Texas Instruments
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TIRIS Technology by Texas Instruments™

Micro-reader

RI-STU-MRD1

Reference Manual

Edition Notice: Second Edition - July 1996

This is the second edition of this manual, it describes the following equipment:

TIRIS Micro-reader Module   RI-STU-MRD1

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CE-Declaration

The Micro-reader module complies with the European CE requirements as specified in the EMC Directive 89/336/EEC. For details please refer to Appendix C of this manual.

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1. **Introduction**

1.1 General

This document provides information about the TIRIS Micro-reader Module RI-STU-MRD1.
It describes the module and how to integrate it.

1.2 Product Description

The Micro-reader is an intelligent module providing RF and Control functions to read and program
TIRIS transponders. It is equipped with a Serial Communications Interface (SCI) which may be
directly connected to commonly used system controllers. The Micro-reader works together with a
47 µHenry, low-Q antenna, and therefore the system does not need tuning.

1.3 Product Option Coding

For product and ordering numbers of TIRIS Products and Accessories, please contact your local
TIRIS Application Center.

There is only one version of the Micro-reader Module, that is: RI-STU-MRD1

1.4 Conventions

Certain conventions are used in this document in order to display important information, these
conventions are:

<div align="center">

WARNING

</div>

**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 Module.**

Note: *Indicates conditions which must be met, or procedures which must be followed, to ensure
proper functioning of the Module.*

HINT: Indicates information which makes usage of the Module easier.
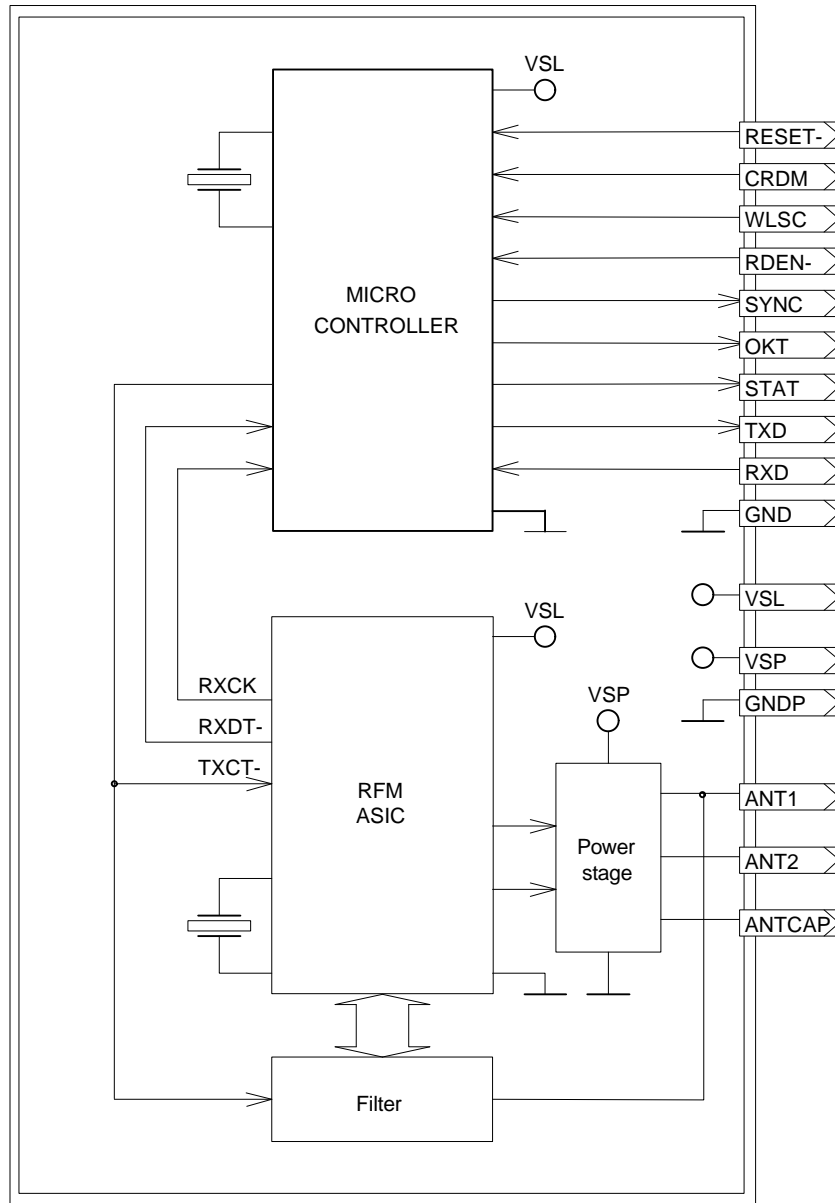
Figure 1: Block Diagram of the Micro-reader
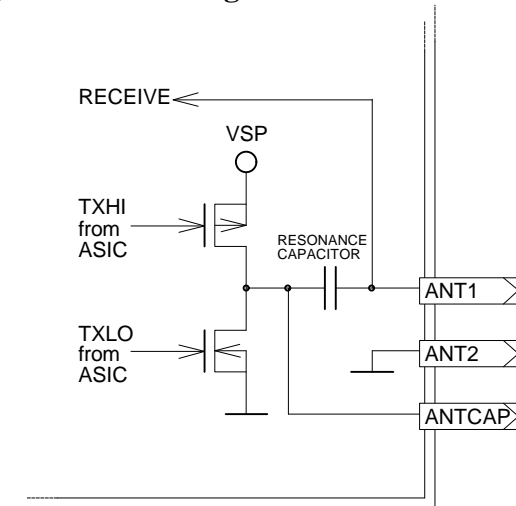
Figure 2: Antenna Circuit Block Diagram

2. Product Function

2.1 Description

The Micro-reader module is an intelligent plug-in module which can be plugged into or soldered onto an application specific adapter board. It supports serial data communications between a PC and TIRIS transponders. With its Serial Communications Interface (SCI) the Micro-reader supports TTL data communications, which with the addition of a communications driver (for example: RS232 or RS422) allows communication to a standard interface. The Micro-reader can be controlled remotely by either providing certain inputs with the corresponding voltage level or sending commands to the SCI. It can be driven either with or without synchronization - the synchronization can be either wireless or wired to enable reliable operation in multi-reader environments. Two outputs show the reader status and inform the user about a successful command execution. The Micro-reader supports all available TIRIS transponders.

