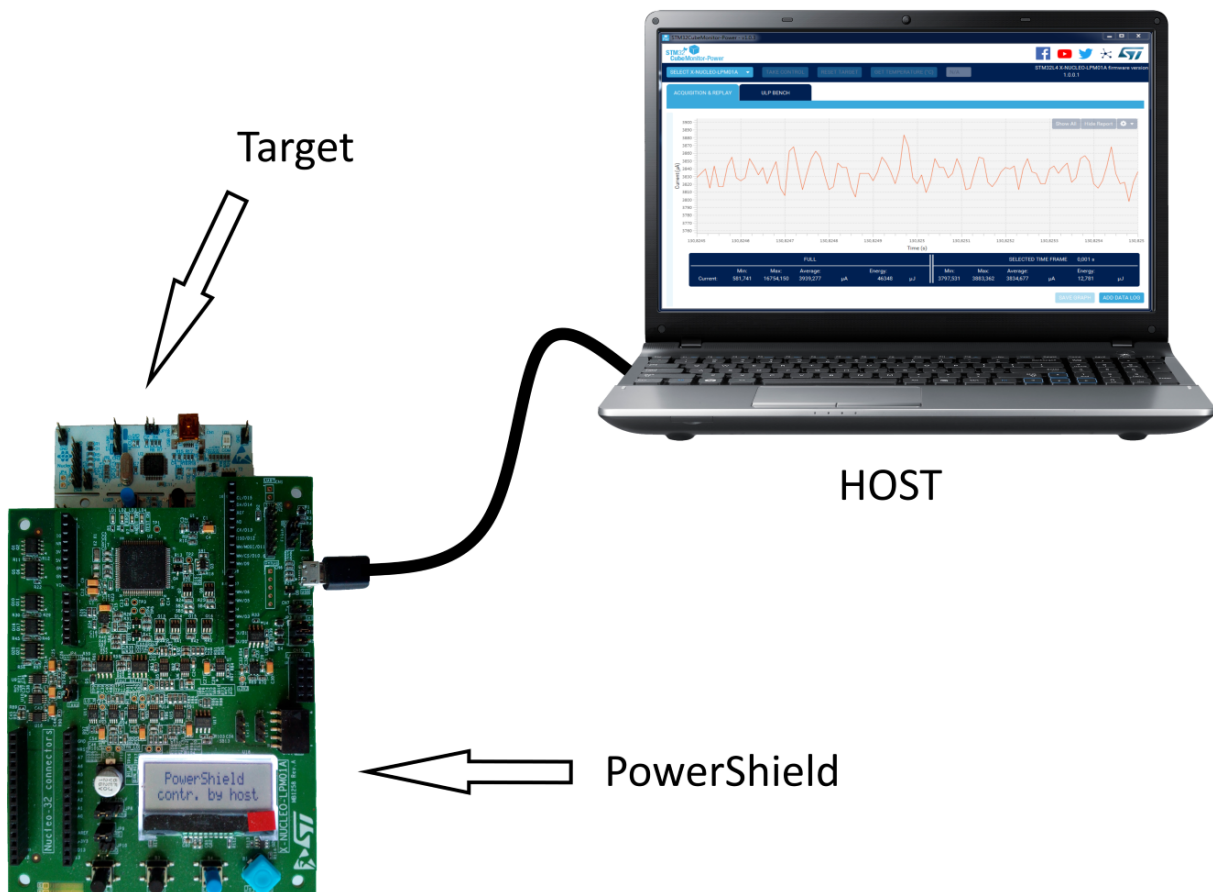# STM32CubeMonitor-Power software tool for power and ultra-low-power measurements

Introduction

STM32CubeMonitor-Power enables developers to swiftly analyze the low-power performance of target boards. This software tool (STM32CubeMonPwr) acquires power measurements through the X-NUCLEO-LPM01A dedicated expansion board, and displays these measurements using an intuitive graphics interface. Dynamic measurement of current covers a range from 100 nA to 50 mA, 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.

UM2202 - Rev 5 - September 2018
For further information contact your local STMicroelectronics sales office.

www.st.com

1 Features

- Graphical power measurement tool on target board
- Using X-NUCLEO-LPM01A dedicated expansion board
- 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

2 Getting started

2.1 Computer requirements

Supported operating systems and architectures

- Windows® 7: 32-bit (x86), 64-bit (x64)
- Windows® 8.x: 32-bit (x86), 64-bit (x64)
- Windows® 10: 32-bit (x86), 64-bit (x64)
- Linux® (tested on Red Hat®, Fedora®, and Ubuntu®, 32 and 64 bits)
- macOS® (minimum version OS X® Yosemite)

Note: *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.

Software requirements

- The Java™ SE Run Time Environment 1.8 (version 1.8.121 or newer) from Oracle® must be installed (download available from www.oracle.com).
- IMPORTANT: Java OpenJDK is not supported. Java SE Run Time Environment 9 by Oracle is not supported.

