

## **Introduction**

This document describes the graphical user interface (GUI) software (STSW-ST25RU001) for the ST25RU3993-EVAL board.

The ST25RU3993-EVAL board is a UHF RFID demonstration reader based on ST's fully integrated Gen2 compatible reader ICs.

Additionally, a quick start guide includes a list of basic steps required to configure the demo reader for the most common applications.

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# 1 Quick start guide

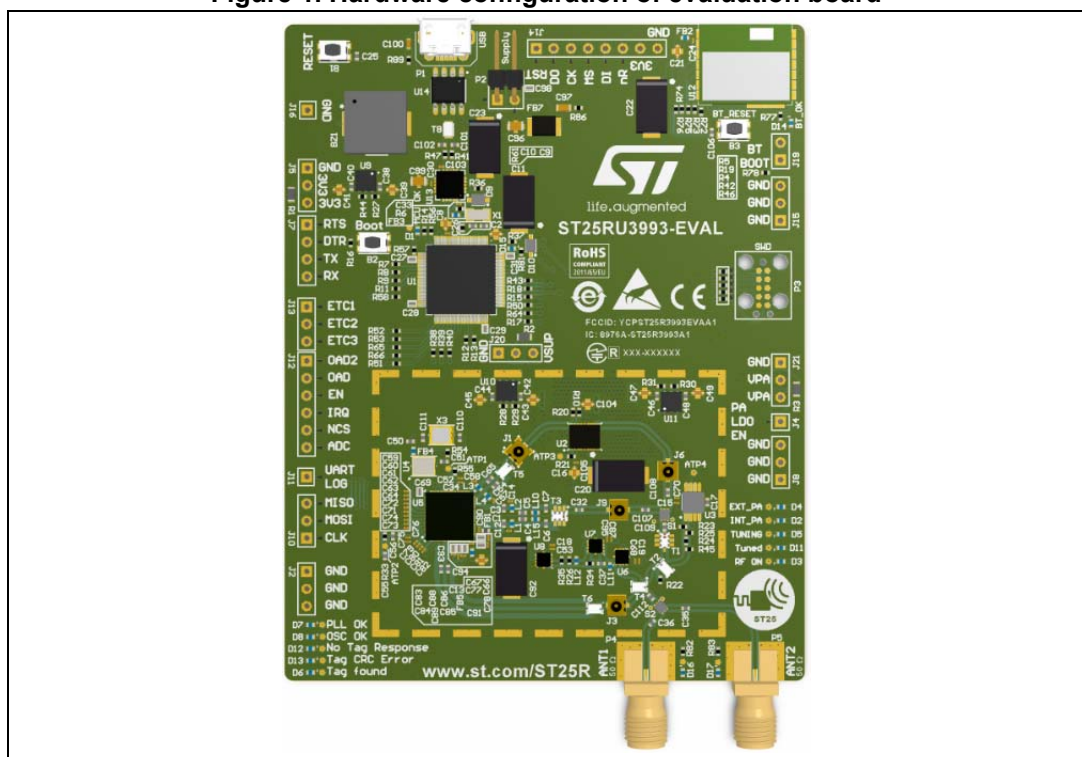
## 1.1 Hardware preparations

1. Connect the coax cable of the antenna to antenna port 1, which is activated by default. Antenna port 2 can be used as well but needs to be configured as output in the reader settings dialog.

*Note:* Always make sure that a 50  $\Omega$  antenna or some other 50  $\Omega$  load is connected to the active antenna port when RF power is switched ON.

2. Connect the ST25RU3993-EVAL board to the host PC running the GUI via a micro-USB cable.

**Figure 1. Hardware configuration of evaluation board**

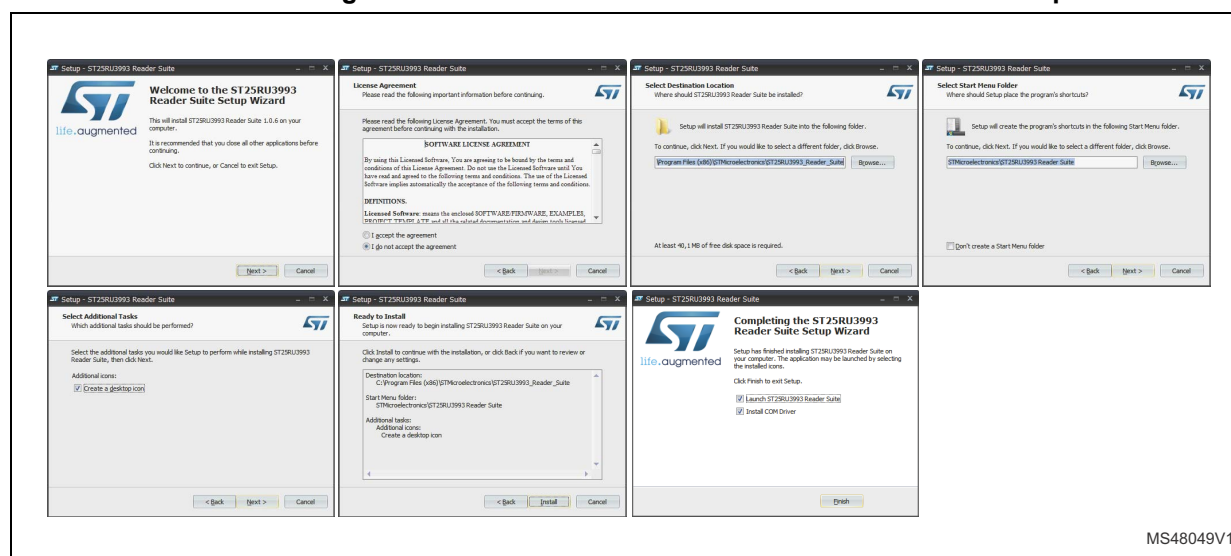


## 1.2 Software installation

1. To install the ST25RU3993 GUI software click on ST25RU3993\_GUI\_vx\_x\_x.exe
2. Follow the instructions of the software installation wizard
3. Install COM driver
4. Start the ST25RU3993 GUI

*Figure 2* shows the software installation wizard step

Figure 2. ST25RU3993 GUI software installation wizard steps

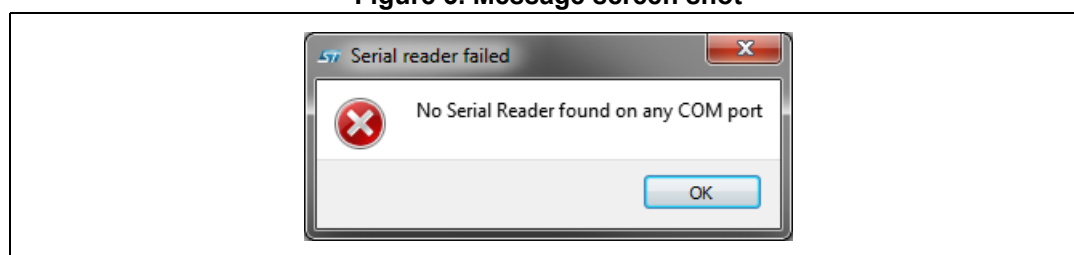


MS48049V1

## 1.3 First connection

1. In case GUI is not already running, start the ST25RU3993 GUI through the desktop symbol shown in [Figure 4](#)
2. Click on the Connect Reader button, or go to the menu Control and select Connect Reader. Alternatively you can also press Ctrl+A ([Figure 5](#)).
3. The application automatically scans all available COM ports for a connected ST25RU3993-Eval board.
4. The connected board is displayed automatically after a few seconds (see [Figure 6](#)).
  - a) If the board is not detected, an error message dialog is displayed (see [Figure 3](#)). Make sure that a USB serial port is detected by Windows® Device Manager when the board is attached to the PC over Micro USB (see [Figure 7](#)).

Figure 3. Message screen shot



- a) To access **Device Manager**, go to **Control panel / All Control panel items / System / Device Manager**.

Figure 4. ST25RU3993 GUI icon

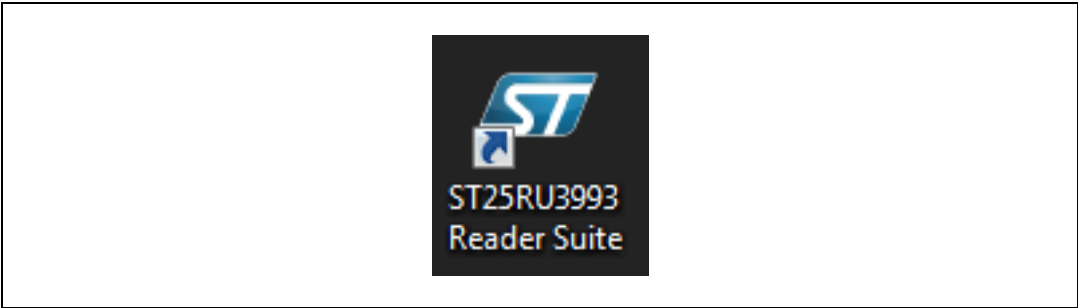


Figure 5. GUI control menu

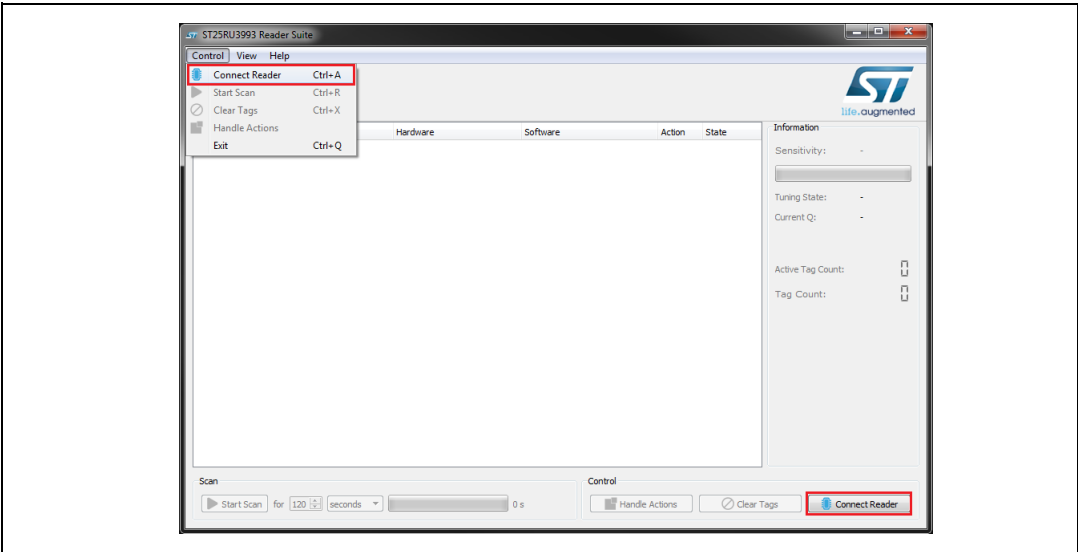
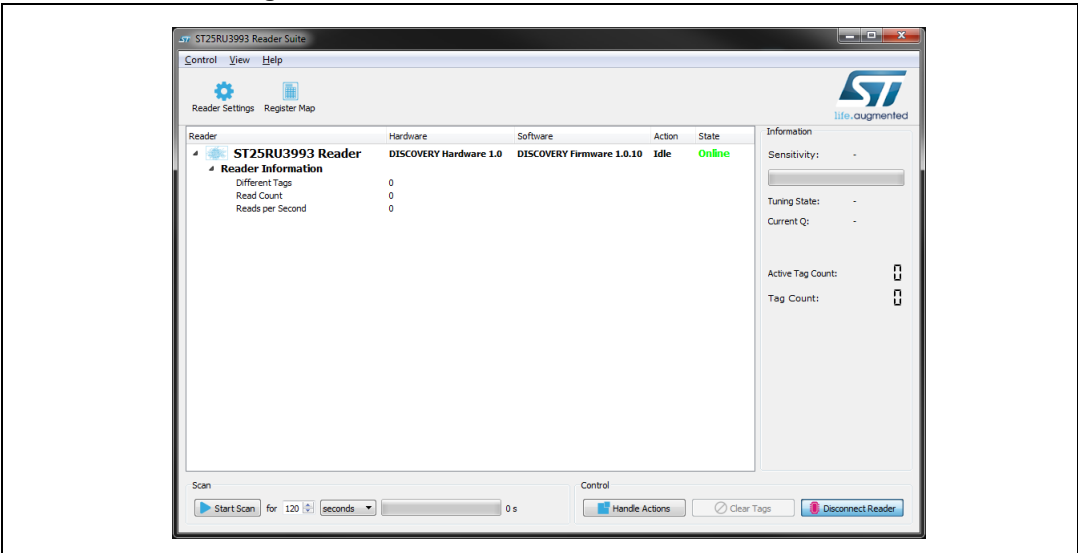
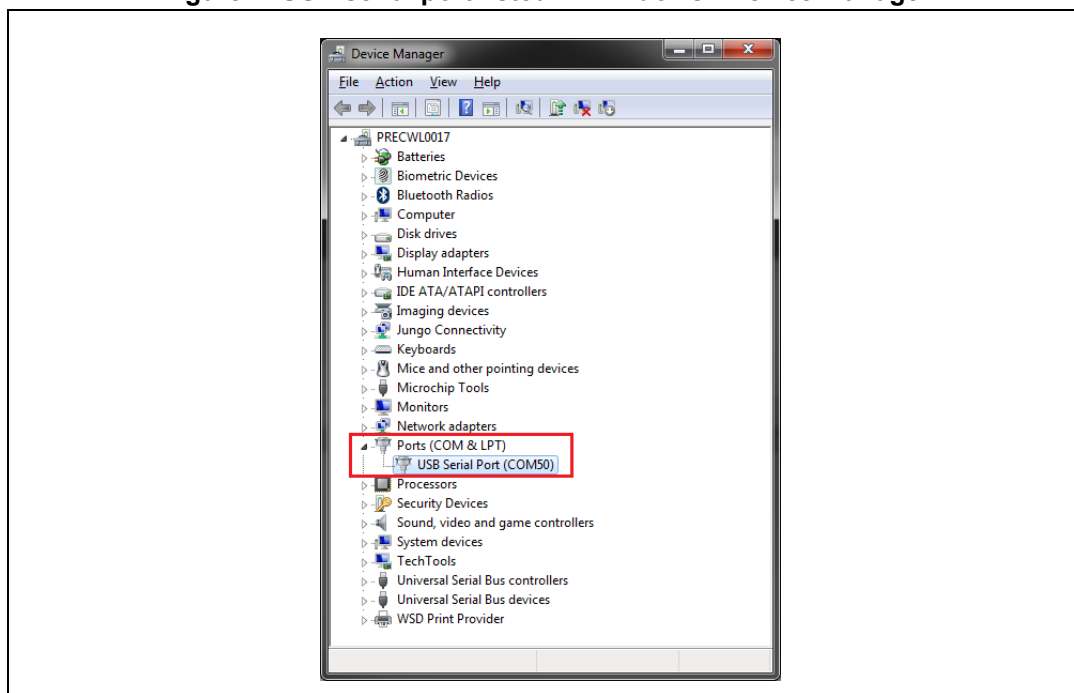


