SmartRCP Interface 2024a
User Manual

October 15, 2024

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1 Overview of SmartRCP Interface

The purpose of this manual is to provide the user with the necessary concepts and procedures to maximize the use of the SmartRCP device, supplied by Power Smart Control S.L.. The SmartRCP Interface allows the user to control from his computer the functionalities offered by the Vivado template included with the device. These functionalities include reading and writing user registers, ADC configuration, and access to internal FPGA waveforms, among others.

Throughout the manual we will detail the location of each option within the interface, the parameters available for configuration, and the steps required to modify them. In addition, the different options for connecting to the board will be discussed, including methods such as VPN and router.

1.1 Introduction to the SmartRCP Interface Application

To access the SmartRCP device software interface, an executable (.exe) file has been provided. The name of the executable contains relevant information, such as the development year of the version and the revision identifier for that year.

Figure 1: SmartRCP Interface .exe file.

The main window of the software consists of a series of buttons to control the main functionalities of the SmartRCP device. These functionalities include enabling the device, resetting alarms, controlling the ADC configuration, and managing write logs. In addition, the software offers additional options such as saving a configuration or loading previously saved configurations. The interface also features two windows in console format embedded in the display. The first one shows the current status of the device, while the second one indicates the activated alarms in case any are triggered, providing accurate information about the events affecting the system.

In addition, the software provides a number of displays that allow the user to obtain information on key metrics, such as reading registers, which are customizable according to the specific needs of each project. Finally, graphical outputs are included to visualize the values read by the ADCs or the registers, providing a clear and direct representation of the data obtained. Finally, graphical outputs are included to visualize the values read by the ADCs or the registers, providing a clear and direct representation of the data obtained. All these functionalities are shown in Fig. 2.

Within the SmartRCP Interface software an additional tool is included, the PL-Datalogger, that performs the functions of a digital oscilloscope. This oscilloscope allows the user to view in real time the waveforms generated by the IP functions implemented in the FPGA and microprocessors or any electrical signal measured by the ADC channels, or any other source.

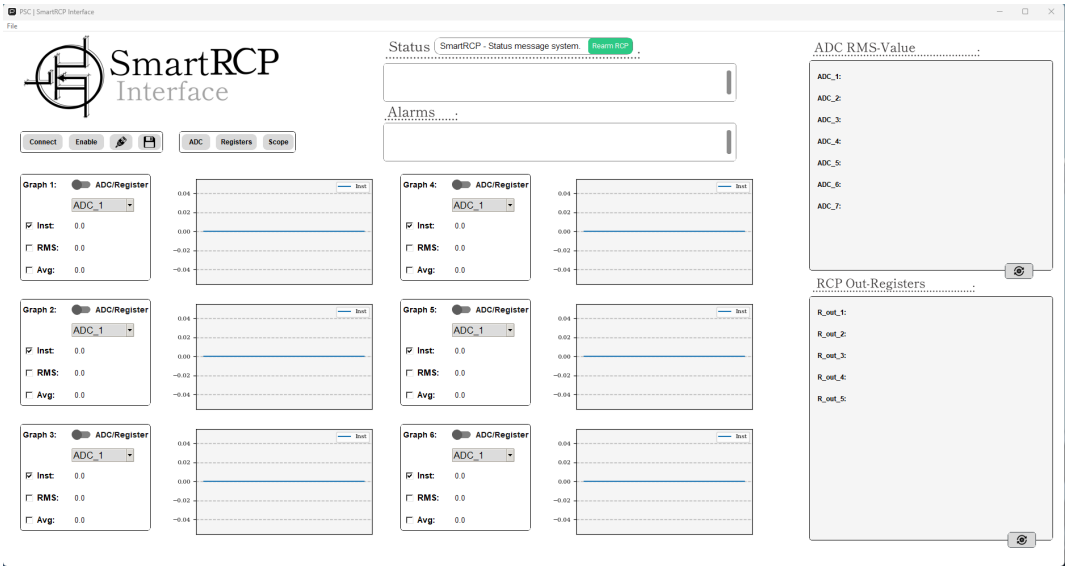

Figure 2: SmartRCP Interface main panel.

The PL-datalogger allows the user to configure several key parameters, such as the sample capture interval (Time-Step), the channels to be displayed (up to 6 of the 32 channels, available by means of a multiplexer integrated in the SmartRCP) and the trigger level, which defines the start point of the captures.

The datalogger offers the option to customize the names of the captured signals, which significantly improves the user experience, facilitating the readability and understanding of the data obtained.

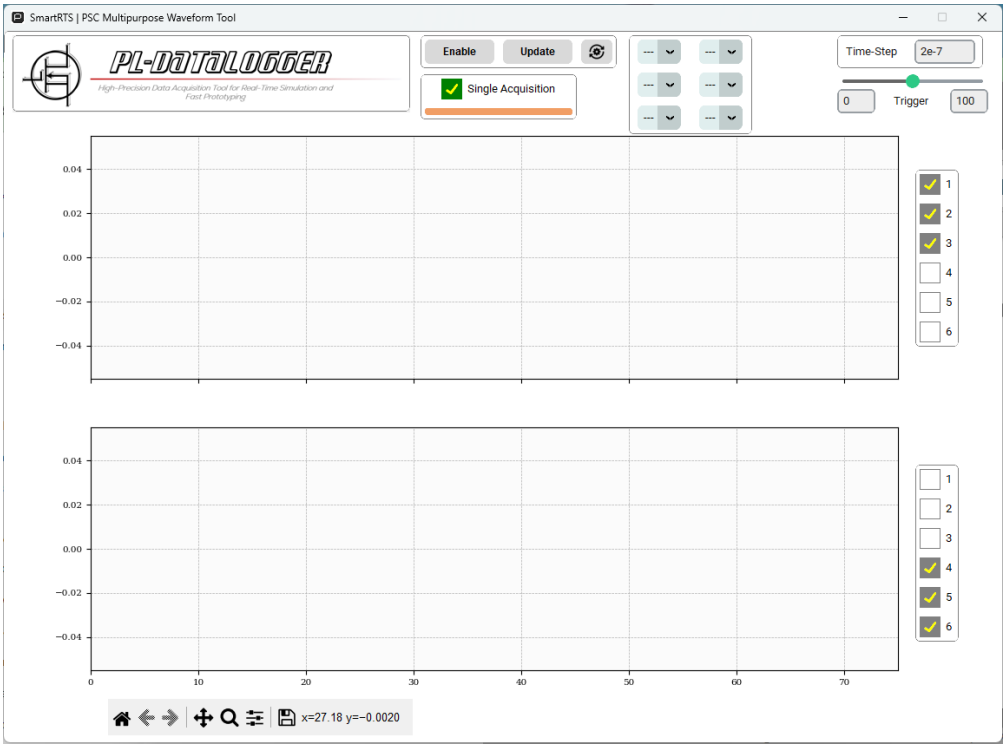

Figure 3: PL-Datalogger software tool.

1.2 SmartRCP Interface usage procedure and troubleshooting of common problems

For the use of the SmartRCP Interface, an executable (.exe) file has been provided, eliminating the need for a prior installation process. The user can directly access the interface by running the file, thus facilitating its immediate use.

On some computers, depending on the antivirus settings, the executable file provided may be mistakenly identified as a threat. This is due to the conversion process to ".exe" format. In these cases, the main option is to configure the antivirus to exclude the executable from detections. Alternatively, you can also try to run the program as an administrator.

Another possible issue when running the software for the first time is that permissions are requested to access public networks. This occurs because all communication with the SmartRCP device is over Ethernet. If this request appears, select the Allow option to ensure proper operation of the device.

2 Description and mode of use of the SmartRCP Interface

2.1 Description of the Main Screen

This section describes the different sections of the main panel of the SmartRCP interface, along with their functions and how they are interconnected. The following subsections will explain in detail how to use and the capabilities of each of these functionalities, to maximize their usefulness to users.

