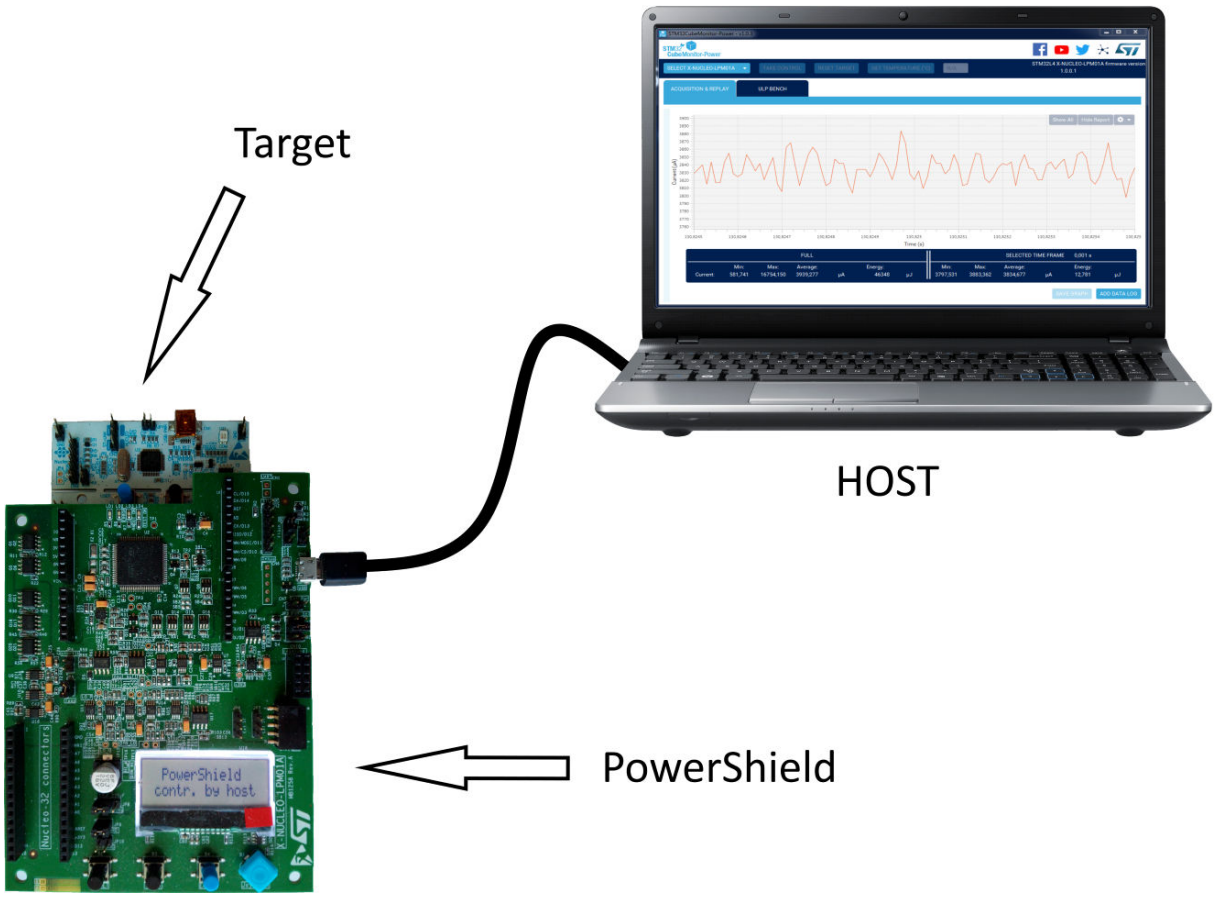
STM32CubeMonitor-Power software tool for power and ultra-low-power measurements

Introduction

STM32CubeMonitor-Power enables developers to analyze swiftly the low-power performance of target boards. This software tool (STM32CubeMonPwr) acquires power measurements through an STLINK-V3PWR source measurement unit (SMU) and in-circuit debugger/programmer for STM32 microcontrollers, or a PowerShield, either the X-NUCLEO-LPM01A dedicated expansion board, or the Energy Meter of the STM32L562E-DK Discovery kit, and displays these measurements using an intuitive graphical interface. Dynamic measurement of current covers a range from 100 nA to 500 mA for the STLINK-V3PWR or from 100 nA to 50 mA for the X-NUCLEO-LPM01A dedicated expansion board, or from 300 nA to 150 mA for the Energy Meter of the STM32L562E-DK Discovery kit, while STM32CubeMonitor-Power allows the update of acquisition parameters and rendering of data in real time. Execution of EEMBC® ULPBench™ tests is also supported to directly provide ULPMark™ score with accuracy.



STM32 CubeMonitor-Power

1 Features

- Graphical power measurement tool on the target board
- Using an STLINK-V3PWR, shown in Figure 1
- Using a PowerShield:
  - Either the X-NUCLEO-LPM01A dedicated expansion board, shown in Figure 2,
  - Or the Energy Meter of the STM32L562E-DK Discovery kit, shown in Figure 3.
- Performing ULPBench™ tests
- Computing ULPMark™ estimation

STM32CubeMonitor-Power supports STM32 32-bit microcontrollers based on the Arm® Cortex®-M processor.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

arm

Figure 1. STLINK-V3PWR SMU and in-circuit debugger/programmer

Figure 2. X-NUCLEO-LPM01A expansion board

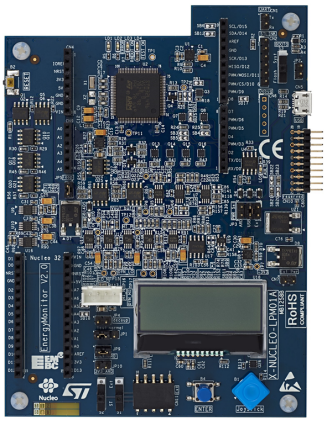
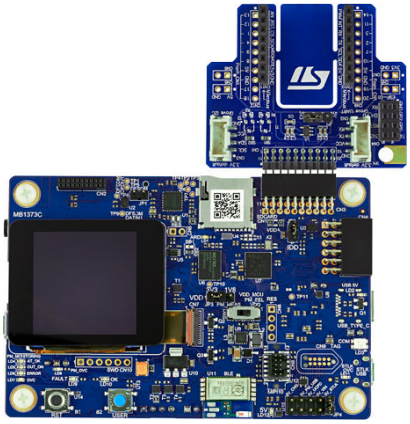


Figure 3. STM32L562E-DK Discovery kit



Pictures are not contractual.

2 Getting started

2.1 Computer requirements

Supported operating systems and architectures

- Windows® 10: 64-bit (x64)
- Linux® (tested on Red Hat®, Fedora®, and Ubuntu®, 64-bit)
- macOS® (minimum version OS X® Yosemite)

Note: Windows is a trademark of the Microsoft group of companies.

Red Hat® is a registered trademark of Red Hat, Inc.

Red Hat® is a registered trademark of Red Hat, Inc.

Fedora® is a trademark of Red Hat, Inc.

Ubuntu® is a registered trademark of Canonical Ltd.

macOS® is a trademark of Apple Inc., registered in the U.S. and other countries and regions.

Software requirements

- For Linux®, the installer requires Java™ runtime.

Note: Oracle and Java are registered trademarks of Oracle and/or its affiliates.

Hardware requirements

- One free USB2 host port
- USB Type-A or USB Type-C® to USB Type-C® cable to use with the STLINK-V3PWR board
- USB Type-A to Micro-B cable to use with the PowerShield boards
- 200-Mbyte free storage
- PowerShield board
- Firmware latest version (downloaded from the STM32-LPM01-XN webpage)
- STM32Lx-based target board (for which power measurements are performed)

Note: For ULPBench™ tests, ULPBench™ firmware must be running on the target board. This ULPBench™ firmware is downloadable from the EEMBC® internet site (www.eembc.org).

