STSW-ONE graphical user interface

STNRG

Introduction

This user manual describes the operation of the ST-ONE® Graphical User Interface, optionally associated with STEVAL-PCC020V2.1, the USB to UART interface board.

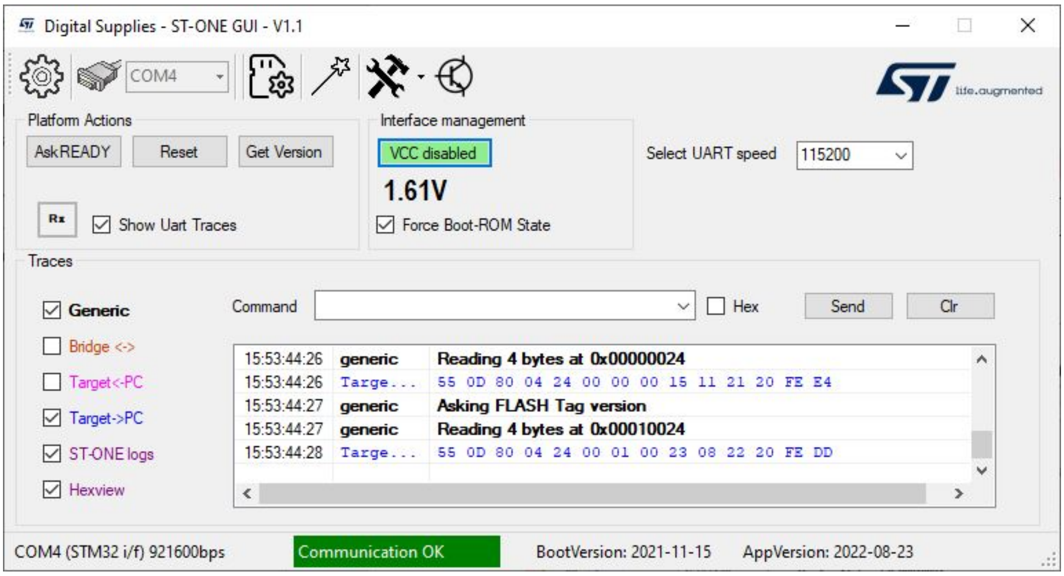
The STEVAL-PCC020V2.1 is an interface board used to connect a Windows® based PC with digital power supply controllers such as ST-ONE, STNRG012, or STNRG011. The layout and the behavior of the interface board are described in the ST-ONE datasheet.

The GUI allows to update the ST-ONE embedded firmware, calculate the main board's components, monitor in real time the status of the digital controller, and tune specific parameters according to customer needs.

GUI features

- Running on Windows XP (.NET 4.0 framework needed), Windows 7, 8, and 10
- Board components setup
- Real time monitor of the digital controller status
- Connection to ST-ONE using either direct standard COM port or through STEVAL-PCC020V2 board.

Figure 1. ST-ONE GUI main form

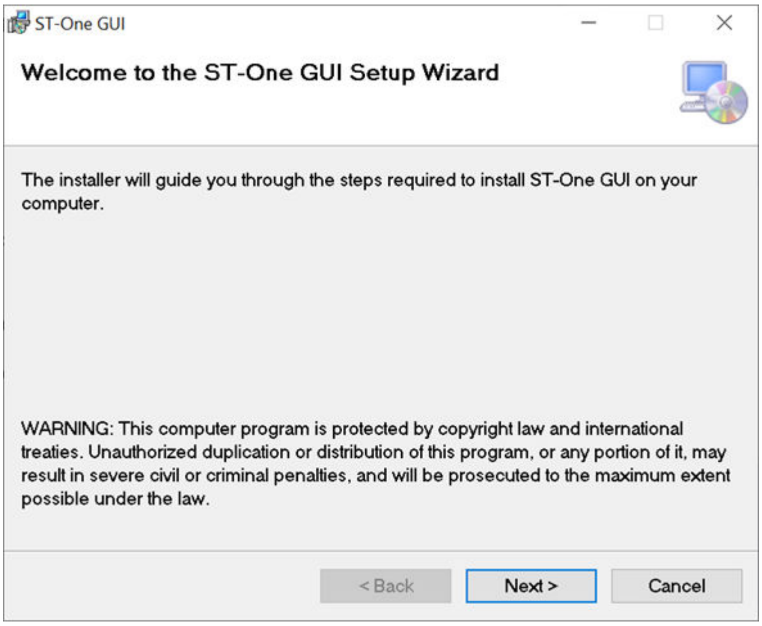


1 GUI installation

The ST-ONE GUI installation is performed by a dedicated installer. The installer does not remove previous versions of the GUI: if an equivalent version is already installed on the PC, it is removed when the installer is launched, and a new installation is required.

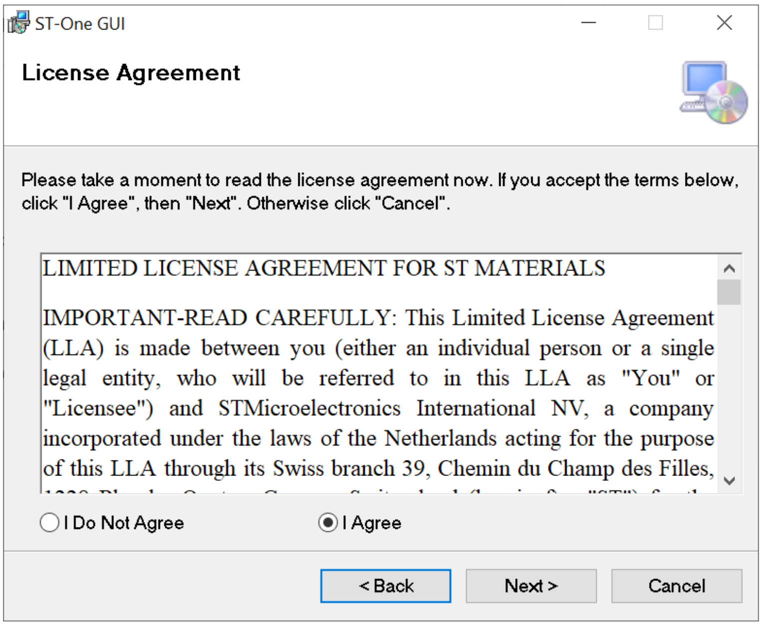
Double-click on *setup.exe* to launch the installer. When the form below appears, select *Next* to continue.