Figure 6. Board detected after initial connection



**Figure 7. USB serial port listed in Windows® Device Manager**



## 2 GUI user guide

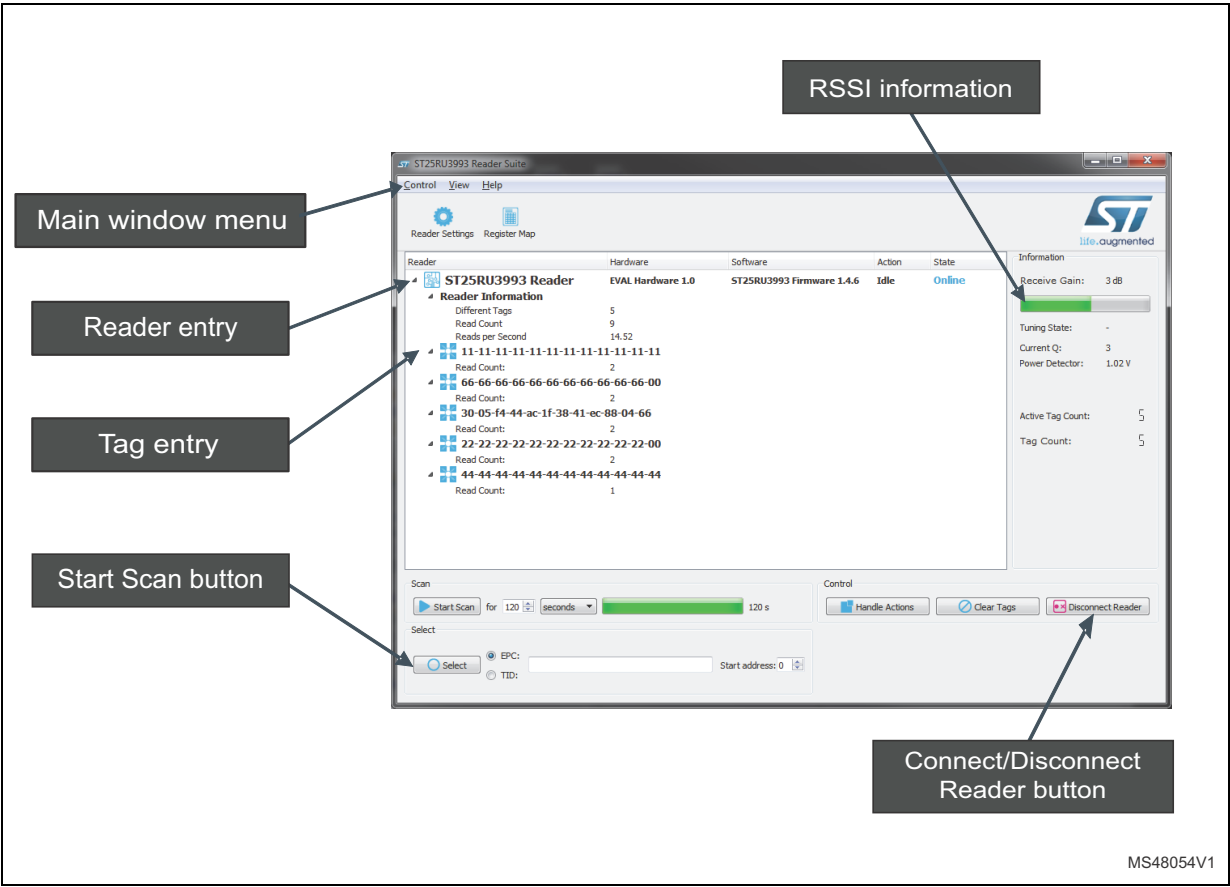
This section provides detailed information about all available functions of the GUI, and illustrates its application structure.

The GUI is a Windows® 7 application and it communicates with the demo reader via a USB serial COM port (UART).

### 2.1 Main Window

Figure 8 shows the ST25RU3993 GUI main window

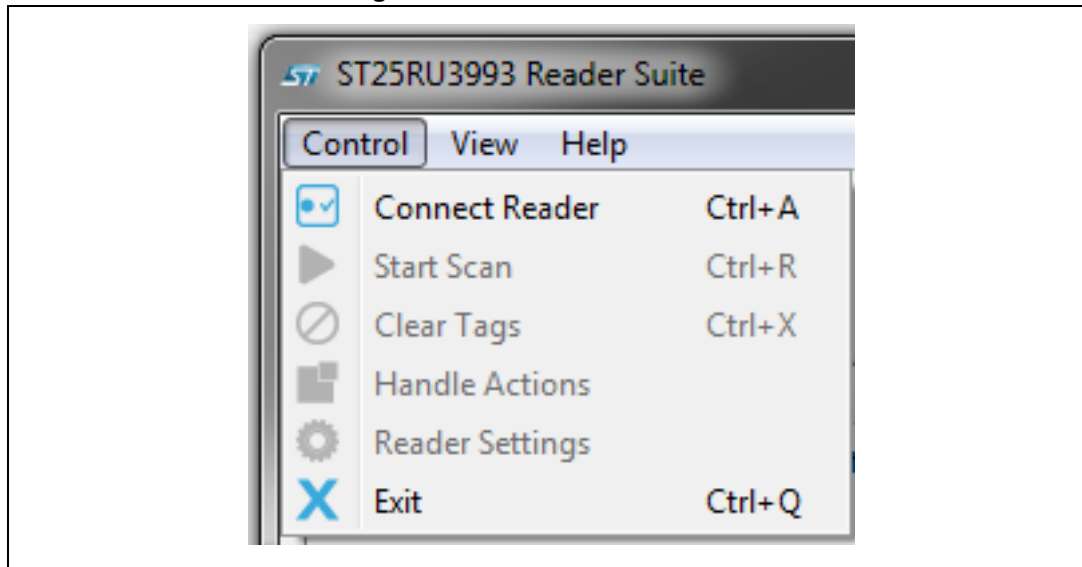
Figure 8. ST25RU3993 GUI main window



## 2.1.1 Main window menu

### Control menu

Figure 9. Control menu window

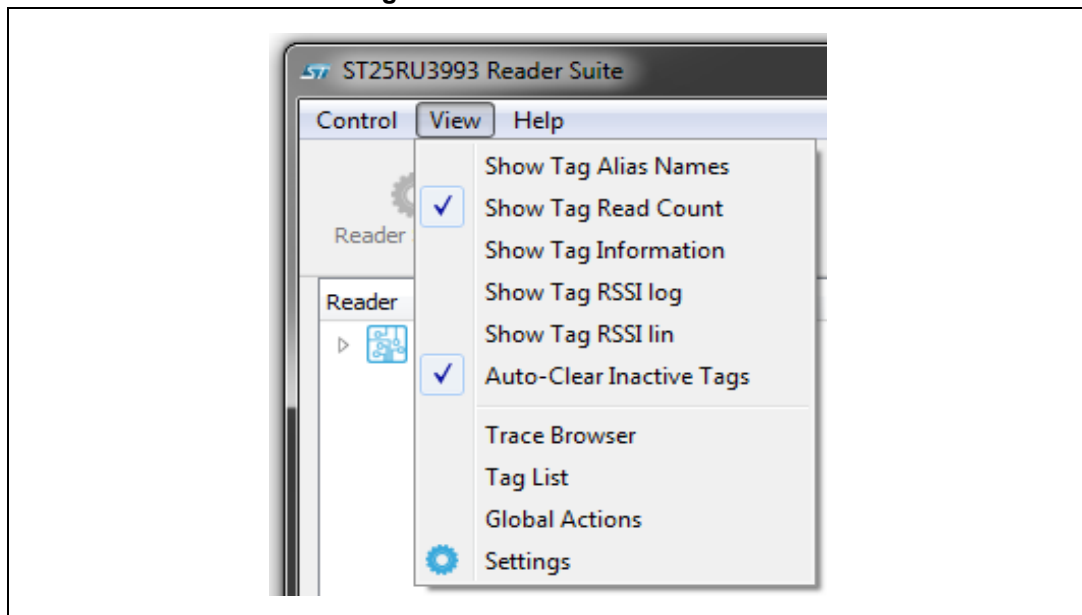


Where:

- **Connect Reader**
  - Connects UHF RFID Reader with the GUI
- **Start Scan:**
  - **Starts** scanning for tags
- **Clear Tags:**
  - Clears tag entries
- **Handle Actions:**
  - Enables GUI actions that could be associated with tags.  
For example: GUI displays a picture upon reading a specific tag EPC
- **Reader Settings:**
  - Set the Reader configuration

## View menu

Figure 10. View menu window

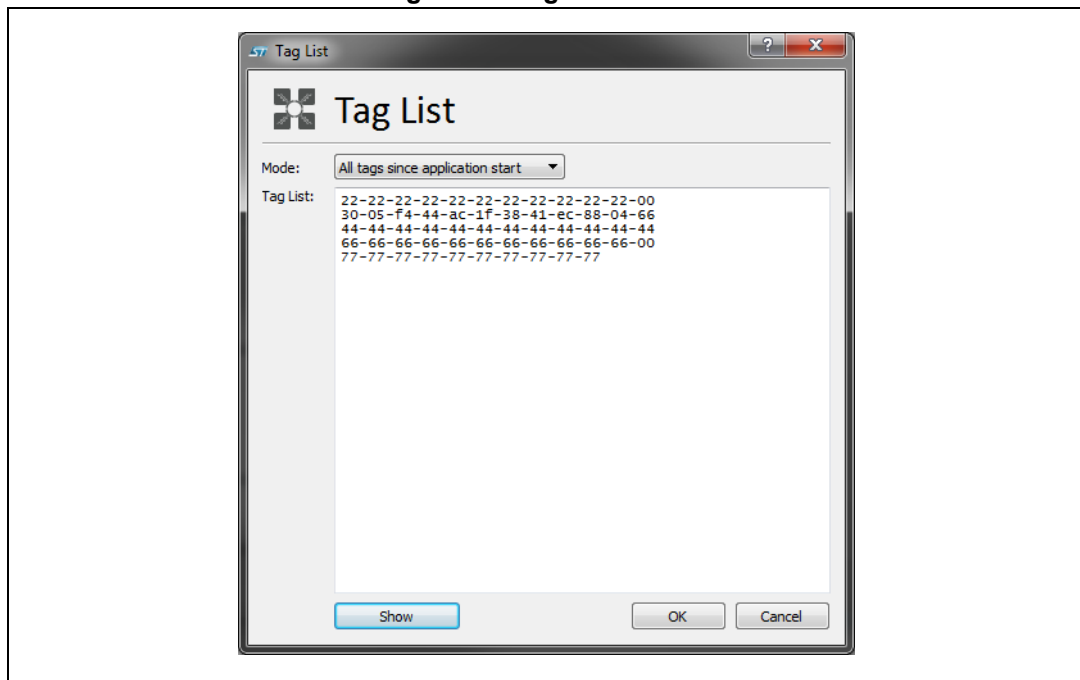


Where:

- **Show Tag Alias Names:**
  - Displays the user defined alias name instead of the EPC number of a tag.
- **Show Tag Read Count:**
  - Displays the number of times each tag is inventoried by the reader
- **Show Tag Information:**
  - Displays additional information about the tag.
- **Show Tag RSSI log:**
  - Display received tag RSSI in logarithmic scale
- **Show Tag RSSI lin:**
  - Display received tag RSSI in linear scale
- **Auto-Clear Inactive Tags:**
  - Applies the timing information for the tag list of the main window defined in the Settings window (see [GUI Settings](#)).
- **Trace Browser:**
  - The Trace Browser window appear at the bottom of the main window.  
Extends the main window by the Trace Browser. The Trace Browser is detachable.
- **Tag List:**
  - Displays a configurable tag list

## Tag List

Figure 11. Tag list window



Where:

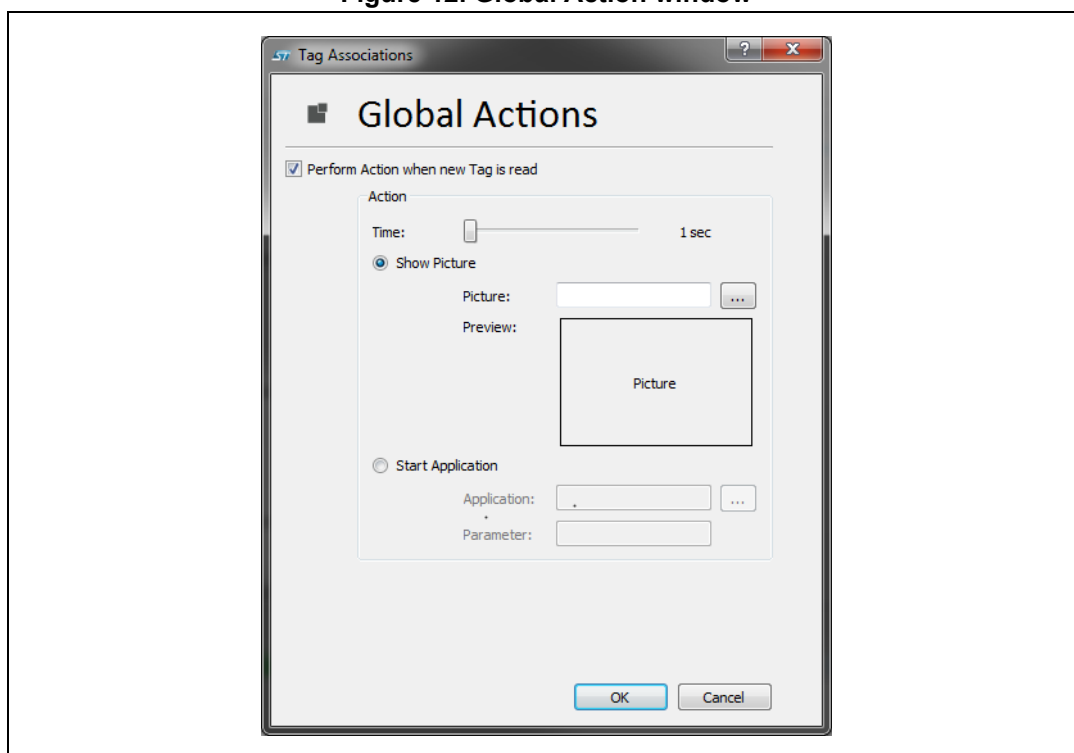
- **Mode:**  
Defines which tags are going to be displayed in the tag list window. The options are:
  - All tags since application start
  - All tags of last scan
  - All current tags

The **Show** button applies the settings.

*Note:* Tags will not be listed by their alias names.

## Global Actions

Figure 12. Global Action window



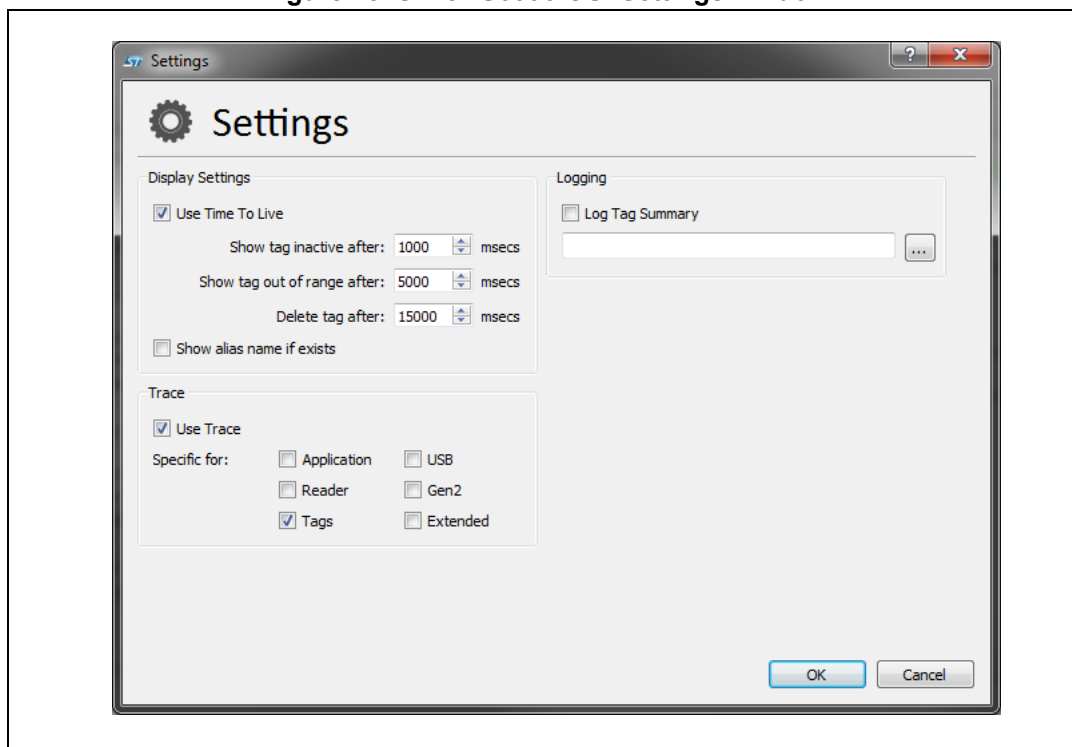
Where:

1. **Perform Action when a new Tag is read:**  
Allows defining an action upon a tag read.
- **Time:**  
Sets the duration of the defined action.
- **Show Picture:**  
GUI displays a picture upon a tag read.
  - **Picture:**  
Browse computer to select the picture used for the tag action
  - **Preview:**  
Shows a preview of the picture used for the tag action.
- **Start Application:**  
Starts an external application upon a tag read.  
Example: Play a sound:
  - **Application:**  
Browse computer to select the external application used for the tag action.
  - **Parameter:**  
Additional command field used for the external application.

*Note:* Any action needs to be activated by the Handle Actions button in the main window.

## GUI Settings

Figure 13. ST25RU3993 GUI Settings window



The setting window showed in [Figure 13](#) is divided in three parts:

1. Display Settings
2. Trace
3. Logging

### Display Settings:

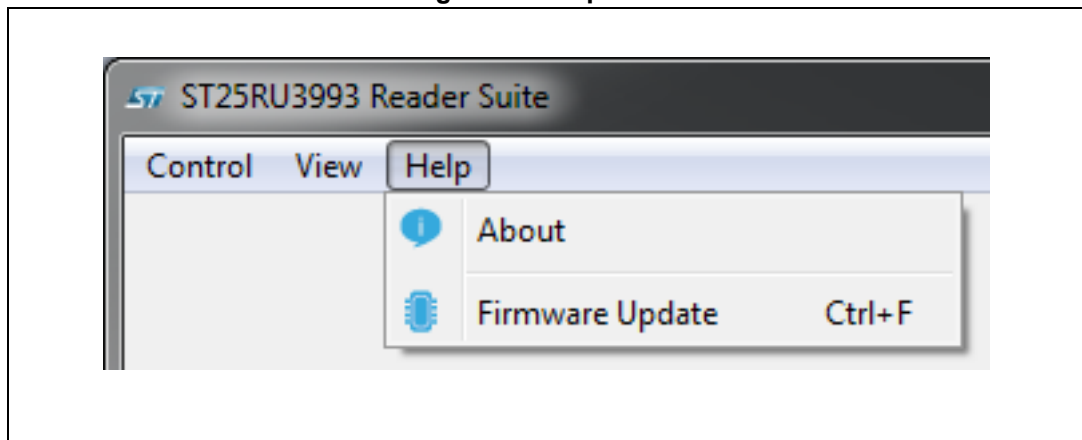
- **Use Time to Live:**  
Activate/Deactivate the timing definitions for tags entries displayed in the main window.
- **Show tag inactive after:**  
Timing definition for a tag entry, which is currently not read and is considered inactive. Tag entry is shaded.
- **Show tag out of range after:**  
Timing definition for a tag entry that has not been read for an extend period of time. Tag entry is defined to be outside the reader field. Tag entry font is "grayed-out".
- **Delete tag after:**  
Timing definition of a tag entry after which it is removed from the tag entry list in the main window.
- **Show alias name if exists:**  
Use a user defined alias name instead of the EPC number.

### Trace:

- **Use Trace:**  
Activates/Deactivates the communication trace.

## Help menu

Figure 14. Help menu

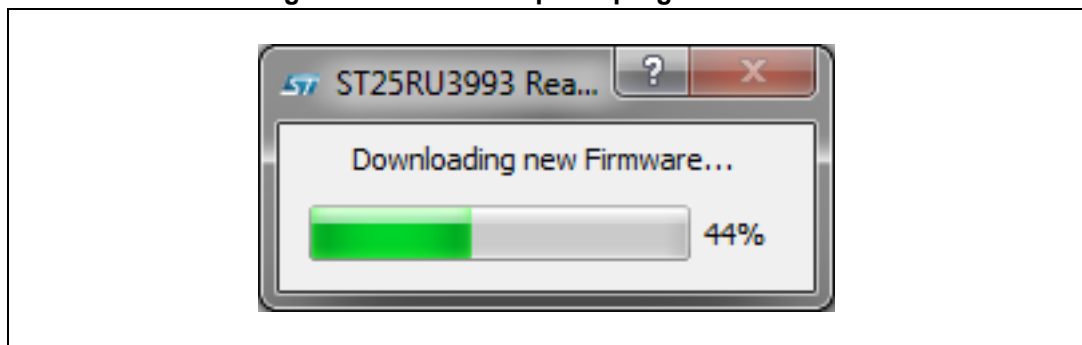


### About:

Displays GUI version and the contact information of STMicroelectronics.

### Firmware update window

Figure 15. Firmware update progress window



This function allows to select a firmware file, and to update the connected reader with the new Firmware.

The FW file (ST25RU3993 FW vx-x-x xxxx.bin) is located in the Firmware folder within the installation directory of the ST25RU3993 GUI. The folder location is automatically set


2.1.2 Main window controls

Reader Entry

Reader Information shows all information related to the current scan activity.

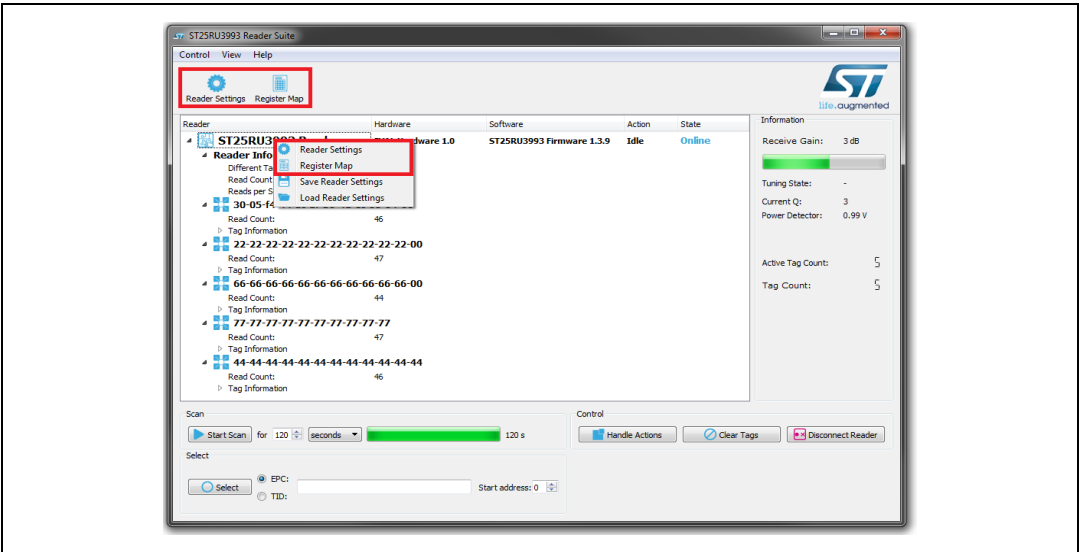
- **Different Tags:** Number of different tags found by the reader.
- **Read Count:** Number of tag reads performed since application start or last reset.
- **Reads per second [tags reads/sec]:** Current tag read rate over all current tags.

