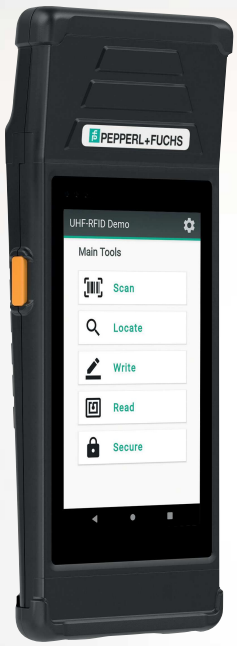
UHF RFID App

for IC-HH51/HH52 Handhelds

Manual



RFID
UHF

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PEPPERL+FUCHS

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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

Note

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Functional safety manual
- Other documents

1.2 Manufacturer

Pepperl+Fuchs Group Lilienthalstraße 200, 68307 Mannheim, Germany
Internet: www.pepperl-fuchs.com

1.3 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

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1.4 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols

Note

This symbol brings important information to your attention.

Action

1. This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

2 Product Description

2.1 Intended Use of the App

This app is used to control the IUH-HH50-FR* UHF read / write heads using the modular IC-HH51 and IC-HH52 handhelds from Pepperl+Fuchs.

The app supports:

- All country-specific versions of these modules
- Scanning multiple tags
- Reading and writing of all memory banks on standard UHF tags according to EPC Gen2 (ISO/IEC 18000-63)

Note

The manual for the IC-HH51/HH52 modular handhelds can be found on our website www.pepperl-fuchs.com.

3 Installation

The RFID demo app is preinstalled on the start page of the modular handhelds from Pepperl+Fuchs.

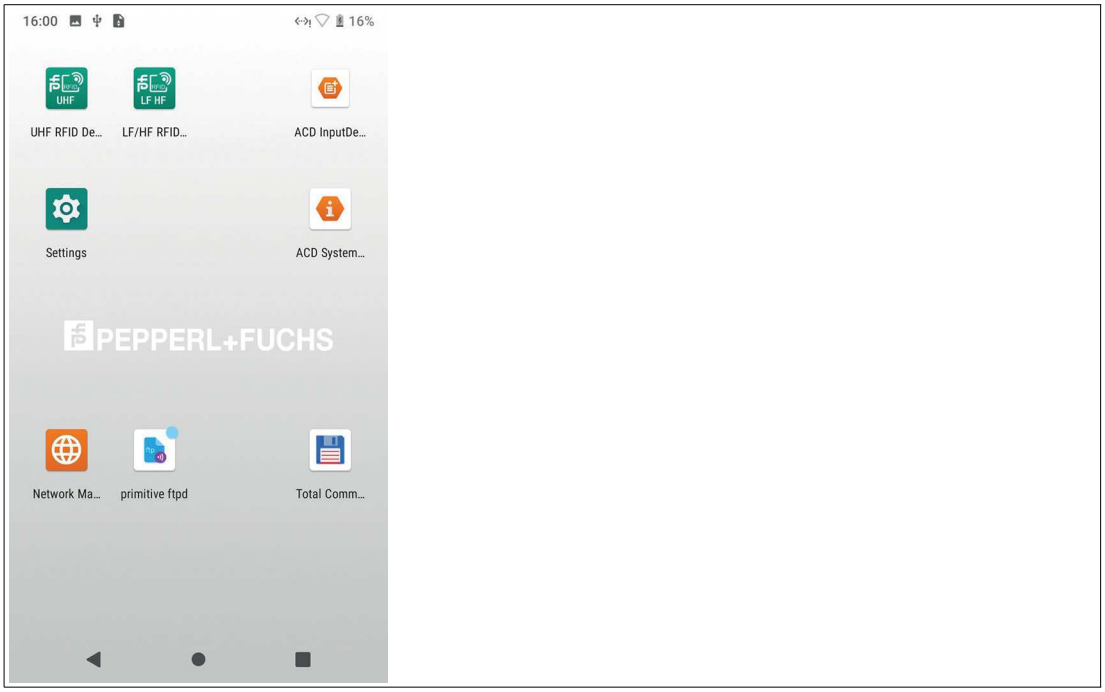


Figure 3.1

Future versions of the app are available as an .apk file on the Pepperl+Fuchs website. There you will also find instructions on how to perform the update. The app can be installed using a USB memory or via the LAN connection on the docking station.

The described app is version 1.25.

4 Operation

4.1 Description

The operating languages of the app are English and German. The language settings from your handheld are copied over. You can change the language of your handheld in the Android settings in the "System" submenu.

The app functions are outlined below.

For additional functions, Pepperl+Fuchs can create customized apps tailored to specific applications.

4.2 Starting the App

Starting

1. Click the RFID UHF app symbol on the handheld screen.

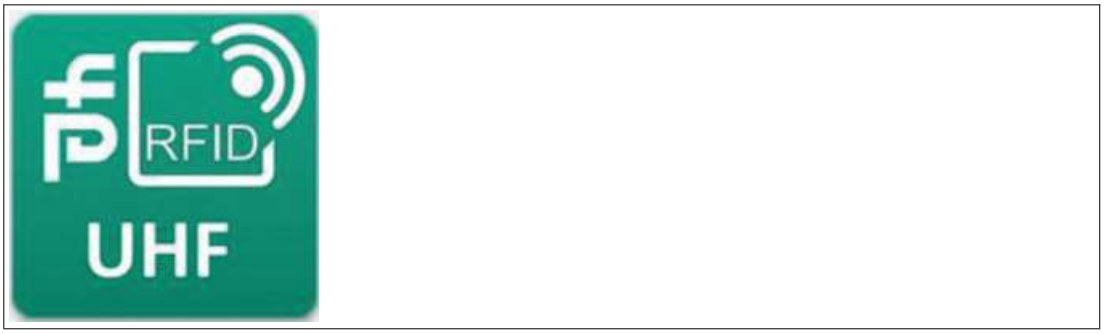


Figure 4.1

↳ The app will start.

4.3 General

Some fields or functions are available in several menus and are described in general terms.

Virtual Keyboard

To input data, click in the appropriate field. The virtual keyboard will appear automatically.

Tip

If the virtual keyboard does not appear automatically, select the keyboard symbol on the right-hand side of the bottom toolbar.

Orange Function Key

There are two orange function keys on the sides of the handheld.

In some menus, both function keys are assigned the main function.

Example

In the "Scan" menu, both function keys are assigned the function "Scan" or "Stop."

Settings

You can use the "Settings" symbol in the top right corner of each menu to set the filter and transmission power of the inserted module.

Note

The default settings are optimal for most applications. Advanced users may select other parameters here.

Radio

You can make settings to the read / write module in the "Radio" submenu.