2.2 Installing

2.2.1 Installing STM32CubeMonitor-Power

Download `SetupSTM32CubeMonitor-Power.zip` from www.st.com/stm32softwaretools, and unzip this file in a temporary location.

Perform the setup process:

- For Windows®, launch `SetupSTM32CubeMonitor-Power-X.Y.Z.exe`, which guides you through the setup process
- For Linux®, launch `SetupSTM32CubeMonitor-Power-X.Y.Z.jar`, which guides you through the setup process
- For macOS®, launch `SetupSTM32CubeMonitor-Power-X.Y.Z.dmg` and into the installer window, drag and drop the STM32CubeMonitor-Power icon on the *Applications* icon

Note: X.Y.Z represents the STM32CubeMonitor-Power software version.

If another version of STM32CubeMonitor-Power is already installed, the existing version must be uninstalled before installing the new version (refer to Section 2.2.3 Uninstalling STM32CubeMonitor-Power to uninstall the current version).

2.2.2 Installing the Virtual COM port driver

Note: This section is only needed for Windows® operating systems.

Download the STM32 USB Virtual COM port driver (STSW-STM32102):

Launch the executable in the zip file corresponding to the Windows version and the CPU architecture: 32-bit (x86) or 64-bit (x64).

Plug then the PowerShield board with a USB cable, Windows® must detect it as an *STMicroelectronics Virtual COM port*, named *COMxx*, for example, *COM10*.

2.2.3 Uninstalling STM32CubeMonitor-Power

- For Windows®:
  - Open the *Windows® Control pane*
  - Select *Programs and Features* to display the list of programs installed on your computer
  - Right-click on STM32CubeMonitor-Power from STMicroelectronics publisher and select the uninstall function

  Or
  - Go to the STM32CubeMonitor-Power installation location (for example `C:\Program Files\STMicroelectronics\STM32CubeMonitor-Power`), right-click on the *Uninstaller folder*, and launch *uninstaller.jar*
- For Linux®:
  - Go to the STM32CubeMonitor-Power installation location (for example `$HOME/STMicroelectronics/STM32CubeMonitor-Power`), select "Uninstaller folder" and launch *uninstaller.jar*
- For macOS®:
  - Drag and drop the SSTM32CubeMonitor-Power application icon onto the *Trash* icon

2.2.4 Uninstalling the Virtual COM port driver

Note: This section is only needed for Windows operating systems.

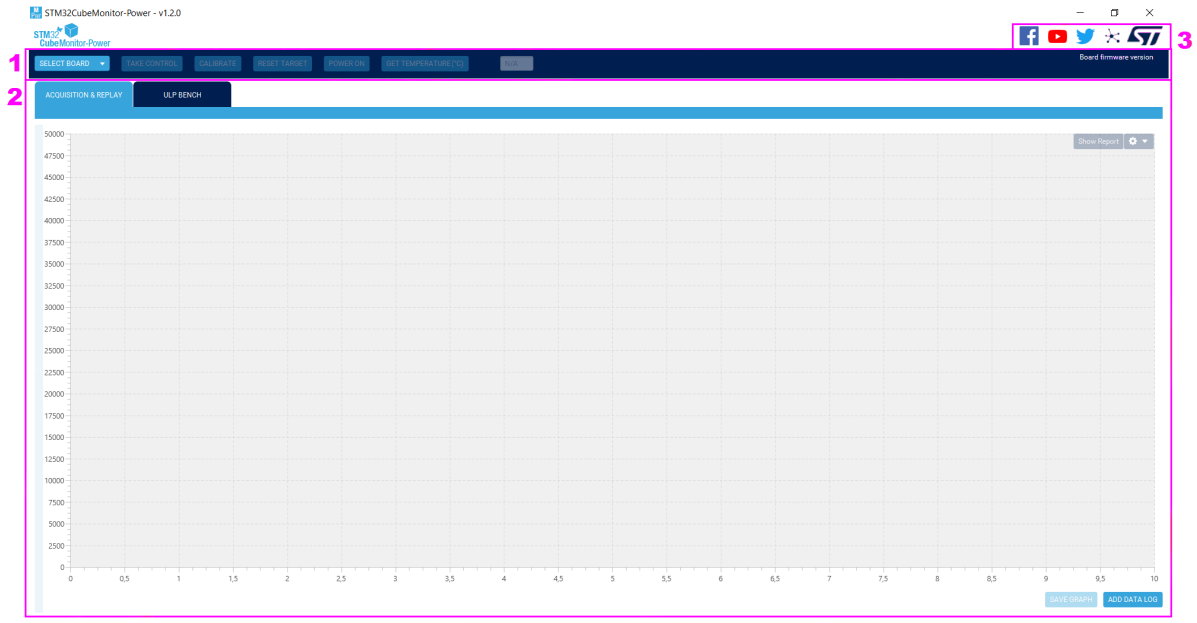
To uninstall the STMicroelectronics USB Virtual COM port driver, follow the steps below:

- Open the Windows® Control pane
- Select *Programs and Features* to display the list of programs installed on your computer
- Right-click on *Virtual COM port driver* from STMicroelectronics publisher and select the uninstall function

3 Main window presentation

After launching STM32CubeMonitor-Power (for example from its Windows® desktop icon), the main window of the application is displayed:

Figure 4. STM32CubeMonitor-Power main window



Several areas are observed in this main window:

1. The ribbon (with a dark blue background)
2. The two tabs *ACQUISITION & REPLAY* and *ULP BENCH*. By default, the first is shown with its chart area
3. The upper-right area containing social network shortcuts

Note: When an item is semitransparent (like the TAKE CONTROL button inside the ribbon in STM32CubeMonitor-Power main window), this means that it is disabled, and clicking on it produces no effect.

3.1 Ribbon

The ribbon contains several controls and information that are valid whatever the tab displayed in the central area:

- *SELECT BOARD* choice list, used to choose one among the COM ports
- *TAKE CONTROL* button, to take control over STLINK-V3PWR or PowerShield, through the chosen COM port. This button can also be named *RELEASE CONTROL* (see below).
- *RESET TARGET*, to reset the connected target MCU once control is taken over the corresponding PowerShield
- *CALIBRATION*, to calibrate PowerShield, with the STLINK-V3PWR button staying grey.
- *POWER ON* or *POWER OFF* depending on the state of the STLINK-V3PWR board. If connected to a PowerShield board, this button stays grey. This button allows the user to power on or off the current on the target.
- *GET TEMPERATURE* to retrieve the ambient temperature measured on STLINK-V3PWR or PowerShield, and display it in the white box on its right
- *Firmware version* to display the version of STLINK-V3PWR or PowerShield firmware

3.2 *ACQUISITION & REPLAY* tab

This tab is shown by default when launching STM32CubeMonitor-Power (refer to STM32CubeMonitor-Power main window).

This tab is mainly used to display the current measurement in a chart form. Those measurements come from a connected STLINK-V3PWR or PowerShield (this is called Acquisition mode) or from a file stored locally (this is called Replay mode).

The *Show Report* button is used to enable the display of the *Acquisition Data Report* pane below the chart area, giving statistical information on the data displayed in the chart.

The gear icon is used to get access to the configuration panes for the two chart axes: time on a horizontal (abscissa) axis and current on the vertical (ordinate) axis.

The *ADD DATA LOG* button is used to open a file previously saved by STM32CubeMonitor-Power and to load its data in the chart (in Replay mode).

The *SAVE GRAPH* button is used to save the data acquired from STLINK-V3PWR or PowerShield (in Acquisition mode) and displayed in the chart area into a file with the *stpm* extension.

3.3 *ULP BENCH* tab

This tab is not visible by default: click on the dark blue tab item named *ULP BENCH* to see the content of the *ULP BENCH* tab.

This tab is used to perform EEMBC ULPBench™ tests, displaying in a chart the consumed energy during those tests, and showing the resulting ULPMark™ - Core profile score at the end of the tests.