Figure 16. Main window - Reader Settings

Reader	Hardware	Software	Action	State
 <b>ST25RU3993 Reader</b>	EVAL Hardware 1.0	ST25RU3993 Firmware 1.3.9	Idle	Online
<b>Reader Information</b>				
Different Tags				
Read Count				
Reads per Second				
	5			
	180			
	54.40			

With a right click on the reader entry (ST25RU3993 Reader) a pop-up menu is shown. This menu allows to access the **Reader Settings**, the **Register Map** and it is possible to save and load the reader settings to the disk. **Reader Settings** and Reader Settings and Register Map can be access through the buttons above the main window as well. can be accessed through the buttons above the main window.

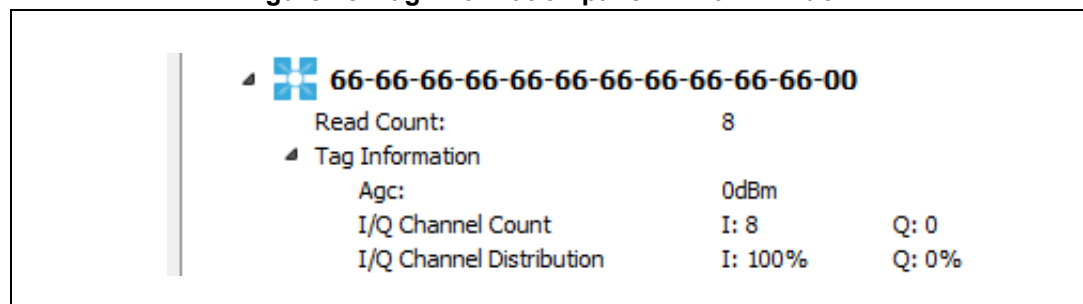
Figure 17. Pop up menu - Reader entry





## Tag information

Figure 18. Tag information panel in main window

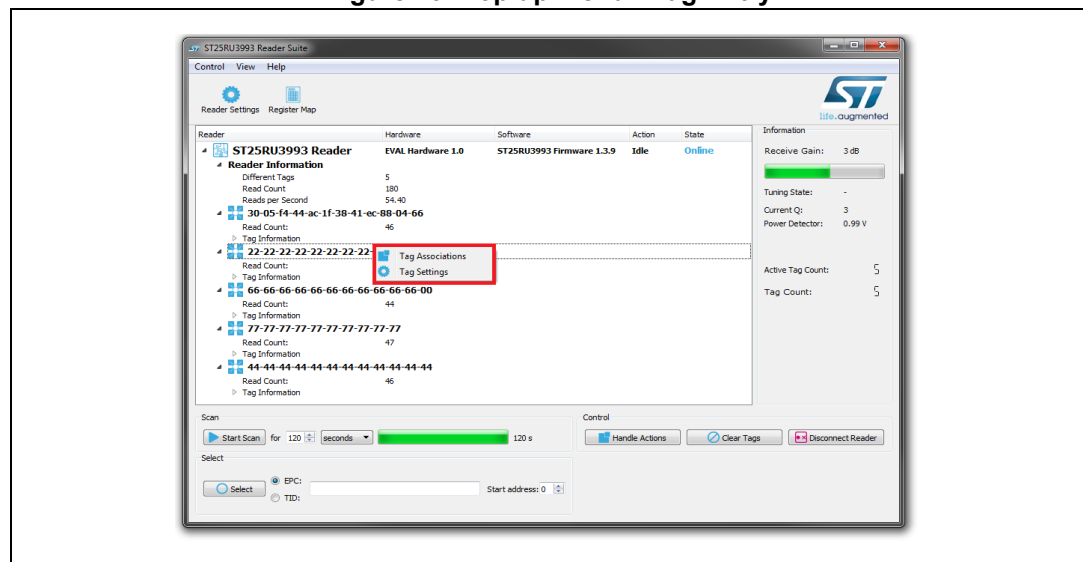


- **Agc:**  
Shows the AGC value of the reader
- **I/Q Channel Count:**  
Displays how often the internal decoder has chosen the I or Q channel for decoding the tag information.
- **I/Q Channel Distribution:**  
Shows the I and Q channel selection distribution per tag
- **Input power:**  
Shows the logarithmic/linear receive signal strength (RSSI) of the tag

## Tag Entry

When the reader has read one or more tags, the EPC number are displayed in the main window. With a right click on the tag entry a pop-up menu appears from which **Tag Associations** and **Tag Settings** dialog can be opened.

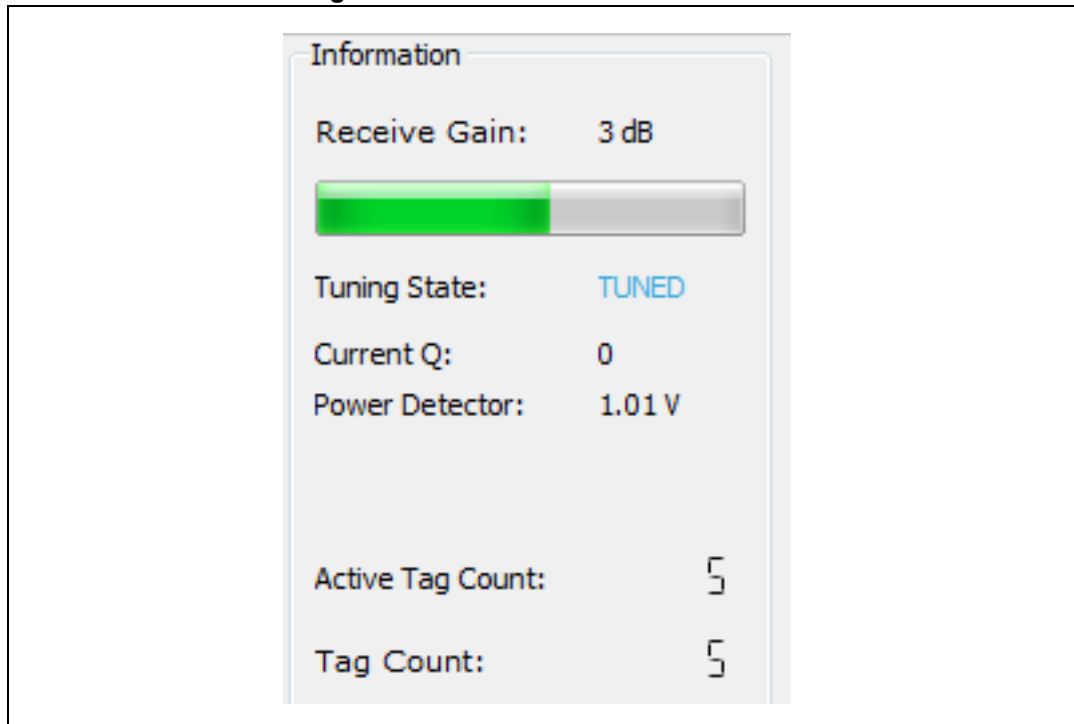
Figure 19. Pop up menu - Tag Entry



### Information panel

The read information panel on the right shows additional information about current read settings and tag counts.

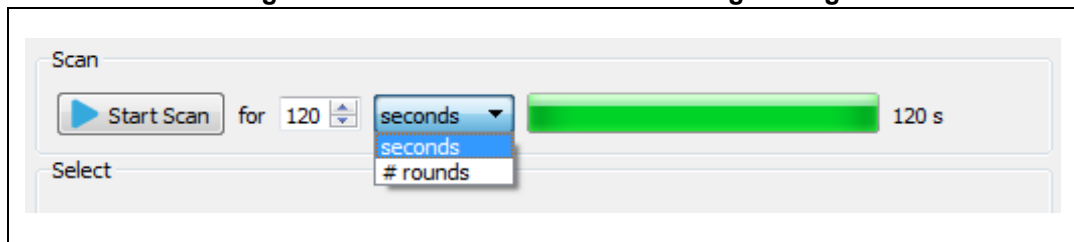
Figure 20. Side bar - Read information



### Scan panel

By clicking on the **Start Scan** button the reader starts to scan for tags.

Figure 21. Main window - Start scanning for Tags



On the right hand side of the scan button there is an entry field to define when the scan operation is stopped again.

There are two options:

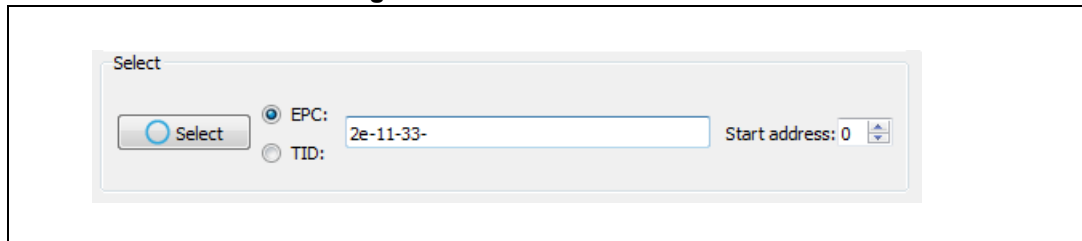
- **Second:**  
After the defined time the scan operation is stopped automatically. The maximum number that can be entered is 600.
- **#rounds:**  
After the defined number of inventory rounds are completed the scan operation is stopped. The maximum number that can be entered is 600.

The progress bar indicates how much time is left, or how many inventory rounds to perform, until the scanning automatically stops.

If a zero value is entered the scanning operation will continue endlessly.

### Selected panel

**Figure 22. Main window - Select**

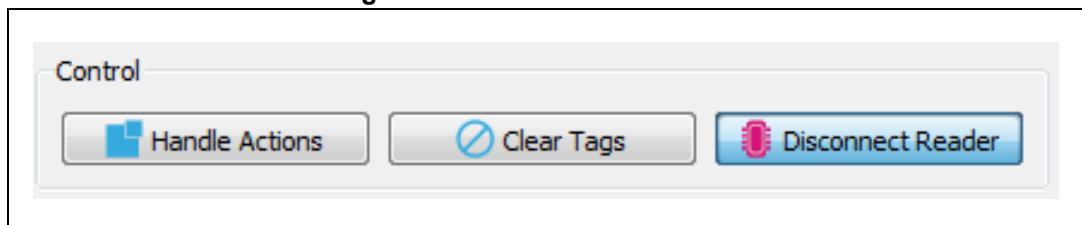


Where:

- **Select button:**  
Enables/disables the selection of tags depending on the EPC/TID entered
- **EPC/TID:**  
Changes which memory region is compared
- **Start address:**  
Starts the byte at which the memory region is compared. The default value is 0.  
For example: e.g. tag EPC = 2e-11-33 then selecting 11-33 starts address is 1.

### Control panel

**Figure 23. Main window - Control**



Where:

- **Handle Actions:**  
Activate/Deactivate tag actions if associated in the Global Actions window. The user may associate a certain action if a tag has been successfully read. *For example:* Play a sound if a certain tag has been read.
- **Clear Tags:**  
Clears tag entries from the main window. Useful to refresh the tag entries during scanning for tags.
- **Disconnect/Connect Reader:**  
Disconnects or Connects a reader over UART.