2.1.1 Power Supply

There are two separate 5V supplies to the Micro-reader, one for the output stage (VSP) and the other for the logic (VSL). On power up VSL should rise faster than 0.1 V/ms to ensure a reliable operation. The Micro-reader has an on-board reset circuit which will reset it should the supply fall below 4 V ($\pm$ 0.2 V).

In order to avoid problems with noise conducted via the supply lines, we recommend that if a single supply is used, separate connections from a common de-coupling capacitor are used to feed the Micro-reader.

Note: *The RF Module must not be supplied by Switched Mode Power Supplies (SMPS). This is because most SMPS operate at frequencies around 50 kHz. The harmonics of the generated field can interfere with the TIRIS receiver. Therefore only use linear regulated power supplies, or SMPS with a* **fundamental operating frequency of 200 kHz or higher**.

2.1.2 Antenna

The Micro-reader has been designed for use with a 47 μH antenna with a Q of 10 to 20 at 132 kHz to generate the exciter frequency of 134.2 kHz. Because of the low Q the system does not need to be tuned.

WARNING
Care must be taken when handling the Micro-reader as high voltages across the antenna pins could be harmful to your health.

2.1.3 Synchronization

There are two possible methods of wired synchronization:

1. Connect a pulse waveform to all RDEN- input pins of the Micro-readers to be synchronized. The pulse would normally be at VSL, dropping to GND for 100 µs every 200 ms.

2. 'Or' all SYNC outputs together and then connect this as an input to RDEN- of each Micro-reader to be synchronized.

Wireless synchronization of the Micro-reader is very effective at synchronizing to adjacent readers, however problems may occur if the antennas are positioned such that a transponder can be within range of two readers at the same time. In this situation one reader could synchronize with the transponder instead of the other reader.

When the WLSC input is active the Micro-reader is in wireless synchronization mode. Wireless synchronization can also be switched on/off by a corresponding command via the serial interface. During execution of this command it has priority over the WLSC input. After the command execution the status of the WLSC input will be considered again.

Note: *It is not recommended to have both wired and wireless synchronization switched on as synchronization could be unreliable.*

We recommend the use of bus drivers for wired synchronization with other Micro-readers and to prevent ESD damage.

Wired or wireless synchronization prolongs the cycle time by typically 20 ms.

2.1.4 Trigger Mode

When the Micro-reader is in idle mode it is possible to trigger a single charge-only read with a power burst duration of 50 ms by taking the RDEN- pin to logic high for 100 µs. The single read will start on the falling edge of the 100 µs pulse.

If a transponder command is sent to the Micro-reader via the SCI while RDEN- is in a logic high state (waiting position), a falling edge would trigger execution of the command. In waiting position the Micro-reader can only store one command. This means that if two commands were to be sent to the Micro-reader while it is in the waiting position the second command will overwrite the first one.

2.1.5 Continuous Mode

When the CRDM input is active the Micro-reader goes into continuous charge-only read mode using a power burst duration of 50 ms. The serial data input takes priority over the CRDM input such that if a serial command is received it will be executed regardless of the state of the CRDM input. After the execution of the serial data command the Micro-reader continues with the previous read mode.

In the default continuous read mode, only those valid RO, R/W or MPT IDs that differ from the previously read ID; or valid IDs read after a "NO READ", are transferred via the SCI (Normal Mode). The Micro-reader can be set to transfer all valid IDs that are read (Line Mode) by means of a corresponding serial data command.

Without synchronization the Micro-reader has a reading frequency of approximately 10 readouts per second using a power burst duration of 50 ms.

2.1.6 Serial Communication

The two serial I/O pins are configured for 9600 Baud, 1 start bit, 8 data bits, no parity and 1 stop bit; they can be connected directly to a communications driver to allow a half duplex communication with a PC via its serial communications interface (for example: RS232 or RS422).

The communications protocol is specified in Section 3.

Handshake

The Micro-reader accepts handshake commands Xon/Xoff. When it receives an Xoff (13hex) the Micro-reader stops its current operation and stops transmitting data via the serial port. It stays in idle mode until Xon (11hex) is received when it continues with the previous mode/command. During this idle period the Micro-reader accepts commands via the serial port , however, it waits for its execution until Xon is received. In this idle period the Micro-reader can store only one command.

Note: *While receiving a command protocol from the serial port Xon/Xoff is interpreted as normal data without affecting the serial communication.*

2.2 Connector Pins

The Micro-reader module has 30 pin connections which are shown in figure 3 and listed in table 1.
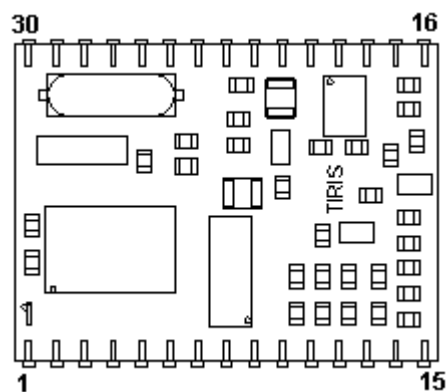
Figure 3: Micro-reader Pin Connections