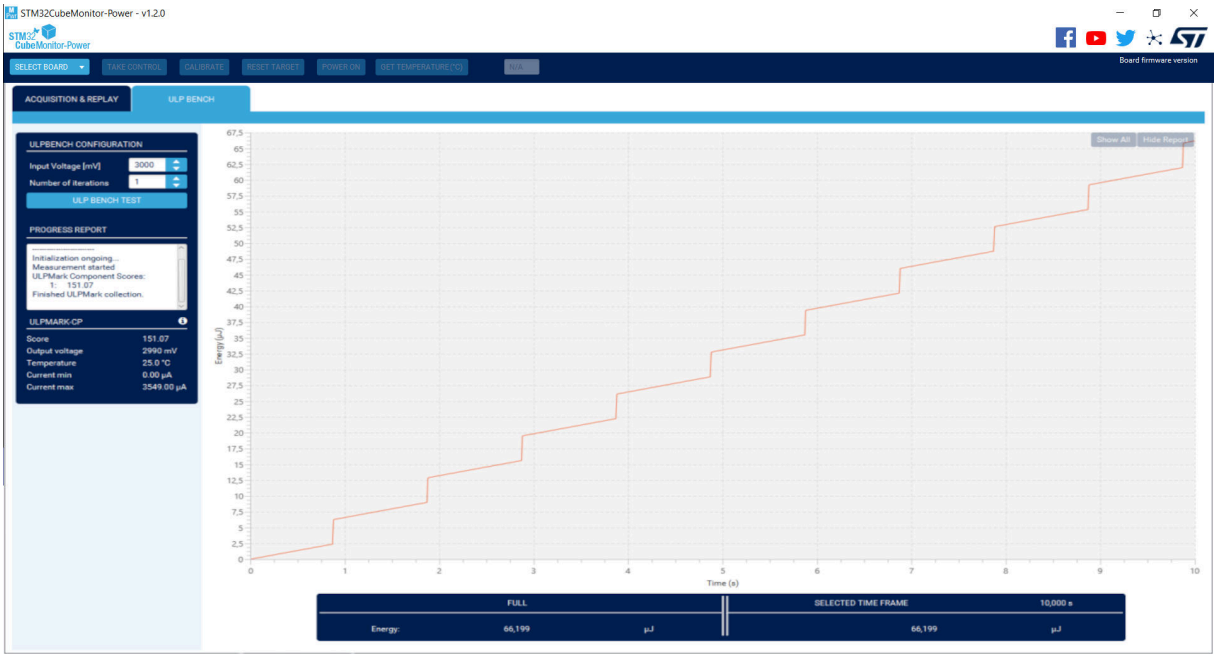
The *ULPBENCH CONFIGURATION* area is used to set the input voltage of the target MCU during the execution of ULPBench™ tests, as well as the number of test iterations to be performed.

The *ULP BENCH TEST* button is used to launch the test according to the chosen configuration parameters.

The *PROGRESS REPORT* area displays information about the ongoing tests.

The *ULPMARK-CP* area displays the ULPBench™ test results, with the computed ULPMark™ - Core profile score, the currently used voltage, the ambient temperature, as well as the minimum and maximum current values.

Figure 5. ULP BENCH tab



3.4 Social network shortcut area

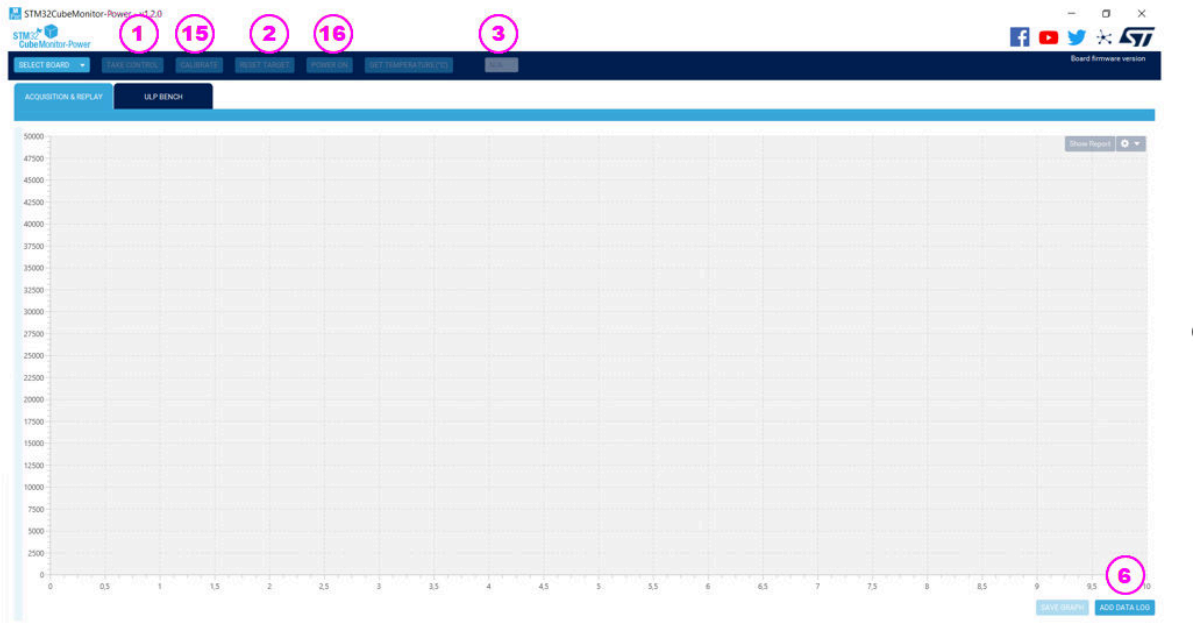
Figure 6. Social network shortcut area

This area contains five shortcuts to social networks and web pages:

- The *Facebook* icon leads to the official STMicroelectronics Facebook page
- The *YouTube* icon leads to the official STMicroelectronics YouTube page
- The *Twitter* icon leads to the official STMicroelectronics Twitter page
- The *Share* icon leads to the ST community website
- The *ST* icon leads to the official STMicroelectronics website

4 How to use STM32CubeMonitor-Power?

Figure 7. **STM32CubeMonitor-Power start page**



After launching STM32CubeMonitor-Power, the main window is displayed with the *ACQUISITION & REPLAY* tab shown by default, as shown on the STM32CubeMonitor-Power start page.

From this start page (also called the Idle state), several actions can be performed:

- Connect to STLINK-V3PWR or PowerShield (refer to Section 4.1)
- Show/hide the acquisition data report (refer to Section 4.7.6)
- Configure the acquisition chart X-axis (abscissas) (refer to Section 4.7.7)
- Configure the acquisition chart Y-axis (ordinates) (refer to Section 4.7.8)
- Load the previously saved data into the acquisition chart (refer to Section 4.7.10)
- Select the ULPBench™ tab (refer to Section 4.8)

4.1 Connect to the hardware

To perform either a current measurement acquisition or an ULPBench™ test campaign, STM32CubeMonitor-Power must be connected to an STLINK-V3PWR or PowerShield and take control of it.

To connect STM32CubeMonitor-Power to an STLINK-V3PWR or PowerShield, the Virtual COM port driver must be previously installed (refer to Section 2.2.2 Installing the Virtual COM port driver), and this STLINK-V3PWR or PowerShield must have its USB cable connected to a USB port of the Host machine running STM32CubeMonitor-Power.

Once the STLINK-V3PWR or PowerShield is plugged in, it is ready for connection after a couple of seconds. In the upper ribbon of STM32CubeMonitor-Power, click on the *SELECT BOARD* choice list that displays the list of COM ports on which STLINK-V3PWR or PowerShield boards are detected. Select the COM port corresponding to the STLINK-V3PWR or PowerShield that you wish to connect.

Figure 8. **COM port selection**

Once a COM port is chosen, the *TAKE CONTROL* button becomes active; click on it to take control over the STLINK-V3PWR or PowerShield.

