

## Features and Benefits

- Standard ISO communications
- User interface software
- RS232 serial communication
- Dedicated instruction set
- 6 to 9Volts supply compliant

## Ordering Information

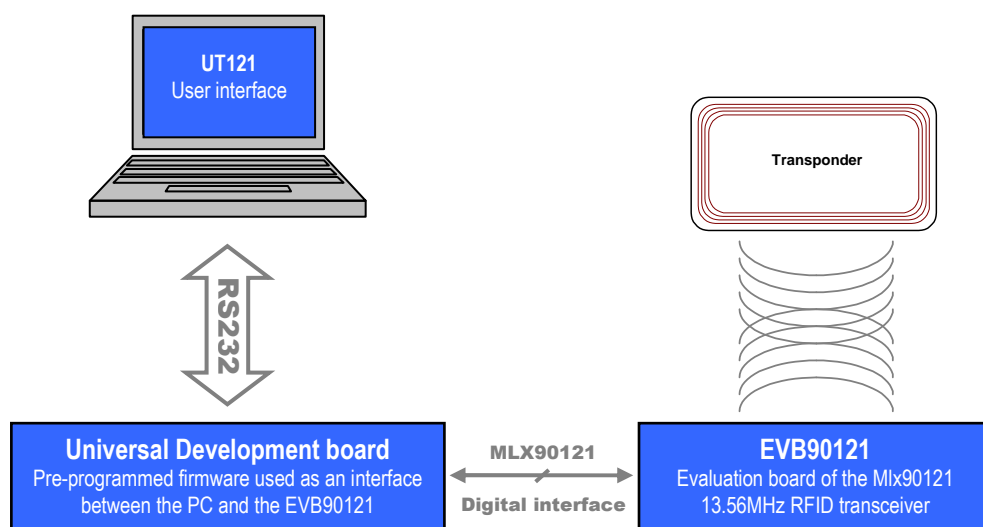
**Part No.**  
DVK90121

## General Description

The development kit DVK90121 has been developed by Melexis to create specific applications using international standards ISO/IEC and to evaluate the advantages and the high flexibility of the MLX90121 13.56MHz multi-norms RFID transceiver.

The DVK90121 consists of the evaluation board EVB90121 connected to the RFID universal development board. The universal development board contains the firmware for the communication with the MLX90121 and the communication with a computer through the RS232 serial interface.

A user interface software UT121, developed by Melexis, allows the user controlling the communication by initializing the MLX90121 device, sending specific commands and receiving the corresponding reply.



**Figure 1:** DVK90121 block schematic

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## 1. Unpacking the system

The DVK90121 is delivered with all the components, documentations and software listed below.

- Evaluation board EVB90121 with its specific antenna,
- Universal development board,
- RS232 and flat cables for PC and EVB90121 connections,
- Disk set consisting of the UT121 software and associated documentations.

## 2. Connecting the system

When you start with the development kit DVK90121, please follow the procedure described below.

- 1) Connect the PCB antenna to the evaluation board EVB90121 using the SMA connector.
- 2) Connect the EVB90121 with its antenna to the universal evaluation board using the flat cable provided in the box. Connect the flat cable in the PORTA connector of the universal development board (in the middle of the three 10 pins connectors in line).
- 3) Connect the universal development board to the PC using the RS232 cable. The RS232 cable is fitted into the DB9 connector of the universal development board and the other end is inserted into the COM port of the PC (DB9 connector). The chosen COM port can be selected in the UT121 software.
- 4) Connect the Power Supply of the universal development board and EVB90121. Both Power Supplies are required with a standard 2.1mm barrel connector and must be DC 6 to 9 Volts.
- 5) Switch on SW1 button on the universal development board.