Table 1: Pin Connections

Pin	Signal Name	Function
1	SYNC	Output for wired synchronization
2	RDEN-	Input for wired synchronization and single read trigger
3	--	Reserved, do not connect
4	RESET-	Reset of the Micro-reader
5	RXD	Receive Data signal input of serial interface
6	TXD	Transmit Data signal output of serial interface
7	--	Reserved, do not connect
8	--	Reserved, do not connect
9	--	Reserved, do not connect
10	--	Reserved, do not connect
11	--	Reserved, do not connect
12	--	Reserved, do not connect
13	--	Reserved, do not connect
14	--	Reserved, do not connect
15	GND	Ground for logic
16	ANT1	Antenna terminal 1
17	ANTCAP	Antenna capacitor terminal
18	--	Reserved, do not connect
19	ANT2	Antenna terminal 2
20	--	Reserved, do not connect
21	GNDP	Ground for output stage
22	VSP	Supply voltage output stage
23	--	Reserved, do not connect
24	VSL	Supply voltage logic
25	GND	Ground for logic
26	CRDM	Input for continuous read mode
27	WLSC	Input to switch wireless synchronization on
28	--	Reserved, do not connect
29	OKT	Output to show if a valid ID was read
30	STAT	Output to show status of RF-transmitter control signal

Pin Connection Description

SYNC (1)
Output for wired synchronization. This output is at GND level until the Micro-reader starts its read cycle, at which time it goes to VSL until the complete reading, programming or locking cycle is finished.

RDEN- (2)
Input for wired synchronization. Taking this pins to VSL acts as a hold-off for the Micro-reader's output stage preventing it from transmitting until the input returns to GND. The Micro-reader only samples this input at the start of its own reading, programming or locking cycle, this means that if the input goes to VSL after a cycle is started, the cycle is not interrupted. RDEN is a high impedance input and must be tied to GND via a suitable resistor (27 kOhm) when it is not being used.

When the Micro-reader is idle it is possible to trigger a single read by taking the RDEN-pin logic high for 100 µs. The single read will start on the falling edge of the 100 µs pulse.

RESET- (4)
Taking this pin to GND holds the Micro-reader in reset. If the reset pin is not used it can be left disconnected as it is internally pulled up. Minimum pulse duration to perform a reset is 1 ms.

RXD (5)
Input configured to receive serial data commands at 9600 Baud, 1 start bit, 8 data bits, no parity and 1 stop bit.

TXD (6)
Output configured to transmit serial data at 9600 Baud, 1 start bit, 8 data bits, no parity and 1 stop bit.

GND (15, 25)
Pins 15 and 25 are ground for the logic part.

ANT1 (16)
Antenna pin for the connection of 47 µH, low Q antennas.

ANTCAP (17)
It is possible to use antennas of lower inductance by connecting a suitable capacitor between ANT1 and ANTCAP. This additional capacitor (ceramic, 100 VDC) will be in parallel with the 30 nF resonance capacitor on board the Micro-reader (see figure 2).

ANT2 (19)
Antenna pin (GND) for the connection of 47 µH, low Q antennas.

GNDP (21)
Pin 21 is ground for the output stage.

VSP (22)
Pin 22 is for connecting the positive supply voltage (5 V) for the output stage.

VSL (24)
Pin 24 is for connecting the positive supply voltage (5 V) for the logic part.

CRDM (26)
Supplying pin 26 with a logic high signal causes the Micro-reader to run in a continuous charge-only read mode (see Section 2.1.5 for more information).

When the CRDM pin is tied to logic low, the Micro-reader is in an idle state waiting for commands via the serial interface or for a trigger signal (RDEN-) to start a single read out cycle. CRDM is a high impedance input and must be tied to either VSL or GND via a suitable resistor (27 kOhm).

WLSC (27)
Pin 27 enables or disables wireless synchronization. To enable the wireless synchronization, pin 27 must be taken to VSL. When wireless synchronization is enabled, the Micro-reader will try to synchronize its transmit signals with any other readers in range. To disable wireless synchronization pin 27 must be taken to GND. Pin 27 is a high impedance input and must be tied to either VSL or GND via a suitable resistor (27 kOhm).

Wireless synchronization can also be switched on/off by a corresponding command via the serial interface. During execution of this command it has priority over the WLSC input.

OKT (29)
This output is set to logic high for approx. 60 ms if a valid transponder was read. It can be connected to an LED externally to indicate the result of the read cycle.

STAT(30)
Pin 30 is set to logic low when the RF-transmitter is activated. Supplying an external LED with this signal makes the status of the Micro-reader visible.

3. **Communications Protocol**

3.1 Protocol PC to Micro-reader

| Start | Length | Cmd 1 | Cmd 2 | Data | | BCC |

Byte   *Contents (hexadecimal value)*
   0   Start Mark (SOH, 01hex)
   1   Length
   2   Command Field (1)
   3   Command Field (2) (optional)
  4(3)   Data Field (1)
   .
   .
 N+3(2)   Data Field (N)
 N+4(3)   BCC

Note: *The total number of bytes sent within a protocol frame (including Start Mark and BCC) is limited to 41 bytes.*

Examples are given in Section 6.1.

3.1.1 Start Mark

The 'Start-Mark' signifies the beginning of a message. It is represented by the ASCII character SOH (Start Of Header, 01hex).

3.1.2 Length

The 'Length' byte indicates the length, in bytes, of the following Command and Data Fields.

3.1.3 Command Field

The 'Command Field(s)' define the mode in which the Micro-reader operates and determines the operation that is to be carried out in the transponder. Depending on the setting of the relevant bits, the corresponding information specified in the Data Fields will be sent to the transponder or not. Thus all functions of each particular transponder type can be executed (see 3.1.4 for further information).