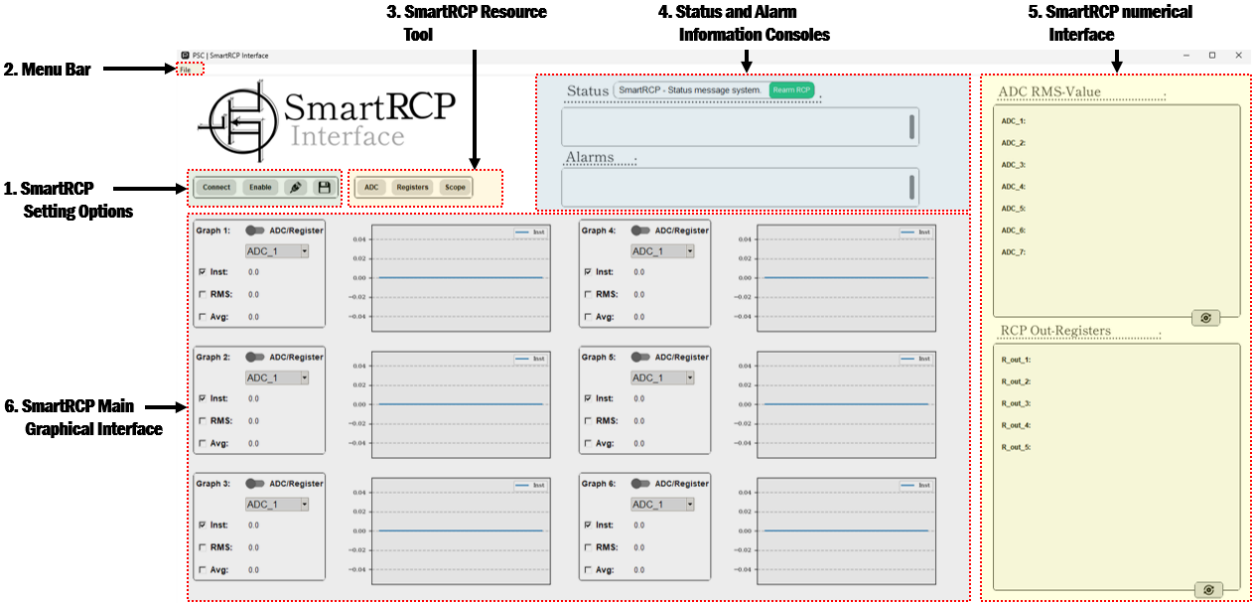

Figure 4: Description of the different elements present in the main panel.

1. **SmartRCP Setting Options.** This menu contains aspects related to the operation of the interface software, such as the configuration of the connection to the SmartRCP (via Ethernet), the device enable button, the IP address configuration (corresponding to the SmartRCP) and the option to save or load previously made configurations.

2. **Drop-down menu.** The drop-down menu provides access to basic software functions, such as saving settings, loading saved settings, closing the program, and accessing a window with basic information about the software and the company Power Smart Control S.L.

3. **Resources Tool.** This section provides access to pop-up windows that allow you to configure different aspects of the device, such as the ADC configuration (gain, offset, alarms, etc.) and the value of the Input-Registers in order to send data according to the needs of each design. One of the options provides direct access to the PL-Datalogger, which offers the functionality of a digital oscilloscope, allowing the user to view in real time the waveforms generated in the SmartRCP. The capabilities and use of the datalogger will be detailed in its corresponding section.

4. **Status and Alarm Information Panels.** This component consists of two text output consoles that provide useful information. The first console displays the current status of the SmartRCP, along with a log of events and their time of occurrence. The second console

reports if any of the ADCs have exceeded the configured alarm limit, showing whether an alarm is currently active and when it was triggered. Alarms will remain active until the user presses the reset button next to the RCP status indicator.

5. **Numerical interface.** This interface consists of two panels displaying numerical information of interest. The upper panel displays the RMS value of the signals measured by the ADCs, while the lower panel displays the values read from the Output-Registers, corresponding to the signals connected by the user in the design phase with Vivado. In the lower right corner of each panel, a button provides access to a window to select which registers are displayed and to modify their names, allowing the user to customize the interface according to his needs and enhance the user experience.

6. **Main Graphical Interface.** This graphical interface shows the evolution of the values of the variables measured by the ADCs, such as the instantaneous value, the RMS value and the average value (AVG), as well as the evolution of the values connected to the reading registers. Six user-configurable graphical outputs are provided, allowing to select which data (ADCs or readout registers) are being plotted on each graph. The names of the data sources shown in the graphs are those defined by the user.

2.2 SmartRCP Setting Options

1. **Connection button.** This button (Fig. 5) allows connecting or disconnecting the SmartRCP software interface from the physical device. The connection will be made using the IP address previously defined in the IP configuration option available in this menu.

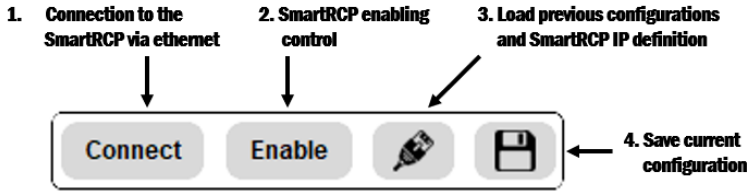

Figure 5: SmartRCP Setting Options.

2. **Enable button.** This button (Fig. 5) controls a signal that can be used to synchronize and manage the design implemented in the SmartRCP during the development phase in Vivado (Available in the IP WRITE REGISTERS).

Figure 6: Enable signal in FPGA IP Function.

The use of this signal (Fig. 6) is optional and is at the discretion of the developer, who will decide whether or not to connect it to his design, depending on the use he wishes to make of it.

The functionality of this button allows to control the logic value of the signal from the user's computer via the Internet. When the button displays the Enable option, the output signal

will be at a logic zero. When the button is pressed, its status will change to Disable and the signal at the output of the IP block (USER_ENABLE) will change to a logic one.

These status changes are reflected in the Status console, so that you can see the current status of the Enable signal and its history with the time at which any changes were made.

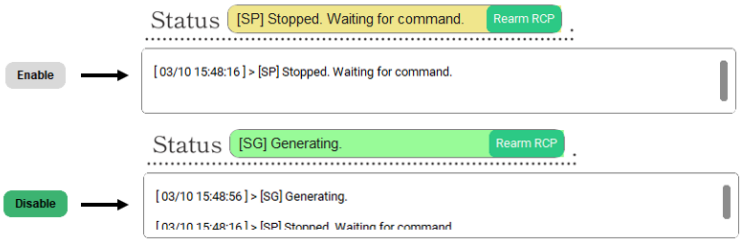

Figure 7: Logging of SmartRCP status changes on the interface..

3. **Main configuration.** This button opens a pop-up window with only two functions. The first one allows entering the IP address of the SmartRCP to establish the connection. The second option allows loading previously used configurations, including parameters such as user-defined signal names, ADC gains, display settings, IP address, among other settings.

   - IP Adress.The IP address of the SmartRCP must be entered in the designated input box. The format of the IP address should be xxx.xxx.xxx.xxx.xxx, following the default IP format as the default parameter. The new IP address will be updated and become effective only after pressing the "UPDATE" button. If this button is not pressed, the change will have no effect.
   - Load of configuration file. To load previously saved configurations, use the "LOAD" button. When pressed, a file browser will appear. The user must go to the location where the previous configuration was saved and select the corresponding file (.txt extension). Once the file has been selected, it will be necessary to press the "UPDATE" button for the configuration to be applied in the software interface.

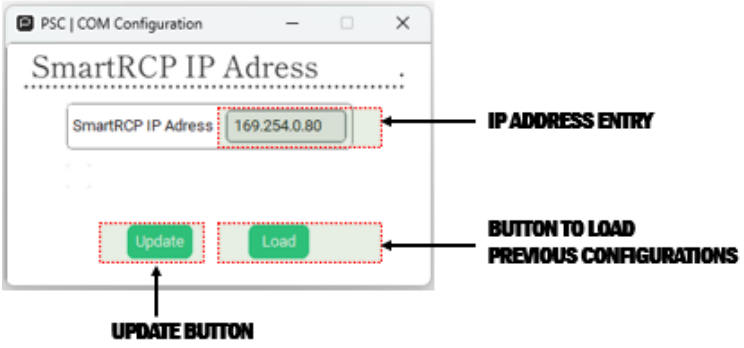

Figure 8: Main configuration window.

4. Save button. This button allows the user to save the current SmartRCP configuration to a file. Clicking the button will open a file browsing window where the user can select the location in which to save the configuration file. The file must be named or, if preferred, an existing file can be selected for overwriting. The configuration file will be saved with the extension ".txt".

2.3 Drop-down menu.

The drop-down menu offers quick access to the "Open" and "Save as" functionalities, already described in the previous section, as well as the option to close the software. In the "About SmartRCP" section, the user will be able to find important information about the version, along with useful contact details for assistance or more detailed information. In addition, this section includes details about the Python packages used in the development of the application.