Figure 2. ST-ONE installer – welcome page



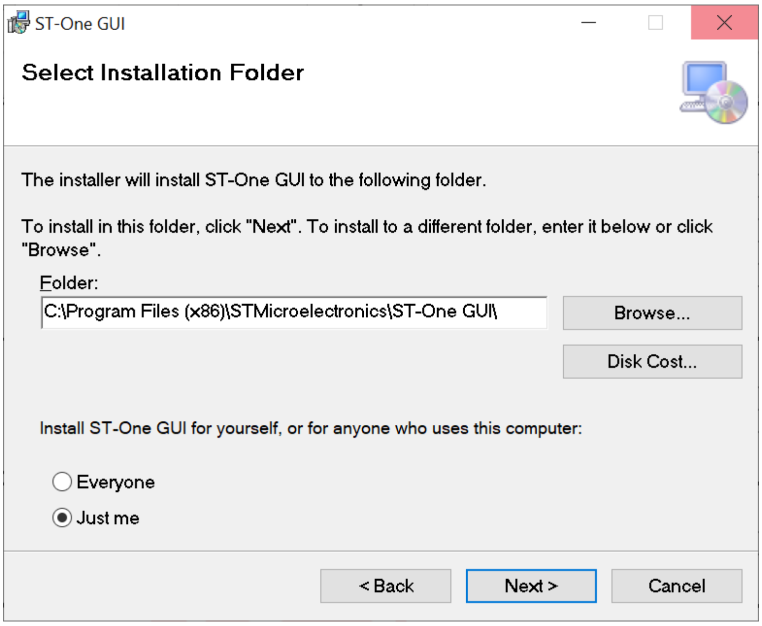
In order to move on with the installation, the license agreement has to be accepted.

Figure 3. ST-ONE installer – license agreement



It is recommended to install the ST-ONEGUI inside a dedicated *STMicroelectronics* folder on disk *C:*, as shown below. In case the user do not own the administration rights, it is recommended to install the ST-ONE GUI in a folder where administration rights are not requested

Figure 4. ST-ONE installer – path selection



Once the installation is concluded, the tool can be launched.

2 GUI introduction

2.1 GUI features

The ST-ONE GUI is a tool developed to help a developer to set up and monitor the behavior of the ST-ONE. At a glance, it allows to:

- Program flash memory
- Calculate main board components
- Read event history data (for example, fault history).

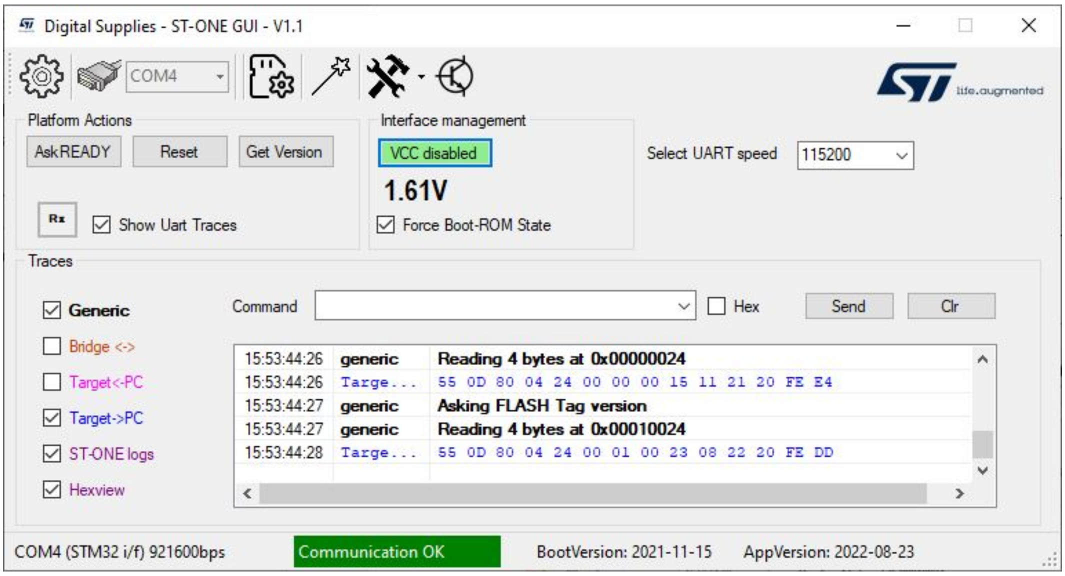
2.2 GUI startup screen

The main form is shown in Figure 5.

The GUI is subdivided in 3 areas:

- **Tool bar:** it allows to select the desired actions to be performed on ST-ONE
- **VCC control & basic actions**: it contains UART controls
- **Traces and status**: Internal debug traces and status bar showing the current status of ST-ONE.

