Rev. 5 - December 23rd, 2020

N1081A

NIM Four-Fold Programmable Logic Unit

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Tools for Discovery

User Manual
UM7385

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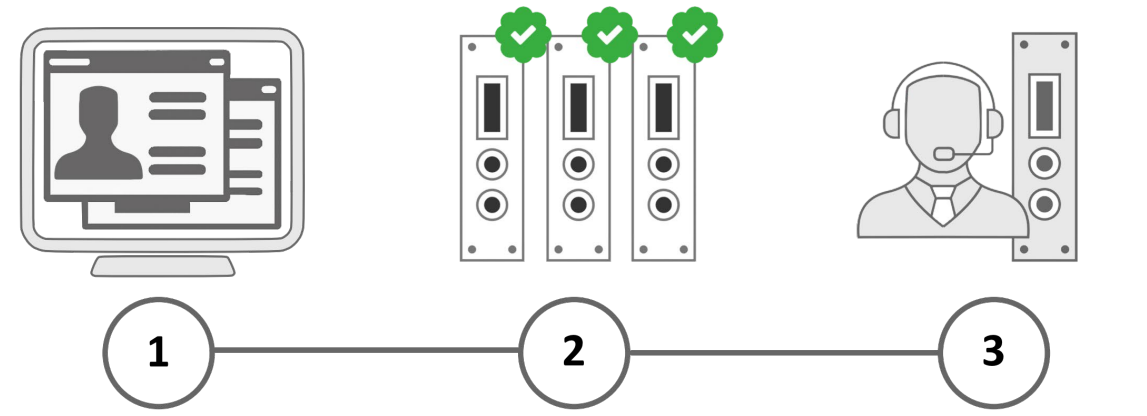

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Purpose of this User Manual

This User Manual contains the full description of the N1081A Four-Fold Programmable Logic Unit and a brief guide to the use of its touch-screen interface and web application.

Change Document Record

Date	Revision	Changes
March 11th, 2020	00	Initial release
June 17th, 2020	01	Updated Chap. **Panel Description**, **Quick Start** and **Web Interface**
September 25th, 2020	02	Revised **Technical Specifications**
November 11th, 2020	03	Revised information about the voltage threshold input stage
December 4th, 2020	04	Revised **Panel Description**
December 23rd, 2020	05	Revised ordering option

Symbols, abbreviated terms and notation

FPGA	Field Programmable Gate Array
OS	Operating system

Reference Document

[RD1] DS7230 – N1081A datasheet

CAEN S.p.A.
Via Vetraia, 11 55049 Viareggio (LU) - ITALY
Tel. +39.0584.388.398 Fax +39.0584.388.959
info@caen.it
www.caen.it

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1 Introduction

The **N1081A –Four Fould Programmable Logic Unit** is a laboratory tool that incorporates in a single **NIM** module the most common functionalities that you need to implement the **logic capabilities** of your experiment.

The module is organized in four sections, with 6 inputs and 4 outputs each (selectable impedance) accepting TTL/NIM signals. Each section is configurable independently according to one of the available pre-programmed functions, like scaler, counter, time stamping, digital pulse generator, etc. The section programming can be done using the 2.8" touch screen display or via the web-interface. Each section integrates a programmable voltage threshold for analog input signals and an asynchronous Gate&Delay. This allows the user to trim at best the needed parameters and to perform accurate measurements.

On the **touch screen** interface, each function is associated to a widget, for quick configuration and monitor purposes, and an online help with cabling instructions is directly accessible on the display.

The **web-interface** allows the user to remotely configure the instrument, monitor the functions output, dump data on file or history chart and access to the most advanced features, like the logic analyser and the configuration of advanced functions. No software installation is required! Using the Web Interface is possible to configure the four sections, view the function output, dump data on file and access extra information not supported by the touchscreen display. For example, it is possible to view the history on chart, reset the output value and access the logic analyser to monitor all I/Os on chart. Thanks to Ethernet connectivity, all these operations can be performed far from the unit.

Available board models and accessories are listed below.

Board	Description	Product Code
N1081A	N1081A – Four Fold Programmable Logic Unit	WN1081AXAAAA

Table 1.1: table of available board models.

2 Technical Specifications

General	**Form Factor** - 2U NIM module	
Power consumption	1.5 A @ 12 V (Typ.)	
Logic Functions	Logic Gates (AND/OR/Majority, …) Fan IN-OUT Gate&Delay Veto Coincidence Scaler, MCS Rate Meter Counter Timer Timing (timestamping, ToF, ToT) Digital Pulse Generator	
N. of Sections	4	
Input	6 NIM/TTL per section	• Programmable Voltage Threshold • Gate&Delay 5ns resolution
Output	4 NIM/TTL per section	
I/O delay	20 ns	
CONNECTORS	LEMO	
Counter max. frequency	30 MHz TTL 40 MHz NIM	
Pulse Generator	NIM/TTL Max. frequency 10 MHz / 20 ns pulse width	
Integration Gate	1 µs ÷ 3600 s	
Connectivity	Ethernet (1Gbps) , USB 2.0	
Touch Screen Display	2.8” LCD, Transmissive type	
Software	- **Touch screen** widgets - **Web-based** Graphical User Interface	

Table 2.1: technical specifications for the N1081A

3 Packaging and compliancy

The N1081A is housed in a double-width NIM unit.