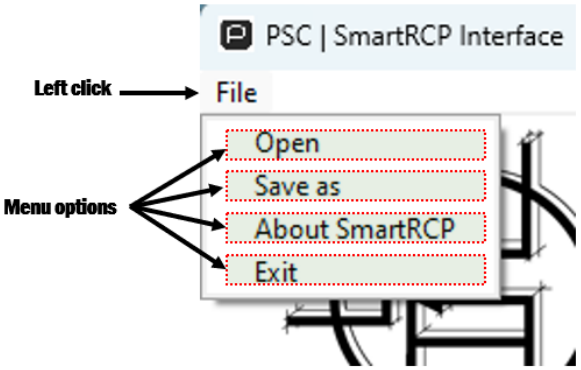

Figure 9: Drop-down menu detail.

Figure 10: About SmartRCP Interface window.

2.4 Resource Tool

The buttons in this menu allow you to configure the main functionalities provided by the SmartRCP Vivado template.

Figure 11: SmartRCP Resource Toolbar.

- **ADC Configuration.** The user can adjust parameter such as gain, offset and cutoff filter frequency. The ADC alarm system can also be configured setting the upper limit, lower limit and the minimum prevalence time required for an alarm to be considered as an emergency event.

  When opening the configuration window, the options for configuring fast ADCs will be displayed by default. If the user wishes to configure the slow ADCs, they can be viewed by clicking on the corresponding tab located in the upper left corner of the window. It is important to note that changes made in the configuration tab will not take effect until the Update button at the bottom of the pop-up window is pressed. If the window is closed without pressing this button, all changes made will be lost.

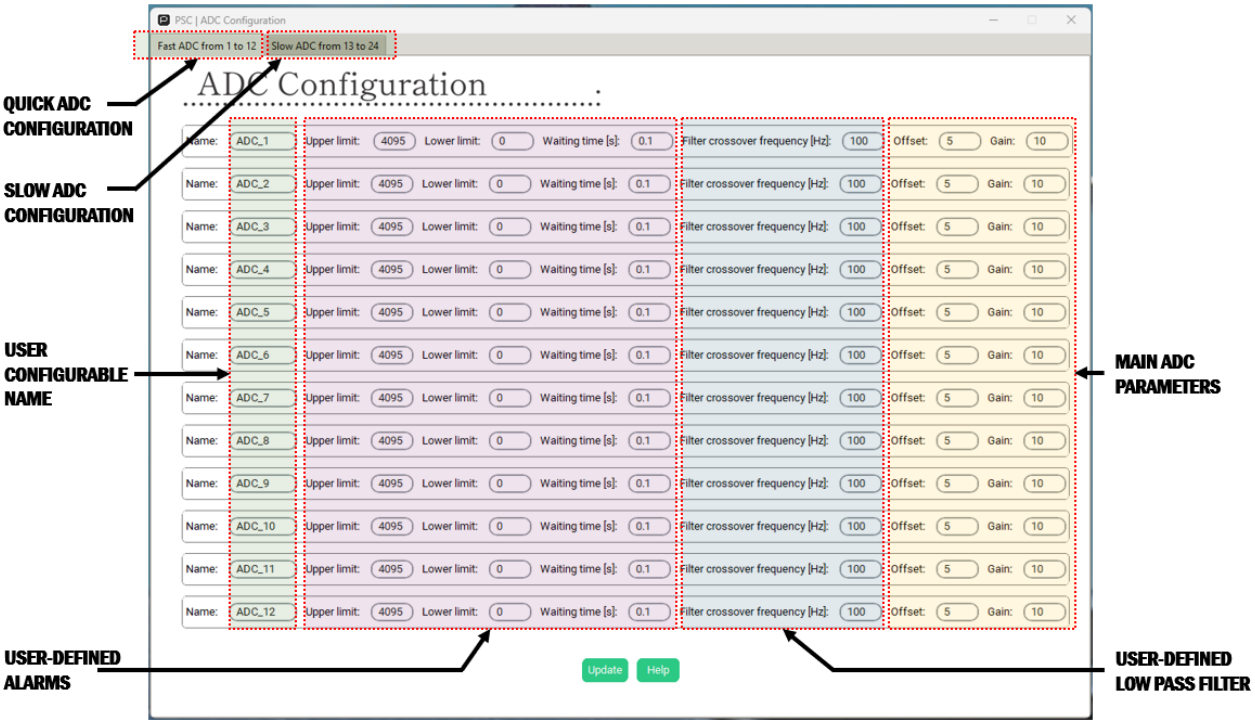

Figure 12: ADC Configuration Window.

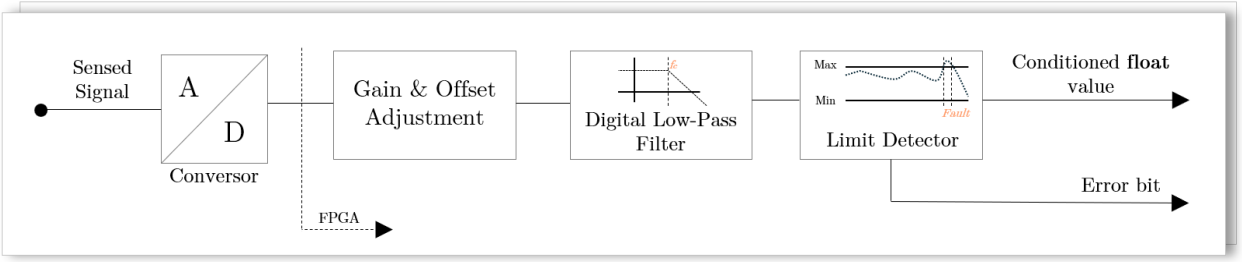

Figure 13: Description of functional elements in signal sensing.

- **Input-Register Configuration.** It allows the user to select the type of data to write, either float or integer, and assign a specific value to each register. These registers will be sent to the SmartRCP hardware platform and will be available for use by the user from the microprocessor and FPGA (Fig. 14). In addition, it is possible to customize the names of the registers to facilitate their identification and to select which of them will be displayed in the configuration window.

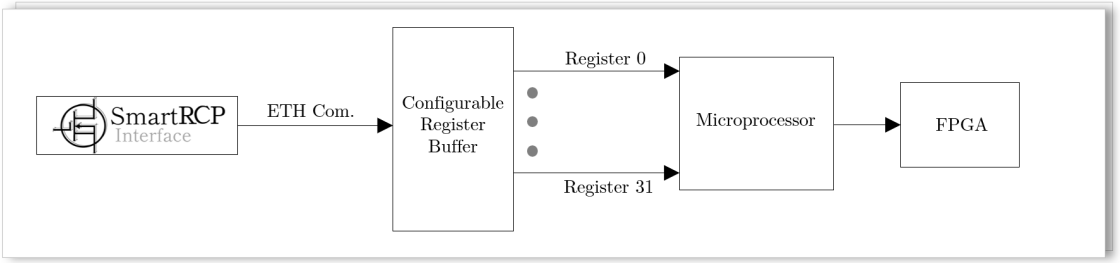

Figure 14: (a) Input-Register Configuration Window and (b) Register data-format config.

The name and value of the registers can be modified directly by double clicking on the corresponding parameter (as shown in the image above). In the record number column, the output of the IP block with which each record is associated is indicated. Finally, the data type column shows the format (float or integer) in which the data is sent to the SmartRCP.

The procedure to modify the type of data being sent and to add a new record to which you want to edit the value is as follows:

1. Right click to show a drop-down menu, selecting the *Add/Delete Register* option that will appear.
2. Then, a different pop-up window will be showed (Fig. 15.b). In this window, the user can select wich registers will be avaible for modification and its data format (float or integer).

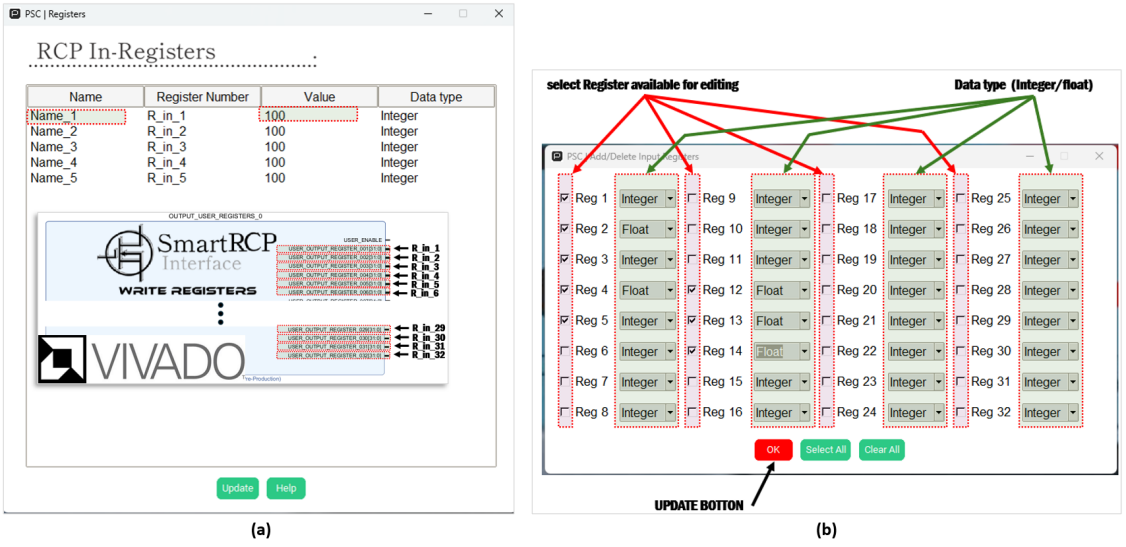

Figure 15: (a) Input-Register Configuration Window and detail capture of this registers on Vivado (b) Register data-format config.