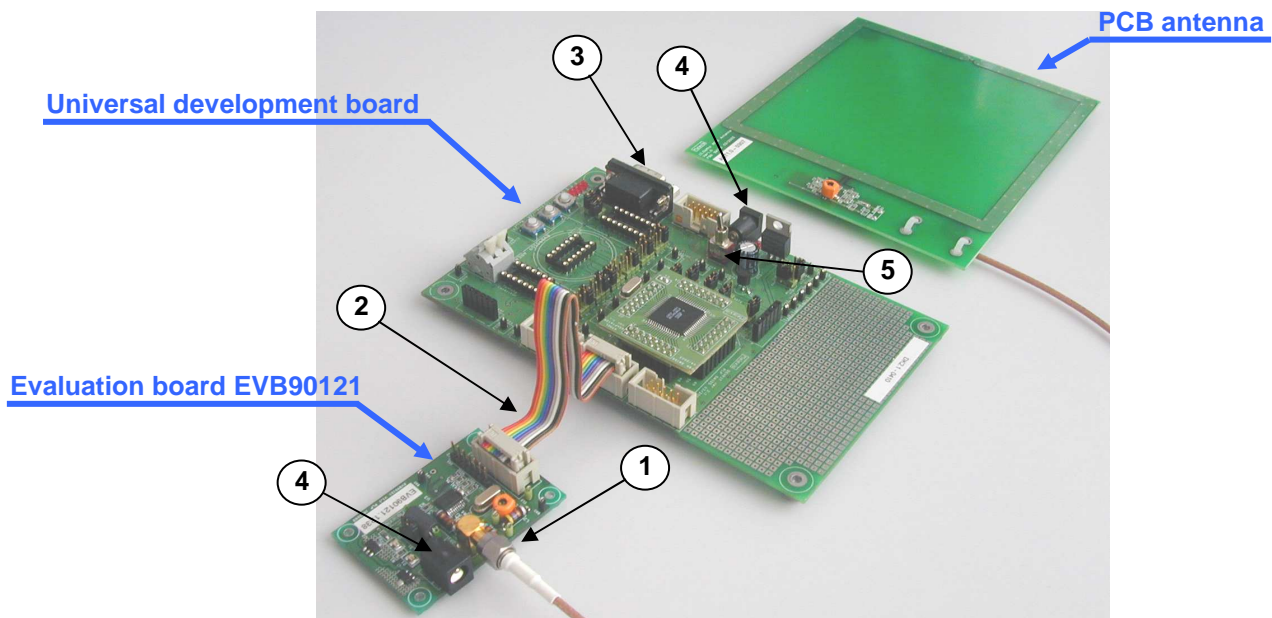


Figure 2: Connection of the DVK90121

**Important Note:** The supply must be between **6 to 9 Volts DC**. Higher voltage may damage permanently the DVK90121 circuit.

### 3. Installing the UT121 user interface software

To install the software, please insert the compact disc provided with the kit in your computer and simply copy the UT121 folder on your computer.

The user interface software is now ready to use and can be started by double-clicking on the icon *UT121*.

**Note:** To remove the UT121 software, you only need to delete the folder that you created on your PC. The software doesn't modify the registry and doesn't write anything to the system folders.

### 4. Working with the UT121 user interface software

#### 4.1 The first run

When you execute the UT121 software for the first time, the following window appears. It contains some explanation about the automatic update. Please read carefully the text displayed, choose the appropriate update check interval and press OK button.