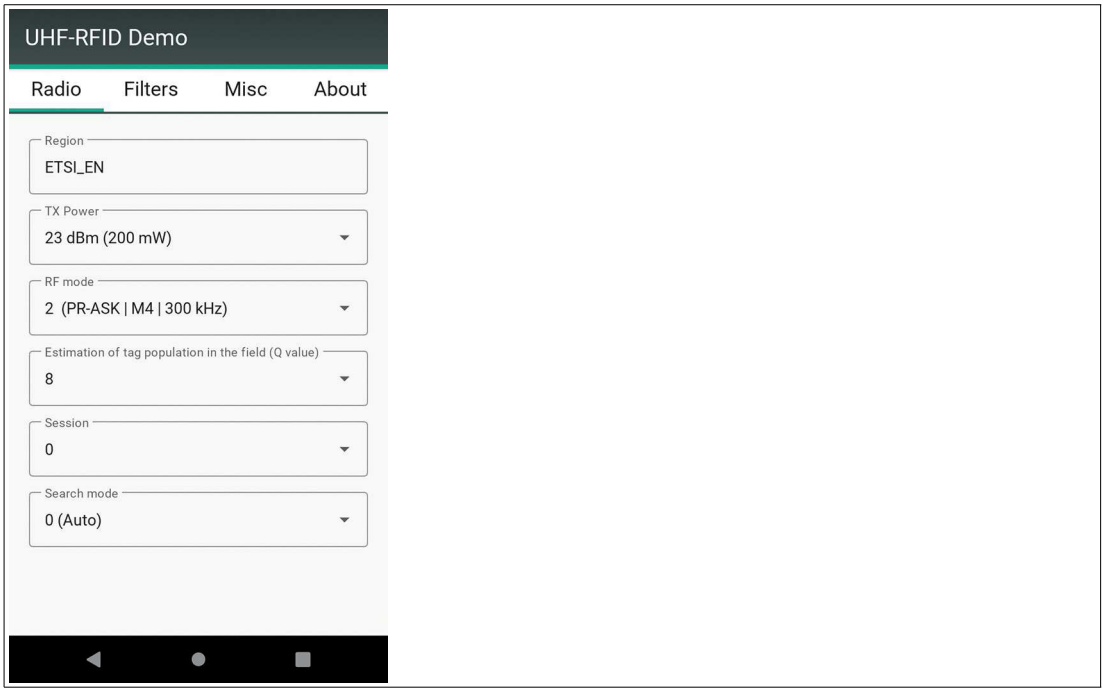


Figure 4.2

Power — Sets the power of the read / write head in dBm or mW

RF Mode — RF mode determines transmission speeds, sensitivity, and susceptibility to interference.
RF mode provides four different settings. The setting depends on the region:

1. Standard mode for FCC operation
2. Standard mode for ETSI operation
3. Rapid mode with reduced sensitivity and increased susceptibility to interference, for FCC operation only
4. Highly sensitive mode with reduced speed and increased susceptibility to interference

Estimating the Tag Population — When starting, the read / write head assumes an estimated number of tags in the field. The read / write head dynamically adjusts the read rate to the number of tags in the sensing range. The read rate is increased or decreased if the number of tags deviates from the estimated value, Q. The readout time can be reduced if the estimated value, Q, is similar to the real number of tags.

Session — It is possible to set four different sessions. When operating multiple read / write heads in parallel, different sessions help to prevent collisions. Each device should use a different session. A maximum of four devices can operate simultaneously.

Search Mode	It is possible to set four different search modes. When operating multiple read / write heads in parallel, different search modes help to prevent collisions.
Scanner Update Interval	The scanner update interval can be changed in the "Scan" menu. Use this setting to change the update rate of the scan list. This does not impact the read / write head.

Filter

You can switch the RSSI filter for reading and writing on and off in the "Filter" submenu.

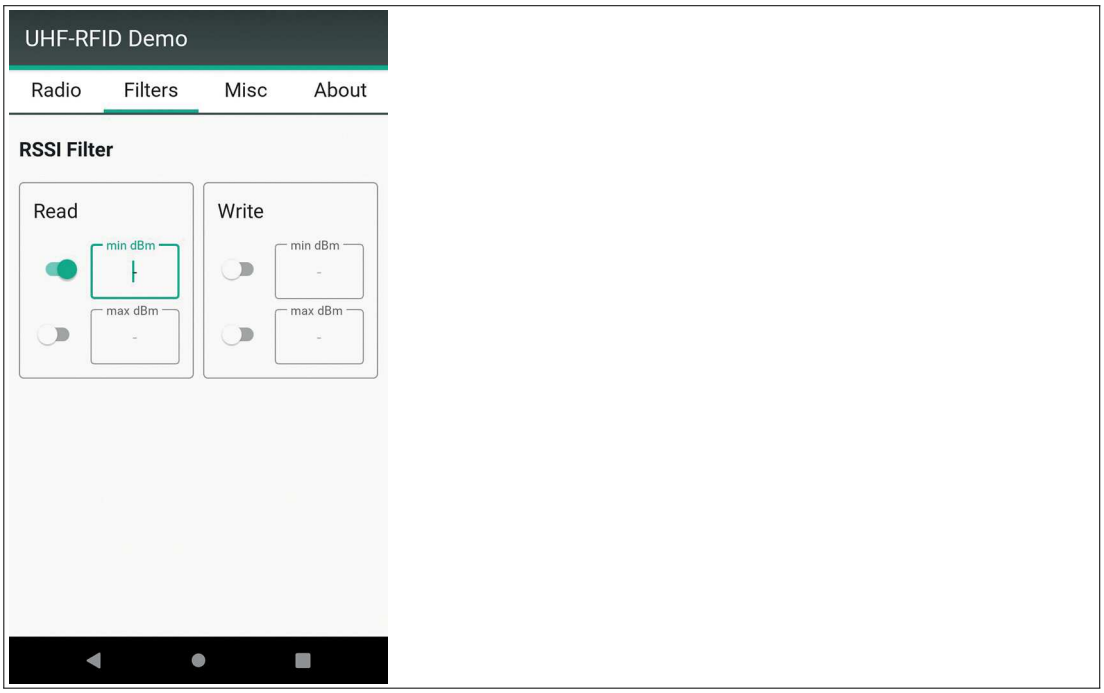


Figure 4.3

The filter displays tags with a signal strength within the specified range. A message is displayed in the respective menu when the RSSI filter is active.

Misc

You can make various settings in the "Misc" submenu.

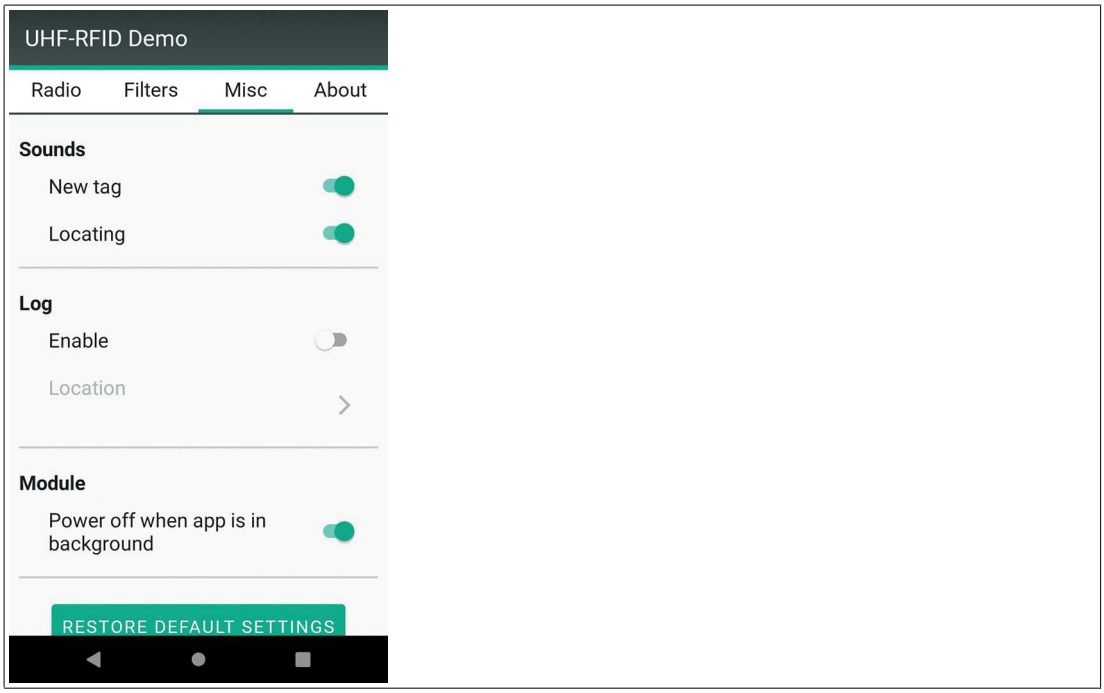


Figure 4.4

Sound	When sound is enabled, a beep sounds when a tag is detected and located.
Log	If log is enabled, all the detected tags are saved in a log file in CSV format. The log files are stored in the "Internal shared memory" in the "Logs" directory.
Module	By default, the module is not switched off when the app is moved to the background by pressing the Home or Recent app buttons. When the option is enabled, the module is always switched off when the app is moved to the background. The module must be re-initialized when the app is displayed again.