Command Field (1)

Bit	*Use*	*Setting*	*Comment*
0/1	Mode/Cmd	00 (MSB,LSB)	Perform single command
			(for example: single read, program, lock)
		01	Read in continuous Normal Mode
		10	Read in continuous Line Mode
		11	Send Micro-reader S/W version
2	FBCC calculation	1/0	If set, Micro-reader calculates FBCC
			of the MPT protocol
3	Power Burst I	1/0	If set, needs to be determined in Data Field
			(see 3.1.4)
4	Power Pause Duration	1/0	If set, needs to be determined in Data Field
5	Power Burst II	1/0	If set, needs to be determined in Data Field
6	Data	1/0	If set, needs to be determined in Data Field
7	Cmd expansion Field	1/0	If set, Command Field (2) follows

If bit 5 (Power Burst II, for example: for programming and locking) is set, the Micro-reader automatically operates in single mode. Thus the user is enabled to validate the programming or lock response before a further cycle is started.

If bit 2 (FBCC calculation) and bit 6 (Data) are set, the Micro-reader automatically calculates a two byte BCC over the data to be sent to the transponder and adds it to the protocol. When bits 2 and 6 are set the PC must not send the 2 byte FBCC to the Micro-reader.

Bit 4 (Power Pause Duration) is for future use and must not be set when addressing standard TIRIS transponders.

Command Field (2)

Command Field (2) is only present if bit 7 of Command Byte 1 is set.

Bit	Use	Setting	Comment
0	Special Write Timing	1/0	If set, needs to be determined in Data Field (see 3.1.4)
1	Wireless Synchronization	1/0	If set, wireless synchronization is used
2	DBCC calculation	1/0	If set, Micro-reader calculates DBCC of the R/W and MPT write data
3-7	Reserved		

If Command Field (2) is not present, standard TIRIS write timings are used and wireless synchronization is switched on/off according to the status of input line WLSC.

Note: *The settings specified in Command Field (1) and (2) are only valid during the execution of the current command.*

3.1.4 Data Field

The presence of the relevant data field depends on the setting of the bits in the Command Field. If the relevant bit (for example: Command bit 3 "Power Burst I") is set to "1", then Data Field 1 is present defining the Power Burst length. If the relevant bit in the Command Field is set to "0" the consequent Data Field is omitted, this results in the following data field being moved forward (decremented) by one.

Data Field	Use	Range (dec)	Comment
1	Power Burst I	1..255 ms	If bit 3 of Command Field(1) is set
2	Power Pause Duration	1..255 ms	If bit 4 of Command Field(1) is set
3	Power Burst II	1..255 ms	If bit 5 of Command Field(1) is set
4/5	toffLow (LSByte/MSByte)	28..2044 µs	If bit 0 of Command Field(2) is set
6/7	tonLow (LSByte/MSByte)	28..2044 µs	If bit 0 of Command Field(2) is set
8/9	toffHigh (LSByte/MSByte)	28..2044 µs	If bit 0 of Command Field(2) is set
10/11	tonHigh (LSByte/MSByte)	28..2044 µs	If bit 0 of Command Field(2) is set
12	# of Data Fields that follow	see *	If bit 6 of Command Field(1) is set
13 ..	Data Fields	LSByte first	

* *The number of Data Fields must not cause an infringement of the total number of bytes allowed within a protocol frame.*

Transponder command protocols are described in detail in Section 5.1.

3.1.5 BCC

The 'BCC' field is a one-byte value of the Longitudinal Redundancy Check calculation (Xor'ed bytes) for the preceding message. The calculation is performed on the whole message excluding the Start-Mark.

3.2 Protocol Micro-reader to PC

Start	Length	Status	Data	‒ ‒	BCC

Byte	*Contents (hexadecimal value)*
0	Start Mark (SOH, 01hex)
1	Length
2	Status
3	Data Field (1) (LSByte)
.	
.	
.	
N+2	Data Field (N) (MSByte)
N+3	BCC

Refer to Section 6.2 for examples.

3.2.1 Start Mark

The 'Start-Mark' signifies the beginning of a message. It is represented by the ASCII character SOH (Start Of Header: 01hex).

3.2.2 Length

The 'Length' byte indicates the length, in bytes, of the following Status and Data Fields.

3.2.3 Status

The 'Status' byte provides feedback from the preceding read or program operation.

Status Bits	*Setting*	*Comment*
0,1	00 (MSB,LSB)	Transponder type: RO
	01	Transponder type: R/W
	10	Transponder type: MPT/SAMPT
	11	Other
2	1/0	If set, Startbyte detected
3	1/0	If set, DBCC O.K.
4	1/0	If set, FBCC O.K.
5	1/0	If set, Micro-reader S/W version follows (all other status bits are reset)
6 - 7	Reserved	

3.2.4 Data Field

Response Type	# of Bytes in Data Field	Comment
RO	8	Identification Data (LSByte first), see 5.2.1
R/W	8	Identification Data (LSByte first)), see 5.2.2
MPT/SAMPT	9	Identification Data (LSByte first), plus Read Address, see 5.2.3
Other	14	Complete transponder protocol without pre-bits provided that a valid RO or R/W start byte was detected
No read	0	No Data Fields, not even transponder start byte was detected, status 03hex
S/W version	1	For example: 15hex means S/W version 1.5

Section 5.2 provides an overview of the response telegrams of the current TIRIS transponder types.

3.2.5 BCC

The 'BCC' field is a one-byte value of the Longitudinal Redundancy Check calculation (Xor'ed bytes) for the preceding message. The calculation is performed on the whole message excluding the Start-Mark.

