1 Introduction

The purpose of this user manual is to teach how to use the M24LRxx tool kit with the M24LRxx_Application_Software. It describes the M24LRxx_Application_Software interface and its menus, and shows how to send commands to M24LRxx tags.
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# Tool kit descriptions

## 2.1 M24LRxx development kit

Ordering information: **DEVKIT-M24LR-A**

The development kit contains:
- A middle-range RF reader (ISO 15693, RF 13.56 MHz) interfaced via the USB bus and an external power supply to have a greater read range. *Figure 1* shows the RF reader.
- An external antenna, shown in *Figure 2*.
- A serial EEPROM USB reader, shown in *Figure 3*: it is an I²C bus reader (interfaced via the USB bus).
- An I²C bus cable to connect the serial EEPROM USB reader to the I²C bus of the reference antenna. *Figure 4* shows the cable to use.
- M24LR64-R reference antennas:
  - ANT1-M24LR-A shown in *Figure 5*: RF antenna size: 75 mm × 45 mm (2.9 in × 1.77 in)
  - ANT2-M24LR-A shown in *Figure 6*: RF antenna size: 20 mm × 40 mm (0.79 in × 1.57 in)
- M24LRxx samples in SO8 package (see *Figure 7*)

*Figure 1. RF reader (ISO 15693, RF 13.56 MHz)*

*Figure 2. External antenna*
Figure 3. Serial EEPROM USB reader

Figure 4. I²C bus cable

Figure 5. ANT1-M24LR-A reference antenna

Figure 6. ANT2-M24LR-A reference antenna
2.2 M24LR64-R demonstration kit

Ordering information: DEMOKIT-M24LR-A

The demonstration kit contains:
- A middle-range RF reader (ISO 15693, RF 13.56 MHz) interfaced via the USB bus, shown in Figure 8
- An M24LR64-R reference antenna: PRIM2-M24LR-A shown in Figure 9
  RF antenna size: 20 mm × 40 mm (0.79 in x 1.57 in)
- Optional: STM32-PRIMER2 (to be ordered separately) shown in Figure 10

Figure 8. RF reader

Figure 9. PRIM2-M24LR-A reference antenna

RF antenna (ANT2-M24LR-A dimension)  M24LR64-R chip
Optional I2C connector
VCC, VSS, SCL, SDA
External connector for PRIMER2
2.3 M24LRxx starter kit

Ordering information: STARTKIT-M24LR-A

The starter kit contains:

- A short-range RF reader (ISO 15693, RF 13.56 MHz), interfaced via the USB bus (including the external I²C bus cable + connector) illustrated in Figure 11

- M24LR64-R reference antennas:
  - ANT1-M24LR-A shown in Figure 12: RF antenna size: 75 mm x 45 mm (2.9 in x 1.77 in)
  - ANT2-M24LR-A shown in Figure 13: RF antenna size: 20 mm x 40 mm (0.79 in x 1.57 in)

- M24LR64-R samples in SO8 package (see Figure 7)
2.4 M24LRxx demonstration kit

Ordering information: DEMO-CR95HF-A.

The DEMO-CR95HF-A is a demonstration kit used to evaluate the performances of ST CR95HF 13.56 MHz multiprotocol contactless transceiver.

It is powered through the USB bus and no external power supply is required. It includes a CR95HF contactless transceiver, a 47 x 34 mm 13.56 MHz inductive etched antenna and its associated tuning components.
Figure 15. DEMO-CR95HF-A demonstration kit
3 How to control the RF and I²C channels from your screen

3.1 Starting \textit{M24LRxx\_Application\_Software}

Before starting, you must have:
- previously installed all the drivers. For how to install the required drivers, please refer to UM0863: “M24LRxx tool driver install guide”
- connected the reader’s USB cable

3.1.1 Choosing your tool kit

On the PC desktop, double click on the \textit{M24LRxx\_Application\_Software} icon. On launching the software, you will be prompted to select the kit you wish to use as shown in \textit{Figure 16}.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure16.png}
\caption{Application home page}
\end{figure}

Select your kit from the list below and press the OK button:
- STARTER KIT
- DEMO KIT (USB based)
- DEMO KIT (RS232 based)
- DEVELOPMENT KIT
- DEMO-CR95HF-A
If you select DEMO KIT (USB based), you can also play with the SERIAL EEPROM USB reader by checking the box to add the Serial EEPROM USB reader.

Once the kit has been selected, the software checks that the selected readers are well connected. A progress bar appears during the check as shown in Figure 17.

Figure 17. Connection check by the software

If a problem occurs, a window appears to indicate what the problem is:

- If the development kit is used, the problem could be:
  - medium-range RF reader not plugged in the USB port
  - medium-range RF reader driver not installed
  - I²C bus reader not plugged in the USB port
  - I²C bus reader driver not installed

- If the demo kit is used, the problem could be:
  - medium-range RF reader not plugged in the USB port
  - medium-range RF reader driver not installed

- If the starter kit is used, the problem could be:
  - Short-range RF reader not plugged in the USB port
  - Short-range RF reader driver not installed
3.1.2 Main menu

If all the drivers have been installed correctly, and the selected readers have been plugged, the window shown in Figure 18 appears.

