> or

> **antenna number**, optional **I**, **carriage return** and **line feed** if no valid transponder response could be detected by the TIRIS reader.

Status 1 (read locked page) in the Multipage transponder protocol provides you with information about a successful locking of the page.

Example:	**Comment**
PC --> Reader	
O	initiates Lock - command
Reader --> PC:	
O	
PC --> Reader	
05	page to be locked in hexadecimal format
Reader --> PC:	
11M 05 1074 4497462691794938<CR><LF>	successful locking of page 05, displayed in decimal format
1<CR><LF>	command not executed

Note:

If more than one MPT is in the field of the antenna, all of the transponders might be programmed with the same number. If more than one MPT send back their identification number at the same time and/or if the transmission is corrupted, the TIRIS reader will indicate that programming has failed, even though the transponder was programmed correctly.

For a more precise overview of possible responses refer to Chapter 3: "Possible Reading Responses".

2.5.6   ANTENNA Commands

The ASCII character **U** and a subsequent character **0** to **2** enable you to address a specific receive only antenna to be used. The following modes can be specified:

Note:

This command is only applicable to the S2000 reader with RFM-104B.

---

    1 = ANTENNA 1

    2 = ANTENNA 2

    0 = TOGGLE MODE

If the character **U** is followed by a character other than **0**,**1** or **2**, the entire command will be ignored. Both command characters will separately be echoed by the reader. The command acknowledgment is completed with the transmission of **carriage return** and **line feed**.

Note:

The antenna addressing can be changed any time during continuous reading (NORMAL mode (2.5.3) and LINE mode (2.5.2)).

For the following examples it is assumed that the LINE mode (section 2.5.2) is used.

2.5.6.1   ANTENNA 1 Mode

The ASCII character **U** and the character **1** cause receive antenna 1 to be connected. In this mode each correct identification read by antenna 1 is directly transferred to the PC.

Example:	**Comment**
PC --> Reader:	
U	initiates Antenna mode - command
Reader --> PC:	
U	
PC --> Reader:	
1	switch to antenna 1
Reader --> PC:	
1<CR><LF>	

When the command is acknowledged, the reader has been switched into the ANTENNA 1 mode and is ready to accept a further command character as follows:

PC --> Reader:	
L	read in LINE mode

Reader --> PC:

L

PC --> Reader:

05   read page 5 of an MPT

Immediately after the ASCII command character **L** the antenna specifier, followed by the **transponder type character** (read status information if an MPT was read), is transferred to the PC. If a transponder protocol could not be detected or the protocol is not valid, only the ASCII character **L** with the antenna specifier **1** and an optional **I** (start byte detected) together with **carriage return** and **line feed** will be transmitted to the PC.

Reader --> PC:

```
L10M 05 4095 4503599627370495   valid MPT response
L10M 05 4095 4503599627370495
L1                              no transponder detected
L1R 1322 0000000000034214       valid RO response
L10M 05 4095 4503599627370495
L1I                             invalid read
L1W 0000 0101010101010101       valid R/W response
.
.
.
```

2.5.6.2   ANTENNA 2 Mode

Switching to antenna 2 requires the command **U2** instead of **U1**. Apart from the antenna specifier (antenna specifier 2 for antenna 2) the response format of the reader is exactly the same as described in 2.5.6.1.

2.5.6.3   TOGGLE Mode

The ASCII character **U** and the character **0** switch the reader into a special antenna toggle mode. In this mode, both receive antennas (antenna 1 and antenna 2) are used consecutively. Thus, two reading cycles are carried out compared to the ANTENNA 1 mode or ANTENNA 2 mode. The protocol sent out by the reader corresponds to the ANTENNA 1 mode (2.5.6.1) and ANTENNA 2 mode (2.5.6.2).

Note:

When the reader is operating in the TOGGLE mode, the response to the commands Programming (2.5.4) and Locking (2.5.5) are only checked at antenna 1.

