UM0892
User manual

STM32 ST-LINK Utility software description

Introduction

The STM32 ST-LINK Utility software facilitates fast in-system programming of the STM32 microcontroller families in development environments via the tools, ST-LINK and ST-LINK/V2.

This is the STM32 ST-LINK Utility user manual, describing its software functions. When working with the STM32 ST-LINK Utility, you are encouraged to download the *ST-LINK in-circuit debugger/programmer user manual (UM0627)* or the *ST-LINK/V2 in-circuit debugger/programmer user manual (UM1075)* for the STM8 and STM32 which provide more information about the ST-LINK tools.

Contents

1 Getting started

This section describes the requirements and procedures to install the STM32 ST-LINK Utility software.

1.1 System requirements

The STM32 ST-LINK Utility PC configuration requires as a minimum:

- PC with USB port and Intel® Pentium® processor running a 32-bit version of one of the following Microsoft® operating systems:
  - Windows® XP
  - Windows 7
- 32 Mbytes of RAM
- 10 Mbytes of hard disk space available

1.2 Hardware requirements

The STM32 ST-LINK Utility is designed to work with:

- STM32 F1, STM32 F2, STM32 F4, STM32 L1 and STM32W series
- ST-LINK or ST-LINK/V2 in-circuit debugger/programmer probe

1.3 Installing the STM32 ST-LINK Utility

Follow these steps and the on-screen instructions to install the STM32 ST-LINK Utility.

1. Download the compressed STM32 ST-LINK Utility software from the ST website.
2. Extract the contents of the *.zip* file into a temporary directory.
3. Double-click the extracted executable, *setup.exe*, to initiate the installation, and follow the on-screen prompts to install the STM32 ST-LINK Utility in the development environment. Documentation for the utility is located in the subdirectory *\Docs* where the STM32 ST-LINK Utility is installed.

1.4 Uninstalling the STM32 ST-LINK Utility

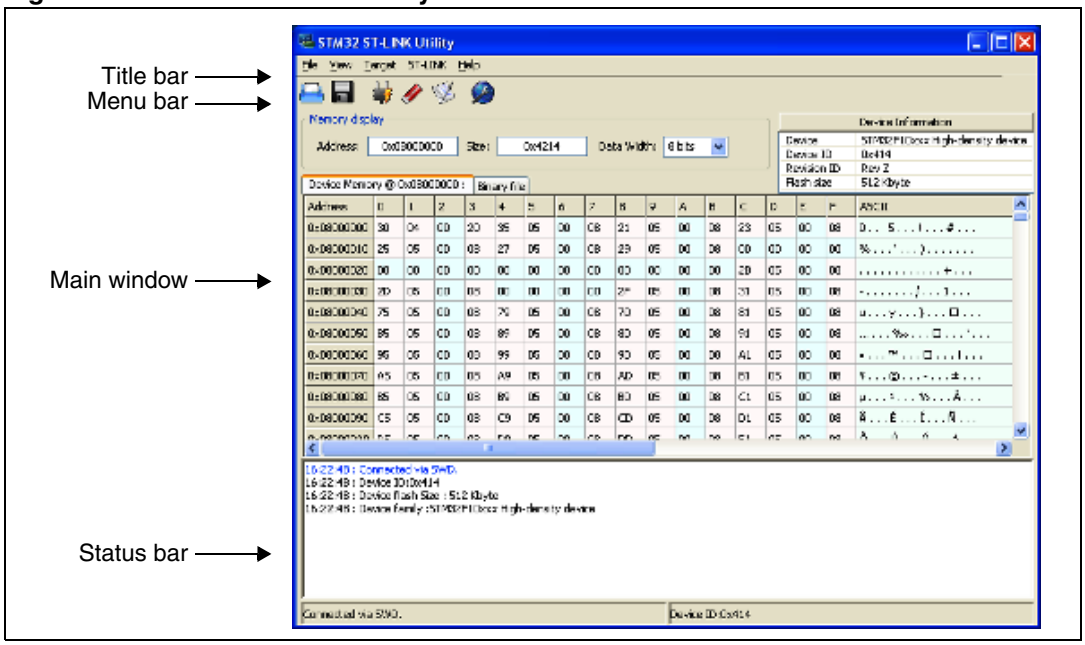
Follow these steps to uninstall the STM32 ST-LINK Utility.

1. Select **Start** | **Settings** | **Control Panel**.
2. Double click on **Add or Remove Programs**.
3. Select **STM32 ST-LINK Utility**.
4. Click on the **Remove** button.

2 STM32 ST-LINK Utility user interface

2.1 Main window

Figure 1. STM32 ST-LINK Utility user interface main window



The main window is composed of three zones and three bars as illustrated in *Figure 1*:

- Memory display zone
- Device information zone
- Memory contents zone
- Title bar: The name of the current menu
- Menu bar: Use the menu bar to access the following STM32 ST-LINK Utility functions:
  - **File** menu
  - **View** menu
  - **Target** menu
  - **Help** menu

  (These menus are described in more detail in *Section 2.2*)
- Status window: The status bar displays:
  - Connection status and debug interface
  - Device ID

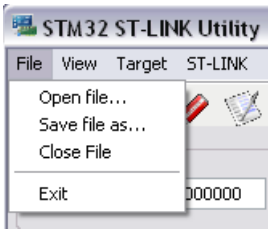
The STM32 ST-LINK Utility user interface also provides additional forms and descriptive pop-up error messages.