The connection status of the readers as well as the version of the software are displayed at the bottom of the window.

Figure 18. Main menu

You can use the menu at the top of the window to select several applications:

Reader Application menu

Click Reader Application and select a product from the list (see Figure 19) to manage all the I²C and RF commands of LRxxx (RFID) and M24LRXX (Dual Interface EEPROM) products.

Figure 19. Reader application menu
3.1.3 Image Transfer Application menu

*Figure 20* shows the Image Transfer Application menu.

Select **show Image Transfer application** to upload or download a picture to or from the M24LR64-R by RF or I²C.

*Figure 20. show Image Transfer application*

3.1.4 Demo STM32-PRIMER2 menu

*Figure 21* shows the **Demo STM32-PRIMER2 menu**.

Select **show Demo STM32-PRIMER2** to upload or download a picture to or from the M24LR64-R by RF.

Pictures are formatted to be usable by the “Dual EE” firmware of your STM32-PRIMER2 demo.

Refer to UM0850 for details on how to use Dual EE.

*Figure 21. show Demo STM32-PRIMER2 menu*
3.1.5 Demo datalogger menu

*Figure 22* shows the Data Logger menu.

Select *show Data Logger* to launch the data logger demonstration. This application performs temperature acquisition and displays a graphical representation of the data. Refer to Section 6: Datalogger demonstration for a description of this demonstration application.

*Figure 22. show Data logger menu*

3.1.6 Demo ESL menu

*Figure 23* shows the ESL Demo menu.

Select *Show ESL demo* to configure your M24LRxx as an ESL (electronic shelf label) and display the ESL data of your device.

Refer to Section 7: ESL demonstration for a detailed description of this demonstration application.

*Figure 23. show demo ESL menu*
3.1.7 Tools menu

Figure 24 shows the Tools menu.

Select **stop animation** to stop the animation in the reader application interface.

![Figure 24. Tools menu](image)

3.1.8 Help menu

Figure 25 shows the Help menu:

- **Open *.bin file with BinEdit** gives you access to a freeware for reading binary files (*.bin format).
- **Change background color** allows you to change the color of the main window.
- **About** provides information about the software.

![Figure 25. Help menu](image)
3.2 Reader application

Select Reader Application in the main menu and choose a product from the list:

- LRxx for ISO15693 RFID products
- M24LRxx for Dual Interface EEPROM products.

The following section describes the Reader Application menu for an M24LR64-R device.

3.2.1 RF commands

The RF user interface opens (see Figure 26). Using this interface you can send any command to the LRxxx or M24LRxx tag present in the RF reader field. Refer to the datasheet for a detailed description of the RF commands.

Figure 26. RF user interface

The Show I2C Commands button is used to switch from the RF user interface to the I2C user interface.
3.2.2 Inventory command

The **Inventory** button launches an Inventory command and thus detects the tags present in the RF field. The command is associated with an anticollision algorithm to detect each tag individually (see **Figure 27** and **Figure 28**).

The **Loop** option is used to loop on inventory commands. It is selected (or deselected) by checking (or unchecking) the box next to **Loop**.

**Figure 27. Inventory button**

![Inventory button](image)

**Figure 28. Three tags detected**

![Inventory button](image)

You can select a tag in the list of detected UIDs by clicking on the desired UID in the list as shown in **Figure 29**. The selected UID will then be used in all RF requests sent in Addressed mode.

**Figure 29. Specific UID selected**

![Inventory button](image)
3.2.3 Get System Info command

The Get System Info button launches a Get System Info command, thus filling the System info fields.

Figure 30. Get System Info button

<table>
<thead>
<tr>
<th>System Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>UID: E0022C1801800912</td>
</tr>
<tr>
<td>DSFID: 00</td>
</tr>
<tr>
<td>API: 00</td>
</tr>
<tr>
<td>Memory size: 577Fh</td>
</tr>
<tr>
<td>Block size: 08h</td>
</tr>
<tr>
<td>IC reference: 2Ch</td>
</tr>
</tbody>
</table>

3.2.4 Viewing RF requests and answers

Figure 31. RF TAG REQUEST/ANSWER report

The RF TAG REQUEST report button shows the RF request sent by the RF reader to the tag.

The RF TAG ANSWER report button shows the RF answer from the tag, detected by the RF reader.

Figure 32 shows an example of a reader’s RF request and the corresponding answer from the tag.

Figure 32. RF request and RF answer

<table>
<thead>
<tr>
<th>RF request</th>
<th>RF answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0A200000</td>
<td>00FD0FED0A658</td>
</tr>
</tbody>
</table>

The RF read request is at address 0000. The RF answer is the read data: FF D8 FF E0.

3.2.5 Selecting the RF mode

The RF ISO 15693 protocol allows the user to communicate in RF in three different modes: the Non-addressed mode, the Addressed mode and the Select mode. For further details, please refer to the M24LRxx datasheet.