Figure 3.1: general view of N1081A.

Figure 3.2: side view of N1081A.

The user is equipped with a standard Ethernet and USB 2.0 communication cable.

Figure 3.3: Ethernet and USB 2.0 cable included in the delivered kit.

CAUTION: to manage the product, consult the operating instructions provided.

A POTENTIAL RISK EXISTS IF THE OPERATING INSTRUCTIONS ARE NOT FOLLOWED!

CAUTION: this product needs proper cooling.

USE ONLY CRATES WITH FORCED COOLING AIR FLOW SINCE OVERHEATING MAY DEGRADE THE MODULE PERFORMANCES!

CAUTION: this product needs proper handling.

THIS MODULE DOES NOT SUPPORT LIVE INSERTION (HOT SWAP)!
REMOVE OR INSERT THE BOARD WHEN THE CRATE IS POWERED OFF!

ALL CABLES MUST BE REMOVED FROM THE FRONT and REAR PANEL BEFORE EXTRACTING THE BOARD FROM THE CRATE!

CAEN provides the specific document "Precautions for Handling, Storage and Installation" available in the documentation tab of the product web page that the user is mandatory to read before to operate with CAEN equipment.

4 Power Requirements

The table below resumes the typical power consumption per relevant power supply voltage.

MODULE	SUPPLY VOLTAGE
N1081A	1.5 A @12 V

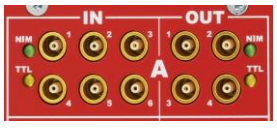
Tab. 4.1: Power requirements table

5 Panel Description

Figure 5.1: Front and rear panel view of N1081A

Front Panel

IN/OUT



FUNCTION

Digital I/Os (section A in the picture)

ELECTRICAL SPECS

NIM/TTL, 50 Ω/1 kΩ

MECHANICAL SPECS

LEMO connectors

Touch Screen Display

FUNCTION

Touch Screen Display for unit configuration and monitoring

MECHANICAL SPECS

2.8” LCD, Transmissive Type

DIAGNOSTIC LEDs

TTL (YELLOW): indicates the standard TTL is set for I/Os

NIM (GREEN): indicates the standard NIM is set for is set for I/Os

OFF (input): analog signal input

Rear Panel

CLOCK IN/OUT

FUNCTION

Digital I/O connectors (BNC) to synchronize the internal clock PLL with an external clock source.

ELECTRICAL SPECS

CLOCK IN: 25 MHz, 3.3V, 50 Ω impedance

CLOCK OUT: 25 MHz, 3.3V, 50 mA

USB PORT

FUNCTION

USB connector for data readout and flow control.

ELECTRICAL SPECS

Standard: compliant to USB 2.0 and USB 1.0.

Transfer rate: up to 30 MB/s.

MECHANICAL SPECS

Series: USB connectors.

Type: 787780-2 (B-Type).

ETHERNET PORT

FUNCTION

1Gbps Ethernet connector for data readout and flow control.

ELECTRICAL SPECS

Standard: compliant to 1Gbps Ethernet

MECHANICAL SPECS

Not available.

6 Functional Description

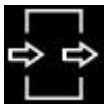
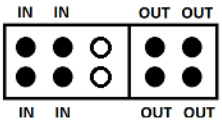
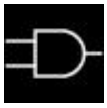
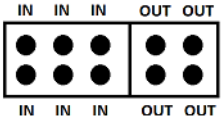
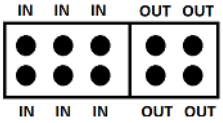
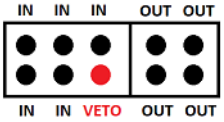
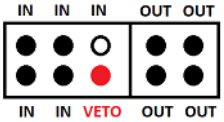
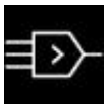
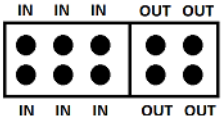
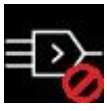
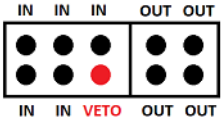
The N1081A is capable of operating as a Logic Unit according to the chosen function among the available ones (scaler, counter, rate meter, pulse generator, timestamping, …).
It is divided into 4 independent sections, each hosting 6 NIM/TTL IN and 4 NIM/TTL OUT. In this way it is possible to attain up to 4 different logic functions working simultaneously in a single module.
The N1081A hosts a 2.8" touch screen LCD for configuration and monitoring. The available logic functions are pre-programmed and listed in the main menu, together with an online help to briefly summarize their operational principle. Thanks to USB2.0 and Ethernet connectivity, the module can be remotely controlled through a web interface, allowing access to the most advanced features.

Available Functions

In the following we list all the functions available on the N1081A, with a brief explanation of their operation, the correspondent logo on the GUI and the usage of the board's I/Os in each configuration .

Note: refer to **Quick Start** and to the online help for more information about how to set each of the available function.

