

# RRU4

## RFID UHF READER



This manual applies to the following types:

Type:	Order no.
RFID-UHF reader RRU4-RS4-E6	52010093
RFID-UHF reader RRU4-ETG-E6	52010094
RFID-UHF reader RRU4-RS4-U6	52010096
RFID-UHF reader RRU4-ETG-U6	52010097

# Foreword and general information

**The information in this manual was correct at the time of editorial deadline.  
We reserve the right however to make changes at any time and without prior notice.**

This document was prepared for specialist personal who install, configure and place in operation the reader.

## Copyright notice

The reproduction or distribution of this document or extracts from it in whatever form and by whatever means (electronic or mechanical) for whatever purpose is permitted only with the prior written permission of Kathrein.

Kathrein accepts no liability for omissions or inaccuracies in this document or in relation to the provision or use of the information contained in this document. Kathrein reserves the right to change the products described in this document and does not accept any liability in relation to the application or usage of the products described in this manual.

This document and the information contained in it are proprietary information of Kathrein and should be treated as confidential. Kathrein provides this document to its customers in connection with contacts of sale for the products described therein. If the person in possession of this document, being a legal or natural person, is not a contractual sales partner of Kathrein, or Kathrein has not intended him by other means as the recipient of the document and the information contained therein, the person in possession is hereby informed that the use of this document is unlawful and a violation of the rights of Kathrein.

## Scope

The information contained in this manual is intended for the support of the development process and as development guidance for the customer. In addition this manual offers supporting information about the standards to be applied at the place of installation and the relevant safety standards for installation and configuration of the Kathrein reader.

## General information

This manual contains information on the installation, configuration, operation and maintenance of the reader. In addition it gives detailed technical data in order better to familiarise the user with the features of the reader.

In order to ensure a long working life and fault-free operation, this manual should therefore be read carefully and all the instructions and information contained in it should be complied with.

## Warranty

Switching on the AC or DC power supply prior to connecting the LAN cable is considered incorrect installation. Any functional defect arising as a result is excluded from the warranty/guarantee. Before installing or servicing the reader, the person concerned must have read the manual and understood its contents. Kathrein accepts no liability if the customer fails to implement the precautions listed here. In such cases, any claims under the warranty/guarantee are void.

## Disposal instruction



Electronic equipment is not classed as household waste and must be disposed of properly in accordance with Directive 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on used electrical and electronic equipment.

At the end of its service life, take this device for disposal at a designated public collection point.



### **Used batteries are special waste!**

Do not put used batteries into your domestic waste; instead take them to a collection point for used batteries!

<b>Foreword and general information</b>	<b>2</b>
<b>List of Contents</b>	<b>3</b>
<b>1. Safety instructions/information</b>	<b>6</b>
<b>2. Introduction</b>	<b>9</b>
2.1. The reader	9
2.2. Further reference material	9
2.3. Scope of supply	9
2.4. Accessories	9
<b>3. Installation</b>	<b>11</b>
3.1. Selecting the installation site	11
3.2. Installing the reader	11
<b>4. Connections and displays</b>	<b>12</b>
4.1. Power supply	12
4.2. Ethernet port	13
4.3. RS422/485 connection	13
4.4. RS232 connection	13
4.5. <b>UART transmission (RS232, RS422, RS485 or similar)</b>	<b>14</b>
4.5.1. Bit transmission layer (physical layer)	14
4.5.2. Data link layer	14
4.5.2.1. Structure of a frame	14
4.5.2.2. Start code and synchronisation	14
4.5.2.3. Status byte	14
4.5.2.4. Frame number	15
4.5.2.5. User data	15
4.5.2.6. Checksum	15
4.5.3. Network layer	15
4.5.4. Transport layer, session layer, presentation layer	15
4.5.5. Application layer	15
4.6. <b>Ethernet transmission</b>	<b>16</b>
4.6.1. Frame structure	16
4.6.2. Port	16
4.6.3. Example	16
4.7. <b>Digital inputs and outputs</b>	<b>17</b>
4.8. <b>Antenna Connection</b>	<b>20</b>
4.9. <b>LED</b>	<b>20</b>
4.10. <b>Buzzer</b>	<b>20</b>
<b>5. Software</b>	<b>21</b>
5.1. <b>System requirements</b>	<b>21</b>

<b>5.2. Installation</b>	<b>21</b>
<b>5.3. Operation</b>	<b>25</b>
5.3.1. General information	25
5.3.2. User interface for ReaderStart v2	26
5.3.3. Menu bar	27
5.3.3.1. File	27
5.3.3.2. Options	28
5.3.3.3. Info	30
<b>6. Operating the reader</b>	<b>32</b>
<b>6.1. Communication</b>	<b>32</b>
6.1.1. COM header	32
6.1.2. USB header	32
6.1.3. Ethernet header	33
6.1.4. I/O card configuration	33
6.1.4.1. RS232	34
6.1.4.2. GPIO	35
6.1.4.3. RS485	37
6.1.4.4. Ethernet	38
<b>6.2. Basic read functions</b>	<b>39</b>
6.2.1. Synchronous mode	40
6.2.2. Asynchronous mode	40
<b>6.3. GPIO functions</b>	<b>41</b>
<b>6.4. Expert settings</b>	<b>42</b>
6.4.1. Expert settings 1	42
6.4.1.1. Transmission power	43
6.4.1.2. Antenna multiplex configuration	45
6.4.1.3. RF settings	45
6.4.1.4. Selection parameters	45
6.4.2. Expert settings 2	46
<b>6.5. Application</b>	<b>47</b>
<b>6.6. Basic write function</b>	<b>49</b>
6.6.1. Synchronous writing	49
6.6.2. Asynchronous writing	50
<b>6.7. Test Gen2 functions</b>	<b>50</b>
6.7.1. Read all EPCs	51
6.7.2. Write EPC	51
6.7.3. Change password	51
6.7.4. Read/write data	52
6.7.5. Block	52
6.7.6. Deactivation	53
<b>7. Reader configuration</b>	<b>54</b>
<b>7.1. Introduction</b>	<b>54</b>
7.1.1. Structure of the configuration IDs	54
7.1.2. The parameter sets	54
<b>7.2. Description of the configuration parameters of the RRU4 reader system</b>	<b>55</b>
7.2.1. The “Global” configuration group	55
7.2.1.1. “DefaultParamset”	55
7.2.2. The configuration group “RFInterface”	55

7.2.2.1.	“RFPower1...8”	55
7.2.2.2.	“TimeToPowerOff”	56
7.2.2.3.	“ModulationType”	56
7.2.2.4.	“MultiplexingAntennaport1...8”	57
7.2.3.	“MultiplexingExposureTime1...8”	58
7.2.3.1.	“CableLoss1...8”	58
7.2.3.2.	“AntennaGain1...8”	58
7.2.3.3.	“RSSIThreshold1...8”	59
7.2.3.4.	“MultiPowerTagAccess1...8”	59
7.2.3.5.	“MaxAllowedAntennaOutputPower1...8”	59
7.2.3.6.	“EnableRSSIThresholdAtSpecificCmds”	60
7.2.3.7.	“FlashWriteAdditionalPower”	60
7.2.4.	The configuration group “Tag communication” (“TagComm”)	60
7.2.4.1.	“UsePilotTone”	60
7.2.4.2.	“InitialQ”	61
7.2.4.3.	“Session”	61
7.2.4.4.	“MaxErrors”	62
7.2.4.5.	“CommunicationProfile”	62
7.2.4.6.	“CommStandard”	62
7.2.4.7.	“IntelligentWrite”	63
7.2.4.8.	“VerifyWrite”	63
7.2.4.9.	“QueryTarget”	64
7.2.4.10.	“QuerySel”	64
7.2.4.11.	“ForcePowerOffAfterEPCWrite”	65
7.2.4.12.	“TransmitGetEPCsPreSelect”	65
7.2.4.13.	“TransmitSelectIfNoFilterIsOn”	66
7.2.4.14.	“NumberOfEPCWords”	66
7.2.4.15.	“UseBlockWrite”	66
7.2.4.16.	“DisableReceivingNXPRReadProtectedTags”	67
7.2.5.	The configuration group “ObservedList”	67
7.2.5.1.	“GlimpsedTimeoutCnt”	67
7.2.5.2.	“ObservedThresholdCnt”	67
7.2.5.3.	“ObservedTimeoutCnt”	68
7.2.6.	The configuration group “Host communication” (“HostComm”)	68
7.2.6.1.	“ExtendedResultFlag”	68
7.2.6.2.	“AntennaIndependentOperation”	68
7.2.6.3.	“ASyncAdditionalRSSIDataDeliveryDelta”	69
7.2.6.4.	“UseMillisecondsAsTimestamp”	69
7.2.7.	The configuration group “ETSI”	70
7.2.7.1.	“PortChannelListGlobalValue1...16”	70
7.2.7.3.	“ChannelSwitchingMode”	70
7.2.7.4.	“PowerCheckOverAllAllowedChannels”	71
7.2.8.	The configuration group “communication standard” (“CommStandard”)	71
7.2.8.1.	“CenterFreqCH0”	72
7.2.8.2.	“ChannelWidth”	72
7.2.8.3.	“MaxChannelTime”	72
7.2.8.4.	“MinChannelWaitTime”	73
7.2.8.5.	“FirstChannel”	73
7.2.8.6.	“LastChannel”	73
<b>8.</b>	<b>Reference literature</b>	<b>74</b>

# 1. Safety instructions/information

## Key



### Caution

Indicates a potentially dangerous situation which, if disregarded, can lead to injuries ranging from minor to severe and/or damage to the unit.

### Note

Information intended to make a specific topic easier to understand and/or enable optimal use of the unit functions.

## General safety notes



### Important!



Before starting installation work or replacing the unit, the accompanying manual must be read carefully and its contents understood.

The detailed information in the data sheets and in this manual must be complied with carefully during installation and operation of the reader!

The installation team must be properly qualified and familiar with the safety regulations applicable in the country concerned.

Connection, installation and maintenance work, as well as all other work on the unit, may only be carried out by properly qualified and trained employees.

The unit may only be used for the purpose intended by the manufacturer.

Unauthorized changes to the unit and the use of spare parts and peripheral devices which are not sold or recommended by the manufacturer can result in fires, electric shocks and injuries. Such actions therefore result in exclusion of liability and make the manufacturer's warranty/guarantee null and void.

The applicable version of the manufacturer's warranty is that which was valid at the time of purchase. We accept no liability for unsuitable manual or automatic adjustments made to the unit's parameters and inappropriate use of the unit.

Repairs may only be undertaken by personnel authorised to perform them. Opening or attempting to repair the unit makes all guarantee/warranty claims null and void! Improper work on the unit may jeopardise electrical safety.

**The manufacturer is not liable for accidents caused by the user opening the unit!**

When carrying out work on the unit, the valid safety regulations must be complied with.

## Supply voltage



### Important!

Make sure that the mains cable (power supply cable) is not damaged. If the mains cable is damaged, the device must not be used. Instead it must be disconnected from the mains and repaired by a qualified technician. Use only the power supply unit supplied!

**Risk of fatal injury due to electric shock!**

The device may be operated only at the stated supply voltage (see the rear of the device or external power supply unit)!

**If the supply voltage is too high, there is a risk of fire!**



# 1. Safety instructions/information

## Ventilation



### Important!

Appropriate means are provided to dissipate the heat generated within this equipment. The device must however not be installed in a cabinet or on shelves with insufficient ventilation. The ventilation slots on the device must not be covered.

**There is a risk of fire!**

## Moisture, direct sunlight, heat, naked flames



### Important!

Protect the device from moisture, dripping water and spraying water. The device must not be placed close to sources of heat, exposed to direct sunlight or operated in a damp environment. The device may not be operated only in moderate climatic zones. It is unsuitable for use under tropical conditions! Do not place anything which has a naked flame on the device! <sup>1)</sup>

**There is a risk of fire!**

## Radiated electromagnetic fields



### Important!

This reader is designed for operation as per EN 302208. When the unit is operated with antennas connected, the human exposure regulations in accordance with EN 50364 must be complied with. Ensure a minimum clearance of 20 cm between the antenna and the human body, and comply with the operating instructions for RFID antennas. In some circumstances, heart pacemakers may suffer interference if wearers are close to the antenna when the unit is in operation (reader and antenna). In case of doubt, the people affected are requested to contact the manufacturer of their pacemaker or their doctor.

The reader output power must be reduced as a function of the antenna cable length and the antenna gain.

## CE labelling

The unit complies with the applicable CE requirements and FCC part 15.

Model designation	Item number	FCC-ID			IC-ID		
RRU4-RS4-U6	52010096	WJ9	-	RRU4RS4U6	5530C	-	RRU4RS46
RRU4-ETG-U6	52010097	WJ9	-	RRU4ETGU6	5530C	-	RRU4ETG6
RRU4-ETL-U6	52010098	WJ9	-	RRU4ETLU6	5530C	-	RRU4ETL6

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and, (2) This device must accept any interference received including interference that may cause undesired operation.

### Industry Canada

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed at page 10 with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not

<sup>1)</sup> If the unit is not expressly designed for these installation locations/installation conditions.

# 1. Safety instructions/information

included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

## **Avis de conformité insérés dans le manuel d'utilisation des appareils radio exempts de licence**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**Modifications or conversions which are carried out on this unit without the express permission of Kathrein may invalidate the FCC permit for the operation of this unit.**

**Note regarding proper installation:**

## Note

*To meet part 15 of the FCC regulations in the United States, the system must be properly installed to guarantee adherence to the certification regulations according to part 15. The operator and the specialist company which carries out installation are responsible for ensuring that only certified systems are used in the United States. Use of this system in any other combination (e.g. several antennas which transmit the same information in the same location) is expressly prohibited.*

## Note

*Following corresponding tests, it has been ascertained that this unit adheres to the limit values for class B digital units in accordance with part 15 of the FCC regulations. These limit values are intended to provide private user's systems with appropriate protection against harmful radio interference. This unit generates and uses energy in the radio frequency range and is also able to radiate this; if it is not installed and used in accordance with the regulations, the unit may cause harmful radio communication interference. However, there is no guarantee that interference will not occur in a specific system. If this unit causes harmful radio or television reception interference, which can be ascertained by switching the unit on and off, we recommend that the user attempts to rectify this interference via one or more of the following measures:*

- *Realign the receive antenna or change its position.*
- *Increase the distance between the unit and the receiver.*
- *Plug the unit into a socket in a current circuit other than that to which the receiver is connected.*
- *Seek advice from the retailer or an experienced radio/television technician.*

**IC Radiation Exposure Statement/Déclaration d'exposition aux radiations**



## **Important!/Attention !**

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.



## 2. Introduction

### 2.1. The reader

The Kathrein RFID (Radio Frequency Identification) reader RRU4 is a multi-protocol-capable device for reading active and passive RFID tags in the frequency range from 865 to 868 MHz for Europe and 902 to 928 MHz for the American market. As supplied the unit can read and write tags in accordance with the EPC-Gen2 standard. Additional protocols can be loaded using software updates.

The reader operates using the frequency skipping process, so as to avoid faults and interference between readers. Readers change their transmission channel in a random or pre-programmed sequence.

For the ETSI area this means that in accordance with EN 302208 V1.2.1 the reader must pause its transmission for 100ms (and change its frequency) after it has transmitted continuously for 4s.

Within the FCC area this procedure is mandatory. The reader changes its transmission frequency randomly, with equal distribution across the 50 available channels.

The device has a maximum of four external antenna ports for connection of the transmission/reception antennas for communication with RFID tags.

For integration into a variety of infrastructures, the device has different communication interfaces depending on the variant. The power supply is provided by a 4-pin M12 panel connector in A coding.

### 2.2. Further reference material

In order to configure the reader correctly and adapt it to the respective application, detailed knowledge of the EPCGlobal standards of GS1 is necessary ((B)). This standard describes the principle of operation of the interface between the tag and reader.

The parameters available for the configuration of the reader are described from section 7 “Reader Configuration” of this manual.

The reader is controlled via the Kathrein-Burgstädt Reader Protocol (KBRP). The current version of the KBRP specification document ((A)) includes a detailed description of the protocol.

### Note

*The versions of the documents must match the software version of the reader. The CD supplied contains the current documents for the reader firmware supplied.*

### 2.3. Scope of supply

The contents of the packaging consist of the following items:

- 1 RRU4 (grey casing)
- 1 CD with demo software, programming examples, DLL and operating instructions

### 2.4. Accessories

The following accessories are available for the reader (if you have questions about the accessories, please contact our Sales Office):

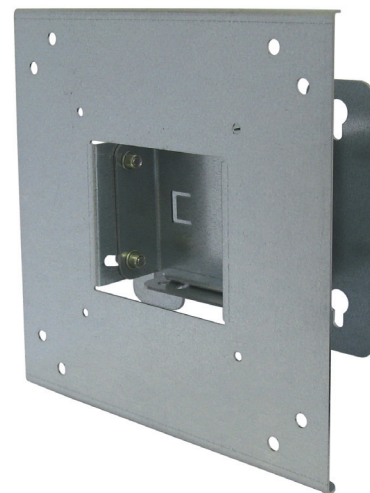
- Antennas: For use with UHF-RFID antennas; we recommend the Kathrein antenna types ULORA, LORA, MIRA, WIRA. These antenna types are available for all frequency ranges.
- Antenna cable

Designation (all cables listed: IP54 standard)	Order no.	50-Ω cable type	Connector 1	Connector 2	Length (cm)
Cable 1 m, TNC-TNC(rev)	52010051	RG058-PE	TNC(f)-rev	TNC(m)	100
Cable 2 m, TNC-TNC(rev)	52010052	RG058-PE			200
Cable 3 m, TNC-TNC(rev)	52010053	RG058-PE			300
Cable 6 m, TNC-TNC(rev)	52010054	RG058-PE			600
Cable 1 m, N-TNC(rev)	52010055	RG058-PE	TNC(f)-rev	N (m)	100
Cable 2 m, N-TNC(rev)	52010056	RG058-PE			200
Cable 3 m, N-TNC(rev)	52010057	RG058-PE			300
Cable 6 m, N-TNC(rev)	52010058	RG058-PE			600

- Connection cable sets (without antenna cables)

Designation	Order no.	Consisting of
cabling set RRU4 RS4	52010125	Power supply cable M12/free end, length 2 m; RS 422/485 interface cable M12/free end, length 2 m; 2 x GPIO cable M12/free end, length 2 m)
cabling set RRU4 ETG	52010126	Power supply cable M12/open, length 2 m; Ethernet interface cable M12/RJ 45 socket, length 2 m; 2 x GPIO cable M12/free, length 2 m)

- Mast and wall clamp, BN 52010128  
Wall/mast clamp for installing RFID antennas and RRU4/ARU4 readers (up to 6.0 kg total weight).



- Protective cap set, BN 52010127  
Accessories set for RRU4/ARU4 reader with screw-on protective caps for 3x antenna input (R-TNC) and 2x digital connection (M12)

## 3. Installation

### 3.1. Selecting the installation site

When the connections are plugged in, the device satisfies the protection class IP65. When selecting the installation location, make sure there is sufficient space around it for appropriate dissipation of the heat generated by the device. Do not install it close to external sources of heat. The maximum operating temperature listed in the data sheet must not be exceeded. The support surface must have a sufficient load-bearing capacity/strength.

### 3.2. Installing the reader

The device has threaded holes at the rear for attaching the reader. The dimensions of the holes pattern can be found in the drawing below. For ease of installation a bracket is available as an accessory, which offers the option of mounting on a mast or wall.

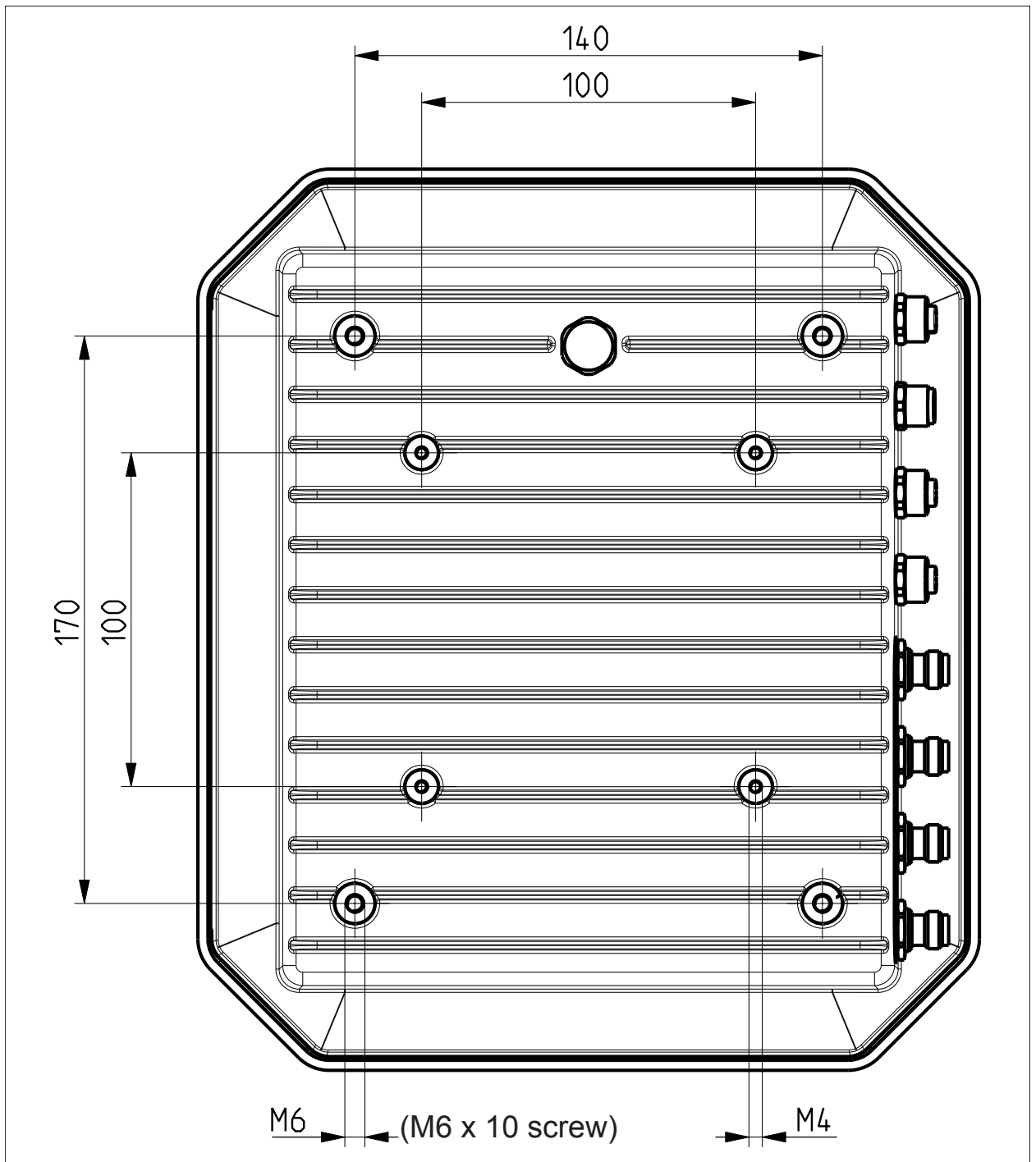


Figure: Rear of the RRU4 with dimensions

## 4. Connections and displays

Depending of the device variant, the reader has various connection options. The illustration below shows an RRU4 standard reader with all its connection options. Details of the connections and the pin assignments of plugs and sockets are provided in the following pages.

