



**BW Paper Systems**  
**13.56 MHz OEM RFID Reader for Quality Control**  
**Hardware and Function Description**

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## 1 Function Description

### 1.1 General

- RFID Device in industrial housing for standard resistance to environmental conditions.
- Power supply via PoE (e.g. from OEM-HF-R840-IDT or OEM-HF-M840-ET).
- Trigger Input (protected by opto-coupler)

### 1.2 Power Supply

The Device is powered either by PoE or 24 V.

### 1.3 Versions

There shall be two versions:

- With internal antenna, tuned for maximum range in installation.
- With SMA connector for external antenna (on request)

### 1.4 Operation Modes

1. Manual control with DESFire command protocol
2. Triggered by an Input

#### 1.4.1 Manual Control

The device is controlled by commands sent via Ethernet to the RFID module. The command protocol is our DESFire communication protocol.

Command Protocol and API Description: OEM-DES devices Communication Protocol\_x.yy\_EN.pdf

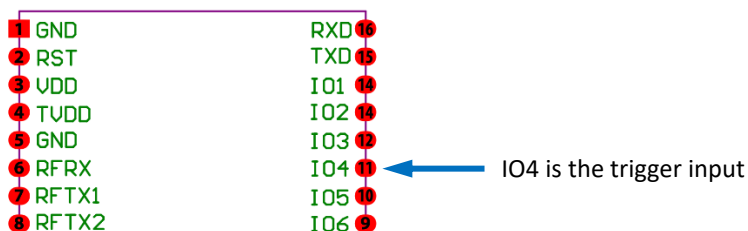
#### Important Note

The API is not applicable with the Ethernet interface.

#### 1.4.2 Triggered by an input

The input shall be provided as protected opto-coupler with the negative port connected to GND. This shall protect the RFID electronics against spikes and overvoltage.

Suggestion: Any command (command sequence needed?) shall be stored in non-volatile memory and executed on edge of trigger signal. Pls. see chapter 4.2



### 1.5 Reference Documents

This device uses the following commands on top of the DESFire communication protocol. So, in order to gain full access to the device, please consult this communication protocol description:

Command Protocol and API Description: OEM-DES devices Communication Protocol\_x.yy\_EN.pdf

For test operation:

Manual of Test/Demo Software:

OEM-DES devices Test Software Manual\_x.y\_EN.pdf

## 2 Housing

Status 2020-12-03: The housing will be provided by the customer. A sample housing is sent to the development.

### 3 Connectors

#### 3.1 General

All connectors are only on one side of the housing. The connectors are on the longer side of the housing.

#### 3.2 Ethernet

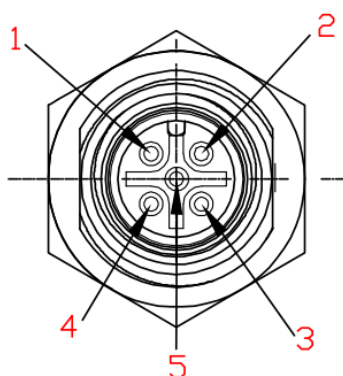
##### Pinout according to TIA-568A

Pin	Signal	Pair #	Wire Color
1	TX+	3	White/green stripe
2	TX-	3	Green solid
3	RX+	2	White/orange stripe
4	PoE+	1	Blue solid
5	PoE+	1	White/blue stripe
6	RX-	2	Orange solid
7	PoE-	4	White/brown stripe
8	PoE-	4	Brown solid



RJ45 Socket with IP67 protection class

#### 3.3 Power Supply + IO



M12 socket, 5 pin, A-coded

##### Pinout

Pin	Signal	IO Type	Description	Wire Color
1	+24 Vdc	PWR	Alternative supply to PoE	Brown
2	Trigger	Input	+24 Vdc, app. 10 mA, internal series resistor, IO4	White
3	GND	PWR		Blue
4	—	—	IO3	Black
5	—	—	—	Grey

## 4 Special Telegrams and Telegram Version

### 4.1 Auto-List Cards (command code 0x23)

This command telegram has 10 Bytes in total. The automatic reply telegrams differ according to the tag type and function.

#### Command description

This command configures, starts or stops an operation mode. The operation mode is the automatic detection of RFID tags.

#### The Bytes in Detail

50	= Start of telegram
00 05	= 5 Bytes of payload between command code and checksum
23	= Command code, auto-list cards
FF	= Data tag type, 0xFF = all types are recognized, do not use this setting for high-speed operation, restrict to only one data tag type
64	= Period, pause time between detections, 0x64 = 100 ms, set this to 0x01 for high-speed operation
00	= Antenna number, if you are unsure, leave it to 0x00
04	= When to notify
00	= RFU
XOR	= Checksum

#### Confirmation Telegram

When you send the auto-list cards telegram, successful receipt and changing the operation mode of the RFID device is confirmed with. It is advices to check for this reply telegram every time you use the auto-list cards command:

50 00 00 23 73

#### 4.1.1 Parameters

##### Period

If the value for Period set to 0x00, the auto-list cards function stops instantaneously.