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

Hardware requirements

- One free USB2 host port
- USB Type-A to Micro-B cable
- 200-Mbyte free storage
- X-NUCLEO-LPM01A board
- Firmware latest version (downloaded from www.st.com/x-cube)
- STM32Lx-based target board (for which power measurements are performed)

Note: *For ULPBench tests, an ULPBench firmware must be running on the target board. This ULPBench firmware is downloadable from 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 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 STM32CubeMonitor-Power SW version.*

If another version of STM32CubeMonitor-Power is already installed, the existing version must uninstalled before installing the new version (see 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 X-NUCLEO-LPM01A board with USB cable, Windows must detect it as "STMicroelectronics virtual COM port", named COMxx (e.g. 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 in the STM32CubeMonitor-Power installation location (for example 'C:\Program Files \STMicroelectronics\STM32CubeMonitor-Power'), go in 'Uninstaller' folder', and launch 'uninstaller.jar'
- For Linux:
    - go in the STM32CubeMonitor-Power installation location (for example '$HOME/STMicroelectronics/ STM32CubeMonitor-Power'), go in 'Uninstaller' folder and launch 'uninstaller.jar'
- For macOS:
    - drag and drop the STM32CubeMonitor-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 application main window is displayed:

Figure 1. STM32CubeMonitor-Power main window
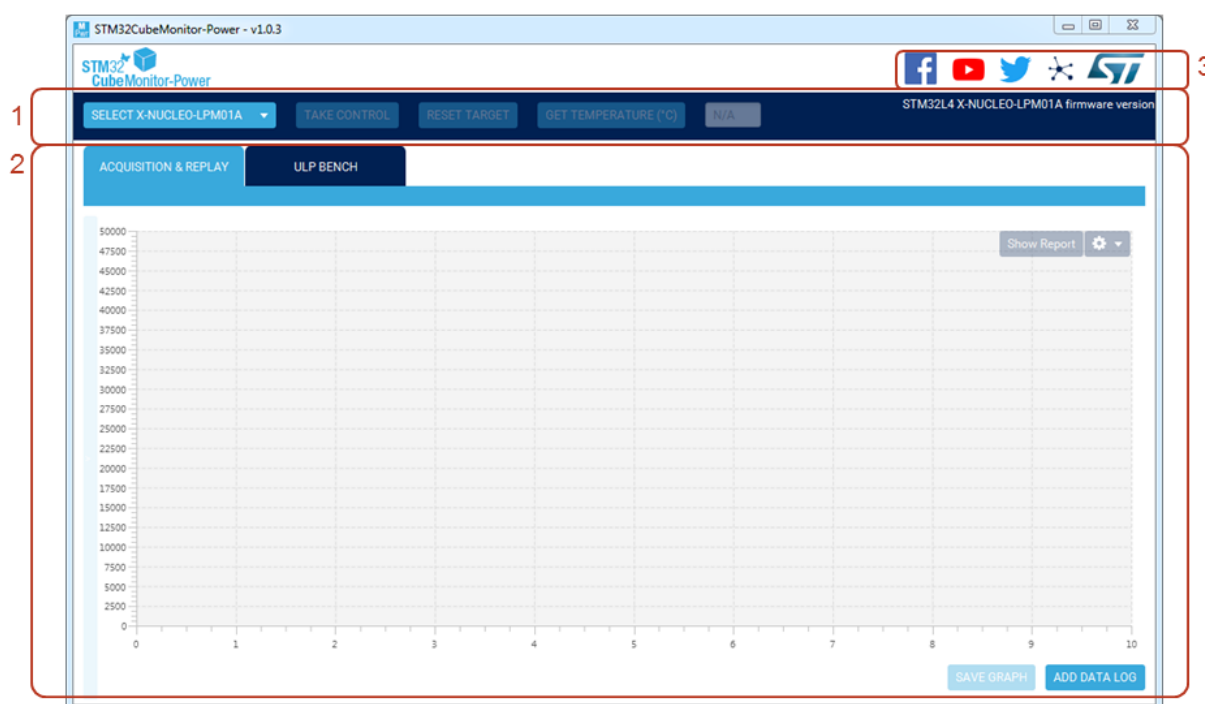
Several areas are observed in this main window:

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 semi-transparent (like the "TAKE CONTROL" button inside the ribbon in STM32CubeMonitor-Power main window), this means that it is disabled and clicking on it has no effect.*

3.1 Ribbon

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

- "SELECT X-NUCLEO-LPM01A" choice list, used to choose one among the COM ports
- "TAKE CONTROL" button, to take control over a X-NUCLEO-LPM01A, 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 X-NUCLEO-LPM01A
- "GET TEMPERATURE" to retrieve the ambient temperature measured on the X-NUCLEO-LPM01A, and display it in the white box on its right
- "Firmware version" to display the version of the X-NUCLEO-LPM01A firmware

3.2 "ACQUISITION & REPLAY" tab

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

This tab is mainly used to display current measurement in a chart form; those measurements come from a connected X-NUCLEO-LPM01A (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 horizontal (abscissa) axis and current on 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 (Replay mode).

The "SAVE GRAPH" button is used to save the data acquired from an X-NUCLEO-LPM01A (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 ULP Bench 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 ULP Bench 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 "PROGESS REPORT" area displays information about the ongoing tests.

The "ULPMARK-CP" area displays the ULP Bench tests results, with the computed ULPMark - Core Profile score, the actual voltage used, the ambient temperature, as well as the minimum and maximum current values.

Figure 2. "ULP BENCH" tab.