Figure 5. ST-ONE GUI startup screen



2.3 Connection management

The communication between the PC and ST-ONE, through PCC020V2, can be implemented with two different configurations. Connect cable A between the PC and PCC020V2, cable B between PCC020V2 and ST-ONE:

Figure 6. Configuration 1

CC connection:

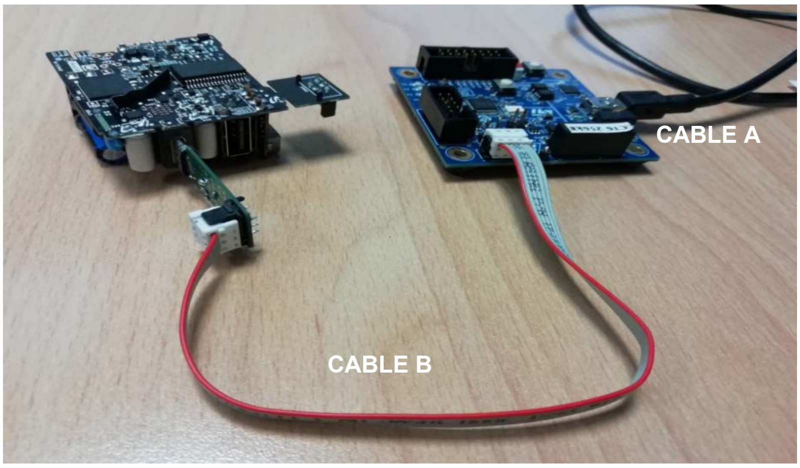
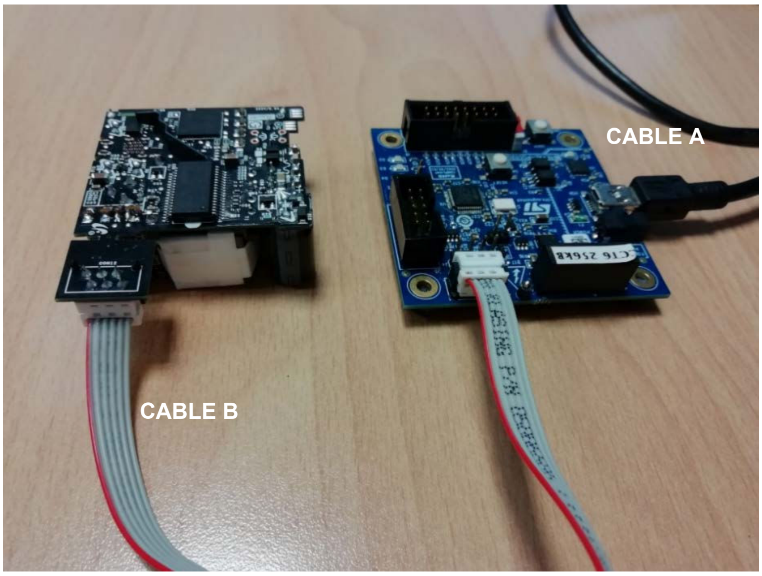


Figure 7. Configuration 2

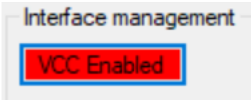
GPIO connection:



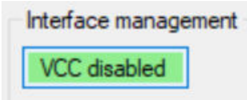
Caution: ***AC voltage must always be disconnected during VCC generation, otherwise there would be a conflict between VCC generated by the interface board and the ST-ONE converter output.***

The procedures below are recommended:

- For flash programming:
  – Disconnect AC source.
  – Connect the interface board and launch the GUI by pressing VCC button. The VCC button changes to VCC Enabled.



  – Perform operations.
  – Disconnect VCC on the GUI by pressing VCC button. The VCC button changes to VCC Disabled.



  – Connect AC source.

2.4 Establishing the communication link, boot modes

Before being able to perform any operation, the user must ensure a correct communication channel with the ST-ONE device.

First of all, the ST-ONE device must be supplied.

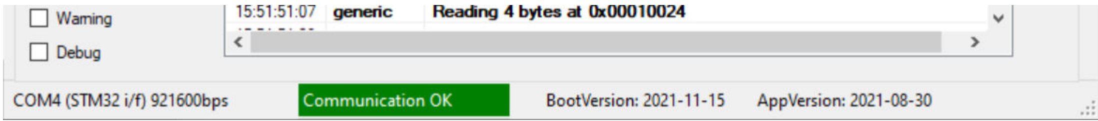
- If a direct UART connection is used, the ST-ONE chip must be powered externally.
- If the STEVAL-PCC020 is used, this is straight forward, the user has to just click on the VCC Enable button.

If the communication is successfully established:

- The ST-ONE boot ROM sends a READY message

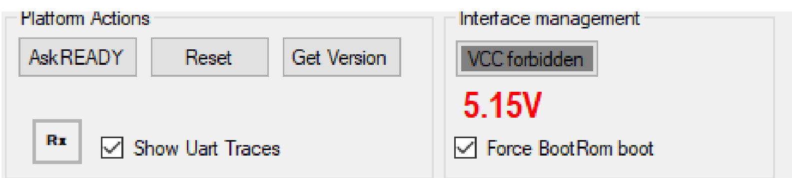
The status bar displays *Communication OK* and the boot and application versions are displayed in the task bar too.

Figure 8. Successful communication with ST-ONE



Note: • *The GUI forbids to Enable VCC if VCC is already detected (supply running).*

Figure 9. VCC generation forbidden



- When VCC is engaged, if it goes down below a given threshold or above the OVP threshold, VCC is automatically disengaged to protect the interface board.

Boot modes:

At startup, the internal boot ROM checks the status of the Rx line.