The default value to be sent through the registers, if they have not been previously added, will be 0. In case the records have been previously added and then deleted, the last value configured before their deletion will continue to be sent.

When designing in Vivado, the user must keep in mind that, for integer type records, the maximum value will be determined by the range of the data type used. In the case of floating numbers, the highest value that can be sent is 49,998.0 while the lowest value is -49,998.0. In addition, the closest values to zero will be 1E-12 and -1E-12. If an attempt is made to exceed either of these limits, a message will be displayed indicating that such action is not possible.

- **Direct Access to Datalogger.** The last options (Fig.11) allow the user to open the PL-Datalogger tool. This application can run in parallel with the rest of functionalities that SmartRCP Interface provides.

2.5 Status and Alarm Notification Console.

The main window include two notifications area (Fig. 16) that display the current status of the SmartRCP, which is updated according to the data sent directly by the device. In addition, any alarms that have been triggered on the ADCs channels will be reported, according to the alarm limits and criteria previously configured by the user.

- **Status Notification.** By pressing the "Connect" button, the current status of the SmartRCP will be received periodically on the software interface. This status can be found in one of the following three:
  - (SP) Stopped. Waiting for command: Indicates that the enable signal is at logic 0.
  - (SG) Generating: Indicates that the enable signal is at logic 1.
  - (PL-E) PL-Alarm is Active: Indicates that one of the ADCs has exceeded the configured maximum limit for sufficient time to activate the corresponding alarm.

  Upon connection, the SmartRCP status will be monitored and periodically updated in the software.

- **Alarms.** In the event that an alarm is triggered, this console will display the time when the alarm occurred, as well as the source of the alarm. This allows the user to efficiently identify the event that triggered the alarm and take the necessary actions.

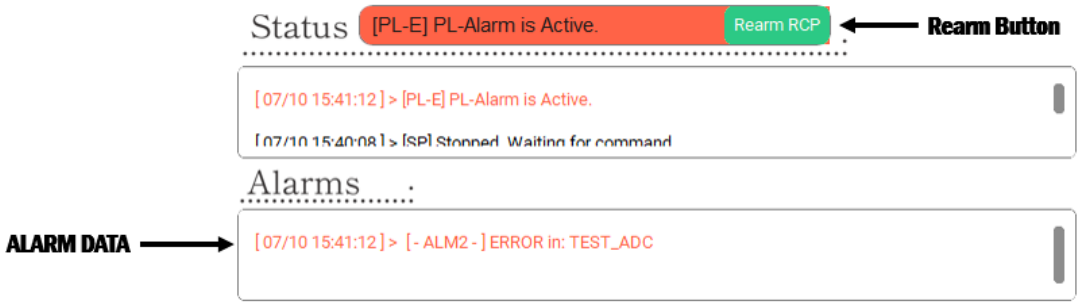

Figure 16: Status and Alarm notification system.

If, during the design process in Vivado, the user has chosen to connect the alarm indicators to his design (Fig. 17), the behavior will be as follows: the general alarm output will be set to 1 if any of the alarms are activated and will remain in this state until the reset command is sent from the user interface.

In addition, there are specific flags for the fast and slow ADC alarms, as well as an 12-bit output that specifically identifies which ADC was responsible for triggering the alarm. The user is free to connect and use these resources as required in his design. In all cases, the alarm value will remain at 1 until the reset command is sent from the user interface. All these indicators are available in the IP block that controls the ADCs.

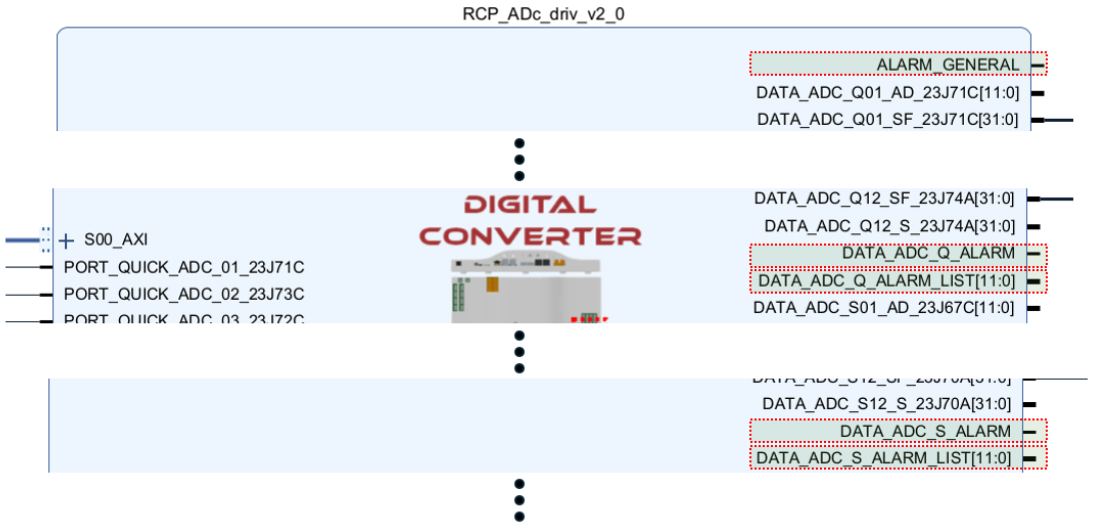

Figure 17: Arrangement of the alarm signals in the FPGA.

2.6 Numerical interface.

This section of the main screen is divided into two panels. The upper panel provides the display of the RMS values of the signals measured by the ADCs, allowing the user to monitor the behavior of the signals in real time. The lower panel acts as the output interface for the values read from the read registers, displaying the data connected to those registers.

- **ADC-RMS Values.** This notification area allows the user to select the RMS values of the ADCs to be displayed on the main screen. The values will appear with the names previously defined by the user for the ADCs. To configure which signals are displayed, the user must left click on the "Setting" button located at the bottom right.

  When doing so, a pop-up window (Fig. 18) will appear where it is possible to select which ADCs are to be displayed. To do so, the user must check the boxes corresponding to the ADCs he/she wants to enable, or uncheck them if he/she wants to hide any of them. The changes will not be applied until the "OK" update button at the bottom of the pop-up window is pressed.

  Next to this "OK" button, there are two additional options: a button that allows you to select all ADCs quickly and another one that removes all selection marks.

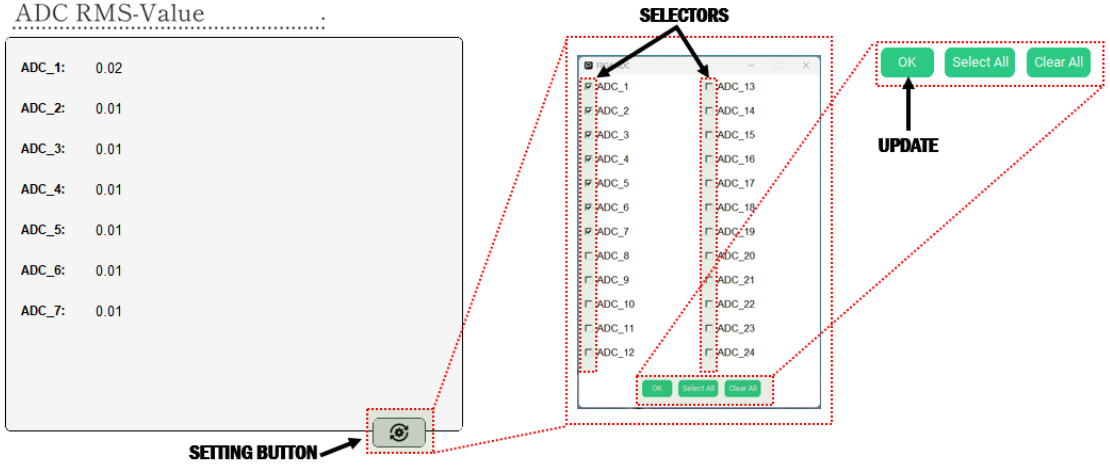

Figure 18: ADC-RMS notification area configuration.