## 2.2 Reader Settings

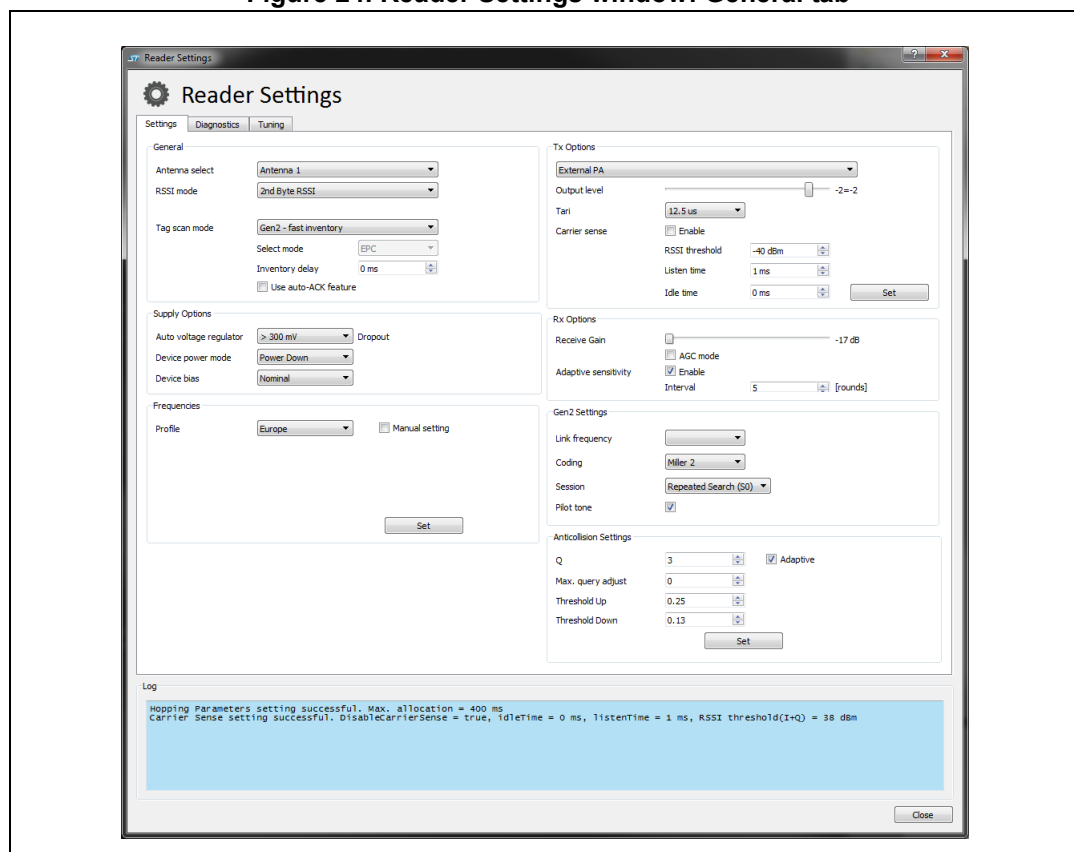
The reader settings dialog allows to configure the frequency profiles, which is needed to comply with radio regulations. The reader configurations and diagnostic tools are accessible through the reader settings dialog. To access the reader settings dialog click on the Reader Settings button above the main window. Alternatively by right-clicking to the reader entry, a pop-up menu is displayed. Click on **Reader Settings** to enter the reader settings dialog. In addition a keyboard shortcut is defined. By pressing [Ctrl+s] on the keyboard the Reader Settings dialog opens.

The **Reader Settings** window is organized in three tabs:

- **Settings:**  
Change/modify basic reader settings.
- **Diagnostics:**  
Contains tools and features that are useful to analyze the RFID reader system. For instance activate a continuous modulation or outputting a constant wave signal.
- **Tuning:**  
Allows to control the carrier cancellation circuitry.

### 2.2.1 Settings tab

Figure 24. Reader Settings window: General tab



### General panel

- **Antenna Select:**  
Select either Antenna 1 or Antenna 2 as the active antenna port depending on the antenna configuration. If the antenna is selected an entry field appears below to define the number of inventory rounds after which the active antenna port should be switched. The maximum number that can be entered is 99 rounds.
- **RSSI mode:**  
Defines when the RSSI of the tag is measured.
- **Tag Scan Mode:**  
Defines the next communication steps once the tag has replied with its EPC.
  - **Gen2 - Fast inventory:**  
The Tag sends EPC number and reverts to READY state.
  - **Gen2 - Normal inventory:**  
The Tag sends HANDLE and reverts to READY state.
  - **Gen2 - Normal Inventory with TID:**  
Same as Normal Inventory with an additional readout of the TID memory. If this option is selected, a pull-down menu named “Select mode” appears, which allows to select the information (EPC, TID or both).
  - **ISO 6B:**  
Scan for a ISO 6B Tag
- **Inventory Delay:**  
By changing the Inventory Delay [ms], an additional wait time is inserted between two consecutive inventory rounds. The maximum value is 20000 [ms].
- **AutoAck feature checkbox:**  
Enables the autoACK feature for tag inventories that automates sending the ACK command or the ACK and ReqRN command according to the Gen2 protocol. Depending on the tag scan mode selection above, AutoACK and Gen2 - fast inventory will send the ACK command after the RN16 and RN16 automatically while AUTOACK and Gen2 - normal inventory will send the ACK command after the RN16 and also the ReqRN command after the EPC response of the tag.

### Supply options panel

In order to measure the power consumption of the ST25RU3993 you can change the device power mode and settings here.

- **Auto voltage regulator:**  
Internal voltage regulators maintain a certain drop-out voltage even with decreased supply/battery voltage.
- **Device power mode:**  
Allows to bring the reader IC into various supply power states.
- **Device Bias**  
Allows to change the bias setting for the entire IC resulting in less current consumption at the expense of performance.

### Tx Options panel

- **External/Internal PA:**  
This allows to switch between external or internal power amplifiers.
- **Output level:**  
The Output level slider changes the output power for the 0-dBm and the internal PA output (register 0x15, bits [4:0]). The output power may be changed by nominal 1 dB per step.
- **TARI:**  
Gen2 transmission setting. Changes the TX-Zero length to:
  - 6.25  $\mu$ s
  - 12.5  $\mu$ s
  - 25  $\mu$ s
- **Carrier Sense:**  
If enabled the reader will sense if the next transmit frequency channel is free or already occupied by another reader.
  - **RSSI threshold:**  
If the signal strength of the sensed carrier is below this threshold, the slot is considered free, and therefore will be used by the reader. The RSSI threshold can be entered from -40 dBm down to -80 dBm.
  - **Listen time:**  
Carrier Sense duration. During this time the RSSI is measured repeatedly. The maximum value is then checked for threshold crossing.
  - **Idle time:**  
Wait time between transmit frequency channel switch and performing Carrier Sense.

### Rx Options panel

- **Receive Gain:**  
The receive gain slider adjusts the receive gain and/or receive attenuation of the reader. The slider affects register 0x0A.
- **AGC Mode:**  
Enables/Disables the automatic gain control feature of the ST25RU3993.
- **Adaptive Sensitivity Section:**  
This section allows to enable/disable adaptive receive gain/attenuation change. If enabled the receive gain will be automatically increased if no tags are found and decreased, if the tag RSSI is high.
- **Interval:**  
Defines after which number of inventory rounds the receive gain/attenuation is re-adjusted. The maximum value that can be entered is 99 rounds.

### Frequencies panel

- **Profile:**  
The **Profile** pull-down menu offers various UHF RFID frequency band allocations for different regulatory regions. By changing the frequency profile, the reader is configured to comply with the requirements of the selected region.

To apply changes press the Set button.

*Note:* If the GUI requires a click on the Set button a notification is displayed next to the Set button.

**Table 1** shows the **Profile** options:

**Table 1. Frequency profiles**

Profile	Start frequency [MHz]	End frequency [MHz]	Increment [MHz]	RSSI threshold [dBm]	Listen time [dBm]	Idle time [ms]	Max allocation [ms]
Europe	865.7	867.5	0.6	-40	1	0	400
Japan	920.5	922.1	0.2	-74	1	0	4000
USA	902.75	927.25	0.5	-40	1	0	400

The frequency profiles are defined in a CSV file, which is located in the installation directory of the ST25RU3993 GUI. The “profiles.csv” file may be modified or extended by new frequency settings. The syntax for adding a new profile is defined as follows:

```
Name,StartFreq,StopFreq,Increment,dBm,listenTime,IdleTime,maxAllocationTime
```

For example the European frequency profile is defined as:

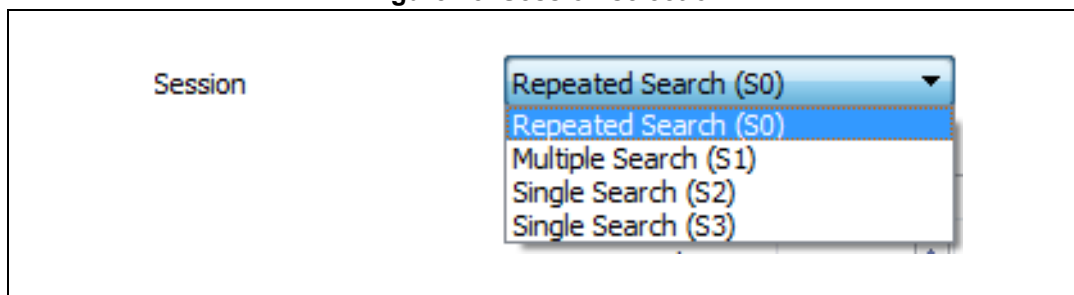
```
Europe,865.7,867.5,0.6,-40,1,0,400
```

**Note:** After modifying the file profiles.csv the GUI needs to be restarted to apply the changes.

### Gen2 Settings panel

- **Link frequency:**  
Changes the backscatter link frequency to:
  - 40 kHz
  - 160 kHz
  - 213 kHz
  - 256 kHz
  - 320 kHz
  - 640 kHz
- **Coding:**  
Changes the coding to:
  - FM0
  - Miller 2
  - Miller 4
  - Miller 8
- **Session:**  
Selects the Session and hence changes the behavior of the inventoried flags of tags.  
[Figure 25.](#) shows all options:

Figure 25. Session selection



Where:

- **Repeated Search (S0):**  
The Tags take part in every inventory round.
- **Multiple Search (S1):**  
When inventoried, tags do not take part in inventory round for at least 500 ms.
- **Single Search (S2, S3):**  
When the tag is inventoried it does not take part in any further inventory rounds unless the tag is not energized for a time longer than its persistence time.

#### Anti-collision settings panel

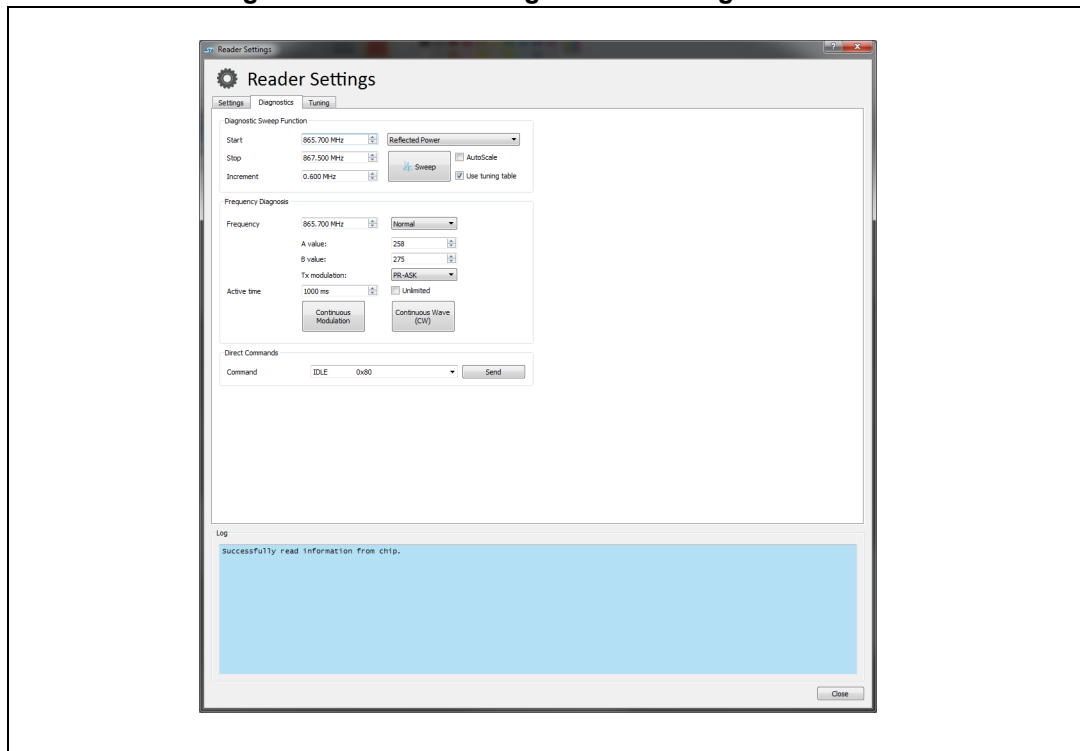
- **Pilot tone:**  
Disables/Enables the extended tag response pre-amble.
- **Q:**  
Defines the initial number of available anti-collision slots according to Gen2 protocol specification. The maximum value that can be entered is 15.
- **Max. query adjust:**  
Maximum rounds (QueryRep) which are additionally performed.  
An inventory round is started with an Query command and collects tags in  $2^Q$  slots. If collisions occur, some tags will not be inventoried. The inventory round will be extended with the number of defined QueryAdjust commands. Tags which are not inventoried will participate in additional rounds with Q adjusted.
- **Thresholds Up:**  
The adjustment of Q is dependent on the occurred collisions. Q will be increased if the number of collisions is greater or equal than the number of slots multiplied by the defined Threshold Up value.
- **Threshold down:**  
The adjustment of Q is dependent on the occurred collisions. Q will be decreased if the number of collisions is lower than the number of slots multiplied by the defined Threshold Down value.