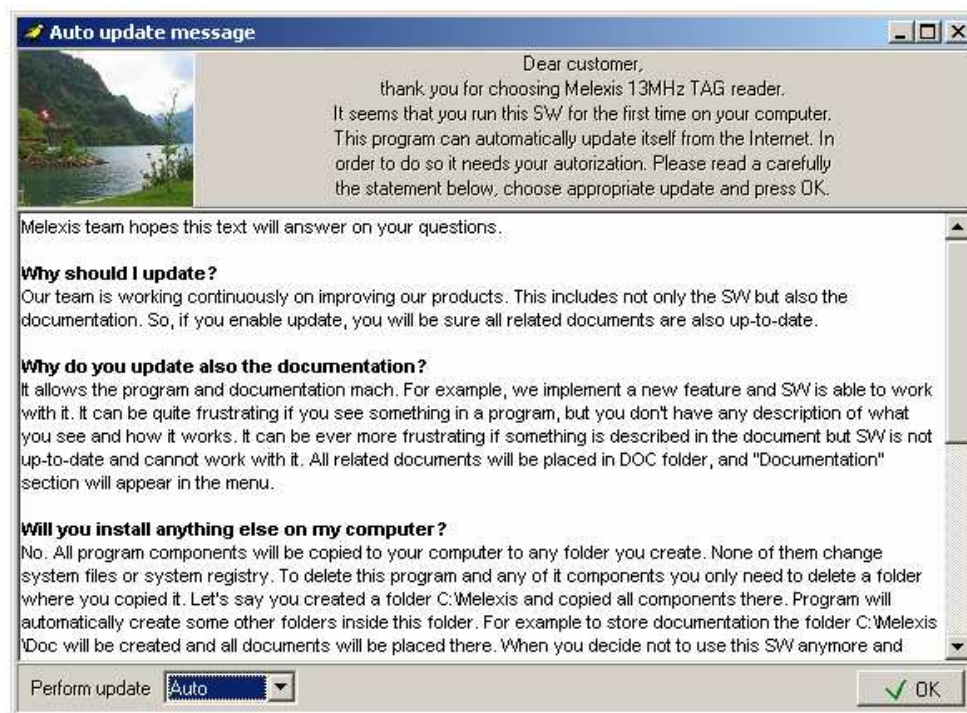


Figure 3: First use message

The update check interval will be used to automatically check on the Melexis WEB-site if new updates are available. The software will ask to the user if he allows the download and the automatic replacement of the user interface software and firmware. If you choose 'Never' as the update interval you will need to update the program by yourself using the "update" command in the "option" menu.

## 4.2 Main window

When the UT121 software is executed, the following main window will be displayed. It is structured in several parts: main menu, device status, communication status, command tree, command list and communication parts.

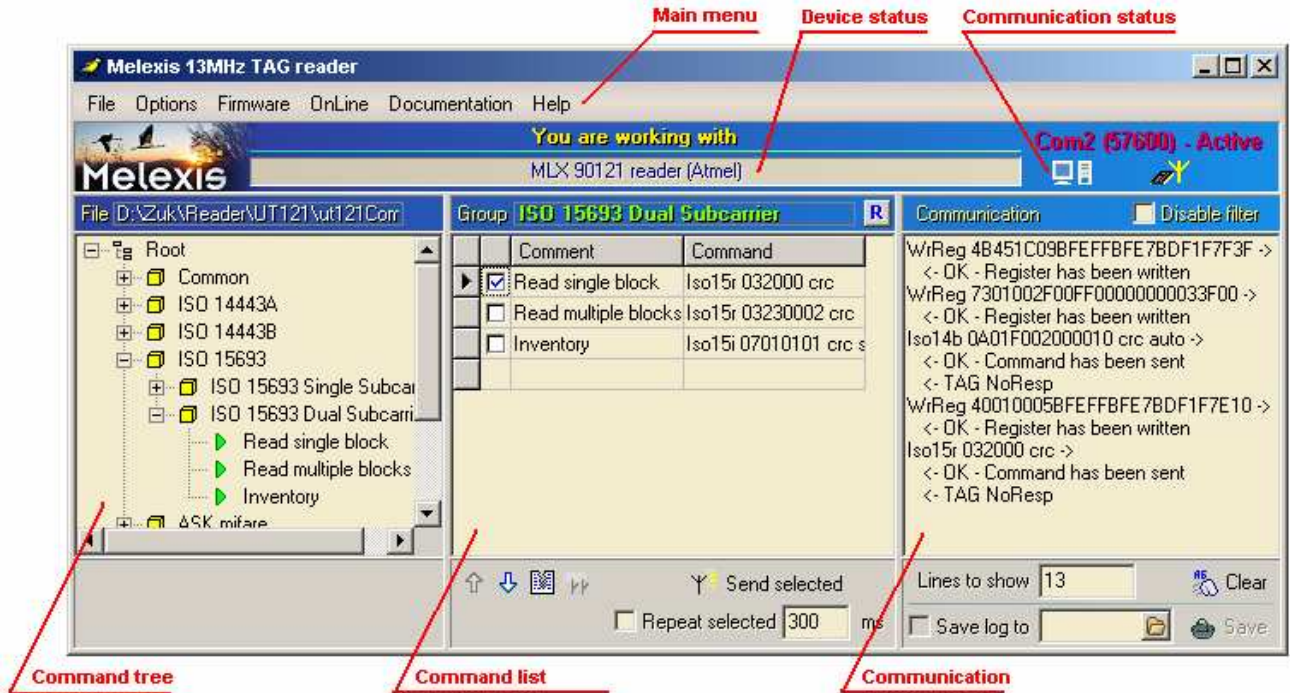


Figure 4: UT121 main window

The following chapters describe in detail all parts which compose the main window to familiarize the user with all the possibilities of the UT121 user interface software.

## 4.3 Communication status

The UT121 user interface software can communicate the RS232 or USB serial interfaces. The *communication status* part displays the status of the selected port. (Use of the DVK90121 is only possible through RS232 port)

A double-click on the *communication status* opens the “select port window” which allows the user selecting the appropriate port and Baud rate. Current data will be updated by pressing on the “update” button.