Tip

Disabling the "Module" option may reduce the device battery life.

The "Default settings" key resets all settings.

Info

The "Info" submenu displays the versions of the hardware and software components.

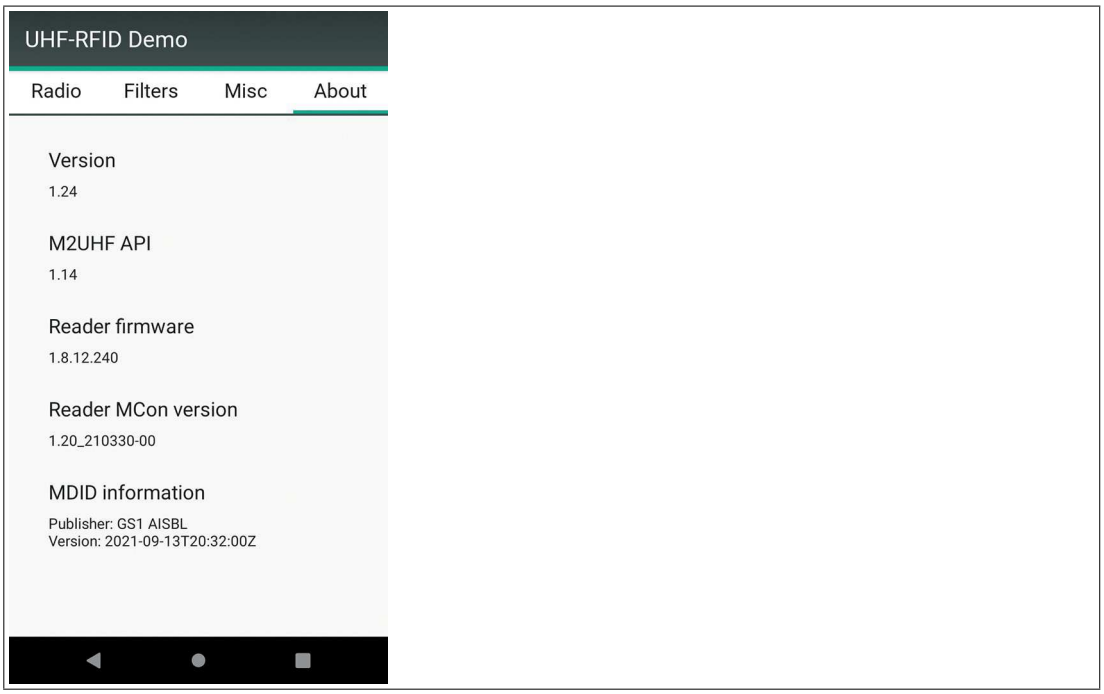
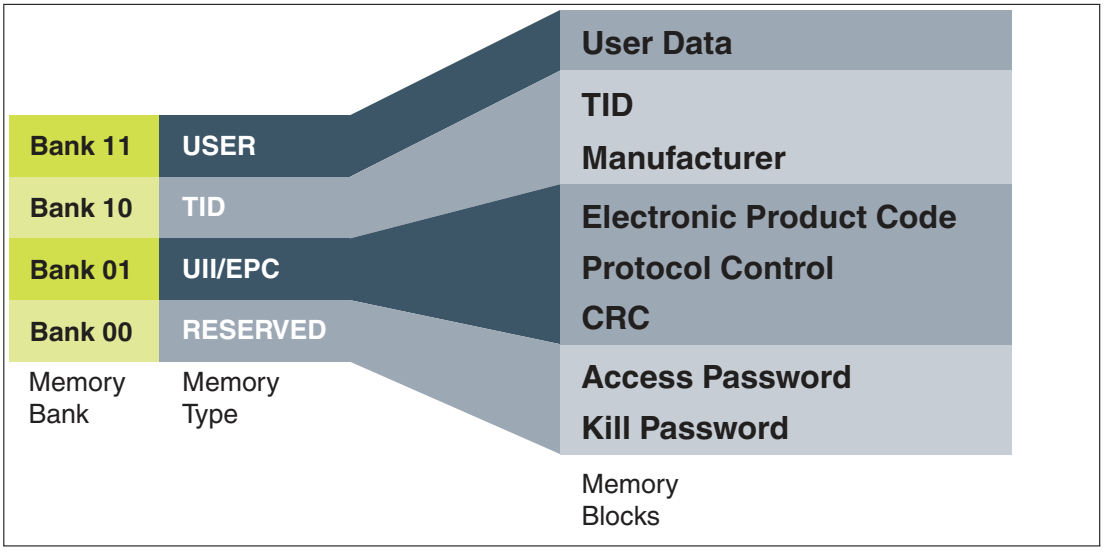


Figure 4.5

4.3.1 Tag Memory Structure



The memory of an EPC Gen2 (ISO/IEC 18000-63) tag is split into four memory banks. The main contents of these memory banks are:

Memory bank	Storage type	Memory blocks
Bank 00 ($00_{bin} = 0_{dec}$)	RESERVED	Password management
Bank 01 ($01_{bin} = 1_{dec}$)	UII/EPC	Unique Item Identifier (UII) Electronic Product Code (EPC)

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Memory bank	Storage type	Memory blocks
Bank 10 ($10_{bin} = 2_{dec}$)	TID	Tag ID (TID)
Bank 11 ($11_{bin} = 3_{dec}$)	USER	User memory

Bank 00: RESERVED

Bank 00 contains the password management information. It comprises the access password and the kill password. This area is available depending on the chip type.

Bank 01: UII/EPC

In addition to the Unique Item Identifier (UII), **Bank 01** contains a calculated checksum CRC (Cyclic Redundancy Check) for verifying data on the tag and the protocol control (PC) area. The PC area contains:

- The length of the UII
- The Application Family Identifier (AFI) field
- A bit switch for an EPC sequence of numbers in accordance with ISO in Bank 01
- A bit switch for data stored in Bank 11, if available

Bank 10: TID

Bank 10 contains the tag identifier (TID), consisting of the part number and optional serial number of the tag. This data is permanently stored without being changed. The first byte denotes the class of the tag with $E0_{hex}$, $E2_{hex}$, or $E3_{hex}$. The rest of the TID depends on the class, and can be derived from standard ISO/IEC 18000-63.

For example:

All tags with the class EPC Gen2 (ISO/IEC 18000-63) are marked with $E2_{hex}$. The TID is comprised as follows:

- 4 bytes: Tag part number
  - 1 byte: Marking
  - 12 bits: Tag Mask Designer Identifier (MDID)
  - 12 bits: Tag model number (TMN), defined by the manufacturer
- 4 or 8 bytes: Tag serial number
  Depending on the manufacturer, the serial numbers do not have to be unique or may even be omitted.

Bank 11: User memory

Bank 11 contains a memory that the user can freely access. The size of this memory depends on the chip type, or this memory may not be present.