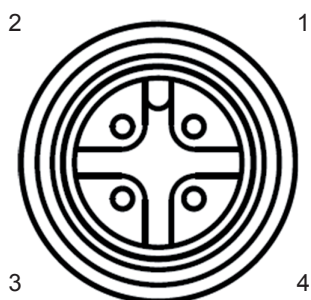


Figure: General view of the RRU4

Sockets, from left to right	Description
1	Communication connection: M12 (depending on the device variant)
2	Power supply connection: M12 male, 4-pin, A-coded
3	GPIO connection 1: M12 female, 8-pin, A-coded
4	GPIO connection 2: M12 female, 8-pin, A-coded
5	Antenna connection 1: R-TNC 50 Ohm
6	Antenna connection 2: R-TNC 50 Ohm
7	Antenna connection 3: R-TNC 50 Ohm
8	Antenna connection 4: R-TNC 50 Ohm
	Status indicators: 3 coloured LEDs (red, green, orange)

### 4.1. Power supply

The power supply is arranged as a four-pin round-pin plug with and M12 connection thread in A-coding.



PIN	Assignment
1	+24 V DC
2	
3	GND
4	

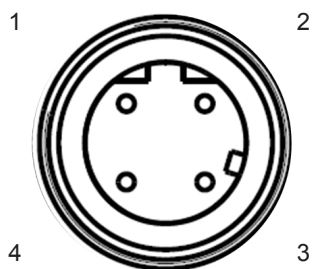
### Note

For operating this device only LPS (Limited Power Source) or NEC class 2 classified power supply units are approved! That means the power of the power supply unit may not exceed 100 W on the secondary side.

## 4. Connections and displays

### 4.2. Ethernet port

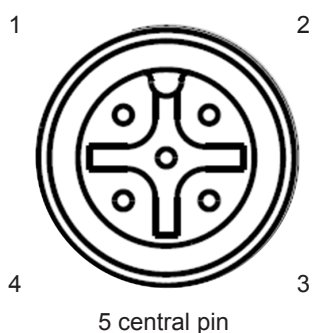
This data interface is arranged as a 4-pin M12 socket with D-coding. Only shielded cables may be used.



PIN	Assignment
1	TD+
2	RD+
3	TD-
4	RD-

### 4.3. RS422/485 connection

This interface is arranged as a 5-pin M12 socket with A-coding. Only shielded cables may be used.

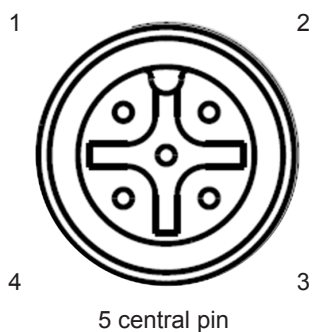


PIN	Assignment
1	RxD+
2	RxD-
3	TxD+
4	TxD-
5	GND

The interface card of the reader is equipped with a combined RS485/RS422 interface. The changeover between RS485 and RS422 is performed using the configuration tool. For operation as RS422, the RS485 cables are connected to RX.

### 4.4. RS232 connection

This interface is also arranged as a 5-pin M12 socket with A-coding. Only shielded cables may be used.



PIN	Assignment
1	CTS
2	RxD
3	RTS
4	TxD
5	GND



## 4. Connections and displays

### 4.5. UART transmission (RS232, RS422, RS485 or similar)

#### 4.5.1. Bit transmission layer (physical layer)

A full or half-duplex connection such as RS232, RS422 or RS485 is used for the physical layer.

#### 4.5.2. Data link layer

Transmission is in frames and blocks. A block comprises a maximum of 256 frames. A frame comprises a maximum of 256 bytes, of which a maximum of 250 bytes can be user data. The result is a maximum block size of 64000 bytes of user data.

The data link layer is used to safeguard the data between sender and recipient. The sender receives a response from the recipient for each frame received. If the sender does not receive a response from the recipient within a time window of 350 milliseconds after sending a frame, the frame sent is repeated until the error counter signals the cancellation of the transmission.

##### 4.5.2.1. Structure of a frame

5A LL SS FF DD ... DD P1 P2

5A: Start code for synchronisation  
LL: Number of bytes in the frame not including the start code  
SS: Status byte  
FF: Frame number  
DD: User data  
P1: 16-bit checksum low byte  
P2: 16-bit checksum high byte

##### 4.5.2.2. Start code and synchronisation

The start code is used to synchronise the recipient to the sender. It further allows the receiver to synchronise to the start of a frame when no data have been received for 15 milliseconds.

##### 4.5.2.3. Status byte

The status byte has the following significance:

50: Data packet  
A0: Response: "OK"  
A1: Response: "Memory error" (the receiver was unable to allocate any memory for the data block received)

A response is only 3 bytes long and is not CRC checked.

"OK" response: 5A 02 A0

"Memory error" response: 5A 02 A1

## 4. Connections and displays

### 4.5.2.4. Frame number

The frame number defines how many more frames there are in this data block. Only the first frame in a data block can be shorter than 256 bytes. Each additional frame must have a length of 256 bytes (length byte LL is FF).

It is therefore possible to calculate the block size from the first frame number.

For example:

A block with 700 bytes of user data is to be transmitted. For this purpose the block is divided into three frames.

1. frame: 5A CD 50 02 – there now follow 200 bytes of user data – P1 P2
2. frame: 5A FF 50 01 – there now follow 250 bytes of user data – P1 P2
3. frame: 5A FF 50 00 – there now follow 250 bytes of user data – P1 P2

The receiver can use the frame number of the first frame (here 02) and its length byte to calculate the block size (block size = frame number \* 250 bytes + length byte -5) (here in the example: 2 \* 250 bytes + 205 bytes - 5 bytes = 700 bytes), and reserve an appropriate amount of memory for the data.

### 4.5.2.5. User data

User data are the bytes in a frame that flow into the block transmitted.

### 4.5.2.6. Checksum

The checksum is calculated using the polynomial  $x^{16} + x^{12} + x^5 + 1$  with a pre-initialisation of 0x0000 from the start code to the last user data byte.

### 4.5.3. Network layer

As the KBRP is a point-to-point protocol, there is no network layer.

### 4.5.4. Transport layer, session layer, presentation layer

Do not exist.

### 4.5.5. Application layer

The application layer transmits data blocks from 1 to a maximum of 64000 bytes.

## 4. Connections and displays

### 4.6. Ethernet transmission

When communication to our reader is via Ethernet, a data transmission layer is also used, as for serial communication.

The transmission layer via Ethernet looks much simpler here, because the TCP/IP protocol already provides a data security layer. All we need to add are the packet start and packet end, since TCP/IP is a streaming protocol.

#### 4.6.1. Frame structure

A frame is structured as follows:

Start + Data block + End

The start consists of 0xAA 0xBB 0x01 0x01, where the first 1 is the data transmit byte and the second 1 a stuff byte. The end consists of 0xAA 0xCC. If the byte 0xAA occurs in the KBRP frame, it must be doubled (0xAA → 0xAA 0xAA)

#### 4.6.2. Port

The TCP communication port is the Port 4007.

#### 4.6.3. Example

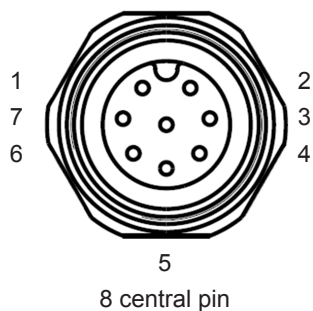
As an example the frame for "ASyncGetEPCs" is shown. The ID for this command is the "0x0111" which then causes the frame to appear as follows:

0xAA 0xBB 0x01 0x01 0x11 0x01 0xAA 0xCC

## 4. Connections and displays

### 4.7. Digital inputs and outputs

The activation and evaluation can be performed using the software *ReaderStart v2*, with the DLL supplied, or by access to the reader protocol.



Pin	GPIO 1	GPIO 2
1	OUT_CMN	OUT_CMN
2	INPUT 4	INPUT 1
3	INP_CMN	INP_CMN
4	GND	GND
5	UB	UB
6	OUTPUT 4	OUTPUT 2
7	OUTPUT 3	OUTPUT 1
8	INPUT 3	INPUT 2

The digital inputs and outputs are communicated via two eight-pin sockets in A-coding with M12 connection threads. The inputs are double isolated from the power supply of the reader and can be operated irrespective of the polarity of the input signal. For this reason there is a common pin for the inputs (INP\_CMN). The connection variants for the inputs are shown below. Depending on the application, the power to the inputs can be double insulated from the external power supply to the reader, or not double insulated from it.

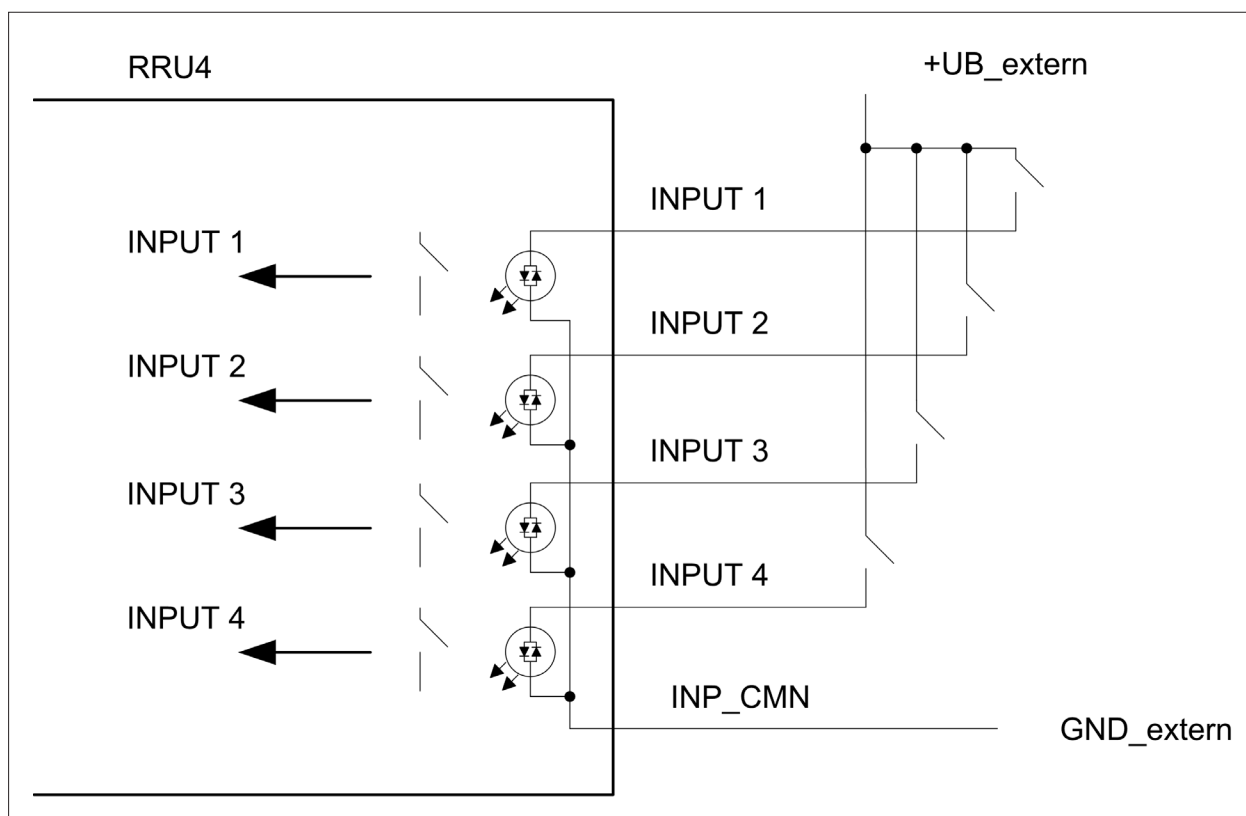


Figure: Inputs double insulated

## 4. Connections and displays

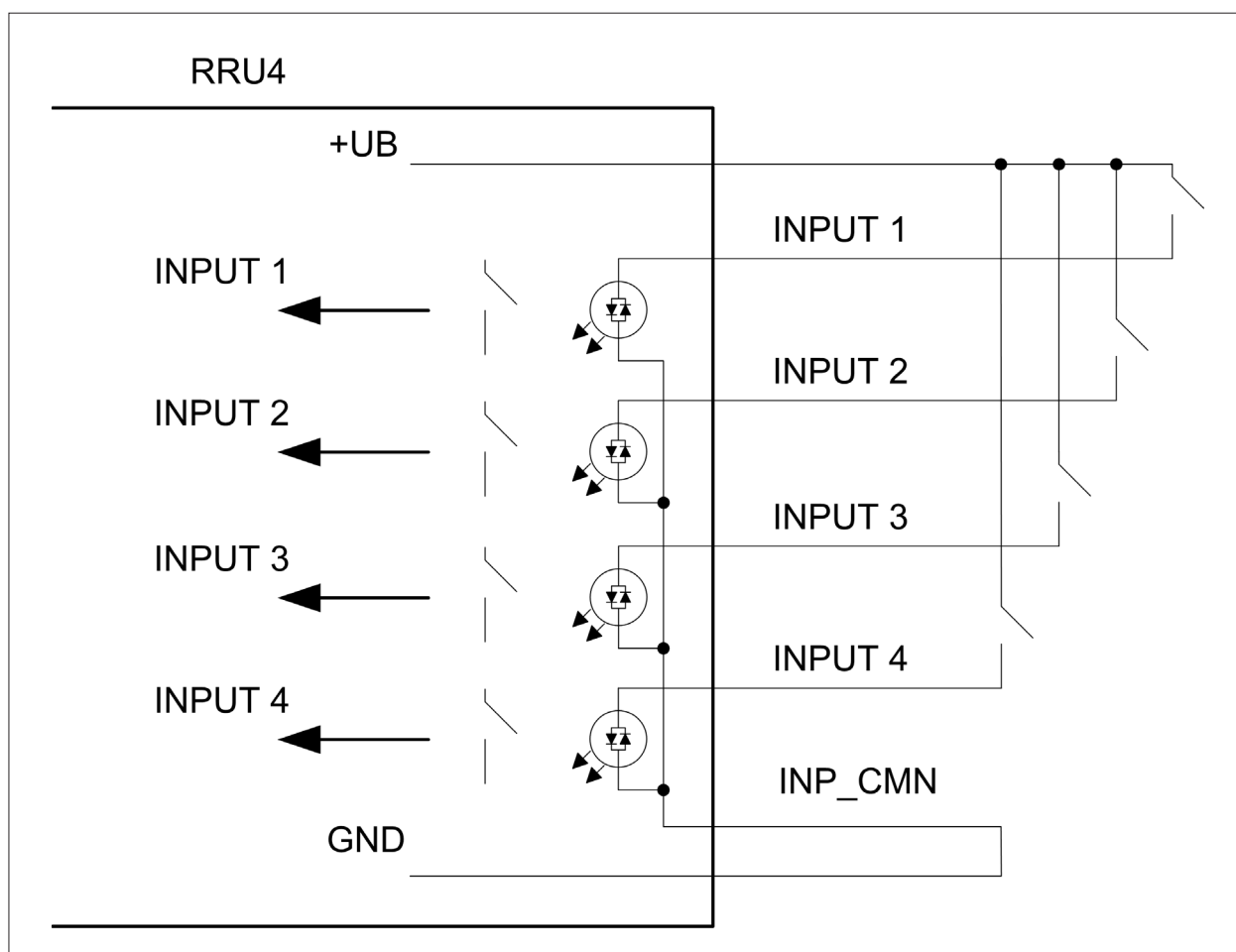


Figure: Inputs not double insulated

The outputs are also double insulated from the power supply to the reader and have a common pin (OUT\_CMN). If the double insulation is not required, the power supply can also be taken directly from the reader.

### Note

*Please note that the load per channel is limited to a maximum of 0.5 A, and the total load across all the channels must not exceed 1.5 A. If the reader's auxiliary power GPIO connection is used, the maximum load is 1.1 A. The inputs and outputs are designed for a maximum voltage of 30 V DC. Further information can be found in the data sheet for the reader. For operating the outputs with an external power source, only LPS (Limited Power Source) or NEC class 2 classified power supply units are approved.*



## 4. Connections and displays

The connection examples for the outputs are shown in the next illustrations.

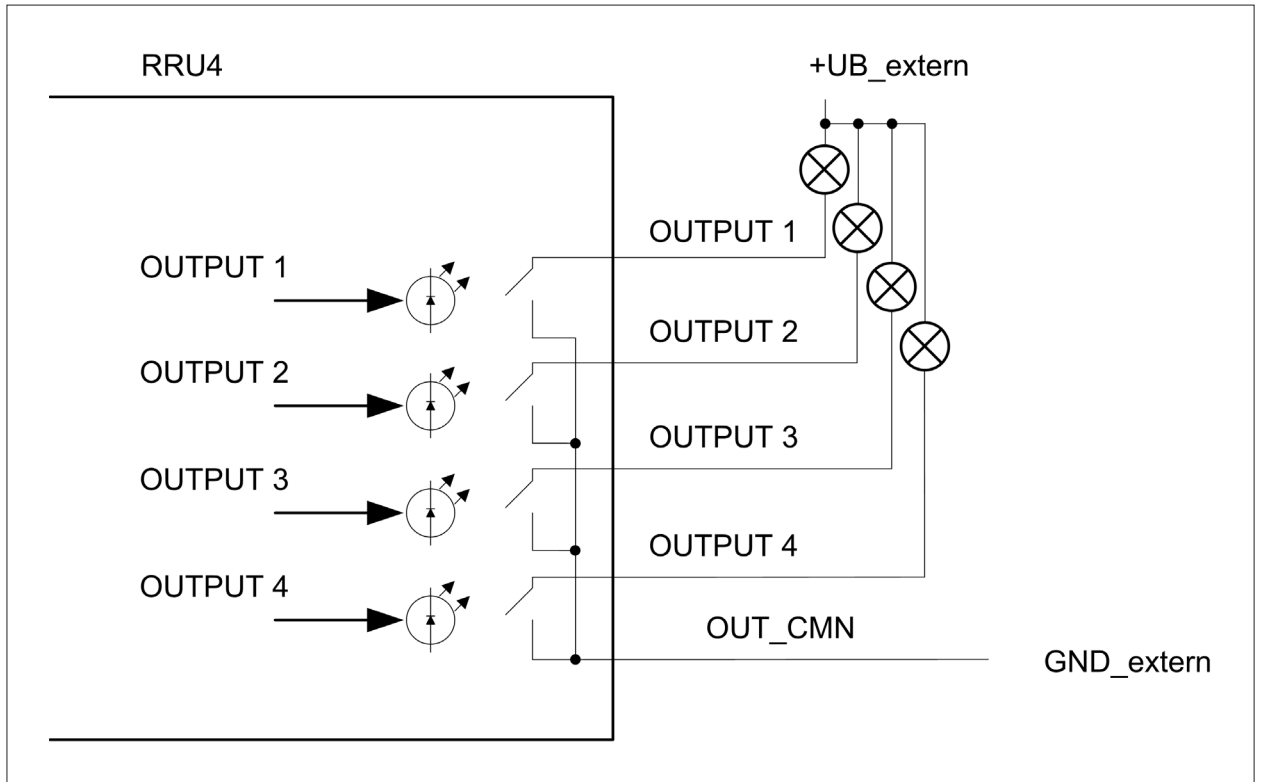


Figure: Outputs double insulated

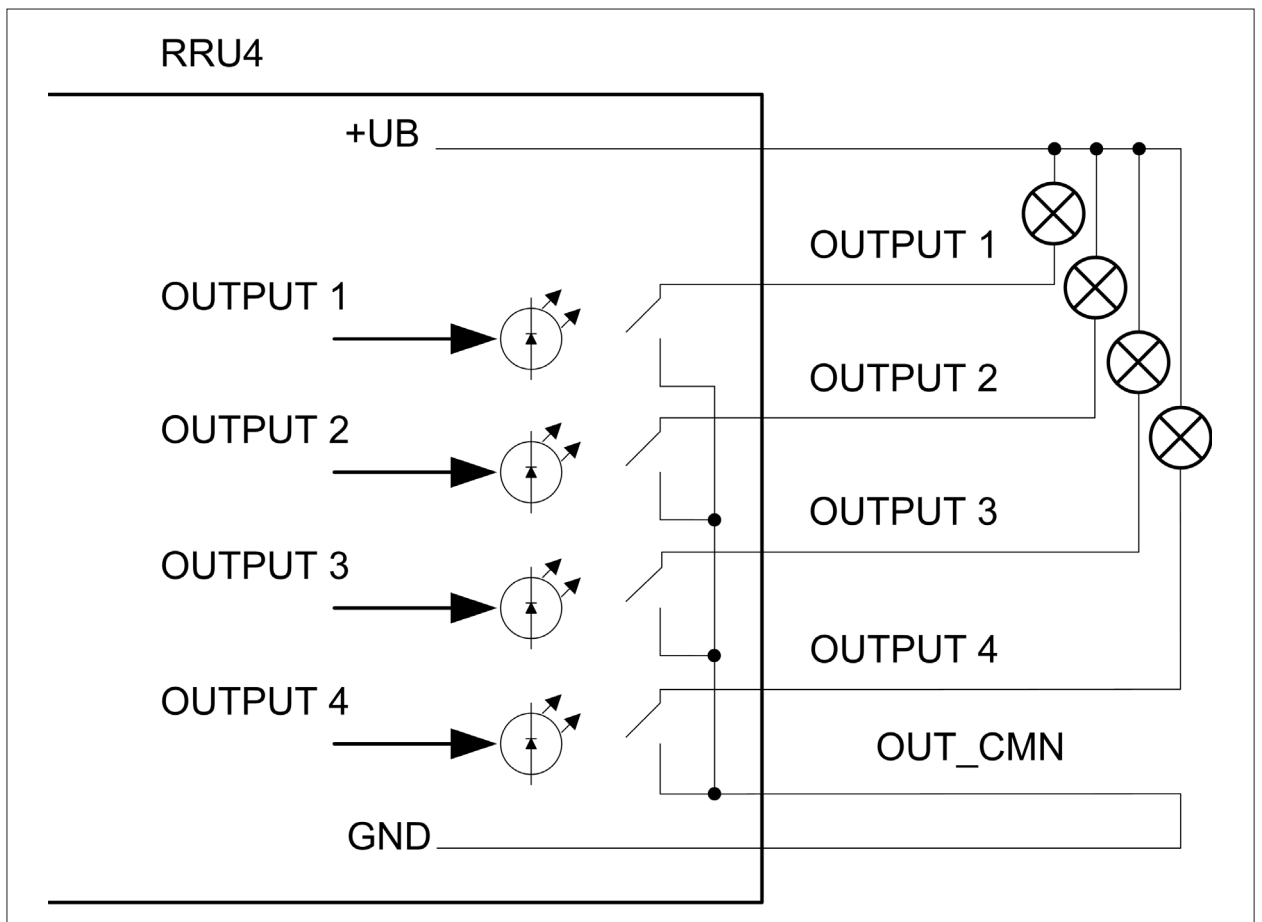


Figure: Outputs not double insulated

## 4. Connections and displays

### 4.8. Antenna Connection

For the connection to the RFID antennas, the reader has four antenna connections that are of reverse TNC design. Please only use the cable from the accessories or equivalent cable for this connection.

#### Note

*Please only use cable suitable for the impedance (50 Ohm), as otherwise the performance of the reader will be severely limited by the mismatch. If the mismatch is large, the reader may indicate a fault.*

### 4.9. LED

The reader has a 2-colour LED for the indication of the operating state. The table below shows the colours used and the related operating state.

Red	Green	Operating state
X	flashes approx. every 8 seconds	Error during initialisation
X	X	Unit is booting
Flashes approx. every 8 seconds	X	Normal operation with heartbeat

Table: Indication of the operating states by the LED

### 4.10. Buzzer

Furthermore the reader is also fitted with a buzzer which, in addition to the LED, indicates successful booting (1 x short) or an error (2 x long).

For test purposes the reader can be operated using the demo software supplied. This software provides all the necessary functionality of the reader for a test in a real environment. As an aid to configuration, various basic settings for application scenarios are provided.