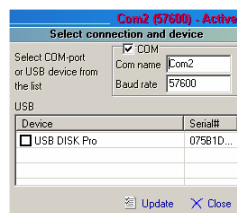


Figure 5: select port window

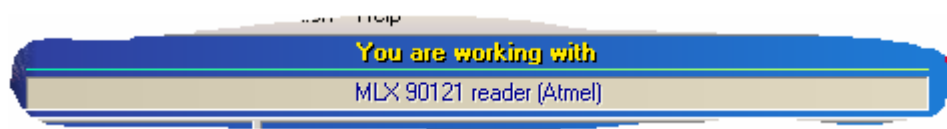
If the selected port exists and can be used by the program, it will be opened and “Active” state will be reported. “Closed” state means that the selected port doesn’t exist on the computer or that an other software already use it.

#### Notes:

- (1) Communication setup are 57600 baud with RS232.
- (2) When the program is closed, the current settings will be saved in the configuration file “*ut121Config.cfg*”. Next time the program is executed these settings will be automatically uploaded.

#### 4.4 Device status

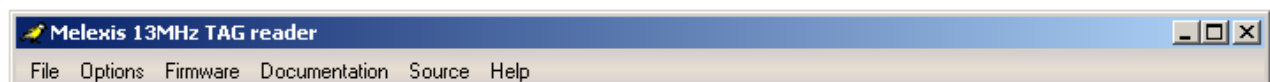
The device status shows if a Melexis development kit is connected to the user UT121. Then the name of the development kit is displayed as shown on the following picture.



If any development kit has been successfully detected, “No device” will be reported in the device status.

#### 4.5 Main menu

The main menu contains several drop-down menus listed and described below. Care should be taken that the view of the main menu can be modified after an update of the software.



**File:** All options to save and load a *Command List*. A *Command list* is a group which may contain commands to be executed.

**Options:** Automatic update options

- o Program settings: *Option to save the firmware file (hexadecimal file) during an automatic updates procedure. Option to remember the screen size when the program is closed.*
- o Auto update options: *Option concerning the automatic check interval.*
- o Connection: *Used to specify a proxy settings if necessary*
- o Update now: *The software will find new updates available on the Melexis WEB-site.*

**Firmware:** Used to load the firmware file (hexadecimal files .hex) and to program it into the DVK90121 through the serial interface. The current firmware into the DVK90121 will be replaced by the new one.



**Documentation:** Contains the up-to-date documentation of the DVK90121. Last files are downloaded when an update is executed

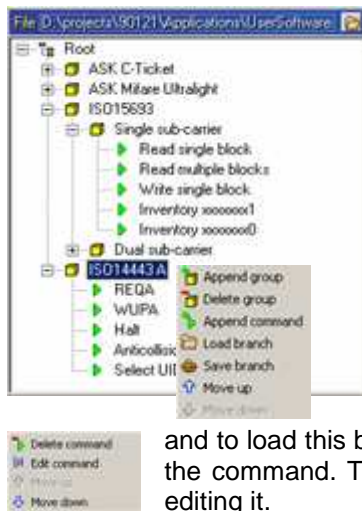
**Source:** Contains the updated microcontroller source code of the DVK90121. Last version is downloaded when an update is executed.

**Help:** To get Libraries and Firmware versions

#### 4.6 Command tree

The command tree window contains a set of commands supported by the DVK90121 organized in groups, sub-groups and commands. The complete structure is saved in the “*ut121ComList.tv*” and will be automatically loaded by the UT121 software when started. The following picture shows an organization’s example of the command tree window.


As an example, ISO14443 A group contains several commands according to ISO14443–A standard. If a DVK90121 is connected and recognized by the software, each command can be executed separately by clicking on the  icon. The entire group can also be executed by clicking on the  icon, in this case all commands include into the corresponding group will be executed one after the other. All groups may contain several sub-groups with another set of commands. In the example nearby, the ISO15693 group contains two sub-groups for Single or Dual sub-carrier specific commands.