Logic Gates

FUNCTION	LOGO	I/Os map	DESCRIPTION
WIRE			The signal on the output channel is equal to the input. According to the set configuration, it is possible to use this function as a NIM/TTL translator.
AND			The AND function generates at the four output channels a signal corresponding to the logic AND of the enabled inputs. As a result, the output signals are logic-high signals only if all the enabled inputs are logic-high signals.
OR			The OR function generates at the four output channels a signal corresponding to the logic OR of the enabled inputs. As a result, the output channels signals are logic -high signals if at least one of the enabled input is a logic high signal.
OR+VETO			The OR+VETO function generates at the four output channels a signal corresponding to the logic OR of the enabled inputs. The output signals are logic high if at least one of the enabled input is a logic-high signal and the veto signal is a logic-low signal.
VETO			The VETO function generates as output a logic-low signal when the veto is a logic-high signal and a signal equal to the input when the veto is a logic-low signal.
MAJORITY			The MAJORITY function generates at the four output channels a signal corresponding to the logic MAJORITY of the enabled inputs. As a result, the output channels signals are logic-high signals when the majority of the enabled inputs is logic-high.
MAJORITY + VETO			The MAJORITY+VETO function generates at the four output channels a signal corresponding to the logic MAJORITY of the enabled inputs. The output channels signals are logic-high when the majority of the enabled inputs is logic-high and the veto is a logic-low signal.

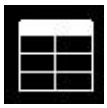
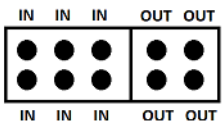
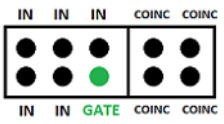
LUT			A lookup table (LUT) defined by the user specifies the output signals depending on the input signals. The lookup table can be provided as a file containing a list of all the desired input/output signals combinations.
COINCIDENCE			The COINCIDENCE function detects the time coincidence between input signals. When a coincidence occurs inside a specified GATE, a pulse is generated at the correspondent output channel. It is also possible to operate in anti-coincidence mode.

Table 6.1: Logic Gates functions available on the N1081A

Counters/Timers

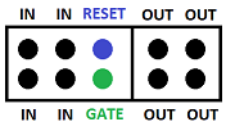
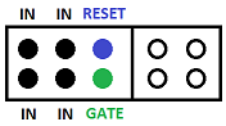
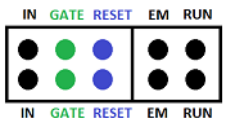
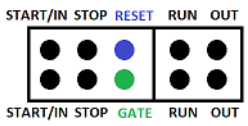
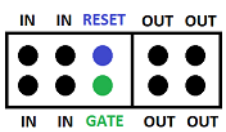
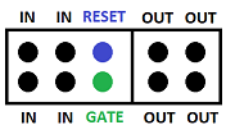
FUNCTION	LOGO	I/Os map	DESCRIPTION
SCALER			The SCALER function acts on the enabled input channels as a frequency divider. The output channel signal frequency is equal to the correspondent input channel scaled by a user-defined factor. The number of pulses at output channels is counted. Input channel 3 is reserved for the RESET signal: when it is logic-high, all counters are reset. Input channel 6 is reserved for the GATE: if enabled, the output signals are generated only when the gate is logic-high.
COUNTER			The COUNTER function counts the pulses on the enabled input channels. Input channel 3 is reserved for the reset signal: when it is logic-high signal, all counters are reset. Input channel 6 is reserved for the gate: if enabled, the input channels signals are counted only when the gate is logic-high.
COUNTER TIMER			The COUNTER TIMER function has different operating counting modes using conting targets or time window. The outputs 1 and 3 are the end mark (EM): they are logic-high when the target value is reached or the time window is ended. The outputs 2 and 4 are RUN signals: they are logic- high if the board is counting the input pulses.
CHRONOMETER			The CHRONOMETER function measures time intervals in GATE or START/STOP mode. Input channel 3 is reserved for the RESET signal: when logic-high, the measured time is set to zero. Input channel 6 is reserved for the GATE signal: when enabled, the time is measured only if the gate is logic-high. When the module is measuring a time interval, the correspondent output channel 1/3 is logic-high (RUN) and the output channel 2/4 (OUT) generates a signal with a defined frequency.
RATE METER			The RATE METER function measures the frequency of the enabled input channels. Input channel 3 is reserved for the RESET signal: when logic-high, the frequency measurement on all input channels is reset. Input channel 6 is reserved for the GATE signal: if enabled, the input frequencies are measured only when the gate is logic-high.
ADVANCED RATE METER			The ADVANCED RATE METER acts exaclt as the RATE METER function with additional features: it is possible to choose the time interval for the frequency measurement and measure the frequency using the average between multiple values. It is also possible to set a threshold on the measured rate for each input channel: if the rate exceeds it, the correspondent output channel signal is logic-high (ALARM).