As well as this documentation, the following documents and programs can be found on the CD supplied:

- data sheet for the reader
- specification of the protocol for communication by the reader with a receiver
- catalogue of the RFID products currently available
- API DLLs for the simplified activation of the reader with Borland and Visual Studio together with some simple programming examples
- set-up program for the Kathrein reader start demo
- .Net Framework 4
- C++ 2008 redistributable

# 5. Software

## 5.1. System requirements

To ensure correct operation using the software on your PC/laptop, your PC/laptop should meet the following minimum requirements:

Processor:	X86 compatible
Memory:	512 MB RAM
Operating system:	Windows XP (SP3), Vista (SP1), Windows 7 or higher
free hard disk memory for:	
32-bit operating system	850 MB (including Microsoft .Net Framework 4)
64-bit operating system	2 GB (including Microsoft .Net Framework 4)

## 5.2. Installation

The demo software is installed by running *KathreinRFIDDemoSetup.exe* from the CD-ROM supplied. During the installation a check is made whether the necessary preconditions for the installation are satisfied. This means that a check is made whether all the dependencies such as the necessary Windows Service Packs, the .NET Framework in the respective version together with the C++ redistributables are installed. If this is the case, during this process the demo software and the DLL for controlling the reader are installed.

After the start of the set-up, you can change the language used during the installation in the window that now opens. Confirm your selection by clicking on the *OK* button.

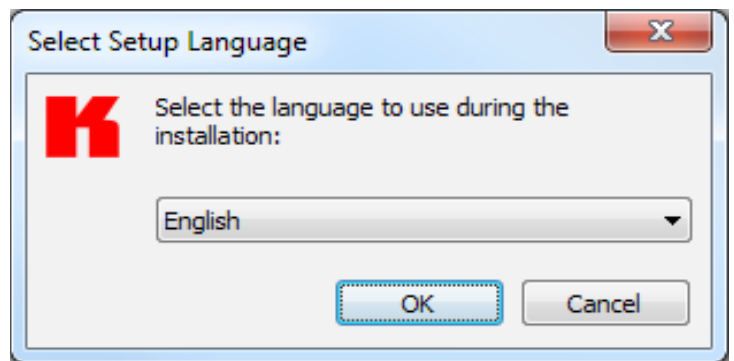


Figure: Language selection for the installation

The welcome screen that now appears gives further information on the exact version issue of the reader start software. This information can later be called up from the drop-down *Info* menu in the menu bar.



Figure: Welcome screen with software version

Clicking on the *Next* button takes you to the license agreement. Please read this through carefully; if you do not accept the terms of the agreement you must decline to accept it. The installation is then terminated at this point.

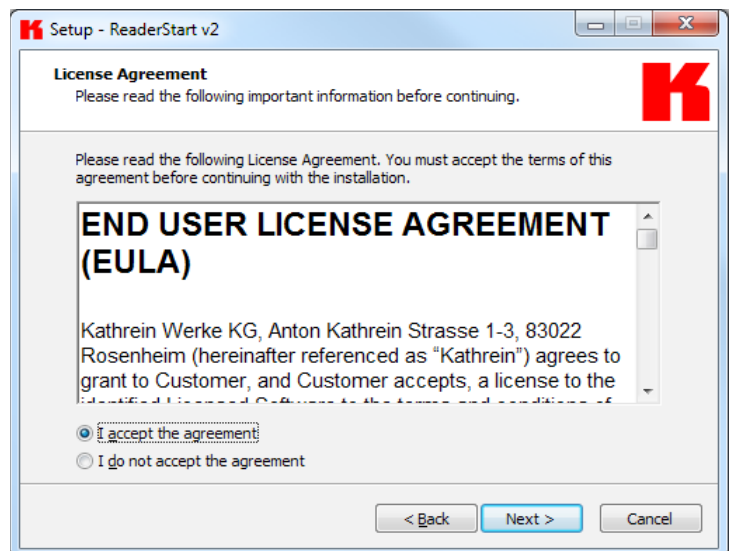


Figure: Confirmation of the license agreement

If you have accepted the license agreement, press the *Next* button, following which you can select the target folder in which to install the software. Don't forget to select the target drive also.

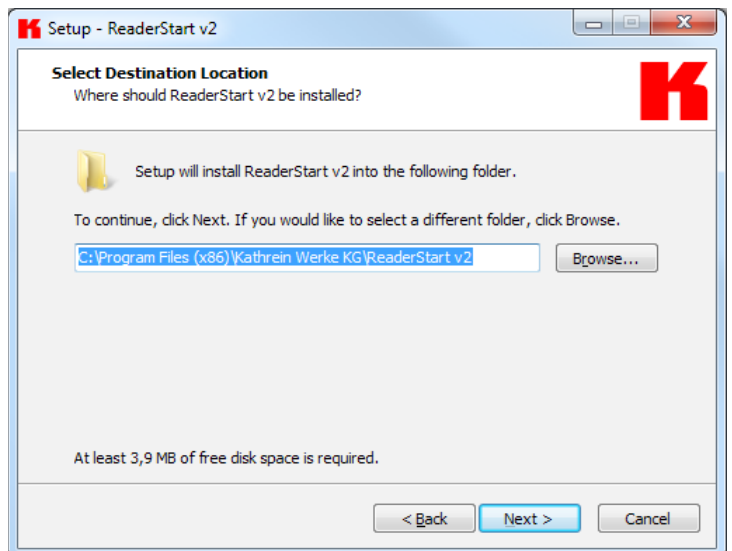


Figure: Selection of the installation folder

In the next screen you can customise the folder in the Windows start menu. Here, as in the previous windows, you are offered the standard settings.

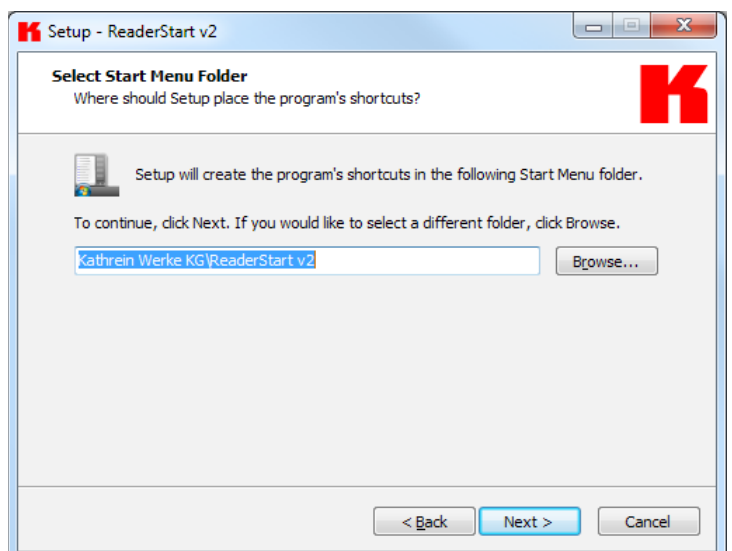


Figure: Selection of the folder in the start menu



## 5. Software

In the following window you can specify whether you wish an icon to be included in the Windows Quick Launch and/or on the Desktop. The default is to generate no icons.

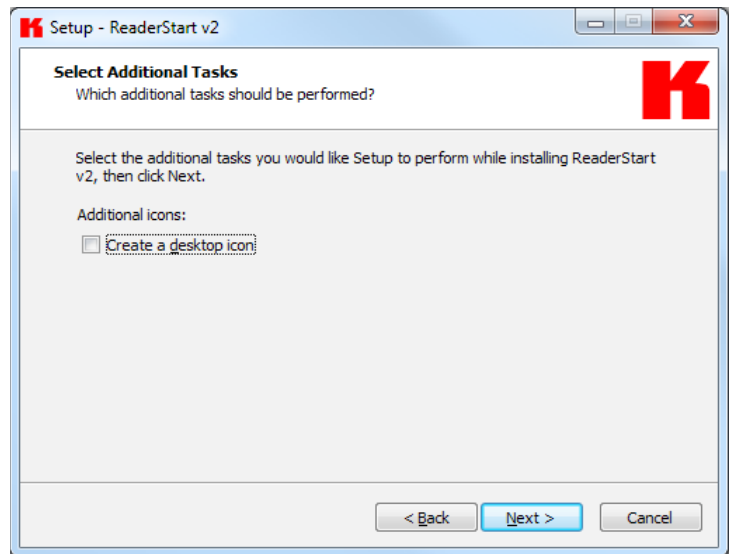


Figure: Selecting installation tasks

Finally a summary of all the installation tasks is shown. Click on the *Install* button to start the installation. If during the installation procedure a request is made to restart the computer, please do so.

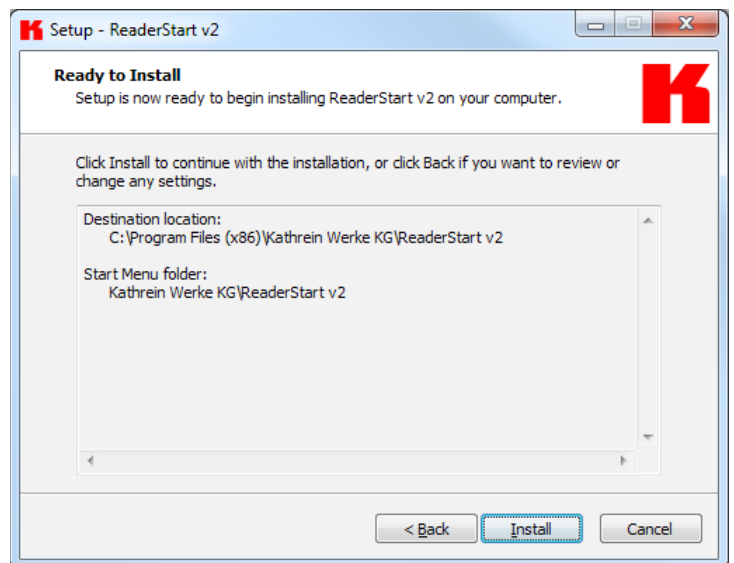


Figure: Summary of the installation tasks

Successful completion of the installation is shown in the following window. If you do not wish to start using the software straight away, please uncheck the *Launch ReaderStart v2*, box, otherwise the program will start immediately once you click on *Finish*.



Figure: Completing the installation

## 5.3. Operation

In the following section, the *ReaderStart v2* demo software for the KATHREIN RFID reader RRU4 is described. Before the description addresses the user interface and the individual configuration features and controls, the principle of operation of this RFID reader system is described.

### 5.3.1. General information

An RFID system consists of the control computer, the reader itself, the antennas, antenna connection cables and the tags. The figure below shows the schematic layout of the system:

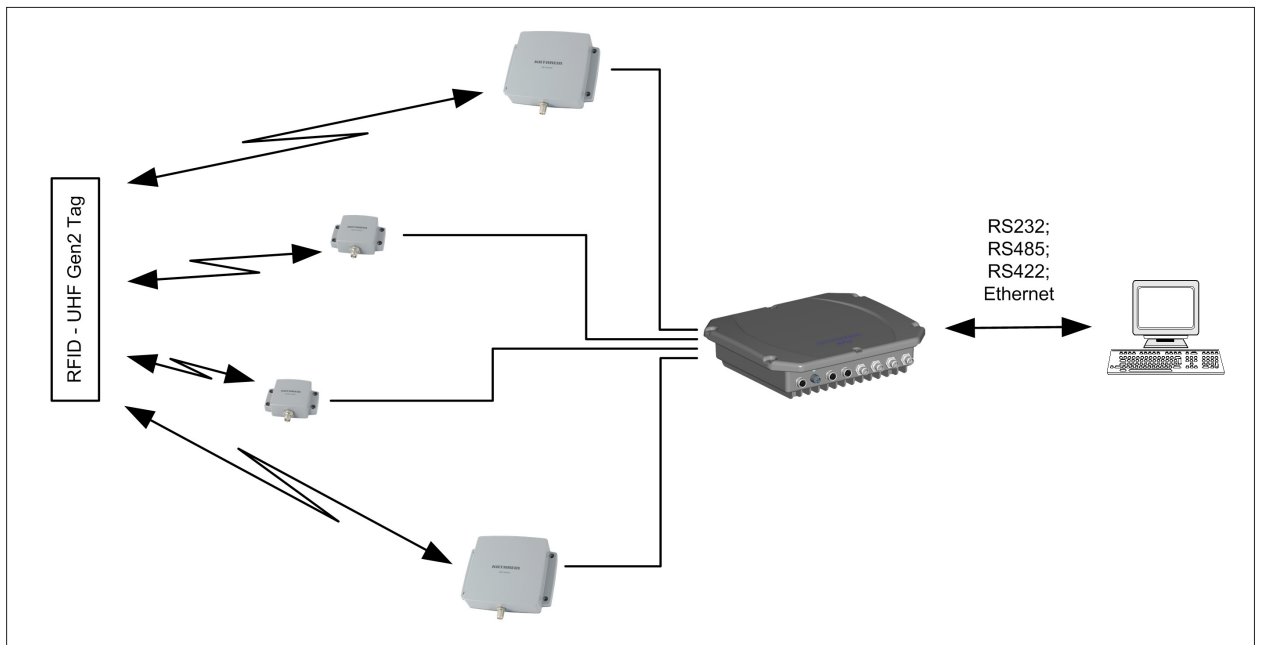


Figure: RFID system

The tags consist of an antenna and a small chip. They are the real carriers of the information, the EPC. These numbers identify the products or product groups. Alternatively the EPC can also be overwritten with your own information.

To read information from an EPC tag, the reader emits an RF carrier via the active antenna and in this way supplies all the tags in this RF field with power. If now it is desired to read the information from a tag, this tag must be selected

from the population of tags (singularisation). After successful completion of the singularisation, a handle is requested from the tag. The rest of the communication with the tag is undertaken using this handle and the EPC is read. The description of the tag is performed in the same way.

The tag's EPC is transmitted by the reader to the PC and can be displayed there with additional information. This information includes, along with the time the tag was read, also the antenna used for communication with the tag. It is always possible to communicate directly with the tag using this EPC, as soon as the tag is within range of the reader.

The communication between ReaderStart v2 and the reader is performed via the DLL supplied. It provides information on the user interface about all the unit's functions that are relevant to the user. Every connection between the application and the reader over the various interfaces in the reader is made using this DLL. The functions that can be used are listed in the header file "ReaderDll.h".

## 5.3.2. User interface for ReaderStart v2

The program is started by *ReaderStart v2.exe*. The splash screen is displayed until all the necessary DLLs have been loaded in the background. After this the user interface shown below appears. This consists essentially of the menu bar, the tabs together with the status field.

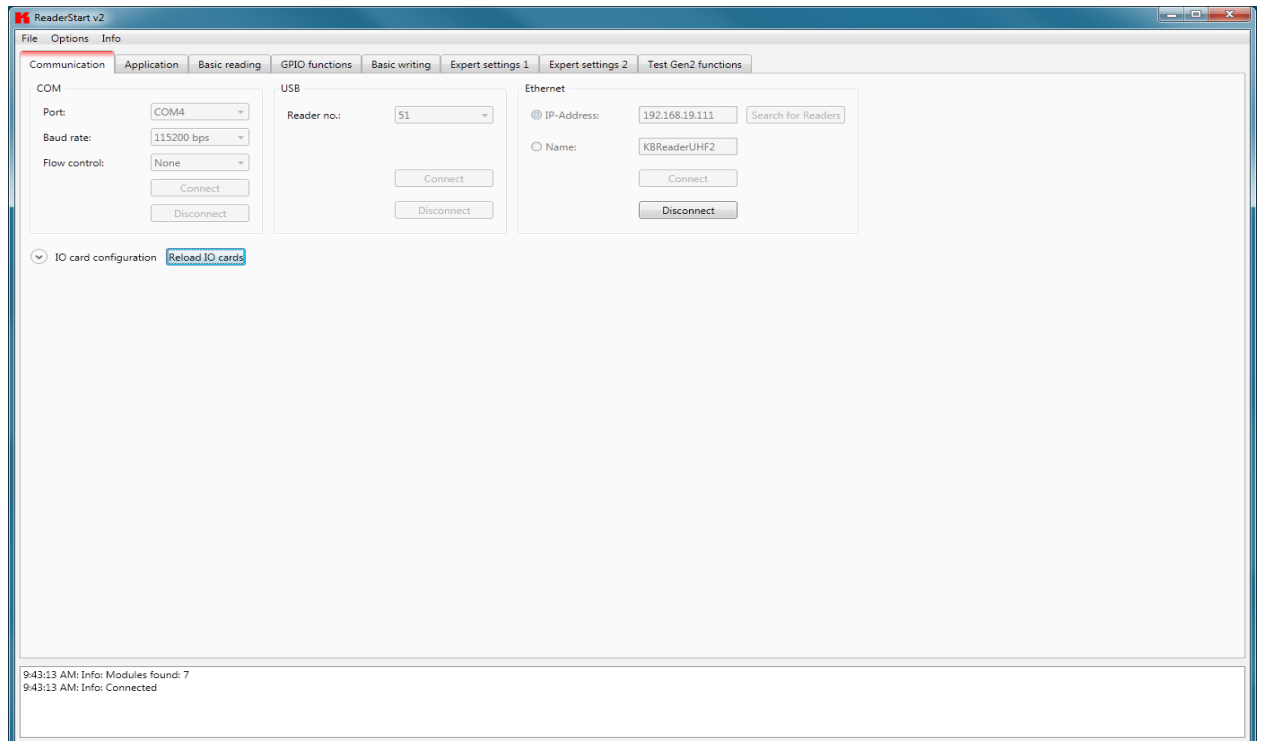


Figure: ReaderStart v2 user interface

## Note

*Functions that are unavailable are greyed out in the program.*

The settings and controls for the reader are divided into individual functional groups under different tabs. The individual sheets can be selected using the tabs. The sequence of the tabs can be changed as required by "drag and drop".

All status messages from the reader and the program are shown in the status field, and if desired logged. 3 message types are defined:

- Info – shows which action was just performed
- Warning – indicates possible problems in the structure and configuration
- Error – indicates that the desired action could not be executed

Every message is provided with a time stamp which is placed in the status field which always lies above the information itself.

## 5. Software

The status field has a context menu which allows deactivation of warnings, information and errors in the status field. Messages that have expired can be deleted in this menu.

### 5.3.3. Menu bar

The menu bar allows the program to be customised to your own requirements. These include for example: language settings, layout, status messages and calling up the program information. It consists of the items: file, options and info.

#### 5.3.3.1. File

There are a wide variety of parameters available for configuring the RF front end. A complete setting can be saved as a parameter set in the menu item file as an XML file, and later reloaded.

Under the item *Save Reader Configuration to File*, a dialogue opens which displays all the available parameter sets (0 - 7). The selection can be changed by setting the check. Furthermore each parameter set can be described briefly. Selecting *Save* opens a further dialogue in which a respective save location and a file name must be selected or input, in order to successfully save the file. The progress of the save operation is shown by a progress bar.

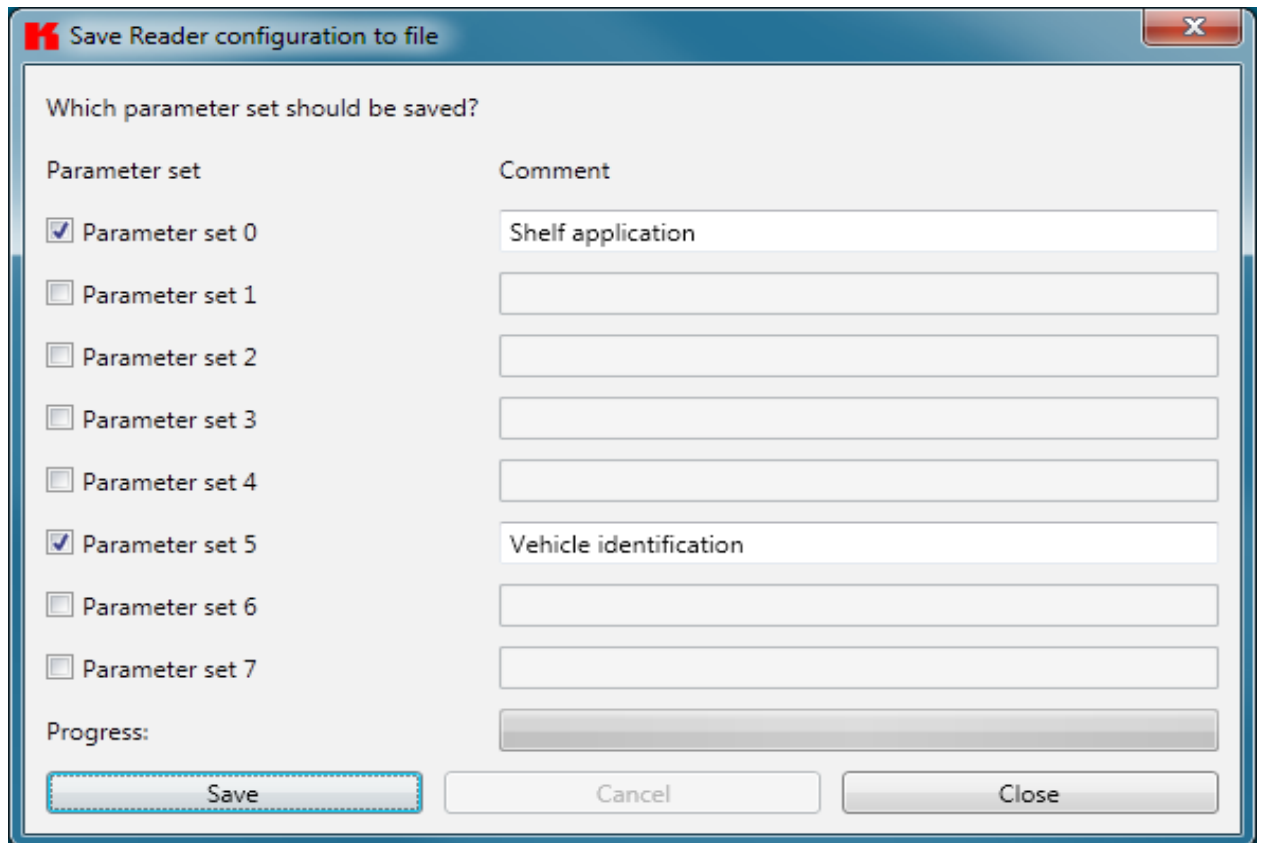


Figure: Saving the configuration in a file

Reloading the settings starts with the selection of the parameter file. In the dialogue which opens, all available parameter sets are displayed. The assignment of them to the individual save locations can be reassigned here. For this purpose the desired parameter set on the reader can be selected in the drop-down menu. Selection of the item *None* means this parameter set is not loaded into the reader. In the default setting a 1:1 assignment applies. Pressing the *Assign parameter sets 1:1* button resets all the changes in the assignment to the default. Pressing the *Delete assignment* button deletes all assignments of the saved parameter sets to those in the reader. In the drop-down menu this is indicated by *None*.