*Note: If none of the above threshold criteria are met Q will remain unchanged.*



## 2.2.2 Diagnostics tab

Figure 26. Reader Settings window: Diagnostics tab



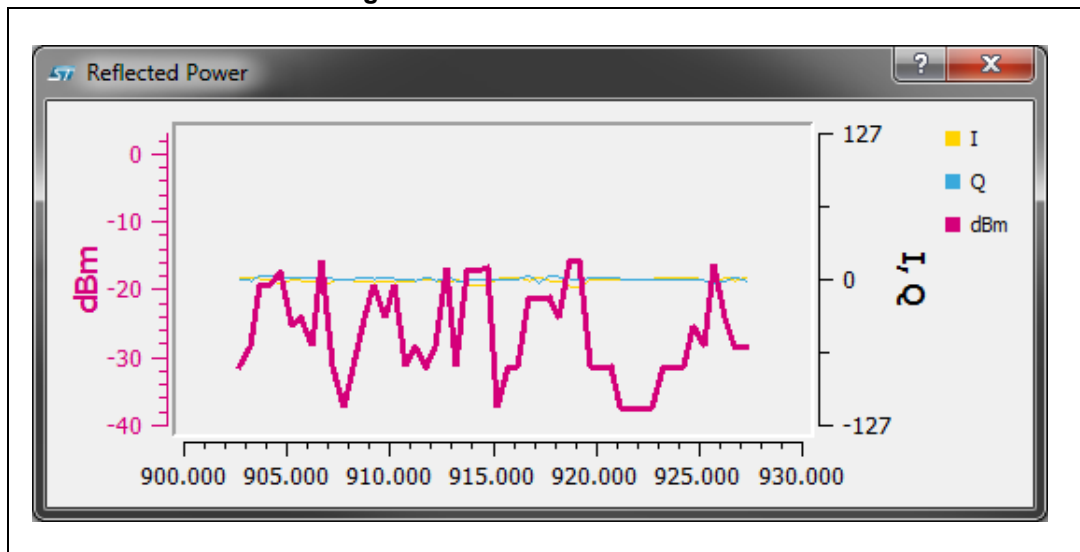
### Diagnostic Sweep Function

In the **Diagnostic Sweep Function** panel it is possible to run a reflected power sweep measurements across the select frequency range, or scan for the presence of an external carrier.

- **Start:**  
Start frequency of the frequency sweep in MHz.
- **Stop:**  
Enter a stop frequency where the sweep should stop in MHz.
- **Mode:**  
Select one of the two available frequency sweep modes:
  - Reflected Power
  - RSSI. Scan frequency for the presence of an external carrier.
- **Increment:**  
Defines the frequency step size for each consecutive measurement in MHz and thus the number of measurement points.
- **Sweep:**  
Starts the frequency sweep for the defined Mode and frequency range.

Once the measurement is completed the result is displayed in a new window.

Figure 27. Reflect Power window



### Frequency Diagnosis panel

- **Continuous Wave (CW):**  
Generates a continuous carrier wave at the selected frequency.
- **Continuous Modulation:**  
In this mode the reader continuously transmits a NAK command at the specified frequency for a given period of time.
  - **Pseudo Random:**  
If this option is selected the reader outputs pseudo random data instead of a NAK command.
  - **ETSI Test Mode:**  
With this option the reader outputs the test signal defined in EN 302 208.

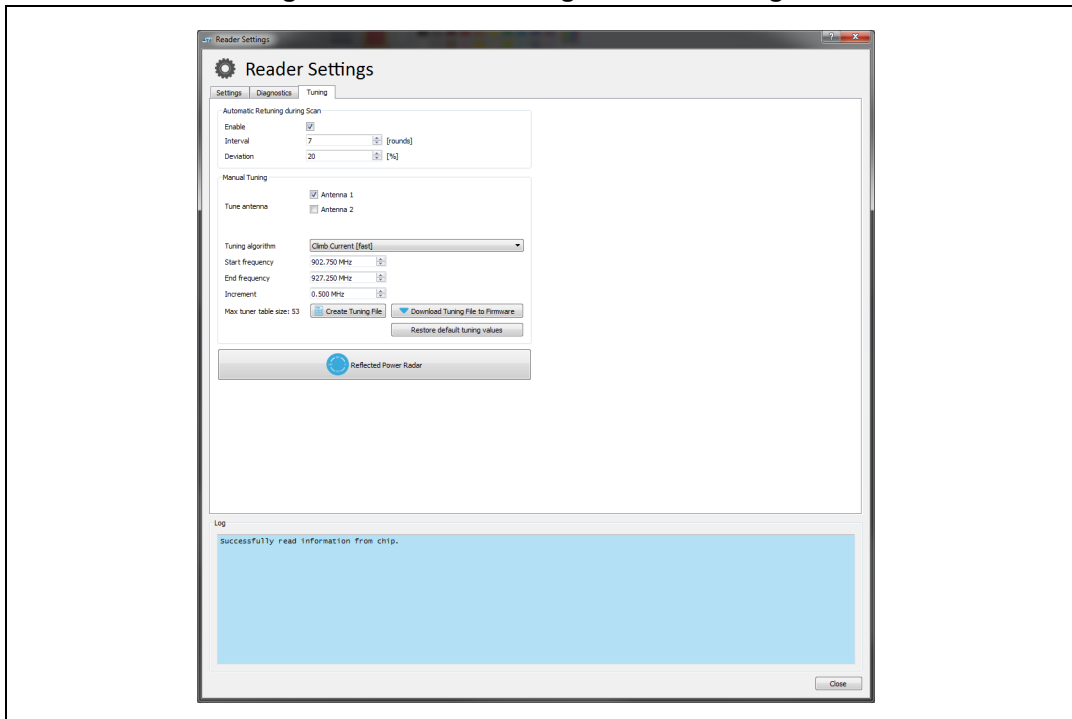
### Direct Commands panel

- **Direct Command:**  
A selection menu from which direct commands may be selected and transmitted.

### 2.2.3 Tuning tab

To control the tuner circuit, the GUI offers a special tuning tab.

**Figure 28. Reader setting window: Tuning tab**



#### Automatic Retuning during Scan panel

- **Enable:**  
By activating the Enable check box automatic re-tuning of the carrier cancellation circuit is enabled.
- **Interval:**  
Defines the number of inventory rounds after which a reflected power measurement is performed. The maximum value that can be entered is 99.
- **Deviation:**  
Defines the maximum difference of the current reflected power measurement from the stored value. If this difference exceeds the defined Deviation value an automatic re-tuning of the carrier cancellation circuit is performed.

*Note:* Enabling this will influence the read performance as tuning takes some time. During tuning no tags will be read.

#### Manual tuning panel

- **Tune antenna:**  
Activating the check box for Antenna 1 or Antenna 2 includes the corresponding antenna in the creating of the tuning table.

*Note:* Note to add a 50 ohm antenna to the antenna port selected here.

- **Tuning algorithm:**
  - Climb current [fast]:  
This algorithm searches for a minimum of reflected power by using the current configuration of the carrier cancellation circuit as starting point.
  - Climb Points [slow]:  
This algorithm searches for a minimum of reflected power with a number of different configurations of the carrier cancellation circuit as starting points. The best result of each individual search is then taken as the final result.
- **Start Frequency:**  
Defines the tuning start frequency. The frequency can be selected between 840 MHz and 960 MHz.
- **Stop Frequency:**  
Defines the tuning stop frequency. The frequency can be selected between 840 MHz and 960 MHz.
- **Increment:**  
Defines the tuning frequency increment. The maximum value that can be entered here is 50 MHz.
- **Creating Tuning File:**  
By clicking on this button the process of creating a tuning file for the defined frequency range and increment is started. The tuning file is a look-up table that defines for each tuning frequency the configuration of the carrier cancellation circuit. The carrier cancellation circuit configuration can be described by three capacitor values. The tuning file will be used during the normal scan operation. Every time the reader changes its transmit frequency the tuning file is queried to retrieve and apply the appropriate configuration of the carrier cancellation circuit for that particular frequency. For best sensitivity of the reader it is recommended to keep the antenna and its environment static while the creation of the tuning files is in progress. The time needed for the creation of the tuning files depends on the selected algorithm and the number of tuning frequencies. The current status of the tuning file creation can be seen in the logging at the bottom of the tuning tab. Once the creation of the tuning file is completed the user is prompted with a file dialog to choose a file location where the tuning file should be stored.

The format of the tuning file is defined as follows:

**Figure 29. Tuning file structure**

# Frequency	TuneEnableAntenna1	Cin1	Clen1	Cout1	i*i+q*q	ReflectedPower1	TuneEnableAntenna2	Cin2	Clen2	Cout2	i*i+q*q	ReflectedPower2
-------------	--------------------	------	-------	-------	---------	-----------------	--------------------	------	-------	-------	---------	-----------------

Tuning Entry - Example:

**Figure 30. Tuning file example**

# Frequency	TuneEnableAntenna1	Cin1	Clen1	Cout1	i*i+q*q	ReflectedPower1	TuneEnableAntenna2	Cin2	Clen2	Cout2	i*i+q*q	ReflectedPower2
902750	1	30	0	3	9	-18,757	1	13	2	2	2	-25,2892

The number of tuning entries in the CSV file is limited to 53.

If the channel frequency during tag-scanning does not exactly match a frequency in the tuning file the closest match between those frequencies is used instead.

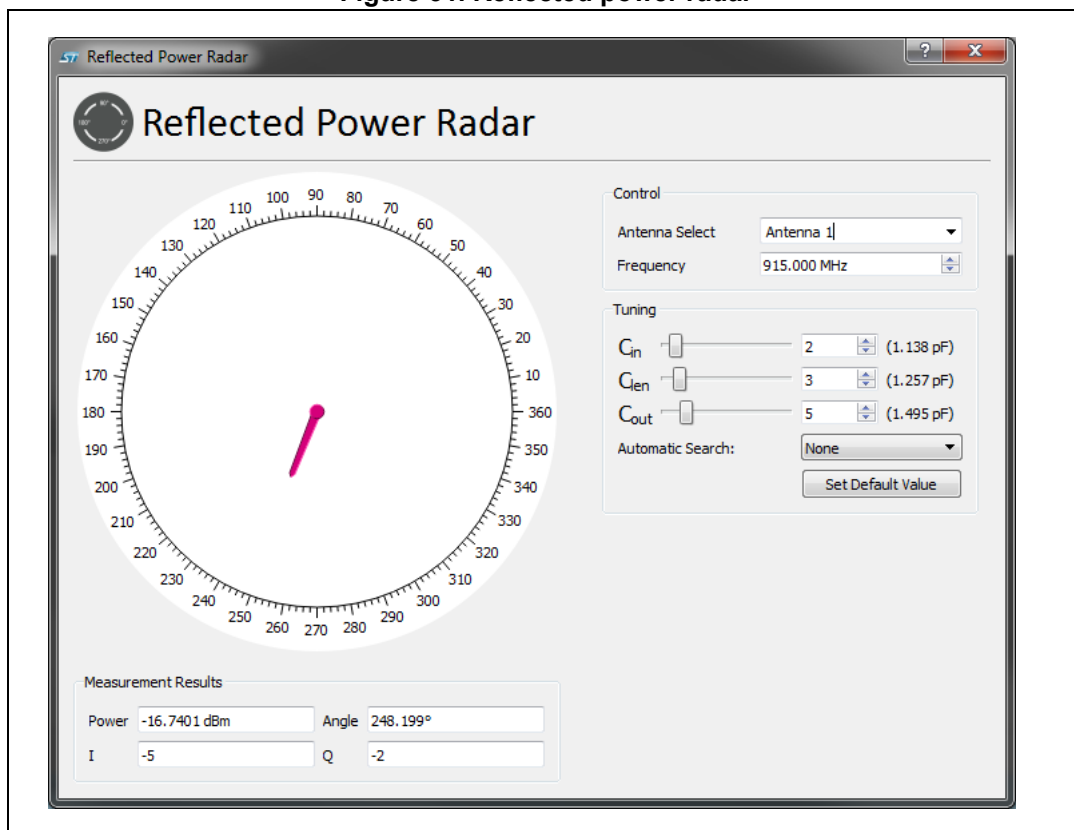
**Note:** Use the “Download Tuning File to Firmware” button after creating the file to apply the tuning settings and save them into the internal flash memory of the micro-controller.

- Download Tuning File to Firmware:**  
 By clicking on this button the created tuning file will be applied to the firmware of the micro-controller. The tuning file will be stored permanently in the flash memory of the micro-controller.
- Restore default tuning values:**  
 Revokes the user-created tuning file information and restores the factory preset look-up table for the carrier cancellation circuit.

## 2.2.4 Reflected Power Radar

The Reflected Power Radar shows a real-time representation of the reflected power. The length of the arrow in the reflected power radar correspond to the magnitude of the reflection while the angle of the arrow represent the phase relative to the local oscillator (LO) signal.

