Technical Data Sheet

RFID Reader

UW-R4G

UW-R4G-man-1
For firmware at least v2.3

1 . Introduction

The UW-R4G is RFID card reader, which belongs to Mifare and I-CODE family.

Features of the card reader include:

- Support for: Mifare S50,S70, Plus, UltraLight C, Desfire, iClass(CSN), I-CODE SLI, ISO14443B
- 1000 card memory with built-in lock driver
- RS-485 interface
- RS-485 bus addressability
- Modbus and Netronix protocol
- Built-in relay and buzzer
- Built-in push-button and warning LED's on front panel
- Built-in push-button for reset to default settings
- Built-in tamper with spring
- Set-up capability for two-state inputs and outputs
- Buzzer, relay and LED's setup
- Two-state outputs control
- Read-out of two-state input
- Full access possibility to all card sectors on read and write level
- Data security by password
- Battery backup RTC
- Events memory with trigger mask
- Software update via RS485 interface using *NEFIR* program

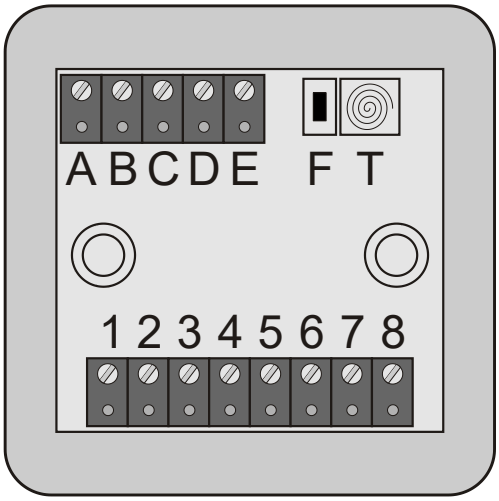
2 . General Specifications

Supported functionality depending on transponder / card type:			
Card Type	**ID number read-out**	**Full write and read-out of memory blocks**	**Supported by internal lock driver**
S50	YES	YES	YES
S70	YES	YES	YES
PLUS S, PLUS X	YES	YES (SL1, SL3)	YES
Ultralight, Ultralight C	YES	YES	YES
DesFire	YES	YES	YES
iCLASS	YES (CSN)	NO	YES
I-CODE	YES	YES	YES
ISO14443B	YES	NO	YES

UW-R4G module parameters	
Supply voltage	8-16 V
Max. supply current	200 mA
Rated operation radio frequency of module	13.56 MHz
Read-out distance	up to 8 cm
Maximum output current	1A
Maximum total output current	2A
RS-485 communication	2400, 4800, 9600, 19200, 38400, 57600, 115200 bps, 8 data bits, 1 stop bit, no parity compliant with „Netronix Protocol”

3. Names and functions of parts

Rear view

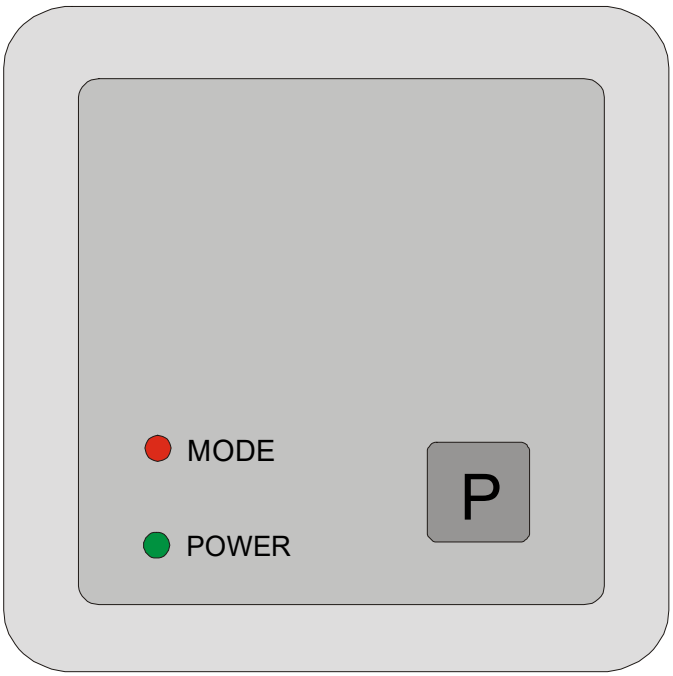


UW-R4G

Symbol on drawing	Function
1	IO 1
2	Synchronization of two readers, which are in-proximity
3	RS-485 pin A
4	RS-485 pin B
5	Module power supply
6	Ground and minus of supply voltage
7	Relay contacts outputs
8	
T	Tamper with spring
F	Push-button for reset to default settings

A	GPIO 2
B	GPIO 3
C	GPIO 4
D	GPIO 5
E	GPIO 6

Front view



Symbol on drawing	Function
LED MODE	Red LED, green LED and blue LED in one Optical indication of operation/configurable
LED POWER	Optical indication of supply
P	Push-button, which state can read via RS-485 bus.

The LED mode and internal buzzer functions are designed to warn user on state, in which buzzer actually is. Additionally, it is possible to change settings, which will compel extra reactions of indication elements. Extra reactions can be modified by means of port settings.

4 . Serial transmission format

In this data sheet RS-485 protocol has been confined to descriptions of commands, responses and their parameters. Header and CRC control sum exist always and are compliant with full “Netronix Prtocol” document.

Command frame:

Header	C_CommandName	Response_parameters1…n	CRC

Response frame:

Header	C_CommandName +1	Response_parametrers…m	OperationCode	CRC

RS protocol operation can be tested by means of development tools including free of charge “FRAMER” software”.

4.1. Key management

Key management feature includes key loading to internal key memory.
For security reasons, these keys cannot be red-out.

To maintain the highest level of data security, employed a particular philosophy of working with these keys.
It allows unit or person who possesses the highest level of confidence to load a key. Such loading operation can be made one time only, or very rarely.
Reader operation in given application is based on using a key not directly, but on recalling key number, to login to sector.
The result is that, in substance, key does not appear in data bus in given application.

Additionally, a user is advised to make sure key should have proper access rights to sectors. This is accomplished by card initialization process, where new confidential keys are loaded to cards with proper access rights, which are assigned to these keys.

Keys A and B are assigned to each sector.
Commands C_LoadKeyToSKB and C_LoadKeyToDKB load these keys to reader memory without information on key type (A or B).
During logging to sector, user has to input as a parameter value of 0xAA or 0xBB, if he wants, the key which is being recalled would be treated as an A or B.