The Non-addressed, Addressed or Select mode can be selected by clicking on the desired mode as shown in Figure 33, Figure 34 or Figure 35.

Non-addressed mode

Selecting the Non-addressed mode clears the bits 5 and 6 in the Request_flags of the RF request (bit 5 = 0, bit 6 = 0).

The request is executed by any M24LRxx device (please refer to the M24LRxx datasheet for details).
Figure 33. Selecting the Non-addressed mode

Addressed mode

Selecting the Addressed mode clears bit 5 and sets bit 6 in the Request_flags of the RF request (bit 5 = 0, bit 6 = 1).

The request is addressed. The UID field is present (please refer to the M24LRxx datasheet for details).

After an Inventory command (see Section 3.2.2: Inventory command), you will be able to click on an UID to select a specific tag. The desired UID will be sent with the request if the Addressed mode is chosen.

If no specific UID tag is selected, the device sends “00 00 00 00 00 00 00 00” instead of the UID value.

Figure 34. Selecting the Addressed mode

Select mode

Selecting the Select mode sets bit 5 and clears bit 6 in the Request_flags of the RF request (bit 5 = 1 and bit 6 = 0).

The request is executed only by the M24LRxx device in the Select State (please refer to the M24LRxx datasheet for details).

To select a tag, refer to the SELECT paragraph below, and to the M24LRxx datasheet (Select paragraph).

Figure 35. Selecting the Select mode

3.2.6 Managing M24LRxx states

The M24LRxx can be in different states: Power-off, Ready, Quiet and Selected (refer to the M24LRxx datasheet for details).

The interface shown in Figure 36 is used to send three types of RF request to place the M24LRxx in one out of three specific states: Selected, Quiet and Ready.

Figure 36. Device state management interface

SELECT
STAY QUIET
RESET to READY

SELECT

The SELECT button is used to send a Select RF request with the UID of a specific tag (Section 3.2.2: Inventory command) (refer to the M24LRxx datasheet for details).
If no tag was selected after the Inventory request, the device sends “00 00 00 00 00 00 00 00” instead of the UID value.

**STAY QUIET**

The **STAY QUIET** button is used to send a Stay Quiet RF request (refer to the M24LRxx datasheet for details).

**RESET TO READY**

The **RESET TO READY** button is used to send a Reset to Ready RF request (refer to the M24LRxx datasheet for details).

### 3.2.7 Read command

**Figure 37. Initiating a read operation**

By pressing the Read button, you launch RF requests to read the contents of the M24LRxx EEPROM from the block address specified in the **from** field to the block address specified in the **to** field.

The result of the read operation is displayed in the **MEMORY seen by RF** area (see **Figure 38** to **Figure 41**).

From **0000** to **07FF** reads all M24LRxx EEPROM contents. **Figure 38** and **Figure 39** only show the results for sector 0 and sector 3F, respectively.
How to control the RF and I²C channels from your screen

**Figure 38. Result of the read operation - Sector 00h**

<table>
<thead>
<tr>
<th>sector</th>
<th>block</th>
<th>data</th>
<th>sss</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>FF</td>
<td>FF FF FF FF</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>00 10</td>
<td>44 46</td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>69 46</td>
<td>00 03</td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>01 01</td>
<td>00 60</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>00 00</td>
<td>00 00</td>
<td></td>
</tr>
<tr>
<td>0005</td>
<td>FF FF</td>
<td>00 72</td>
<td></td>
</tr>
<tr>
<td>0006</td>
<td>45 70</td>
<td>60 66</td>
<td></td>
</tr>
<tr>
<td>0007</td>
<td>00 00</td>
<td>49 49</td>
<td></td>
</tr>
<tr>
<td>0008</td>
<td>14 00</td>
<td>08 00</td>
<td></td>
</tr>
<tr>
<td>0009</td>
<td>00 00</td>
<td>03 00</td>
<td></td>
</tr>
<tr>
<td>000A</td>
<td>69 07</td>
<td>04 00</td>
<td></td>
</tr>
<tr>
<td>000B</td>
<td>01 00</td>
<td>00 00</td>
<td></td>
</tr>
<tr>
<td>000C</td>
<td>1A 00</td>
<td>00 00</td>
<td></td>
</tr>
<tr>
<td>000D</td>
<td>00 00</td>
<td>00 00</td>
<td></td>
</tr>
<tr>
<td>000E</td>
<td>01 00</td>
<td>00 00</td>
<td></td>
</tr>
<tr>
<td>000F</td>
<td>02 00</td>
<td>38 00</td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00 00</td>
<td>2C 00</td>
<td></td>
</tr>
<tr>
<td>0010</td>
<td>00 00</td>
<td>00 00</td>
<td></td>
</tr>
<tr>
<td>0011</td>
<td>00 00</td>
<td>41 52</td>
<td></td>
</tr>
<tr>
<td>0012</td>
<td>65 41</td>
<td>54 4F</td>
<td></td>
</tr>
<tr>
<td>0013</td>
<td>62 3A</td>
<td>20 67</td>
<td></td>
</tr>
<tr>
<td>0014</td>
<td>69 22</td>
<td>4A 70</td>
<td></td>
</tr>
<tr>
<td>0015</td>
<td>65 07</td>
<td>20 76</td>
<td></td>
</tr>
<tr>
<td>0016</td>
<td>51 2E</td>
<td>30 28</td>
<td></td>
</tr>
<tr>
<td>0017</td>
<td>19 76</td>
<td>03 69</td>
<td></td>
</tr>
<tr>
<td>0018</td>
<td>64 07</td>
<td>20 09</td>
<td></td>
</tr>
<tr>
<td>0019</td>
<td>4A 47</td>
<td>20 4A</td>
<td></td>
</tr>
<tr>
<td>001A</td>
<td>50 45</td>
<td>47 30</td>
<td></td>
</tr>
<tr>
<td>001B</td>
<td>76 3E</td>
<td>32 29</td>
<td></td>
</tr>
<tr>
<td>001C</td>
<td>2C 20</td>
<td>64 65</td>
<td></td>
</tr>
<tr>
<td>001D</td>
<td>68 03</td>
<td>73 6C</td>
<td></td>
</tr>
<tr>
<td>001E</td>
<td>74 20</td>
<td>71 75</td>
<td></td>
</tr>
<tr>
<td>001F</td>
<td>74 20</td>
<td>71 75</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 39. Result of the read operation - Sector 3Fh**