- If it has asserted to ground, the MCU does not start the application. This mode is called the **“rescue” mode** and it is used to update the application firmware

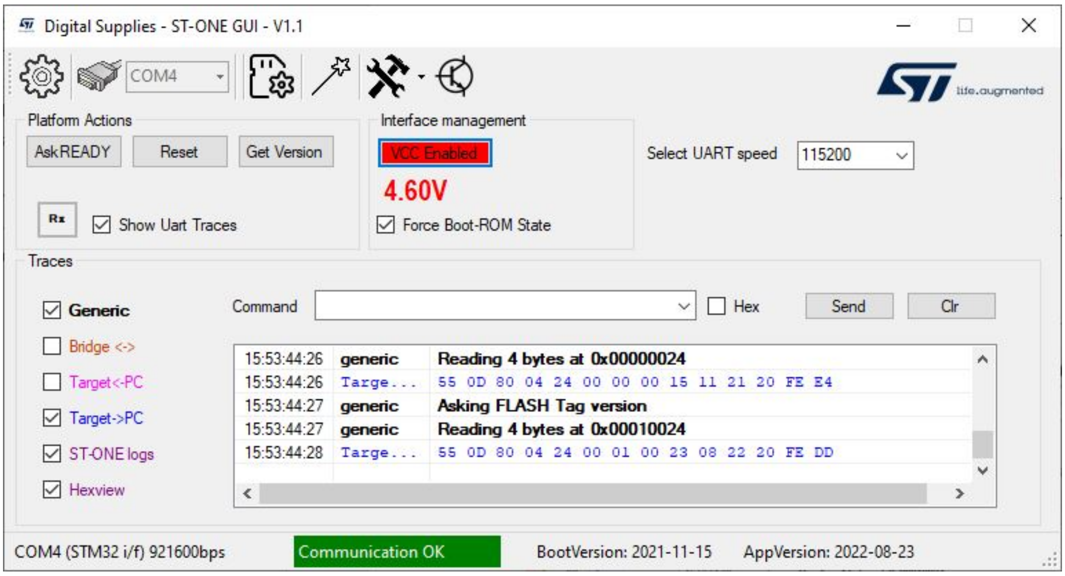
- Otherwise, if there is a valid application firmware image stored in flash, the MCU branches to the application, which is the **normal mode** of operation.

Note: If the STEVAL-PCC020 interface board is not used, the user must apply the following sequence:

- VCC off, tied UART_RX line to ground in order to select rescue mode.
- Apply VCC
- Release UART_RX line
- Press *AskReady* button to check if the link has been successfully established.

If the STEVAL-PCC020 board is attached, boot mode can be selected (rescue mode or normal mode).

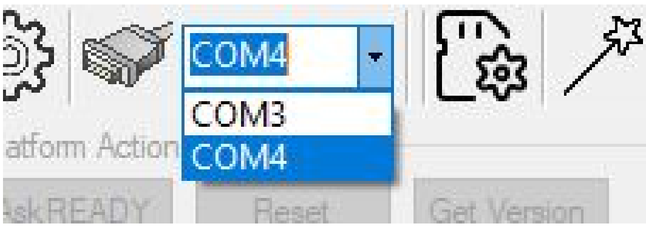
Figure 10. Rescue mode boot: the MCU remains in boot ROM state



Note that in this case, the application firmware detected that the ST-ONE chip is powered from the secondary side (so by the STEVAL-PCC020 interface in our case).

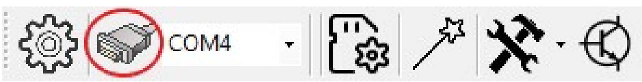
At startup, **the GUI automatically detects the COM port to be used** (the GUI selects the CP2102 based VCP). In case of multiple CP2102, the user has to manually select the right COM port through the COM port menu.

Figure 11. COM port selection



It is possible to open/close the COM port using the dedicated icon:

Figure 12. COM port open and close



Some sections of the GUI can operate even without a connected ST-ONE board, but real time monitoring is not available.

Once the right COM port is selected, the GUI tries to communicate with the interface board microcontroller with the selected speed, see Figure 2. In case the connection is not correctly established, modify the UART speed or switch between the interface connection selected (for example, from GPIO to CC or from CC to GPIO).

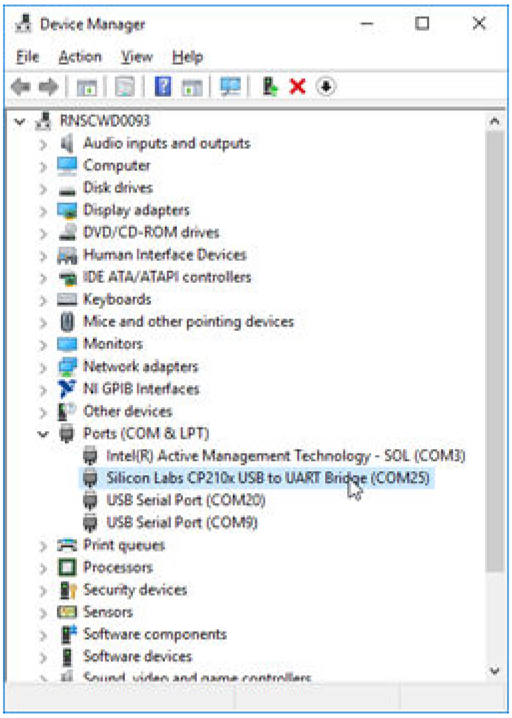
Figure 13. Traces during GUI connection

15:23:36:42	generic	HW:STM32 - HVDPS interface
15:23:36:42	generic	FW:3.6.14835 Date:Feb 14 2020 17:59:06
15:23:36:44	generic	Requesting READY message @ 115200 bps...
15:23:36:50	error	unable to find Uart Speed
15:26:08:64	generic	HW:STM32 - HVDPS interface
15:26:08:64	generic	FW:3.6.14835 Date:Feb 14 2020 17:59:06
15:26:08:65	generic	Requesting READY message @ 115200 bps...
15:26:08:73	error	unable to find Uart Speed

Note: If the GUI does not find a SiLabs based VCP, an error message pops up.

Check in the Device Manager that the SiLabs VCP is correctly recognized. (see Figure 14).