4. Specifications

4.1 Absolute Maximum Ratings
over operating free-air temperature range (unless otherwise noted)

Supply voltage for power stage	V_VSP	6.0 V
Supply voltage for logic	V_VSL	6.0 V
Voltage on any pin (except ANT1)	Vpin	-0.6 V to V_VSL + 0.6 V
Maximum output current sunk by an output pin	I_su	22 mA
Maximum output current sourced by an output pin	I_so	22 mA
Antenna quality factor	Q_Ant	25
Operating free-air temperature range	T_oper	-25 to +70 $^{\mathrm{o}}$C
Storage temperature range	T_store	-40 to +85 $^{\mathrm{o}}$C

CAUTION: Exceeding absolute maximum ratings may lead to permanent damage to the Module. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Note: Free-air temperature: air temperature immediately surrounding the Module. If the module is incorporated into a housing, it must be guaranteed by proper design or cooling that the internal temperature does not exceed the absolute maximum ratings.

4.2 Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_VSP	Supply voltage for power stage	4.5	5.0	5.5	V
V_VSL	Supply voltage for logic	4.5	5.0	5.5	V
I_VSP	Supply current for power stage		110*[1]		mA
I_VSL	Supply current for logic		30*[2]		mA
I_su	Output current sunk by an output pin		5.0	15.0	mA
I_so	Output current sourced by an output pin		5.0	15.0	mA
I_sutot	Output current sunk by all output pins		20.0	60.0	mA
I_sotot	Output current sourced by all output pins		20.0	60.0	mA
V_ret	VSP start voltage to guarantee power on reset			GND	
Vrise_ret	VSP rise rate to guarantee power on reset	0.1			V/ms
I_idle	Supply current with Micro-reader idle		5.0		mA
I_act	Supply current with Micro-reader active		100*[3]		mA
ViH	Input high voltage	0.8 VSL		VSL	
ViL	Input low voltage	GND		0.2 VSL	
VoH	Output high voltage	VSL - 0.7		VSL	
VoL	Output low voltage	GND		0.6	V
Q_Ant	Antenna quality factor	10	15	20	
L_Ant	Antenna inductance value	46.1	47.0	47.9	µH

*[1]   *Typical supply current (peak value) for the power stage when the RF transmitter is switched on (L = 47mH, Q = 12).*

*[2]   *Typical supply current for logic when the RF transmitter is switched on.*

*[3]   *Typical supply current (average value) of the Micro-reader when the RF transmitter is switched on (L = 47mH, Q = 12).*

4.3 Timings

Parameter	Typical	Maximum	Unit
Read Cycle time without synch (no read)	100	105	ms
Read Cycle time with synch (no read)	120	175	ms
Read Cycle time without synch (valid read)	170	175	ms
Read Cycle time with synch (valid read)	190	245	ms
Interbyte time-out for serial communication	10*[1]		ms

*[1]   *If an Interbyte time-out occurs the Micro-reader performs a reset.*

4.4 Mechanical Data

Parameter	Minimum	Typical	Maximum	Unit
Length	37.9	38.3	38.7	mm
Width	28.8	29.3	29.6	mm
Height including pins	12.5	13.5	14.0	mm
Weight		5.0		Grams

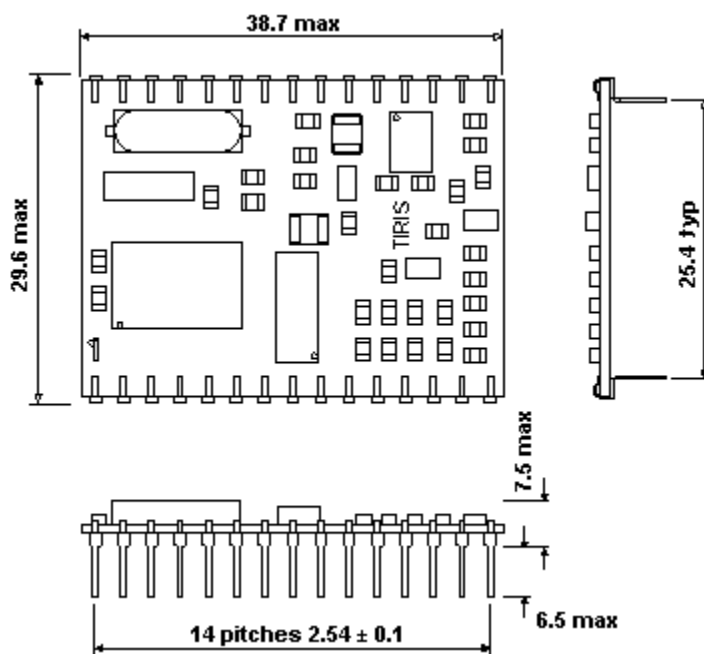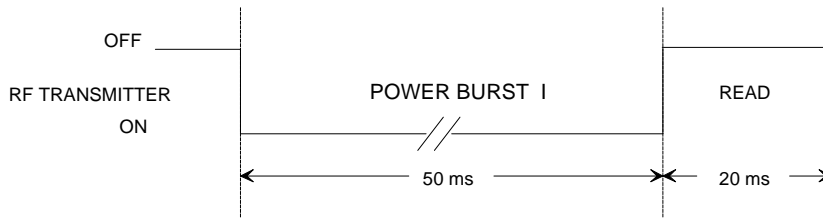Recommended finished pin hole size is 1 mm diameter.