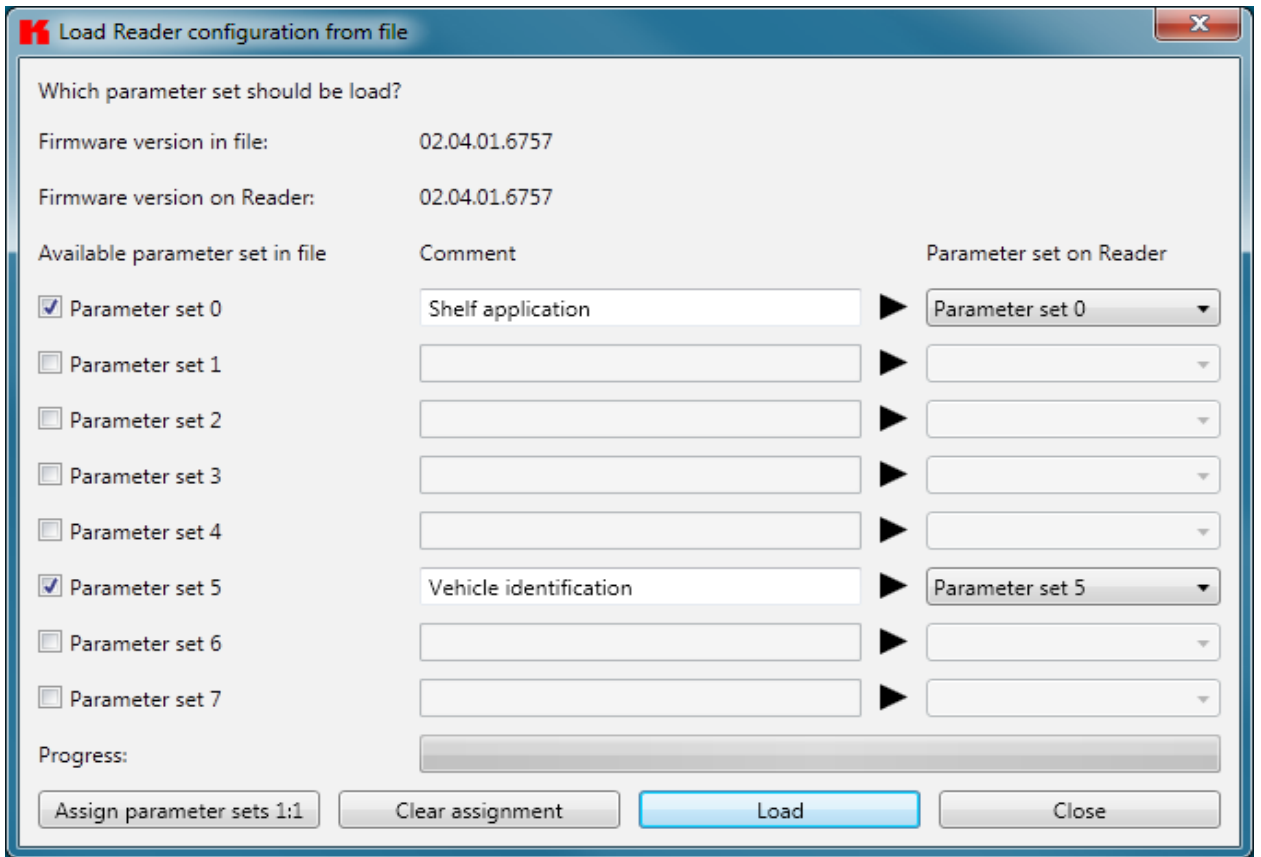


Figure: Loading a configuration from the file

### 5.3.3.2. Options

The *Options* are divided into two groups. One part offers the facility to change or reset some properties of the program. The second part permits the reader to be provided with new firmware and to change its system time.

The first group includes changing the language, selection of the warnings that are displayed, resetting the layout and deletion of the status messages in the status field. The language used in the program set to the desired language by clicking on Language Selection in the menu item. The currently selected language is shown by a check; if a computer restart is necessary in order to load the change, the program will indicate this.

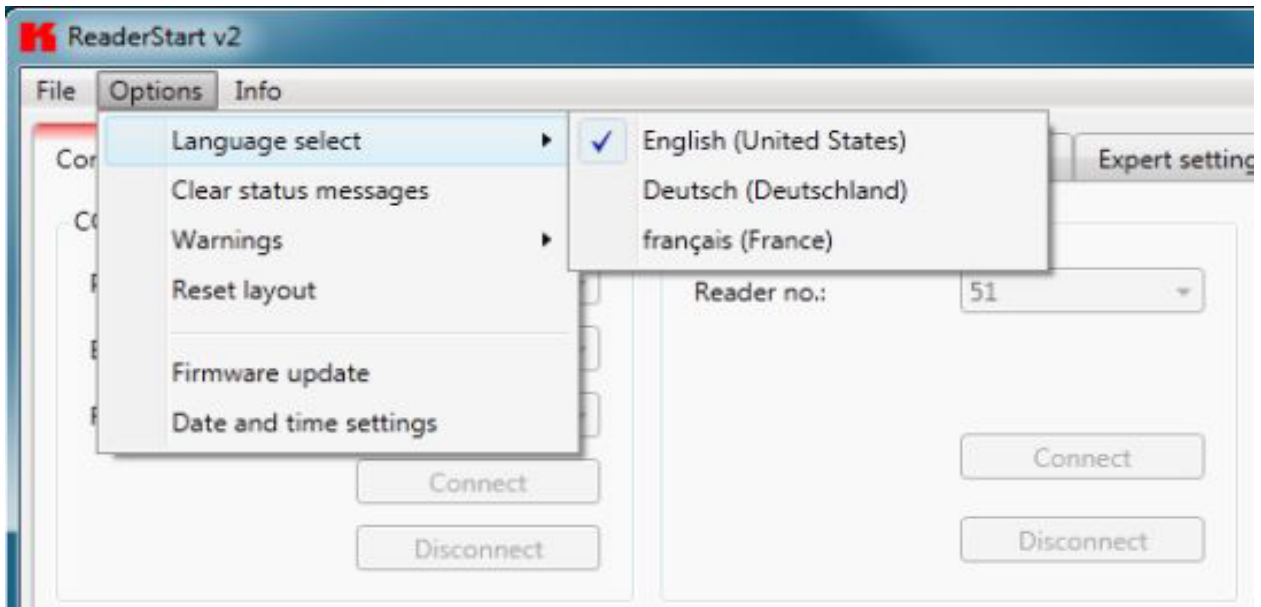


Figure: Changing the language

## 5. Software

Under the item *Warnungen* (Warnings), the confirmation queries for the actions Describe, Block or Deactivate the tags in the field are activated or deactivated.

### Note

Changing the memory content of the tags can render them unusable.

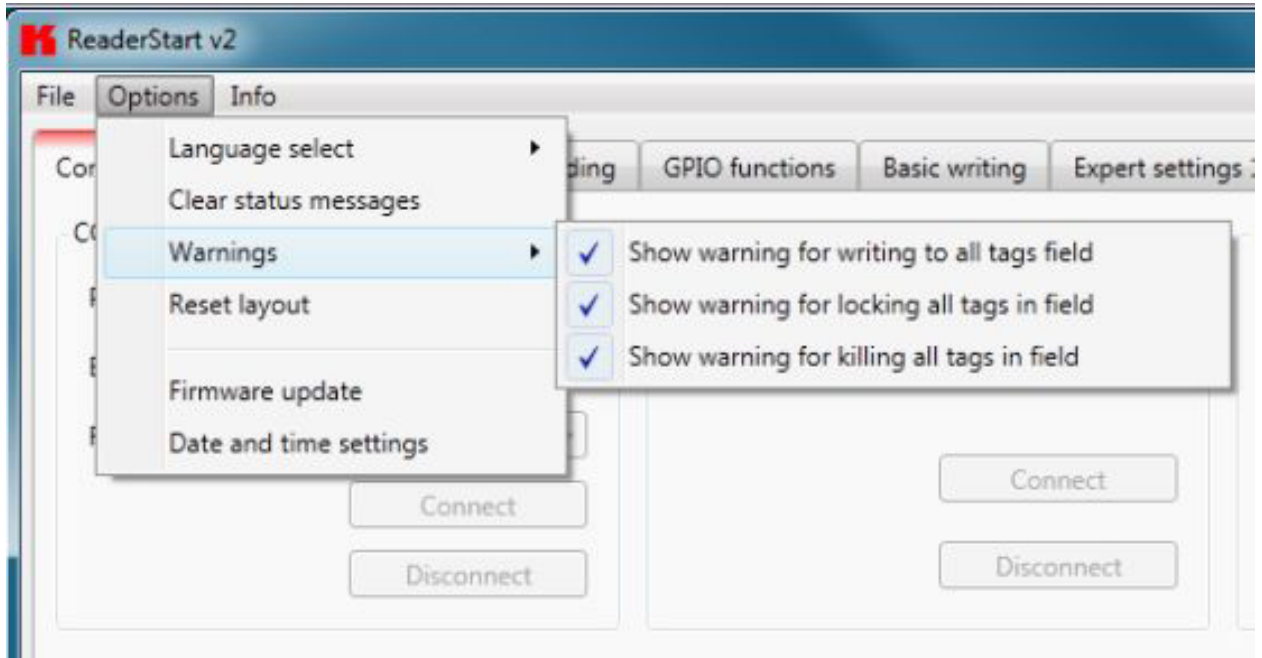


Figure: Setting the warnings

If it is desired to recreate the original layout of the program in respect of window size and sequence of tabs, this can be achieved by means of the *Reset layout* menu item.

The Firmware Update item permits the update of the reader firmware. The window that opens shows the version currently mounted in the reader. After selection of a firmware file, this version is shown in the next line. Pressing the *Update* button starts the procedure. The progress is shown in the *Update progress* line in a bar. After a successful update the reader must be restarted, either by pressing the *Restart* button or by switching the power supply off and on again.

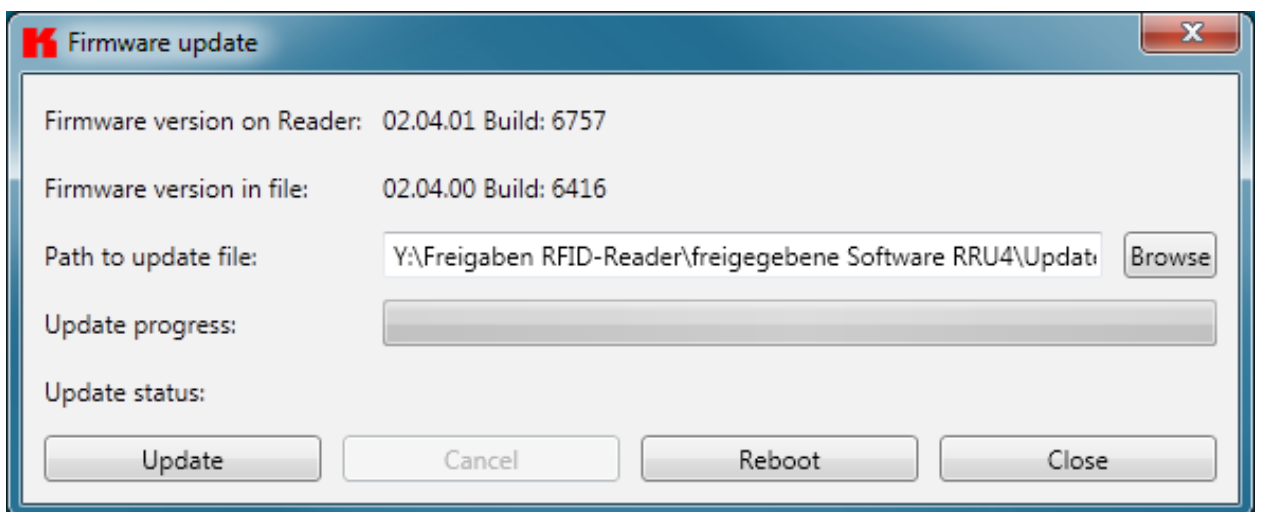


Figure: Updating the firmware

## 5. Software

The reader has an integral clock, which can deliver the time stamp for a tag operation. This clock is set using the *Date and time settings* in the menu. When this menu item is opened, it automatically reads the current date and time from the reader and compares this with the date and time from the host computer. The date and time of the host computer can now be loaded to the reader by pressing the *Set system date and time on Reader* button. There is also the facility to set the reader date and time manually and load it to the reader. This is done by entering the desired date and time on the reader side and pressing the *Set adjusted system date and time on Reader* button. The status line indicates which action was just executed and whether the action was successful.

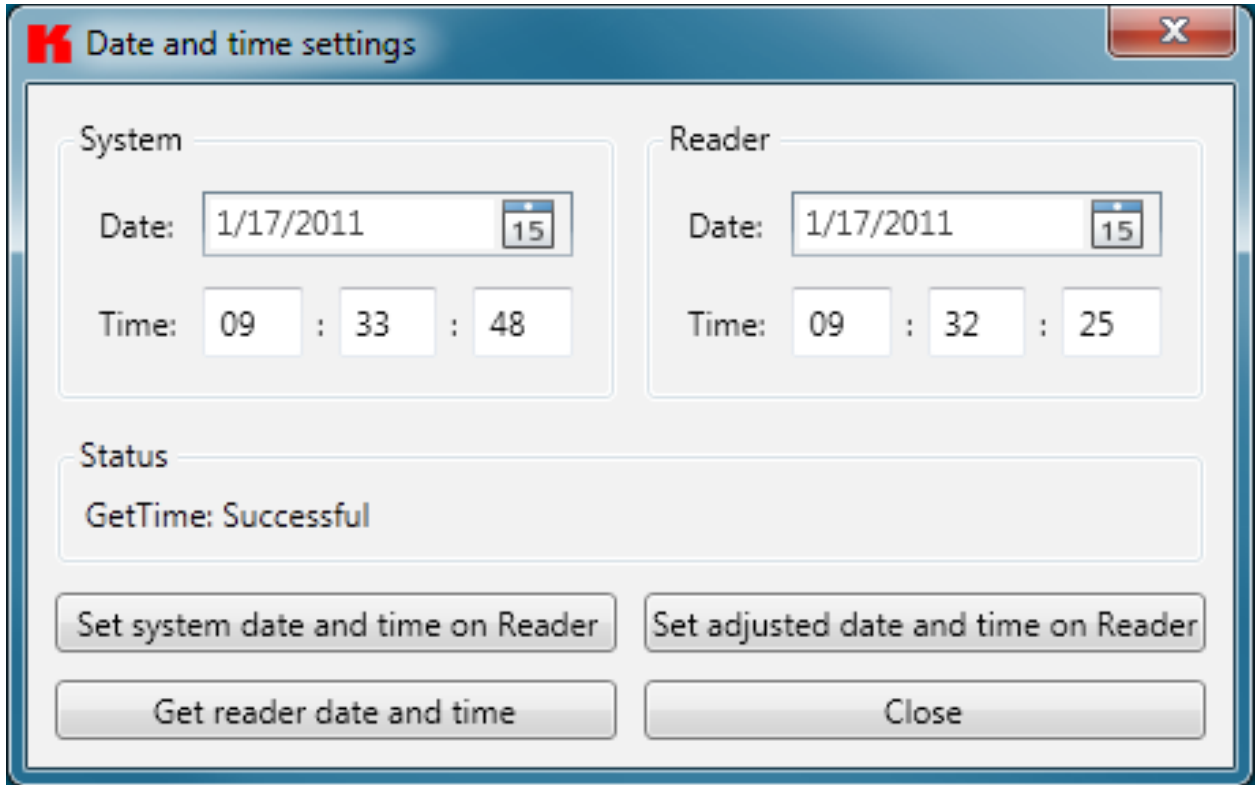


Figure: Setting the date and time

### 5.3.3.3. Info

This item on the menu bar allows information about the reader start software and the reader to be interrogated. The version issue of the PC software can be interrogated under the first item.



Figure: About reader start v2

## 5. Software

The second item automatically reads the license key. The key plays back various factory-set parameters of the reader. In certain cases it may be necessary to send this key to Kathrein (rfid@kathrein.de). The window that opens allows the key to be copied to the clipboard.

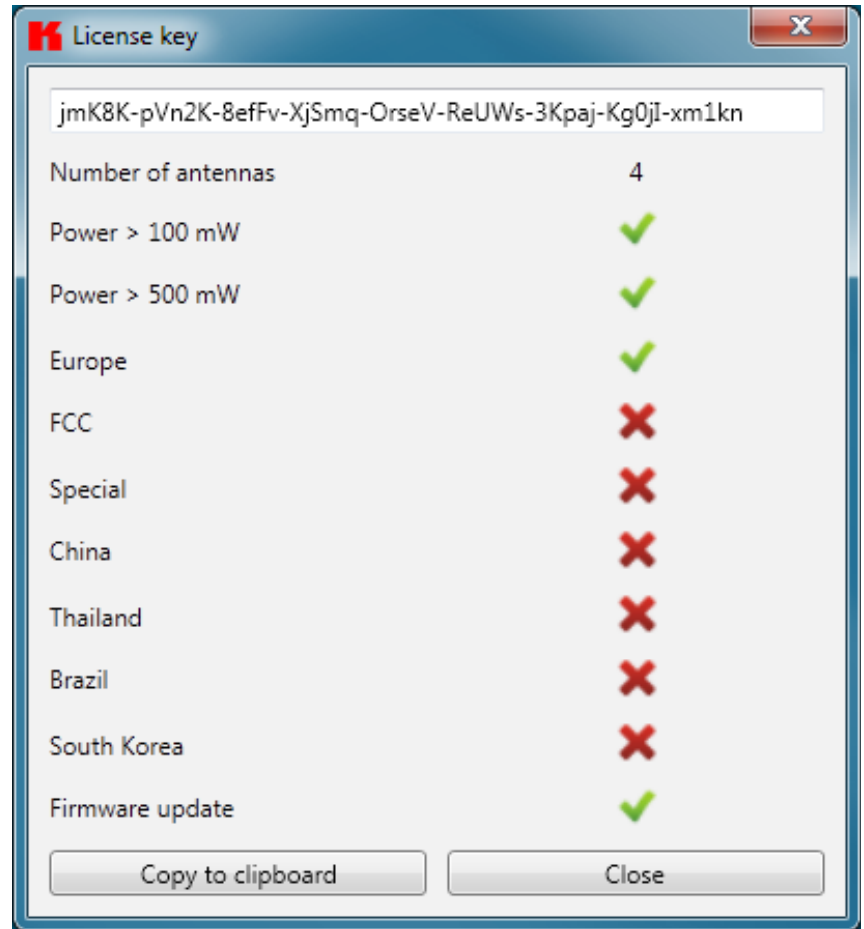


Figure: Displaying the license key

The third item supplies detailed information about the software and hardware versions of the reader. The firmware is specified with version number and build number. The hardware issue is divided into CPU module, PA module and the various I/O modules. The information about the I/O modules are stated in the format *Insert position : module type* .

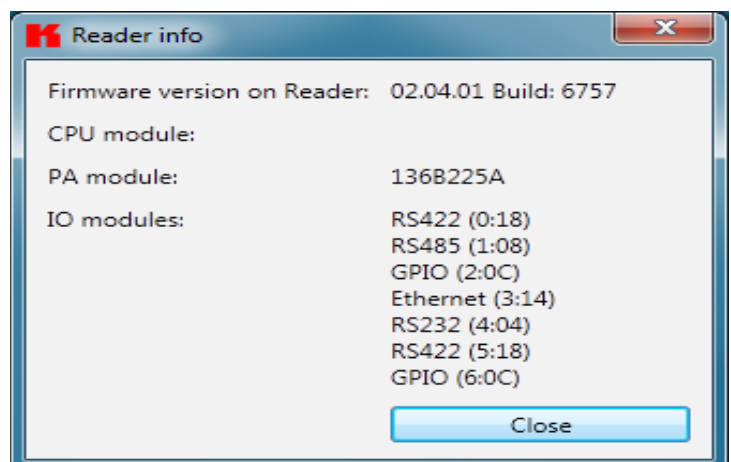


Figure: Interrogating information about the reader

The Error status item reads the error status of the reader and shows all errors that are still outstanding in the status field.



# 6. Operating the reader

## 6.1. Communication

The communication tab groups together all the functions for establishing connections and configuring the interface cards. The various communication connections are grouped under 3 headers, COM for serial connections via the COM port (RS232/485/422), USB for connections up to version USB 2.0 and Ethernet for connections via TCP/IP.

When the connection is established, the program interrogates the information about the installed I/O cards. The information can be viewed and changed via the I/O card configuration.

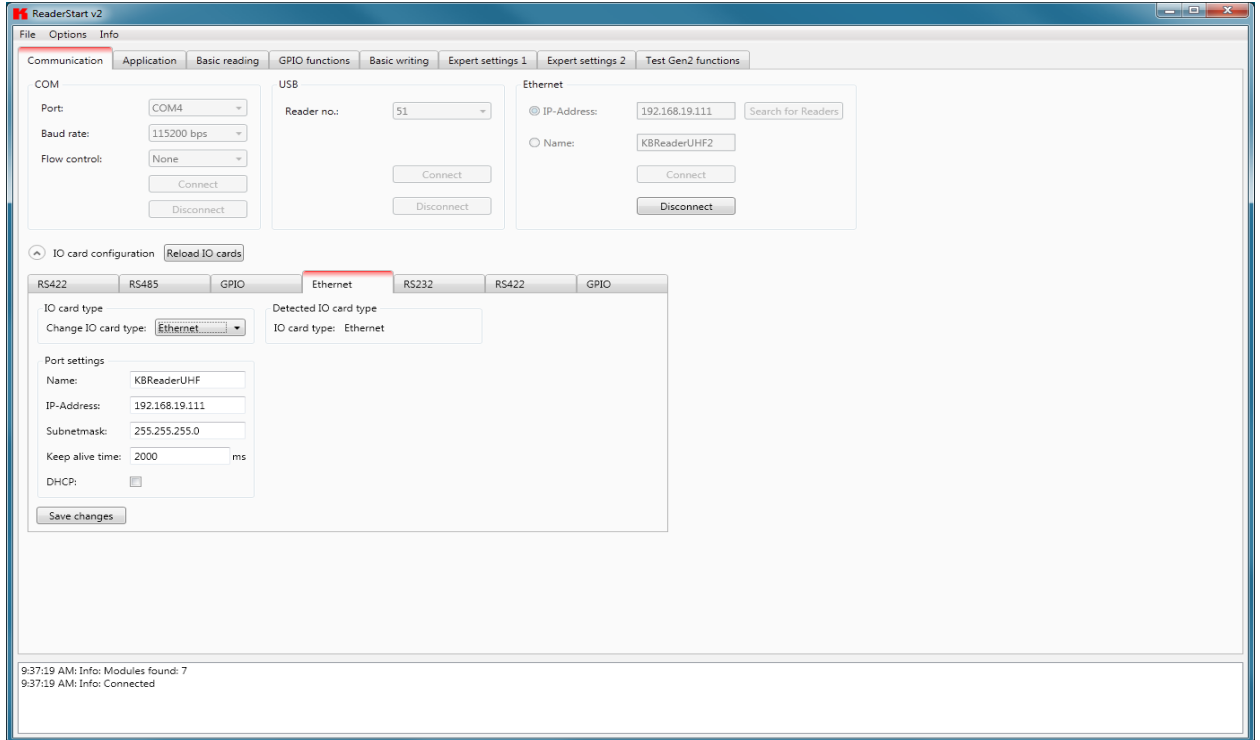


Figure: Tab for the Communication by Ethernet I/O card

### 6.1.1. COM header

The serial interface is used for communication with the reader via RS-232, RS-485 and RS-422. The RS-485/ RS-422 interface card supports the standard data rates of the serial interface on a PC. A level converter is also required for communication to convert the RS-232-compliant signal from the PC into a differential RS-485/RS-422 signal.

A serial COM port on the PC can be opened in this group box. For this purpose the correct serial interface must be selected in the *Port* drop-down list box. Only the ports available on the PC are displayed in this list box. It is not checked whether this port is already in use by other applications.

In the menu below the desired Baud rate must still be set, and if used, the flow control setting. The COM port is opened by clicking on the *Connect* button, which blocks it for other applications. If this port is already being used by another application, a corresponding error message is output. If the port is free, the reader can be operated using this port.

Pressing the *Disconnect* button breaks the connection and releases the interface again.

### 6.1.2. USB header

If a RRU4 is connected to the PC via USB, the unit is installed in the system as a USB HID-compliant device. Correct logging in can be seen in the program if a reader number appears in the drop-down menu. This number is unique for each reader. If several readers are connected to the PC, the related reader can be selected on this menu. Clicking on Open now establishes the connection between the reader and PC.

## 6. Operating the reader

### 6.1.3. Ethernet header

The Ethernet connection can be achieved by linking the reader into an existing network, or by a direct connection between the reader and a control computer. For direct connection of the reader to the PC, a cross-link cable is required, unless the LAN interface on the PC supports “auto-mdi-x”. Alternatively two standard patch cables and a switch can be used.