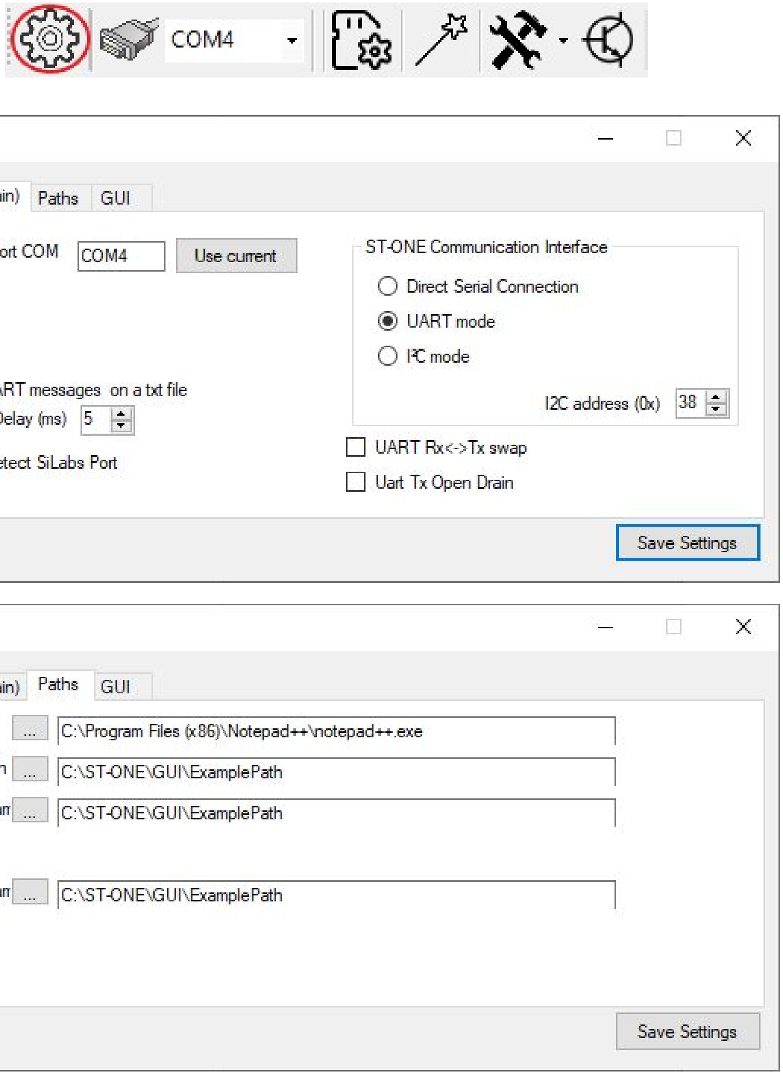
Figure 14. SiLabs VCP in the device manager

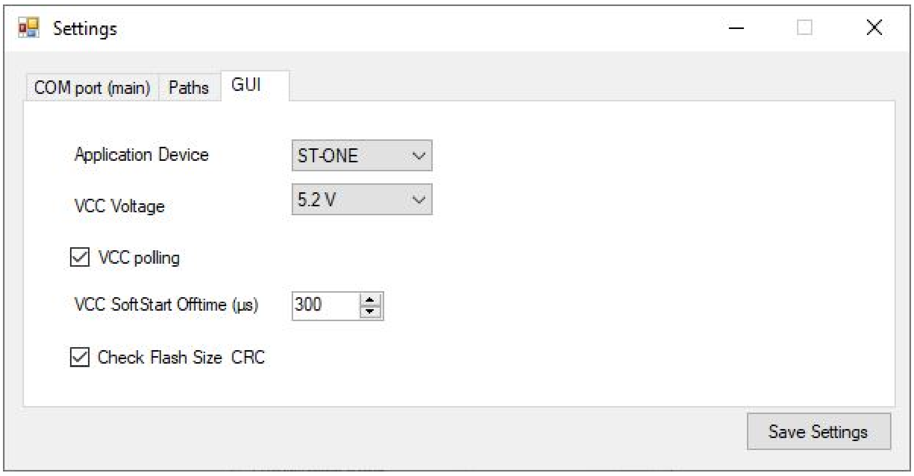


2.5 Settings

The GUI settings are accessible by clicking the **Settings** icon.

Figure 15. Available settings panels





The *Save Settings* button allows to save the settings into the config.xml file, located in: ".\\xml\\config.xml", maintaining the same choices for the next time the GUI is opened.

Table 1. GUI settings

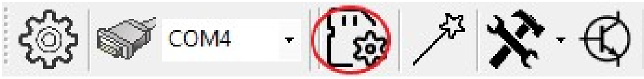
All the options configurable through the *Settings* form are listed below:

COM port (main)	
Default port COM	The UART COM port used by default if autodetection is not enabled.
Direct serial connection	Check this box to use the GUI without the STEVAL-PCC020V2 board (using a standard USB 2 serial cable), otherwise VCC cannot be supplied.
AutoDetect SiLabs port	Autodetect SiLabs COM port.
UART Tx open drain	If checked, Tx is open drain (then a pull-up resistor is needed on the ST-ONE Rx line).
Log UART messages from STNRG	Option to log the UART exchange on a file (uart_trace.txt on the GUI executable directory).
Default paths	
Editor path	Default path for the text editor.
Flash	Default path for the application firmware.
Parameters	Default path for the flash parameters.
Flash + parameters	Default path for the complete file to set up both application firmware and flash parameters.
GUI settings	
Application device	Select the target device (ST-ONE, ST-ONE MP or ST-ONE HP); this choice automatically configures the correct .xml files package.
VCC voltage	Select the VCC voltage
VCC polling	Enable or disable VCC polling
VCC SoftStart off-time	PWM off-time used during VCC startup. The longer this value is, the smoother the VCC. The default value may be fine with most of the ST-ONE applications.
Check flash size CRC	Check the correctness of the CRC computed from the flash content.