The complete tree structure can be modified by the user and a right click on the name of the group or sub-group opens a popup menu with several options. Then the user can append a subgroup, delete the entire group, append a new command into this group and move the branch up and down in the list. It is also possible to save the complete branch (group with its complete structure, sub-groups, commands and register’s configuration)

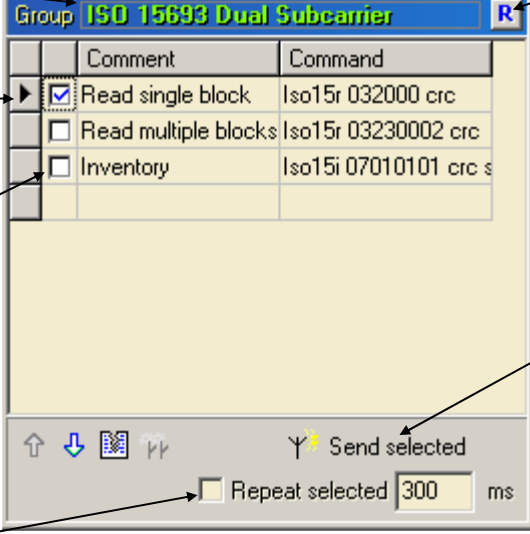
and to load this branch into another group. The same menu can be opened with a right-click on the command. Then the user can delete the command, change its position in the group and editing it.

All commands of the UT121 software are separated in two parts. The *Comment* part, which is a name chosen by the user and the *Command* part, which is the real command send to the DVK90121. This command cannot be completely defined by the user and should have a fixed definition part to be understood by the firmware.

To create a new command, right-click on a group to open the popup menu and chose the ‘*Append command*’ line. Then enter the name (*comment*) of the command and press “*OK*” button. The command will appear with a red symbol  while the *Command* part has not been entered. Then, to fill in the *Command* part, right-click on the command and chose the “*Edit command*” button.

#### 4.7 Command list & Register's configuration

The middle part of a main window represents the list of commands included in the group selected in the command tree window. Both, *Comment* and *Command* parts are displayed.



Group selected

Access to the registers configuration of the MLX90121

Press onto this grey rectangle to send the command

Each command in the command list can be selected by checking the square

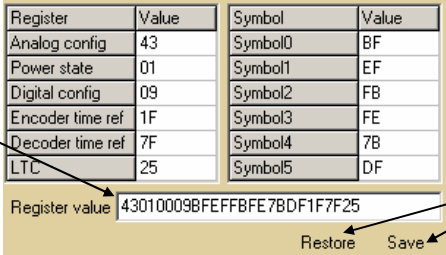
Button used to send all selected commands one after the other.

When "Repeat selected" is checked, the selected commands will be sent continuously according to the repeat interval.

The commands can be executed by pressing the grey rectangle on the left. Several commands can be selected and executed altogether by checking the corresponding white square  and by pressing on the 'Send selected' button. If  Repeat selected is checked all selected commands will be sent continuously according to the repeat interval.

**Note:** If the specified interval is too small and the system cannot execute commands that fast, it will increase this interval automatically.

To each group or sub-group selected corresponds a specific registers configuration of the MLX90121, and all commands grouped will be executed with the same registers configuration. When a group or sub-group is selected, the UT121 software automatically sends the current configuration to the DVK90121 to update the registers of the MLX90121 transceiver. To access this registers configuration, press onto the 'R' and a window with all register's name and hexadecimal values will be displayed. The current value is automatically updated when this window is closed (press again on the 'R' button).



Registers configuration of the MLX90121 transceiver. Start from address 0 (AnalogConfig register) to address 11 (LTC register)

Buttons used to save the current configuration or restore the previous one.

| Register         | Value | Symbol  | Value |
|------------------|-------|---------|-------|
| Analog config    | 43    | Symbol0 | BF    |
| Power state      | 01    | Symbol1 | EF    |
| Digital config   | 09    | Symbol2 | FB    |
| Encoder time ref | 1F    | Symbol3 | FE    |
| Decoder time ref | 7F    | Symbol4 | 7B    |
| LTC              | 25    | Symbol5 | DF    |