3.4 Social network shortcut area

Figure 3. Social network shortcut area
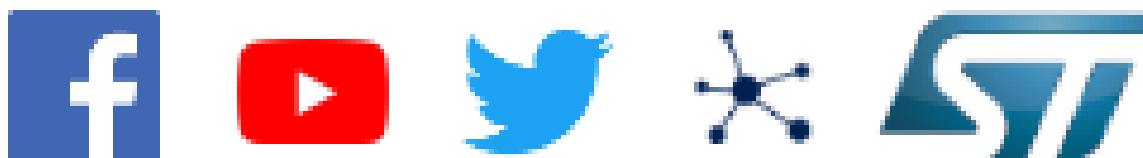
This area contains five shortcuts to social networks and web pages:
- The Facebook icon leads to the official STMicroelectronics Facebook page
- The YouTube icon leads to the official STMicroelectronics YouTube page
- The Twitter icon leads to the official STMicroelectronics Twitter page
- The Share icon leads to the ST Community web site
- The ST icon leads to the official STMicroelectronics web site

4 How to use STM32CubeMonitor-Power?

Figure 4. STM32CubeMonitor-Power start page

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

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

- Connect to an X-NUCLEO-LPM01A (see Section 4.1)
- Show/hide the Acquisition Data Report (see Section 4.5.6)
- Configure acquisition chart X-axis (abscissas) (see Section 4.5.7)
- Configure acquisition chart Y-axis (ordinates) (see Section 4.5.8)
- Load previously saved data into acquisition chart (see Section 4.5.10)
- Select the ULPBench tab (see Section 4.6)

4.1 Connect to an X-NUCLEO-LPM01A

In order to perform either a current measurement acquisition or an ULPBench test campaign, STM32CubeMonitor-Power must be connected to an X-NUCLEO-LPM01A and take control on it.

To be able to connect STM32CubeMonitor-Power to an X-NUCLEO-LPM01A, the virtual COM port driver must have been previously installed (see Section 2.2.2 Installing the virtual COM port driver), and this X-NUCLEO-LPM01A must have its USB cable connected to a USB port of the Host machine running STM32CubeMonitor-Power.

Once the X-NUCLEO-LPM01A is plugged, it is ready for connection after a couple of seconds. In the upper ribbon of STM32CubeMonitor-Power, click on the "SELECT X-NUCLEO-LPM01A" choice list, that displays the list of COM ports on which X-NUCLEO-LPM01A boards have been detected. Select the COM port corresponding to the X-NUCLEO-LPM01A you wish to connect.

Figure 5. COM port selection

Once a COM port is chosen, the "TAKE CONTROL" button becomes active; click on it to take control over the X-NUCLEO-LPM01A.

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 X-NUCLEO-LPM01A, an "X-NUCLEO-LPM01A CONFIGURATION" pane appears in the "ACQUISITION & REPLAY" tab, and the X-NUCLEO-LPM01A LCD display shows "Controlled by Host".

From this moment, STM32CubeMonitor-Power is in Connected State.

If an error occurs while taking control on the X-NUCLEO-LPM01A, check the selected COM port or the X-NUCLEO-LPM01A USB cable.

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

- Release control on X-NUCLEO-LPM01A (see Section 4.2)
- Reset target MCU (see Section 4.3)
- Get ambient temperature (see Section 4.4)
- Configure X-NUCLEO-LPM01A acquisition parameters (see Section 4.5.1 Configure X-NUCLEO-LPM01A acquisition parameters)
- Start acquisition (see Section 4.5.2)
- Show/hide the Acquisition Data Report (see Section 4.5.6)
- Configure acquisition chart X-axis (abscissas) (see Section 4.5.7)
- Configure acquisition chart Y-axis (ordinates) (see Section Section 4.5.8 Configure acquisition chart Y-axis (ordinates))
- Launch ULPBench test (see Section 4.6)

4.2 Release control on X-NUCLEO-LPM01A

Figure 6. Release control on X-NUCLEO-LPM01A

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

From this moment, STM32CubeMonitor-Power is back in Idle State. However if some data were present in the chart, they are still visible and STM32CubeMonitor-Power then switches into the Data Available State, where other actions become possible (see sections below).

4.3 Reset target MCU

Figure 7. Reset target MCU

If STM32CubeMonitor-Power is in Connected, Acquisition or Data Available states, click on the "RESET TARGET" button of the upper ribbon resets the target MCU.

The X-NUCLEO-LPM01A stays connected and data acquisition continues if previously started, allowing for instance to perform current measurement during the target MCU start-up phase.

4.4 Get ambient temperature

Figure 8. Get ambient temperature

If STM32CubeMonitor-Power is in Connected State, Acquisition State or Data Available State, click on the "GET TEMPERATURE" button of the upper ribbon, which requests to the X-NUCLEO-LPM01A the ambient temperature. The result is displayed (in °C) 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 X-NUCLEO-LPM01A board.