4.3.2 Password

Each UHF tag has two passwords:

1. **Kill Password**
   This password is only needed to destroy the tag.
2. **Access Password**
   This password protects individual memory banks and memory ranges from read / write access.

The passwords are both two words (=32 bits) long and stored in the "Reserved" memory bank. The kill password is stored as the first and second words in the reserved bank. The access password is stored as the third and fourth words in the reserved bank.

Note

In the password field, the two words are displayed in HEX format with a hyphen in the middle. Input must be in HEX format.

The default value of the two passwords is `0000-0000` for all tags. This value corresponds to the decimal value 0.

Shorter passwords are allowed, but are always converted into two words. For example, `0000-00` corresponds to the default value of 0.

For changing passwords see chapter 4.4.3.

4.4 Main Menu

Once the app is started, the main menu appears on the screen.

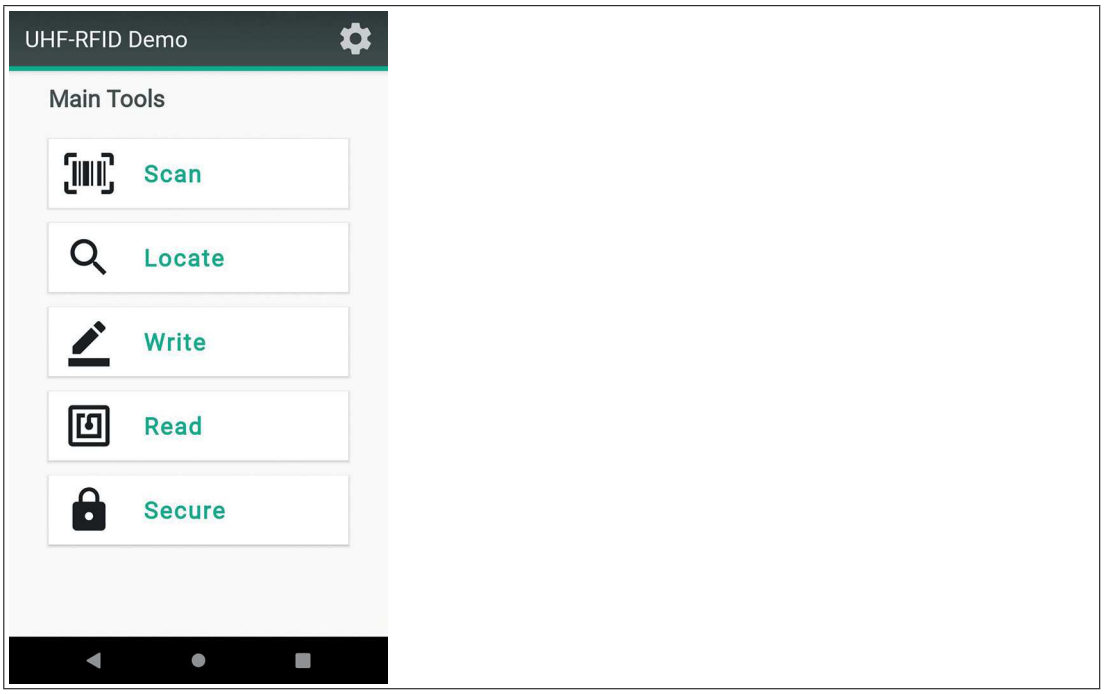

Figure 4.6 Hauptmenü

The main menu has the following options to select from:

Scan	Pressing "Scan" allows the handheld to detect the tag in the sensing range and to read it out.	See chapter 4.4.1
Locate	You can use "Locate" to enter the required tags and have them detected by the handheld.	See chapter 4.4.2
Write	Press "Write" to write to detected and selected tags.	See chapter 4.4.3
Read	Press "Read" to read out the memory of a detected and selected tag.	See chapter 4.4.4
Secure	Pressing "Secure" will adjust the read / write protection of a detected and selected tag. Making the appropriate setting allows you to render the tag unusable.	See chapter 4.4.5

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Module Status

The lower half of the main menu shows the status of the inserted module. When the module is unplugged, loaded, initialized, or an error has occurred, the buttons are disabled and a red status appears in the lower half of the main menu.

The module is always switched off to save power when the screen is switched off or the handheld is placed in idle mode. The module is switched on again and initialized when the handheld is reactivated.

Tip

Unplug the module if error messages are displayed or the module is not initialized.

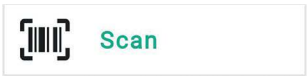
If no notification is displayed when the module is plugged in, ModuleService will not detect the module. Hardware issues, such as contact problems, are likely to be the issue if the module is still not detected after restarting the device.

4.4.1 Scanning

Pressing "Scan" allows the handheld to detect the tag in the sensing range and to read it out.

Scanning Tags

1. Click "Scan"



↳ The "Scan" menu will open.

2. If necessary, enable logging by checking the "Log enabled" checkbox.
3. Click "Start."

↳ The handheld scans all tags in the sensing range and displays the result in a list.

↳ Tags in the sensing range at the time of scanning are highlighted in green. Tags that have left the sensing range since the last scan are highlighted in red.

Figure 4.7

Tip

Swipe to the left to view more details about the individual tags.

4. Click the "Stop" button to stop the search. The "Stop" button appears instead of the "Start" button when the scan is running.

↳ All tags in the sensing range are displayed.

Note

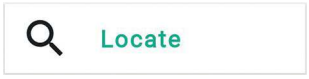
Scanning stops automatically after 118 seconds. This prevents the UHF RFID module from overheating.

4.4.2 Locating

You can use "Locate" to enter the required tags and have them detected by the handheld.

Locating Tags

1. Click "Locate."



↳ The "Locate" menu will open.

↳ The handheld scans all tags in the sensing range and displays the result in a list. You can select a tag from the list or search for a tag by entering the tag ID in the input field.

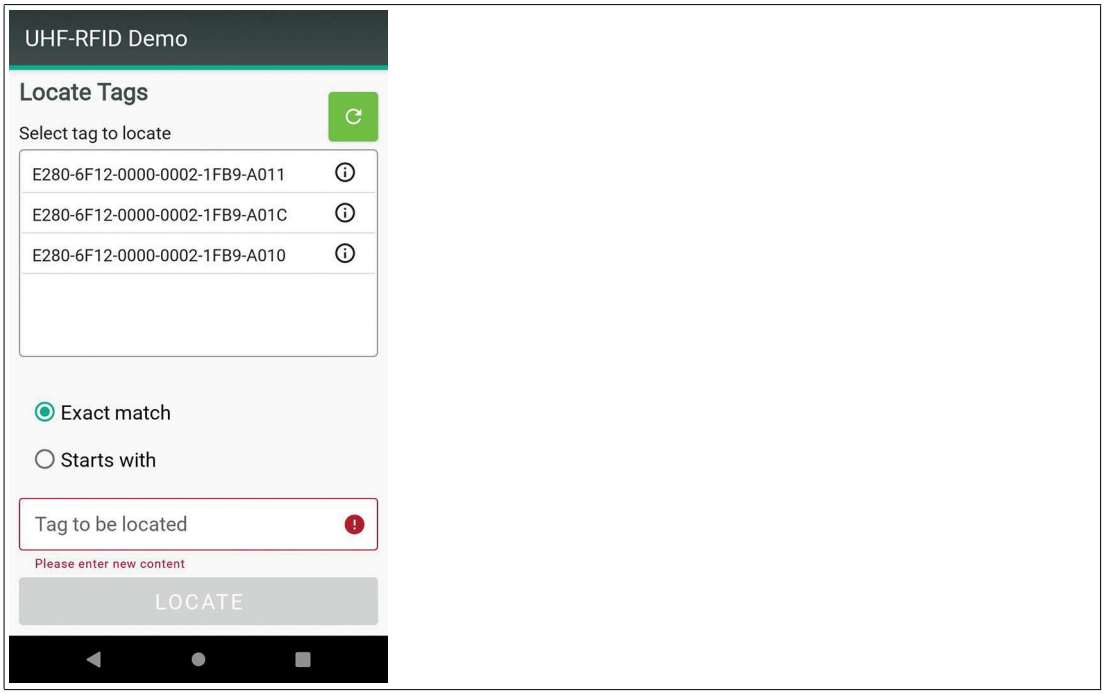


Figure 4.8

Tip

To refine your search, choose between "Exact match" and "Starts with."