If taking control is successful, this button becomes *RELEASE CONTROL*, the other buttons of the upper ribbon become active, the firmware version area is updated to show the firmware version of the connected STLINK-V3PWR or PowerShield, a *CONFIGURATION* pane appears in the *ACQUISITION & REPLAY* tab, and the STLINK-V3PWR or PowerShield LCD shows *Controlled by Host*.

From this moment, STM32CubeMonitor-Power is in the Connected state.

If an error occurs while taking control of the STLINK-V3PWR or PowerShield, check the selected COM port or the STLINK-V3PWR or PowerShield USB cable.

From the Connected state, several other actions can be performed:

- Release control on the STLINK-V3PWR or PowerShield (refer to Section 4.2)
- Calibrate the STLINK-V3PWR or PowerShield (refer to Section 4.3 Calibrate the hardware)
- Reset target MCU (refer to Section 4.4)
- Get ambient temperature (refer to Section 4.5)
- Configure the STLINK-V3PWR or PowerShield acquisition parameters (refer to Section 4.7.1 Configure the hardware acquisition)
- Start acquisition (refer to Section 4.7.2)
- Show/hide the acquisition data report (refer to Section 4.7.6)
- Configure the acquisition chart X-axis (abscissas) (refer to Section 4.7.7)
- Configure the acquisition chart Y-axis (ordinates) (refer to Section 4.7.8)
- Launch ULPBench™ test (refer to Section 4.8)

4.2 Release control on the hardware

Figure 9. **Release control on a PowerShield**

If STM32CubeMonitor-Power is in the Connected state, click on the *RELEASE CONTROL* button on the upper ribbon, which deactivates the *RESET TARGET* and the *GET TEMPERATURE* buttons on the upper ribbon.

From this moment, STM32CubeMonitor-Power is back in the Idle state. However, if any data are present in the chart, they are still visible and STM32CubeMonitor-Power then switches into the Data available state, where other actions become possible (refer to the sections below).

4.3 Calibrate the hardware

Figure 10. **Calibrate the hardware**

If STM32CubeMonitor-Power is in the Connected state, clicking on the *CALIBRATE* button on the upper ribbon calibrates PowerShield. This button is deactivated with STLINK-V3PWR.

4.4 Reset target MCU

Figure 11. **Reset target MCU**

If STM32CubeMonitor-Power is in the Connected, Acquisition, or Data available states, clicking on the *RESET TARGET* button on the upper ribbon power resets the target MCU.

The STLINK-V3PWR or PowerShield remains in the Connected or Data acquisition state if previously started, allowing, for instance, to measure the current during the target MCU startup phase.

4.5 Get the ambient temperature

Figure 12. **Get ambient temperature**

If STM32CubeMonitor-Power is in the Connected, Acquisition, or Data available state, click on the *GET TEMPERATURE* button of the upper ribbon, which requests the ambient temperature to the STLINK-V3PWR or PowerShield. The result is displayed in celsius degrees in the white box near this button.

Caution: This temperature is NOT the temperature of the target board under test, but the ambient temperature measured on the STLINK-V3PWR or PowerShield board.

Note: STLINK-V3PWR ambient temperature- is measured once during probe power-up and not updated.

4.6 Power ON/OFF

If STM32CubeMonitor-Power is connected to STLINK-V3PWR the POWER button is clickable. If it is connected to PowerShield this functionality is not available and the button is not clickable.

By clicking on "POWER ON", the VOUT alimentation is switched on. By clicking on "POWER OFF", the VOUT alimentation is switched off. This feature allows the user to easily monitor the change when the VOUT is switched on.

Figure 13. POWER ON button

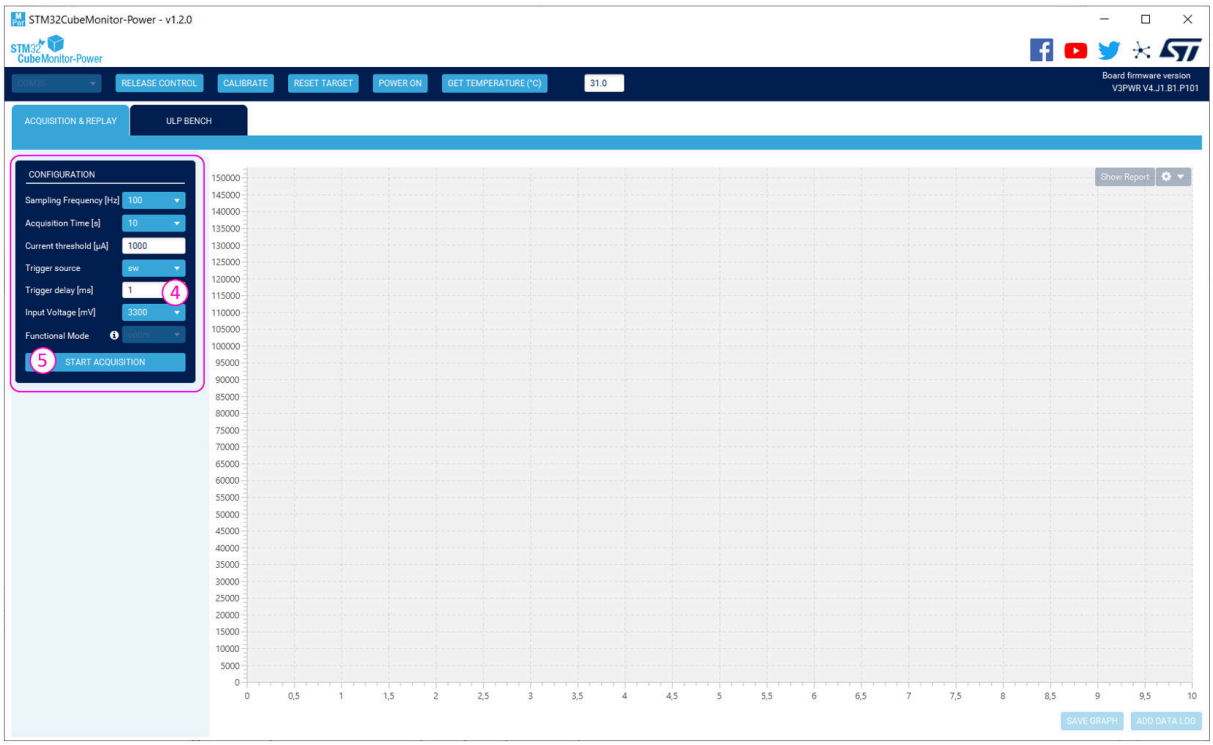
Figure 14. POWER OFF button

4.7 Performing a current acquisition

4.7.1 Configure the hardware acquisition

If STM32CubeMonitor-Power is in Connected or Data available state, a *CONFIGURATION* pane is present on the left of the *ACQUISITION & REPLAY* tab, as shown on the STM32CubeMonitor-Power start page. As it can be hidden, click in the blue area on the left of the chart area to make it visible again.

Figure 15. Acquisition configuration pane (on the left)



This configuration pane is used to specify acquisition parameters:

- Sampling frequency: Hardware current measurement frequency choice list, from 1 Hz to 100 kHz. The default value is 100 Hz for STLINK-V3PWR and PowerShield.
  Each measurement sample is sent from the hardware to STM32CubeMonitor- Power and is temporarily stored.
- Acquisition time: Time after which the acquisition automatically stops, in a choice list from 0.1 s to the *infinite*. It is up to the user to stop the acquisition manually. The default value is 10 s.
- Current threshold: Current threshold in mA is used to trig events inside STLINK-V3PWR or PowerShield, when the measured current exceeds this limit, like switching on an LED or setting a hardware signal (refer to the PowerShield user manual for more details); there is no effect on STM32CubeMonitor-Power. The maximum value is 500 mA for STLINK-V3PWR, 50 mA for the X-NUCLEO-LPM01A dedicated expansion board, and 150 mA for the Energy Meter of the STM32L562E-DK Discovery kit. The default value is 1 mA.
- Trigger source: Source of the trigger used to start the acquisition. It can be from internal software or external hardware (D7 pin for PowerShield, TGI pin for STLINK-V3PWR). Refer to hardware documentation for further details. The default value is software.
- Trigger delay: Time to wait after the trigger event occurred, before really starting the acquisition. The maximum value is 30000 ms.
- Input voltage: Supply voltage (in mV) applied to the target MCU board. For STLINK-V3PWR, allowed values are 100 mV steps between 1600 and 3600 mV. For PowerShield, allowed values are between 1800 and 3300 mV.
- Functional mode:
  – Optim(ized): Mode focusing on having accurate current measurements from 100 nA to 50 mA X-NUCLEO-LPM01A dedicated expansion board, and from 300 nA to 150 mA for the Energy Meter of the STM32L562E-DK Discovery kit for any sampling frequency, but some artifacts are seen in some cases where very low and very high current measurements coexist.
  – High: Mode focusing only on high currents, from 30 µA to 50 mA for the X-NUCLEO-LPM01A dedicated expansion board, and from 90 µA to150 mA for the Energy Meter of the STM32L562E-DK Discovery kit, avoiding optimized mode current artifacts, but values being inaccurate below 30 µA for the X-NUCLEO-LPM01A dedicated expansion board, and below 90 µA for the Energy Meter of the STM32L562E-DK Discovery kit; only valid for 50 kHz and 100 kHz sampling frequencies.

Note: This is not applicable for STLINK-V3PWR, where both configurations behave the same.

Those parameters are used only when starting a new acquisition (refer to Section 4.7.2).

A red rectangle indicates when one parameter is outside the allowed range, and it is impossible to launch a new acquisition until a valid value is entered.

Figure 16. Input voltage

Erase all data in a parameter input field to show the range of allowed values.

4.7.2 Start acquisition

Figure 17. Start acquisition

If STM32CubeMonitor-Power is in the Connected or Data available state, it is possible to start or restart acquisition of current measurements by pressing the *START ACQUISITION* button at the bottom of the *CONFIGURATION* pane.

STM32CubeMonitor-Power switches into the Acquisition state and then clears the chart data if any (these are lost if they have not been previously saved), and launches the acquisition process by applying the acquisition parameters values present in the *CONFIGURATION* pane that are then inaccessible.

The *START ACQUISITION* button becomes *STOP ACQUISITION*. Data samples are received from STLINK-V3PWR or PowerShield and stored in a temporary location and some are displayed in the chart area in real-time to lower the graphical load. If visible, the acquisition of data report values is updated in real-time according to the received data (min/max/average current, and energy values).

In the Acquisition state, the only possible actions are to reset the target MCU (refer to Section 4.4), get the ambient temperature (refer to Section 4.5) or stop the current acquisition (refer to Section 4.7.3).

4.7.3 Stop acquisition

Figure 18. **Stop acquisition**

To stop the acquisition process before the end of the planned acquisition time, or when the acquisition time is set to *infinite*, press the *STOP ACQUISITION* button, which becomes *START ACQUISITION* again. Acquisition parameters become accessible.

If the acquisition time is not *infinite*, and the *STOP ACQUISITION* button is not pressed, the acquisition process automatically stops at the end of the acquisition time, and the user can save data using the *Save* button.

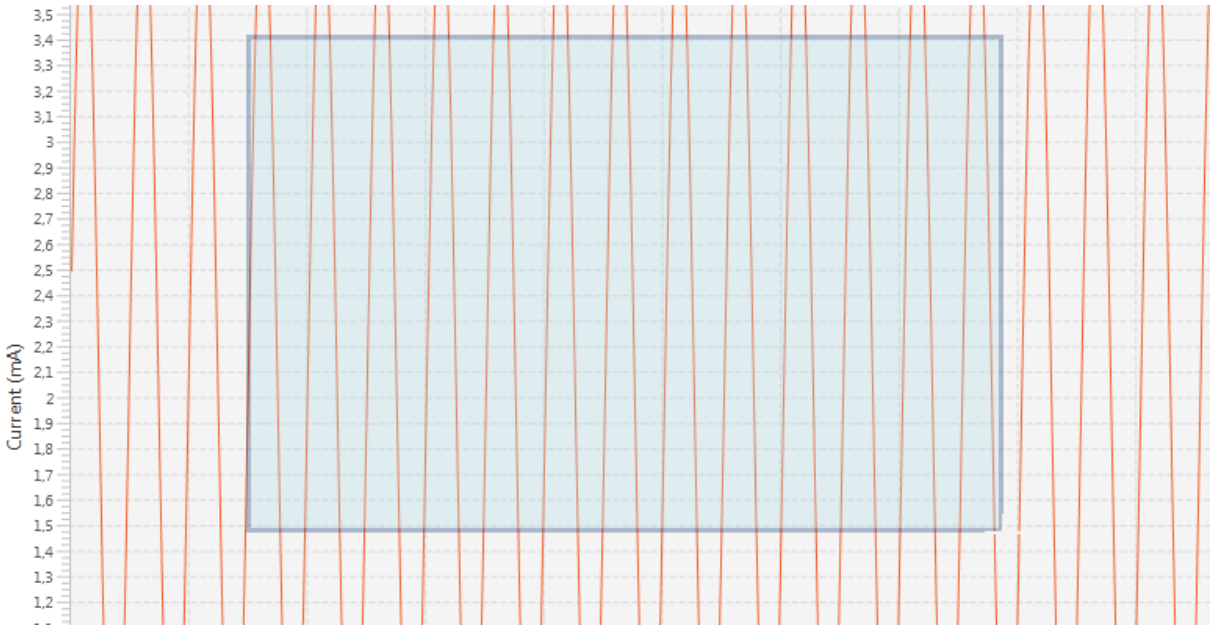
Acquired data is still visible in the acquisition chart and STM32CubeMonitor-Power then switches into the Data available state, where other actions become possible (see below).

4.7.4 Zoom in and zoom out in the acquisition chart area

If STM32CubeMonitor-Power is in the Data available state, it is possible to zoom in and out inside the chart area:

- Use the left mouse button and move the mouse to create a blue rectangle used for zoom-in selection. If the mouse pointer is above one of the axis areas, it selects the full data width or height.

Figure 19. **Zoom in acquisition**



- Use the mouse wheel forward to gradually zoom in, centered on the mouse position. If the mouse pointer is above one of the axis areas, only this axis is zoomed in.
- Use the mouse wheel backward to zoom out gradually, centered on the mouse position. If the mouse pointer is above one of the axis areas, only this axis is zoomed out.
- Press the *ShowAll* button in the upper-right corner of the chart area to zoom out on the full data range.

When zooming in or out, the *SELECTED TIME FRAME* area of the visible acquisition data report is updated to adapt to the time frame visible in the chart area (min/max/average current, and energy values).

Note: Data samples are reloaded from temporary storage for each zoom-in or zoom-out operation, therefore some loading lags may occur, especially for high sampling frequencies.

4.7.5 Moving in the acquisition chart area

If STM32CubeMonitor-Power is in the Data available state, it is possible to slide data inside the chart area by pressing the right mouse button and moving the mouse, but it is not possible to slide beyond the actual data limits.

Data is reloaded after the mouse button is released, therefore some loading lags may occur.

When moving into the chart area, the *SELECTED TIME FRAME* area of the visible acquisition data report is updated to adapt to the time frame visible in the chart area: Minimum, maximum, average current, and energy values.

4.7.6 Show and hide the acquisition data report

Figure 20. Acquisition data report (below the acquisition chart)

If STM32CubeMonitor-Power is in the Connected or Data available state, it is possible to show or hide the acquisition data report pane located below the acquisition chart, by clicking on the *Hide Report/Show Report* button (number 8 in the Acquisition data report (below the acquisition chart)) in the upper-right corner of the chart area.