4.5 Performing a current acquisition

4.5.1 Configure X-NUCLEO-LPM01A acquisition parameters

If STM32CubeMonitor-Power is in Connected State or Data Available State, an "X-NUCLEO-LPM01A CONFIGURATION" pane is present on the left of the "ACQUISITION & REPLAY" tab, as shown 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 9. Acquisition configuration pane (on the left)
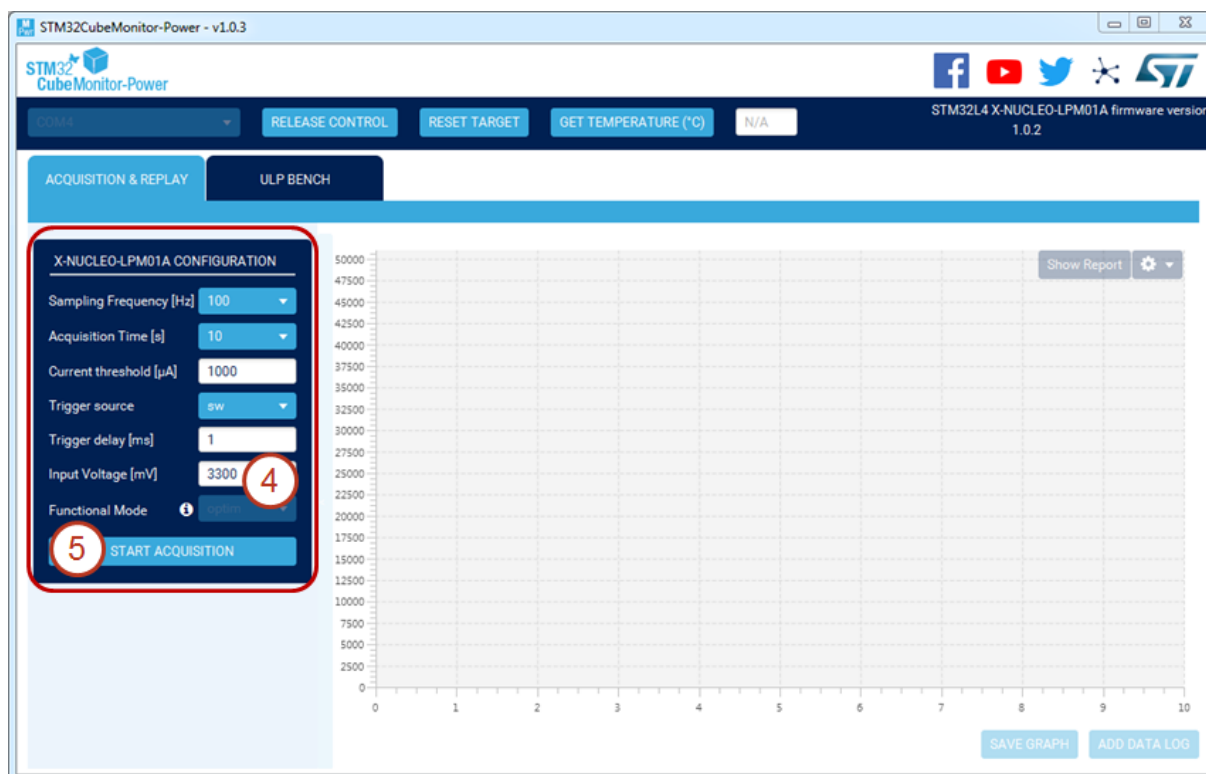
This configuration pane is used to specify acquisition parameters:

- Sampling frequency: X-NUCLEO-LPM01A current measurement frequency choice list (1 Hz, 2 Hz, 5 Hz, 10 Hz, 20 Hz, 50 Hz, 100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, 100 kHz). Default value is 100 Hz.

  Each measurement sample is sent from X-NUCLEO-LPM01A to STM32CubeMonitor- Power and is temporary stored.

- Acquisition time: time after which the acquisition automatically stops, in a choice list from 0.1 s, 1 s, 10 s, 100 s to the "infinite". It is up to the user to stop the acquisition manually. Default value is 10 s.

- Current threshold: current threshold (in mA) used to trig events inside the X-NUCLEO-LPM01A, when measured current exceeds this limit, like switching on a LED or setting an hardware signal (please refer to X-NUCLEO-LMP01A User Manual for more details); there is no effect on STM32CubeMonitor-Power. Maximum value is 50 mA. Default value is 1 mA.

- Trigger source: source of the trigger that is used to start the acquisition; it can be from internal software or from an external interrupt (D7 pin). Default value is SW.

- Trigger delay: time to wait after the trigger event occurred, before really starting the acquisition. Maximum value is 30000 ms Default value is 1 ms.

- Input voltage: supply voltage (in mV) applied to the target MCU board. Allowed values are between 1800 mV and 3300 mV. Default value is 3300 mV.

- Functional mode:

  – optim(ized): mode focusing on having accurate current measurements from 100 nA up to 50 mA 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), avoiding optimized mode current artifacts, but values being inaccurate below 30 µA; only valid only for 50 kHz and 100 kHz sampling frequencies.

Figure 10. Input Voltage
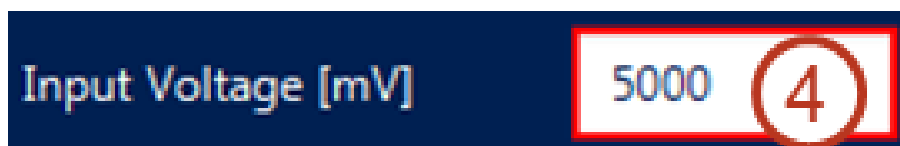
Those parameters are taken into account only when starting a new acquisition (see Section 4.5.2).

If one parameter is outside the allowed range, it is indicated by a red rectangle, and it is impossible to launch a new acquisition until a valid value is entered.

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

4.5.2 Start acquisition

Figure 11. Start acquisition

If STM32CubeMonitor-Power is in Connected State or Data Available State, it is possible to (re-)start an acquisition of current measurements by pressing the "START ACQUISITION" button at the bottom of the "X-NUCLEO-LPM01A CONFIGURATION" pane.

STM32CubeMonitor-Power then switches into the Acquisition State, 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 "X-NUCLEO-LPM01A CONFIGURATION" pane, that are then inaccessible.