When saving a current configuration of the SmartRCP interface, the selection of signals displayed on the console will also be stored. When loading a previously saved configuration, the selection of displayed signals will be automatically updated according to the configuration stored in the file.

- **RCP Output-Registers.** This console allows the user to access and visualize the values of the signals read through the readout logs, which have been connected during the development phase in Vivado according to the specific needs of the project. The user can select which registers will be displayed on the main screen of the console using the options that appear in the pop-up window by pressing the "Setting" button located at the bottom right (Fig. 19).

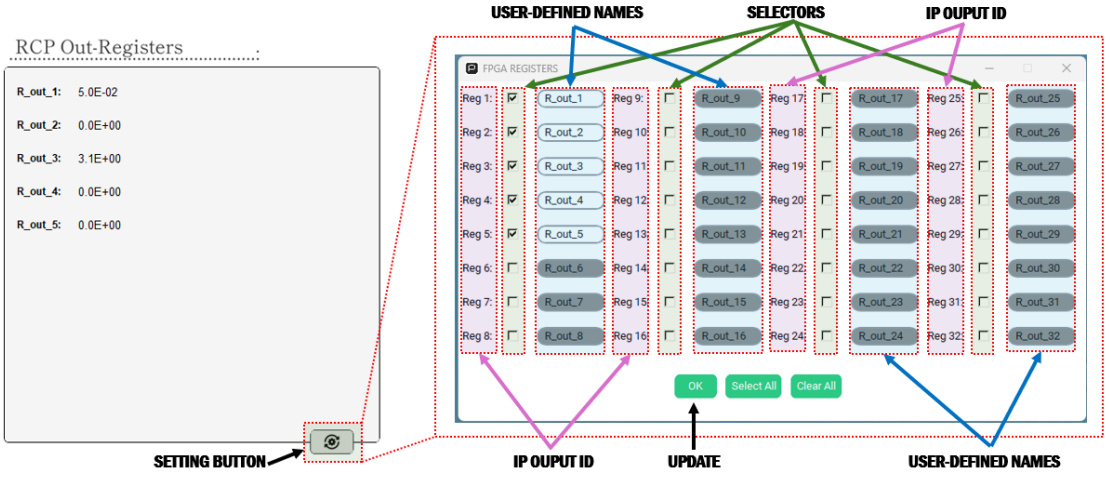

Figure 19: RCP Output-Registers notification area configuration.

In the "Setting" pop-up window, you can select which register will be presented and assign them custom names that make them easier to understand. These names should be related to the variables to which they were connected during the design in Vivado, providing greater clarity in the interpretation of the data. It is important to note that, in this version of the console, read registers only support data in floating point format. Therefore, the user must take this requirement into account when developing his project in Vivado.

The "ID" column in the table links the record name to the corresponding entries in the IP of the read records. The changes will not take effect until the "Update" ("OK") button at the bottom of the pop-up window is clicked. In addition, two other buttons are provided to select all records for display in the console or to remove them from the console.

The user has a total of 32 input registers that can be connected according to the specific needs of his project (Fig. 20). Saving a current configuration of the SmartRCP interface will also store the selection of signals displayed on the console. When loading a previously saved configuration, the selection of displayed signals will be automatically updated according to the configuration stored in the file.

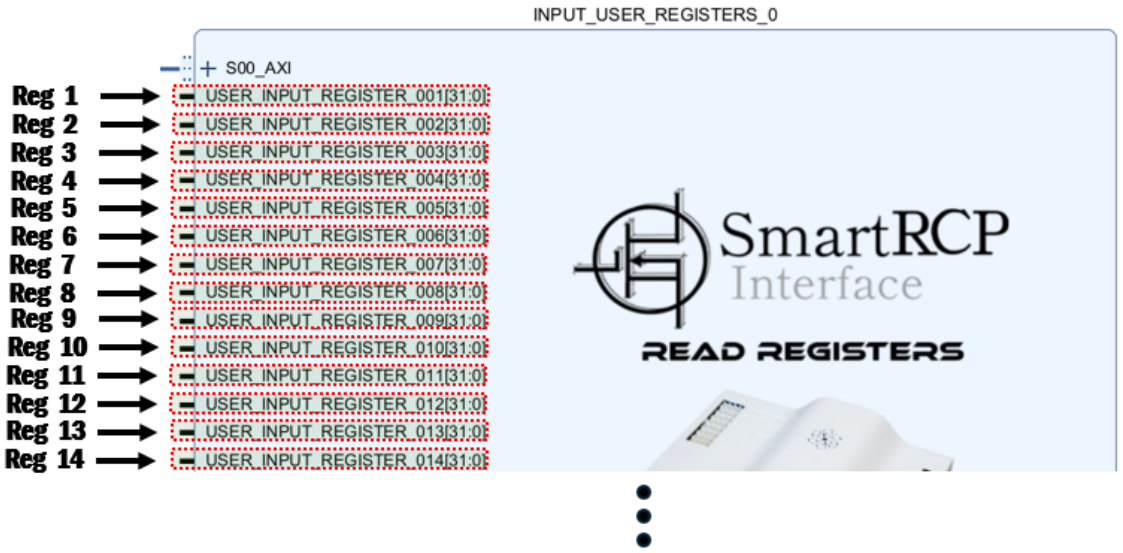

Figure 20: Arrangement of the RCP output records to be sent to the interface.

2.7 Main Graphical Interface

The SmartRCP Interface offers the user six configurable graphs (Fig. 21), which can be connected according to their needs to monitor in real time the evolution of the parameters required by their project. As data sources, the user can select both ADC values and read registers that are enabled. In both cases, the signals will appear with the names previously defined by the user during the configuration of the ADCs and read registers, which facilitates the identification of each monitored variable.

Each graph in the graphical interface is composed of a control panel (Fig. 22) that includes a drop-down list of selectable sources, as well as a switch to toggle between ADC or register options. If configured as ADC, the panel will display options to select which values are to be plotted on the graph (instantaneous value, RMS or AVG). The user can decide which values are displayed by activating or deactivating the corresponding selectors. In the case of readout registers, it is possible to choose whether or not to display the register chosen as the signal source for that graph. Next to the selectors, the instantaneous value received from the SmartRCP is displayed for each selected parameter.

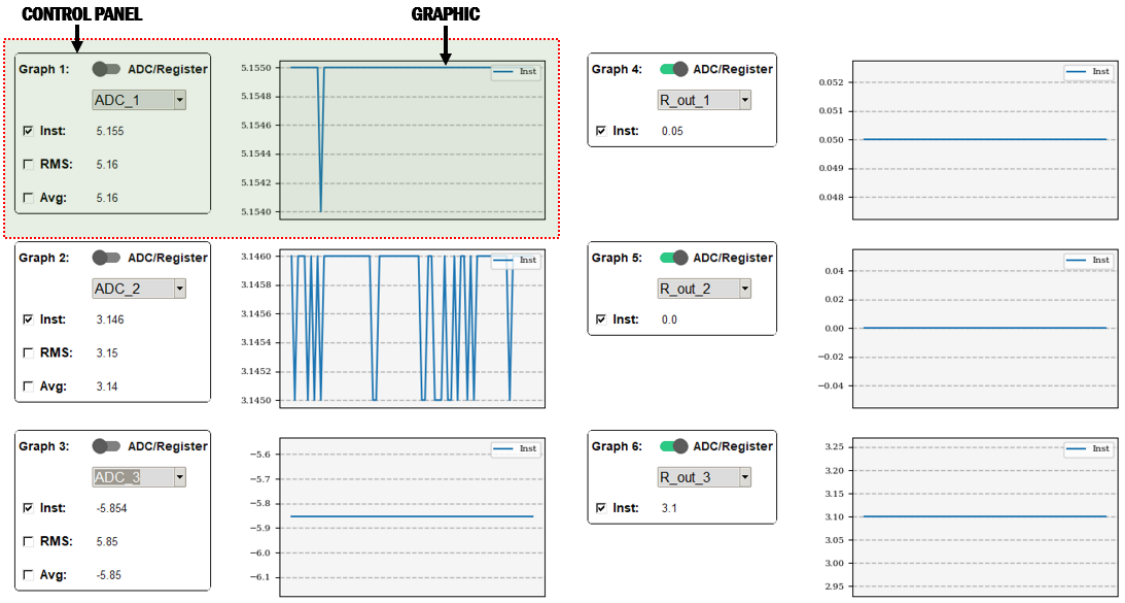

Figure 21: Main Graphical Interface of the SmartRCP Interface main panel.