Table 6.2: Counters/Timers functions available on the N1081A

Timing

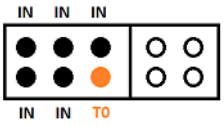
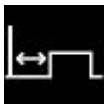
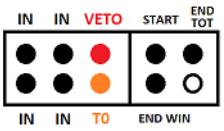
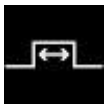
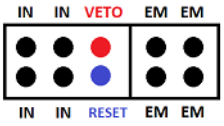
FUNCTION	LOGO	I/Os map	DESCRIPTION
TIME TAGGING			The TIME TAGGING function measures the time of arrival of the enabled input channels with respect to a common T0 signal. The function generates a file containing a list of time-stamped events.
TIME OF FLIGHT			The TIME OF FLIGHT function generates, for each input channel, a histogram of the signal time of arrival with respect to a common T0 signal. Each histogram is obtained by counting the number of pulses on each input arriving in a defined time window: the first window is opened by the T0 and the subsequent ones start when the previous window closes. When a time window ends, a pulse is generated at the output channel 3, while a pulse is generated at the output channel 2 at the end of the last window.
TIME OVER THRESHOLD			The TIME OVER THRESHOLD function generates, for each input channel, a histogram of the signals time length. Each histogram is obtained by measuring the ToT (Time over Threshold) of each incoming signal and counting the number of signals whose length falls in a defined time window. The output channels 1,2,3 and 4 (EM) generate a pulse when a signal length measurement is added to the histogram.

Table 6.3: Timing functions available on the N1081A

Digital Pulse Generator

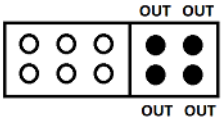
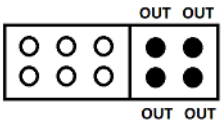
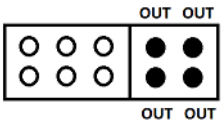
FUNCTION	LOGO	I/Os map	DESCRIPTION
PULSE GENERATOR			The PULSE GENERATOR function generates, at each enabled output channel, the digital signal defined by the user. It is possible to set the type of statistics occurrence between deterministic and poissonian, the frequency and the width of the output signals.
DIGITAL GENERATOR			The DIGITAL GENERATOR function allows to set each output channel to be a logic-low or a logic-high digital signal.
PATTERN GENERATOR			The PATTERN GENERATOR function allows to define the logic state of each enabled output channel and the frequency at which the pattern changes. The pattern can be provided by uploading a file.

Table 6.4: Digital pulse generator functions available on the N1081A

Operating Modes

Module control can take place either locally, assisted by a 2.8" Touchscreen Graphic color LCD display or remotely, via USB 2.0 or 1Gbps Ethernet. Thanks to the 1Gbps Ethernet connectivity, it is possible to set and monitor the instrument, far from the unit, through a Web Interface. USB 2.0 supports virtual Ethernet connectivity and can be used as well for connection to the Web GUI.

Local Control

After insertion of the N1081A in a powered NIM crate, it is possible to switch it on. At power on, the N1081A starts the boot process (about 30 seconds) showing a black screen with logos. Then the FPGA is programmed, and a progress bar appears to show the percentage of the current process. This will take about 5 seconds. In this view it is also possible to see the serial number of the instrument.

Figure 6.1: the touchscreen display of the N1081A during boot process (left) and programming process (right).

When the instrument startup is finished, the *Main Menu* view is displayed (see Figure 6.2). On top, the module serial number is reported, while in the bottom the instrument Ethernet IP address and USB virtual address are visible. The main menu supports the following features:

- the *VIEW* button allows to see the status of the instrument, the function set for each one of the four section, the input and output channels status and the data acquisition.
- the *CONFIGURE* button can be used to choose a function for each section of the N1081A as well as check, change and set all the parameters for the input and output channels and for the function itself.
- the *SETTINGS* button allows to control the Ethernet parameters, to manage the configuration files and to access the instrument version information.

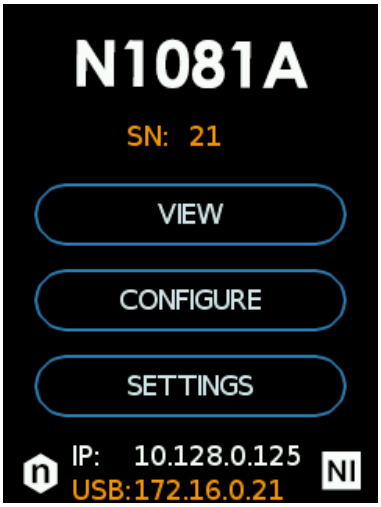


Figure 6.2: the *Main Menu* of the N1081A on the Touchscreen Display.

For information about how to use each tab of the touchscreen to set the module I/Os and functions, refer to Chap. **Quick Start** and to the online help.

Each view of the touchscreen GUI has a top toolbar reporting the title of the view and arrow buttons when it is possible to navigate between subsequent tabs. On the bottom toolbar, in the center, it is always present the *Home* button to go back to the *Main Menu*. When available, the *Close* button allows to close the current view and come back to the previous one. The *Save* button is used to save parameters or files.

Figure 6.3: top and bottom toolbars of the touchscreen GUI.

During the navigation in tabs for the configuration, a thin sidebar on the left of the screen, indicates with its color the correspondent section: red for the first, green for the second, yellow for the third and purple for the fourth.