4.1.1. Key loading into dynamic key memory

Dynamic memory features of automatic content delete in case of supply decay. The memory can be overwritten many times.

Command frame:

Header	C_LoadKeyToDKB	Key1…6	CRC

Where:

Parameter name	Parameter description	Value range
C_LoadKeyToDKB	Key loading to key dynamic memory	0x14
Key1…6	6-byte code	whichever

Response frame:

Header	C_LoadKeyToDKB +1		OperationCode	CRC

4.1.2. Key loading to key static memory

Important feature of static memory is that in case of supply decay, data stored in it will not be lost. The memory can be overwritten many times.

Command frame:

Header	C_LoadKeyToSKB	Key1…6, KeyNo	CRC

Where:

Parameter name	Parameter description	Value range
C_LoadKeyToSKB	Key loading to key static memory	0x16
Key1…6	6-byte key	whichever
KeyNo	Key number. It possible to load 32 different keys to a reader.	0x00…0x1f

Response frame:

Header	C_LoadKeyToSKB +1		OperationCode	CRC

4.2. Commands for communication with transponder

4.2.1. On/off switching of reader field

Command frame:

Header	C_TurnOnAntennaPower	State	CRC

Where:

Parameter name	Parameter description	Value range
C_TurnOnAntennaPower	On/off switching of reader field	0x10
State	On state	0x00 – switching the field off 0x01 – switching the field on

Response frame:

Header	C_TurnOnAntennaPower +1		OperationCode	CRC

4.2.2. Selecting one of many transponders

Command frame:

Header	C_Select	RequestType	CRC

Where:

Parameter name	Parameter description	Values
C_Select	Selecting one of many transponders	0x12
RequestType	Type of transponder selection	0x00 - Standard selecting from group of transponders, which are not in stand-by mode 0x01 - Selecting from group of transponders, which are in reader field.

Response frame:

Header	C_Select +1	ColNo, CardType, ID1…….IDn	OperationCode	CRC

Where:

Parameter name	Parameter description	Meaning
ColNo	Number of collisions during one transponder selecting. This figure can be equal to the transponder quantities, which are in the field simultaneously, and which are not in stand-by state.	
CardType	Type of selected transponder	0x50 – S50 0x70 – S70 0x10 – Ultra Light 0xdf – Des Fire
ID1…IDn	Unique number of transponder	ID1 – LSB, IDn – MSB

4.2.3. Logging by means of Dynamic Key Buffer to selected sector of transponder

To complete logging successfully, it is important after any input of the reader, to reload the Dynamic Key Buffer.

Command frame:

Header	C_LoginWithDKB	SectorNo, KeyType, DKNo	CRC

Where:

Parameter name	Parameter description	Value range
C_LoginWithDKB	Logging to sector	0x18
SectorNo	Transponder sector number, to which user wants to login.	0x00 – 0x0f (s50) 0x00 – 0x27 (s70)
KeyType	Key type, which is inside internal Dynamic Key Buffer.	0xAA – key of A type 0xBB – key of B type
DKNo	Dynamic key number	0x00

Response frame:

Header	C_LoginWithDKB +1		OperationCode	CRC

4.2.4. Logging by means of Static Key Buffer to selected sector of transponder

To complete logging successfully, it is important to load Static Key Buffer first.

Command frame:

Header	C_LoginWithSKB	SectorNo, KeyType, SKNo	CRC

Where:

Parmeter name	Parameter description	Value range
C_LoginWithSKB	Logging to sector	0x1a
SectorNo	Transponder sector number, to which user wants to login.	0x00 – 0x0f (s50) 0x00 – 0x27 (s70)
KeyType	Key type, which is inside internal Static Key Buffer.	0xAA – key of A type 0xBB – key of B type
SKNo	Static Key number	0x00…0x1F

Response frame:

Header	C_LoginWithSKB +1		OperationCode	CRC

4.2.5. Reading-out the content of transponder block

Command frame:

Header	C_ReadBlock	BlockNo	CRC

Where:

Parameter name	Parameter description	Value range
C_ReadBlock	Read-out of transponder block content	0x1e
BlockNo	Block number within given sector	**Sector and block numeration

Response frame:

Header	C_ReadBlock +1	Data1….. Data16	OperationCode	CRC

Where:

Parameter name	Parameter description	Value range
Data1…. Data16	Red-out of data from transponder block	

4.2.6. Writing the content of transponder block

Command frame:

Header	C_WriteBlock	BlockNo, Data1….. Data116	CRC

Where:

Parameter name	Parameter description	Value range
C_WriteBlock	Write of transponder block content	0x1c
BlockNo	Block number within given sector	**Sector and block numeration
Data1…. Data16	Data, which are to be written into transponder block.	whichever

Response frame:

Header	C_WriteBlock +1		OperationCode	CRC

4.2.7. Copying the content of transponder block into other block

Command frame:

Header	C_CopyBlock	SourceBlockNo, TargetBlockNo	CRC

Where:

Parameter name	Parameter description	Value range
C_CopyBlock	Copying the content of transponder block into other block	0x60
SourceBlockNo	Source block	**Sector and block numeration
TargetBlockNo	Target block for data	

Response frame:

Header	C_CopyBlock +1		OperationCode	CRC

4.2.8. Writing the page content into Mifare UL

Command frame:

Header	C_WritePage4B	PageAdr, Data1...4	CRC

Where:

Parameter name	Parameter description	Value range
C_WritePage4B	Writing the page content into Mifare UL	0x26
PageAdr	Page number in transponder	0x00…0x0f
Data1...4	Data, which are to be written	whichever

Response frame:

Header	C_WritePage4B +1		OperationCode	CRC

4.2.9. Reading the page content in Mifare UL

Command frame:

Header	C_ReadPage16B	PageAdr	CRC

Where:

Parameter name	Parameter description	Value range
C_ReadPage16B	Read-out of page content in Mifare UL	0x28
PageAdr	Page address, from which read-out of following four pages should start. If PageAdr>0x????, starts read-out process of pages, which are present at memory beginning.	0x00…0x0f

Response frame:

Header	C_ReadPage16B +1	Data1…16	OperationCode	CRC

Where:

Parameter name	Parameter description	Value range
Data1…16	Red-out of data from four subsequent pages.	whichever

4.2.10. Writing values to transponder block

Command frame:

Header	C_WriteValue	BlockNo, BackupBlockNo,Value1...4,	CRC

Where:

Parameter name	Parameter description	Value range
C_WriteValue	Write of values to transponder block.	0x34
BlockNo	Block number within given sector, into which the Value will be written.	**Sector and block numeration
BackupBlockNo	Declared block number including the Value copy. BackupBlockNo has no influence for system operation, but user can/should make the Value copy by himself.	**Sector and block numeration
Value1...4	The Value, which is written to transponder block.	whichever

Response frame:

Header	C_WriteValue +1		OperationCode	CRC

4.2.11. Reading-out the values from transponder block

Command frame:

Header	C_ReadValue	BlockNo	CRC

Where:

Parameter name	Parameter description	Value range
C_ReadValue	Read-out of the Value from transponder block.	0x36
BlockNo	Block number within given sector, from which the Value will be red-out.	**Sector and block numeration

Response frame:

Header	C_ReadValue+1	Value1...4, BackupBlockNo	OperationCode	CRC

Where:

Parameter name	Parameter description	Value range
Value1...4	Red-out Value from transponder block.	
BackupBlockNo	Block number, which can include the Value copy.	**Sector and block numeration

4.2.12. Increasing the value included in transponder block

To execute a command successfully, format of data included in declared block should be "Value" format.

Command frame:

Header	C_IncrementValue	BlockNo, Value1...4	CRC

Where:

Parameter name	Parameter description	Value range
C_IncrementValue	Increasing the value included in transponder block.	0x30
BlockNo	Block number within given sector, in which the Value will be modified.	**Sector and block numeration
Value1...4	Value, which is being added to existed real value of block transponder.	

Response frame:

Header	C_IncrementValue +1		OperationCode	CRC

4.2.13. Decreasing the value included in block transponder

To execute a command successfully, format of data included in declared block should be "Value" format.

Command frame:

Header	C_DecrementValue	BlockNo, Value1...4	CRC

Where:

Parameter name	Parameter description	Value range
C_DecrementValue	Decreasing the Value included in transponder block.	0x32
BlockNo	Block number within given sector, in which the Value will be modified	**Sector and block numeration
Value1...4	The Value, which is being subtracted from existed real value of block transponder.	whichever

Response frame:

Header	C_DecrementValue+1		OperationCode	CRC

4.2.14. Setting the transponder in field into sleep mode

To set transponder to sleep mode, select it first.

Command frame:

Header	C_Halt		CRC

Parameter name	Parameter description	Value range
C_Halt	Setting the transponder in field into sleep mode.	0x40

Response frame:

Header	C_Halt+1		OperationCode	CRC

4.3. Mifare Plus/ Desfire

Please contact with our support at netronix@netronix.pl

4.4. Electrical inputs and outputs

The reader has configurable inputs and outputs. All the outputs are of OC (open drain) type and feature 1 mA load capacity (1.5 A for pulse of width less than 10 ms). Module comprising outputs is fitted with overcurrent protection feature, which switches outputs off in case of excessive current occurs, and switches them on, after current drops below given limit value.

4.4.1. Describing the output state

Command frame:

Header	C_WriteOutputs	IONo, State	CRC

Where:

Parameter name	Parameter description	Value range
C_WriteOutputs	Description of output state	0x70
IONo	Number of I/O port. It should be set as an output.	0x02…0x06
State	Desired output state	0x00 lub 0x01

Response frame:

Header	C_WriteOutputs +1		OperationCode	CRC

4.4.2. Reading-out the input state

Command frame:

Header	C_ReadInputs	IONo	CRC

Where:

Parameter name	Parameter description	Value range
C_ReadInputs	Read-out of input state	0x72
IONo	Number of I/O port. It should be set as an input.	0x00,0x01,0x07

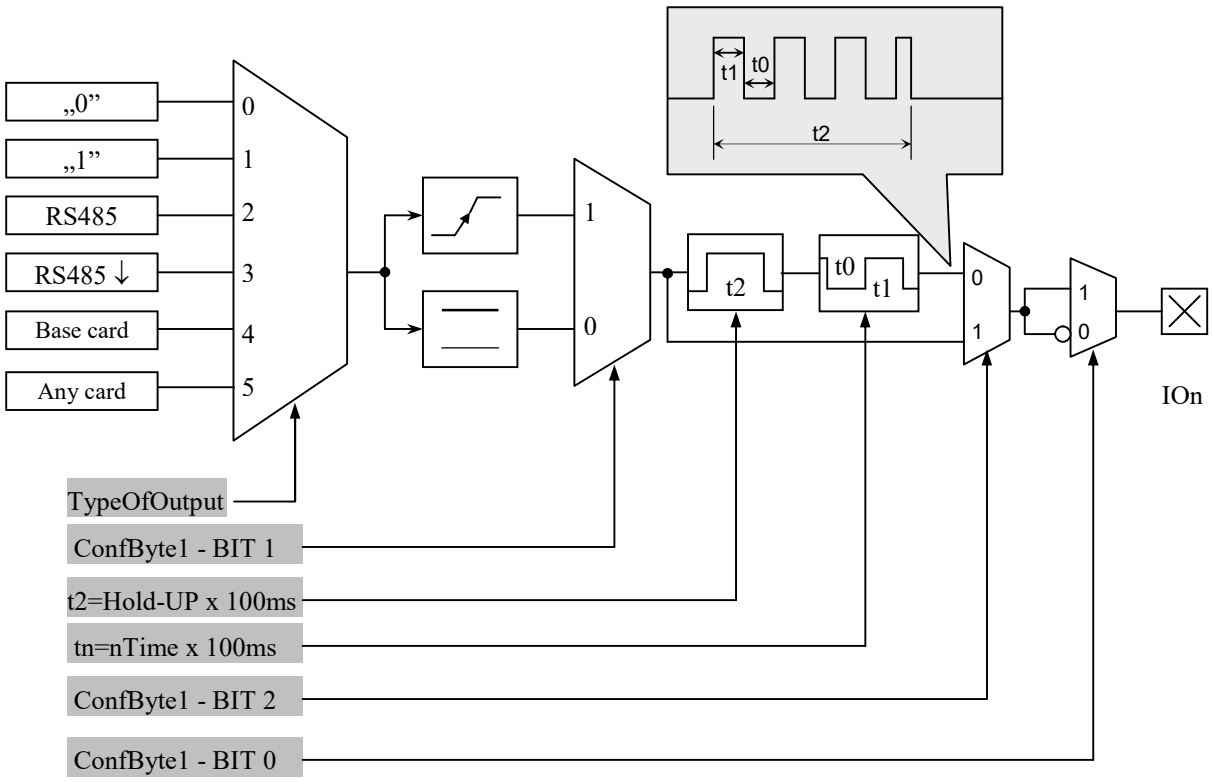
Response frame:

Header	C_ReadInputs +1	State,[counter]	OperationCode	CRC

Where:

Parameter name	Parameter description	Value range
State	Red-out of output state	
Counter	Counter state for counter type of input	

4.4.3. Writing the settings to any port



Command frame:

Header	C_SetIOConfig	IONo, IOConfigData1…n	CRC

If we set a port as output, IOConfigData1…n parameters are as below:

Dir, ConfByte1, TypeOfOutput, Hold-up, 0Time, 1Time

Where:

Parameter name	Parameter description	Value range
C_SetIOConfig	Writing the configuration to any port.	0x50
IONo	Number of I/O port, which is to be configured.	0x02…0x06
Dir	Port direction	0x00 – output
ConfByte1	One byte, in which younger byte defines output type as a NO or NC. Next byte characterizes response manner of given output, as responding for actuation change (slope responding) or responding for actuation state (state responding).	ConfByte1.BIT 0 0-Normally Closed 1-Normally Open ConfByte1.BIT 1 0-level responding 1-slope responding

TypeOfOutput	Source of driving signal	0x00 – permanently off 0x01 – permanently on 0x02 – driven via serial interface 0x03 – driven via serial with automatic reset 0x04 – driven by internal access control mechanism ACM. This output is driven in case of applying the card to reader, which is written into internal card base. 0x05 – set in case of applying freely selected card to reader.
Hold-up	Time of maintaining the on state after actuation stopped. This time is specified as: Hold-up x 100 ms During "hold-up" time, it is possible to configure the output, whish is able to generate rectangular wave. By means of following parameters are configured "Logic 1" time and "Logic 0" time:	
0Time	Logic 0 time	
1Time	Logic 1 time	

If we set a port as a input, IOConfigData1…n parameters would be as below:
Dir, Neg, TypeOfInput, RFU1, RFU2, RFU3,

Where:

Parameter name	Parameter description	Value range
C_SetIOConfig	Writing the configuration of freely selected port.	0x50
IONo	I/O port number, which is to be configured.	0x00,0x01,0x07, 0x08-0x0C
Dir	Port direction	0x01 – input
Neg	0: return negation state of input 1: return direct state of input	0x0,0x1
TypeOfInput	0x03 – normal input 0x04 – counter type input	0x03,0x04
RFU1-RFU3	Reserved, must be set to '0'	0x00

UW-R4G reader has no possibility to toggle port direction.
To accomplish proper configuration, input proper direction option to given port.

LIST OF EXISTING PORTS, WHICH CAN BE DRIVEN IN UW-R4G		
Port number	Direction	Description
0	input	Switch located on front panel of reader
1	input/output	GPIO 1
2	output	Green LED: „mode”
3	output	Red LED: „mode”
4	output	buzzer
5	output	relay
6	output	Blue LED “mode”
7	input	Tamper switch
8	input/output	GPIO2
9	input/output	GPIO3
10	input/output	GPIO4
11	input/output	GPIO5
12	input/output	GPIO6

Response frame:

Header	C_SetIOConfig +1		OperationCode	CRC

4.4.4. Reading-out the configuration of freely selected port

Command frame:

Header	C_GetIOConfig	IONo	CRC

Where:

Parameter name	Parameter description	Value range
C_GetIOConfig	Reading-out the configuration of freely selected port.	0x52
IONo	I/O port number, which configuration is to be red-out.	0x00…0x05

Response frame:

Header	C_GetIOConfig +1	IOConfigData1…n	OperationCode	CRC

Where:

Parameter name	Parameter description	Value range
IOConfigData1…n	This is the same, as in case of configuration write.	

4.5. Access password

4.5.1. Logging to reader

Command frame:

Header	C_LoginUser	Data1…n, 0x0	CRC

Where:

Parameter name	Parameter description	Value range
C_LoginUser	Logging to reader	0xb2
Data1…n	This is any byte string	Any from range: 0x01…0xff. String length, which can be 0 to 8 bytes
0x00	Logic Zero, which terminates a string.	0x00

Response frame:

Header	C_LoginUser +1		OperationCode	CRC

4.5.2. Changing the password

Command frame:

Header	C_ChangeLoginUser	Data1…n, 0x0	CRC

Where:

Parameter name	Parameter description	Value range
C_ChangeLoginUser	Password change	0xb4
Data1…n	This is any byte string, which will form valid access password.	Any from range: 0x01…0xff. String length, which can be 0 to 8 bytes
0x00	Logic Zero, which terminates a string.	0x00

If =0x00, a reader will not be protected by password. At any moment, there is possible to set new password later on, to protect the reader by it.

Response frame:

Header	C_ChangeLoginUser+1		OperationCode	CRC

4.5.3. Logging out of the reader

This command sets latest password as an invalid.

Command frame:

Header	C_LogoutUser		CRC

Parameter name	Parameter description	Value range
C_LogoutUser	Logging out of the reader.	0xd6

Response frame:

Header	C_LogoutUser +1		OperationCode	CRC

4.6. Operating the transponder internal memory

4.6.1. Reading-out the transponder number from memory

Command frame:

Header	C_CardMemoryRead	AdrL, AdrH	CRC

Where:

Parameter name	Parameter description	Value range
C_CardMemoryRead	Read-out of transponder number from memory.	0x20
AdrL, AdrH	Younger and older byte respectively.	0x0000…0x01fd

Response frame:

Header	C_CardMemoryRead +1	ID1(L)….ID5(H), Right	OperationCode	CRC

Where:

Parameter name	Parameter description	Value range
ID1(L)….ID5(H)	Five bytes of transponder number	
Right	Access rights to given transponder	0x01

4.6.2. Writing the transponder name to memory

Command frame:

Header	C_CardMemoryWrite	AdrL, AdrH, ID1(L)….ID5(H), Right	CRC

Where:

Parameter name	Parameter description	Value range
C_CardMemoryWrite	Write of transponder number into memory.	0x22
AdrL, AdrH	Younger and older byte respectively	0x00…0x01fd
ID1(L)….ID5(H)	Five bytes of transponder number	Any of five bytes
Right	Access rights or function performed by transponder.	0x01

Response frame:

Header	C_CardMemoryWrite+1		OperationCode	CRC

Where:

4.7. Operating the built-in access control

4.7.1. Writing the configuration of access control

Command frame:

Header	C_AccesControlConfigWrite	Mode	CRC

Where:

Parameter name	Parameter description	Value range
C_AccesControlConfigWrite	Write of access control configuration.	0x74
Mode	Operation mode of control access module.	0x00 – module disabled 0x01 – module enabled

Response frame:

Header	C_AccesControlConfigWrite+1		OperationCode	CRC

Where:

4.7.2. Reading-out the configuration of access control

Command frame:

Header	C_AccesControlConfigRead		CRC

Where:

Parameter name	Parameter description	Value range
C_ AccesControlConfigRead	Read-out of access control configuration.	0x76

Response frame:

Header	C_AccesControlConfigRead+1	Mode	OperationCode	CRC

Where:

Parameter name	Parameter description	Value range
Mode	Operation mode of access control module.	0x00 – module disabled 0x01 – module enabled

4.7.3. Writing the automatic device configuration

This command sets operation method of automatic device, reading the unique transponder number UID.