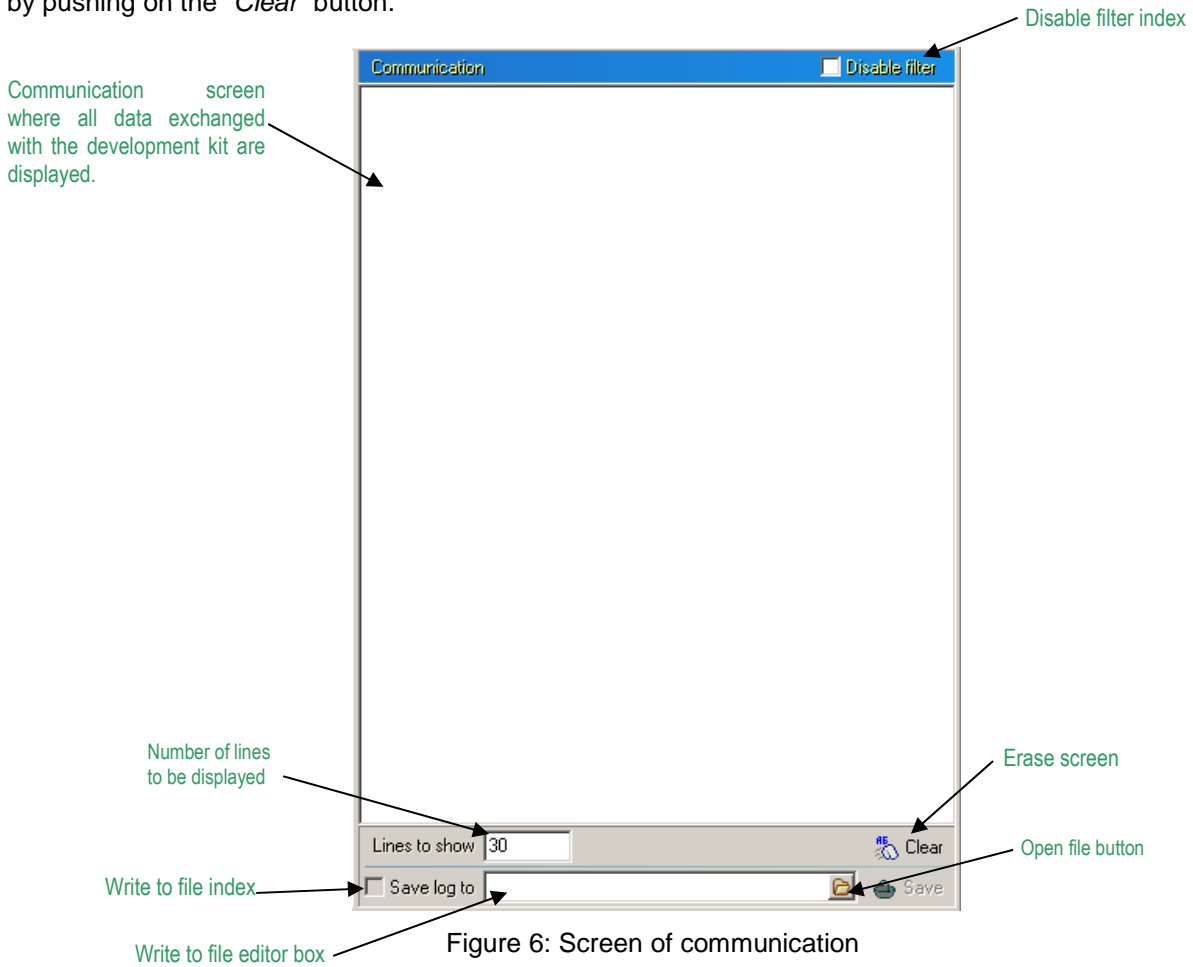
Register value: 430100098FEFFBFE7BDF1F7F25

Restore Save



### 4.8 Communication screen

The right side of the main window shows the communication between the computer and the development kit. Each time the user sends a command, it appears in the screen, followed by the reply of the DVK90121. The user can specify the number of displayed lines in the “*Lines to show*” window. It was set up to make sure the most recent command or reply are displayed without scrolling. Moreover, it is possible to erase the screen by pushing on the “*Clear*” button.



The content of the screen can be automatically written to a file. To do this, the file name must be specified and the index “*Save log to*” must be selected. File name can directly be specified by the user in the “*Write to file*” editor box or an existing file can be opened by using “*Open file*” button.

The program continuously communicates with the reader to test its presence, but these internal commands are filtered. It is possible to disable the filter with “*Disable filter*” option, and thus see all communications between the computer and DVK90121 device.

## 5. Set of commands

The firmware controls the communication with the MLX90121 multi-protocol RFID reader. Therefore, it has to be informed by the UT121 software of the protocol used and the command that needs to be executed. This chapter describes in detail the set of instructions used for the communication to the DVK90121 (microcontroller firmware).

The different commands are based on Mnemonic assignment defined by several ASCII characters forming the OP code and defining the protocol used. The OP code is followed by a variable number of Hexadecimal parameters, which form the command according to the protocol used and specific key words as CRC, CRCA, BCC.

### Notes:

- (1) The commands are always defined MSB first in the UT121 software. The firmware will take care of the data direction according to the standards specification.
- (2) Please note that the commands of the UT121 software are case insensitive. Then it is possible for the user to type commands with capital or small letters.