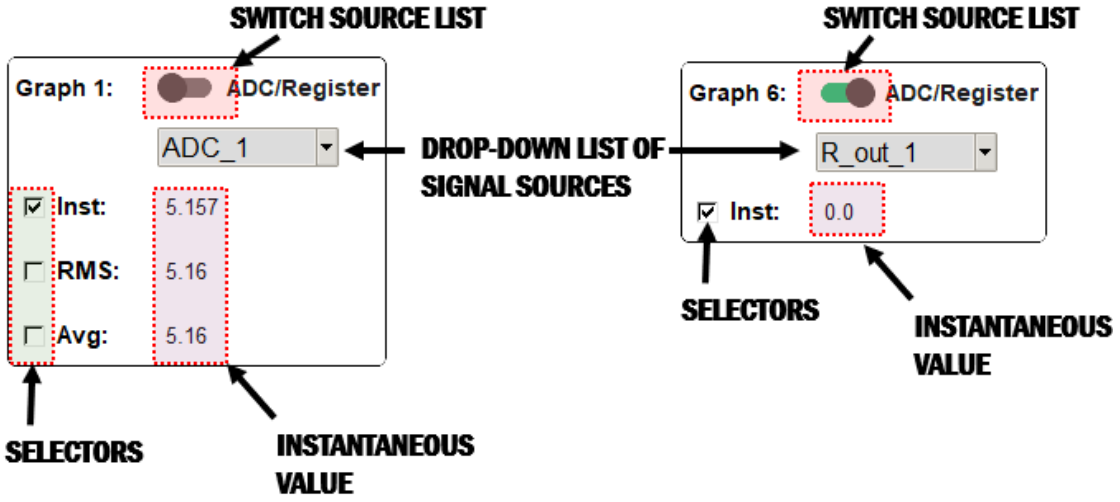

Figure 22: Plotting control of each of the graphical interfaces.

When the configuration of the SmartRCP software interface is saved, the configuration of the graphs will also be stored. This means that, when loading a previously saved configuration, the options selected in the graphs (data sources, values to be displayed, etc.) will be restored according to what was configured in the loaded file, allowing the user to resume working with the same visualizations previously defined.

3 PL-Datalogger

3.1 Main window and functionalities

The SmartRCP PL-Datalogger (Fig. 23) has the functionalities of a digital oscilloscope, allowing the user to view any signal within the FPGA, regardless of its origin, whether it comes from a custom IP block or an ADC channel. During the design stage in Vivado, the user has the possibility to connect up to 32 signals to the inputs of the PL-Datalogger IP block. From the software interface, up to 6 of these signals (6 channels) can be selected for display in the two available graphical windows, allowing real-time monitoring.

The SmartRCP PL-Datalogger allows you to select a signal as a trigger source and adjust the trigger level to synchronize the capture of the waveforms, similar to a physical oscilloscope. In addition, the sampling time (Time-Step), which determines the interval between each capture, can be set. In continuous capture mode, 2500 samples are recorded per channel. In single capture mode, 15,000 samples are captured per channel.

The PL-Datalogger also allows you to zoom in on signals for more detailed analysis and offers the option to save waveforms. The user can assign custom names to the 32 signal inputs, making it easy to identify them throughout the oscilloscope, including the drop-down menus for each channel and the graph legends.

It is important to note that changes to the configuration will not take effect until the update button in the control section of the PL-Datalogger is clicked. If the user saves the configuration from the main window of the SmartRCP software interface, all settings made will be stored and will be available the next time that configuration is loaded.

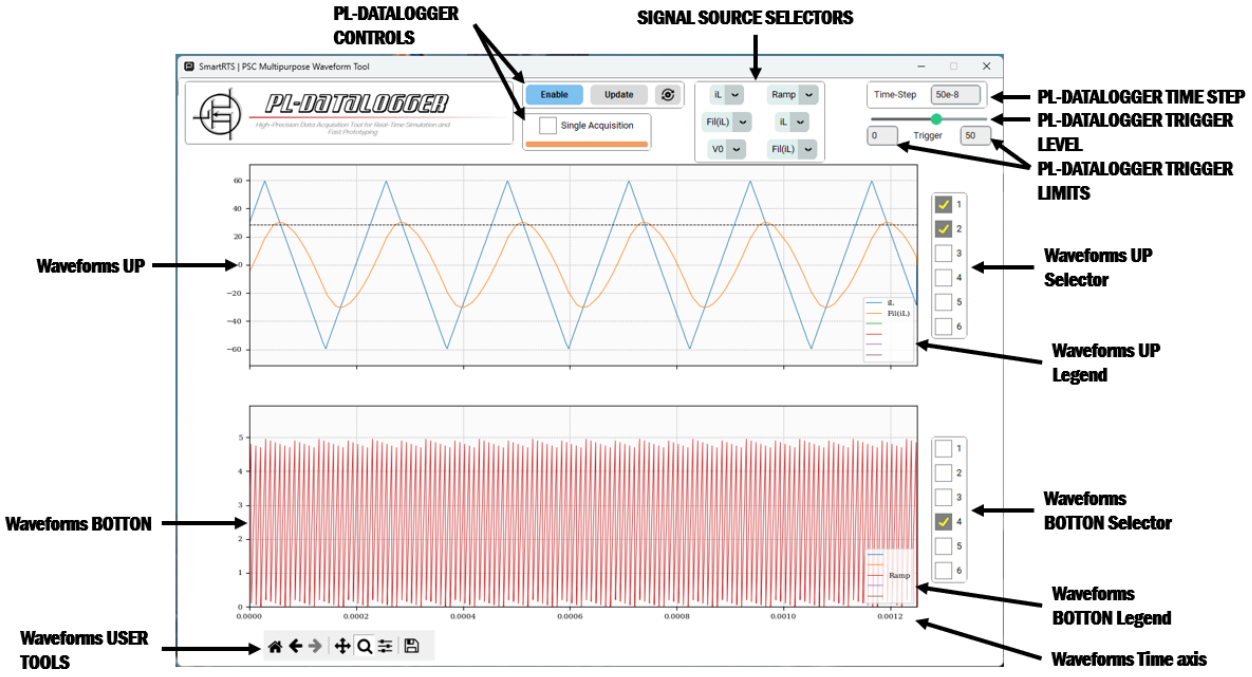

Figure 23: PL-Datalogger application window.

3.2 Configurable parameters and controls

The PL-Datalogger control panel offers several options to manage and customize data captures:

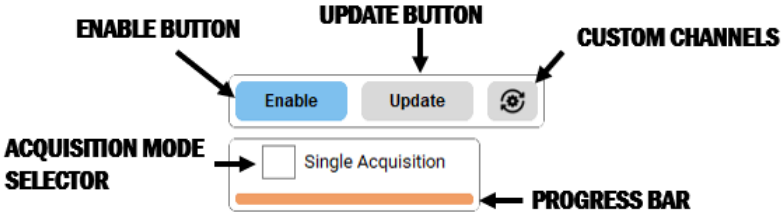

Figure 24: Main PL-Datalogger control panel.

- **Enable.** This button initiates the data capture process using the last parameters configured by the user. The mode in which the datalogger will acquire the information will depend on the selected acquisition mode.
- **Update.** This button will send to the SmartRCP the parameters according to the most recent user-defined settings. It is essential to press this button after making any changes to the settings for them to be applied to the system.
- **Customize channels.** This button allows the user to assign custom names to the connected input signals during the design in Vivado. This facilitates the identification of signal sources during monitoring and data capture. The changes made will not take effect until you click on the "OK" update button at the bottom of the pop-up window.

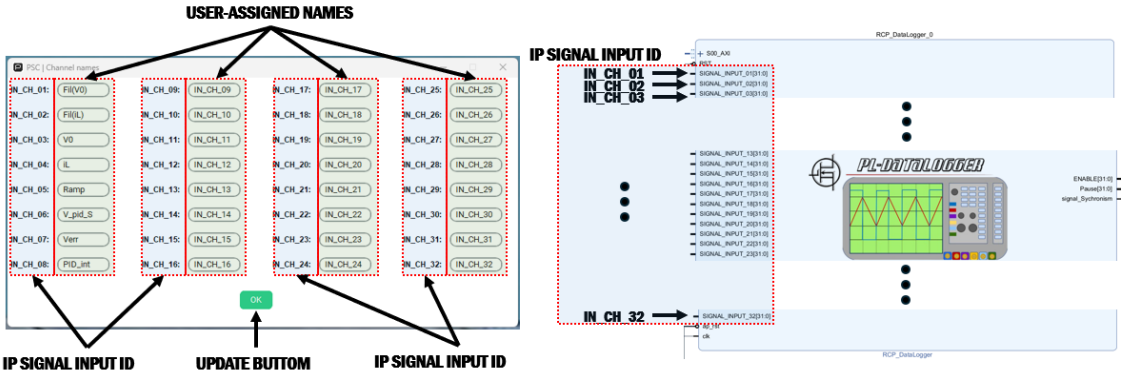

Figure 25: Relationship between channel naming in the application vs. the FPGA..