##### Notification

Event notification, supports 4 types of card event notification:

0x01 = Send telegram when a tag enters the field

0x02 = Send telegram when a tag leaves the field

0x03 = Send telegram when a tag enters and leaves the field

0x04 = Send telegram continuously as long as the tag is in field, notification PERIOD is defined with parameter PERIOD

##### RFU

Reserved for future use. The value of this parameter is ignored.

#### 4.1.2 Automatic Notification Telegrams

##### Format

SOF	LEN0	LEN1	CMD	TYPE	PERIOD	ANT	NOTICE	RFU	INFOR	EOF
50	00	XX	23	00-FF	00-FF	00-FF	01-04	00	XX...	XOR

Only one "INFOR" more than the set command this is the card information

##### ISO14443A Information

ATQL	ATQH	SAK	UID Length	UID
Low byte of ATQ	High byte of ATQ	SAK	4 or 7	4 or 7 bytes UID



Example 1: Mifare 1 S50 Information: 04 00 08 04 11 22 33 44 (11 22 33 44 is the UID) according to the setting of CMD 50 00 05 23 05 64 03 01 00 15. If this card place to ANT1 field , the module will output >>50 00 0D 23 01 64 01 01 00 04 00 08 04 11 22 33 44 57

The 5 byte of the red font corresponds to the 5 Bytes of the automatic list card command, but the information is more specific:

01: TYPE, inform that this is a ISO14443A card, if 04 that is ISO15693

64: PERIOD, 100ms

01: ANT, 01 inform that the first antenna ANT1 detected this card

01: NOTICE, 01 inform that this is an Entry event

00: RFU

#### ISO15693 Information

UID1	UID2	UID3	UID4	UID5	UID6	UID7	UID8
Xx	Xx	Xx	Xx	Xx	Xx	Xx	E0

Example 2: 15693 Information is 11 22 33 44 00 01 04 E0 (8 Bytes UID, end with 0xE0 In general) according to the setting of CMD 50 00 05 23 05 64 03 01 00 15. If this card place to ANT2 field, the module will output 50 00 0D 23 04 64 02 01 00 11 22 33 44 00 01 04 E0 BC.

The 5 byte of the red font corresponds to the 5 Bytes of the automatic list card command, but the information is more specific:

04: TYPE, inform that this is an ISO15693 card, if 01 that is ISO14443A

64: PERIOD, 100ms

02: ANT, 02 inform that the second antenna ANT2 detected this card

01: NOTICE, 01 inform that this is an Entry event

00: RFU

## 4.2 Program Triggered Command (command code 0x0F)

This command is intended to program any command into the  $\mu$ C. This command is stored in non-volatile memory. This command is then executed by a trigger signal at an input. So the hardware executed this command every time the corresponding input is set.

### Command description

This command configures, starts or stops an operation mode.

This command programs a command into non-volatile memory.

When triggered operation is started, this command is executed on every first edge of the trigger.

This command telegram has an unknown size. The confirmation telegram is 5 Bytes in size.

### The command operation has subcommands

- Program = Store size information (Byte) + Triggered Command at a well-known memory address. OR terminate the Triggered Command with NUL.
- Read = Read Triggered Command from this well-known memory address.
- Start = Set up interrupt service routine for input (unknown number of input). If interrupt is triggered, copy Triggered Command from well-known memory address into serial input buffer, then trigger "input buffer has received a telegram" interrupt.
- Stop = Unarm or inhibit this interrupt service routine for input (unknown number of input).

- Erase = Overwrite the Triggered Command and delete the interrupt service routine for the input (unknown number of input).

These subcommands are controlled by flags in the control Byte (see chapter 4.2.1).

#### The Bytes in Detail

50	= Start of telegram
<size Bytes>	= 2 Bytes describing the payload between command code and checksum
0F	= Command code, auto-list cards
07	= Control Byte, bit-coded
<trigg'd_command>	= This command is executed instantaneously on the first edge of the trigger
XOR	= Checksum

#### Confirmation Telegram

When you program a triggered command, successful receipt and changing the operation mode of the RFID device is confirmed with. It is advices to check for this reply telegram every time you program a triggered command:

50 00 00 0F <status> <XOR>

#### Shut OFF Triggered Command

Send telegram only with control Byte, e.g.: 50 00 01 0F 00 5E = stop

#### The Bytes in Detail

50	= Start of telegram
00 01	= 1 Bytes of payload
0F	= Command code, auto-list cards
00	= Stop, unarm the triggered command
5E	= Checksum

#### 4.2.1 Control Byte bit-Coding

Bit	Usage	Action when set to 1	Action when set to 0
0	Program	Program triggered command in non-volatile memory	Do nothing
1	Read	Read out triggered command	Do nothing
2	Start or stop	Start arming the triggered command, set up interrupt handling on trigger input	Unarm the triggered command
3	Erase	Overwrite the size Byte + triggered command in non-volatile memory	Do nothing
4	RFU		
5	RFU		
6	RFU		
7	RFU		

The bit shall be decoded from LSB to MSB.