The "START ACQUISITION" button becomes "STOP ACQUISITION". Data samples are received from the X-NUCLEO-LPM01A, stored in a temporary location and some are displayed in the chart area in real time to lower graphical load. The Acquisition Data Report values (if visible) are 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 (see Section 4.3), get the ambient temperature (see Section 4.4) or stop the current acquisition (see Section 4.5.3).

4.5.3 Stop acquisition

Figure 12. 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 on 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, acquisition process automatically stops at the end of the acquisition time, and STM32CubeMonitor-Power proposes to save the acquired data in a dedicated file (see Section 4.5.9).

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).

4.5.4 Zoom in / zoom out in the acquisition chart area

If STM32CubeMonitor-Power is in 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 13. Zoom in acquisition
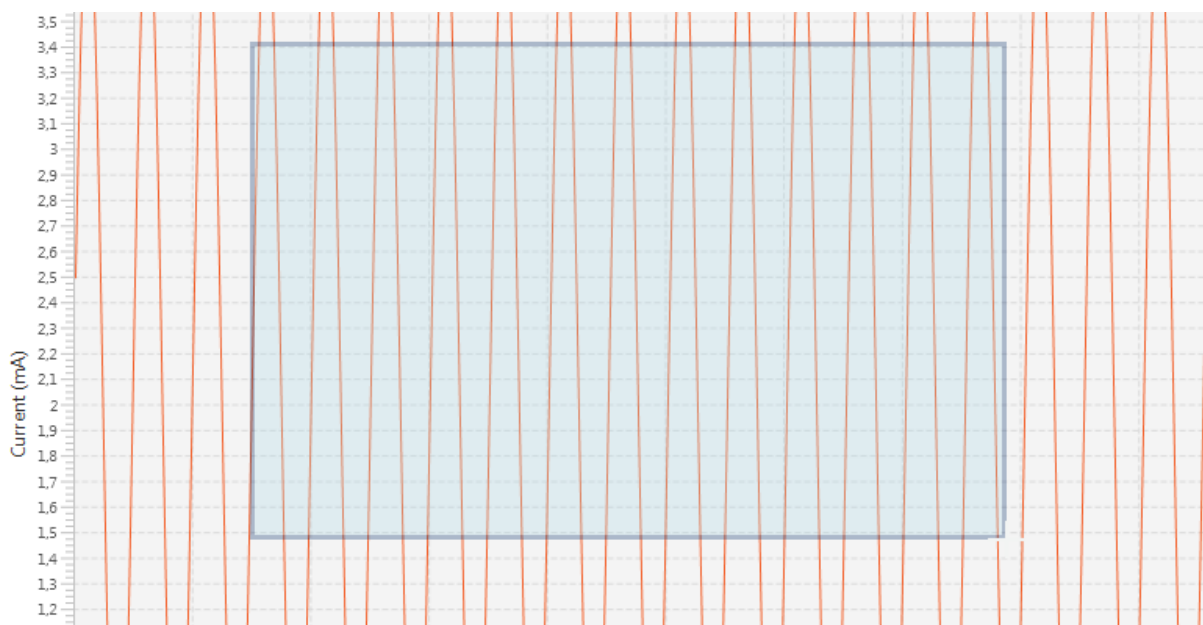
- Use the mouse wheel forward to gradually zoom-in, centered on the mouse position. If the mouse pointer is above one of the axis areas, only this axis is zoomed-in.
- Use the mouse wheel backward to gradually zoom-out, centered on the mouse position. If the mouse pointer is above one of the axis areas, 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 Acquisition Data Report (if visible) is updated to adapt to the timeframe 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.*

4.5.5 Moving in the acquisition chart area

If STM32CubeMonitor-Power is in 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 Acquisition Data Report (if visible) is updated to adapt to the timeframe visible in the chart area (min / max / average current and energy values).

4.5.6 Show/hide the acquisition data report

Figure 14. Acquisition data report (below the acquisition chart)
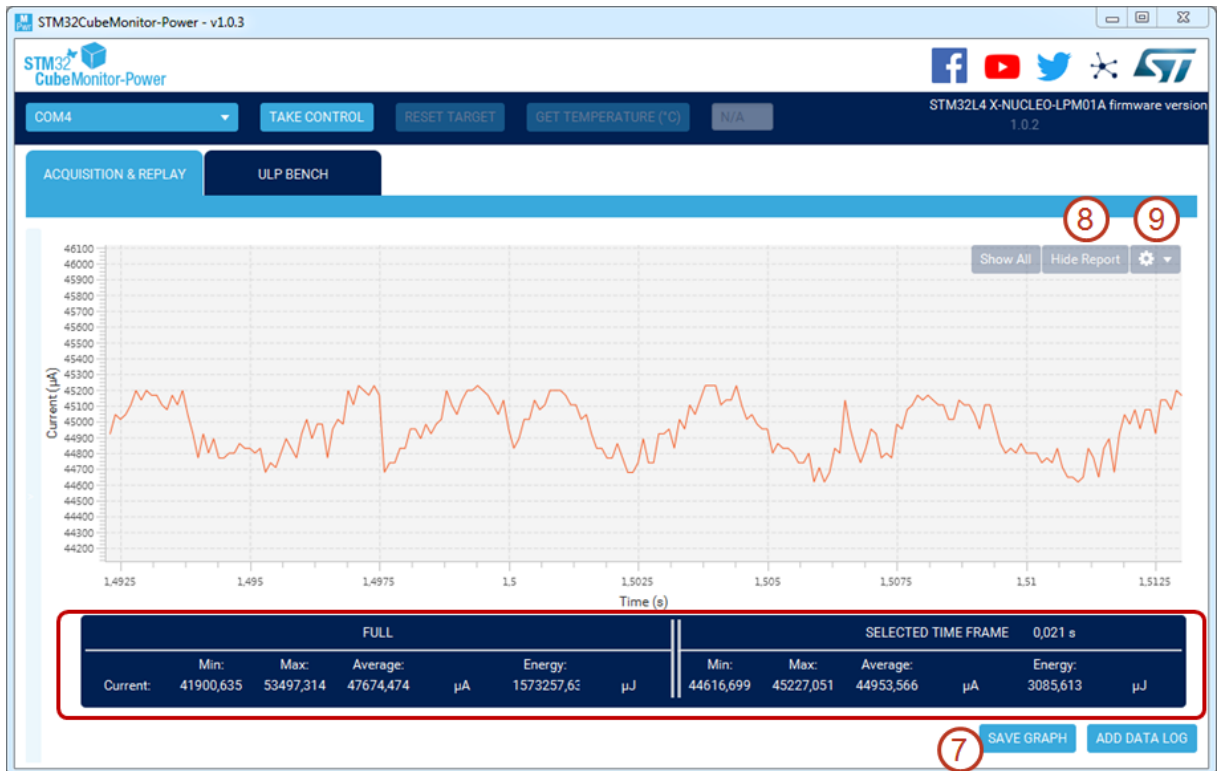
If STM32CubeMonitor-Power is in Connected State or Data Available State, it is possible to show or hide the Acquisition Data Report pane located below the Acquisition chart, by clicking on the "Hide Report" / "Show Report" button (number 8 in Acquisition data report (below the acquisition chart)) in the upper-right corner of the chart area.