2. If you want to locate a tag in the sensing range, select the tag from the list and click "Locate."

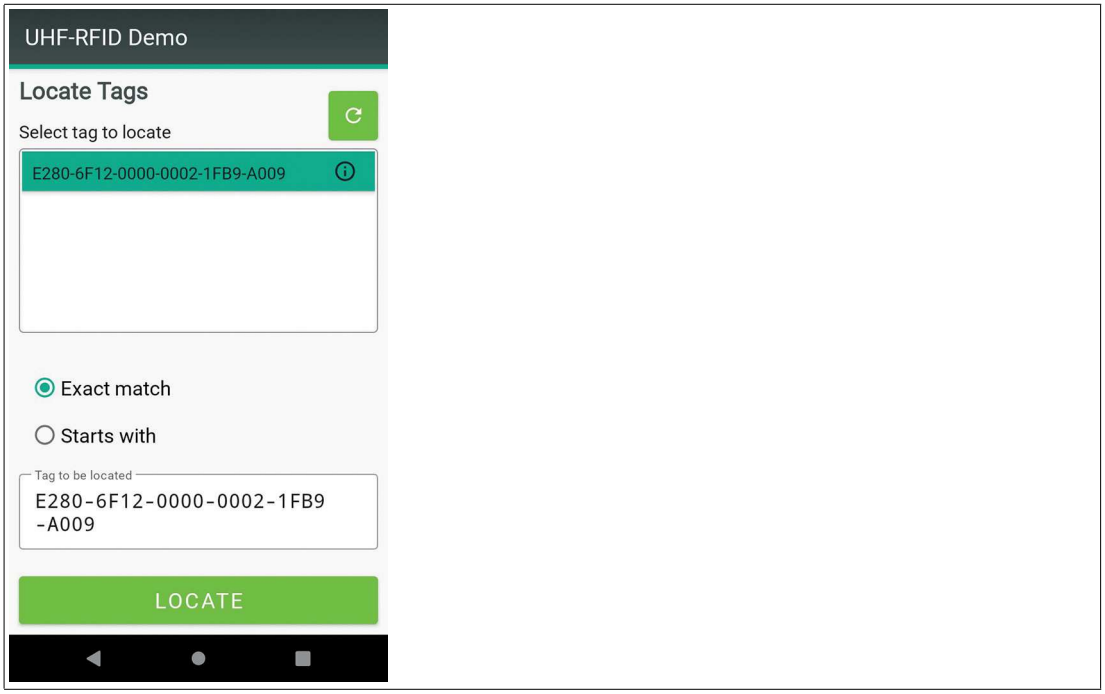


Figure 4.9

↳ All tags in the sensing range are scanned. The tag signal strength is displayed when the tag to be located is found.

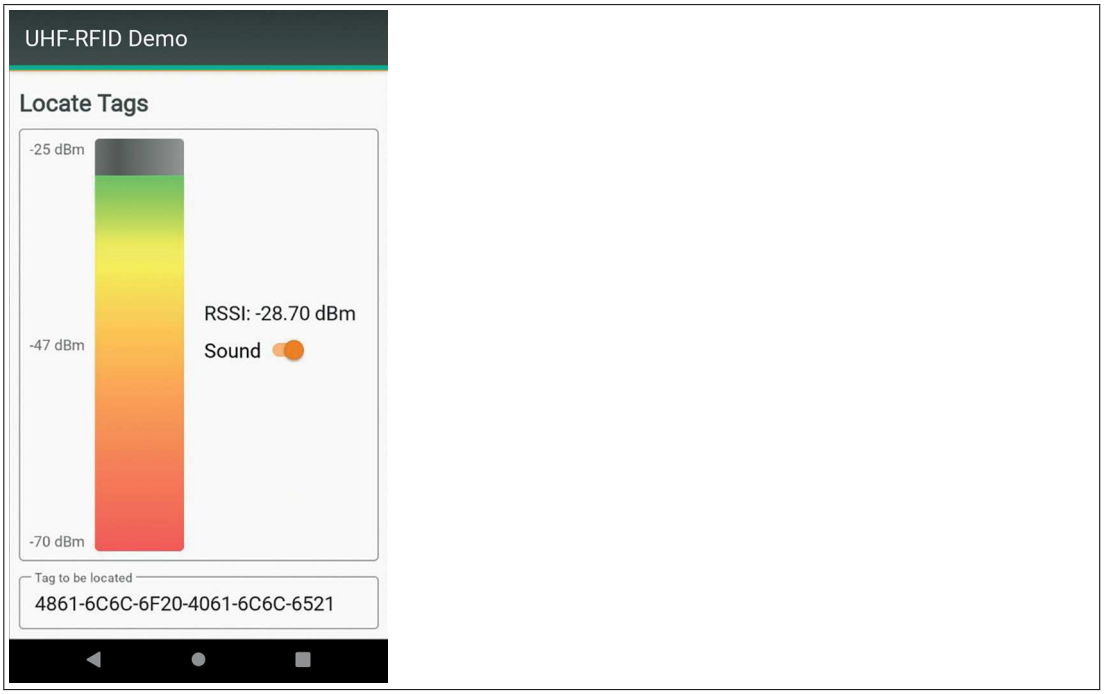


Figure 4.10

Note

Localization automatically stops after 118 seconds. This prevents the UHF RFID module from overheating.

3. Click back to return to the "Locate" menu.

Retrieving Tag Information

In the TID memory bank, each tag contains information about the manufacturer and the microchip used. You can read this information from the memory bank and decode it.

1. Click the Info icon ⓘ next to the tag data.

↳ The available data is displayed in decoded form.