2.2 Menu bar

The Menu bar allows users to execute the STM32 ST-LINK Utility software features.

2.2.1 File menu

Figure 2. File menu



Open file... Opens a binary file.

Save file as… Saves the content of the memory panel into a binary file.

Close File Closes the loaded binary file.

Exit Closes the STM32 ST-LINK Utility program.

2.2.2 View menu

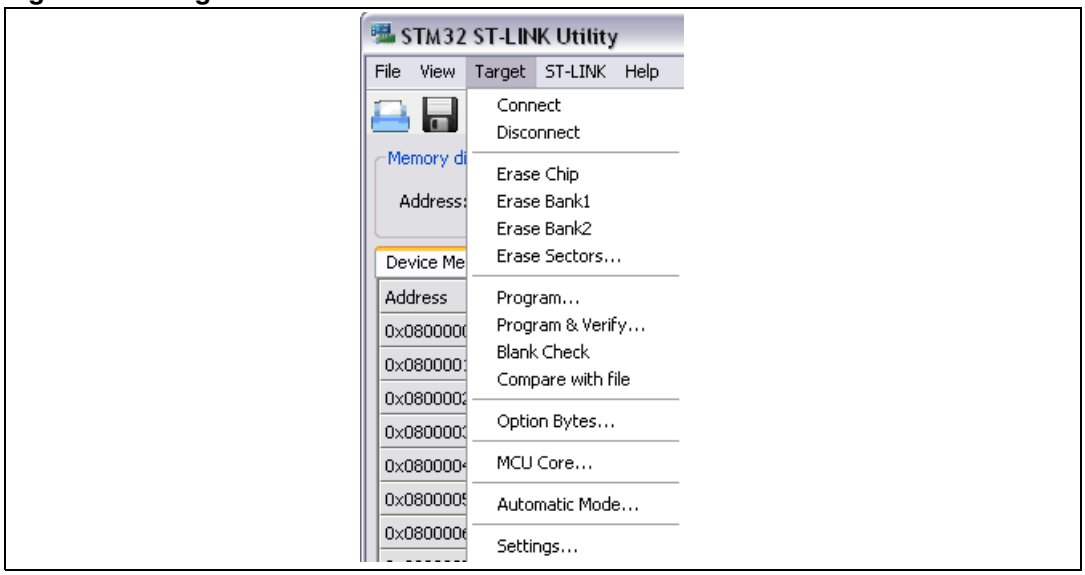
Figure 3. View menu

Binary file Displays the content of the loaded binary file.

Device memory Displays the content of the device memory.

2.2.3 Target menu

Figure 4. Target menu



Connect Connects to the target device and displays the Device Type, Device ID and Flash memory size in the device information zone.

Disconnect Disconnects from the target device.

Erase Chip Performs a Flash memory mass erase and then displays the Flash memory content in the memory panel.

Erase Bank1 Erases bank 1 of the Flash memory. This menu is enabled only when connected to an XL-density device.

Erase Bank2 Erases bank 2 of the Flash memory. This menu is enabled only when connected to an XL-density device.

Erase Sectors… Selects sector(s) to erase using the erase sectors dialog window (see *Section 3.3: Flash memory erase* for more details).

Program… Loads a binary file into the device memory (Flash or RAM). To do this, select a binary file, enter the start address (where to put the file in the device) in the program dialog window and then click on program button (see *Section 3.4: Device programming*).

Program & Verify… Loads a binary file into the device memory (Flash or RAM) then performs a verification of the programmed data.

Blank Check Verifies that the STM32 Flash memory is blank. If the Flash memory is not blank, the first address with data is highlighted in a prompt message.

Compare with file Compares the MCU device memory content with hex, binary or srec file.

Option Bytes… Opens the Option Bytes dialog window (See *Section 3.5: Option bytes configuration* for more details).

MCU Core… Opens the MCU Core dialog window (See *Section 3.6: MCU core functions* for more details).

Automatic Mode... Opens the Automatic mode dialog window (See *Section 3.7: Automatic mode functions* for more details).

Settings... Opens the Settings dialog box to select the debug interface (JTAG or SWD).
The “connect under reset” option allows you to connect to the target before executing any instruction.
This is useful in many cases like when the target contains a code that disables the JTAG/SWD pins.

When connecting to the target via an ST-LINK/V2, the “Supply voltage” combo box displays the target voltage.
When connecting to an STM32 F2 or STM32 F4 device using an ST-LINK, the “Supply voltage” combo allows you to select the supply voltage of your target to be able to correctly program the Flash memory.

Note: The “connect under reset” option is available only with ST-LINK/V2 and in SWD mode. The RESET pin of the JTAG connector (pin 15) should be connected to the device reset pin.