<table>
<thead>
<tr>
<th>sector</th>
<th>block</th>
<th>data</th>
<th>sss</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0003</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0004</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0005</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0006</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0007</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0008</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0009</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>000A</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>000B</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>000C</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>000D</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>000E</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>000F</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0010</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0011</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0012</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0013</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0014</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0015</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0016</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0017</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0018</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>0019</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>001A</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>001B</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>001C</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>001D</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>001E</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
<tr>
<td>001F</td>
<td>FF FF</td>
<td>FF FF</td>
<td></td>
</tr>
</tbody>
</table>

Use the arrows on the keyboard to change the sector or block to be read.

From 0000 to 0000 reads block 0 in sector 0 as shown in **Figure 40**.
How to control the RF and I²C channels from your screen

Figure 40. Sector 0 block 0

<table>
<thead>
<tr>
<th>sector</th>
<th>block</th>
<th>data</th>
<th>sss</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>0001</td>
<td>49 46</td>
<td>XX</td>
</tr>
<tr>
<td>0002</td>
<td>0100</td>
<td>00 01</td>
<td>XX</td>
</tr>
<tr>
<td>0003</td>
<td>0200</td>
<td>00 00</td>
<td>XX</td>
</tr>
<tr>
<td>0004</td>
<td>0300</td>
<td>00 00</td>
<td>XX</td>
</tr>
<tr>
<td>0005</td>
<td>0400</td>
<td>00 00</td>
<td>XX</td>
</tr>
</tbody>
</table>

From 0001 to 0005 reads the blocks 1, 2, 3, 4, 5 in sector 0 as shown in Figure 41.

Figure 41. Sector 0 blocks 1 to 5

<table>
<thead>
<tr>
<th>sector</th>
<th>block</th>
<th>data</th>
<th>sss</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>0001</td>
<td>49 46</td>
<td>XX</td>
</tr>
<tr>
<td>0002</td>
<td>0100</td>
<td>00 01</td>
<td>XX</td>
</tr>
<tr>
<td>0003</td>
<td>0200</td>
<td>00 00</td>
<td>XX</td>
</tr>
<tr>
<td>0004</td>
<td>0300</td>
<td>00 00</td>
<td>XX</td>
</tr>
<tr>
<td>0005</td>
<td>0400</td>
<td>00 00</td>
<td>XX</td>
</tr>
</tbody>
</table>

How to read the memory area with the RF Interface:

- The first column (sector) indicates the sector read.
- The second column (block) indicates the address of the block read.
- The third column (data) shows the contents of the M24LRxx at the specified addresses.
- The fourth column (sss) gives the sector security status.

Example: in Figure 41 above, the data 49 46 00 01 means:

49 (49h Hex) is the first piece of data read in block number 0002 (sector 0)
46 (46h Hex) is the second piece of data read in block number 0002 (sector 0)
00 (00h Hex) is the third piece of data read in block number 0002 (sector 0)
01 (01h Hex) is the fourth piece of data read in block number 0002 (sector 0)

3.2.8 Write command

The Write button launches RF requests to write data to the M24LRxx EEPROM from the block address specified in the from field to the block address entered in the to field.

In Figure 42, the Write command fills the blocks 0000h to 001Fh with “A1 34 09 67”.

Figure 42. Initiating a write operation

You can choose to write the same byte four times by changing the value in the Fill with field. In the example below, the byte 55 is to be written four times.
Get Multiple Block Security Status command

The Get Multiple Block Security Status button launches RF requests to read the security statuses of the blocks that correspond to the address range specified in the from and to fields.