Example: **Comment**

PC --> Reader:

U   initiates Antenna mode - command

Reader --> PC:

```
U
```

PC --> Reader:

```
0                                          select antenna toggle mode
```

Reader --> PC:

```
0<CR><LF>
```

When the command is acknowledged the reader has been switched into the ANTENNA TOGGLE mode and is now ready to accept a further command character. The following example shows the reader operating in the Toggle mode:

Reader --> PC:

```
L1W 4095 4503599627370495        valid R/W response at antenna 1
L20M 05 1045 4000003215766690    valid MPT response at antenna 2
L1I                              invalid read at antenna 1
L20M 05 1045 4000003215766690
L1W 4095 4503599627370495
L2                               no read at antenna 2
L1W 4095 4503599627370495
L20M 05 1045 4000003215766690
L1W 4095 4503599627370495
L20M 05 1045 4000003215766690
L1W 4095 4503599627370495
L20M 05 1045 4000003215766690
```

Possible Responses

This chapter describes the response format from the reader to the PC.It consists of transponder type, the requested transponder information as also a status information to the execution of the command.

Topic   Page

3.1   Possible Reading Responses

This section illustrates the response formats sent out by transponders after an attempt to read a RO or R/W or to access a certain page of an MPT by a command represented by one of the characters **X**, **L**, **Esc** or **O**.

a. A complete transponder protocol could be detected by the TIRIS reader

Reader --> PC:

```
(a)(b)c (dd) eeee ffffffffffffffff<CR><LF>
```
Standard TIRIS output format (decimal format)

```
(a)(b)c (dd) ffffffffffffffff<CR><LF>
```
If the FORMAT command (hexadecimal format) was used

Element	Description	Range
a (K1 mode only)	antenna that has tried to read the transponder	1, 2
b (MPT only)	reading status	0, 1, 2, 4, 5
	0:	reading of an unlocked page was correctly executed
	1:	reading of a locked page was correctly executed
	2:	the requested page and the received page were not equal
	3:	locking not reliable
	4:	locking not correctly executed
	5:	special data
c	transponder type	M (MPT), R (RO), W (R/W)
d (MPT only)	specifies the transponder page that was received after an attempt to read a certain page	01 to 17_{dec} respectively 01 to 11_{hex}
e	application number that was received after an attempt to address a transponder	0 to 4095_{dec}
f	identification code that was received after an attempt to address a transponder (e and f together)	0 to 4503599627370495_{dec} Respectively 0 to $FFFFFFFFFFFFFFFF_{hex}$

b. There was no transponder in the reading area of the TIRIS reader

Reader --> PC:

```
(a)(I)<CR><LF>
```

Element	Description	Range
a (K1 mode only)	antenna that has attempted to read a transponder	1, 2
(I)	invalid command	I
	I is present: At least the transponder start byte was detected, the complete protocol could not be received	
	I is not present: If the TIRIS reader could detect neither a complete transponder protocol nor a transponder start byte	

3.2   Possible Programming Responses in MPT Mode (K1)

This section illustrates the response formats sent out by MPTs after an attempt is made to program it.

a. A complete transponder protocol could be detected by the TIRIS reader

Reader --> PC:

`abc dd eeee ffffffffffffffff<CR><LF>`	Standard TIRIS output format (display in decimal format)
`abc dd ffffffffffffff<CR><LF>`	If the FORMAT command (display in hexadecimal format) was used

Element	Description	Range
a	antenna that has attempted to program the transponder	1, 2
b	programming status	0, 1, 3, 4, 5, 6, 7
	0:	programming was executed and the comparison between read and written data was O.K.
	1:	programming was executed but the comparison between read and written data was not equal
	2:	see 3.2.b
	3:	programming was disabled because the programming voltage was too low
	4:	programming was not executed because there was an attempt to program a locked page
	5:	page to be programmed is not available
	6:	programming not reliable
	7:	special data
c	transponder type	M (MPT)
d	specifies the transponder page that was read after an attempt to program that page	01 to 17_{dec} respectively 01 to 11_{hex}
e	read application number after an attempt to program a transponder	0 to 4095_{dec}
f	identification number that was read after an attempt to program a transponder (e and f together)	0 to 4503599627370495_{dec} Respectively 0 to $FFFFFFFFFFFF_{hex}$

b. An incomplete transponder protocol was detected by the TIRIS reader

Reader --> PC:

`ab<CR><LF>`

Element	Description	Range
a	antenna that has attempted to program a transponder	1, 2
b	programming status	2:No transponder response detected