2.2.4 ST-LINK menu

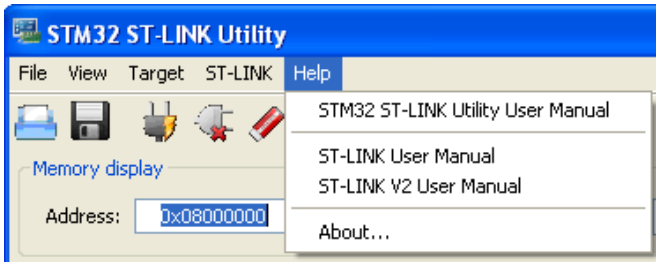
Figure 5. ST-LINK menu

Firmware update Displays the version of ST-LINK and ST-LINK/V2 firmware and updates it to the last version:

ST-LINK : V1J12S3
ST-LINK/V2 : V2J14S3

2.2.5 Help menu

Figure 6. Help menu



STM32 ST-LINK Utility User Manual Opens the *STM32 ST-LINK Utility User Manual*.

ST-LINK User Manual Opens the *ST-LINK User Manual*.

ST-LINK/V2 User Manual Opens the *ST-LINK/v2 User Manual*.

About... Displays STM32 ST-LINK Utility software version and copyright information.

3 STM32 ST-LINK Utility features

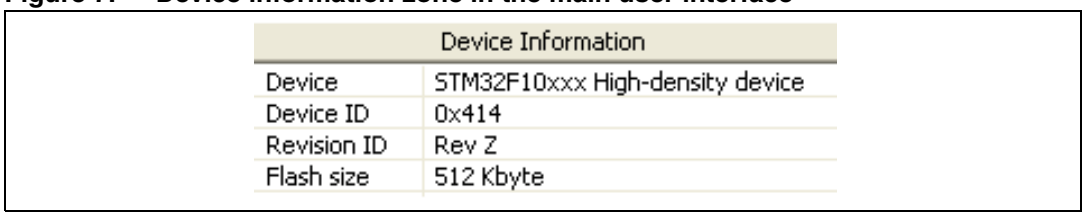
This section provides a detailed description of how to use STM32 ST-LINK Utility features:

- *Device information*
- *Memory display and modification*
- *Flash memory erase*
- *Device programming*
- *Option bytes configuration*
- *MCU core functions*
- *Automatic mode functions*

3.1 Device information

The *Device information* zone displays information as shown in *Figure 7*.

Figure 7. Device information zone in the main user interface



Device: Family of the connected STM32 device. Each device type includes many devices with different characteristics such as Flash memory size, RAM size and peripherals.

Device ID: MCU device ID code located in the external PPB memory map

Revision ID: The revision ID of the connected MCU device

Flash size: Size of the on-chip Flash memory(1)

1. This field is not available for STM32 F2 and STM32 F4 series devices.

3.2 Memory display and modification

In addition to the **Device information** zone, the main window contains 2 other zones:

- **Memory display**
- **Memory data**

Memory display: This zone contains three edit boxes:

Address: Memory start address from which you want to read.

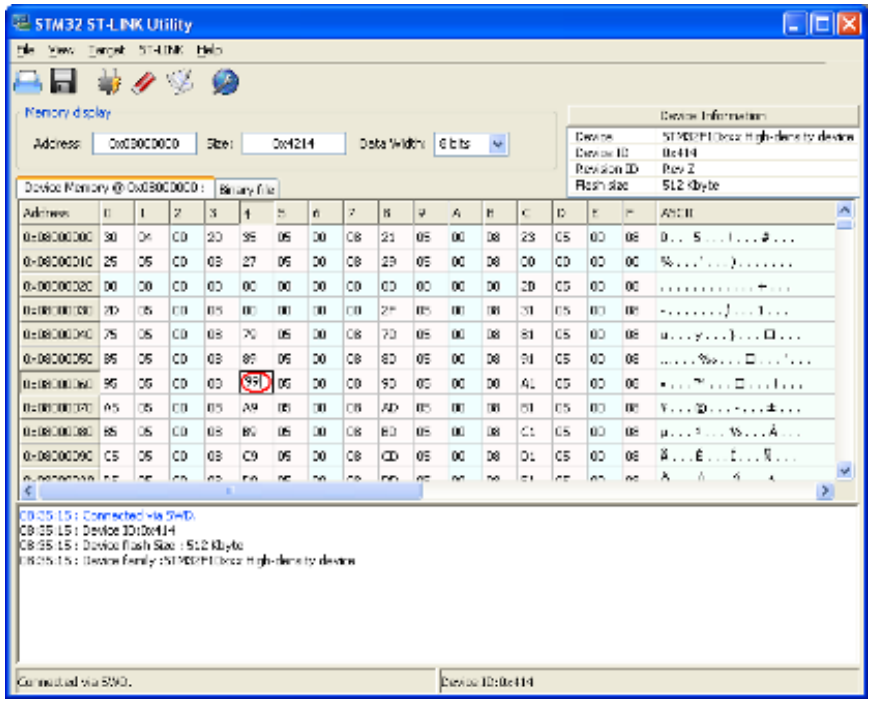
Size: Amount of data to read.

Data width: Width of the displayed data (8-bit, 16-bit or 32-bit).

Memory data: This zone displays the data read from a binary file or the memory content of a connected device. You can modify the content of the file before downloading.

- To use this zone to display the content of binary file, go to **File | Open file...**
- To use this zone to read and display memory content of a connected device, enter the memory start *Address*, data *Size* and the *Data Width* in the *Memory display* zone and then press **Enter**.
- After reading data, you can also modify each value merely by double clicking on the concerned cell as illustrated by *Figure 8*. You can also save the device memory content into a binary file using the menu **File | Save file as...**

Figure 8. STM32 ST-LINK Utility user interface



Note: When the Memory data zone displays device memory contents, any modification is automatically applied to the chip. You can modify user Flash memory, RAM memory and peripherals registers.