Figure 4: Top, Front and Side View (measurements in mm)

5. Transponder Protocols
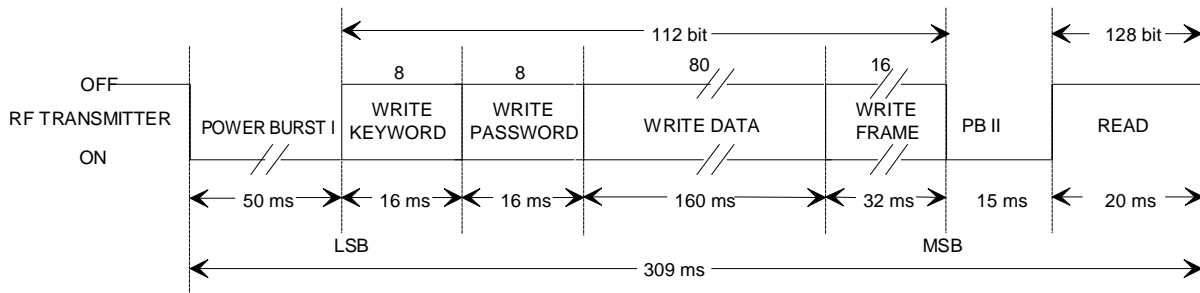
5.1 Transponder commands

This section describes the protocols that need to be sent by the PC to the transponder via the Micro-reader in order to execute the required function.

5.1.1 Read RO, R/W

Figure 5: Read function

5.1.2 Program R/W

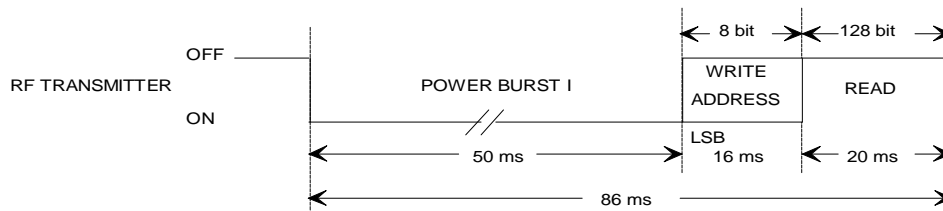**Figure 6: Programming data format of the 64-bit Read/Write Transponder**

Write Keyword   :   BBhex
Write Password   :   EBhex
Write Frame   :   0300hex

5.1.3 Addressing MPTs/SAMPTs

Since MPT/SAMPTs allow the execution of the different commands applicable to multiple pages the 'Write Address' needs to be sent within the protocol in order to determine the function to be executed with a specific MPT/SAMPT page.
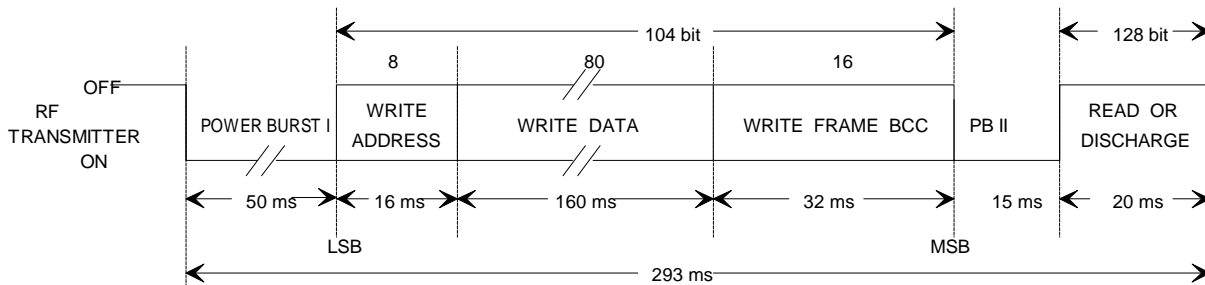
```
              WRITE ADDRESS
        MSB                   LSB
          P P P P P P  C C
                  |           |
              PAGE  COMMAND
            MSB     LSB   MSB LSB
  Page 1   000001        00        General read page
  Page 2   000010        01        Program page
    .  .         .        10        Lock page
  Page 16  010000        11        Selective read
  Page 17  010001
```
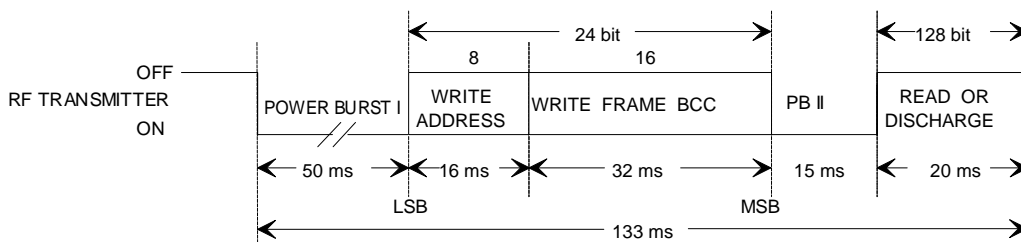
5.1.3.1 General Read Page of MPT/SAMPT