### 5.1 OP codes

The OP codes are used to inform the firmware of the protocol used to be able to control the communication.

|        |  |
|--------|--|
| Iso14a | OP code for ISO14443 type A                      |
| Iso14b | OP code for ISO14443 type B                      |
| Iso15  | OP code for ISO15693 single and dual sub-carrier |

### 5.2 Parameters

The parameters form the request sends to the transponder according to the standard used. For more information concerning these parameters, please refer to the ISO norms and the chapter 5.5 below.

### 5.3 Key words

Some key words are used to facilitate the implementation of the complete commands. For example, all parity check bytes or words are automatically calculated by the firmware and send with the request.

|               |   |
|---------------|---|
| <b>crc</b>    | The 16bits CRC ( $X^{16} + X^{12} + X^5 + 1$ ) is automatically calculated by the firmware and sends with the request.    |
| <b>crca</b>   | The 8bits CRC for type A TAG is automatically calculated by the firmware and sends with the request.                      |
| <b>bcc</b>    | The UID check byte for type A TAG is automatically calculated by the firmware and sends with the request.                 |
| <b>slot_X</b> | Used to define the number of slots during an <i>Inventory</i> and Write requests of ISO15693. X must be between 1 and 16. |

## 5.4 Help

The user can access to a complete comment about a command by sending a special command composed by the OP code followed by a space and a question mark (examples of help commands : "Iso14b ?", "Iso14a ?" and "Iso15 ?". The following is an example of how to access to the command's help.

| Group ISO14443 A         |   | Communication                  |
|--------------------------|---|--------------------------------|
| <input type="checkbox"/> | REQA                                      | Iso14a 26 7                    |
| <input type="checkbox"/> | WUPA                                      | Iso14a 52 7                    |
| <input type="checkbox"/> | Halt                                      | Iso14a 5000 8 crca             |
| <input type="checkbox"/> | Anticollision Level 1                     | Iso14a 9320 8                  |
| <input type="checkbox"/> | Select UID0 to UID2                       | Iso14a 937088049503 8 bcc crca |
| <input type="checkbox"/> | Anticollision Level 2                     | Iso14a 9520 8                  |
| <input type="checkbox"/> | Select UID3 to UID6                       | Iso14a 957011127A10 8 bcc crca |
| <input type="checkbox"/> | Anticollision, split after 2 bytes 5 bits | Iso14a 932508 5                |
| <input type="checkbox"/> | Anticollision sequence                    | Iso14a anticollision           |
| <input type="checkbox"/> | !help                                     | iso14a ?                       |

iso14a ? ->  
 <- Usage Iso14A <DATA Hex> <bit mask> [auto] [bcc] [crca]  
 <- DATA Hex - hexadecimal data stream  
 <- bit mask - number of significant bits in the last byte  
 <- auto - start MV automatically by HW  
 <- bcc - calculate XOR check value of the last 4 bytes  
 <- crca - calculate crc (using Iso14443-a algorithm)

## 5.5 Examples

Some examples of commands are described in this chapter.

### 5.4.1 ISO14443 type A

The DVK90121 allows the communication until the level 3 of the ISO14443 protocol called "Initialization and anticollision".

**Note:** The ISO14443 -A is a bit oriented protocol and all commands should include a hexadecimal parameter between '0' and '8', which defines where the command is split.

- o REQA (Request type A TAG)

| Op code       | Parameters          | Bit oriented parameter  |
|---------------|---------------------|---|
| <b>Iso14a</b> | <b>26</b>           | <b>7</b>  |
|               | '26' : REQA command | The last byte of parameter is coded on 7bits (command split after 7bits). |

- o ANTICOLLISION

| Op code       | Parameters  | Bit oriented parameter  |
|---------------|---|---|
| <b>Iso14a</b> | <b>9320</b>   | <b>8</b>  |
|               | '93' : ANTICOL. Level 1 command<br>'20' : Number of valid bit | The last byte of parameter is coded on 8bits (command split after 8bits). |

o SELECT

| Op code       | Parameters   | Bit oriented parameter  | Key word  | Key word  |
|---------------|--|---|---|---|
| <b>Iso14a</b> | <b>937088049503</b>  | <b>8</b>  | <b>bcc</b>  | <b>crca</b>   |
|               | '93' : Select command level 1<br>'70' : Number of valid bit<br>'88049503' : CT + UID0 to UID2 (The UID read after a successful <i>Anticollision level 1</i> command should be placed here) | The last byte of parameter is coded on 8bits (command split after 8bits). | The BCC check byte is automatically calculated by the firmware. | The 8bits CRC type A is automatically calculated by the firmware and send with the request. |

o INVENTORY SEQUENCE

| Op code   | Parameters       |
|---|------------------|
| <b>Iso14a</b>   | <b>Inventory</b> |
| Perform a complete Inventory sequence. All the UIDs of the transponders in the field will be displayed. |                  |