**Figure 31. Reflected power radar**



### Control panel

- Antenna Select:**  
 The active antenna port can be selected here.
- Frequency:**  
 The frequency for which the reflected power should be tuned can be set here. The allowed frequency ranges from 840 MHz to 960 MHz.

### Tuning panel

- **Cin:**  
This slider changes the capacitance value of the input shunt capacitor of the carrier cancellation circuit.
- **Clen:**  
This slider changes the capacitance value of the series capacitor of the carrier cancellation circuit.
- **Cout:**  
This slider changes the capacitance value of the output shunt capacitor of the carrier cancellation circuit.
- **Autom. Search:**  
This pull-down menu defines which algorithm will be used to search for the reflected power minimum.
- **Climb Current [fast]:**  
Searches for a reflected power minimum starting from the current configuration of the carrier cancellation circuit. To find the minimum the variable capacitors are adjusted and a measurement of the resulting reflected power is initiated. The automatic algorithm stops when capacitor configurations are found that result to the lowest reflected power. The best capacitor configurations are automatically applied. Changing the three capacitor values manually defines a new starting point for the search.
- **Climb Points [slow]:**  
Performs multiple reflected power minimum searches starting from different pre-defined capacitor configurations. The automatic algorithm stops when all individual searches are completed. The reflected power measurement results of all individual searches are compared against each other and the capacitor configurations for the overall minimum reflected power is applied.
- **Set Default Value:**  
Reverts the configuration of all variable capacitors to their default value for a default frequency. If the current active frequency is not a default frequency the capacitor values are set to step 15 (1.495 pF).

### Measurement Results panel


- **Power:**  
Shows the reflected power measurement result in a numeric form. The reflected power measurement is performed by ST25RU3993.
- **Angle:**  
Shows the phase of the reflected power relative to the local oscillator signal.
- **I:**  
ADC results for the in-phase component of the reflected power measured by ST25RU3993
- **Q:**  
ADC results for the quadrature component of the reflected power measured by ST25RU3993

## 2.3 Register Map

The purpose of the register map is to provide access to all registers in order to observe and after register settings. By moving the mouse pointer over a bit cell a tool-tip text is displayed providing detailed information about the actual bit and its function. The register map also provides means to modify the contents of the write-able registers. By clicking on a bit cell the value of the actual bit can be changed. Alternatively a register may be modified by entering a new hexadecimal value in the right-most Value column. Note that it is not recommended to alter any registers through the register map while the reader is scanning or any other automatic procedure such as tuning file creation is on going.

The register map can be accessed by clicking on the Register Map button above the main window. Alternatively by a right-click on the reader entry a pop-up menu appears from which the register map can be accessed. In addition a keyboard shortcut is defined as well. By pressing [Ctrl+m] the register map opens as well.

Figure 32. Register map window



	Addr.	7	6	5	4	3	2	1	0	Value
Device Status Control Register	0x00	0	0	0	0	0	0	1	0	0x02
Protocol Selection Register	0x01	1	0	0	0	0	0	0	0	0x80
TX Options Register	0x02	0	0	1	0	0	0	0	0	0x20
RX Options Register	0x03	1	1	0	0	0	0	1	0	0xc2
TRcal High Register	0x04	0	0	0	0	0	0	0	0	0x00
TRcal Low Register	0x05	1	1	1	1	1	0	1	0	0xfa
AutoACK Wait Time	0x06	0	0	0	0	0	1	0	0	0x04
RX No Response Time Register	0x07	0	0	0	0	0	0	1	1	0x03
RX Wait Time Register	0x08	0	0	0	0	0	1	0	0	0x04
RX Filter Setting Register	0x09	0	0	1	0	0	1	0	0	0x24
RX Mixer and Gain Register	0x0a	0	1	1	0	0	0	0	0	0x60
Regulator and PA Bias Register	0x0b	0	0	0	1	1	0	1	1	0x1b
RF Output and LO Control Register	0x0c	0	0	0	0	0	0	1	0	0x02
Miscellaneous Register 1	0x0d	1	0	1	1	0	0	0	0	0xb0
Miscellaneous Register 2	0x0e	0	0	0	0	0	0	0	0	0x00
Measurement Control Register	0x10	0	0	0	0	0	0	0	0	0x00
VCO Control Register	0x11	0	1	0	0	0	0	0	0	0x40
CP Control Register	0x12	0	0	1	1	0	1	0	1	0x35
Modulator Control Register 1	0x13	0	0	1	0	0	0	0	0	0x20
Modulator Control Register 2	0x14	1	1	0	1	1	1	0	1	0xdd
Modulator Control Register 3	0x15	0	0	0	0	0	0	1	0	0x02
Modulator Control Register 4	0x16	0	1	1	1	1	1	1	0	0x7e
PLL Main Register	0x17	0	1	0	0	0	0	0	1	0x41
PLL Main Register	0x18	1	0	1	0	1	0	0	0	0xa8
PLL Main Register	0x19	0	1	1	1	1	0	1	0	0x7a
PLL Auxiliary and Auto-Hop Wait Register	0x1a	0	0	0	0	0	1	0	0	0x04
PLL Auxiliary Register	0x1b	0	1	1	0	0	0	0	1	0x61
PLL Auxiliary Register	0x1c	0	0	0	1	1	0	0	0	0x18
Interrogator Collision Detection and IQ Selection Register	0x1d	0	0	0	0	0	0	0	0	0x00
Emitter-Coupled Mixer Options	0x22	0	0	0	0	0	0	0	0	0x00
Status Readout Page Setting Register	0x29	0	0	0	1	0	1	1	0	0x16

### 2.3.1 Register Map - File menu

- Copy All Registers To Clipboard [Ctrl+c]:**  
 Copies all registers by their hexadecimal addresses and their corresponding to the clipboard. The register map contents can then be inserted for example into an editor for further manipulation by pressing [Ctrl+v] on the keyboard.



**Table 2. Copy Registers to Clipboard - Example 1**

REG	VAL
0x00	0x00
0x01	0x80
...	...

- **Copy Selected Register To Clipboard [Ctrl+Shift+C]:**  
Copies the current selected register to the clip board. The register contents can then be inserted for example into an editor for further manipulation by pressing [Ctrl+v] on the keyboard.

**Table 3. Copy Registers to Clipboard - Example 2**

REG	VAL
0x09	0x34

- **Load register values from file... [Ctrl+L]:**  
Restores the contents of all registers from a previously stored register map file.
- **Store register values to file... [Ctrl+S]:**  
Stores the contents of all registers to a register map file. The format of this file is shown below:

```
<!DOCTYPE STSimpleXml>
<RegisterMap Version="1.3.6.0">
  <Registers>
    <Register Value="0" Address="0"/>
    ...
    <Register Value="9" Address="62"/>
  </Registers>
</RegisterMap>
```

### 2.3.2 Register map - View menu

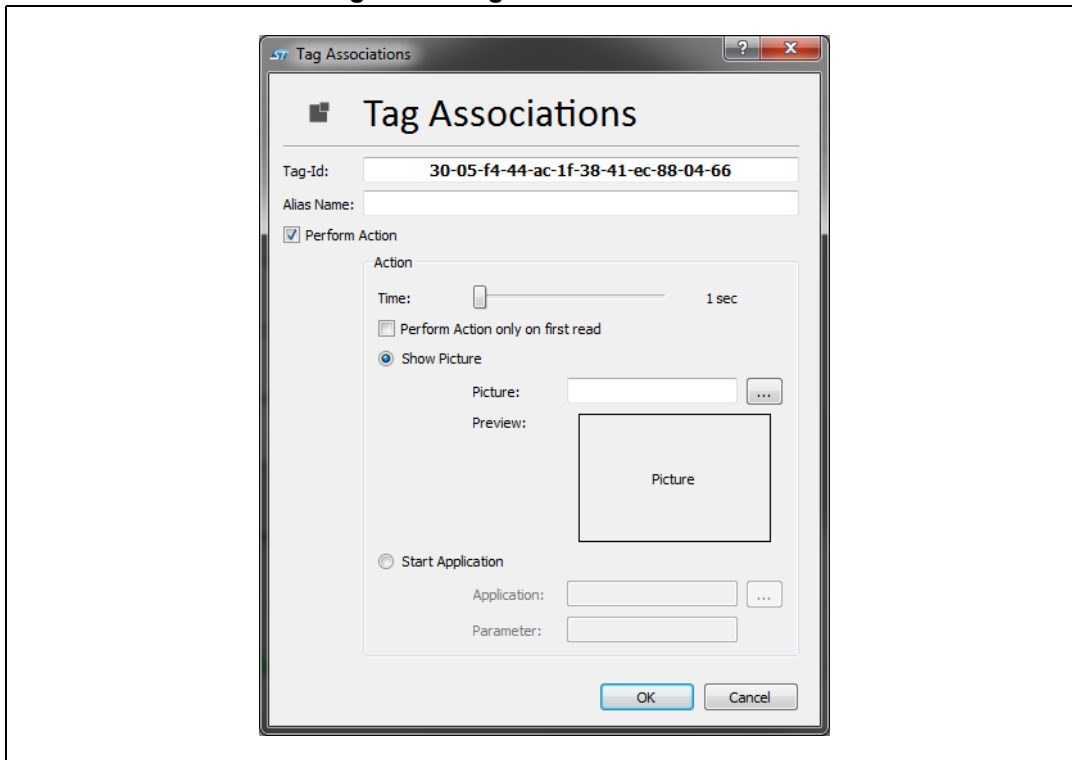
- **Readout All Registers [Ctrl+R]:**  
Updates the displayed register map to the current states of all register of the reader IC ST25RU3993.
- **Readout Selected Register [Ctrl+Shift+S]:**  
Updates the selected register to the current register state of the reader IC ST25RU3993.
- **Toggle Value Hex/Dec [Ctrl+V]:**  
Changes the hexadecimal register addresses and values to decimal numbers.
- **Stay On Top [Ctrl+T]:**  
Keeps the register map window always in the foreground.

## 2.4 Tag Associations

The **Tag Associations** window is opened by right-clicking a tag entry and selecting Tag Associations.

Within the **Tag Associations** window the user can assign certain tasks which are triggered when the actual tag is inventoried by the reader.

**Figure 33. Tag association window**



- **Tag-Id:**  
Shows the EPC number of the actual tag.
- **Alias Name:**  
This entry field allows to assign an alias name for the EPC code of the current tag. A maximum number of 50 characters can be entered.
- **Perform Action:**  
Activates the defined Actions.

*Note:* Once this check-box is activated the user has to define an action otherwise the dialog cannot be closed. For example for Show Picture a picture has to be defined.

- **Time:**  
Defines the duration of the action. For example how long a picture will be shown once the actual tag is inventoried by the reader. The time setting can range from 1 second to 30 minutes in pre-defined steps.
- **Perform Action Only On First Read:**  
By activating this check-box the defined action is carried out only at the first inventory of the actual tag.