3 GUI features

3.1 Application flash parameters editor

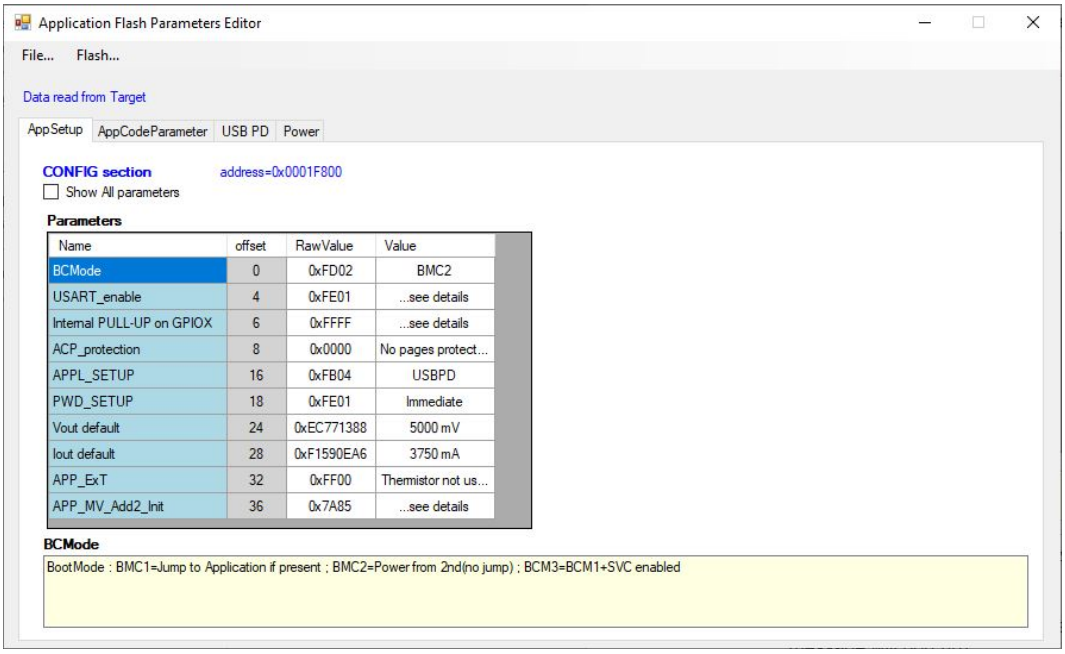
Figure 16. **Application flash parameters editor**



In applicative mode or rescue mode, this feature is used to update persistent application parameters:
• read and write the application flash parameters
• store and recall the parameters to disk
• edit the parameters in a convenient way.

There are various sections for the parameters:
• App setup: defines the behavior of the application boot
• App code parameters: configures traces, default voltage settings, and protection
• USB PD: related to USB PD compliance and parameters as per specification
• Power: firmware parameters of the power section.
The parameters description is outside the scope of this document, and they are subject to change with the application firmware evolution, so a dedicated document is available. ST-ONE

Figure 17. **Application flash parameters editor window**



Note:
- *In order to Read or Write parameters, the ST-ONE chip must be supplied (otherwise an error message pops up)*
- *It is also possible to update the flash parameters in application mode but this is not recommended, furthermore, some parameters might not be taken into account before reset.*

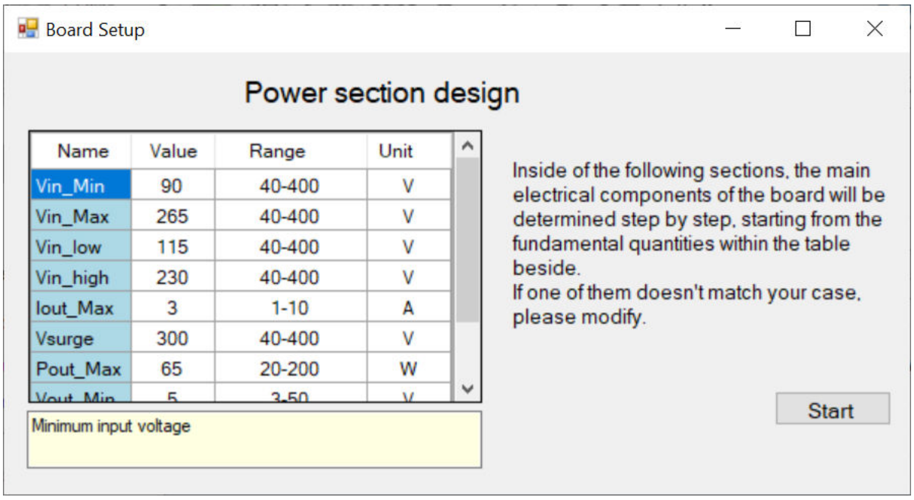
3.2 Setup board – wizard

This module has been designed to guide the user during the first approach to the board's electrical components and ST-ONE behavior.

It is required to fill the first table, Figure 18 , with the theoretical desired values of the application under analysis; a brief description of each parameter is reported inside the *Info Box*. If the inserted value exceeds the range an error message is reported. The inserted values are automatically implemented in the mathematical model after the *start* button is pressed. If values are not consistent with each other (for example, a minimum greater than a maximum), an error box is displayed.

Note: No further modifications of these parameters are considered after the simulation steps have started. In order to make changes effective, a new simulation has to be performed by pressing the start button again.