When navigating to monitor or set a function for a section of the N1081A, an *Info* button is available in some tabs. The *Info* button opens the online help page. This page describes the corresponding function and gives a brief guide to its usage.

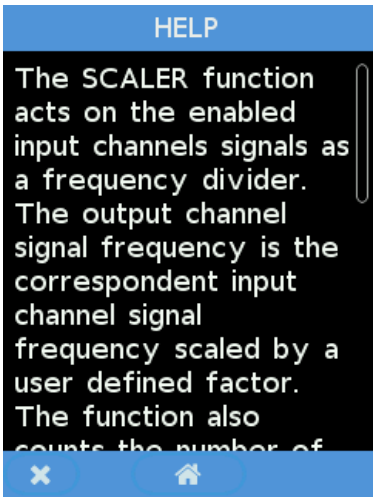


Figure 6.4: the online Help accessible from a configuration tab, explaining briefly how to use the SCALER function

During the configuration of the parameters of a function, it is possible to press the *Keyboard* button (when available), in order to insert values or words in a field,. A numeric or alphanumeric keyboard appears on the screen. The × button deletes the last inserted element, while the ✓ button closes the keyboard.

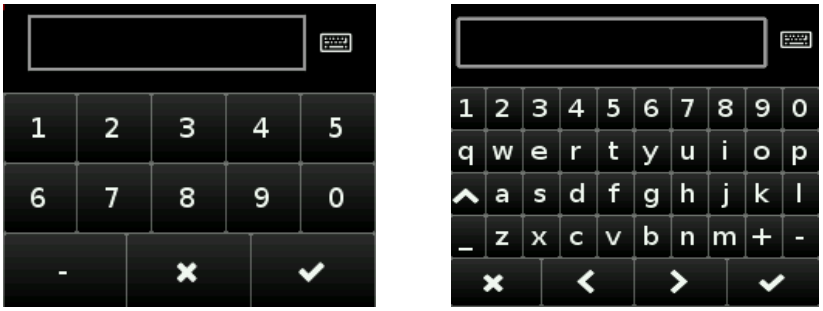


Figure 6.5: keyboards available for some tabs of the touchscreen GUI.

Remote Control

Alternatively to the usage of the touch screen display, it is possible to set and monitor the N1081A via a Web Graphical Interface, which is accessible connecting the instrument via **Ethernet** or **USB (Virtual Ethernet).** The Web Interface allows to have full control of the instrument, with access to advanced features, configuration of those functions which cannot be set on the touch screen, complete monitoring options and the possibility to download measurement on files.

After instrument startup, the *Main Menu* view is displayed (see **Figure 6.2**). On top, the module serial number is reported, while in the bottom the instrument Ethernet IP address and USB virtual address are visible. These addresses can be used to access the Web interface from any device with access to a standard Web Browser.

Note: when connecting via **Ethernet**, the PC Ethernet Network port must be set accordingly to the module IP address in order to reach it via Web Browser. For example, to reach default IP 10.128.0.125, the Ethernet port of the PC could be set with static IP 10.128.0.1

Note: if using **USB connection**, please be sure that your PC has **Remote NDIS Compatible Device** driver installed. If not, after connecting the USB, go into the Device Manager, locate the RNDIS device. Then right click → update driver → Browse my computer → Let me pick from a list → Network Adapters. Select Microsoft as manufacturer and Remote NDIS Compatible Device as model. Authorize the installation and the driver should be installed.

By typing the IP/USB address in a Web browser, the Web Interface opens.