Addresses are managed in the same way as for read operations. In Figure 45 the security status byte is shown for the blocks with addresses ranging between 0x00E0 and 0x00FF (sector 07).
Figure 46 shows the security status bytes for the blocks located at addresses 00FAh to 0109h (sector 07 & sector 08).

Figure 46. Security status bytes for sectors 07 and 08

3.2.9 Write AFI command

The Write AFI button launches a Write AFI command. The data in the dedicated field next to the Write AFI button are written to the AFI register.

Figure 47. Write AFI command

3.2.10 Write DSFID command

The Write DSFID button launches a Write DSFID command. The data in the dedicated field next to the Write DSFID button are written to the DSFID register.

Figure 48. Write DSFID command

3.2.11 Lock AFI command

The Lock AFI button launches a Lock AFI command. The execution of this command locks the AFI field permanently.

Figure 49. Lock AFI command

Caution: Once the AFI field has been locked, it cannot be unlocked.

For this reason, a warning (shown in Figure 50) is displayed before locking the AFI. To abort the Lock AFI command, click on Cancel. To confirm the command, click on OK.
3.2.12 Lock DSFID command

The Lock DSFID button launches a Lock DSFID command. When executed, this command locks the DSFID field permanently.

**Caution:**

Once the DSFID field has been locked, it cannot be unlocked.

This is the reason why a warning (shown in Figure 52) is displayed before locking the DSFID field. To abort the Lock DSFID command, click on Cancel. To confirm the command, click on OK.

3.2.13 RF password management

The user interface displays a warning concerning password changes: you should be very careful when you change a password because there is no way of retrieving forgotten RF passwords. You have to remember the new passwords you enter. The sectors locked by a password can only be unlocked if you can provide the correct password. Figure 53 shows the displayed warning.

By default, the RF and I²C passwords are ‘00 00 00 00’.
Present-sector Password command

The **Present password** button issues a Present-sector Password command with the data filled in the **password data** field and the selected password number.

The result of the Present-sector Password command appears in the RF answer field. **Figure 55** shows a successful command, and **Figure 56** shows an example where an error occurred.
Write-sector Password command

The **Write Password** button issues a Write-sector Password command with the data filled in the **password data** field and the selected password number.

**Figure 57. Write-sector Password command**

When you press the **Write password** button, a warning pops up to prevent any unwanted password change. To abort the Write-sector Password command, click on **Cancel**. To confirm the command, click on **OK**.

**Figure 58. Warning before changing the password**

**Figure 59. Write-sector Password command successful**

Write Password HS

**Figure 60. Write-sector Password command error**

Lock-sector Password command

The **Lock sector** button issues a Lock-sector Password command with the data configured in the **select sector number**, **select password number** and **select lock config** fields.
3.2.14 Additional feature: energy harvesting commands

M24LRXXE devices, such as the M24LR16E-R, have the Energy Harvesting capability.

Clicking the **Display Energy Harvesting commands** button (see Figure 64) opens a new window which allows to manage Energy Harvesting (see Figure 65). Several RF commands are available:

- Click the **Read config byte** button to send a ReadCfg command to the M24LRXXE and display the value of the config byte.
- Click the **Write E.H. config** button to send a WriteEHCfg command to the M24LRXXE in order to change EH configuration (EH_MODE and EH config bits).
- Click the **Write D.O. config** button to send a WriteDOCfg command to the M24LRXXE and change Digital Output config.
- Click the **Check E.H. enable** button to send a CheckEHEn command to the M24LRXXE and display the value of this Control Register.
- Click the **Reset/Set EH** buttons to send a SetRstEHEn command to the M24LRXXE and deactivate/activate energy harvesting (when possible)

Refer to the datasheets for full details on energy harvesting commands.

**Figure 64. Energy harvesting commands button**
3.3 I²C commands

You can use the I2C User Interface window, illustrated in Figure 66, to exchange data between a tag connected to the I2C reader and the M24LRxx.
With the **Show RF interface** button (**Figure 67**) you can switch from the RF user interface to the I²C user interface.

**Figure 67. Button to switch between the RF and I²C interfaces**

### 3.3.1 I²C READ commands

The **Read** button issues read commands to the M24LRxx connected to the I²C reader. To do so, select the I²C READ area, and then press on the **Read** button.

**Read command to the memory array**

To read the memory array, select **Memory** from the list and specify the address range to be read. Then click on the **Read** button. Addresses are managed in the same way as for RF commands (see **Section 3.2.7: Read command**).

**Figure 68** shows an example where the user decides to issue a Read Memory operation from address 0010h to address 003Fh.
Let us take the example corresponding to the data < 69 87 04 00 >

- 69 (69h Hex) is data for address 0028h (sector 0)
- 87 (87h Hex) is data for address 0029h (sector 0)
- 04 (04h Hex) is data for address 002Ah (sector 0)
- 00 (00h Hex) is data for address 002Bh (sector 0)

**Reading the sector security status**

To read all the sector security status bytes (RF block security), select **Sector Security Status (system)** then press the **Read** button.