#### Note

*From reader firmware 2.04, the reader in the ex-works condition has the IP address 192.168.0.1 with the network mask 255.255.255.0. Reader versions earlier than this are configured for DHCP.*

To integrate the reader into a corporate network, please contact your administrator who will be able to allocate you a spare IP address and assign the correct network mask. Alternatively the reader can also be configured to obtain an IP address automatically. For this service, referred to as DHCP, an appropriate DHCP server must be operating in the network. You can obtain more details about this from your network administrator.

#### Note

*The IP addresses of the control computer and the reader must be in the same IP range, but they must not be the same. The network mask on the other hand must be identical.*

In order to establish the connection to the reader, the program offers two options. On the one hand, it is possible to communicate directly with the reader by entering the IP address, on the other hand it is also possible to establish a connection using the reader's host name.

For the connection using a host name, there must be a correspondingly configured DHCP server and a DNS in the network. After power up, the reader makes a DHCP request and logs on to the DHCP server. This assigns the reader an IP address and reports the network name and IP address to the DNS server. If now the connection has been established, the IP address of the reader is determined by an enquiry on the DNS server.

The establishment of the connection is achieved if the establishment of the connection is selected under the Ethernet header, meaning the selection of the IP address or name. For this, the correct IP address or the host name of the reader must be entered in the corresponding field. Pressing the *Connect* button then opens the data channel to the reader.

If you wish to establish a connection via an IP address, the *IP address* field must be highlighted and this address entered in it. The connection is established by clicking on the *Connect* button.

### 6.1.4. I/O card configuration

The communication interface settings can be changed using the *I/O card configuration*. All available I/O cards are displayed here in the form of tabs. Clicking on the respective tab opens the associated card and displays all respective configuration parameters, together with the card type that was detected.

Under the *I/O card type* header there is a drop-down menu, in which the card type can be set to *Auto detect*, *Card not used* or to the actual card type. Automatic detection restores the interface to the default settings. What these settings are is described in the following sections in relation to the interfaces. If the card type is set to not used, this interface can no longer be used.

All card-specific configuration parameters are displayed on the card sheet when the recognised card type is set. These parameters are described in the following sections for the respective card. The settings are saved to the reader by pressing the *Save changes* button.

#### Note

*The new parameters, provided nothing to the contrary is specified for the specific card, become valid only when the reader has been restarted. If incorrect parameters are loaded, the reader can no longer be accessed!*

## 6. Operating the reader

### 6.1.4.1. RS232

The serial interface supports communication to the EIA232 standard and, depending on the expansion stage, has five outputs for activation of LEDs. The configuration parameters are split between the *Port settings* and *Output* headers.

Function	First antenna	Last antenna	Turn-off time
LED 1	4 Hz frequency	Antenna 1	2000 ms
LED 2	Off	Antenna 1	2000 ms
LED 3	Tag found	Antenna 4	2000 ms
LED 4	Off	Antenna 1	2000 ms
LED 5	Off	Antenna 1	2000 ms

Figure: Configuration of the RS232 card

The communication parameters are grouped as follows:

- 1 Baud rate – the speed of the connection. All popular serial data rates up to 230,400 bps are supported
- 2 Data bits – the number of data bits transmitted per byte. The card supports 5 – 8 data bits.
- 3 Parity – a bit for security of the data transmission

If *None* is selected, this bit is not transmitted. For all other settings this bit is transmitted. The even or odd parity checks whether the number of bits including the parity bit is even or odd. Based on this information the recipient can determine whether a bit has been switched. Mark and space specify whether the parity bit should be transmitted with a fixed 1 or 0. In this case no data transmission security is achieved.

- 3 Stop bits – specifies whether the transmission of a byte should be terminated with one or two stop bits.
- 4 Flow control – for readers with the appropriate interface, this allows specification of whether the synchronisation between the PC and reader should be by software *None* or by hardware wires (*Hardware*).

### Note

*Note that for a point-to-point connection, the setting of this parameter must be the same for both participants, otherwise no connection can be established. RS232 readers, whose serial interface is performed via 4-pin M12 connector, do not support hardware flow control.*

*The RS232 card has a further five outputs, which can be used for activation of LEDs. The configuration parameters for these outputs can be found under the **Output** header.*

### Note

*Not all reader hardware issues support this functionality. Please check the reader data sheet for information.*

## 6. Operating the reader

If the LEDs are present (only for ARU), the LED channels can be assigned various functionalities under this heading. Further parameters can be activated, depending on the function selected. The following functions are available:

- 1 Off – the selected LED is deactivated
- 2 On – the selected LED is always on
- 3 1Hz frequency – the selected LED flashes at a frequency of 1 Hertz
- 4 2Hz frequency – the selected LED flashes at a frequency of 2 Hertz
- 5 4Hz frequency – the selected LED flashes at a frequency of 4 Hertz
- 6 8Hz frequency – the selected LED flashes at a frequency of 8 Hertz
- 7 RF on – the LED lights up for *Turn-off time* milliseconds as soon as the radio frequency is present at the antenna *First antenna* to *Last antenna*.
- 8 Antenna error – the LED lights up for *Turn-off time* milliseconds as soon as an antenna error occurs at antenna *First antenna* to *Last antenna*.
- 9 Tag found – the LED lights up for *Turn-off time* milliseconds as soon as a tag is found at the antenna *First antenna* to *Last antenna*.
- 10 RF on – the LED lights up for *Turn-off time* milliseconds as soon as an operation on a tag was successful at the antenna *First antenna* to *Last antenna*.
- 11 Protocol access – the LED can be switched on and off directly via the protocol.

Default configuration:

Baud rate: 9600  
Data bits: 8  
Parity: None  
Stop bits: 1  
Flow control: None  
LEDs: Off

### 6.1.4.2. GPIO

The GPIO card allows the reader to interact with its environment. In this tab, the inputs and outputs can be configured for the respective application under the headings *Input* and *Output*.

### Note

Refer to the electrical characteristics of the inputs and outputs in the data sheet; if these characteristics are exceeded the card and the reader may be damaged.

Input	Invert logical input	Debounce time
Input 1	<input type="checkbox"/>	0 ms
Input 2	<input type="checkbox"/>	0 ms
Input 3	<input type="checkbox"/>	0 ms
Input 4	<input type="checkbox"/>	0 ms

Output	Invert logical output	Function	First antenna	Last antenna	Turn-off time
Output 1	<input type="checkbox"/>	1 Hz frequency	Antenna 1	Antenna 1	2000 ms
Output 2	<input type="checkbox"/>	Antenna error	Antenna 1	Antenna 4	2000 ms
Output 3	<input type="checkbox"/>	Off	Antenna 1	Antenna 1	2000 ms
Output 4	<input type="checkbox"/>	Tag found	Antenna 3	Antenna 4	2000 ms

Figure: Configuration of the GPIO card

## 6. Operating the reader

Each input channel has two configuration parameters available. The *Invert logical input* option negates the electrical input signal and uses this status for processing in the reader. If the check is not set, the signal is used unchanged. Depending on the sensor being used (mechanical or electrical switch), a debounce time in milliseconds can be assigned to each channel.

The outputs from the card can be assigned various functions. Further parameters can be activated, depending on the function selected. The following functions are available:

- 1 Off – the selected output is deactivated
- 2 On – the selected output is always on
- 3 1Hz frequency – the selected output flashes at a frequency of 1 Hertz
- 4 2Hz frequency – the selected output flashes at a frequency of 2 Hertz
- 5 4Hz frequency – the selected output flashes at a frequency of 4 Hertz
- 6 8Hz frequency – the selected output flashes at a frequency of 8 Hertz
- 7 RF on – the output is active for *Turn-off time* milliseconds as soon as the radio frequency is present at the antenna *First antenna to Last antenna*.
- 8 Antenna error – the output is active for *Turn-off time* milliseconds as soon as an antenna error occurs at antenna *First antenna to Last antenna*.
- 9 Tag found – the output is active for *Turn-off time* milliseconds as soon as a tag is found at the antenna *First antenna to Last antenna*.
- 10 RF on – the output is active for *Turn-off time* milliseconds as soon as an operation on a tag was successful at the antenna *First antenna to Last antenna*.
- 11 Protocol access – the output is released and can be activated with all KBRP commands for GPIO.

### Note

*If the output is not set to protocol access, it cannot be accessed when processing action lists. See the **GPIO functions** section for more details on action lists.*

*Once all the settings have been performed, the changes are loaded to the reader by pressing the **Save changes** button, and take effect immediately.*

#### Default configuration

No default configuration is provided for this card.

### Note

*If this card setting is changed from **Auto detect** or **Card not used** to **GPIO**, the reader must be restarted so that the card is correctly initialised.*

## 6. Operating the reader

### 6.1.4.3. RS485

In order to establish a serial symmetrical connection to the EIA-485 standard, a RS485/RS422 card is required for the reader. In addition to the parameters Baud rate, parity and stop bits, which are identical to RS232, the tab for configuration of this interface has certain other specific settings under the *Port settings* header.

The screenshot shows the 'IO card configuration' window with the 'RS485' tab selected. At the top, there is a 'Reload IO cards' button. Below the tabs, the 'IO card type' is set to 'RS485' in a dropdown menu, and the 'Detected IO card type' is also 'RS485'. Under the 'Port settings' section, the 'Baud rate' is set to '115200 bps', 'Parity mode' is 'None', 'Two stop bits' is unchecked, 'Pull ups' is unchecked, 'Load resistor' is checked, and 'RS422' is unchecked. A 'Save changes' button is located at the bottom left of the configuration area.

Figure: Configuration of the RS485 card

The parameters have the following meaning:

- 1 Pull-up – when this parameter is set, the differential wires are pulled up with 120 Ohm to a fixed reference potential (+5 V and GND). This procedure is recommended when the signal ratios between the communications participants are critical.
- 2 Load resistor – terminates the differential wires against each other with 120 Ohm. This variant is required when the reader forms the end point of the network.
- 3 RS422 – activates the RS422 mode of the interface card. This changes over the connection from 2-wire for RS485 to 4-wire for RS422. This achieves a full duplex connection with differential RX and TX wires.

### Note

*Note that for a point-to-point connection or for connection of the participants in a network, the setting of this parameter must be the same for both participants, otherwise no connection can be established.*

Default configuration:

Baud rate: 115200  
Data bits: 8  
Parity: None  
Stop bits: 1  
Load resistor: activated  
RS422: deactivated

## 6. Operating the reader

### 6.1.4.4. Ethernet

The parameters *Name*, *IP-Address*, *Subnetmask*, *Keep-alive time* and *DHCP* can be set for the Ethernet card on the reader.

The screenshot shows the 'IO card configuration' window with the 'Ethernet' tab selected. At the top, there is a 'Reload IO cards' button. Below the tabs (RS422, RS485, GPIO, Ethernet, RS232), the 'IO card type' is set to 'Ethernet' in a dropdown menu. To the right, the 'Detected IO card type' is also 'Ethernet'. The 'Port settings' section includes: 'Name' (KBReaderUHF), 'IP-Address' (192.168.19.111), 'Subnetmask' (255.255.255.0), 'Keep alive time' (2000 ms), and 'DHCP' (unchecked). A 'Save changes' button is at the bottom.

Figure: Configuration parameters for the Ethernet module

The parameters have the following functions:

- 1 Name – Here the host name of the reader which is logged on to the DNS server is stated. The reader can be addressed by this name as an alternative to the IP address.
- 2 DHCP – activates the automatic issuing of an IP address by a DHCP server; if the network has a configured DNS server, the host name of the reader can also be used.
- 3 IP address – for manual issuing of the address. This parameter can be used only if the DHCP is deactivated
- 4 Subnet mask – for manual issuing of a network mask. This parameter can be used only if the DHCP is deactivated.
- 5 Keep-alive time – this time specifies the intervals of time at which the reader sends a data packet to check whether the receiver is still available. If the connection to the reader is broken, the reader shuts down the connection. If this parameter is deactivated (0 ms), the socket is shut down only when the reader is restarted.

### Note

*If no keep-alive time is set it may happen that the reader cannot take up any further connections because the existing connections have not been properly shut down (e.g. following a breakage in the wire). In this case the reader has to be restarted. It is recommended that the keep-alive time is used to check the connection between the reader and PC.*

The data are saved in the reader by pressing the *Save changes* button. The data are however not loaded to the working configuration until the reader is restarted.



## 6. Operating the reader

### Note

If the interface is wrongly configured, no connection to the reader can be established. Please make a note of the data settings.

Default configuration:

Host name: KBRReaderUHF  
IP address: 192.168.0.1  
Subnet mask: 255.255.255.0  
Keep-alive time: 2000ms  
DHCP: deactivated

### 6.2. Basic read functions

This tab is split into two columns; the first column contains a table with information about the tags that were read, the second column contains the controls for controlling the read process.

The screenshot shows the 'ReaderStart v2' application window with the 'Basic reading' tab selected. The main area contains a table with the following columns: Length, EPC, Antenna, RSSI, Reads, Cycles, Last read, and First read. The table lists several tags, with some rows highlighted in green and others in red. To the right of the table are control buttons: Start, Stop, and Clear. Below these buttons are checkboxes for 'Synchronous' (selected), 'Asynchronous', 'Break after reading:' (with a field for 'ms'), 'Bulk reading for:' (with a field for 'ms'), 'Tags per second:' (displaying 79.9), and 'Save to file'. At the bottom of the window, a log shows successful 'SyncGetEPC' operations with execution times.

Length	EPC	Antenna	RSSI	Reads	Cycles	Last read	First read
96	1122 3344 0000 0000 0000 0002	3	106	31	31	09:32:29.575	09:32:25.371
96	A11A 0511 10A0 6563 1A02 1802	3	101	31	31	09:32:29.575	09:32:25.373
96	0A00 A051 110A 0655 38A0 2100	3	106	31	31	09:32:29.575	09:32:25.393
96	0B10 A051 110A 0655 36A0 2099	3	107	31	31	09:32:29.575	09:32:25.393
96	1AFD 019F 81E8 EAB3 0C89 BB9E	3	104	31	31	09:32:29.575	09:32:25.393
96	AFFE A051 110A 0655 35A0 2080	3	103	31	31	09:32:29.574	09:32:25.393
96	0000 0000 0000 0000 0000 2002	3	85	31	31	09:32:29.574	09:32:25.431
96	A01A 0511 10A0 6553 4A02 0102	3	91	31	31	09:32:29.575	09:32:25.431
96	BA00 A051 110A 0655 39A0 2110	3	99	31	31	09:32:29.575	09:32:25.432
464	CCCC BBBB AAAA 9999 8888 7777 6666 5555 4444 3333 2222 1111 0000 FFFF EEEE DDDD CCCC BBBB AAAA 9999 8888 7777 6666 5555 4444	3	95	31	31	09:32:29.575	09:32:25.432
32	1111 82A1	4	110	31	31	09:32:29.576	09:32:25.432

Figure: Basic read functions tab

In addition to the Electronic Product Code (EPC), the table contains the following data:

- 1 Length – gives the length of the EPC in bits, valid lengths 0-496 bits
- 2 EPC – the EPC of the tag in hexadecimal format
- 3 Antenna – the antenna port by which the tag was read, valid values 1-4
- 4 RSSI – the dimensionless number for the signal strength of the tag answer, valid values 0-255
- 5 Readings – states how often this tag was successfully read
- 6 Cycles – states how often an inventory was started
- 7 Last read – the time stamp of the last time the tag was read
- 8 First read – the time stamp of the first time the tag was read

For better visualisation, the appearance and disappearance of the tag is shown by colour in the field. When a tag comes into the field, the line with the tag information is shown green; when it disappears again, the line is shown red.



## 6. Operating the reader

The controlling of the read process is performed in the second column of the tab. This allows differentiation between two different modes.

### 6.2.1. Synchronous mode

This mode is intended for applications when the requirements for timing are not so demanding. This mode allows the facility to switch the carrier off during the idle times, thus saving power.

The inventory of the tags (the read process) is performed across all the antennas that are configured. Once all tags in the field have been read on the last antenna, data are sent to the PC. The inventory of the tags is then automatically retriggered by the PC.

The *Pause after reading* option specifies how many milliseconds the pause between two inventories should be. During this waiting time the carrier can be deactivated. See section 7 “Reader configuration” for more information about switching off the carrier.

In order to keep the time between inventories as short as possible in synchronous mode, data transmission between the inventories can be dispensed with. That means that the reader saves all the tags that it finds in the field in its internal RAM. After a configurable time this results list is sent to the PC. This time is given in milliseconds by the *Bulk read* parameter.

The current reading performance is displayed under the item *Tags per second*.

#### Note

*The read rate is influenced by many parameters; these include in addition to the selected broadcasting profile with the respective data rates also application-specific data such as how many tags the reader should expect in the field. You can optimise these parameters using the expert settings 1 and 2. There is more about this in the following sections. If you are unsure whether the settings you have chosen are optimum for your application, please contact KATHREIN Support.*

*If the tags that have been read are to be saved to a file, this can be done by activating the **Save to file** option. The EPC, the length of the EPC, the antenna on which the tag was read, the RSSI value together with the time stamp when the tag was read are saved.*

*The data are then saved in a csv file in the Program directory. The file can be opened or deleted in the context menu for this item.*

### 6.2.2. Asynchronous mode

This mode is intended for applications for which maximum performance is required.

The reader starts the inventory as quickly as possible, and at the end of an inventory it does not deliver every tag that was read to the PC, but only those that had newly appeared in the field or newly left it. This allows the time required for communication with the higher level to be minimised.

The timing of when a tag was reliably read in the field and when the tag no longer appears in the field can be defined more precisely using parameters. Details of these *ObservedThresholdCnt* and *ObservedTimeoutCnt* parameters can be found in section 7 “Reader configuration”.

#### Note

*The read rate is influenced by many parameters; these include in addition to the selected broadcasting profile with the respective data rates also application-specific data such as how many tags the reader should expect in the field. You can optimise these parameters using the expert settings 1 and 2. There is more about this in the following sections. If you are unsure whether the settings you have chosen are optimum for your application, please contact KATHREIN Support.*

*If the tags that have been read are to be saved to a file, this can be done by activating the **Save to file** option. The data are then saved in a csv file in the Program directory. The file can be opened or deleted in the context menu for this item.*

*Once the mode and the parameters have been selected, the read process can be started. Both modes are stopped by pressing the **Stop** button. The **Delete** button removes all tag entries from the table.*

# 6. Operating the reader

## 6.3. GPIO functions

Readers with GPIO functionality offer the facility to set up small controls which trigger the reader for instance by a light barrier or which trigger an action at the outputs of the reader by reading specific tags. Such an action might be switching an output to control the flow of goods.

The *GPIO function* tab allows the user of the program the facility to load or switch inputs and outputs manually. For more complex procedures, action lists can be created here, which execute a sequence of commands on the reader. This list can then be linked to various inputs.

This configuration sheet is divided into 5 different headers. In order to perform settings on a card, firstly the card number must be selected in the GPIO card drop-down menu. This shows only cards of this type.

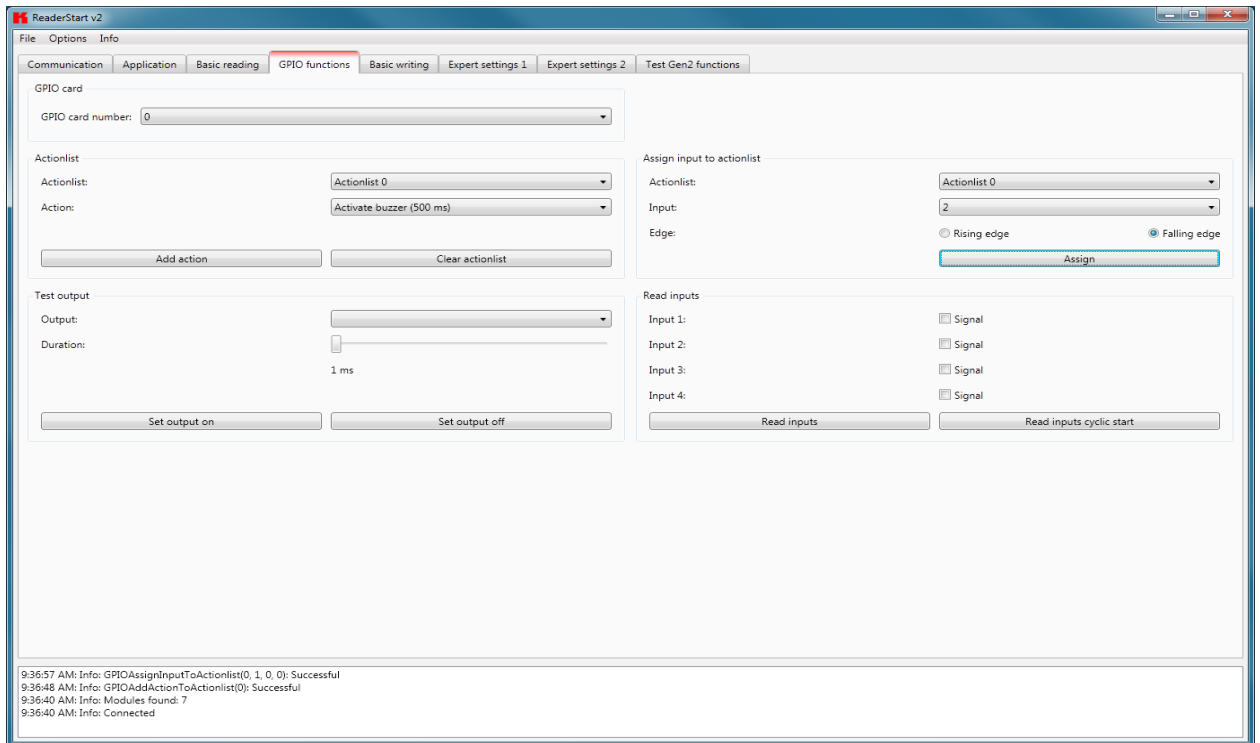


Figure: GPIO functions tab

The *Test output* header can be used in order to selectively connect an output manually. In order to enable this access, the respective output of this card must previously have been connected to protocol access (see I/O card configuration). The output in the drop-down menu is now selected in the header, and time is defined using the *Duration* parameter, until the output automatically returns to its idle mode. The connections can now be made using the *Set output on* and *Set output off* buttons.

The inputs to the reader can be interrogated under the *Read inputs* header. Whether an input is set or not is shown in the signal fields. A one-off read process can be triggered by pressing the *Read inputs* button. If this interrogation should be performed automatically, this process can be started by pressing the *Read inputs cyclic start* button.

To automate the processes, command sequences in the form of action lists can be stored on the reader. These are triggered by a change of flank at the selected input on the respective GPIO card.

The action lists consist of a sequence of individual actions, which can be loaded in the form of an ML file in the context menu of the *Action* item under the *Action list*. This file can be created or edited manually, using a text editor. The syntax can be seen from the example. The individual actions can be selected from the functions described in section 7 “Reader configuration”.

The file is saved in the folder “..My files\Kathrein Werke KG\ReaderStart v2\” and can be edited using a text editor. In order to use the newly added actions in the program, the file must be reloaded into the context menu.

The action list must be selected from the drop-down list. The desired actions are now selected individually from the action list and added to the action list in the sequence in which they are to be executed. Pressing the *Clear action list* button clears down the selected list.

# 6. Operating the reader

When the action list has been created, it is assigned under the *Assign input to action list* header to an input and a selected flank. If it is desired to assign the list to both flanks, the assignment must be made once for the positive flank and once for the negative flank.

The assignment can be cancelled again by a restart/reset of the reader or by assignment of the *No action list* item.

## Note

The action lists that are created are stored only in the RAM of the reader. On restarting the reader these lists are deleted again.

### 6.4. Expert settings

The *ReaderStart v2* software is a powerful tool for configuration of the reader. It allows the reader to be customised to any application. The expert settings 1 and 2 allow the reader's RF interface and communications profile to be optimised to the tag so that the reader is optimally customised to the application.