Because of high security level provided by Milfare transponders, there is no possibility of operation of UID reading automatic device and communication with transponders via RS-485 simultaneously.

The reader described below makes possible to hold-on operation of automatic device for a while, in case of suitable transmission via serial interface.

If the reader will operate in mixed mode i.e.:
- automatic reading device UID is enabled and:
- master device (computer, controller) communicates with reader or with transponders via reader,
it is required, to configure the reader correctly, so in case of communication with a reader or transponder, automatic reading device would hold-on its operation.

Command frame:

Header	C_SetAutoReaderConfig	ATrig, AOffTime, ASerial, Amode,Abuzz,Amask	CRC

Where:

Parameter name	Parameter description	Value range
C_SetAutoReaderConfig	Writing the automatic device configuration.	0x58
ATrig	Defines, when automatic reading device UID will operate.	0-automatic device disabled permanently 1-automatic device enabled permanently 2=enabled automatically in case of transmission lack on RS485 for a time longer than AOfflineTime 3=enabled automatically, in case of no recall of communication commands with transponder for a time longer than AOfflineTime
AOfflineTime	Lack of transmission time on RS485 bus T= AofflineTime * [100ms] Lack of transmission can concern to	0x00…0xff

<table>
<tr><td></td><td>any commands (Atrig=2), or commands for communication with transponder (Atrig=3).

Commands for communication with transponder:
C_TurnOnAntennaPower
C_Select
C_LoginWithDKB
C_LoginWithSKB)
C_ReadBlock
C_WriteBlock
C_CopyBlock
C_WritePage4B
C_ReadPage16B
C_IncrementValue
C_DecrementValue
C_WriteValue
C_ReadValue
C_Halt</td><td></td></tr>
<tr><td>ASerial</td><td>Automatic sending the UID transponder number, after reading it automatically from transponder.</td><td>0-never
1-for the first applying the transponder only
2-sends all</td></tr>
<tr><td>AMode</td><td>Selection the format of sending number

8 bits:

MSB LSB
R R R CR M E I A</td><td>R Reserved, always 0
CR=1 Number which is ended with line end mark CR+LF
M=1 Number which begins with “M”sign
E=1 information extended with cards umber in filed and card type (UW-M4x readers only)
I=1 Number in reversed order
A=1 Number sent in ASCII format
A=0 Number sent in Nertonix format</td></tr>
<tr><td>ABuzz</td><td>Automatic indication of reading by means of buzzer, after automatic UID read-out from transponder.</td><td>0-never
1-for the first applying the transponder only
2-indicates all</td></tr>
<tr><td>AMask</td><td>Defines which transponder will be read:
MSB LSB
R R R R S I B M</td><td>R Reserved, always 0
M=1 Mifare (ISO14443A)
B=1 ISO14443B
I=1 IClass CSN
S=1 ICode SLI (ISO15693)</td></tr>
</table>

Response frame:

Header	C_ SetAutoReaderConfig +1		OperationCode	CRC

4.7.4. Reading-out the configuration of automatic device

Command frame:

Header	C_ GetAutoReaderConfig		CRC

Where:

Parameter name	Parameter description	Value range
C_GetAutoReaderConfig	Read-out of automatic device configuration.	0x5a

Response frame:

Header	C_ GetAutoReaderConfig +1	ATrig, AOfflineTime, ASerial, ABuzz	OperationCode	CRC

Where:

The meaning of response parameters is the same as described before.

4.7.5. Setting the date and time

Following setting has no influence for reader operation today.

Command frame:

Header	C_SetRtc	Year, Month, Day, Hour, Minute, Second	CRC

Where:

Parameter name	Parameter description	Value range
C_SetRtc	Date and time set-up	0xb8
Year	year	0…99
Month	month	1…12
Day	day	1…31
Hour	hour	0…23
Minute	minute	0…59
Second	second	0…59

Response frame:

Header	C_SetRtc +1		OperationCode	CRC

4.7.6. Reading-out the date and time

Command frame:

Header	C_GetRtc		CRC

Where:

Parameter name	Parameter description	Value range
C_GetRtc	Read-out of date and	0xb6

	time	

Response frame:

Header	C_GetRtc+1	Year, Month, Day, Hour, Minute, Second	OperationCode	CRC

Where:
The meaning of response parameters is the same as described before.

4.8. Configuring the RS-485 serial interface

4.8.1. Writing the configuration of serial port

Command:

	C_SetInterfaceConfig	Mode, Adr, Baudrate	

Where:

Parameter name	Parameter description	Value range
C_SetInterfaceConfig	Serial interface configuration write	0x54
Mode		0x01
Adr	Address on RS-485 bus	0x01…0xfe
Baudrate	Data baud rate on RS-485 bus	0x01=2400 bps 0x02=4800 bps 0x03=9600 bps 0x04=19200 bps 0x05=38400 bps 0x06=57600 bps 0x07=115200 bps

Response:

	C_SetInterfaceConfig +1		OperationCode	

4.8.2. Reading the configuration of serial interface

Command:

	C_ GetInterfaceConfig		

Where:

Parameter name	Parameter description	Value range
C_GetInterfaceConfig	Serial interface configuration read-out	0x56

Odpowiedź:

	C_ GetInterfaceConfig +1	Mode, Adr, Baudrate	OperationCode	

Where:
The meaning of response parameters is the same as described before.

4.9. Managing the events

The UW-x4x series readers has equipped with event memory of capacity 4400 records. Reason of event can be operation related to card or state changing on reader outputs. The readers have RTC clock with battery back-up. After supply failure above 7 days, clock is reset to defaults: date: 1 January 2019, time: 15:01:01. Event counter is reset.