*Figure 70* shows how to launch an operation to read the sector security status.
Reading the I2C_Write_Lock bit area

To read the I2C_Write_Lock bit area (I2C sector security), select **I2C write lock bits (system)** and press the **Read** button.

*Figure 72* shows how to launch an operation to read the I2C_Write_Lock bit area.
Reading the system parameter sector

To read the data in the system parameter sector, select **System Parameter Sector (system)** and press the **Read** button.

*Figure 74* shows how to launch an operation to read the system parameter sector.

### 3.3.2 I2C WRITE commands

The **Write** button is used to issue write commands to the M24LRxx connected to the I2C reader. The button is located in the I2C WRITE area of the I2C User Interface window (see *Figure 66*).

To issue a command, select the I2C WRITE area and press the **Read** button.

Write command to the memory array

To write to the memory array, select **Memory** and choose the address range to be written. Then press the **Write** button. Addresses are managed is the same way as for RF commands (see **Section 3.2.7: Read command**).

*Figure 76* shows how to launch a write operation to the memory array.
In this example, a write operation is issued to write the data <12 34 56 78> to EEPROM memory addresses 0000 to 003F by I2C communication. Note that in the I2C answer, you are notified of whether the write cycle succeeded or failed (see Figure 77 and Figure 78).

Figure 77. Write cycle successful

Write cycle successful (7.9 ms)

Figure 78. Write cycle failed (no write cycle detected)

Write Fail: NO WRITE Cycle

Figure 79 shows the result of the write operation.

Figure 79. Result of the Write operation (003C)

You can write 1, 2, 3 or 4 bytes by playing with the Page Size field.

Figure 80. Page Size field
Figure 81 shows how to write “A1” to EEPROM memory address 0005.

**Figure 81. Writing A1 to the memory array**

Writing to the sector security status area

To write to the sector security status area, select **Sector Security Status (system)** and type the address range to be written, then press the **Write** button. Addresses are managed is the same way as for RF commands (see **Section 3.2.7: Read command**).

Please note that the I2C password has to be presented successfully prior to writing to the Sector Security Status area.

**Figure 82** shows how to write to the sector security status area.

**Figure 82. Writing to the sector security status area**

Figure 83 shows the result of the operation.
Figure 83. Result of the write to sector security status area operation

<table>
<thead>
<tr>
<th>MEMORY seen by I2C</th>
</tr>
</thead>
<tbody>
<tr>
<td>system</td>
</tr>
<tr>
<td>0000</td>
</tr>
<tr>
<td>0004</td>
</tr>
<tr>
<td>0008</td>
</tr>
<tr>
<td>000C</td>
</tr>
<tr>
<td>0010</td>
</tr>
<tr>
<td>0014</td>
</tr>
<tr>
<td>0018</td>
</tr>
<tr>
<td>001C</td>
</tr>
<tr>
<td>0020</td>
</tr>
<tr>
<td>0024</td>
</tr>
<tr>
<td>0028</td>
</tr>
<tr>
<td>002C</td>
</tr>
<tr>
<td>0030</td>
</tr>
<tr>
<td>0034</td>
</tr>
<tr>
<td>0038</td>
</tr>
<tr>
<td>003C</td>
</tr>
</tbody>
</table>

Writing to the I2C_Write_Lock bit area

To write to the I2C_Write_Lock bit area, select I2C write lock bits (system) and fill the address range to be written, then press the Write button. Addresses are managed in the same way as for RF commands (see Section 3.2.7: Read command).

Please note that the I2C password has to be presented successfully prior to writing to the I2C_Write_Lock bit area.

Figure 84 shows how to launch a write operation to the I2C_Write_Lock bit area.

Figure 84. Writing to the I2C_Write_Lock bit area

Figure 85 shows the result of the operation.

Figure 85. Result of the write to I2C_Write_Lock bit area operation

<table>
<thead>
<tr>
<th>MEMORY seen by I2C</th>
</tr>
</thead>
<tbody>
<tr>
<td>system</td>
</tr>
<tr>
<td>0000</td>
</tr>
<tr>
<td>0004</td>
</tr>
</tbody>
</table>
3.3.3 I2C PASSWORD commands

In the I2C PASSWORD area of the I2C User Interface window (see Figure 66), select Present Password to be able to send an I2C Present Password command. The button at the bottom right-hand side of the I2C PASSWORD area will indicate Present.

In the same area, select Write Password to be able to send an I2C Write Password command. The button at the bottom right-hand side of the I2C PASSWORD area will indicate Write.

I2C Present Password command

To issue an I2C Present Password command, select Present Password and type the I2C password into the Present Password field.

Figure 86 shows how to launch an I2C Present Password command.

Figure 86. Issuing an I2C Present Password command

In this example, an I2C Present Password command is sent with the I2C password <AE 45 80 63>.