Figure 18. Power section design table



3.2.1 Bulk capacitor

This tab allows to compute the valley voltage and to obtain the capacitor's behavior curves, selecting:

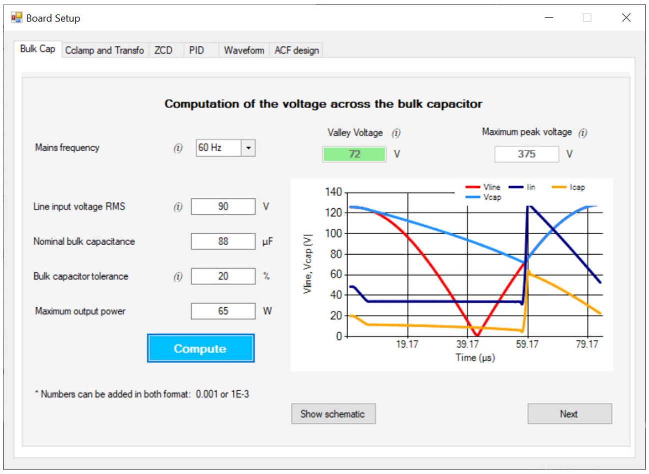
- The mains frequency, choosing between 50 Hz or 60 Hz basing the application
- The bulk capacitor (capacitance and tolerance)
- The maximum output power (the default value is imported from the power section design table, but the value can be modified to analyze changes in the graph).

Press *Compute* to obtain the results.

The valley voltage box assumes a red background color if the result cannot be accepted, otherwise a green background confirms that the choice is correct.

In order to create a readable chart, current values have been modified before plotting with a stretching factor (*20) and an offset (+ 20). Thus, the values reported on the Y axis have to be considered valid for voltages only. All the raw results for both voltages and currents, to perform a partial plotting, are contained inside *\output\ST-ONE_CapResults.txt*.

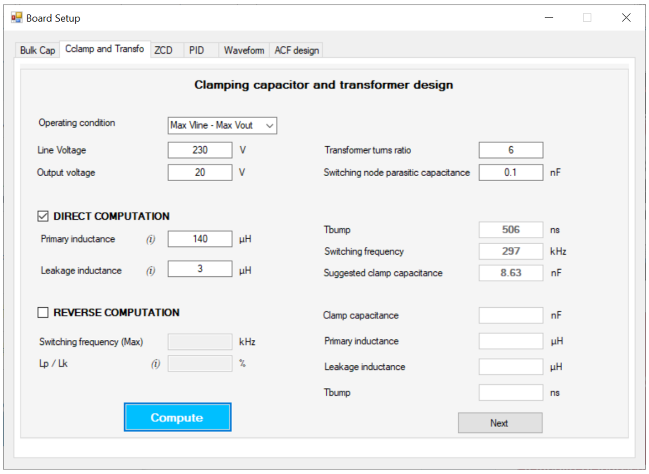
Figure 19. Capacitor computations form



3.2.2 Clamping capacitor and transformer

This tab allows to compute fundamental quantities related to the transformer. The mains voltage and the output voltage may be defined directly inserting the value with the correspondent box or selecting an operating condition among the choices in the ComboBox.

Figure 20. Clamping capacitor and transformer design form



The user can choose a direct or a reverse approach through the CheckBox, depending on which parameters are essential. The direct one starts from the primary and leakage inductances to obtain the switching frequency. On the contrary, the reverse approach computes the leakage and the primary inductances and from the primary-leakage ratio and the switching frequency.

Press *Compute* to obtain the results.

For both cases, the width of the bump and the clamping capacitance are calculated.

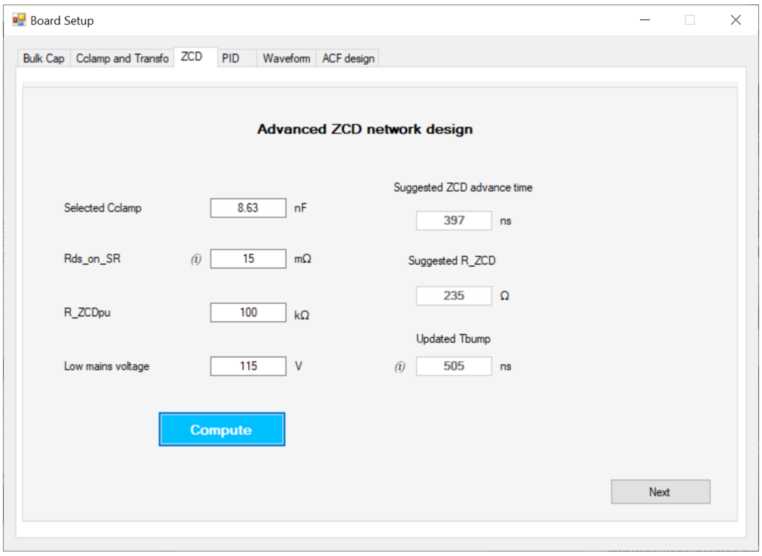
3.2.3 Zero current detector

This tab allows to compute the zero current detection (ZCD) advance time.

Basing on the value suggested by the previous tab, a clamping capacitance has to be selected, satisfying the constraints on Tbump: it has to be kept between a range of (12-18) % of the switching period. If this requirement is not satisfied an error box is shown when the *next* button is pressed.

Press *Compute* to obtain the results.