0x00 = 0b0000.0000 = stop

0x01 = 0b0000.0001 = program

0x02 = 0b0000.0010 = read

0x03 = 0b0000.0011 = program + read (back)

0x04 = 0b0000.0100 = start

0x05 = 0b0000.0101 = program + start

0x06 = 0b0000.0110 = read + start

0x07 = 0b0000.0111 = program + read (back) + start  
 0x08 = 0b0000.1000 = erase  
 0x09 = 0b0000.1001 = USELESS!  
 0x0A = 0b0000.1010 = read + erase  
 0x0B = 0b0000.1011 = USELESS!  
 0x0C = 0b0000.1100 = USELESS!  
 0x0D = 0b0000.1111 = USELESS!  
 0x0E = 0b0000.1110 = USELESS!  
 0x0F = 0b0000.1111 = USELESS!

#### 4.2.2 Status Codes, bit-coded

Bit	Usage	Action when set to 1	Action when set to 0
0	Program	Successful programmed	Nothing programmed or OK
1	Read	Successful read	Nothing read or OK
2	Start or stop	Successful started	Nothing started or OK
3	Erase	Successful erased	Nothing erased or OK
4	Program failure	Programming failed	Nothing programmed or OK
5	Read failure	Read failed (no data or other error)	Nothing read or OK
6	Start failure	Start failed (no data or other error)	Nothing started or OK
7	Erase failure	Erase failed (nothing to erase or other error)	Nothing erased or OK

#### 4.2.3 Example A: Program Get UID of ISO14443A data tag

Telegram: 50 00 08 0F 07 50 00 02 22 10 52 32 50

##### The Bytes in Detail

50 = Start of telegram  
 00 08 = 8 Bytes describing the payload between command code and checksum  
 0F = Command code, auto-list cards  
 07 = Control Byte, bit-coded  
 50 00 02 22 10 52 32 = This command is executed instantaneously on the first edge of the trigger  
 50 = Checksum

Every time an input is triggered by a positive signal, the command 50 00 02 22 10 52 32 is executed.

The result of this command execution is then sent on the serial interface. The result is either an error message or a telegram containing the values ATQ, SAK and the UID of the data tag.

#### 4.2.4 Example B: Read Memory Block from ISO 15693 data tag

Telegram: 50 00 09 0F 07 50 00 03 A3 02 00 01 F3 51

##### The Bytes in Detail

50 = Start of telegram  
 00 09 = 2 Bytes describing the payload between command code and checksum  
 0F = Command code, auto-list cards  
 07 = Control Byte, bit-coded  
 50 00 03 A3 02 00 01 F3 = This command is executed instantaneously on the first edge of the trigger  
 XOR = Checksum

Every time an input is triggered by a positive signal, the command 50 00 03 A3 02 00 01 F3 is executed.

The result of this command execution is then sent on the serial interface. The result is either an error message or a telegram containing the status, block lock status and the block data.

#### 4.2.5 Example C: Program Get FW Version

Telegram: 50 00 06 0F 07 50 00 00 04 54 5E

##### The Bytes in Detail

50	= Start of telegram
00 06	= 8 Bytes describing the payload between command code and checksum
0F	= Command code, auto-list cards
07	= Control Byte, bit-coded
50 00 00 04 54	= This command is executed instantaneously on the first edge of the trigger
50	= Checksum

Every time an input is triggered by a positive signal, the command 50 00 00 04 54 is executed.

## 5 Setting of the Com-Server

The Com-Server is the translator between the internal serial communication of the RFID device and the Ethernet.