I2C Write Password command

To issue an I2C Write Password command, select Write Password and type the I2C password into the Write Password field.

Figure 87 shows how to launch an I2C Write Password command.

Figure 87. Issuing an I2C Write Password command

In this example, an I2C Write Password command is sent with the I2C password <54 13 4B C8>.

A warning (see Figure 88) was added to prevent unwanted password changes.
Figure 88. Warning

Note that in the I2C answer, you are notified of whether the write cycle succeeded or failed (see Figure 89 and Figure 90).

Figure 89. Write Password cycle successful

Figure 90. Write Password cycle failed (no cycle detected)
4  Data transfer management (picture demo)

Select **show Image Transfer Application** from the main menu of the `M24LRxx_Application_Software` application.

*Note:* `M24LR64-R` reference antennas are required to play this demonstration.

**Figure 91. show Image Transfer Application menu**

The show Demo application allows you to play with the `M24LR64-R` device with both interfaces: I2C and RF.

With this demo you can load a picture by RF or I2C (.jpeg file of 2 Kbytes) into the `M24LR64-R` device. You can also download and display the contents of the memory by I2C or RF. If JPG-like contents were previously loaded into the EEPROM, you will be able to visualize them.

### 4.1 Check communication

This tool help you test the I2C or RF communications between the `M24LR64-R` device and the reader.

**Figure 92. Check communication tool**
If you want to use the RF interface to check communications, click on the **check RF communication** button. If you want to use the I2C bus, click on the **check I2C communication** button.

### 4.1.1 Check communication by RF

After clicking on **check RF communication**, the button changes to **running** as shown in **Figure 93**.

If the circle next to the **running** button is green, the communication by RF between the M24LR64-R and the reader is OK.

**Figure 93. RF communication between the tag and the reader is OK**

If the circle next to the **running** button is red, the communication by RF between the M24LR64-R and the reader is NOT OK.

**Figure 94. No RF communication between the tag and the reader**

### 4.1.2 Check communication by I2C

After clicking on **check I2C communication**, the button changes to **running** as shown in **Figure 95**.

If the circle next to the **running** button is green, the communication by I2C between the M24LR64-R and the reader is OK.

**Figure 95. I2C communication between the tag and the reader is OK**

If the circle next to the **running** button is red, the upload by I2C failed.

**Figure 96. Failed upload by I2C**
4.2 Writing a picture to your M24LR64-R

In the show Demo application window, go to the WRITE PICTURE TO M24LR64 area (see Figure 97), and choose the picture you would like to upload into the memory. Click on the picture to select it.

Figure 97. WRITE PICTURE TO M24LR64

In Figure 98, the ST logo was chosen as an example.

Figure 98. Picture to be uploaded

After selecting the picture, you need to choose which of the I2C or RF interface you will use to upload it to the memory of the M24LR64-R device.

To upload it by I2C, click on I2C as shown below.

Figure 99. Selecting I2C to upload the picture

You then have to click on the Upload by I2C button as shown in Figure 100.
To upload the picture by RF, click on RF as shown below.

You then have to click on the **Upload by RF** button to launch the upload process (see **Figure 102**).

You can use the CHECK COMMUNICATION area to verify whether the data are written successfully or not.

If the I2C bus was used, click on **check I2C communication**. The color of the circle will tell you if the upload process was successful (green circle like in **Figure 103**) or failed (red circle like in **Figure 104**).

If the RF interface was used, click on **check RF communication**. The color of the circle will tell you if the upload process was successful (green circle like in **Figure 105**) or failed (red circle like in **Figure 106**).
4.3 Read/display the M24LR64-R memory content

In the show Demo application window, the READ M24LR64 CONTENT area allows you to display the contents of the memory on your computer screen if the picture was uploaded.

You first have to select which of the I2C or RF interface you will use to download the picture from the memory of the M24LR64-R.

To download it by I2C, click on I2C as shown below.

You then have to click on the Upload by I2C button to launch the upload process (see Figure 109).

To download the picture by RF, click on RF as shown below.
Figure 110. Selecting RF to download the picture

You then have to click on the Upload by RF button to launch the upload process (see Figure 111).

Figure 111. Downloading the picture by RF

The application reads the contents of the EEPROM. A progress bar (shown in Figure 112) indicates that the process is running.

Figure 112. Progress bar

If the download process is successful, the picture is displayed on the screen like in Figure 113. Otherwise, an error message appears (see Figure 114).

Figure 113. The ST logo is displayed

Figure 114. Error message

You can use the CHECK COMMUNICATION area to verify whether the data were read successfully or not.

If you used the I2C bus to download the picture, click on check I2C communication. The color of the circle will tell you if the upload process was successful (green circle) or failed (red circle).

If you used the RF interface to download the picture, click on check RF communication. The color of the circle will tell you if the upload process was successful (green circle) or failed (red circle).
5 DEMOKIT-M24LR-A demonstration

The demonstration application menu, shown in Figure 115, is intended for use with the DEMOKIT-M24LR-A kit. All the pictures are in bitmap format to be compliant with the STM32-PRIMER2 firmware and LCD screen driver.