4.9.1. Setting the event recorder

Command frame:

Header	C_SetEventTrig	CardTrig, In4Trig, In3Trig, In2Trig, In1Trig	CRC

Wherein:

Parameter name	Parameter description	Value range
C_SetEventTrig **0x7C**	Setting the event masking	0x7C
CardTrig	Masking the events related to card (see below)	0x00 - 0xFF
In1Trig-In4Trig	Masking the events related to inputs (see below)	0x00-0xFF

Response frame:

Header	C_SetEventTrig+1		OperationCode	CRC

Masking byte of events related to card

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
Reserve	No memory	Card removal	Card adding	Reserve	Master card	Outside base card	Inside base card

E.g. byte 0x25(00100101) means that events will be written in case of:

- *inside base card has been red-out,*
- *card written as master has been written,*
- *inside base card has been removed*

Masking bytes related to inputs state change

Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
In1Trig	IO[3]F	IO[3]R	IO[2]F	IO[2]R	IO[1]F	IO[1]R	IO[0]F	IO[0]R
In2Trig	IO[7]F	IO[7]R	IO[6]F	IO[6]R	IO[5]F	IO[5]R	IO[4]F	IO[4]R
In3Trig	IO[11]F	IO[11]R	IO[10]F	IO[10]R	IO[9]F	IO[9]R	IO[8]F	IO[8]R
In4Trig	IO[15]F	IO[15]R	IO[14]F	IO[14]R	IO[13]F	IO[13]R	IO[12]F	IO[12]R

Bits IO[n]R denote reaction to the input **n** positive slope**,**
Bits IO[n]F denote reaction to the input **n** negative slope

E.g. In4Trig-In1Trig configuration byte sequence: ***0x00,0x31,0x40,0x08****, causes, that events will be written in case of:*

- *Any state change of input with index 10 occurs*
- *Positive slope appears on input with index 8*
- *Positive slope appears on input with index 7*
- *Negative slope appears on input with index 1*

During configuring the event triggers, decide which port is configured as an input. Do not configure events for those I/O's, which are outputs.

To guarantee correctness of event write process, time between two subsequent triggers must be longer than 20 ms.

4.9.2. Reading the event recorder

Command frame:

Header	C_GetEventTrig		CRC

Wherein:

Parameter name	Parameter description	Value range
C_GetEventTrig **0x7E**	Reading the configuration of event recorder	0x7E

Response frame:

Header	C_GetEventTrig+1	CardTrig, In4Trig, In3Trig, In2Trig, In1Trig	OperationCode	CRC

Response bytes (CardTrig, In4Trig, In3Trig, In2Trig, In1Trig) are related to bytes from point 10.1.

4.9.3. Reading the counters related to event memory.

Command frame:

Header	C_GetEventParam		CRC

Wherein:

Parameter name	Parameter description	Value range
C_GetEventParam **0x78**	Reading the configuration of event recorder	0x78

Response frame:

Header	C_GetEventParam+1	CapL, CapH, PointerL, PointerH, TotB3,TotB2,TotB1,TotB0	OperationCode	CRC

CapH:CapL – two-byte value, which defines event memory capacity.
PointerH:PointerL – two-byte value, which marks from first free event.

TotB3:TotB2:TotB1:TotB0 – four-byte value, which defines number of events recorded from the moment of counter reset.
Events are recorded in sequence from index 0 up to Cap-1. In the moment memory gets full, the counter is being "overturned", and older inputs are overwritten.

Example:
If using C_GetEventParam command, we have red that event memory capacity is 4400 inputs; the total value of input events is 5678. For instance, if we want to read the event with no. 5600, event index event of interest will be 5678-4400=1278.
If we want to read the last event, we can use Pointer value. The last event index will be Pointer-1.

4.9.4. Reading the events

Command frame:

Header	C_GetEvent	EvNoL, EvNoH	CRC

Wherein:

Parameter name	Parameter description	Value range
C_GetEvent **0x7a**	Reading the event	0x7a
EvNoL,EvNoH	LSB and MSB of event index	

Response frame:

Header	C_GetEvent+1	YY,MM,DD,hh,mm,ss,type,B1,B2,B3,B4,B5	OperationCode	CRC

YY,MM,DD – year, month, day of event occurrence
hh,mm,ss - hour, minute, second of event occurrence
type - event type

Depending on value "type" the 8-th bit of byte, there are distinguished two assignments:

Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1
0 – card	No memory	Removed	Added	reserved	Master	Outside base	Inside base
1 -inputs	reserved	reserved	reserved	N4	N2	N1	N0

N4:N0 –number of input, on which event trigger signal appeared.

- If given event was related to card, the B1-B5 bytes comprise card ID number.

B1	B2	B3	B4	B5
UID1	UID2	UID3	UID4	UID5 (Unique)

- If event is related to input change, B1-B5 bytes comprise information regarding input state, and have format:

B1				B2				B3				B4				B5
IO0	IO1	IO2	IO3	IO4	IO5	IO6	IO7	IO8	IO9	IO10	IO11	IO12	IO13	IO14	IO15	Reserved

4.10. MAD – Mifare Application Directory

4.10.1. Card MAD formatting

Command frame:

Header	C_FormatMad	Type, Infobyte	CRC

Wherein:

Parameter name	Parameter description	Value range
C_FormatMad **0xA8**	Formatting to MAD	0xA8
Type	1 - MAD1 (15 sectors) 2 – MAD2 (30 sectors)	0x01,0x02
Infobyte	Mark in emitent sector (default 0x00)	0x00-0x1F

Response frame:

Header	C_FormatMad+1		OperationCode	CRC

Notes:

Before you run C_FormatMad command:

- switch AutoReader mode off (using C_SetAutoReaderConfig command)
- load the keys (default 0xff,0xff,0xff,0xff,0xff,0xff)
- turn antenna supply on (using C_TurnOnAntennaPower)
- select the cart (using C_Select command)
- login to sector with number 0, using key of AA type

4.10.2. Adding the application to MAD directory

Command frame:

Header	C_AddApplication	LSB, MSB, Sector	CRC

Wherein:

Parameter name	Parameter description	Value range
C_AddApplication **0xAA**	Adding application	0xAA
LSB	LSB of application number	0x00 - 0xFF
MSB	MSB of application number	0x00 - 0xFF
Sector	Number of sector, in which the application is to be present	0x01-0x0F :MAD1 0x01-0x1F :MAD2

Response frame:

Header	C_AddApplication+1		OperationCode	CRC

Notes:

Application number should be other than 0x0000

Before you run C_AddApplication command:

- switch AutoReader mode off (using command C_SetAutoReaderConfig)
- load the keys (default 0xff,0xff,0xff,0xff,0xff,0xff)

- turn antenna supply on (using C_TurnOnAntennaPower command)
- select the card (using C_Select command)
- login to sector with number 0, using key of AA type

4.10.3. Pursuing the sector for given application

Command frame:

Header	C_GetSectorMad	LSB, MSB	CRC

Wherein:

Parameter name	Parameter description	Value range
C_GetSectorMad **0xAC**	Pursuing the sector	0xAC
LSB	LSB of application number	0x00 - 0xFF
MSB	MSB of application number	0x00 - 0xFF

Response frame:

Header	C_GetSectorMad+1	Sector	OperationCode	CRC

Notes:

Before you run C_GetSectorMad command:

- switch AutoReader mode off (using C_SetAutoReaderConfig command)
- load the keys (using 0xff,0xff,0xff,0xff,0xff,0xff)
- turn antenna supply on (using C_TurnOnAntennaPower command)
- select the card (using C_Select command)
- login to sector with number 0, using key of AA type

If response byte is 0x00, it will mean, that given application is not present in MAD catalogue.