### Welcome To C2000 Turbo

软件版本: 04.00.06.00

请输入登录密码:

Web V2.0 E210

### Welcome To C2000 Turbo

配置网络参数	配置串口参数	修改密码	应用C2000设置
--------	--------	------	-----------

本机MAC地址: 00.09.F6.10.72.B6

动态获取IP地址(DHCP): ☐ 是 ☒ 否

IP 地址:

子网掩码:

网关:

DNS服务器地址:

Web V2.0 E210

Welcome To C2000 Turbo			
配置网络参数	配置串口参数	修改密码	应用C2000设置
<p>选择串口: COM1 ▾</p> <p>串口工作模式: RS232 ▾</p> <p>SOCKET类型: TCP-SERVER ▾</p> <p>本地端口: 8000</p> <p>使用虚拟串口或控件: <input type="checkbox"/> 是 <input checked="" type="checkbox"/> 否</p> <p>对端IP: <input type="text"/> . <input type="text"/> . <input type="text"/></p> <p>对端端口: <input type="text"/></p> <p>是否使用对端域名: <input type="checkbox"/> 是 <input checked="" type="checkbox"/> 否</p> <p>输入对端域名: <input type="text"/></p>		<p>串口波特率: 115200 ▾</p> <p>串口数据位: 8 ▾</p> <p>串口校验方式: 无 ▾</p> <p>串口停止位: 1 ▾</p> <p>串口流控方式: 无 ▾</p> <p>间隔超时(ms): 20</p> <p>最大帧长度(byte): 1000</p> <hr/> <p>主动上传串口编号: <input type="checkbox"/> 是 <input checked="" type="checkbox"/> 否</p> <p>串口编号: <input type="text"/></p>	
<p>提交</p>			
Web V2.0 E210			

Welcome To C2000 Turbo			
配置网络参数	配置串口参数	修改密码	应用C2000设置
<p>请输入旧密码: <input type="text"/></p> <p>输入新密码: <input type="text"/></p> <p>确认新密码: <input type="text"/></p> <p>提交</p>			
Web V2.0 E210			

<b>Welcome To C2000 Turbo</b>			
<a href="#">配置网络参数</a>	<a href="#">配置串口参数</a>	<a href="#">修改密码</a>	<b>应用C2000设置</b>
<p>点击下方按钮，退出 C2000-turbo 设置页面</p> <p><b>应用设置</b></p>			
			Web V2.0 E210

## 6 Revision History

Version	Date	Notes
0.1	2019-08-30	Initial draft
0.2	2019-09-11	Output ON time changed to 5 ms. Preliminary technical data added.
0.3	2019-10-18	Added example to program triggered command. Operation modes with additional graphics.
0.4	2019-10-28	Pinout of M12 connector with numbers in drawing
0.5	2019-11-05	Bore Template added, IOs in detail,
0.6	2019-11-18	Technical data revised, trigger input with more detailed information, output changed to high-side switch, input with internal series resistor,
0.7	2020-12-03	Housing chapter cleared
0.8	2022-07-01	Consolidated version of current product



## 7 Technical Data · Preliminary

Electrical Specifications	
Power Supply	+24 Vdc or PoE
Power Consumption	
Operating Frequency	13.56 MHz
Baudrate	115200 bit/s, internal interface between Ethernet COM-Server and RFID hardware
Antenna	Internal, or external via SMA connector
Reader IC	CL 663
RF TX Speed	up to 848 kBd
Interface	Ethernet
Trigger Input	Opto-coupler PS2501-1, 10 mA, internal series resistor, apply +24 Vdc to trigger
Signal Output	High-Side switch, 25 V max, 20 mA

Mechanical Specifications	
Dimensions	80 × 80 × 55 mm
Weight	250 g
Material	ABS

Supported Standards / Tags	
ISO 14443 A and compatible	Read/write: MIFARE® Classic Mini / 1K /4K, MIFARE Ultralight®, MIFARE Ultralight® C, MIFARE® DESFire®EV1, MIFARE® Smart MX, MIFARE® Plus S / X, MIFARE® Pro X, NTAG 21x Read UID only of all other ISO14443A RFID tags
ISO 14443 B and compatible	SRI4K, SRIX4K, AT88RF020, 66CL160S, SR176
ISO 15693 and compatible	EM4135, EM4043, EM4x33, EM4x35, I-Code SLI / SLIX, M24LR16/64, TI Tag-it HF-I, SRF55Vxx (my-d vicinity)

Applicable Standards	
EMC	EN 301489-1:2012-04 (v1.9.21) EN 301489-3:2013-12 (V1.6.1)
Radio Regulation	EN 300330-1:2015-08 (V1.8.1) EN 300330-2:2015-08 (V1.6.1)
Safety	EN 60950-1:2014-08 EN 62369-1:2010-03 EN 50364:2010-11
RoHS, REACH	EU Guideline 1907/2006, updated by 2018/2005/EU (REACH) EU Guideline 2011/65/EU (RoHS 2) EU Guideline 2015/863/EU (RoHS 3)

SDK Information	
Supported OS	Windows XP, Vista, 7, 8, 8.1, 10
Supported Languages	Binary command protocol, VS2005 C++ Library
Demo Software	Windows

Other functions and details to be continued and upgraded.