This Acquisition Data Report pane is divided in 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 (see time boundaries on the X-axis)

4.5.7 Configure acquisition chart X-axis (abscissas)

If STM32CubeMonitor-Power is in Idle State, Connected State or Data Available State, it is possible to configure acquisition chart X-axis (also called abscissas), 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 abscissa axis item. This opens the X-axis configuration pane.

Figure 15. X-axis configuration
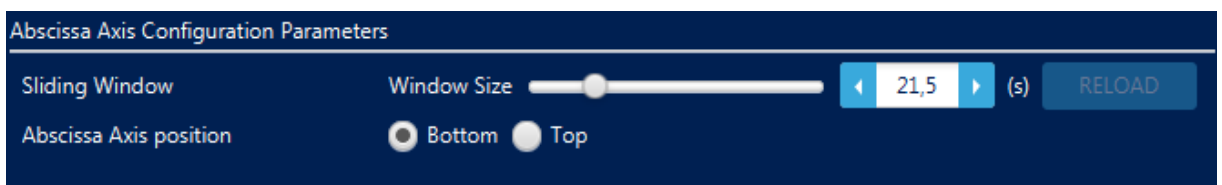
The upper area is used to configure the chart width, timeframe visible into the acquisition chart area. This value can be changed using the slider on the left, or the arrow buttons for a better precision. As soon as a change is

detected, the "RELOAD" button becomes active, in order 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 at the top of the acquisition chart area (with an immediate effect).

Clicking outside of this pane closes it.

Note: *Window Size setting is directly linked to the Acquisition Time setting present in the "X-NUCLEO-LPM01A CONFIGURATION" pane. Changing Acquisition Time automatically changes Window Size. However changing Window Size does not change Acquisition Time. When Acquisition Time is set to "infinite", Window Size is set to 10 s.*

Note: *If Window Size setting is lower than Acquisition Time setting, the visible time frame "slides" to always show the latest acquired data, until acquisition is stopped (automatically or manually).*

4.5.8 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 16. Y-axis configuration
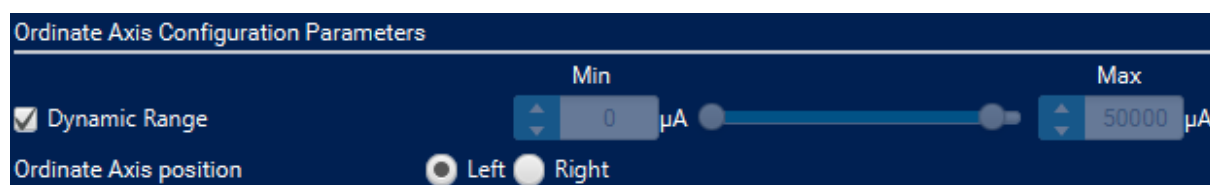
The upper area is used to configure the chart height, span of the current values. Minimal and maximal values can be changed using the slider or the arrow buttons of "Min" and "Max" boxes for a better precision.

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 at the right of the acquisition chart area.

Clicking outside of this pane closes it.

4.5.9 Save acquisition data

Figure 17. 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.

4.5.10 Load previously saved data into acquisition chart

Figure 18. Load previously saved data into 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 "stpm" extension must be selected.

Once a "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 X-axis and Y-axis are adjusted to maximize data visibility. A loading progress indicator is displayed during the loading operation.

Figure 19. Loading progress indicator
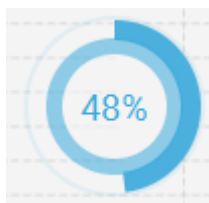
The Acquisition Data Report (if visible) is updated according to the received data (min / max / average current and energy values).

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 X- and Y-axis (see above).