4.10.4. Pursuing the next sector of application

Command frame:

Header	C_GetSectorMadNext	LSB, MSB	CRC

Wherein:

Parameter name	Parameter description	Value range
C_GetSectorMad **0xAE**	Pursuing the next sector	0xAE

Response frame:

Header	C_GetSectorMadNext+1	Sector	OperationCode	CRC

Notes:
Before you run C_GetSectorMadNext command, perform sector searching operation using C_GetSectorMad, command, of which pursuing result was other than 0.

If response byte is 0x00, it will mean, than no more sectors have been found for given application.

4.11. Other commands

4.11.1. Remote reset of reader

Command frame:

Header	C_Reset		CRC

Where:

Parameter name	Parameter description	Value range
C_Reset	Remote reader reset	0xd0

Response frame:

Header	C_Reset +1		KodOperacji	CRC

4.11.2. Reading-out the reader software

Command frame:

Header	C_FirmwareVersion		CRC

Where:

Parameter name	Parameter description	Value range
C_FirmwareVersion	Read-out of reader software version	0xfe

Response frame:

Header	C_FirmwareVersion+1	Data1…..n	OperationCode	CRC

Where:
Data1…n is sequence of dots, which are written as an ASCII codes.

4.11.3. Setting buzzer volume

Command frame:

Header	C_SetBuzzerConfig	volume	CRC

Gdzie:

Parameter name	Parameter description	Value range
C_ SetBuzzerConfig	Settings buzzer parameters	0xD8
volume	volume	0 - 0xA

Response frame:

Header	C_ SetBuzzerConfig +1		OperationCode	CRC

4.11.4. Reading buzzer volume

Command frame:

Header	C_GetBuzzerConfig		CRC

Where:

Parameter name	Parameter description	Value range
C_ GetBuzzerConfig	Reading buzzer parameters	0xDC

Response frame:

Header	C_ GetBuzzerConfig +1	volume	OperationCode	CRC

Where,

Volume: buzzer volume In range 0-10

4.12. Meaning of operation code in response frame

Operation code name	Description	Value
OC_Error	Error	0x00
OC_ParityError	Parity error	0x01
OC_RangeError	Parameter range error	0x02
OC_LengthError	Data quantity error	0x03
OC_ParameterError	Parameter Error	0x04
OC_Busy	Momentary occupation status of internal modules	0x05
OC_NoACKFromSlave	No internal communication	0x22
OC_CommandUnknown	Unknown command	0x07
OC_WrongPassword	Wrong password or last password expired i.e. automatic LogOut occurred.	0x09
OC_NoCard	No transponder	0x0a
OC_BadFormat	Wrong data format	0x18
OC_FrameError	Transmission error. Noise occurrence possibility.	0x19
OC_NoAnswer	No response from transponder	0x1E
OC_TimeOut	Operation time limit exceeded. Possible the lack of transponder in reader field.	0x16
OC_Successful	Operation finished successfully	0xff

5. MODBUS RTU protocol

5.1. Supported MODBUS protocol functions:

0x01	Read coils
0x03	Read holding register
0x05	Write single coil
0x06	Write single register
0x17	Write read multiple registers

5.2. MODBUS adress (decimal)

Lp	Address	Type	R/W	Description
1	1000	Holding Reg	R	Transpoder code [0]
2	1001	Holding Reg	R	Transpoder code [1]
3	1002	Holding Reg	R	Transpoder code [2]
4	1003	Holding Reg	R	Transpoder code [3]
4.1	1004	Holding Reg	R	Transpoder code [4]
4.2	1005	Holding Reg	R	Transpoder code [5]
4.3	1006	Holding Reg	R	Transpoder code [6]
4.4	1007	Holding Reg	R	Transpoder code [7]
6	1011	Holding Reg	R/W	Relay mode 0 – inactive, 1 – bi-stable 2 – a-stable 3 – 1 impuls
7	1012	Holding Reg	R/W	Relay ON time (*100ms, max 255)
8	1013	Holding Reg	R/W	Relay OFF time (*100ms, max 255)
9	1014	Holding Reg	R/W	RED LED mode (see p.6)
10	1015	Holding Reg	R/W	GREEN LED mode (see p.6)
11	1016	Holding Reg	R/W	BLUE LED mode (see p.6)
12	1017	Holding Reg	R/W	BUZZER mode (see p.6)
13	1020	Holding Reg	R/W	On-time of RED LED (*100ms)
14	1021	Holding Reg	R/W	Off-time of RED LED (*100ms)
15	1022	Holding Reg	R/W	On-time of GREEN LED (*100ms)
16	1023	Holding Reg	R/W	Off-time of GREEN LED (*100ms)
17	1024	Holding Reg	R/W	On-time of BLUE LED (*100ms)
18	1025	Holding Reg	R/W	Off-time of BLUE LED (*100ms)
19	1026	Holding Reg	R/W	On-time of buzzer (*100ms)
20	1027	Holding Reg	R/W	Off-time of buzzer(*100ms)
21	1028	Holding Reg	R/W	Mode of IO1 (jak w p.6)
22	1029	Holding Reg	R/W	Mode of IO2 (jak w p.6)
23	1030	Holding Reg	R/W	Mode of IO3 (jak w p.6)
24	1031	Holding Reg	R/W	Mode of IO4 (jak w p.6)
25	1032	Holding Reg	R/W	Mode of IO5 (jak w p.6)
26	1033	Holding Reg	R/W	Mode of IO6 (jak w p.6)