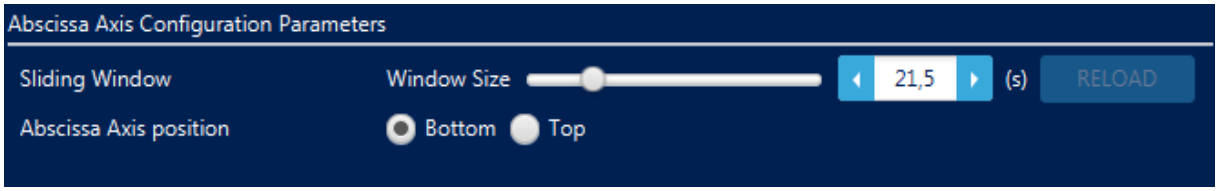
This acquisition data report pane is divided into two parts:

- The *FULL* area gives statistical information on current measurements and energy computation for the full data range, even if not currently visible in the acquisition chart.
- The *SELECTED TIME FRAME* area gives statistical information on current measurements and energy computation, corresponding only to the time frame visible in the acquisition chart (refer to the time boundaries on the X-axis).

4.7.7 Configure acquisition chart X-axis (abscissas)

If STM32CubeMonitor-Power is in the Idle, Connected, or Data available state, it is possible to configure the acquisition chart X-axis (also called abscissas), by clicking on the gear icon (number 9 in the Acquisition data report (below the acquisition chart)) located in the upper-right corner of the acquisition chart, and selecting the abscissa axis item. This opens the X-axis configuration pane.

Figure 21. X-axis configuration



The upper area is used to configure the chart width and timeframe visible in the acquisition chart area. This value can be changed using the slider on the left, or the arrow buttons for better precision. As soon as a change is detected, the *RELOAD* button becomes active, to request data reloading into the chart to apply this change and check its impact on the chart.

The lower area is used to choose the position of the X-axis, at the bottom or the top of the acquisition chart area, with an immediate effect.

Clicking out of this pane closes it.

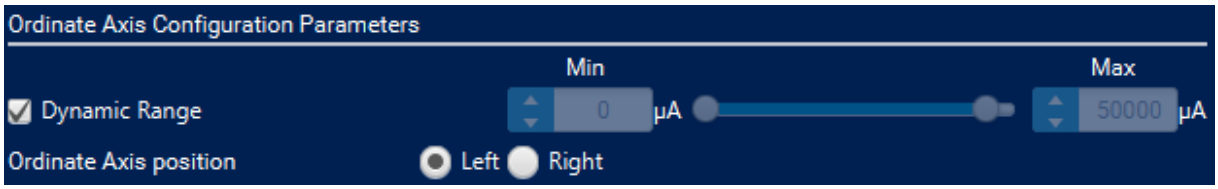
Note: The window size setting is directly linked to the acquisition time setting present in the CONFIGURATION pane. Changing acquisition time automatically changes window size. However, changing the Window Size does not change Acquisition Time. When Acquisition Time is set to infinite, Window Size is set to 10 s.

Note: If the Window Size setting is lower than the Acquisition Time setting, the visible time frame slides to show always the latest acquired data until the automatic or manual acquisition is stopped.

4.7.8 Configure acquisition chart Y-axis (ordinates)

If STM32CubeMonitor-Power is in Idle State, "Connected State" or "Data Available State", it is possible to configure acquisition chart Y-axis (also called ordinates axis) by clicking on the gear icon (number 9 in Acquisition data report (below the acquisition chart)) located in the upper-right corner of the acquisition chart, and selecting the ordinate axis item. This opens the Y-axis configuration pane.

Figure 22. Y-axis configuration



The upper area is used to configure the chart height and the span of the current values. Minimal and maximal values can be changed using the slider or the arrow buttons of the *Min* and *Max* boxes for better precision.

The “Dynamic Range” checkbox is used to activate the automatic adaptation of the Y-axis min and max boundaries to the data values loaded into the acquisition chart. When this box is checked, it is impossible to set those boundaries manually (see above).

The lower area is used to choose the position of the Y-axis, at the left or the right of the acquisition chart area.

Clicking outside of this pane closes it.

4.7.9 Save acquisition data

Figure 23. **Save acquisition data**

If STM32CubeMonitor-Power is in Data Available State after an acquisition procedure, it is possible to save the acquired data samples into a dedicated file by clicking on the “SAVE GRAPH” button.

Doing this opens a file chooser window. The saved file has the “stpm” extension.

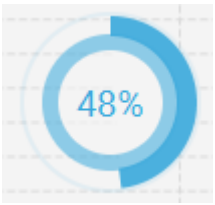
4.7.10 Load previously saved data into the acquisition chart

Figure 24. **Load previously saved data into the acquisition chart**

If STM32CubeMonitor-Power is not in Connected State (no control on an X-NUCLEO-LPM01A), it is possible to load previously saved acquisition data by clicking on the “ADD DATA LOG” button. Doing this opens a file chooser window, where a file with the *stpm* extension must be selected.

Once an *stpm* file is chosen to be opened, its data is read and loaded into the Acquisition tab chart (previous data are cleared before this loading). No action can be performed until the end of data loading. By default, the chart shows the whole scope of the loaded data: both the X-axis and Y-axis are adjusted to maximize data visibility. A loading progress indicator is displayed during the loading operation.

Figure 25. **Loading progress indicator**



The Acquisition Data Report (if visible) is updated according to the received data (min/max/average current and energy values).

From this moment, STM32CubeMonitor-Power is in Data Available State.

The firmware version area of the upper ribbon is also updated to show the version of the X-NUCLEO-LPM01A firmware that has been originally used to perform the acquisition of the loaded data.

From this Data Available State, several other actions can be performed, such as zooming in/out or moving in the acquisition chart area or configuring the X- and Y-axis (see above).

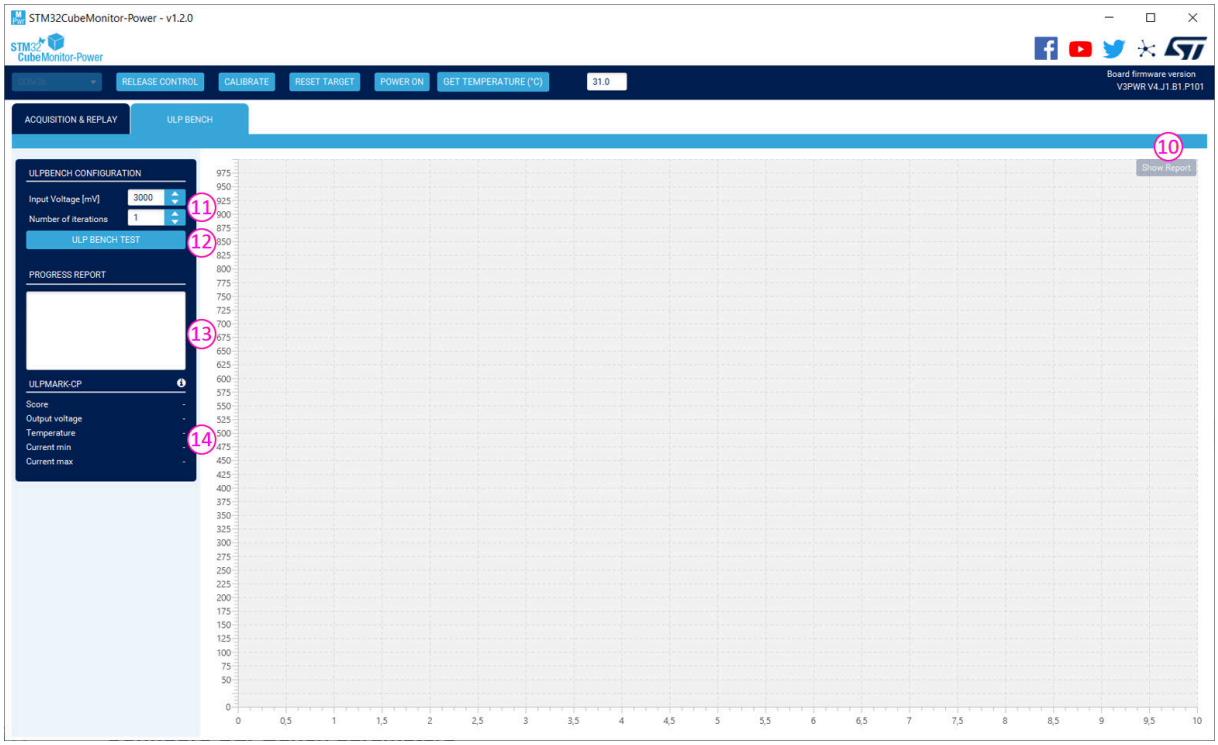
4.8 Performing ULPBench tests

When STM32CubeMonitor-Power is in Idle State (not connected to STLINK-V3PWR or X-NUCLEO-LPM01A), click on the dark blue tab item named “ULP BENCH” to see its content.