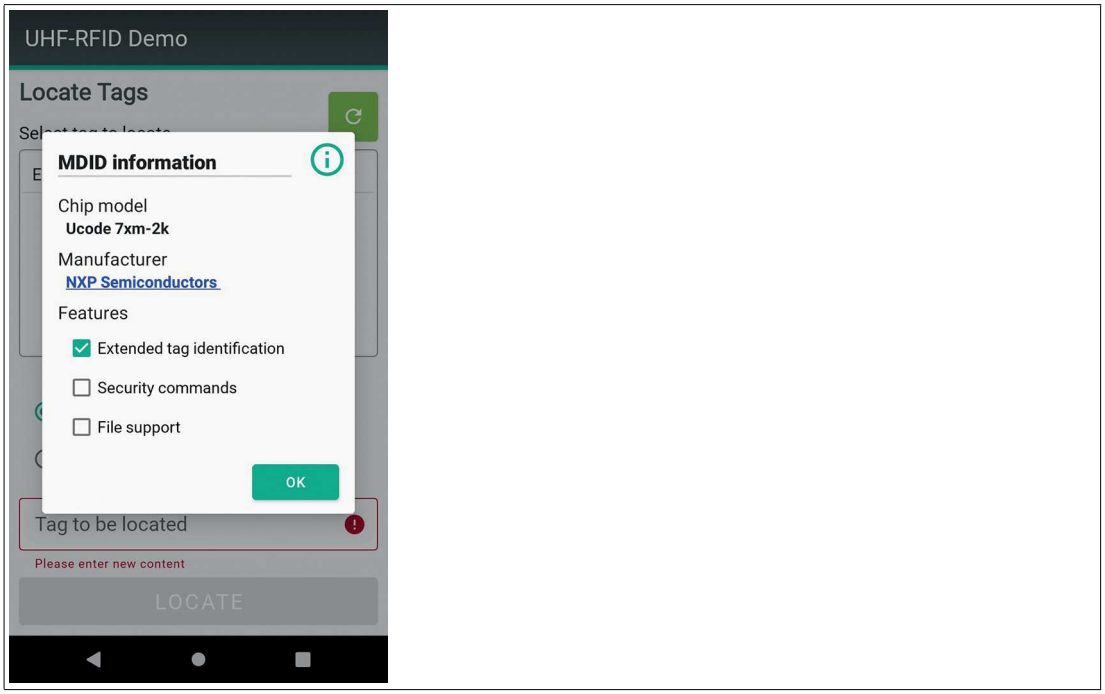


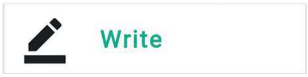
Figure 4.11

4.4.3 Write

Press "Write" to write to detected and selected tags.

Write to Tags

1. Click "Write"

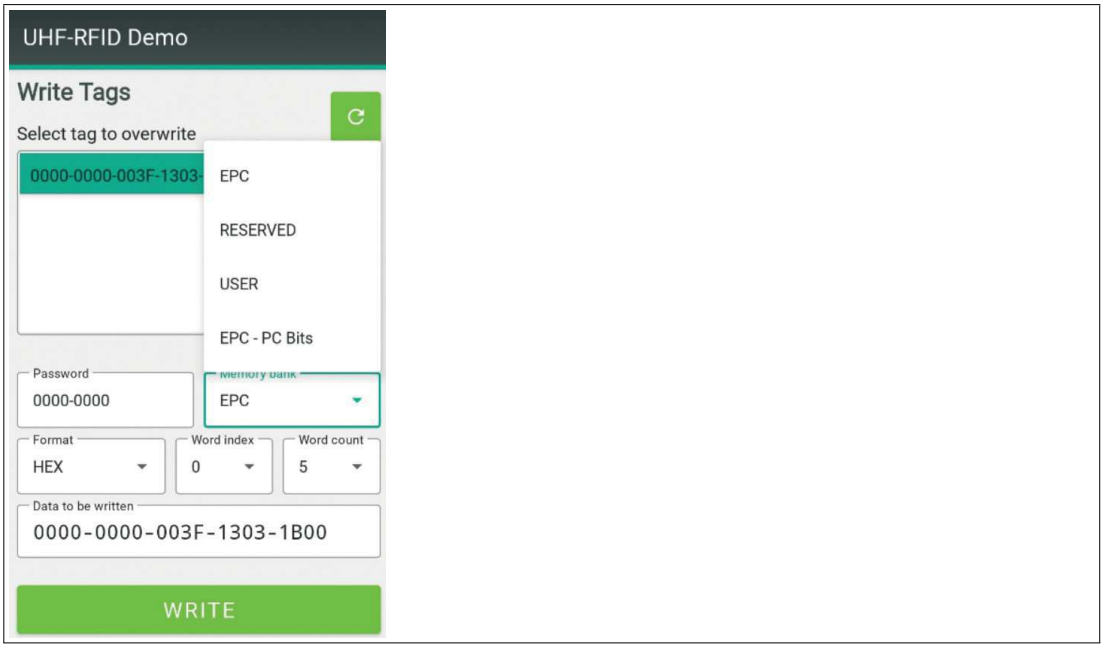


↳ The "Write" menu will open.

↳ The handheld scans all tags in the sensing range and displays the result in a list.

2. Click on the tag that you want to write.

↳ The content of the memory bank is displayed.



3. You can change the text in the "Data to be written" field.

Tip

When writing, observe the respective format specifications from the "Format" field.

The length of the data to be written does not need to match the selected number of words. The content of the input field is always written.

4. Confirm by pressing "Write."

↳ The content of the "Data to be written" field is written to the selected memory bank, starting from the specified word index. The password that has been entered is set.

Note

An error message is displayed if incorrect parameters are selected during writing, too much data is entered, or the tag is removed.

In some cases, the data is written but the tag does not respond. The app displays an error.

Format

HEX	HEX characters only; four characters always result in a word. Hyphens are inserted automatically.
8-bit ASCII	All ASCII characters are allowed.
6-bit ASCII	Only characters according to VDA 5500 are permitted.
Decimal	Only numbers from 0 to 255 are permitted.

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Changing Passwords

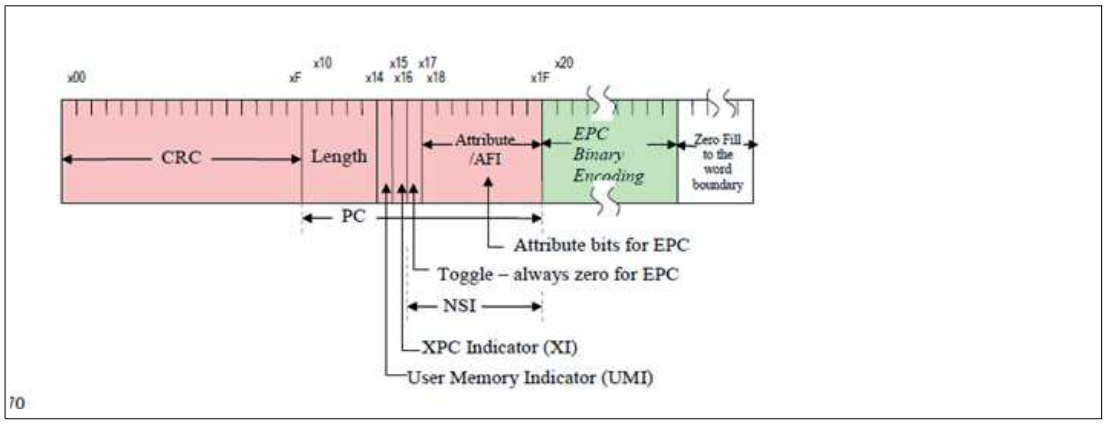
You can change the kill and access passwords of a selected tag. Send a write command specifying the following parameters.