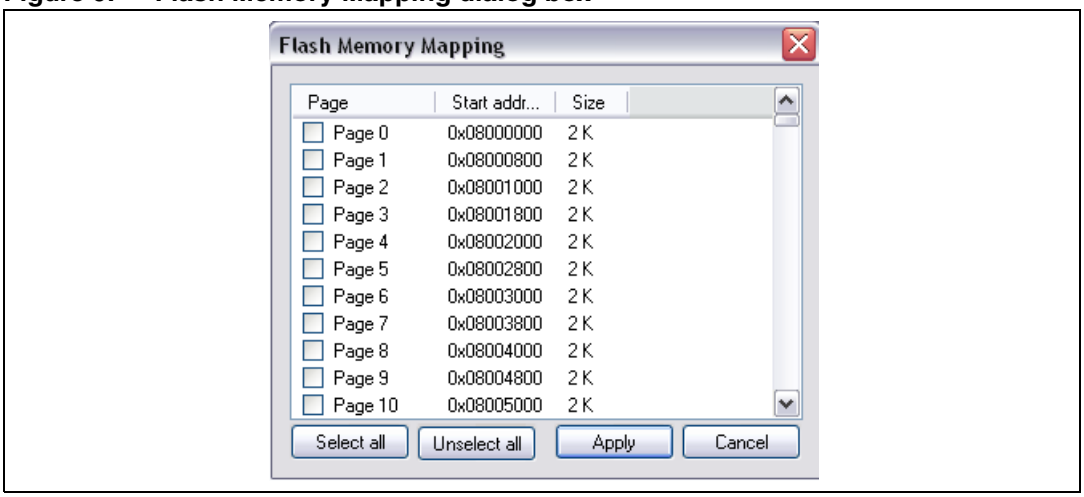
For the STM32 F2 and STM32 F4 devices, you can modify the OTP area directly from the memory data zone.

3.3 Flash memory erase

There are two type of Flash memory erase:

- **Flash mass erase**: Erase all the memory Flash memory sectors of the connected device. This is done by clicking on the menu **Target | Erase Chip**.
- **Flash Sector Erase**: Erase the selected sector(s) of the Flash memory. To select sector(s), go to **Target | Erase Sectors...** which then displays the **Flash Memory Mapping** dialog box where you select the sector(s) to erase as shown in *Figure 9*.
  - **Select all** button selects all the Flash memory pages.
  - **Deselect all** button deselects all sectioned page.
  - **Cancel** button discards the erase operation even if some pages are selected.
  - **Apply** button erases all the selected pages.

Figure 9. Flash Memory Mapping dialog box



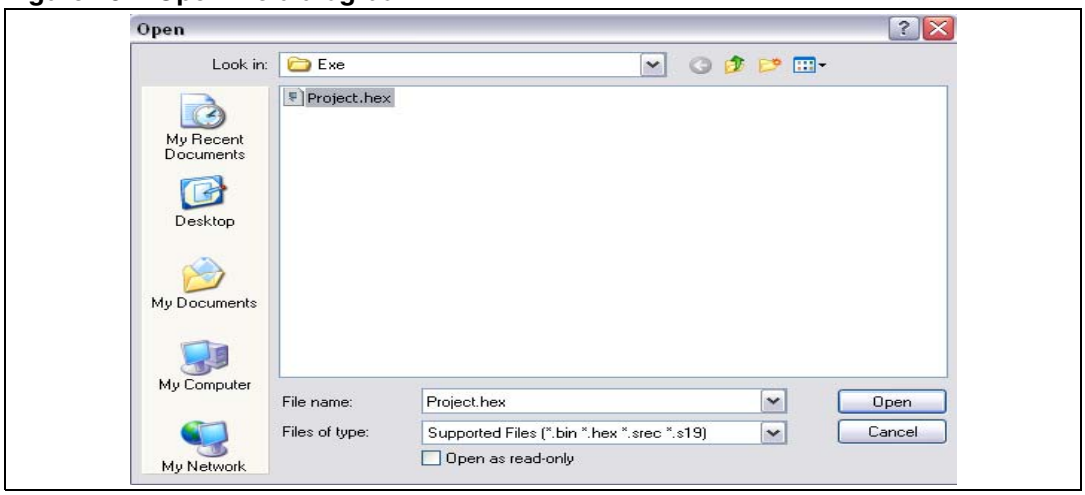
*Note: To erase the Flash data memory sector of the ultralow power STM32 L1 devices, select the data memory box at the end of the list and click **Apply**.*

3.4 Device programming

The STM32 ST-LINK Utility can download binary, Hex, or srec files into Flash or RAM memory. To do this, follow these steps:

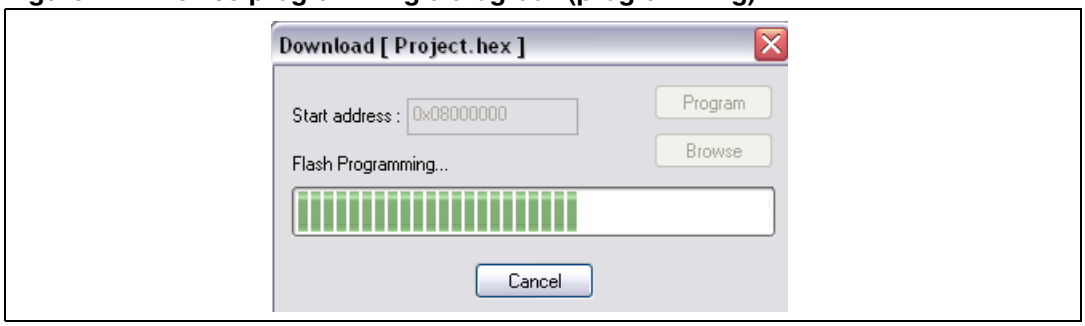
1. Click on **Target** I **Program...** (or **Target** I **Program & Verify...** if you want verify the written data) to open the **Open** file dialog box as shown in *Figure 10*.
   If a binary file is already opened, go to step *3.*

Figure 10. Open file dialog box



2. Select a binary file and click on the **Open** button.
3. Specify the address from which to start programming as shown in *Figure 11*, it may be a Flash or RAM address.

Figure 11. Device programming dialog box (programming)

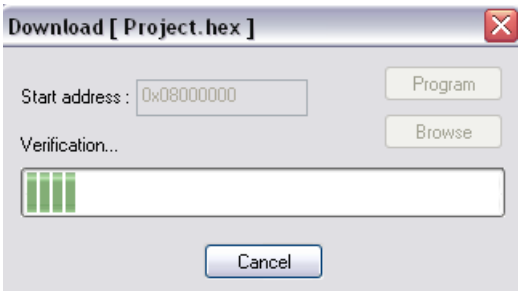


4. Finally, click on the **Program** button to start programming. If you selected **Target** I **Program & Verify...** in the first step, a check is done at the end of the programming operation (see *Figure 12*).

*Note: 1 The STM32 F2 and STM32 F4 series supports different programming modes depending of the MCU supply voltage. When using ST-LINK, the MCU supply voltage should be specified in the **Target** I **Settings** Menu to be able to program the device with the correct mode. When using ST-LINK/V2, the supply voltage is detected automatically.*

2 If the device is read protected, the protection will be disabled. If some Flash memory pages are write protected, the protection will be disabled during programming and then recovered.

Figure 12. Device programming dialog box (verification)



3.5 Option bytes configuration

The STM32 ST-LINK Utility can configure all the option bytes via the **Option Bytes** dialog box shown in *Figure 13* which is accessed by **Target I Option Bytes...**.

The **Option Bytes** dialog box contains the following sections:

- **Read Out Protection**: Modifies the read protection state of the Flash memory.

  For STM32 F2, STM32 F4 and STM32 L1 devices, read protection levels are available:

  – Level 0: no read protection
  – Level 1: memory read protection enabled
  – Level 2: memory read protection enabled and all debug features disabled.

  For the other devices, the read protection can only be enabled or disabled.

- **BOR Level**: Brownout reset level. This list contains the supply level threshold that activates/releases the brownout reset. This option is enabled only when connected to the STM32 L1 device.

  For ultralow power devices, 5 programmable VBOR thresholds can be selected:

  – BOR LEVEL 1: Reset threshold level for 1.69 to 1.8 V voltage range
  – BOR LEVEL 2: Reset threshold level for 1.94 to 2.1 V voltage range
  – BOR LEVEL 3: Reset threshold level for 2.3 to 2.49 V voltage range
  – BOR LEVEL 4: Reset threshold level for 2.54 to 2.74 V voltage range
  – BOR LEVEL 5: Reset threshold level for 2.77 to 3.0 V voltage range

  For STM32 F2 and STM32 F4 devices, 4 programmable VBOR thresholds can be selected:

  – BOR LEVEL 3: Supply voltage ranges from 2.70 to 3.60 V
  – BOR LEVEL 2: Supply voltage ranges from 2.40 to 2.70 V
  – BOR LEVEL 1: Supply voltage ranges from 2.10 to 2.40 V
  – BOR off: Supply voltage ranges from 1.62 to 2.10 V

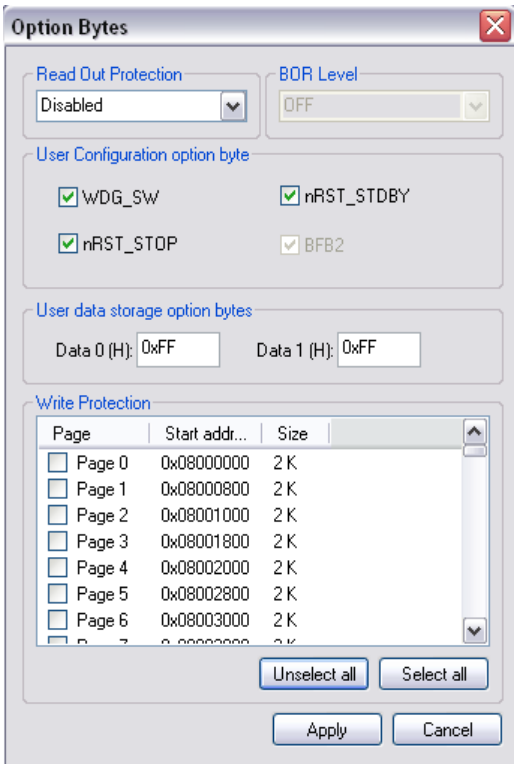
- **User Configuration option byte:**

  – WDG_SW: If checked, watchdog is enabled by software - otherwise it is automatically enabled at power-on.
  – nRST_STOP: If not checked, reset is generated when entering Standby mode (1.8V domain powered-off). If checked, no reset is generated when entering Standby mode.