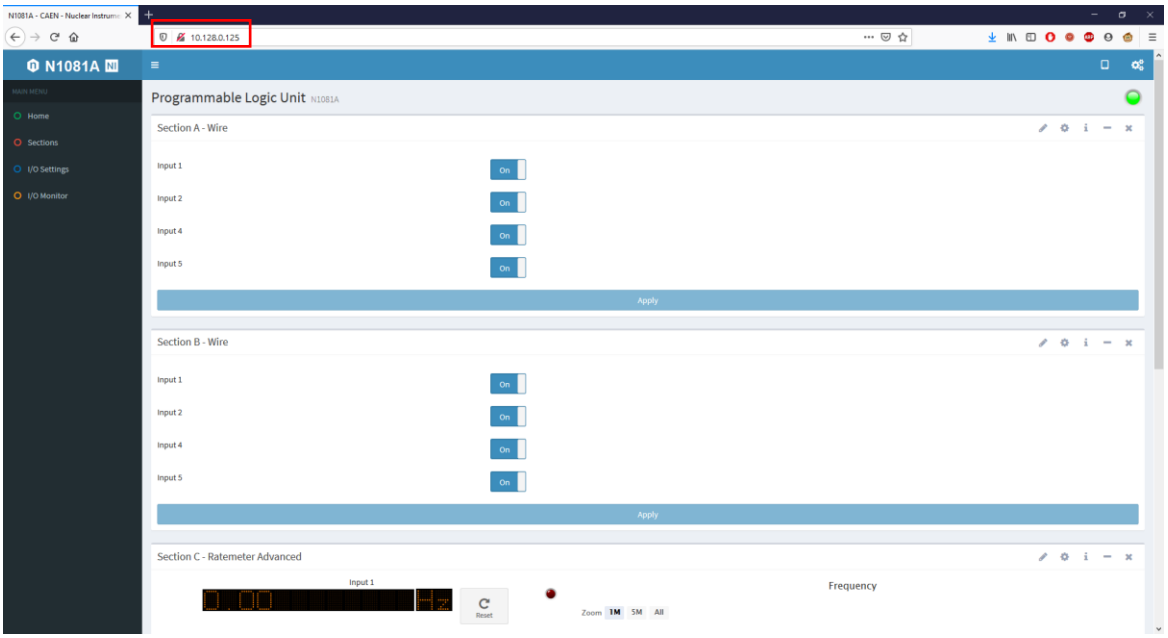


Figure 6.6: general view of the N1081A Web Interface home page. In the Web Browser search tab, the IP address of the N1081A is highlighted.

Refer to Chap. **Web Interface** for more details on the Web GUI usage and operation.

7 Quick Start

In this chapter we describe an operative procedure to use the N1081A via local control. In particular we will describe how to set I/Os, how to set a function and how to monitor the results of an acquisition.

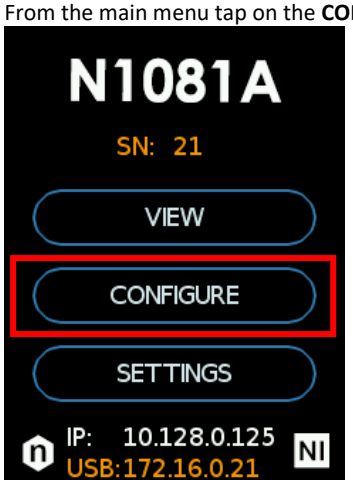
Each section of the N1081A needs to be configured in three aspects:

- Function configuration
- Input settings
- Output settings

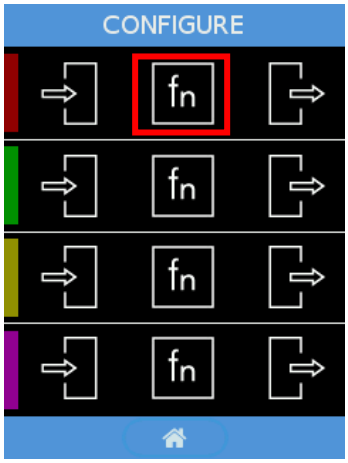
How to configure a function

Follow this step-by-step procedure to configure, for example, a RATE METER for section A of the N1081A:

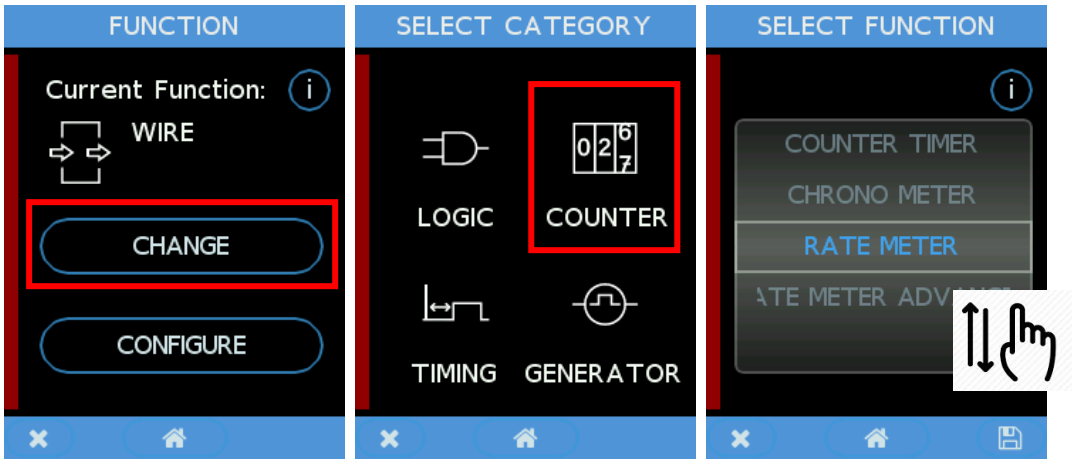
- From the main menu tap on the **CONFIGURE** button



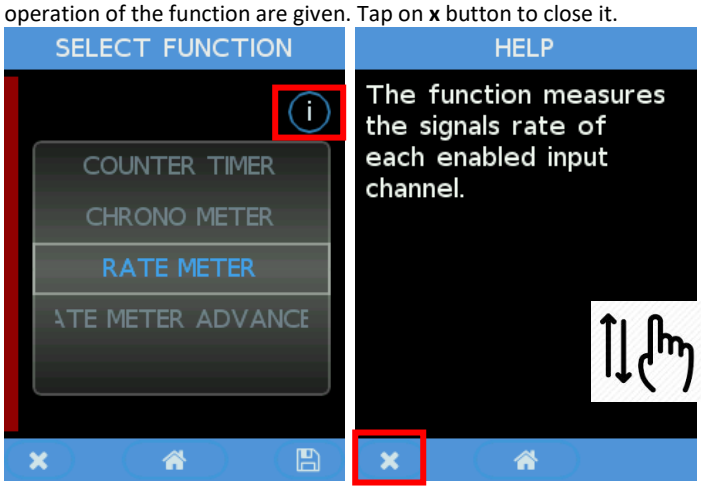
- The subsequent menu is divided in four rows, one for each section of the board, and gives access to the configuration of inputs, function and outputs. Tap on fn button in the top row, to choose a function for section A.