Note: M24LR64-R reference antennas are required to play this demonstration.

Figure 115. Demo STM32-PRIMER2 application menu

5.1 Checking RF communications

To check the RF communication between the reader and the reference antenna, press the check RF communication button (see Figure 116). The button changes to running. If the RF communication between the reader and the reference antenna is good, the circle is green like in Figure 117. If there is no RF communication between the reader and the reference antenna, the circle appears red like in Figure 118.

Figure 116. Check RF communication button

Figure 117. RF communication ongoing between reader and reference antenna
5.2 Uploading a picture to your DEMOKIT-M24LR-A by RF

Use the frame shown below to upload a picture by RF.

![Upload frame](image)

Click on a picture to upload the picture in bmp format to the M24LR64-R by RF.

You can use the three additional icons on the right-hand side (HELLO WORLD, HALLO WELT..) to decrease the upload time (3 seconds versus 20 seconds).

5.3 Downloading a picture from your DEMOKIT-M24LR-A by RF

Press the **click to download Picture** button shown below to download a picture by RF. Once downloaded, the picture appears next to the button as shown in *Figure 121* and *Figure 122*.

![Click to download Picture button](image)
5.4 Check communications status

You can use the CHECK COMMUNICATION area to verify whether the data were written or read successfully or not.

The green circle (Figure 123) indicates that the RF upload/download process is going smoothly.

The red circle (Figure 124) indicates that errors are occurring during the RF upload/download process.

Figure 123. Upload/download process going smoothly

Figure 124. Upload/download process with errors
5.5 Using your STM32-PRIMER2 to read the contents of the reference antenna through I²C

If the picture was uploaded by RF as described above, you will be able to display it on the LCD screen of your STM32-PRIMER2.

Please refer to the UM0850 user guide to configure your STM32-PRIMER2 and use the embedded software.
6 Datalogger demonstration

The datalogger demonstration must be used in conjunction with the DATALOG-M24LR-A datalogger reference board. Refer to UM0925 “Using the M24LR64-R datalogger reference design” and AN3209 “Developing your M24LR64-R datalogger application for temperature acquisition” for a detailed description of the datalogger reference board and application.

To run the datalogger demonstration:
1. Select Show Datalogger to display the User Interface for Datalogger demo (see Figure 125).
2. Select Show Datalogger Setting to display the Datalogger setting menu (see Figure 126).

Figure 125. Datalogger demonstration home page

![Figure 125. Datalogger demonstration home page](image1)

Figure 126. Datalogger setting menu

![Figure 126. Datalogger setting menu](image2)
7 ESL demonstration

The ESL demonstration allows to use the M24LRxx devices as electronic shelf labels (ESLs).

To run the ESL demonstration:

1. Select **show demo ESL** from the main menu to launch the ESL application (see Figure 127).

2. Several parameters can be set to configure your ESL device (see Figure 128):
   - **Logo**
     Check the French (PROMO) or English logo (DISCOUNT) to indicate that a special price is proposed. Check the blank logo if no special price is applied.
   - **Price trend arrow**
     Check the up or down arrow to indicate if the price has been increased or decreased, or the blank arrow if no indication is required.
   - **Enter the product price**
   - **Enter text in ASCII format in Line 1 and Line 2 to display the name and a brief description of the product.**

1. To write the data in your ESL-like M24LRxx:
   a) Emerge the M24LRxx in your reader RF field.
   b) Click the **Transfer data to your ESL** button.

2. To read and modify the data contained in your ESL-like M24LRxx:
   a) Emerge the M24LRxx in your reader RF field.
   b) Click the **Read ESL configuration** button. A window is then displayed at the right of the ESL demo - configuration tool area (see Figure 128). It shows the type of discount, the product description, as well as the price and the price trend.

*Figure 127. show Demo ESL menu*
Figure 128. ESL setting menu

[Image of ESL setting menu]

- ESL demo - Configuration tool
- Price: $7.99
- French red wine
- Château du Sœil
- Read ESL configuration
- Transfer data to your ESL

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8  Revision history

Table 1.  Document revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-Jan-2010</td>
<td>1</td>
<td>Initial release.</td>
</tr>
<tr>
<td>10-Oct-2011</td>
<td>2</td>
<td>Extended document scope to the whole M24LR64xx family. Added Section 2.4: M24LRxx demonstration kit. Updated Figure 16: Application home page, Figure 18: Main menu. Updated Section : Reader Application menu. Updated Figure 20: show Image Transfer application, Figure 21: show Demo STM32-PRIMER2 menu. Added Section 3.1.5: Demo datalogger menu and Section 3.1.6: Demo ESL menu. Updated Figure 24: Tools menu and Figure 25: Help menu. Updated Section 3.2: Reader application. Added Section 3.2.14: Additional feature: energy harvesting commands. Added Section 6: Datalogger demonstration and Section 7: ESL demonstration. Updated disclaimer on last page.</td>
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