- nRST_STDBY: if not checked, reset is generated when entering Stop mode (all clocks are stopped). If checked, no reset is generated when entering Stop mode.
- BFB2: If not checked, and if the boot pins are set to make the device boot from user Flash at startup, the device boots from Flash memory bank 2, otherwise it boots from Flash memory bank 1. This option is enabled only when connected to a device containing two Flash banks.

- **User data storage option bytes:** Contains two bytes for user storage. These two option bytes are not available in the STM32 F2, STM32 F4 and STM32 L1 devices.
- **Write Protection:** Depending on the device, Flash sectors are grouped by a defined number of sectors. You can modify the write protection of each Flash sector group here.

Figure 13. Option Bytes dialog box



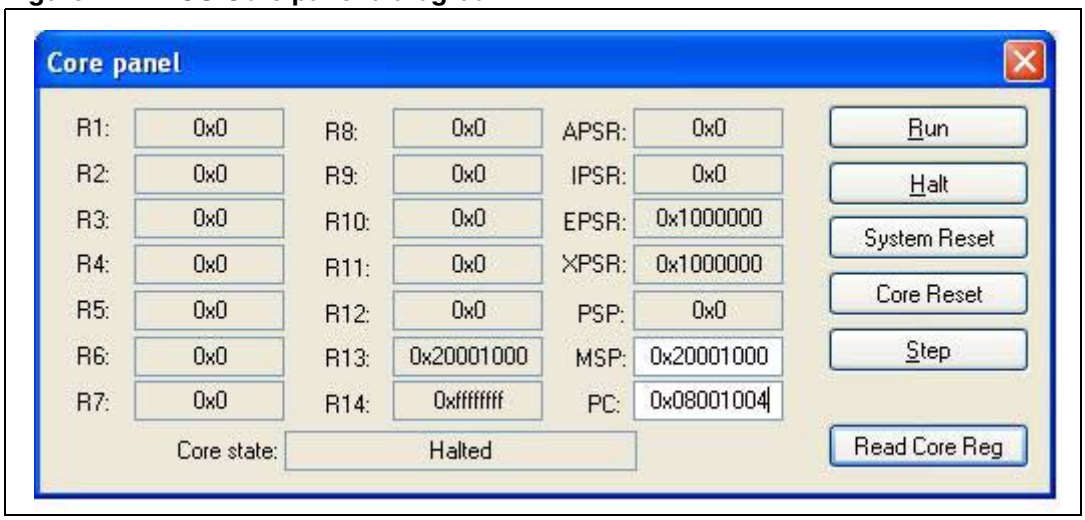
For more details, please refer to the Option Bytes section in the Flash programming manual available from www.st.com.

3.6 MCU core functions

The **Core panel** dialog box shown in *Figure 14*, displays the Cortex™-M3 core register values. It also allows you to carry out the following actions on the MCU, using the buttons on the right:

- **Run**: Run the core.
- **Halt**: Halt the core.
- **System Reset**: Send a system reset request.
- **Core Reset**: Reset the core.
- **Step**: Execute only one step core instruction.
- **Read Core Reg**: Update the core registers values.

Figure 14. MCU Core panel dialog box



Note: The PC and MSP registers can be modified from this panel.

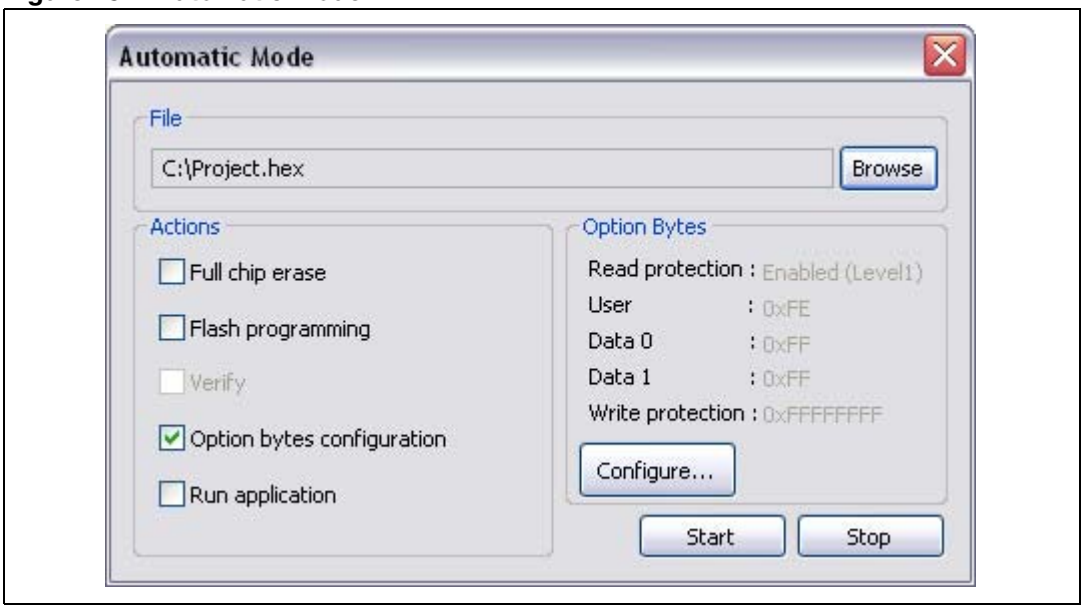
3.7 Automatic mode functions

The **Automatic Mode** dialog box shown in *Figure 15* allows programing and configuring STM32 devices in loop. It allows you to carry out the following actions on the STM32 device:

- **Full chip erase**
- **Flash programming**
- **Verify**
- **Option bytes configuration**
- **Run application**

Clicking on Start button will execute the selected actions on the connected STM32 device and will wait to repeat the same actions after disconnecting the current device and connecting the new device.

Figure 15. Automatic mode



Note: 1 If user deselects Flash programming action while the STM32 Flash memory is readout protected, it will be automatically unprotected.

2 If user deselects Flash programming action while some or all STM32 Flash memory are write protected, they will be automatically unprotected and restored after programming operation.

3 Connection to the device should be established to be able to select the option Bytes configuration using the configure button.

4 The connected devices should be derivatives of the same STM32 family and will be all connected in the same mode (JTAG or SWD).

4 STM32 ST-LINK Utility command line interface (CLI)

4.1 Command line usage

The following sections describe how to use the STM32 ST-LINK Utility from the command line.

The ST-LINK Utility Command Line Interface is located at the following address:

[Install_Directory]\STM32 ST-LINK Utility\ST-LINK Utility\ST-LINK_CLI.exe

4.1.1 Connection and memory manipulation commands

–c

Description: Selects JTAG or SWD communication protocol. By default, JTAG protocol is used.

Syntax: `-c [JTAG/SWD] [UR]`

[`UR`]: Connect to target under reset.

Example: `-c SWD UR`

Note: [UR] available only with ST-LINK/V2 and in SWD mode. The RESET pin of the JTAG connector (pin 15) should be connected to the device reset pin.

–w8

Description: Writes 8-bit data to the specified memory address.

Syntax: `-w8 <Address> <data>`

Example: `-w8 0x20000000 0xAA`

Note: -w8 supports writing to Flash memory, OTP, SRAM and R/W registers.

–w32

Description: Writes 32-bit data to the specified memory address.

Syntax: `-w32 <Address> <data>`

Example: `-w32 0x08000000 0xAABBCCDD`

Note: -w32 supports writing to Flash memory, OTP, SRAM and R/W registers.

–r8

Description: Reads <NumBytes> memory.

Syntax: `-r8 <Address> <NumBytes>`

Example: `-r8 0x20000000 0x100`

4.1.2 Core commands

–Rst

Description: Resets the system.

Syntax : `-Rst`

-HardRst

Description: Hardware reset.

Syntax : `-HardRst`

Note: -HardRst command is available only with ST-LINK/V2. The RESET pin of the JTAG connector (pin 15) should be connected to the device reset pin.

–Run

Description: Sets the Program Counter and Stack pointer as defined at user application and performs a run operation. This is useful if the user application is loaded with an offset (e.g. 0x08003000). If the address is not specified, 0x08000000 is used.

Syntax : `-Run [<Address>]`

Example: `-run 0x08003000`

–Halt

Description: Halts the core.

Syntax : `-Halt`

–Step

Description: Executes Step core instruction.

Syntax : `-Step`

–SetBP

Description: Sets the software or hardware breakpoint at a specific address. If an address is not specified, 0x08000000 is used.

Syntax : `-SetBP [<Address>]`

Example: `-SetBP 0x08003000`

–ClrBP

Description: Clears all hardware breakpoints, if any.

Syntax : `-ClrBP`

–CoreReg

Description: Reads the Core registers.

Syntax: `-CoreReg`

–SCore

Description: Detects the Core status.

Syntax: `-SCore`

4.1.3 Flash commands

-ME

Description: Executes a Full chip erase operation.

Syntax: `-ME`

-SE

Description: Erase Flash sector(s).

Syntax: `-SE <Start_Sector> [<End_Sector>]`

Example:
```
-SE 0     => Erase sector 0
-SE 2 12 => Erase sectors from 2 to 12
```

-P

Description: Load binary, Intel Hex or Motorola S-record file into device memory without verification. For hex and srec format, the address is relevant.

Syntax: `-P <File_Path> [<Address>]`

Examples:
```
-P "C:\file.srec"
-P "C:\file.bin" 0x08002000
-P "C:\file.hex"
```

Note: 1 STM32 F2 and STM32 F4 series supports different programming modes depending on the MCU supply voltage. When using ST-LINK/V2, the supply voltage is detected automatically. Therefore, the correct programming mode is selected. When using ST-LINK, the 32-bit programming mode is selected by default.

2 If the device is read protected, the protection will be disabled. If some Flash memory pages are write protected, the protection will be disabled during programming and then recovered.

-V

Description: Verifies that the programming operation was performed successfully.

Syntax: `-V`

Example:
```
-P "C:\file.srec" -V
```

4.1.4 Option byte commands

-rOB

Description: Displays all option bytes.