#### 6.4.1. Expert settings 1

There are eight parameter sets available for saving the configuration of the reader. All settings for the transmission power, the antenna multiplex configuration, the RF settings and the air interface parameters can be saved in these memory slots. Other parameters can be changed in *Expert settings 2*. See section 7 "Reader configuration" for more information about the individual parameters.

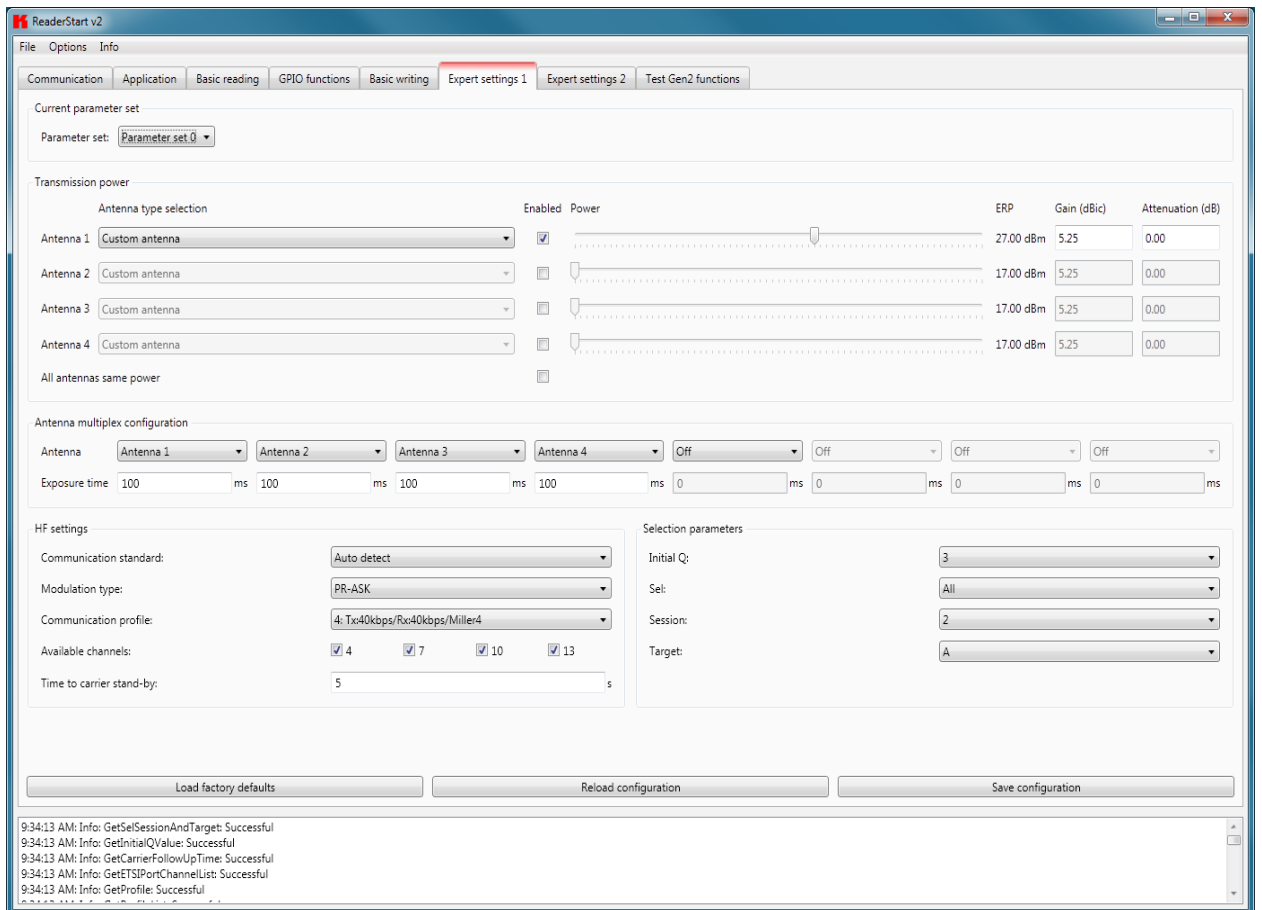


Figure: Expert settings 1 tab

## 6. Operating the reader

Pre-setting can be selected under the *Current parameter set* header. This is done by selecting a parameter set in the drop-down menu. This parameter is now active and loaded, and the headers are updated. When all the desired changes have been made, they can be saved. The changes to the settings can be discarded by pressing the *Reload configuration* button. The parameter set can be reloaded by pressing the *Load factory defaults*.

Under the *Transmission power* header, the parameters of the transmission path can be entered; these include the transmission power, transmission channel (only EU) and spectrum. The applicable standards in the related approval region are to be observed when setting the transmission power.

### Note

*To operate the reader in accordance with the related national standards, the antenna gain and the cable attenuation must be taken into account in the transmission power setting. In no circumstances is it allowed to exceed the permitted transmission power. Failure to observe this instruction can result in non-compliant operation of the reader rendering void the unit's type approval.*

#### 6.4.1.1. Transmission power

The radiated power is limited in Europe in accordance with ETSI 302208 to 2 W ERP. In the FCC region, max. 1 W connected RF power applies with an antenna gain of 6 dBi. If the antenna gain is greater than 6 dBi, the RF power must be reduced accordingly. While the European standard refers to a half-wave dipole, FCC part 15 refers to an isotropic radiator.

To set the transmission power, the length-dependent cable attenuation and the antenna gain must be included in the calculation of the transmission power. An example for the calculation of the transmission power for Europe and FCC is given in the following.

The following applies to the European approval region:

$$P_{\text{Reader}} = P_{\text{ERP}} + D_{\text{Kabel}} - G_{\text{HW}}$$

$P_{\text{Reader}}$ .....Transmission power of the reader in dBm

$P_{\text{ERP}}$ .....Transmission power based on a half-wave dipole in dBm

$D_{\text{Kabel}}$ .....Cable attenuation in dB

$G_{\text{HW}}$ .....Antenna gain based on a half-wave dipole

The cable attenuation is the length-dependent attenuation of the cable at the related frequency:

$$D_{\text{Kabel}} = l \cdot D_{\text{dB/m}}$$

$D_{\text{Kabel}}$ .....Cable attenuation in dB

$l$ .....Length in m

$D_{\text{dB/m}}$ .....Attenuation in db/m at frequency

The antenna gain is stated in various different units. These units include dBi and dBic. The units dBi and dBic refer to an isotropic (spherical) radiator, where dBic refers to a circularly polarised isotropic radiator and dBi to a linearly polarised isotropic radiator.

In the European approval area, the radiated power must not exceed 2 W ERP. This figure refers to a half-wave dipole. The relationship shown below exists between an isotropic radiator (dBi) and a half-wave dipole.

## 6. Operating the reader

$$G_{HW} = G_{isot} - 2.14dB$$

$G_{HW}$ .....Gain based on a half-wave dipole

$G_{isot}$ .....Gain based on an isotropic radiator in dBi

If the gain of the antenna is referred to the polarisation of a circular isotropic antenna (dBic), the linear gain of the antenna is 3 dB lower. As a result the transmission power can be increased by 3 dB.

$$G_{HW} = G_{isot} - 2.14dB - 3dB$$

$G_{HW}$ .....Gain based on a half-wave dipole

$G_{isot}$ .....Gain based on an isotropic radiator in dBic

In the FCC approval region, the RF power connected at the antenna input must not exceed 1 W. If the gain of the antenna is higher than 6 dBi, the RF power connected must be reduced correspondingly. The reader's transmission power is then:

$$P_{Reader} = P_{cond} + D_{Kabel} \text{ with } P_{cond} \leq 1W \text{ and } G_{isot} \leq 6dB$$

$P_{Reader}$ .....Transmission power of the reader in dBm

$P_{cond}$ .....Power on antenna output in dBm

$D_{Kabel}$ .....Cable attenuation in dBm

$G_{HW}$ .....Antenna gain in dBi

If the antenna gain is stated in dBic, the reader's transmission power can be increased by 3 dB.

The transmission power for the European variant can be set in 0.25-dB steps from 20 dBm to 33 dBm.

The heading provides separate fields for inputting the antenna gain and the attenuation.

### Note

*The antenna gain must be stated in dBic.*

*The RFID reader's transmission power can be set separately for each antenna or all antennas at the same time. If the **All antennas same power** check box is set, the sliders for the other antennas are set to the same power when a slider for the power for antenna 1-4 is adjusted. If this check box is not selected, the power at the antennas can be set separately for each output.*

*Pre-defined antennas can be selected in the **Antenna type selection** drop-down menu. This selection sets the antenna gain in the program, and limits the transmission power to the maximum value permitted for this antenna. If **Custom antenna** is selected, the gain and power can be freely set.*

*The context menu allows the XML file to be opened, and if changes are made to the file also allows it to be reloaded. When the file has been loaded, the changes are visible in the program.*

## 6. Operating the reader

### 6.4.1.2. Antenna multiplex configuration

The sequence in which the antennas are used to read the tag can be set under this header. If this antenna is not activated, the system proceeds to the next entry on the multiplex list. For asynchronous operation of the reader, the exposure time on the antenna can also be specified. See section 7 “Reader configuration”, sections *MultiplexingAntennaport* and *MultiplexingExposureTime* for more details.

### 6.4.1.3. RF settings

Depending on the approval region, the reader transmits in the frequency range 865 MHz to 868 MHz for Europe or 902 MHz to 928 MHz for USA.

In Europe the number of channels to be used can be limited. For this purpose the related check box for each channel the reader is to use must be selected on the *Available channels* list. In this manner it is possible to avoid from the start the usage of specific channels on which there is interference.

Each read command connects the channels under country-specific conditions and in accordance with the selected communications standard. The reader then starts to search through the channels in ascending order.

In the *Communication standard* drop-down menu, when necessary and when permitted by the reader, the reader can be switched to a different country-specific communications standard. The device version governs the communications standards that are permitted.

The modulation type can be switched between double sideband and PR-ASK modulation in this drop-down menu.

The communications profile is critical for the data rate and the read reliability. This option allows the technician to directly influence the performance of the reader and the spectrum of the signal. The profile names contain basic orientation on the transmission and reception data rates.

### Note

*A special data rate may be necessary, depending on the tag used. Please contact Kathrein ([rfd@kathrein.de](mailto:rfd@kathrein.de)) for further details.*

*The “Time until carrier stand-by” parameter specifies how long the carrier of the reader remains active on the air interface after the last action. Once this time has elapsed the carrier is switched off.*

### 6.4.1.4. Selection parameters

Under this heading the user can configure the singularisation of the tags to the EPC standard ((B)). The parameters can be selected in the drop-down menu, and have the following meanings:

- 1 Initial Q value – reflects the number of tags expected in the field. (see 7.2.4.2. “*InitialQ*”)
- 2 Sel – specifies whether other parameters are of interest for an inventory of the tag population, or not. (see 7.2.4.10. “*QuerySel*”)
- 3 Sessions - this configuration parameter instructs the reader the session with which it should work. (see 7.2.4.3. “*Sessions*”)
- 4 Target – specifies which tags in the population should participate in the inventory. (see 7.2.4.9. “*QueryTarget*”)

# 6. Operating the reader

## 6.4.2. Expert settings 2

The *Expert settings 2* tab is split into four headings for further configuration of the Kathrein RRU4 reader. The default parameter set can be changed, one parameter set copied into another, reader parameters read to determine their ID and select filter settings configured.

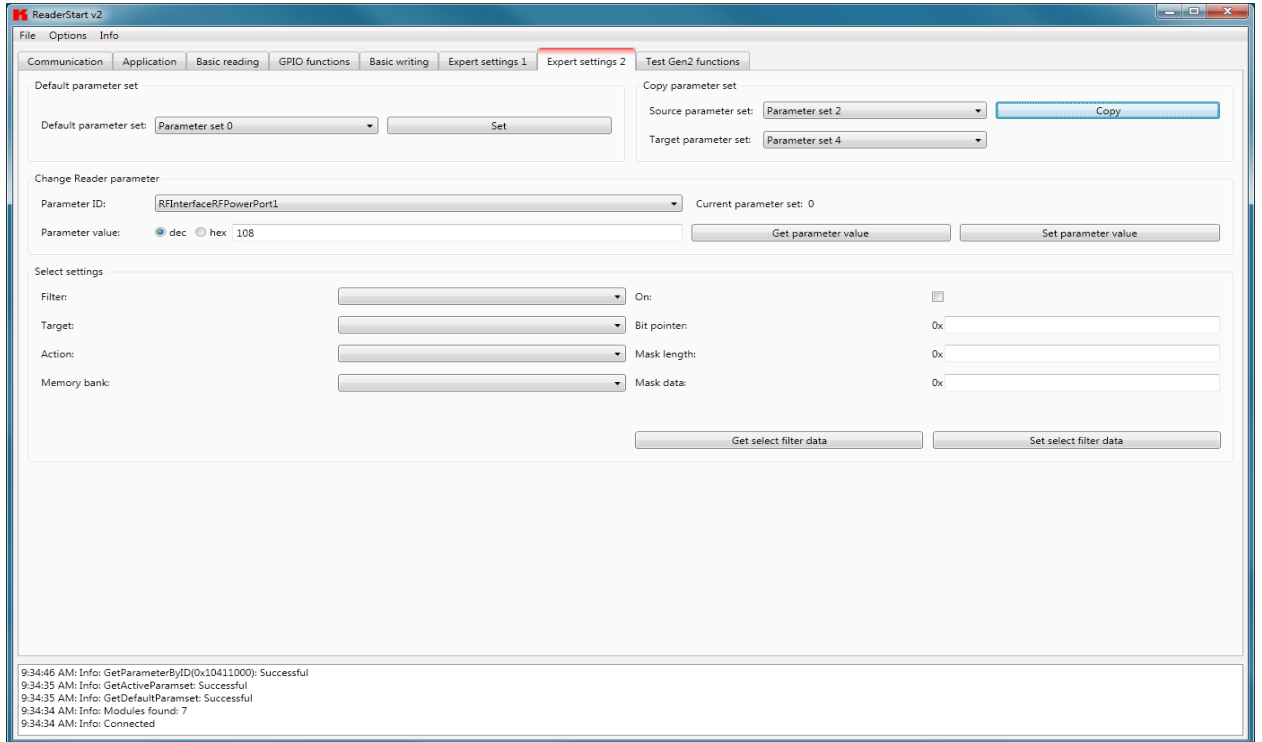


Figure: Expert settings 2 tab

The *Default parameter set* rubric allows configuration of the parameter set that is loaded from the EEPROM into the RAM when the Kathrein RRU4 reader is started.

The *Copy parameter set* header allows one parameter set to be copied into another. On successful completion of the copy operation, the *Copy* button glows green briefly and a corresponding message is displayed in the status window, otherwise the *Copy* button glows red.

The *Change reader parameter* header allows all the Kathrein RRU4 reader settings to be changed using their respective configuration IDs. After selection of the parameter ID, the corresponding value of the current parameter set of the Kathrein RRU4 reader is read by clicking on *Get parameter value* and displayed in the field *parameter value*, optionally as a decimal (*dec*) or hexadecimal (*hex*) value. A value that has already been read can be converted to *dec* or *hex* by pressing the radio button. The *Set parameter value* button writes the value stated in the *Parameter value* field into the selected parameter ID. The two actions (read and set) are shown by the respective buttons glowing the respective colour to indicate success and failure, and a message appears in the status window accordingly.

In the *Select settings* area, filters can be set which are brought into effect by means of a *Select* command. This offers the facility to filter out certain tags, or to detect only tags with certain defined data in the respective memory banks. Up to 32 filters can be set in total. Successful reading of the values of the selected filter and successful writing of the filter values is indicated by the respective button glowing green and a text appearing in the status field. Otherwise the respective button glows red and a description of the error is output.

# 6. Operating the reader

## 6.5. Application

The *Application* tab enables quick and easy configuration of the Kathrein RRU4 reader for a selected application. The available applications are represented visually in the upper area of the tab by labelled pictograms. Under the *Settings* header, the number of tags expected, the antennas to be used, the parameter set in which the configuration should be saved and the values for *max. read frequency* and *max. read reliability* options are stated.

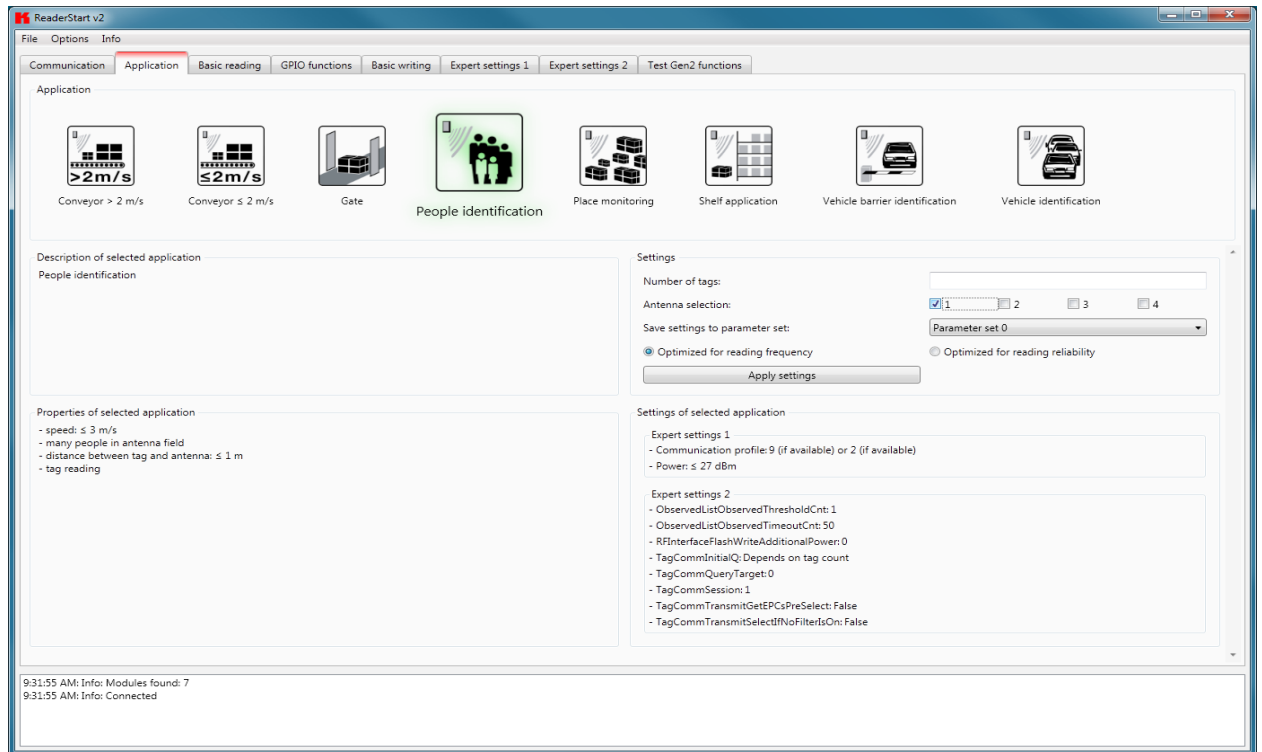


Figure: Application tab

When the button for the desired application is clicked, it glows green continuously. In addition the designation, the properties and the settings of the selected application are displayed in the respective fields.

The following applications are available for selection in version 2.00 of the *ReaderStart v2*:

- Conveyor belt > 2 m/s
  - Application for detecting individual tags in the antenna field on a conveyor belt moving at more than 2 m/s
  - the distance between the tags and the antenna is only a few centimetres
- Conveyor belt ≤ 2 m/s
  - Application for detecting and describing individual tags in the antenna field on a conveyor belt moving at less than or equal to 2 m/s
  - the distance between the tags and the antenna is only a few centimetres
- Gate
  - Application for detecting multiple tags in the antenna field as they pass through a gate
- Slot monitoring
  - Application for detecting and describing multiple tags in the antenna field, which are not moving
  - the distance between the tags and the antenna should be less than 1 m
- Vehicle identification
  - Application for detecting and describing multiple tags in the antenna field, which are moving at more than 14 m/s
  - the distance between the tags and the antenna should be less than a few metres



## 6. Operating the reader

- Vehicle identification (barrier)
  - o Application for detecting and describing individual tags in the antenna field, which are not moving
  - o the distance between the tags and the antenna should be less than a few metres
- Shelving application
  - o Application for detecting and describing very many tags in the antenna field, which are not moving
  - o the distance between the tags and the antenna should be less than 1 m
- Personal identification
  - o Application for detecting multiple tags in the antenna field, which are moving at not more than 3 m/s
  - o the distance between the tags and the antenna should be less than 1 m

If there are more applications than fit on the screen, the buttons alongside the applications are activated to allow scrolling.

When the *max. read frequency* is set, for every detection (inventory) all tags are reset in order to read them afresh. Under some circumstances the time allowed for detecting the tags may be insufficient, so that some transponders are not detected. The frequency for detecting the tags should then be increased.

When the *max. read reliability* is set, tags that have already been read are not reset at every detection (inventory), provided they are still being supplied with power. This means that only those tags which have not yet been registered are detected. The confidence that all tags are read is thus increased.

Clicking on the *Apply settings* button saves the settings that were made, as well as the settings for the selected application, in the selected parameter set. This is done by first resetting them to the factory settings and thus overwriting the previous configuration. This must be acknowledged. Success is indicated by a the *Apply settings* button glowing briefly, and by display of a success message in the status window. If the process fails, the button glows briefly orange for a warning or briefly red for an error (and if the failure was due to an entry being omitted, in addition the field that is lacking the entry glows red), and by display of a warning description or error description in the status window.

If the settings have been loaded successfully, a switch can now be made to the *Basic reading* tab and the read process can be started.

## 6. Operating the reader

### 6.6. Basic writing function

The *Basic writing* tab allows input of basic descriptions of tags. A fundamental distinction is maintained between synchronous writing - *write on command* - and asynchronous writing - *write on arrival*.

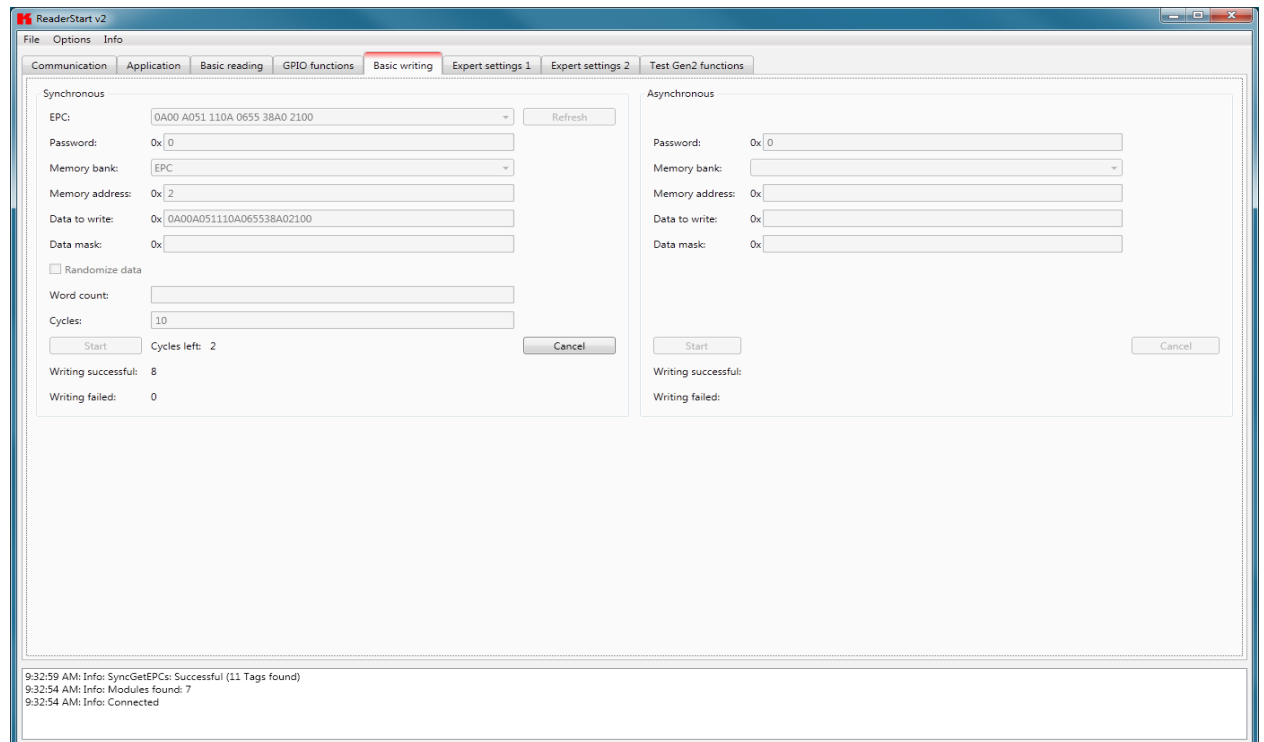


Figure: Basic write function tab

#### 6.6.1. Synchronous writing

In this type of writing the data can only ever be written selectively to one EPC. This is selected in the *EPC* ComboBox. Clicking on the *Refresh* button detects once again all tags in the antenna field and adds them to the ComboBox.