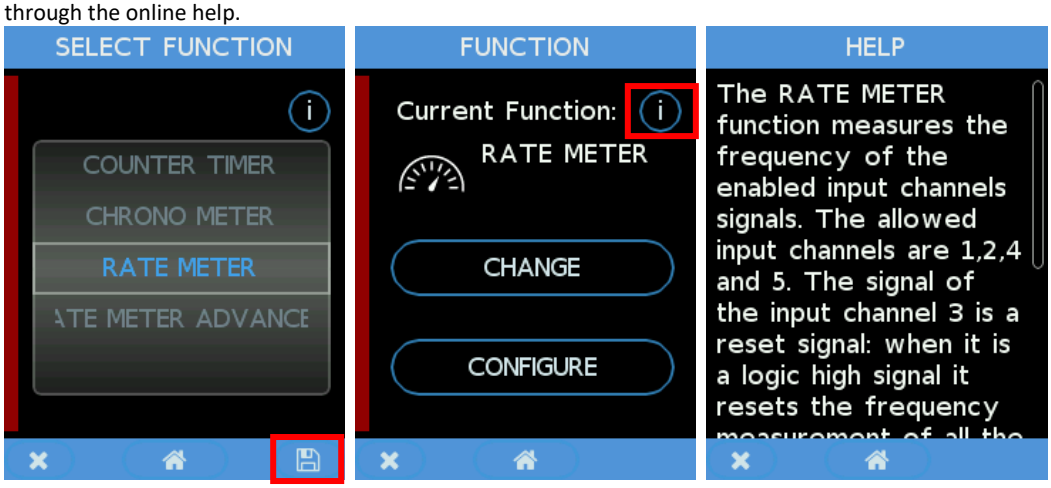
- The currently set function is showed (in this case a WIRE function). It is possible to read the online help about that function, change it or configure the parameters of the currently set function. In this example we want to change it to RATE METER and set the parameters for this function. In order to do this, tap on CHANGE button. Select COUNTER category and then scroll the list of function in the roller menu to select RATE METER.



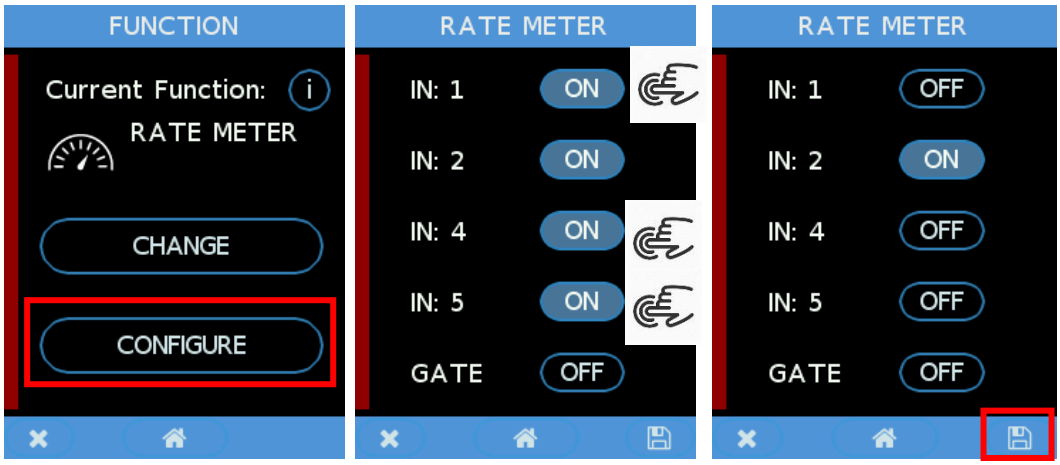
- Before going ahead, it is possible to have a look at the online help for this function. Press the info button to access the online help (scroll on the touchscreen to read all the text if needed). Basic information about the operation of the function are given. Tap on **x** button to close it.



- To confirm the selection of the RATE METER function, tap on the *Save* icon. The GUI will return to the initial view, showing the currently set function. It now possible to access a more complete description of the function through the online help.



- In order to configure the RATE METER parameters, tap on CONFIGURE button. The RATE METER settings menu will open. It is possible to switch ON/OFF the inputs 1,2,4,5 of section A, while input 3 is reserved for a reset signal and input 6 is reserved for the GATE, which can be turned ON/OFF as well. For example, it is possible to leave only input 2 active. To do this, tap on ON/OFF to change the status of the correspondent input. After that, tap on the *Save* icon.