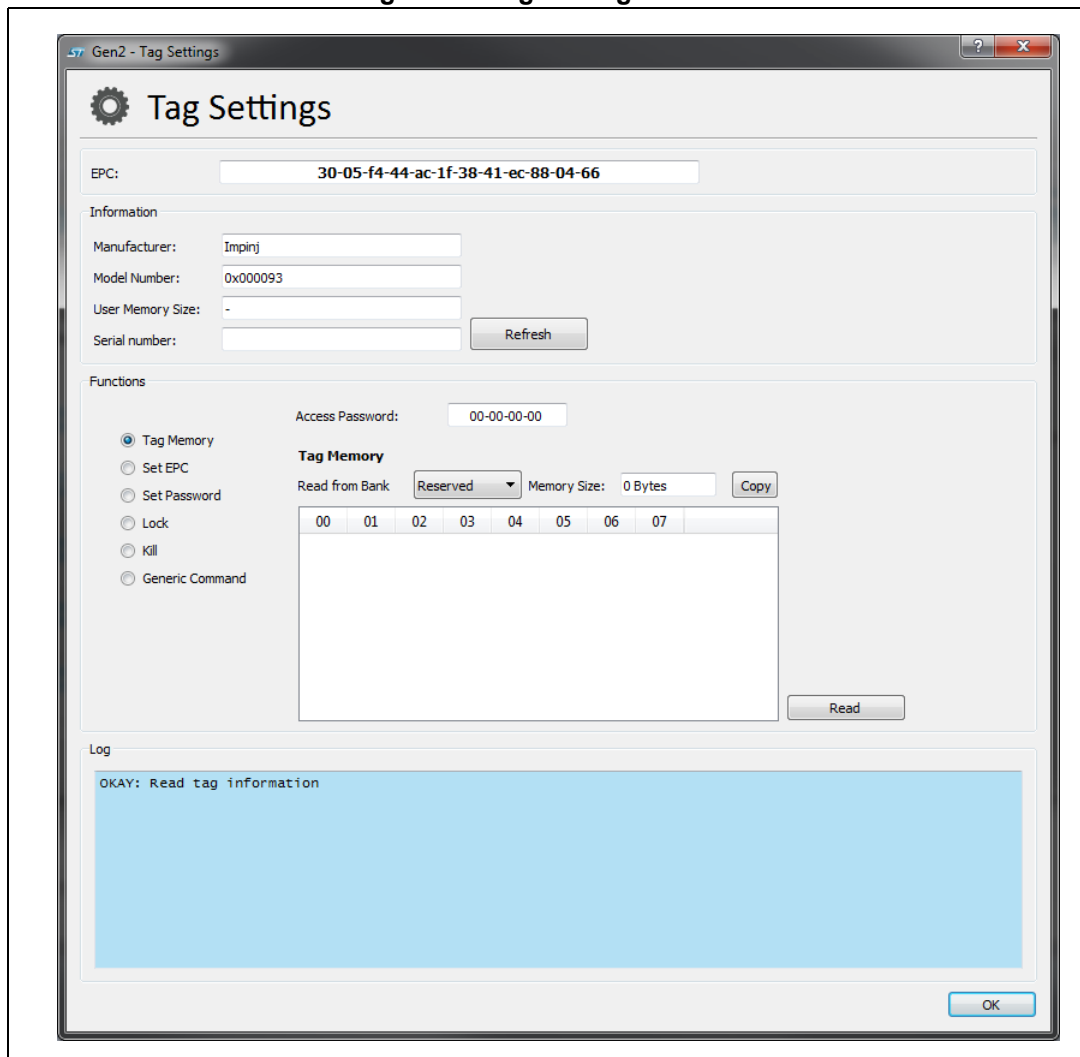
- **Show Picture:**  
If Show Picture is selected a picture is shown when the actual tag is inventoried by the reader.
- **Picture:**  
In the entry field the file location of the picture can be entered. Alternatively a select file dialog can be opened by pressing on the button next to the entry field.
- **Preview:**  
Shows a thumbnail preview of the select picture.
- **Start Application:**  
If Start Application is selected an application can be started when the actual tag is inventoried by the reader.
- **Application:**  
In the entry field the file location of the executable of the application can be entered. Alternatively a select file dialog can be opened by pressing on the button next to the entry field.
- **Parameter:**  
Enter parameters needed for the application here.

To activate the assigned tag action, click on Handle Actions button.

## 2.5 Tag Settings

In the tag settings dialog more information about the tag can be retrieved and tag access operations can be performed. To access this dialog right-click on a tag entry in the main window to show a pop-up menu from which the Tag Settings can be selected.

Figure 34. Tag Setting window



- **EPC:**  
Shows the EPC code of the actual tag
- **Reader ID:**  
Shows the reader identification of the reader

### 2.5.1 Information panel

- **Manufacturer:**  
Shows the name of the tag manufacturer of the actual tag.
- **Model Number:**  
Shows the tag model number for the actual tag.
- **User Memory Size:**  
If the tag implements a tag user memory the memory size is displayed here.
- **Serial Number:**  
Shows the TID number of the actual tag
- **Refresh:**  
Re-reads the actual tag information.

### 2.5.2 Functions panel

- **Access Password:**  
Enter the assigned access password of the actual tag if required. For example: If the EPC memory bank is locked then the access password needs to be entered here in order to make changes to the EPC number possible.

#### Read Tag Memory

The user reads or sets various memory banks of a tag. The **Read from Bank** pull-down menu allows the user to select the following memory banks:

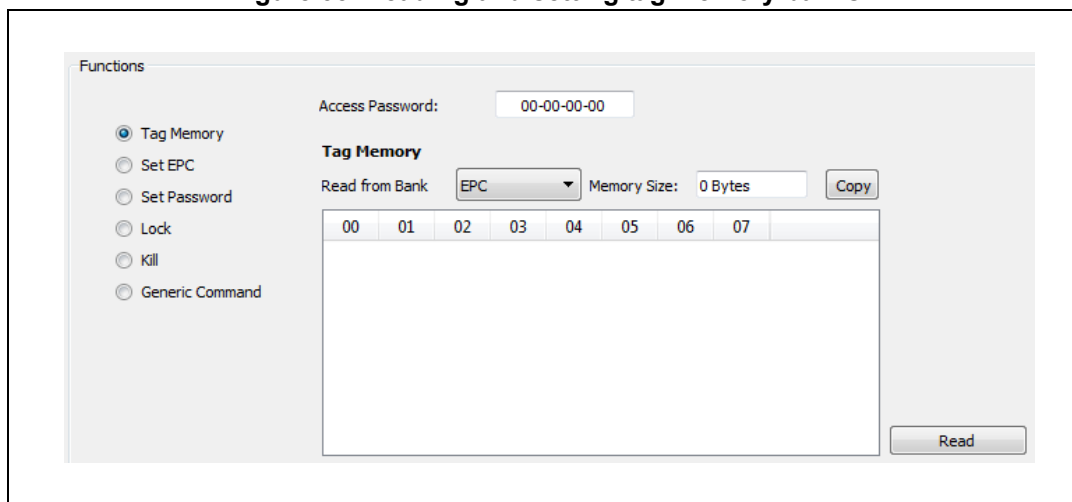
- Reserved
- EPC
- TID
- User

By pressing the **Read** button the contents of the memory bank is displayed.  
The **Memory Size** field shows the size of the respective memory bank in bytes.

The **User** memory bank may be changed by the user (if proper security settings are set) by entering the desired data into the memory table and pressing **Set** button.

*Note:* The **Set** button is only shown for the **User** memory bank.

Figure 35. Reading and setting tag memory banks



### Tag Memory

- **Read From Bank:**  
This drop down menu selects the different memory banks of the actual tag for further access. Accessible memory banks are:
  - Reserved memory bank
  - EPC memory bank
  - TID memory bank and if the tag implements a user memory
  - User memory bank
- **Memory Size:**  
Shows the size of the memory bank as a number of Bytes.
- **Set:**  
If the actual tag implements a user manual the contents of the user memory can be changed through the memory table. In order to write these changes to the tag the Set button needs to be clicked on.
- **Read:**  
Reads information from the selected memory bank.

## Set EPC

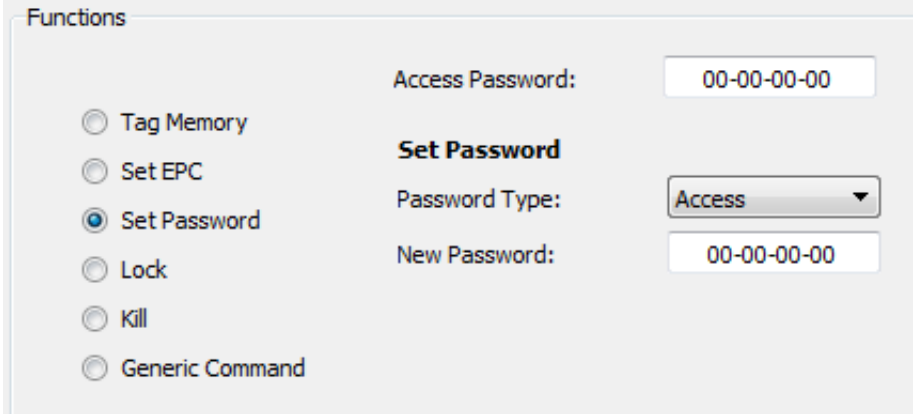
Figure 36. Set EPC

The screenshot shows a software interface for setting the EPC (Extended Programming Code) of a tag. On the left, under the 'Functions' header, there are six radio button options: 'Tag Memory', 'Set EPC' (which is currently selected), 'Set Password', 'Lock', 'Kill', and 'Generic Command'. The main panel displays the configuration for the 'Set EPC' function. It includes an 'Access Password' field with the value '00-00-00-00'. Below this, the 'Set EPC' section contains an 'EPC length' field set to '6' with a unit of 'words', and a 'New EPC' field containing the hexadecimal string '00-00-00-00-00-00-24-06-01-fd-ee'. At the bottom center of the panel is an 'Execute' button.

- **EPC Length:**  
The length of the new EPC number can be defined here. The EPC length is defined as a number of words.
- **New EPC:**  
The new EPC number of the actual tag can be entered here.
- **Execute:**  
By clicking on the Execute button the new EPC number is written to the actual tag.

## Set Password

Figure 37. Set password



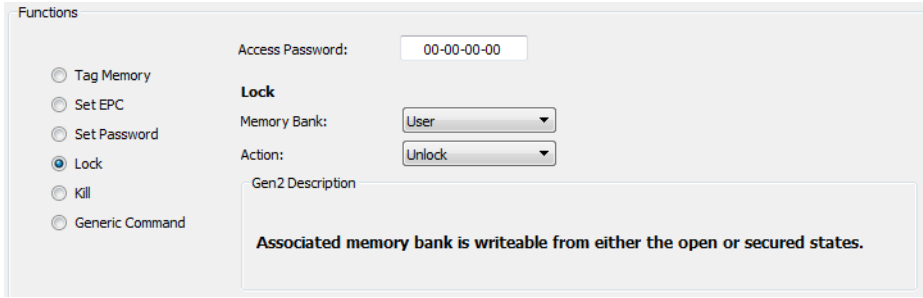
The screenshot shows a 'Set Password' dialog box. On the left, under the 'Functions' header, there are six radio button options: 'Tag Memory', 'Set EPC', 'Set Password' (which is selected), 'Lock', 'Kill', and 'Generic Command'. On the right side of the dialog, there are three input fields. The first is labeled 'Access Password:' and contains the text '00-00-00-00'. Below this is a section titled 'Set Password'. Inside this section, there is a 'Password Type:' label followed by a dropdown menu currently set to 'Access'. Below the dropdown is a 'New Password:' label followed by another input field containing '00-00-00-00'.

- **Password Type:**  
This drop-down menu defines the password type for the new password. Options are:
  - Kill
  - Access
- **New Password:**  
The new password information can be entered here.
- **Execute:**  
By clicking on the Execute button the new password is written to the actual tag.



## Lock

Figure 38. Lock and unlock Tag Memory



The screenshot shows a software interface titled 'Functions'. On the left, there is a list of functions with radio buttons: 'Tag Memory', 'Set EPC', 'Set Password', 'Lock' (which is selected), 'Kill', and 'Generic Command'. To the right of this list, there is an 'Access Password' field containing '00-00-00-00'. Below that, under the heading 'Lock', there are two dropdown menus: 'Memory Bank' set to 'User' and 'Action' set to 'Unlock'. At the bottom, there is a 'Gen2 Description' box containing the text: 'Associated memory bank is writeable from either the open or secured states.'

- **Memory Bank:**  
The memory bank for which the lock status is going to be changed can be selected here. Options are:
  - User
  - EPC
  - TID
  - Access Password
  - Kill Password
- **Action:**  
Select the type of lock status change here. Options are:
  - Unlock:  
Unlocks the selected memory bank
  - Permanently Unlock:  
Permanently prevents the selected memory bank from being locked ever again.
  - Lock:  
Locks the selected memory bank
  - Permanently Lock:  
Permanently locks the selected memory bank. No subsequent unlocking of the selected memory bank is possible anymore.
- **Execute:**  
By clicking on the Execute button the new lock status is written to the actual tag.

## Kill

Figure 39. Killing a tag

The screenshot shows a 'Functions' dialog box with a list of radio buttons on the left: Tag Memory, Set EPC, Set Password, Lock, Kill (selected), and Generic Command. On the right, there are two password fields. The first is labeled 'Access Password:' and the second is labeled 'Insert kill password'. Both fields contain the text '00-00-00-00'. The word 'Kill' is also displayed in bold text between the two password fields.

- **Insert Kill Password:**  
Enter the Kill password in this entry field. Note that a zero-valued kill password will not lead to successful kill operation.
- **Execute:**  
By clicking on the Execute button the actual tag will be killed.

## Generic Command

- **Direct Command:**  
The type of ST25RU3993 transmit command can be selected here. Options are:
 

– ST25RU399X_CMD_TRANSMCRC	0x90
– ST25RU399X_CMD_TRANSMCRCEHEAD	0x91
– ST25RU399X_CMD_TRANSM	0x92
- **TX Bit Length:**  
Defines the total number of bits in the transmit command.
- **RX Bit Length:**  
Defines the total number of bits the are expected to receive from the tag.
- **RX No Resp. Timeout:**  
Defines the timeout after which the reception of the tag response is aborted.
- **Command Data:**  
Defines the data to be transmitted in hexadecimal format.
- **Bit Sequence Editor:**  
Allows to enter a series of ones and zeros which are converted to hexadecimal and inserted in the Command Data field.
- **Execute:**  
By clicking on the Execute button the generic command will be transmitted to the actual tag.

This screen allows the user to view and change tag data.

### 3 Revision history

Table 4. Document revision history

Date	Revision	Changes
27-Mar-2018	1	Initial release.
12-Apr-2018	2	Updated: – <i>Introduction</i>

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