When all necessary data such as password, memory bank and memory address have been input a decision can be made whether to specify the data to be written or to generate them at random. If specified data should be written, optionally a data mask can be specified. When using random data, the number of them should be stated in words (16-bit).

### Note

Right-clicking on the **Data to write** field opens a context menu, which allows the selected EPC to be copied into this field.

### Note

Right-clicking on the **Data mask** field allows this to be filled optionally with **0** or **F** according to the number of the data entered to be written.

Clicking on *Start* starts the performance of the previously specified number of write attempts. The error-free completion of all write attempts is once again indicated by the button glowing green and by a message in the status window. If any necessary data are lacking, the button briefly glows red and the field lacking the data glows red somewhat longer. The associated error message appears in the status window.

The *Writing successful* and *Writing failed* fields indicate how often the write attempt succeeded or failed. Hovering the mouse over the number of failed write attempts (provided indeed any failures did occur), calls up a window with detailed information.

# 6. Operating the reader

## 6.6.2. Asynchronous writing

In this type of writing the data is written to every EPC that occurs in the antenna field. When all necessary data (password, memory bank, memory address, data to be described - the input of the data mask is optional) have been input, clicking on Start starts the asynchronous write process. Successful and failed write attempts are shown in the respective fields. Hovering the mouse over the number of failed write attempts (provided indeed any failures did occur), calls up a window with detailed information.

### Note

Right-clicking on the **Data mask** field allows this to be filled optionally with **0** or **F** according to the number of the data entered to be written.

## 6.7. Test Gen2 functions

This tab makes it possible to access individual functions of the reader. This includes, along with the functionality in accordance with the EPC-Gen2 standard, e. g.: read individual tags, describe tags, set and change passwords, and also select the antenna for the operation.

The user interface consists of the headers *Get all EPCs*, *Write EPC*, *Change password*, *Read/write data*, *Lock*, *Kill* and the display window for EPCs that have been read. The sections that follow explain this functionality in more detail.

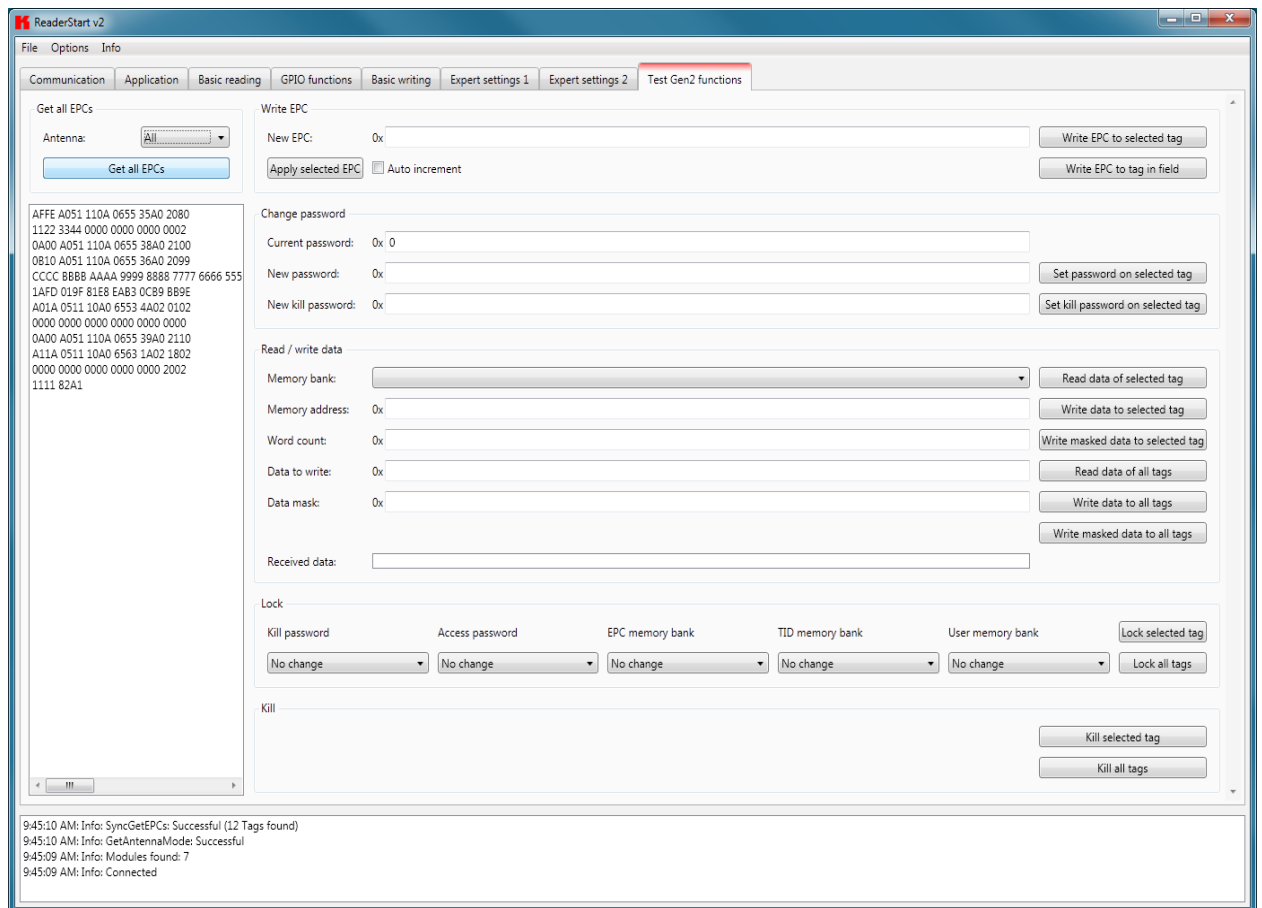


Figure: The Test Gen2 functions menu tab

## 6. Operating the reader

### 6.7.1. Get all EPCs

To read a tag in this menu, the *Get all EPCs* button must be clicked once the reader has been correctly configured. The reader now tries once again to read all the tags in the field of the selected antenna. If in the *Antenna selection* drop-down menu the number of antennas has been restricted, reading will now be performed using the currently selected antenna, or using the antenna selected with *All* in the *Expert settings 1*.

The EPCs from the tags read successfully are displayed in the field below. For the following operations, a tag can be selected from this list by clicking on it.

#### Note

*Right clicking on the tag brings up additional information on the manufacturer and the chip type.*

### 6.7.2. Write EPC

The EPC of the tag can be altered as desired under this header. For this purpose an EPC in hexadecimal format must be entered in the *New EPC* field.

#### Note

*Comply with the maximum EPC length supported by the tag - if this is exceeded the tag will return an error.*

*If the requirement is only to amend an existing tag, this tag can be loaded to the field by pressing the **Apply selected EPC** button. Now the EPC can be changed manually, or by using the **Auto increment** option can be increased by one at each write event.*

*The write event itself can optionally be executed on this tag by pressing the **Write EPC to selected tag** button. At this time there may be several tags in the field, but at least one tag from the list must be selected. The second option is to write the specified EPC without a tag being selected. When using this function, make sure there just one single tag in the field.*

### 6.7.3. Change password

The EPC standard (see (B)) specifies that the tag should have two modes, the *open* and the *secured state*. In the open state, operations can be performed on the tag if the associated memory areas are not secured with a password greater than 0. If a password has been set and the *Lock* header has been used to set the memory areas to password protected, the desired operation will not be executed, and the tag will report an access error. Normal access remains available in areas that are not blocked.

If when the tag is accessed the valid password is given, the tag switches into the secured state and access is available even in blocked areas. Setting the password and setting how individual areas are blocked is performed under the *Change password* and *Lock* headers.

Under the first header, the password for restricting access to the tag and the password for deactivation of the tag are set. The access password can be used to restrict access to the tag in the open state. Depending on the configuration under the *Lock* header, parts of the tag can be provided with completely or partially restricted access rights.

The deactivation password is required to deactivate the tag permanently by means of a Kill command.

#### Note

*After a **Kill tag** command, the tag will be unusable.*

*To change the password, the current password must be given. If no password has yet been set, the default value is 0. The new password is entered in the field of the same name, in hexadecimal format. Clicking on the **Set password on selected tag** button replaces the old password with the new password. The deactivation password is entered in the field of the same name by clicking on the associated button.*

*If the password is changed and the memory area in question is already protected by the access password, in addition to the new password the access password must be entered in the **Current password** field.*

## 6. Operating the reader

### 6.7.4. Read/write data

This header supplies detailed access to all the data areas of the tag. Access is obtained by entering the selected memory bank, the address within the memory bank and the number of words, expressed as 16-bit words.

If data are to be written, they must be entered in the *Data to write* field. The data mask allows only individual bits on the tag to be changed. To do this, the mask must be entered in the *Data mask* field. The reader uses this mask to change the data read from the tag at the points where 1 bits are written in the mask, and writes the result back into the tag. The desired data can optionally be written to a single tag in the field or to all tags in the field. If they are written to all tags in the field, these tags must all have the same configuration (lock and password).

The header also offers the facility to read data from the selected tag or from all tags in the field. If the tags in the field have differing passwords and are configured differently, the data must be read by individual tags.

The next section deals in more detail with the saving of the individual memory areas.

### 6.7.5. Lock

The EPC Gen 2 standard provides security mechanisms for the tag data areas. This allows individual memory areas and functionalities of the tags to be provided with a password to protect it against access and/or changes.

Under the *Lock* header, the mask that specifies access to the areas in accordance with the EPC Gen 2 standard can be customised to suit the application. If no changes are required for an area, *No change* must be selected in the respective drop-down menu. The areas are grouped as follows:

- 1 Deactivate – specifies whether or not a deactivation password is necessary for deactivating the tag. Further details can be found in (B).
- 2 Access – specifies whether an access password is necessary for accessing a tag. If no access password is set, the TAG can be addressed in the open state condition. Further details can be found in (B).
- 3 EPC – allows specification of whether or not the access password is necessary for changing the EPC.
- 4 TID – this area contains general information about the tag. This area can also be protected against user access by setting the access password.
- 5 USER – if the tag has a memory area provided for user data, these can be protected by setting the access password.

The respective items in the drop-down menu are divided into access blocks, which prevent reading and writing, and write blocks.

#### Note

*If the option with the suffix is permanently selected, this option can no longer be changed. Further details can be found in (B).*

*Clicking on the **Lock selected tag** button loads the mask that was created to the list of the selected tag. Alternatively all the tags in the field can be blocked, on the precondition that the tags all have the same password.*

#### Note

*Wrongly configuring the **Lock** header can render the tag unusable.*

## 6. Operating the reader

### 6.7.6. Kill

Pressing the *Kill selected tag* button, with the stated password, executes a Kill command on this tag. The *Kill all tags* button, with the stated password, attempts to execute a Kill command on all the tag in the field.

#### Note

*For the deactivation of a tag, a deactivation password that is not 0 must have been set.*

#### Note

*After a **Kill tag** command, the tag will be unusable.*

# 7. Reader configuration

The RRU4 Kathrein UHF RFID reader system is characterised by great flexibility in addressing RFID applications. One reason for this is the wide variety of reading devices from the Kathrein product portfolio, which are compatible with each other and permit optimum configuration to the application. A further reason for the high flexibility is the wide range of parameters for configuring the reader firmware. This configuration manual explains the various configuration parameters and give instructions on how to make the optimum parameter settings for the application of your Kathrein RFID reader.

## 7.1. Introduction

A configuration parameter of the RRU4 reader system consists of a 32-bit long identification number (ID) and a data part which is 8 to 32 bits depending on the parameter. The data part is referred to below as the “parameter value” or just the “value”. The ID allows the various parameters to be read or set in the reader system. Each ID – and hence each configuration parameter – stands for a special functionality within the reader system.

### 7.1.1. Structure of the configuration IDs

The ID of a configuration parameter is not selected arbitrary, rather it contains information about the respective configuration parameter. The ID of a configuration parameter contains the following information:

- the configuration group to which the parameter belongs
- a sequential number to differentiate parameters within a group
- the data type (byte, word, etc.) of the value
- the number of data bytes in the value
- whether the value of the parameter is signed (are negative values possible)
- the unit of the value

For ease of handling the configuration parameters are addressed by their plain text names. The plain text name begins with “cfgid” followed by the name of the configuration group. This includes the function name of the parameter. That is the part that clearly states the function/use of the configuration parameter. For example:

Configuration parameter “cfgidTagCommIntelligentWrite”

“cfgid”	initial code
“TagComm”	Name of the configuration group
“IntelligentWrite”	Function name of the parameter

For more details about the structure of the ID or the naming of configuration parameters, see the file “konfigids.h” in the source files for the programming environment of the RRU4 reader system.

**For programmers:** This file contains macros in the programming language “C”, which offers you the facility in your programming environment to address the configuration parameters by their plain text names. The plain text name is then translated into the respective configuration ID at compile time.

### 7.1.2. The parameter sets

The configuration of an RFID reader of the RRU4 reader system is organised in parameter sets. Each reader has eight parameter sets. Apart from one exception (“cfgidGlobalDefaultParamset”) all the configuration parameters listed below are represented in every parameter set. The use of parameter sets allows an RFID reader to switch from one configuration to another with only one command. The parameter set selected is then designated the “active parameter set”. Reading and writing configuration parameters using the protocol commands “GetParameterById” and “SetParameterById” is always performed on the active parameter set. When the active parameter set is changed it can be saved into the reader’s EEPROM using “SetActiveParamset”, and thus is available again when the reader is restarted. Changing over between parameter sets is performed using the command “SetActiveParamset”.

## 7. Reader configuration

### 7.2. Description of the configuration parameters of the RRU4 reader system

#### 7.2.1. The “Global” configuration group

##### 7.2.1.1. “DefaultParamset”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-7

Description:

This parameter is the only one in its configuration group. In contrast to all the other parameters, this one is “independent”. That means that this parameter is not held in any parameter set, it just exists on its own. The parameter indicates which parameter set is loaded and activated when the reader is started up.

#### 7.2.2. The configuration group “RFInterface”

##### 7.2.2.1. “RFPower1...8”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	$\frac{1}{4}$ dBm(erp)
Value range:	0; 68-136

Description:

This parameter allows the reader transmission power to be set for respective antenna port. More precisely: The power which the antenna should radiate. The data is given in dBm(erp). So that the power radiated by the antenna really does correspond to the value of this parameter, the parameters for the attenuation of the antenna cable and the antenna gain must be set correctly.

It is a precondition that the transmission power is set to a value greater than 0 dBm(erp), in order that an inventory can be performed using this antenna port.

### Note

The transmission power is always set in dBm(erp). If the desired transmission power is stated in dBm(eirp), this must be converted to dBm(erp):  $\text{dBm(erp)} = \text{dBm(eirp)} - 2.14$



## 7. Reader configuration

### 7.2.2.2. “TimeToPowerOff”

Characteristics:

available from firmware:	v1.30.00
Data type:	Word (16-bit)
Unit:	Seconds
Value range:	0-65535

Description:

This parameter sets the duration for how long the transmission carrier remains switched on after the completion of an inventory, or a tag operation in general.

A certain time must elapse after receipt of an inventory command before the reader can start the inventory. This time is required by the reader amongst other things for LBT (Listen before Talk) and for an antenna test. Using this parameter it is now possible to reduce this time: If an inventory has been completed by the reader, and the next inventory command is received within the time configured by this parameter, the reader can dispense with the LBT and the antenna test and start the inventory more quickly.

### Note

*The time during which the transmission carrier is switched on by not performing any tag operation represents an increase in the overall power consumption of the reader.*

*The LBT (Listen Before Talk) operating mode is permissible only in existing systems.*

### 7.2.2.3. “ModulationType”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	-
Value range:	0; 1

Description:

This parameter is used by the reader to specify the modulation type used for tag communication. There are two modulation types available:

- 0: Double Side Band (DSB)
- 1: Phase Reversal Amplitude Shift Keying (PR-ASK)

### Note

*For readers manufactured for the European Union (EU), Phase Reversal Amplitude Shift Keying is used irrespective of the setting of this parameter.*

# 7. Reader configuration

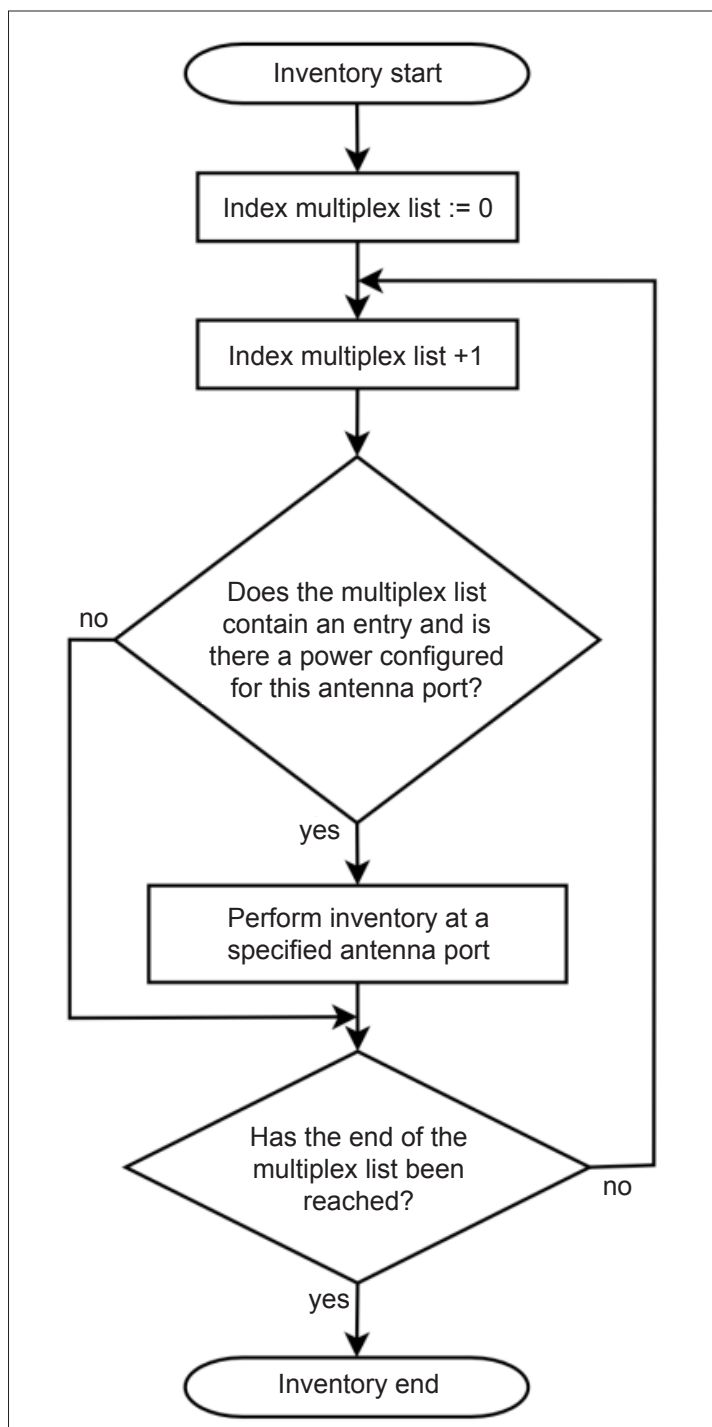
## 7.2.2.4. "MultiplexingAntennaport1...8"

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	-
Value range:	0; 1-8

Description:

These eight parameters form the antenna multiplex list of the reader. Either an antenna port number (1 to 8) or a zero can be entered in each of the eight list slots. If a zero is entered, the list slot is deactivated and the reader skips to the next list slot. This is shown in the following diagram:



## 7. Reader configuration

### 7.2.3. “MultiplexingExposureTime1...8”

Characteristics:

available from firmware:	v1.30.00
Data type:	Word (16-bit)
Unit:	milliseconds
Value range:	0-65535

Description:

The values of these configuration parameters are of interest only to reader commands that start with “ASync...”. Each parameter stands for an exposure time which specifies how long the reader maintains exposure for inventories the respective position – and hence antenna – in the multiplex list. In contrast to synchronous commands, when using asynchronous commands the reader does not proceed to the next entry in the multiplex list immediately after performing an inventory; instead it first waits until the exposure time given by these parameters for the respective multiplex entry has expired. An inventory in progress is not interrupted at the expiry of the exposure time, but is continued to completion.

#### 7.2.3.1. “CableLoss1...8”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	¼ dB
Value range:	0-255

Description:

These parameters contain the cable attenuation of the antenna cable between the reader and the antenna for the respective antenna port of the reader. The reader can set the transmission power correctly only if the attenuation values for the antenna cable have been entered correctly.

#### 7.2.3.2. “AntennaGain1...8”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit); signed
Unit:	¼ dBic
Value range:	-128 – 127

Description:

These parameters allows the antennas gain for the antennas connected to the reader to be communicated to the reader. The reader calculates from the transmission power setting (antenna radiated power), the antenna gain and the cable attenuation the port power at the RF output:

$$\text{Port power}_{dBm} = \text{radiated power}_{dBm(erp)} - \text{antenna gain}_{dBic} + \text{cable attenuation}_{dB} + 5.14$$

Use the following formula to convert an antenna gain expressed in *dB*i to *dB*ic units:

$$\text{Antenna gain}_{dBic} = \text{antenna gain}_{dB} + 3$$

## 7. Reader configuration



### Important!

Close field antennas have a negative gain, since they are designed not for electromagnetic coupling with the tag but for magnetic coupling. To configure close field antennas correctly, enter the antenna gain as 5.25 dBic (a parameter value of 21 dec) and the antenna radiated power ("RFPower1...8") as the maximum input power stated in the antenna data sheet.

#### 7.2.3.3. "RSSIThreshold1...8"

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	-
Value range:	0; 255

Description:

When the reader is performing an inventory, at the same time the field strength of the response from the tag that is addressed is measured. This is called the RSSI value. These parameters allow the threshold value for the RSSI value to be set for each antenna port. Tags with an RSSI value less than the threshold setting are then no longer detected by the reader.

#### 7.2.3.4. "MultiPowerTagAccess1...8"

Characteristics:

available from firmware:	v1.30.00
Data type:	Bool (8-bit)
Unit:	-
Value range:	0; 255

Description:

The stronger the reader transmission signal that strikes the tag, the more difficult it is for the tag to modulate the reader transmission signal by means of backscatter. The strength of the tag response thus decreases as the reader transmission power increases. Because of this behaviour in certain circumstances it may occur that the reader can no longer read a tag which is immediately in front of the antenna, but at a lower transmission power it can easily detect it. If "MultiPowerTagAccess" is activated for an antenna port, after an inventory with high transmission power, the reader reduces the transmission power by a half and searches for "overlooked" tags.

#### 7.2.3.5. "MaxAllowedAntennaOutputPower1...8"

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	$\frac{1}{4}$ dBm(erp)
Value range:	0-255

Description:

This parameter allows the radiated power of the antenna at an antenna port to be limited to a specified value.