The only possible action here is to show or hide the *ULPBench Data Report* pane (refer to Section 4.8.4). The content of the *ULPBench Configuration* and *Report area* on the left of the chart area is inactive.

When STM32CubeMonitor-Power is in Connected State (refer to Section 4.1), the content of the ULPBench Configuration and Report area becomes active as shown in the ULPBENCH tab in "Connected State". It is possible to configure ULPBench parameters (refer to Section 4.8.1), launch the ULPBench tests, follow Progress Report (refer to Section 4.8.2), and see the ULPMark results after the tests (refer to Section 4.8.3).

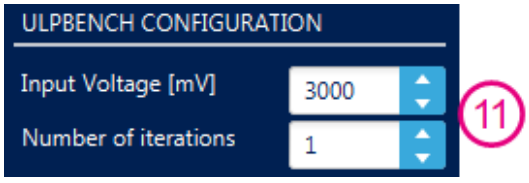
Figure 26. ULPBENCH tab in "Connected State"



4.8.1 Configure ULPBench parameters

When STM32CubeMonitor is in Connected State, it is possible to configure ULPBench parameters.

Figure 27. ULPBench configuration



- Input voltage: supply voltage (in mV) applied to the target MCU board. Allowed values are between 1800 mV and 3300 mV. The default value is 3000 mV. Only 100 mV steps via the arrow keys are possible.
- Number of iterations: number of ULPBench test iterations to perform to compute a median result over those iterations. Values are between 1 and 15. The default value is 1. Changes are allowed only one by one via the arrow keys.

Note: The duration of an ULPBench test iteration is 10 seconds.

Those parameters are taken into account only when starting a new ULPBench test (refer to Section 4.8.2).

4.8.2 Launch ULPBench test

Figure 28. ULPBench test

When STM32CubeMonitor is in "Connected State", it is possible to launch the ULPBench test by clicking on the *ULP BENCH TEST* button.

STM32CubeMonitor-Power then switches into the "ULPBench Test State", clears the chart data if any, and launches the ULP Bench test process by applying the ULP Bench configuration parameters (refer to Section 4.8.1).

In the "ULPBench Test State", no action is possible until the end of the test process.

Caution: To perform properly the ULPBench test, there must be firmware loaded and running into the target board. If the target board is an STMicroelectronics Nucleo board, check the *www.st.com* website to get this firmware and load it.

Just after launching the ULPBench test, a board initialization phase is needed to avoid perturbations on current measurements.

During this phase, awaiting animation is displayed in the ULPMARK-CP area:

Figure 29. Board initialization phase

When this board initialization phase is finished, the data samples of the current ULPBench test iteration are received from PowerShield and displayed in the chart area in real time. The chart area is cleared between two iterations, thus only the data samples of the last iteration are visible at the end of the ULPBench test.

During the entire ULPBench test, a percentage of progression is displayed in the ULPMARK-CP area and the *Progress Report* console informs of the ULPBench test progression and gives the ULPMark estimation for each iteration.

Figure 30. Progress report

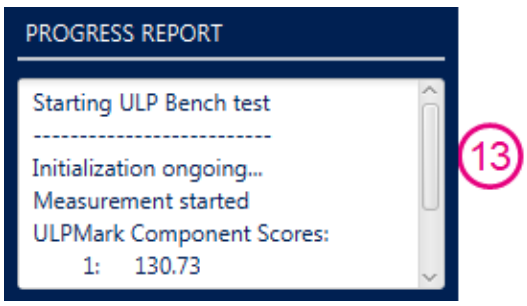
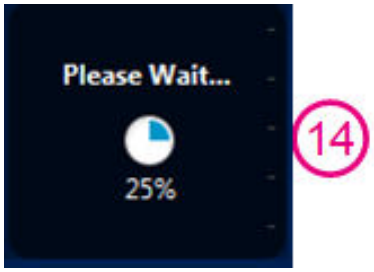


Figure 31. **ULPBench iteration**

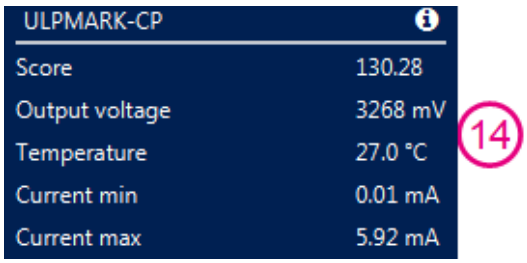


When the ULPBench test is finished, the ULPBench test result is shown in the ULPMARK-CP area (refer to Section 4.8.3). The last iteration data samples are shown in the chart area and STM32CubeMonitor-Power switches into the "ULPBench Data Available State", where other actions become possible (see below).

4.8.3 ULPMark results

When the ULPBench test is finished, several pieces of information are made available in the ULPMARK-CP area.

Figure 32. **ULPMark results**

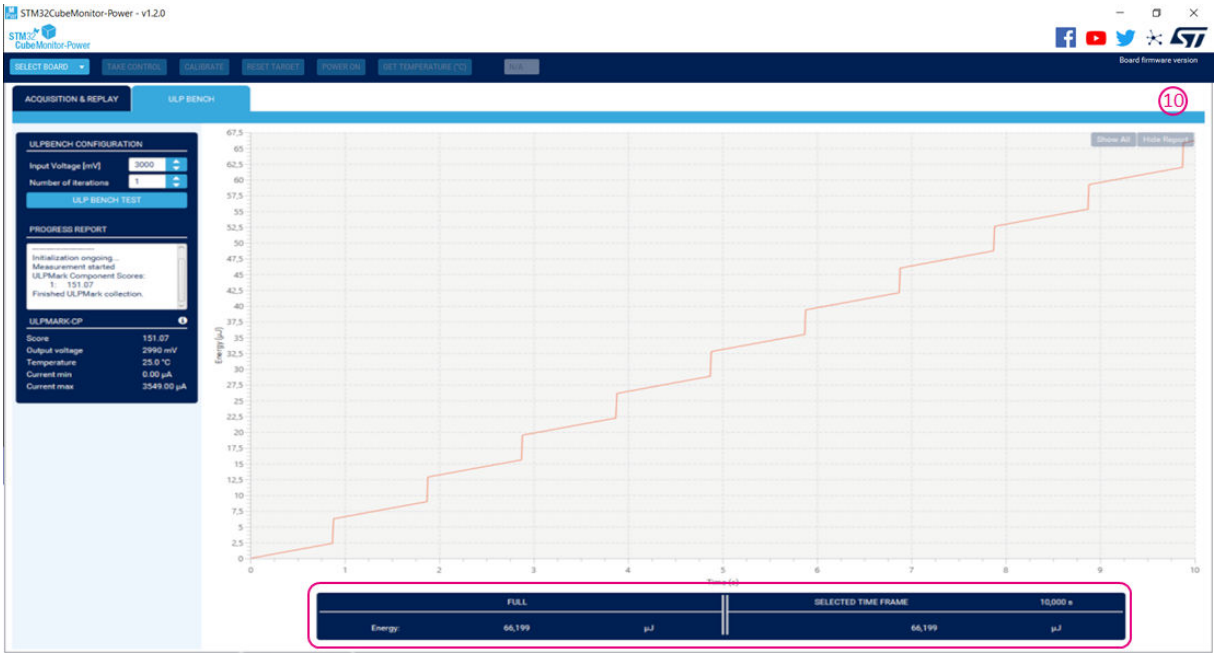


- Score: ULPMark Core Profile score
  Leave the mouse pointer a few seconds on the information icon to know how this score is computed from results of the test iterations.
- Output voltage: accurate voltage used to supply the target board
- Temperature: ambient temperature
- Current min: lowest current measured
- Current max: highest current measured

4.8.4 Show/hide the ULPBench data report

When STM32CubeMonitor-Power is not in ULPBench Test State, it is possible to show or hide the ULPBench Data Report pane located below the chart area, by clicking on the “Hide Report”/“Show Report” button in the upper-right corner of the chart area (refer to ULPBench data report (below the chart area)).