Syntax: `-rOB`

-OB

Description: Configures the option bytes. This command:

– sets the Read Protection Level to Level 0 (no protection)

– sets the IWDG_SW option to '1' (watchdog enabled by software)

– sets the nRST_STOP option to '0' (reset generated when entering Standby mode)

– sets the Data0 option byte

– sets the Data1 option byte

Syntax:
```
-OB [RDP=<Level>][BOR_LEV=<Level>][IWDG_SW=<Value>]
[nRST_STOP=<Value>][nRST_STDBY=<Value>][BFB2=<Value>]
[Data0=<Value>] [Data1=<Value>][WRP=<Value>]
```

Example:
```
-OB RDP=0 IWDG_SW=1 nRST_STOP=0
Data0=0xAA Data1=0xBC
```

Option byte command parameter descriptions

RDP=<Level>:

RDP=<Level> sets the Flash memory read protection level.

The <Level> could be one of the following levels:

0 : Protection disabled

1 : Protection enabled

2 : Protection enabled (debug and boot in SRAM features are DISABLED)

Note: Level 2 is available on STM32 F2, STM32 F4 and STM32 L1 series only.

BOR_LEV=<Level>:

BOR_LEV sets the Brownout Reset threshold level.

For STM32 L1 series:

0 : BOR OFF, 1.45 to 1.55 V voltage range

1 : 1.69 to 1.8 V voltage range

2 : 1.94 to 2.1 V voltage range

3 : 2.3 to 2.49 V voltage range

4 : 2.54 to 2.74 V voltage range

5 : 2.77 to 3.0 V voltage range

For STM32 F2 and STM32 F4 series:

0 : BOR OFF, 1.8 to 2.10 V voltage range

1 : 2.10 to 2.40 V voltage range

2 : 2.40 to 2.70 V voltage range

3 : 2.70 to 3.60 V voltage range

IWDG_SW=<Value>:

The <Value> should be 0 or 1:

0 : Hardware independent watchdog

1 : Software independent watchdog

nRST_STOP=<Value>:

The <Value> should be 0 or 1:

0 : Reset generated when CPU enters the Stop mode

1 : No reset generated.

nRST_STDBY=<Value>:

The <Value> should be 0 or 1:

0 : Reset generated when CPU enters the Standby mode

1 : No reset generated.

BFB2=<Value>:

The <Value> should be 0 or 1:

0 : Boot from Flash bank 2 when boot pins are set in boot from user Flash position (default)

1 : Boot from Flash bank 1 when boot pins are set in boot from user Flash position (default).

Note: BFB2 is available only on devices containing two Flash banks.

Data0=<Value>:

Data0 sets the Data0 option byte.

The <Value> should be in [0..0xFF].

Note: Not available on STM32 F2, STM32 F4 and STM32 L1 devices.

Data1=<Value>:

Data1 sets the Data1 option byte.

The <Value> should be in [0..0xFF].

Note: Not available on STM32 F2, STM32 F4 and STM32 L1 devices.

WRP=<Value>:

WRP enables/disables write protection of the MCU flash sectors.
Each bit will Enable/Disable the write protection of one sector or more depending on the connected device.

For STM32 L1 devices, WRP[i] = 0 : Flash sector(s) is protected.
For other devices, WRP[i] = 1 : Flash sector(s) is protected.

This command is sufficient to enable/disable all flash sectors protection except for STM32 L1 High density where WRP2 and WRP3 commands are needed.

The <Value> should be in [0..0xFFFFFFFF]

WRP2=<Value>:

WRP2 is available only for STM32 L1 high density devices to enable/disable the protection of flash sectors from sector 512 to sector 1023.

The <Value> should be in [0..0xFFFFFFFF]

WRP3=<Value>:

WRP3 is available only for STM32 L1 high density devices to enable/disable the protection of flash sectors from sector 1024 to sector 1535.

The <Value> should be in [0..0xFFFFFFFF]

Note: 1 All parameters listed above should be in hexadecimal format.

2 For more details, please refer to the Option Bytes section in the Flash programming manual corresponding to your device available at www.st.com

5 Revision history

Table 1. Document revision history

Date	Revision	Changes
22-Jan-2010	1	Initial release.
12-Feb-2010	2	Changed figures 1, 2, 3, 4, 5, 6 and 7. Added SWD support.
20-May-2010	3	Added support of XL-density devices in *Section 2.2.3* and *Section 3.5*.
27-Aug-2010	4	Added support of STM32 L1.
03-Feb-2011	5	Hex, srec format support. Command Line Interface support. Changed name and all figures. Added *Section 3.7: Automatic mode functions*
01-Aug-2011	6	Added ST-LINK/V2 support in *Section 1.2: Hardware requirements* and support of different programming modes for STM32 F2 series in *Section 3.4: Device programming* and *Section 4.1.3: Flash commands*. Added MCU revision ID Display in *Section 3.1: Device information*.
18-Oct-2011	7	Added support of STM32W and STM32 F4 throughout the document. Added support of “Connect under reset” option in *Section 2.2.3: Target menu*. Replaced *Figure 14: MCU Core panel dialog box*. Updated Flash with modifications in *Section 3.2: Memory display and modification* via GUI commands and in *Section 4.1.1: Connection and memory manipulation commands* via CLI commands. Added *-HardRst* command in CLI mode in *Section 4.1.2: Core commands* . Added WRP2 and WRP3 for STM32 L1 high density devices in *Option byte command parameter descriptions*.

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