Figure 7: Data Format of the General Read Page Function

5.1.3.2 Program Page of MPT/SAMPT

Figure 8: Programming Data Format of the MPT

5.1.3.3 Lock Page of MPT/SAMPT

Figure 9: Lock Page Data Format of the MPT/SAMPT

5.1.3.4 Selective Read Page of SAMPT

Figure 10: Data Format of the Selective Read Page Function

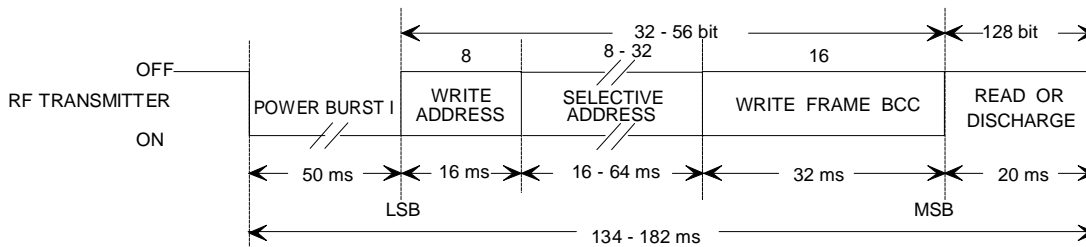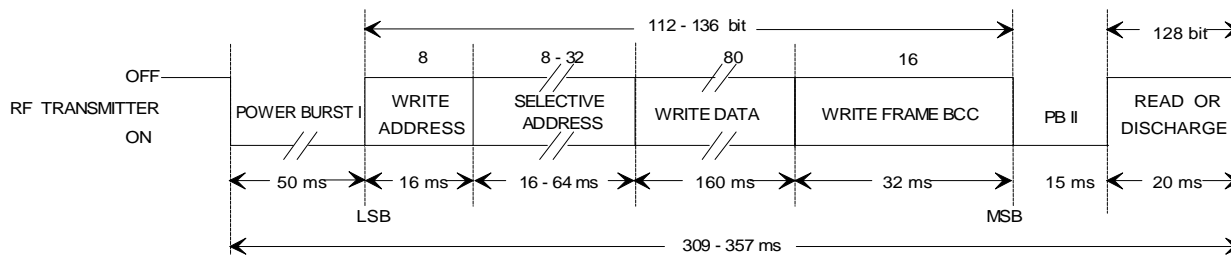## 5.1.3.5 Selective Program Page of SAMPT

Figure 11: Data Format of the Selective Program Page Function

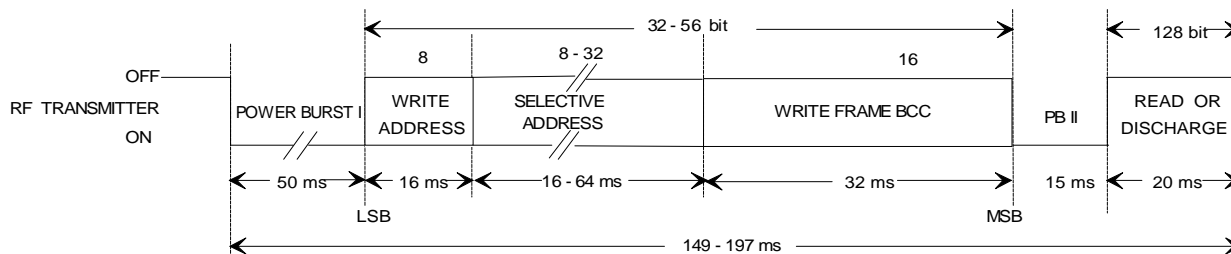## 5.1.3.6 Selective Lock Page of SAMPT

Figure 12: Data format of the Selective Lock Page function

5.2 Transponder Responses

This section shows the response telegrams of the current TIRIS transponder types.
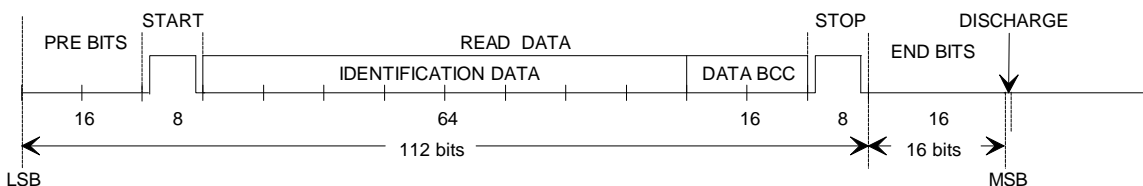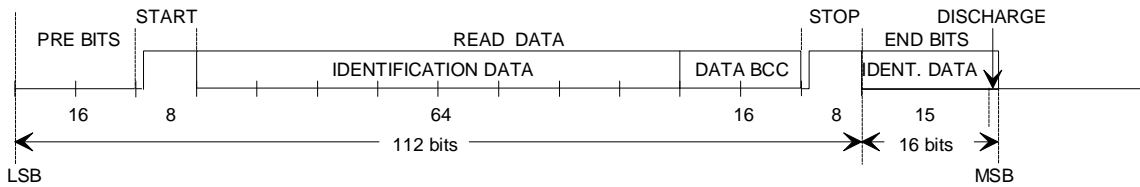
5.2.1 Read Only Transponder

Figure 13: RO Read Data Format

5.2.2 Read/Write Transponder

Figure 14: R/W Read Data Format

5.2.3 MPT/SAMPT
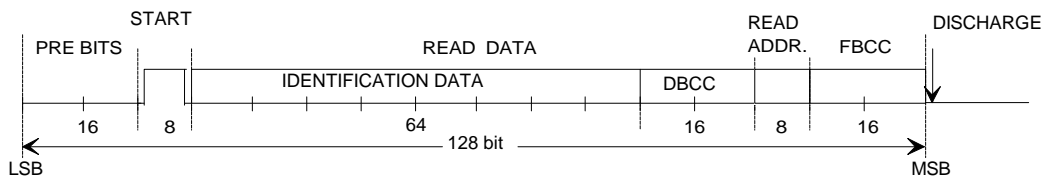
Figure 15: MPT/SAMPT Read Data Format

The Read Address consists of a 2-bit status field and a 6-bit page field. The status field provides information about the function the multipage transponder has executed and the page field shows which page was affected.

READ ADDRESS

MSB   LSB

P P P P P P   S S

| |

PAGE   STATUS

	MSB LSB	MSB LSB	
Page 1	000001	00	Read unlocked page
Page 2	000010	01	Programming done
. .	.	10	Read locked page
Page 16	010000	11	Reserved *)
Page 17	010001		
	000000	00	Read unlocked page, locking not correctly executed
	000000	01	Programming done, but possibly not reliable
	000000	10	Read locked page, but locking possibly not reliable

*) If the status indicates 'Reserved', the read data cannot be interpreted as identification data.