### 5.4.2 ISO14443 type B

The DVK90121 allows the communication until the level 3 of the ISO14443 protocol called "*Initialization and anticollision*".

o WUPB (Wake-up type B TAG)

| Op code       | Parameters  | Key word   |
|---------------|---|--|
| <b>Iso14b</b> | <b>050008</b>   | <b>crc</b>   |
|               | '05' : Anticol. Prefix byte APF<br>'00' : Application Family Id. AFI<br>'00' : PARAM (WUPB, Nbr of slots) | The 16bits CRC type B is automatically calculated by the firmware and send with the request. |

o Slot-MARKER (slots after REQW/WUPB command)

| Op code       | Parameters                              | Key word   |
|---------------|---|--|
| <b>Iso14b</b> | <b>15</b>                               | <b>crc</b>   |
|               | '15' : Anticol. prefix byte APn 2 slots | The 16bits CRC type B is automatically calculated by the firmware and send with the request. |

o ATTRIB

| Op code       | Parameters   | Key word   |
|---------------|--|--|
| <b>Iso14b</b> | <b>1D92036A960000101</b>   | <b>crc</b>   |
|               | '1D' : Attrib command<br>'92036A96' : Identifier PUPI send by the TAG after a successful REQW/WUPB command<br>'00' : Param 1<br>'00' : Param 2<br>'01' : Param 3<br>'01' : Param 4 | The 16bits CRC type B is automatically calculated by the firmware and send with the request. |

### 5.4.3 ISO15693 single/dual sub-carrier

The DVK90121 allows the communication until the level 3 of the ISO15693 protocol called “*Anticollision and transmission protocol*”.

○ READ SINGLE BLOCK (RSB)

| Op code      | Parameters   | Key word   |
|--------------|--|--|
| <b>Iso15</b> | <b>022000</b>  | <b>crc</b>   |
|              | '02' : Flags of the request<br>'20' : Read single block command<br>'00' : Block number | The 16bits CRC type B is automatically calculated by the firmware and send with the request. |

○ WRITE SINGLE BLOCK (WSB, CSB)

| Op code      | Parameters  | Key words   |                                   |
|--------------|---|---|-----------------------------------|
| <b>Iso15</b> | <b>42210011223344</b>   | <b>crc</b>  | <b>Slot 2</b>                     |
|              | '42' : Flags of the request<br>'21' : Write single block command<br>'00' : Block number<br>'11223344' : Data to write | The 16bits CRC is automatically calculated by the firmware and send with the request. | Two slots send after the request. |

**Note:** Certain transponder doesn't support the write command with the option bit set (Flags to 42/43) or cleared (Flags to 02/03).

○ INVENTORY

| Op code      | Parameters   | Key words   |                                   |
|--------------|--|---|-----------------------------------|
| <b>Iso15</b> | <b>06010100</b>  | <b>crc</b>  | <b>Slot 15</b>                    |
|              | '06' : Flags of the request<br>'01' : Inventory command<br>'01' : mask length (in this case we use only 1 bit)<br>'00' : mask value. In this example mask value is xxxxxx0 | The 16bits CRC is automatically calculated by the firmware and send with the request. | Two slots send after the request. |

○ ANTICOLLISION SEQUENCE

| Op code      | Parameters  |
|--------------|---|
| <b>Iso15</b> | <b>Inventory</b>  |
| For ASK      | Perform a complete Inventory sequence. All the UIDs of the transponders in the field will be displayed. |

| Op code      | Parameters  |
|--------------|---|
| <b>Iso15</b> | <b>Inventory</b>  |
| For FSK      | Perform a complete Inventory sequence. All the UIDs of the transponders in the field will be displayed. |

## **6. Disclaimer**

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Europe and Japan:

Phone: +32 1367 0495  
E-mail: [sales\\_europe@melexis.com](mailto:sales_europe@melexis.com)

All other locations:

Phone: +1 603 223 2362  
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