27	1034	Holding Reg	R/W	On-time of IO1 (*100ms)
28	1035	Holding Reg	R/W	Off-time of IO1 (*100ms)
29	1036	Holding Reg	R/W	On-time of IO2 (*100ms)
30	1037	Holding Reg	R/W	Off-time of IO2 (*100ms)
31	1038	Holding Reg	R/W	On-time of IO3 (*100ms)
32	1039	Holding Reg	R/W	Off-time of IO3 (*100ms)
33	1040	Holding Reg	R/W	On-time of IO4 (*100ms)
34	1041	Holding Reg	R/W	Off-time of IO4 (*100ms)
35	1042	Holding Reg	R/W	On-time of IO5 (*100ms)
36	1043	Holding Reg	R/W	Off-time of IO5 (*100ms)
37	1044	Holding Reg	R/W	On-time of IO6 (*100ms)
38	1045	Holding Reg	R/W	Off-time of IO6 (*100ms)
39	1050	Holding Reg	R/W	RS485 address
40	1051	Holding Reg	R	Firmware version
41	1000	Single Coil	W	Enable output (relay)
42	1001	Single Coil	W	Enable RED LED
43	1003	Single Coil	R	Front switch state
44	1004	Single Coil	R/W	New card state* Reading: 1-new transponder detect Writing: 0 – clear this flag *flag is clearing aquatically after 6 seconds
45	1010	Single Coil	W	Enable GREEN LED
46	1011	Single Coil	W	Enable BLUE LED
47	1012	Single Coil	W	Enable Buzzer
48	1020	Single Coil	R/W	W- Enable IO1, R- read state of IO1
49	1021	Single Coil	R/W	W- Enable IO2, R- read state of IO2
50	1022	Single Coil	R/W	W- Enable IO3, R- read state of IO3
51	1023	Single Coil	R/W	W- Enable IO4, R- read state of IO4
52	1024	Single Coil	R/W	W- Enable IO5, R- read state of IO5
53	1025	Single Coil	R/W	W- Enable IO6, R- read state of IO6

5.3. Encapsulation Netronix protocol inside MODBUS RTU

Each frame from Netronix protocol can be sent using below schematic:

MODBUS frame for function 0x17:

Request

Function code	1 Byte	**0x17**
Read Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity to Read	2 Bytes	0x0001 to 0x007D
Write Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity to Write	2 Bytes	0x0001 to 0X0079
Write Byte Count	1 Byte	2 x **N***
Write Registers Value	**N***x 2 Bytes	

***N** = Quantity to Write

Response

Function code	1 Byte	**0x17**
Byte Count	1 Byte	2 x **N'***
Read Registers value	**N'*** x 2 Bytes	

***N'** = Quantity to Read

Read Starting Address	Function code
Quantity to Read	-
Write Starting Address	Always 0x0000
Quantity to Write	-
Write Byte Count	Length of parameters
Write Registers Value	Parameters

5.3.1. Example of using 0x17 function

To send Netronix C_ReadBlock 0x01 command, below frame must be sent:

Address	0x01
Command	0x17
ReadStartingAddress Hi	0x00
ReadStartingAddress Lo	0x1e
Quantity to Read Hi	0x00
Quantity to Read Lo	0x00
Write Starting Address Hi	0x00
Write Starting Address Lo	0x00
Quantity to Wrtie Hi	0x00
Quantity to Wrtie Lo	0x00
Write Byte Count	0x01
Write Register Value Hi	0x00
Write Register Value Lo	0x01
CRC Lo	0xC5
CRC Hu	0x3E

6. Meaning of symbols and markings used in the specification

**Sectors and block numeration

For S50 cards:
SectorNo=0x00…0x0f
BlockNo=0x00…0x03

For S70 cards:
SectorNo=0x00…0x20 BlockNo=0x00…0x03
SectorNo=0x21…0x27 BlockNo=0x00…0x0f

7 . Mechanism of Master ID

Master ID mechanism is based on principle the quick adding/removing of user card to/out of reader memory by means of „master card".

If you want to register a card as a „master card", it is required to clear card memory first by means of reset function to factory defaults.
After clearing the memory, apply selected card to module, whenever you like. This moment, the card becomes "master card". It is impossible to remove or add the master card by means of other card.

If you want to register a card as a "user card", apply "master card" to reader first, and next during five seconds, apply registered card.

If you want to remove "user card" from memory, apply "master card" to reader first, and next during five seconds apply card which is being removed.

After applying to a reader the "user card", the reader enables electric output, which has been programmed as a controlled by internal access control mechanism.

8 . Clearing the card memory and resetting to factory defaults

To reset the device to factory defaults, push for ca. 5 seconds button "F" on rear panel.
During reset to factory defaults, following parameters of reader are fixed:

Name of parameter or its functionality	Value or setting
Address on serial bus	0x01
Baud rate on serial bus	9600 bps
Whole internal memory of transponders with Master card	0xff ff ff ff ff means "memory cleared"
Access password	0x31 32 33 34 00 means „1234" in dot transcription
Port 0 – front switch	every purpose
Port 1 – two-state input/output	every purpose input
Port 2 – green LED	lock "on" indication
Port 3 – red LED	lock "on" indication
Port 4 – buzzer	lock "on" indication
Port 5 – relay	lock "on" indication
Port 6 – blue LED	every purpose
Port 7 - tamper	Input
Port 8 – IO2	every purpose input
Port 9 – IO3	every purpose input
Port 10 – IO4	every purpose input
Port 11– IO5	every purpose input

Port 12 - IO6	every purpose input
Master card	no Master card in card memory

9. Operation example of transponder

After correct connection of reader and achieving the bi-directional communication between the reader and master computer, it is possible to perform read-out and write operation of transponder memory.
Following operation assumes, that reader is in default condition, and applied S50 card is in default condition too. It means this card has full access rights and both 0xff ff ff ff ff ff keys.

Logging to the reader is to make changes in its factory configuration.
C_LoginUser, 0x31, 0x32, 0x33, 0x34, 0x00

Because during manual experiments, time between subsequent commands sent via serial interface is large and reaches values from some second to some minutes, it is required to disable internal UID automatic read-out device.
It should be done by means of command:
SetAutoReaderConfig with parameters: 0x00, 0x00, 0x00, 0x00.

To read-out the transponder, first load key to key memory.
So load the key to SKB, by means of:
C_LoadKeyToSKB, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0x00

Enable the field.
TurnOnAntennaPower, 0x01
Apply transponder to reader.

Select transponder
C_Select, 0x00

Login to e.g. sector 3.
C_LoginWithSKB, 0x03, 0xAA, 0x00

Read-out 2nd block content in 3rd sector.
C_ReadBlock, 0x02

If all Operation Codes in response frames were marked as OC_Successful, so obtained values are the values which have been red-out from the block.

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