- **Acquisition mode.** This switch allows to alternate between two operating modes:
  - Continous capture mode. The datalogger will continuously capture and display 2500 samples per channel. The data will be updated periodically and the capture will continue until the user deactivates the process by pressing the "Disable" button.
  - Single capture mode.In this mode, the system captures 15000 samples per channel, spaced according to the value of the sampling time parameter (Time Step). After capturing the samples, the process stops and the user can view the static data. A progress bar below the selector will show the progress of the capture.

- **Signal source.** The PL-Datalogger has 32 signal inputs, but can only capture and display up to 6 channels simultaneously on the two available graphs. This implies that the signals are multiplexed, i.e. the user must select which signals to display on each channel.

  Each channel of the graphs can be configured by means of drop-down lists (Fig. 26), which allow selecting the signal to be monitored. The names that appear in these drop-down lists will be those that the user has previously customized in the "Custom Channel" option, available in the PL-Datalogger control.

  For the selections or changes in the data sources associated with each channel to take effect, it is imperative that the user clicks on the "Update" button on the PL-Datalogger controls. Only then will the signals visible in the capture plots be updated.

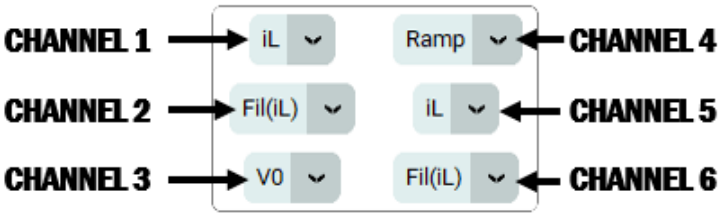

Figure 26: Drop-down menu for the channel selector.

  It is important for the user to note that the signal selected as the trigger source must be set to channel 1.

  All changes made to the signal source selection for each channel will be automatically saved when the user decides to save the configuration. These settings will be available again when loading previous configurations.

- **Time-step and trigger.** The following parameters directly affect the operation of the PL-Datalogger IP:

  The Time-Step represents the time interval that elapses between each sample acquisition in the PL-Datalogger IP. The minimum time that can be set is 50 ns (5E-8s) between samples. It is important to note that any changes made to the Time-Step value will not take effect until the parameters are updated. To do this, the user must click on the "Update" button at the PL-Datalogger controls.

  The time axis of the waveform plots depends directly on the Time-Step value. In continuous acquisition mode, the values will range from 0 to Time-Step * 2500, while in single acquisition mode, the range will be from 0 to Time-Step * 15000.

  The trigger level is the level that will be used to synchronize the start of data acquisition on the PL-Datalogger IP. The data acquisition will start when the signal configured on channel 1 crosses this level. To adjust the trigger level, a control is used to move the level (Fig. 27), which will be represented on the waveforms up graph as a dashed dotted line.

  For ease of use, the user can define a maximum and a minimum limit within which the trigger level can be adjusted. It is important to note that changes to the limits or trigger control will not take effect until the user clicks on the "Update" button available in the PL-Datalogger controls.

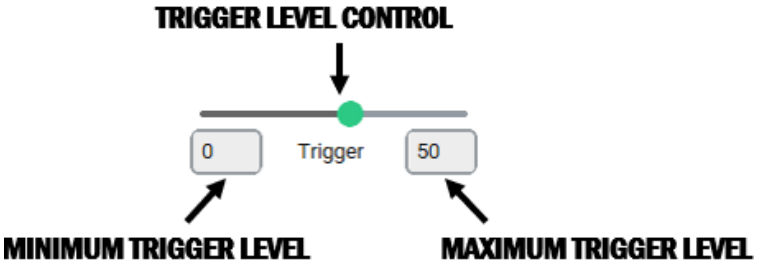

Figure 27: Trigger options.

All changes made to the Time-Step and Trigger Level will be stored when the user saves the settings. These settings will be available when loading old configurations.

- **Waveform selector and legend.** Each of the waveform plots, called Waveforms UP and Waveforms BOTTOM, has its own selector (Fig. 28). This selector allows the user to customize the data displayed on the screen by choosing which channels are represented and in which of the plots they will be displayed. To make the selection, the user must click on the selector of the channel to be displayed. This change will be reflected in the legend, where the color corresponding to the waveform of each represented channel will be indicated. The channel selection will be stored when saving the configuration and will be available when loading previous configurations.

Figure 28: Waveform selector panel.

- **Plot visualization options.** These tools allow the manipulation of waveform plots, facilitating tasks such as zooming in on specific areas, moving plots and saving waveforms according to the user's needs.

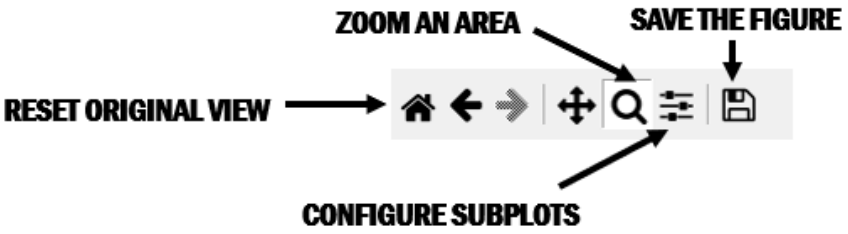

Figure 29: Plot visualization options.

4 Connection process between SmartRCP platform and the Interface

4.1 Configuration of the Ethernet Communication

The connection configuration is defined in a file called PSC_TCP.txt , which is located on the µSD card of the SmartRCP . This file contains the following parameters:

- PSC_TCP_IP_ADDR ="xxx.xxx.xxx.xxx.xxx": IP address assigned to the SmartRCP.
- PSC_TCP_IP_MASK ="xxx.xxx.xxx.xxx.xxx": Subnet mask.
- PSC_TCP_IP_GW_ADDRESS ="xxx.xxx.xxx.xxx.xxx": Gateway address.
- PSC_TCP_ETH_MAC="xx.xx.xx.xx.xx.xx.xx": MAC address of the device.
- PSC_TCP_AUTO_con ="Y": Indicates the connection mode (automatic or direct).
- PSC_RCP_ID="zzzzzzzzzz": SmartRCP identifier.

The connection mode is defined by the value of the PSC_TCP_AUTO_con variable. When this is set to "Y", the SmartRCP will use the automatic connection via the router. If the value is "N" the connection will be manual.

Manual connection. The SmartRCP is connected directly to the user's computer via an Ethernet cable, or via a switch. To properly configure the manual connection between the computer and the SmartRCP, you must edit the parameters in the PSC_TCP.txt file located on the SmartRCP µSD card. Specific steps to ensure that the configuration is correct are detailed below:

1. Modification of the PSC_TCP.txt file in the µSD: Insert the SmartRCP µSD card into your computer and open the PSC_TCP.txt file. Change the value of the PSC_TCP_AUTO_con parameter to "N", to select the direct connection.

2. Configuration of the SmartRCP IP address: In the PSC_TCP.txt file, make sure that the value in PSC_TCP_IP_ADDR is the IP address you want to assign to the SmartRCP. Verify that the PSC_TCP_IP_MASK (subnet mask) and PSC_TCP_IP_GW_ADDRESS (gateway) parameters are correctly configured consistent with the network to which you are connecting the SmartRCP. These must match the IP address structure of your computer.

3. Configuration of the IP address of the computer: Make sure that the IP address of your computer is on the same network as the SmartRCP, but is not the same as the one configured in PSC_TCP_IP_ADDR. For example, if the SmartRCP has the address 192.168.1.100, configure the computer with an address such as 192.168.1.101. Keep the same subnet mask (PSC_TCP_IP_MASK) and gateway (PSC_TCP_IP_GW_ADDRESS) on your computer to communicate correctly with the SmartRCP.

4. Physical connection: Connect the SmartRCP to your computer using an Ethernet cable or, if necessary, use a switch as an intermediary.

5. Configuration in the SmartRCP software interface: When opening the SmartRCP software interface on your computer, enter the IP address you configured for the SmartRCP in the

IP address field of the interface. These steps ensure that both the SmartRCP and the computer are correctly configured to communicate on the same local network through a direct connection. For this type of connection, the computer must have an Ethernet port to which the cable can be connected. If your computer does not have a built-in Ethernet port, you must use a USB Ethernet adapter to establish the connection to the SmartRCP. Without this physical connection, it will not be possible to establish communication between the computer and the SmartRCP using this method.