4.6 Performing ULPBench tests

When STM32CubeMonitor-Power is in Idle State (not connected to an 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 / hide "ULPBench Data Report" pane (see Section 4.6.4). 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 (see Section 4.1), the content of the ULPBench Configuration and Report area becomes active as shown in ULPBENCH tab in connected state. It is possible to configure ULPBench parameters (see Section 4.6.1), launch ULPBench tests, follow Progress Report (see Section 4.6.2) and see the ULPMark results after the tests (see Section 4.6.3).

Figure 20. ULPBENCH tab in connected state
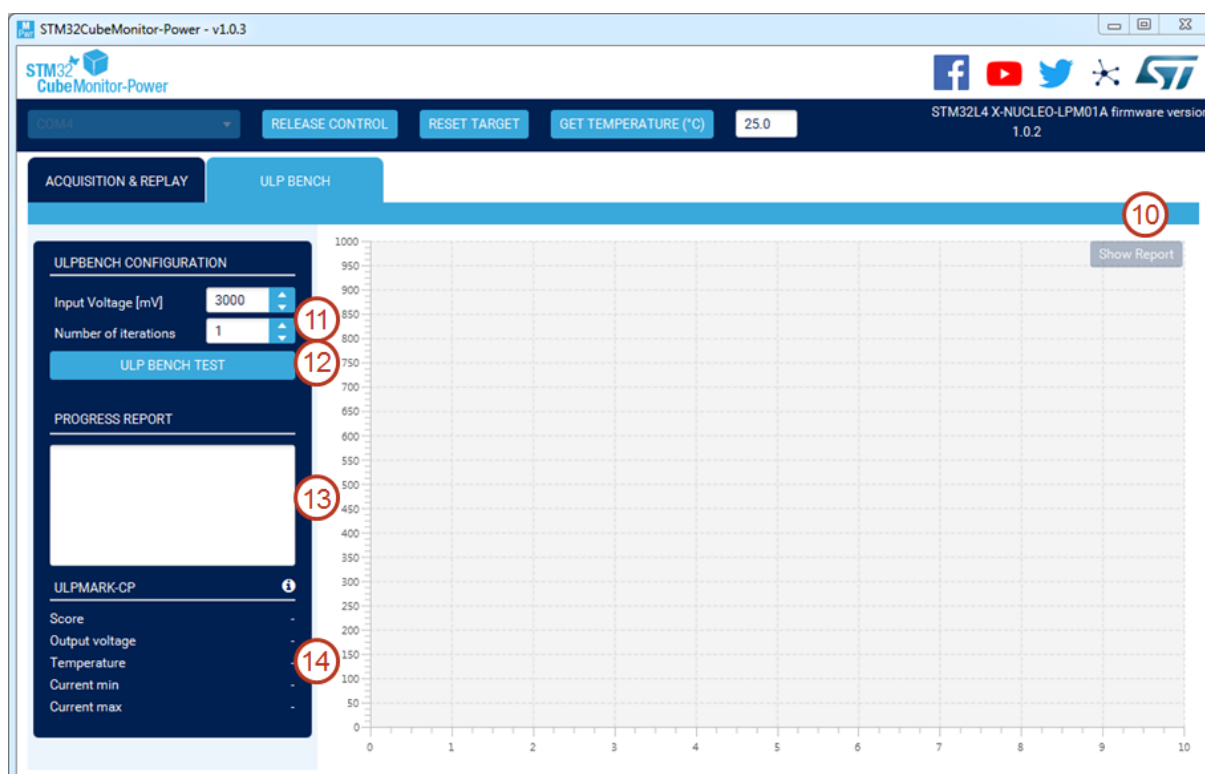
4.6.1 Configure ULPBench parameters

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

Figure 21. ULPBench configuration
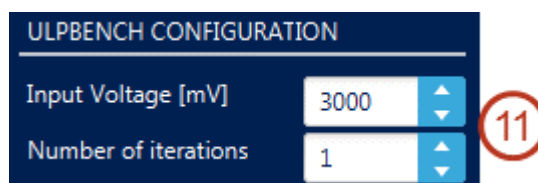
- Input voltage: supply voltage (in mV) applied to the target MCU board. Allowed values are between 1800 mV and 3300 mV. Default value is 3000 mV. Only 100 mV steps via the arrow keys are possible.
- Number of iterations: number of ULPBench test iterations to perform in order to compute a median result over those iterations. Values are between 1 and 15. 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 (see Section 4.6.2).

4.6.2 Launch ULPBench test

Figure 22. ULPBench test

When STM32CubeMonitor is in Connected State, it is possible to launch 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 (see Section 4.6.1).

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

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

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

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

Figure 23. Board initialization phase
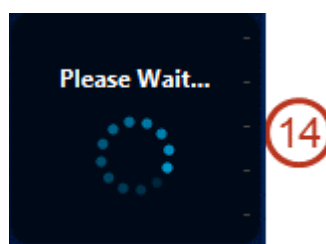
When this board initialization phase is finished, the data samples of the current ULPBench test iteration are received from the X-NUCLEO-LPM01A and displayed in the chart area in real time. Chart area is cleared between two iterations, thus only the data samples of the last iteration are visible at the 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 24. Progress report
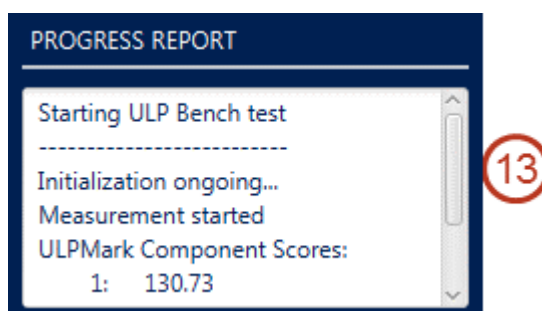
Figure 25. ULPBench iteration
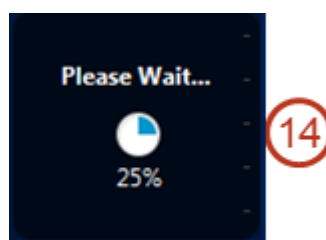
When ULPBench test is finished, the ULPBench test result is shown in the ULPMARK-CP area (see Section 4.6.3). The last iteration data samples are shown in the chart area and STM32CubeMonitor-Power switches into the ULPBench Data Available State, where other actions become possible (see below).