Note: *It is strongly recommended to verify whether the requested function has actually been carried out in the transponder by checking the Read Address. If a 'not reliable' response message is received, the command must be sent again to guarantee transponder data retention.*

6. Communication Protocol Examples

6.1 PC to Micro-reader

Read RO, R/W

Byte	Content (hex)	Comment	Description
0	01	Start Mark	
1	02	Length	Two bytes follow excluding BCC
2	08	Command Field (1)	Perform Single command, send Power Burst I
3	32	Data Field (1)	Power Burst I with 50 ms duration (charge-up)
4	38	BCC	BCC over previous bytes excluding Start Mark

General Read Page of MPT

The following sequence of bytes reads page 2 of an MPT.

Byte	Content (hex)	Comment	Description
0	01	Start Mark	
1	04	Length	Four bytes follow excluding BCC
2	48	Command Field (1)	Perform Single command, send Power Burst I with data
3	32	Data Field (1)	Power Burst I with 50 ms duration (charge-up)
4	01	Data Field (2)	One Data Field follows
5	08	Data Field (3)	Write Address specifying General Read Page 2
6	77	BCC	BCC over previous bytes excluding Start Mark

Program Page of MPT

The following sequence of bytes programs page 2 of an MPT with:
```
    00 00 00 00 00 2D C6 47
MSByte                    LSByte
```

Byte	Content (hex)	Comment	Description
0	01	Start Mark	
1	0F	Length	15 bytes follow excluding BCC
2	6C	Command Field (1)	Perform Single command, calculate FBCC, send Power Burst I & II with Data
3	32	Data Field (1)	Power Burst I with 50 ms duration (charge-up)
4	0F	Data Field (2)	Power Burst II with 15 ms duration (Progr. burst)
5	0B	Data Field (3)	11 Data Fields follow
6	09	Data Field (4)	Write Address specifying Program Page 2
7	47	Data Field (5)	Programming data (LSByte)
8	C6	Data Field (6)	Programming data
9	2D	- : -	- : -
10	00	- : -	- : -
11	00	- : -	- : -
12	00	- : -	- : -
13	00	Data Field (11)	Programming data
14	00	Data Field (12)	Programming data (MSByte)
15	96	Data Field (13)	DBCC (LSByte)
16	50	Data Field (14)	DBCC (MSByte)
17	36	BCC	BCC over previous bytes excluding Start Mark

6.2 Micro-reader to PC

Successful Read of RO

Byte	Content (hex)	Comment	Description
0	01	Start Mark	
1	09	Length	9 bytes follow excluding BCC
2	0C	Status	Valid RO, Startbyte detected, DBCC O.K.
3	6A	Data Field (1)	Identification Data (LSByte)
4	58	Data Field (2)	Identification Data
5	4C	- : -	- : -
6	00	- : -	- : -
7	00	- : -	- : -
8	00	- : -	- : -
9	00	Data Field (7)	Identification Data
10	00	Data Field (8)	Identification Data (MSByte)
11	7B	BCC	BCC over previous bytes excluding Start Mark

Successful Program Page 2 of MPT

Byte	Content (hex)	Comment	Description
0	01	Start Mark	
1	0A	Length	10 bytes follow excluding BCC
2	1E	Status	Valid MPT, Startbyte detected, DBCC O.K., FBCC O.K.
3	47	Data Field (1)	New Identification Data (LSByte)
4	C6	Data Field (2)	New Identification Data
5	2D	- : -	- : -
6	00	- : -	- : -
7	00	- : -	- : -
8	00	- : -	- : -
9	00	Data Field (7)	New Identification Data
10	00	Data Field (8)	New Identification Data (MSByte)
11	09	Data Field (9)	Read Address specifying successful progr. of page 2
12	B1	BCC	BCC over previous bytes excluding Start Mark

No Read

Byte	Content (hex)	Comment	Description
0	01	Start Mark	
1	01	Length	One byte follows excluding BCC
2	03	Status	Other, no Startbyte, DBCC not O.K., FBCC not O.K.
3	02	BCC	BCC over previous bytes excluding Start Mark

Appendix A: Abbreviations

AM	Amplitude Modulation
AQL	Acceptable Quality Level
ASK	Amplitude Shift Keying
BCC	Block Check Character
Cmd	Command
CRC	Cyclic Redundancy Check
DBCC	Data BCC
EM	Electro-Magnetic
EMI	Electro-Magnetic Interference
FBCC	Frame BCC
FM	Frequency Modulation
FM/FSK	Frequency Modulation/Frequency Shift Keying
FSK	Frequency Shift Keying
IC	Integrated Circuit
LSB	Least Significant Bit
LSByte	Least Significant Byte
MPT	Multipage Transponder
MSB	Most Significant Bit
MSByte	Most Significant Byte
NRZ	Non Return to Zero
PB I	Power Burst one
PB II	Power Burst two
RF	Radio Frequency
RF-ID	Radio Frequency Identification
RO	Read Only Transponder
R/W	Read/Write Transponder
SCI	Serial Communications Interface
SAMPT	Selective Addressable Multipage Transponder
S/W	Software
TIRIS	Texas Instruments Registration and Identification System

Appendix B: Signal Names

RXCK	Receiver Clock
RXDT-	Receiver Data Signal
TXCT-	RF - Transmitter Control Signal
TXHI	Positive Transmission Signal Output
TXLO	Negative Transmission Signal Output

Appendix C: CE Declaration

The Micro-reader module complies with the European CE requirements specified in the EMC Directive 89/336/EEC. The relevant documentation numbers are:

Declaration of Conformity	11-06-02-005
Type Examination Certificate	11-06-05-001

If the Micro-reader is operated from a mains power supply, all power connections and additional components of the final device must comply with the European EMC directive.

Additional connections may have a length of up to 2 m maximum, or up to 1 m maximum in fixed installations.

European customers must themselves make sure that the final device conforms to the European EMC Directive.