Automatic connection. In this type of connection, the router acts as an intermediary between the computer and the SmartRCP. The connection can be fully automatic, where the SmartRCP negotiates with the router and receives a dynamic IP address within the range of IPs that the router assigns. This assignment depends on the MAC address of the SmartRCP, so it is crucial that, if several SmartRCPs are connected to the same router, they have different MAC addresses to avoid conflicts.

To enable this connection method, you must:

1. Modify the PSC_TCP.txt file on the SmartRCP µSD card.
2. Make sure that the parameter PSC_TCP_AUTO_con is set to "Y".
3. Connect the SmartRCP to the router using an Ethernet cable.
4. Turn on SmartRCP.

The router will automatically assign an IP address to the SmartRCP.

Advantages of this method:

- It does not require a direct connection between the computer and the SmartRCP. This allows the SmartRCP to be controlled from any computer connected to the same local network, either by Wi-Fi or Ethernet.
- It is possible to control the SmartRCP from remote locations if the router is configured as an exit node and a VPN is used to create a virtual local network, which extends the accessibility of the SmartRCP beyond the direct local network.

4.2 Connection Status Verification.

To verify whether the SmartRCP is correctly connected to the network, either by a direct connection or through a router, you can ping the IP address assigned to the SmartRCP. This method is applicable for both types of connection (manual or automatic).

Procedure:

1. Open the CMD console on your computer: To do this, press the Win + R keys, type cmd, and press Enter.
2. In the console, type the following command: ping [SmartRCP IP address].

   Replace [SmartRCP IP address] with the IP address assigned to the device, either manually or automatically, depending on the type of connection configured. Example: ping 192.168.1.100
3. If the connection is successful, you will receive a response indicating the latency times, as in the following example: Response from 192.168.1.100: bytes=32 time=2ms TTL=64
4. If there is no connection, you will receive a message like: This application has timed out.

4.3 SmartRCP connection troubleshooting.

If the ping result (previous section) indicates that the SmartRCP IP address cannot be reached, follow these steps to fix the problem:

1. Verify the Connection Configuration: Make sure that the connection steps have been performed correctly.
2. Check the Local Network: Make sure that both the computer and the SmartRCP are within the same local network. This includes verifying that both devices have IP addresses in the same range.
3. Check the Ethernet cable: Make sure that the Ethernet cable is securely connected to both the SmartRCP and the computer or router. Also check that the cable is not damaged.
4. Confirm the µSD Card: Verify that the µSD card is correctly inserted in the SmartRCP reader. Make sure that it contains the correct configuration file (PSC_TCP.txt) and that the connection parameters are properly configured.
5. Restart the Devices: If after performing all the checks the connection still fails, try restarting both the SmartRCP and the computer.
6. Verify IP Addresses: If a static IP address is being used, make sure there are no conflicts with other addresses on the network. Verify that the SmartRCP IP address is not being used by another device.

4.4 Process to obtain the IP adress through serial port

When a router establishes connection with a device, it usually assigns the same IP address to a device that has the same MAC address. If a SmartRCP connects to the router in automatic mode for the first time, the user may not know the assigned IP address. Although the router can be accessed to verify this information, it often requires credentials that the user may not have.

If it is not possible to access the router, there is an alternative method to obtain the IP address of the SmartRCP through the serial connection. Follow these steps:

1. Physical Connection: Connect the SmartRCP to your computer using a USB type B cable. Connect the USB type B end to the SmartRCP and the other (regular) USB end to an available port on your computer.
2. COM port identification: Once the SmartRCP is powered on, access the Device Manager on your computer to identify which COM port has been assigned to the SmartRCP. You should see two new ports when you turn on the device. Take note of the COM port with the lower number.
3. Connection to the Serial Console: Use a serial console program such as PuTTY, Tera Term, or MobaXterm to connect to the SmartRCP. Set the connection to baudrate115200.
4. SmartRCP restart: If you have loaded a boot.bin file on the µSD card, simply make sure that the program is running correctly and the reset button. If you are programming from Vitis, load the program back on the board.
5. Display of the IP address: Once rebooted, the serial console will display the IP address that the router has assigned to the SmartRCP. This IP address will generally remain constant as long as the MAC address is not changed.

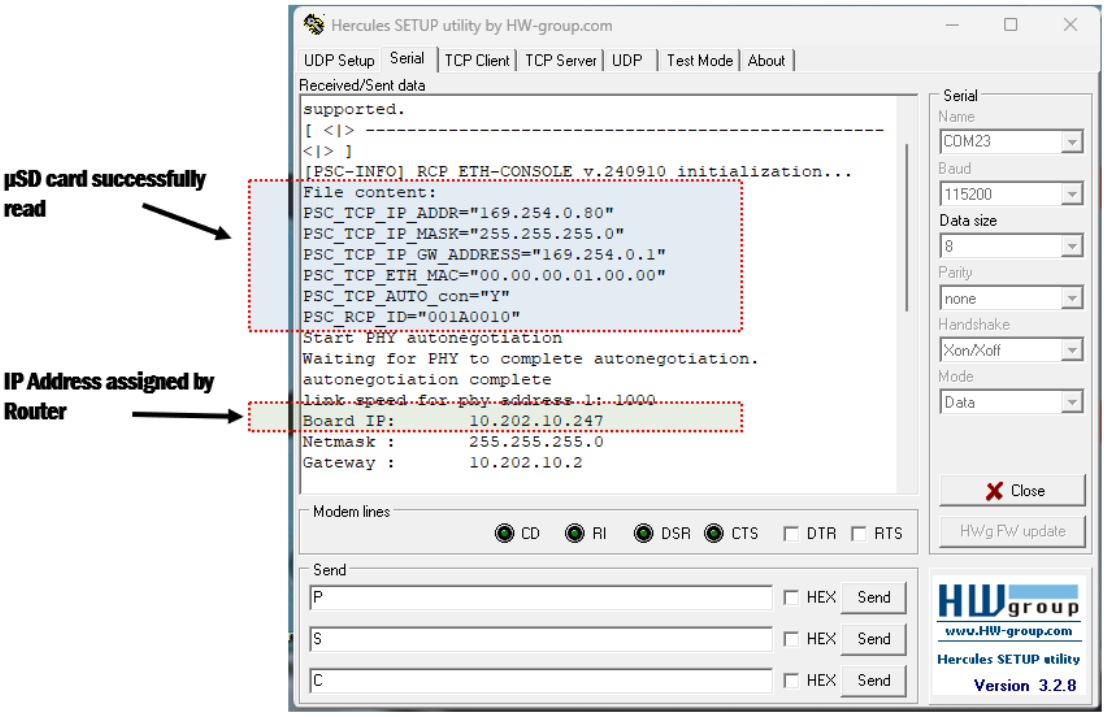

Figure 30: Information sent by the SmartRCP trough the serial port.

5 Frequent problems with the SmartRCP Interface

5.1 Conflict with antivirus software

On some computers, depending on the antivirus installed, a conflict may arise when starting the SmartRCP application (.exe file). Often, a message appears indicating a possible threat, as the software requires access to public networks (Ethernet), which may be perceived as risky by the antivirus. The behavior of the antivirus may vary:

- In some cases, the user will be asked for confirmation to run the program if he/she trusts its origin.
- In other cases, the file may be blocked or deleted automatically, depending on the antivirus settings.

There are three possible solutions to solve this problem:

1. Classify the Software as Secure: Access the antivirus settings and classify the SmartRCP program as safe or trusted. This is the recommended method, but may not be available to all users, as in some companies antivirus settings are restricted and require special permissions.
2. Temporarily disable the Antivirus: Disable the antivirus for a few seconds while starting the application. Once the software is running, re-enable the antivirus. This usually resolves conflicts without major problems.
3. Execute the program with Administrator permissions: Try to run the SmartRCP program as an administrator. However, this method is not always effective and its operation depends

on the type of antivirus installed. Of the three options, the most recommended is the first one, whenever possible, since classifying the program as safe avoids future conflicts without compromising the antivirus protection of the system.

5.2 Display of the SmartRCP Interface

To ensure correct display of the SmartRCP software interface, the screen scaling must be set to 100%. Any other scaling setting may cause the interface structure to be deformed, which could affect the usability of certain controls or make them inaccessible.

5.3 Supported operating systems

Currently, the SmartRCP interface software executable application is only available for Windows operating systems. If you require a solution compatible with another operating system, please contact us via email at info@powersmartcontrol.com or visit our website at www.powersmartcontrol.com for more information or assistance.