Figure 21. **ZCD design form**

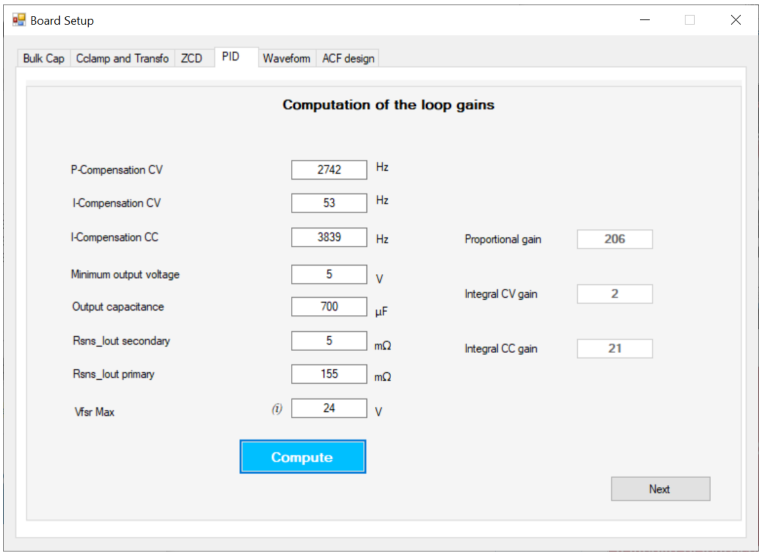


3.2.4 Loop

This tab allows to compute the loop gains at constant current and constant voltage, starting from the fundamental loop parameters.

Press *Compute* to obtain the results.

Figure 22. **Loop parameters design form**



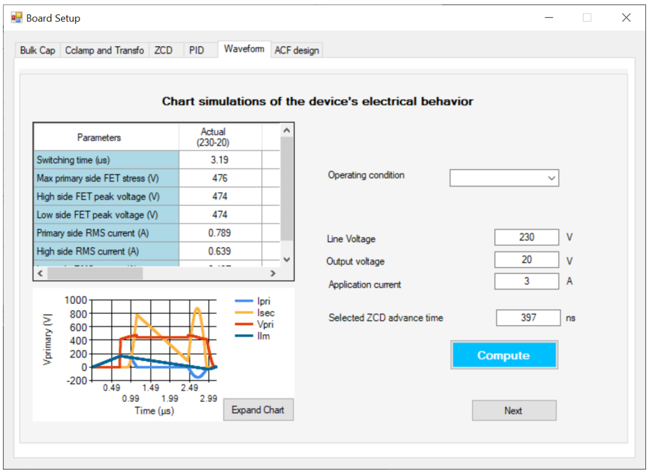
3.2.5 Waveforms

This tab allows to generate the waveforms representing the device's behavior. When pressing the *Compute* button, all the simulation results are saved on a file *GeneralWave_wizard_x_.txt* and summarized inside the table. The second column of the table is based on the current-voltage conditions specified within the boxes. From the third to the last column simulation results on the four fundamental corners are reported, respectively:

- Maximum line voltage, maximum output voltage
- Minimum line voltage, maximum output voltage
- Maximum line voltage, minimum output voltage
- Minimum line voltage, minimum output voltage

Press *Compute* to obtain the results. The *expand chart* button shows a larger version of the computed graph. The data represented within the chart are the ones related to the *Actual* conditions. In order to update the graph starting from the new conditions, press again *Compute*, then *Expand Chart.*

Figure 23. **Waveform parameters simulation form.**

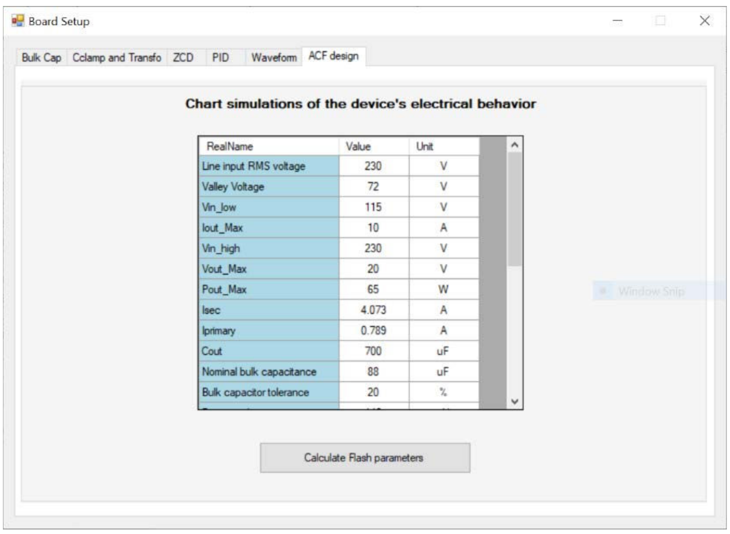


3.2.6 ACF design

This form exploits a recap of the design parameters selected or obtained through previous computations. When *Calculate Flash parameters* is pressed, the power parameters section of the application flash form is updated with the new values.

Note: *In order to be effective, the application flash update has to be saved before closing the form.*

Figure 24. **Active clamp flyback design recap**

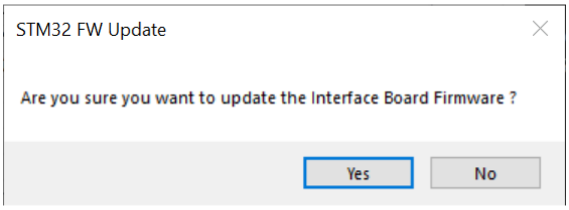


3.3 Firmware update

Figure 25. **Firmware update menu and window**

The onboard STM32 firmware can also be updated from the GUI; the last firmware version associated with the GUI is always provided inside the GUI delivery. When the GUI boots, it tries to locate the interface board and then identifies the firmware version: if too old, to obtain a correct setup an update is required.

Figure 26. **Firmware update confirmation window**



- If the embedded firmware version is later than or equal to the v. 2.4, **the process is automatic**, no user action (for example, jumper connection) is required.
- On the other hand, if the embedded firmware has been corrupted or there is no firmware at all, it is necessary to connect a jumper on J2 and hit the Reset button (user has to follow up instructions).
- Once the firmware has been updated, the GUI reboots the board and the new firmware can be used.

Revision history

Table 2. Document revision history

Date	Version	Changes
28-Jun-2023	1	Initial release.
16-Sep-2024	2	Changed title; updated Section 2.5.

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