4.6.3 ULPMark results

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

Figure 26. ULPMark results

- Score: ULPMark Core Profile score

  Leave 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

4.6.4 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 (see ULPBench data report (below the chart area)).

Figure 27. 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 in 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)

4.6.5 Zoom in / 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 28. Zoom on ULPBench
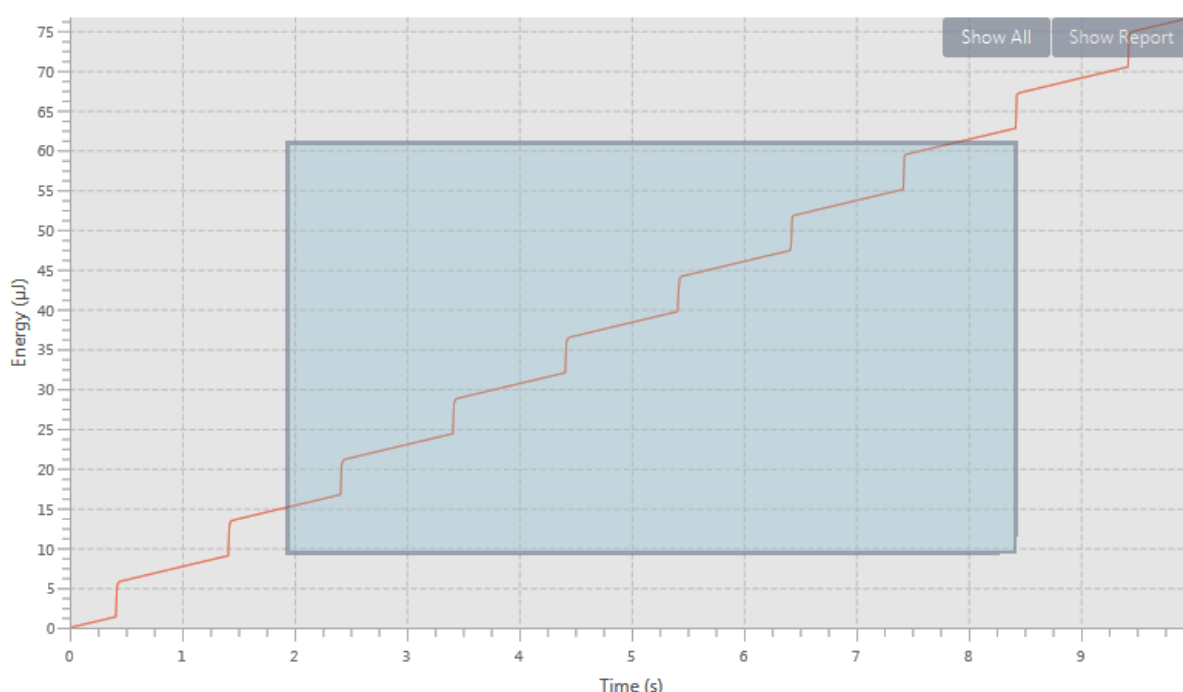
- Use the mouse wheel forward to gradually zoom-in, centered on the mouse position. If the mouse pointer is above one of the axis areas, only this axis is zoomed-in.
- Use the mouse wheel backward to gradually zoom-out, centered on the mouse position. If the mouse pointer is above one of the axis areas, 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 timeframe visible in the ULPBench chart area.

4.6.6 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 timeframe visible in the chart area.

5 Troubleshooting

5.1 COM ports list not displayed in Linux OS

- Plug X-NUCLEO-LPM01A on Linux machine and list device owner,
  for example ttyACM0:
  $ ls -la /dev/ttyACM0
  for example, 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.
- Check that the correct Java JRE is used for your machine (64-bit JRE on 64-bit machines).
- On 32-bit machines, check that the used 32-bit Java Virtual Machine is in server mode, and not in client mode. For this purpose, it may be necessary to install a 32-bit JDK.

5.4 Long-duration acquisitions

- In order 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 X-NUCLEO-LPM01A is connected and ready to answer (few seconds after its power-up).
- Check that no other application is connected on the same COM port as the X-NUCLEO-LPM01A.
- Check only for Windows that ST drivers have been properly installed (see Section 2.2.2 Installing the virtual COM port driver),

6 Support material

6.1 Related design support material

- Nucleo extension board X-NUCLEO-LPM01A
- embedded firmware STM32-LMP01-XN

6.2 Documentation

- X-NUCLEO-LPM01A user manual UM3800 for the board itself
- STM32-LPM01-XN user manual UM3262 for the embedded firmware

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 social network area in all main screenshots.

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IMPORTANT NOTICE – PLEASE READ CAREFULLY