Password	0000–0000 or the password currently set
Memory Bank	Reserved
Format	HEX[1]
Word Index	0 = kill password 2 = access password
Word Length	2

1. The password must be entered in HEX format

Changing the formatting of an EPC tag

Detailed structure of the EPC memory bank

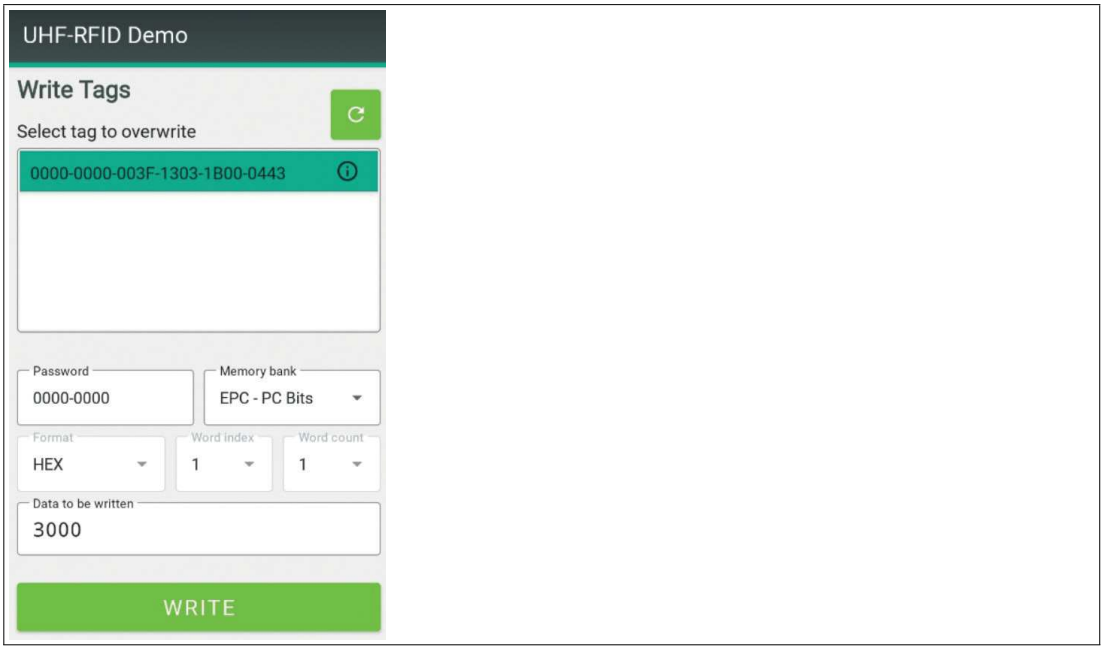


The first data word of the EPC memory bank contains the CRC checksum. This checksum is generated by the tag and transmitted when the memory bank is read out.

The second data word of the EPC memory bank contains the Protocol Control Information PC. The PC describes the formatting information:

Length	The length of the UII
User Memory Indicator	Indicator for data in user memory
Toggle bit	Formatting according to EPC directive: Bit = 0: GS1 Bit = 1: ISO 15961
Attribute/AFI	Application Familiy Identifier

From the 3rd data word, the data is saved via the "Write Tags" menu.



In the "Read single Tag" menu, this data is displayed with the checksum and the PC.

Example: Formatting according to GS1:

PC	Size of EPC memory bank [byte]
10 00	4
28 00	10
30 00	12[1]
40 00	16[2]
60 00	24
78 00	30[3]
A0 00	44
E0 00	56[4]
F0 00	60[5]
F8 00	62[6]

1. 96 bit, standard value for many applications
2. 128 bit, limit for IUC77
3. 240 bit, limit for IUC72
4. 448 bit, limit for IUC82
5. 480 bit, limit for IUC76
6. 496 bit, maximum length, limit for IUC84 + IUC87

Example: Formatting according to ISO15961:

PC	Size of EPC memory bank [byte]
31 00	12
79 A1	30[1]

1. 240 bit, formatting acc. to VDA 5500

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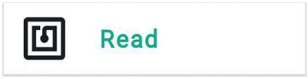
4.4.4 Read

Press "Read" to read out the memory of a detected and selected tag.

Reading out Tags

1. Click "Read."



↳ The "Read" menu will open.

↳ The handheld scans all tags in the sensing range and displays the result in a list.

2. Click the tag that you want to read out.

↳ The content of the selected memory bank is displayed.

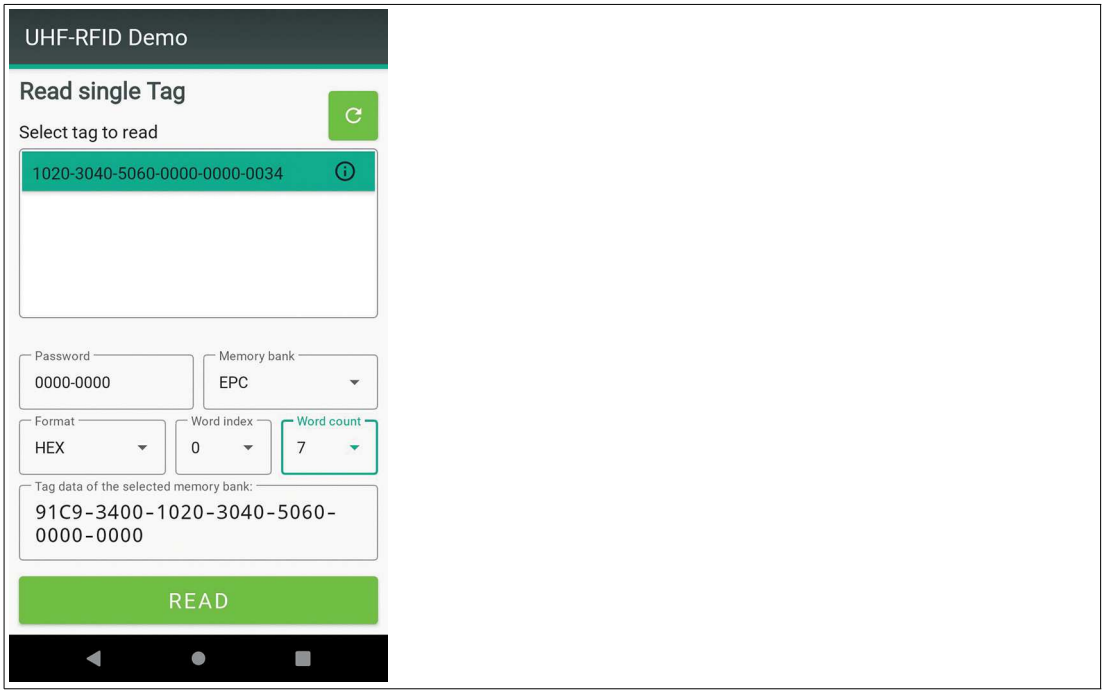


Figure 4.12

3. Adjust the relevant parameters.
4. Press "Read."

↳ The tag data with the entered parameters is read out.

↳ In the example, four words starting from the start address of 0 are read out from the EPC memory bank with the password 0000–0000 and displayed in HEX format.

Note

An error message appears if the parameter values are invalid.

4.4.5 Secure

Pressing "Secure" will adjust the read / write protection of a detected and selected tag. Making the appropriate setting allows you to render the tag unusable.

Securing the Tag

1. Click "Secure."

↳ The "Secure" menu will open.

↳ The handheld scans all tags in the sensing range and displays the result in a list.