## 7. Reader configuration

### 7.2.3.6. “EnableRSSIThresholdAtSpecificCmds”

Characteristics:

available from firmware:	v1.46.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

The RSSI threshold value set by the “RSSIThreshold1...8” parameter applies equally to non-specific (“...GetEPCs”, “...Any”) and specific (“...Specific”) tag reader commands. The effect on specific tag reader commands can however be switched on and off by these configuration parameters. The following scenario can be set: “SyncGetEPCs” commands the reader to scan cyclically for tags in the antenna field. The configuration parameter “RSSIThreshold1...8” means that tags with less than a specified RSSI value are not reported. One tag is now close to the RSSI threshold and when the threshold is reached is reported by the reader to the higher level. This triggers a specific command for the reported tag. If “EnableRSSIThresholdAtSpecificCmds” is activated it can now happen that the specific command comes to nothing, since the RSSI value of the tag is fluctuating around the threshold value. In such a scenario, “EnableRSSIThresholdAtSpecificCmds” should be deactivated.

### 7.2.3.7. “FlashWriteAdditionalPower”

Characteristics:

available from firmware:	v2.00.00
Data type:	Byte (8-bit)
Unit:	$\frac{1}{4}$ dB
Value range:	0-48

Description:

It takes more energy to write to a tag than to read a tag. Therefore for a given transmission power the tag must be nearer the antenna for writing than for reading. In order to overcome this distance differential, this parameter can be used to specify whether and by how much the reader transmission power needs to be increased for write commands compared to read commands.

## 7.2.4. The configuration group “Tag communication” (“TagComm”)

### 7.2.4.1. “UsePilottone”

Characteristics:

available from firmware:	v1.30.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

This parameter allows the pilot tone tag to be switched on and off. Tags to EPCGlobal Class 1 Gen 2 are able to carry a pilot tone ahead of the user data. The purpose of the pilot tone is the synchronisation of the reader to the response of the tag. Without a pilot tone it is more difficult for the reader to synchronise itself to the tag response. In order to ensure reliable tag detection, this parameter should always be activated.

## 7. Reader configuration

### 7.2.4.2. “InitialQ”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-15

Description:

The value Q in the inventory process specifies how many tags there are in the reader antenna field and which must be detected. The number x on tag is calculated by the following formula:

$$x = 2^{Q-1}$$

The value Q is communicated to the tags by the reader, whereupon each of these selects from x a random “Communications slot” for its response. In order to perform an inventory as quickly and efficiently as possible, as many of the x communications slots should be occupied by tags, but without there being any multiple occupation of communications slots (which would lead to collisions). If the reader detects that the value chosen for Q is too large (hardly any communications slots are occupied) or too small (collisions occur), it will be adjusted automatically and loaded to the tags. Since this adjustment takes time, the reader with this configuration parameter should be informed of the approximate number of tags to expect in the antenna field. This allows the number of communications slots to be set to an appropriate value right from the start of the inventory process.

### 7.2.4.3. “Session”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-3

Description:

Tags to EPCGlobal Class 1 Gen 2 support four different “sessions”. At each session a tag can be given an inventoried flag to indicate whether or not it has already been detected by the reader during an inventory process. Inventoried flags have different properties for the individual sessions, which allows recognition of their persistence times. The time thus indicates how long a tag indicates that it has been detected or not by the reader.

	Tag has energy	Tag has no energy
Session 0	unlimited persistence	no persistence
Session 1	persistence greater than 500 milliseconds but less than 5 seconds	persistence greater than 500 milliseconds but less than 5 seconds
Session 2	unlimited persistence	persistence greater than 2 seconds
Session 3	unlimited persistence	persistence greater than 2 seconds

This configuration parameter instructs the reader the session with which it should work.

## 7. Reader configuration

### 7.2.4.4. “MaxErrors”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

The “MaxErrors” configuration parameter indicates how often a command is issued by the reader to the tag when the response expected by the reader from the tag remains outstanding.

### 7.2.4.5. “CommunicationProfile”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255
Note:	Up to firmware v2.04.00 this parameter was called “DefaultProfile”. The configuration ID was not changed.

Description:

This configuration parameter sets the “communication profile” between the reader and tag. A communication profile consists of:

- the data transmission rate (reader to tag communication)
- the data reception rate (tag to reader communication)
- the coding of the data from tag to reader

There are various data transmission rates, data reception rates and codings available. Since not every combination of these three properties is viable, selected combinations are available as communication profiles. A list of the viable communication profiles can be downloaded from the reader by the command “GetProfileList”. It is dependent on the selected communication profile whether “Dense Reader Mode” is in operation in the reader or not.

### 7.2.4.6. “CommStandard”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

Different countries have different regulations regarding the permissible transmission power and transmission channels that can be used for communication with RFID tags. This configuration parameter informs the reader which regulations to comply with for radio communication with RFID tags.

For more details on the country profiles that are supported, see the file “rui4api.h” in the source files for the programming environment of the RRU4 reader system.

## 7. Reader configuration

### 7.2.4.7. “IntelligentWrite”

Characteristics:

available from firmware:	v1.30.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

Depending on the type of tag, it requires 10 to 20 milliseconds time to write 16 bits of data (one word). If for instance a 96-bit EPC should be written, then the time which a tag requires for saving the data is 120 milliseconds in the worst case. Only a fifth to a tenth of this time would be required for reading the data from a tag. In practice it often happens that the data written to a tag were already present on it. Despite this, the tag requires the full stated time to complete the write command. This configuration parameter should be activated in order to accelerate the write event and to avoid writing data when they are already present on the tag. To achieve this, before writing to the tag the reader first reads the relevant data area on the tag. It then writes only those parts which it is necessary to change.

Note: If a memory area on a tag is protected by a “Lock” against overwriting, and if identical content is scheduled to be written to the tag with “IntelligentWrite” activated, no error message is generated by the reader. No write command is issued to the tag in the process of reading the existing data, comparing it with the data to be written and establishing by the reader that no changed data need be written to the tag. With no write command issued, the reader is not in the position to detect the “Lock” on the memory area.

### 7.2.4.8. “VerifyWrite”

Characteristics:

available from firmware:	v1.30.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

After a write operation, a tag sends the result to the reader. This result can be either an error code or a success message. The memory cells of a tag cannot be written infinitely many times, since they are subject to ageing. Depending on the tag, it has a working life of 1,000 to 1,000,000 write cycles. At the end of a tag's working life it can occur that following a write operation a tag sends out a success message to the reader, but has not stored the data correctly in the tag memory. If “VerifyWrite” is activated, the reader issues a read command after receiving the success message. This reads the data in the tag memory and reports any mismatches to the higher level as “Verify Fail”.



### Important!

Even with “VerifyWrite” activated, there is no guarantee that the data are stored correctly in the tag memory. Aged tags may “forget” the content of their memory, be it minutes or hours after the write operation!



## 7. Reader configuration

### 7.2.4.9. “QueryTarget”

Characteristics:

available from firmware:	v1.30.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

Tags to EPCGlobal Class 1 Gen 2 support four different “sessions”. At each session a tag can be given an inventoried flag to indicate whether or not it has already been detected by the reader during an inventory process. The status of the inventoried flag can be either “A” or “B”. When the tag is detected in the inventory, the status of the flags switches either from A to B or from B to A. The status of the flag can also be influenced by “Select commands”.

The configuration parameter “QueryTarget” determines which tags should participate in the inventory. If the configuration parameter has the value zero, the tags participate in the inventory for which the inventoried flag is set to A.

Otherwise only the tags for which the inventoried flag is set to B. In conjunction with the “Select filters”, filter tasks can be performed in this way.

### Note

See also the “EPCglobal Class 1 Generation 2 UHF RFID” specification V1.2.0 section 6.3.2.2 (page 43f).

### 7.2.4.10. “QuerySel”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-3

Description:

This configuration parameter specifies the content of the field “Sel” in the Gen2 command “Query”. This field instructs the tag whether the content of the “Selected flag” is or is not relevant for participation in the inventory. In conjunction with the “Select filters”, filter tasks can be performed in this way.

### Note

See also the “EPCglobal Class 1 Generation 2 UHF RFID” specification V1.2.0 section 6.3.2.11.2.1 (page 57).

## 7. Reader configuration

### 7.2.4.11. “ForcePowerOffAfterEPCWrite”

Characteristics:

available from firmware:	v1.40.00
Data type:	Byte (8-bit)
Unit:	milliseconds
Value range:	0-255

Description:

During the inventory process a tag transmits its EPC and a checksum to the reader. This checksum is formed when the tag is “Powered up” from the memory area of the EPC. If now a write command changes the EPC and a new inventory is started without any intervening “Power up” – i.e. without switching off the antenna field, the tag cannot participate in the inventory, because the checksum it communicates no longer matches the EPC it transmits.

This configuration parameter specifies whether and for how long after a write operation to the memory bank of the EPC the carrier should be switched off so as to “repower” the tag.

### Note

See also the “EPCglobal Class 1 Generation 2 UHF RFID” specification V1.2.0 section 6.3.2.1.2.1 (page 38).

### 7.2.4.12. “TransmitGetEPCsPreSelect”

Characteristics:

available from firmware:	v1.41.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

The content of this configuration parameter affects only the protocol commands “SyncGetEPCs”, “SyncBulkGetEPCs”, “ASyncGetRawEPCs” and “ASyncGetEPCs”. All other protocol commands behave as if “TransmitGetEPCsPreSelect” is zero. Depending on the value of this configuration parameter, an inventory runs as follows:

- “TransmitGetEPCsPreSelect” is zero:
  1. the first antenna is selected from the multiplex list
  2. a Select to reset all tags within the reception range of the selected antenna is executed
  3. an inventory is executed by the selected antenna, until no further tags are found
  4. as long as there remain further antennas in the multiplex list, the next antenna is selected and the process resumes at point 2
  5. the protocol command is completed and the result is transferred to the higher level
- “TransmitGetEPCsPreSelect” is not equal to zero:
  1. the first antenna is selected from the multiplex list
  2. a Select to reset all tags within the reception range of the selected antenna is executed
  3. as long as there remain further antennas in the multiplex list, the next antenna is selected and the process resumes at point 2
  4. the first antenna is selected from the multiplex list
  5. an inventory is executed by the selected antenna, until no further tags are found
  6. as long as there remain further antennas in the multiplex list, the next antenna is selected and the process resumes at point 5
  7. the protocol command is completed and the result is transferred to the higher level

## 7. Reader configuration

If several antennas look at a population of tags and it is immaterial which antenna detects any tag, the time for a complete detection of the tag population can be reduced by activation of this configuration parameter: Tags which had already been detected by one antenna are no longer detected by the following antennas in the multiplex list.

### 7.2.4.13. “TransmitSelectIfNoFilterIsOn”

Characteristics:

available from firmware:	v1.45.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

At the start of an inventory the reader sets all tags that are within antenna range to a defined initial status, using a defined “select filter” or a “select” command. The subsequent inventory then detects all tags that are in this defined initial status. If no select filters were defined, this configuration parameter can be used to specify whether or not before the inventory a select command should be sent to perform a global reset of all tags within the antenna range.

### 7.2.4.14. “NumberOfEPCWords”

Characteristics:

available from firmware:	v2.00.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-31; 255

Description:

From firmware version v2.00.00, RRU4 RFID readers of the Kathrein reader system can read tags with an EPC length of 0 to 31 words (0 to 496-bit EPCs). This parameter allows deactivation of the automatic detection of the EPC length, thus forcing the reader to work with a fixed length.

### 7.2.4.15. “UseBlockWrite”

Characteristics:

available from firmware:	v2.00.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

If this configuration parameter is activated, the reader uses the command “BlockWrite” for writing data to a tag. This means that more than 16 bits (one word) can be written to a tag with just a single command and thus save “write time”.

### Note

*Not all tags support the command “BlockWrite”. See also the “EPCglobal Class 1 Generation 2 UHF RFID” specification V1.2.0 section 6.3.2.11.3.7 (page 74).*

## 7. Reader configuration

### 7.2.4.16. “DisableReceivingNXPReadProtectedTags”

Characteristics:

available from firmware:	v2.01.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

If a tag from the company NXP was protected by “ReadProtect”, at inventory it would no longer communicate its EPC or a valid checksum. The data content of the EPC and the checksum is zero. To allow such tags to be detected, the reader allows tags for which the EPC and checksum are zero to pass. Since such tags are no longer secured with a valid checksum, it can happen very occasionally that the reader detects such a tag where none exists. In order to prevent this, the reception of “ReadProtected” tags can be suppressed by activation of this configuration parameter.

### 7.2.5. The configuration group “ObservedList”

#### 7.2.5.1. “GlimpsedTimeoutCnt”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

This configuration parameter applies only to asynchronous protocol commands (“ASync...”). For the duration of an asynchronous command, the reader compiles a list of all the tags found within the antenna range. If a tag is present in the antenna range for multiple inventories, a “coming” message is generated for that tag and the message is sent to the higher level. If a tag is no longer detected during multiple inventories, a “going” message is generated and sent.

Once the “going” message has been generated for a tag, this configuration parameter specifies the number of inventories where the tag is not detected, which then triggers deletion of this tag from the internal administration list. This parameter should not be changed. It has no influence over the generation of a “coming” or “going” message. Kathrein reserves the right to remove this parameter from firmware versions at a future point in time.

#### 7.2.5.2. “ObservedThresholdCnt”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

This configuration parameter applies only to asynchronous protocol commands (“ASync...”). For the duration of an asynchronous command, the reader compiles a list of all the tags found within the antenna range. If a tag is present in the antenna range for multiple inventories, a “coming” message is generated for that tag and the message is sent to the higher level. If a tag is no longer detected during multiple inventories, a “going” message is generated and sent.

This configuration parameter specifies the number of inventories where the tag is detected, which then triggers the generation of a “coming” message which is sent to the higher level.

## 7. Reader configuration

### 7.2.5.3. “ObservedTimeoutCnt”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

This configuration parameter applies only to asynchronous protocol commands (“ASync...”). For the duration of an asynchronous command, the reader compiles a list of all the tags found within the antenna range. If a tag is present in the antenna range for multiple inventories, a “coming” message is generated for that tag and the message is sent to the higher level. If a tag is no longer detected during multiple inventories, a “going” message is generated and sent.

This configuration parameter specifies the number of inventories where the tag is no longer detected, which then triggers the generation of a “going” message which is sent to the higher level.

### 7.2.6. The configuration group “Host communication” (“HostComm”)

#### 7.2.6.1. “ExtendedResultFlag”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-15

Description:

This configuration parameter allows specification of which additional information on a tag should be sent when tag data are sent to the higher level. Every bit of the lower four bits that is set to “1” in this configuration parameter causes the sending of certain additional information:

Bit 0: Sending the antenna information (the antenna which detected the tag)

Bit 1: Sending the RSSI value (field strength information of the tag response)

Bit 2: Sending the time stamp (the time when the tag was detected)

Bit 3: Sending the protocol control word of the tag (PC, [XPC\_W1, [XPC\_W2]]; see also the “EPCglobal Class 1 Generation 2 UHF RFID” specification V1.2.0 section 6.3.2.1.2 (page 38).)

#### 7.2.6.2. “AntennaIndependentOperation”

Characteristics:

available from firmware:	v1.30.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

This configuration parameter allows differentiation between “antenna-dependent” (configuration parameter deactivated) and “antenna-independent” (configuration parameter activated) operation of the reader. This configuration parameter is relevant to all asynchronous protocol commands (“ASync...”) and to the command “SyncBulkGetEPCs”. In the case of the specified protocol commands the reader compares a tag which it has detected during an inventory with the tags listed on an internal list.

## 7. Reader configuration

During antenna-dependent operation the antenna information is used in this process, as well as the EPC. That means that a tag which was detected by multiple antennas also generates multiple records in the reader. Each record then contains the same EPC but a different antenna port number. During antenna-independent operation the antenna information is irrelevant. A tag which was detected by multiple antennas generates only a single record in the reader.

### 7.2.6.3. “ASyncAdditionalRSSIDataDeliveryDelta”

Characteristics:

available from firmware:	v2.00.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

This configuration parameter influences the behaviour of all asynchronous protocol commands (“ASync...”) except for “ASyncGetRawEPCs”.

During asynchronous commands, when a tag comes within range of an antenna, a “coming” message is generated and sent to the higher level. When the tag leaves the antenna field, a “going” message is generated. In various application scenarios it is of interest to view how the field strength (RSSI value) of a tag behaves in the time between the “coming” message and the “going” message. This allows amongst other things conclusions to be drawn regarding the movement of a tag within the antenna field.

This configuration parameter specifies how much the change in strength of the RSSI value of a tag must be in order to generate a “TagDataChanged” message which is then sent to the higher level. At a value of 255, no “TagDataChanged” messages are generated.

### Note

*In order that the RSSI value is also included in the “TagDataChanged” message, the configuration parameter “ExtendedResultFlag” should also be set.*

### 7.2.6.4. “UseMillisecondsAsTimestamp”

Characteristics:

available from firmware:	v2.00.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

After an inventory, a time stamp with the time of detection of the tag can also be sent to the higher level as part of the tag information (see “ExtendedResultFlag”). This configuration parameter specifies whether the time stamp should be the UTC time in seconds since the 01.01.1970 0:00, or the milliseconds elapsed since the the reader was started. If this configuration parameter is activated, the milliseconds since the start of the reader will be sent as the time stamp.

## 7. Reader configuration

### 7.2.7. The configuration group “ETSI”

#### 7.2.7.1. “PortChannelListGlobalValue1...16”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-15

Description:

These configuration parameters are relevant only if “ETSI\_EN302208” or “ETSI\_EN302208\_LBT” was selected as the communications standard.

These configuration parameters serve for the administration of the radio channels approved for Europe; taken together they constitute the ETSI channel list. This channel list contains a maximum of 16 entries. Each entry can contain an ETSI channel number in the range from 1 to 15. A value of zero denotes the end of the channel list. All entries of configuration parameters with a higher index are then ignored. If the configuration parameter “ChannelSwitchingMode” is set accordingly, the reader selects a channel from this channel list at random for communication with the tags.

#### 7.2.7.3. “ChannelSwitchingMode”

Characteristics:

available from firmware:	v1.30.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-1

Description:

This configuration parameters is relevant only if “ETSI\_EN302208” or “ETSI\_EN302208\_LBT” (only in existing systems) was selected as the communications standard.

### Note

*The LBT (Listen Before Talk) operating mode is permissible only in existing systems.*

This configuration parameter specifies whether the reader performs the channel selection in “mode 0” or in “mode 1”:

ETSI-Communication standard	Mode 0	Mode 1
ETSI_EN302208	no LBT; uses the global channel list for every port, random selection of the channel	no LBT; uses the channel list associated with the port, with random selection of the channel
ETSI_EN302208_LBT	LBT on the first parameterised antenna; uses the global channel list for every port, with random selection of the channel sequence; no new LBT - and hence no channel change - when changing port	LBT at each change to this port; uses the channel list associated with the port, with random selection of the channel

## 7. Reader configuration

### 7.2.7.4. “PowerCheckOverAllAllowedChannels”

Characteristics:

available from firmware:	v1.30.00
Data type:	Bool (8-bit)
Unit:	–
Value range:	0; 255

Description:

These configuration parameters are relevant only if “ETSI\_EN302208” or “ETSI\_EN302208\_LBT” was selected as the communications standard.

Different maximum transmission powers are allowed per channel, depending on the communications standard:

For EN 302208 these are:

channel		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
maximum permitted transmission power	W	0	0	0	2	0	0	2	0	0	2	0	0	2	0	0

For EN 302208\_LBT these are:

channel		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
maximum permitted transmission power	W	0,1	0,1	0,1	2	2	2	2	2	2	2	2	2	2	0,5	0,5

1. The transmission power that is used is limited to the lowest maximum power for the selected channels. For example: If “EN302208\_LBT” was selected and channels 3 and 4 are entered in the channel list, and 2 Watt has been set as the transmission power, the reader transmits only at 0.1 Watt, since within these channels channel 3 has a maximum power setting of only 0.1 Watt.
2. If point 1 yields a maximum power setting of 0 Watt (if for instance “EN302208” was selected and a channel other than channels 4, 7, 10 or 13 was entered in the channel list), the reader generates a “power check error” for the respective antenna port.

### 7.2.8. The configuration group “communication standard” (“CommStandard”)

The following configuration parameters contain the setting options for the “Special” communications standard. This communications standard allows country profiles to be entered for countries (so far) lacking an entry implemented in the reader. The principal condition for this is that the communications standard to be entered is in the form of a schematic channel grid specified exposure times and pause times, and random channel selection. A further condition is that the values of the configuration parameter, taken together, ensure 100% coverage of the time. That means that the reader is in the position at all times to determine a valid channel from the values set in the parameters. For 100% coverage of the time, one of the following conditions must be satisfied:

$$(\text{“FirstChannel”} = \text{“LastChannel”}) \text{ AND } (\text{“MinChannelWaitTime”} = 0)$$

or

$$(\text{“MaxChannelTime”} - 5\text{ms}) * (\text{“LastChannel”} - \text{“FirstChannel”} + 1) \geq \text{“MinChannelWaitTime”}$$



## 7. Reader configuration



### Important!

Since there are frequencies which the hardware of the RFID reader cannot deliver, when using the “Special” communications standard, a spectrum analysis must be performed to check whether each channel frequency is available for the correct setting.

#### 7.2.8.1. “CenterFreqCH0”

Characteristics:

available from firmware:	v1.32.00
Data type:	DWord (32-bit)
Unit:	kiloHertz
Value range:	0-1048575

Description:

This configuration parameter specifies the mid-frequency of channel 0 for the “Special” communications standard.

#### 7.2.8.2. “ChannelWidth”

Characteristics:

available from firmware:	v1.32.00
Data type:	Word (16-bit)
Unit:	kiloHertz
Value range:	0-65535

Description:

This configuration parameter allows the width of each radio channel for the “Special” communications standard to be specified.

#### 7.2.8.3. “MaxChannelTime”

Characteristics:

available from firmware:	v1.32.00
Data type:	Word (16-bit)
Unit:	milliseconds
Value range:	0; 10-65535

Description:

This configuration parameter for the “Special” communications standard specifies how long the reader may occupy a selected channel until it must change to the next channel.

## 7. Reader configuration

### 7.2.8.4. “MinChannelWaitTime”

Characteristics:

available from firmware:	v1.32.00
Data type:	Word (16-bit)
Unit:	milliseconds
Value range:	0-65535

Description:

This configuration parameter for the “Special” communications standard specifies how long the reader must wait before returning to a channel after its maximum exposure time (“MaxChannelTime”) has elapsed.

### 7.2.8.5. “FirstChannel”

Characteristics:

available from firmware:	v1.32.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

This configuration parameter for the “Special” communications standard specifies the first channel to be used for this communications standard. The frequency of the channel is determined by the following formula:

$$f = \text{“CenterFreqCH0”} + \text{“FirstChannel”} * \text{“ChannelWidth”}$$

### 7.2.8.6. “LastChannel”

Characteristics:

available from firmware:	v1.32.00
Data type:	Byte (8-bit)
Unit:	–
Value range:	0-255

Description:

This configuration parameter for the “Special” communications standard specifies the last channel to be used for this communications standard. The frequency of the channel is determined by the following formula:

$$f = \text{“CenterFreqCH0”} + \text{“LastChannel”} * \text{“ChannelWidth”}$$

## 8. Reference literature

- (A) Kathrein-Burgstädt Reader Protocol (KBRP) V1.23
- (B) EPCTM Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID in the version V1.2.0 on [www.epcglobalinc.org](http://www.epcglobalinc.org)



0711/ZWT - Technical data subject to change.

Internet: [www.kathrein-rfid.de](http://www.kathrein-rfid.de)

KATHREIN-Werke KG • Anton-Kathrein-Straße 1 - 3 • P.O. Box 100 444 • 83004 Rosenheim • GERMANY • phone +49 8031 184-0 • Fax +49 8031 184-494