Figure 33. **ULPBench data report (below the chart area)**



If STM32CubeMonitor-Power is in ULPBench Data Available State, some energy values are shown. The ULPBench Data Report pane is divided into two parts:

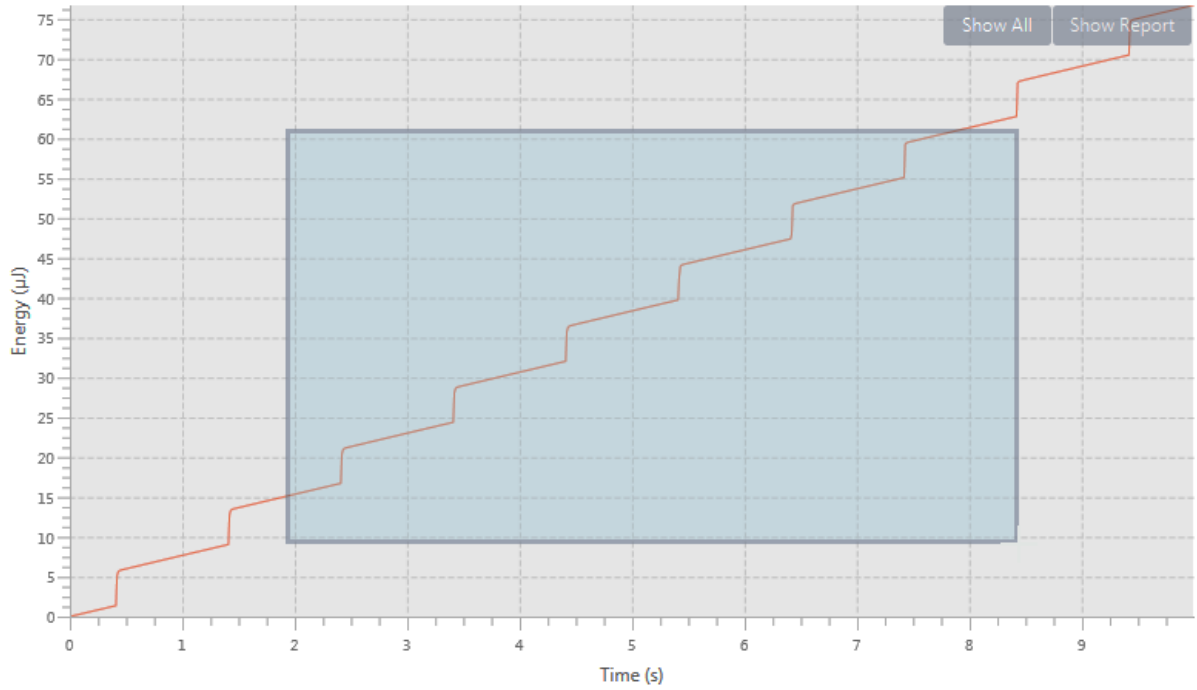
- The “FULL” area gives statistical information on energy measurements for the full range of the last test iteration, even if not currently visible in the ULPBench chart area.
- The “SELECTED TIME FRAME” area gives statistical information on energy measurements corresponding only to the time frame visible in the ULPBench chart area (see time boundaries on the X-axis)

4.8.5 Zoom in and zoom out in the ULPBench chart area

If STM32CubeMonitor-Power is in ULPBench Data Available State, it is possible to zoom in and out inside the ULPBench chart area:

- Use the left mouse button and move the mouse to create a blue rectangle used for zoom-in selection. If the mouse pointer is above one of the axis areas, the full data width or height is selected.

Figure 34. Zoom on ULPBench



- Use the mouse wheel forward to gradually zoom in, centered on the mouse position. If the mouse pointer is above one of the axis areas, only this axis is zoomed in.
- Use the mouse wheel backward to gradually zoom out, centered on the mouse position. If the mouse pointer is above one of the axis areas, only this axis is zoomed out.
- Press the “ShowAll” button in the upper-right corner of the chart area to zoom out on the full data range.

When zooming in or out, the “SELECTED TIME FRAME” area of the ULPBench Data Report (if visible) is updated to adapt to the time frame visible in the ULPBench chart area.

4.8.6 Moving in the ULPBench chart area

If STM32CubeMonitor-Power is in ULPBench Data Available State, it is possible to slide data inside the chart area by pressing the right mouse button and moving the mouse, but it is not possible to slide beyond the actual data limits.

When moving into the chart area, the “SELECTED TIME FRAME” area of the ULPBench Data Report (if visible) is updated to adapt to the time frame visible in the chart area.

5 Troubleshooting

5.1 COM ports list not displayed in Linux OS

- Plug the PowerShield on the Linux machine and list the device owner,
  For example ttyACM0:
  $ ls -la /dev/ttyACM0
  The command returns:
  crw-rw---- 1 root ubuntu 166, 0 Jun 23 12:24 /dev/ttyACM0
- Add user name to device group name:
  $ sudo adduser MyUserName deviceGroup
  As shown above, deviceGroup is "ubuntu"
- Optionally, update the access rights for this device:
  $ sudo chmod a+rw /dev/ttyACM0

5.2 COM port detection is long (10 to 20 s) in Linux Ubuntu OS

Ubuntu modem manager may interfere with STM32CubeMonitor-Power.

Uninstall modem manager: "sudo apt-get purge modemmanager".

5.3 Acquisition lags or stops unexpectedly

- CPU or storage speed of the current machine may not be adapted.
- Try lowering sampling frequency or acquisition time.

5.4 Long-duration acquisitions

- To keep user interface responsiveness, it is not recommended to perform acquisitions of more than one hour at 100 kHz sampling frequency (means above 360 million points).
- If free storage size becomes lower than 100 Mbytes, acquisition automatically stops.

5.5 COM port list remains empty

- Check that at least one PowerShield is connected and ready to answer (a few seconds after its power-up).
- Check that no other application is connected on the same COM port as the PowerShield.
- Check only for Windows that ST drivers have been properly installed (refer to Section 2.2.2 Installing the Virtual COM port driver),

6 Support material

6.1 Related design support material

- STLINK-V3PWR debug/programming probe and source measurement unit
- X-NUCLEO-LPM01A Nucleo expansion board
- STM32L562E-DK Discovery kit
- STM32-LMP01-XN embedded firmware

6.2 Documentation

- STLINK-V3PWR user manual (UM3097)
- X-NUCLEO-LPM01A Nucleo expansion board user manual (UM2243)
- STM32L562E-DK Discovery kit user manual (UM2617)
- STM32-LPM01-XN embedded firmware user manual (UM2269)

Revision history

Table 1. **Document revision history**

Date	Version	Changes
18-Sep-2017	1	Initial release
2-Oct-2017	2	Added restriction for Java SE Run Time Environment in Section 2.1: Computer requirements
18-Dec-2017	3	Tool installer aligned with new VCP driver version
19-Feb-2018	4	Root part number of the STM32CubeMonitor-Power software tool changed to STM32CubeMonPwr
18-Sep-2018	5	Added two shortcuts to the social network area in all main screenshots
26-Sep-2019	6	Added support to the Energy Meter of the STM32L562E-DK Discovery kit
3-Mar-2023	7	Added support to STLINK-V3PWR

Contents

List of tables

List of figures