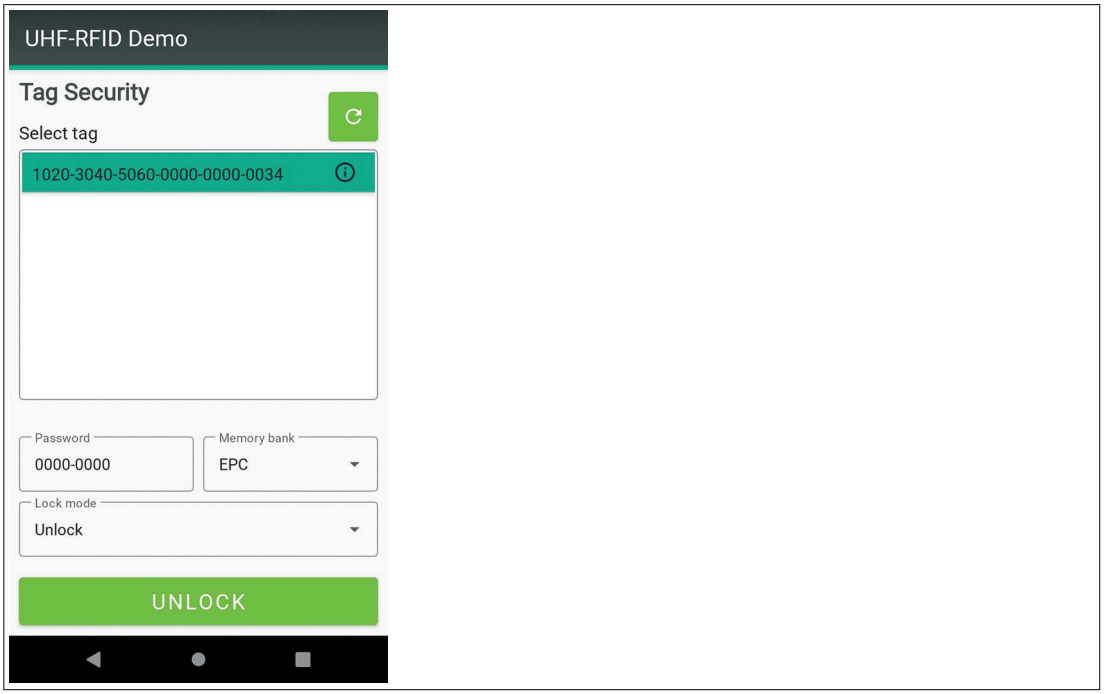


Figure 4.13

2. Select a tag from the list.
3. Depending on the status, you can perform the following actions.
4. Click "Unlock"

↳ The memory bank of the selected tag is unlocked with the set password.

↳ Memory protection can still be changed.

5. Click "Lock"

↳ The memory bank of the selected tag is locked with the set password.

↳ Memory protection can still be changed.

6. Click "Permanently unlock"

↳ The memory bank of the selected tag is permanently unlocked with the set password.

↳ Memory protection can no longer be changed.

7. Click "Permanently lock"

↳ The memory bank of the selected tag is permanently locked using the set password.

↳ Memory protection can no longer be changed.

8. Click "Destroy"

↳ The selected tag becomes unusable when the correct kill password is entered.

↳ The kill password must not have the default value of 0000–0000 and must be changed in advance.

Note

- For all actions except destroy, the password entered is used as the access password. When destroying a tag, it is used as a kill password.
- The action will not be performed if the password is incorrect. An error message will be displayed.
- Some tags do not support any of the listed functions or only some of the listed functions.

5 Glossary

ASCII	The American Standard Code for Information Interchange (ASCII) is an 8-bit character encoding
EPC Gen2	A worldwide GS1 radio interface standard. It defines the physical and logical requirements for RFID systems operating in the frequency range from 860 to 960 MHz.
RSSI	The received signal strength indicator (RSSI) indicates the signal strength that the reader receives from a tag in dBm.
VDA 5500	VDA 5500 is an industry recommendation from the German Association of the Automotive Industry (VDA). It defines aspects such as the coding of RFID data structures. Coding is in 6 bits according to ISO 17363-17367.
Word	A word or data word is the smallest amount of data that is read or written in a read or write operation of a tag. According to EPC Gen2 (ISO 18000-63), the length of a word is 2 bytes (16 bits) for tags.

5.1 ASCII table

hex	dec	ASCII	hex	dec	ASCII	hex	dec	ASCII	hex	dec	ASCII
00	0	NUL	**20**	**32**	**Space**	40	64	@	**60**	**96**	'
01	1	SOH	**21**	**33**	**!**	41	65	A	**61**	**97**	**a**
02	2	STX	**22**	**34**	**"**	42	66	B	**62**	**98**	**b**
03	3	ETX	**23**	**35**	**#**	43	67	C	**63**	**99**	**c**
04	4	EOT	**24**	**36**	**$**	44	68	D	**64**	**100**	**d**
05	5	ENQ	**25**	**37**	**%**	45	69	E	**65**	**101**	**e**
06	6	ACK	**26**	**38**	**&**	46	70	F	**66**	**102**	**f**
07	7	BEL	**27**	**39**	**'**	47	71	G	**67**	**103**	**g**
08	8	BS	**28**	**40**	**(**	48	72	H	**68**	**104**	**h**
09	9	HT	**29**	**41**	**)**	49	73	I	**69**	**105**	**I**
0A	10	LF	**2A**	**42**	*****	4A	74	J	**6A**	**106**	**j**
0B	11	VT	**2B**	**43**	**+**	4B	75	K	**6B**	**107**	**k**
0C	12	FF	**2C**	**44**	**,**	4C	76	L	**6C**	**108**	**I**
0D	13	CR	**2D**	**45**	**-**	4D	77	M	**6D**	**109**	**m**
0E	14	SO	**2E**	**46**	**.**	4E	78	N	**6E**	**110**	**n**
0F	15	SI	**2F**	**47**	**/**	4F	79	O	**6F**	**111**	**o**
10	16	DLE	**30**	**48**	**0**	50	80	P	**70**	**112**	**p**
11	17	DC1	**31**	**49**	**1**	51	81	Q	**71**	**113**	**q**
12	18	DC2	**32**	**50**	**2**	52	82	R	**72**	**114**	**r**
13	19	DC3	**33**	**51**	**3**	53	83	S	**73**	**115**	**s**
14	20	DC4	**34**	**52**	**4**	54	84	T	**74**	**116**	**t**
15	21	NAK	**35**	**53**	**5**	55	85	U	**75**	**117**	**u**
16	22	SYN	**36**	**54**	**6**	56	86	V	**76**	**118**	**v**
17	23	ETB	**37**	**55**	**7**	57	87	W	**77**	**119**	**w**
18	24	CAN	**38**	**56**	**8**	58	88	X	**78**	**120**	**x**
19	25	EM	**39**	**57**	**9**	59	89	Y	**79**	**121**	**y**
1A	26	SUB	**3A**	**58**	**:**	5A	90	Z	**7A**	**122**	**z**
1B	27	ESC	**3B**	**59**	**;**	5B	91	[	**7B**	**123**	**{**
1C	28	FS	**3C**	**60**	**<**	5C	92	\	**7C**	**124**	**I**
1D	29	GS	**3D**	**61**	**=**	5D	93	]	**7D**	**125**	**}**
1E	30	RS	**3E**	**62**	**>**	5E	94	^	**7E**	**126**	**~**
1F	31	US	**3F**	**63**	**?**	5F	95	_	**7F**	**127**	**DEL**

5.2 ASCII Table, 6-Bit Coding

ASCII	Binary value	ASCII	Binary value	ASCII	Binary value	ASCII	Binary value
Spaces	100000	**0**	110000	**@**	000000	**P**	010000
<EOT>	100001	**1**	110001	**A**	000001	**Q**	010001
<Reserved>	100010	**2**	110010	**B**	000010	**R**	010010
<FS>	100011	**3**	110011	**C**	000011	**S**	010011
<US>	100100	**4**	110100	**D**	000100	**T**	010100
<Reserved>	100101	**5**	110101	**E**	000101	**U**	010101
<Reserved>	100110	**6**	110110	**F**	000110	**V**	010110
<Reserved>	100111	**7**	110111	**G**	000111	**W**	010111
(	101000	**8**	111000	**H**	001000	**X**	011000
)	101001	**9**	111001	**I**	001001	**Y**	011001
*	101010	:	111010	**J**	001010	**Z**	011010
+	101011	;	111011	**K**	001011	**[**	011011
,	101100	<	111100	**L**	001100	\	011100
-	101101	=	111101	**M**	001101	**]**	011101
.	101110	>	111110	**N**	001110	**<GS>**	011110
/	101111	?	111111	**O**	001111	**<RS>**	011111

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