- The RATE METER is now correctly set, it is possible to come back to the Main menu by tapping on the *Home* icon

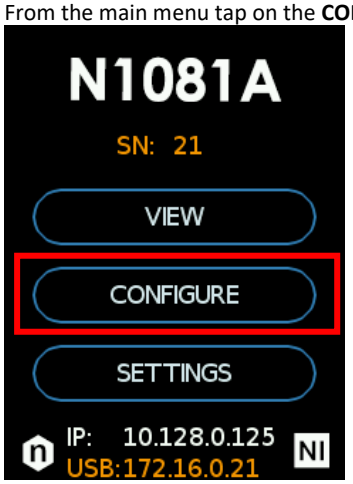
Note: refer to Sec. **Available Functions** and to the online help to understand the operation and the parameters of other functions. Some functions are labeled as WEB ONLY: these can be configured only via web interface (refer to **Web Interface**). For a complete list of the available functions, refer to **Table 6.1**, **Table 6.2**, **Table 6.3**, **Table 6.4.**

How to set the Input

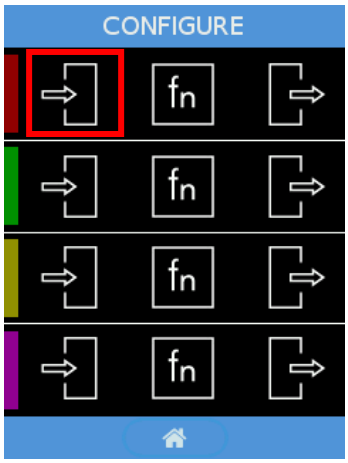
Once the function of a certain section is configured, it is possible to configure the inputs accordingly. In the following we refer to section A, configured as a RATE METER. We are assuming we want to measure TTL signals on input 1 only.

Follow this step-by-step procedure to configure the inputs for section A of the N1081A:

- From the main menu tap on the **CONFIGURE** button

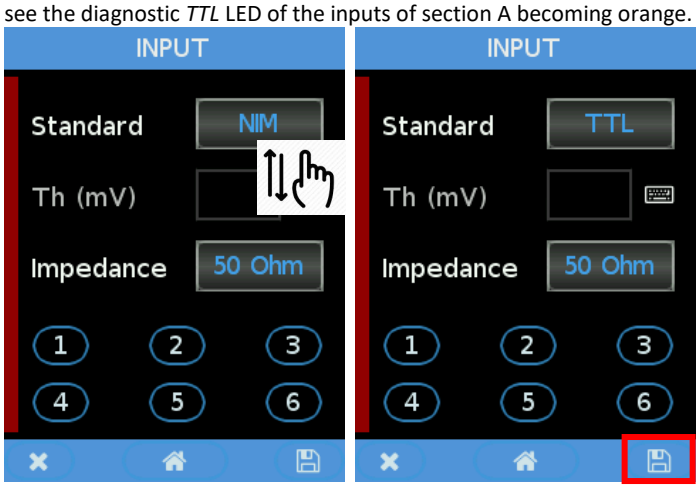


- The subsequent menu is divided in four rows, one for each section of the board, and gives access to the configuration of inputs, function and outputs. Tap on  button in the top row, to configure the inputs of section A.



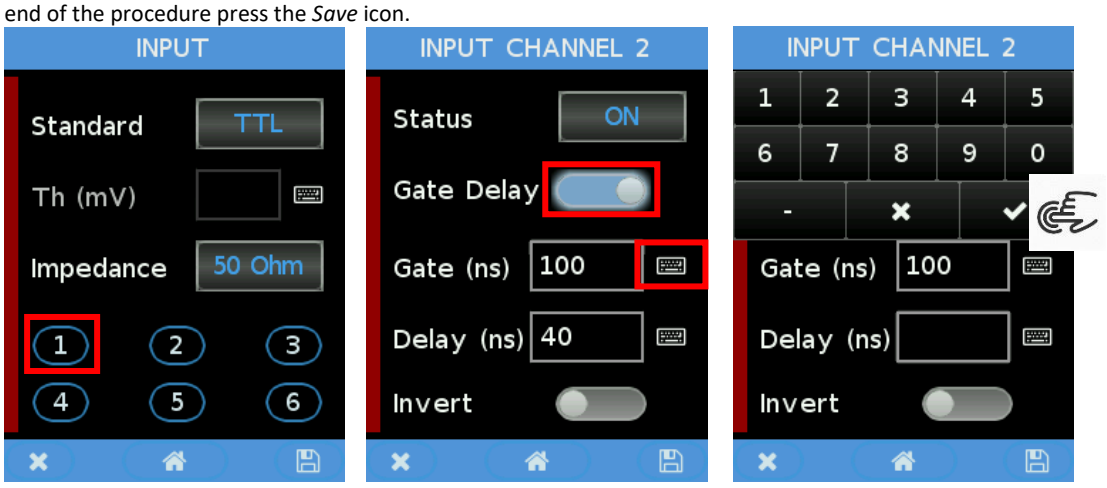
- In the subsequent tab, it is possible to set the general settings for the inputs of section A. It is possible to set the *Standard* (NIM, TTL , DISC) and the *Impedance* (50 Ohm or 1 kOhm) to be used for the input signals. The DISC option allows to discriminate the input signal with a programmable voltage threshold (0-1.8 V range) whose value (in mV) can be defined by inserting the desired number in the *Th* field.

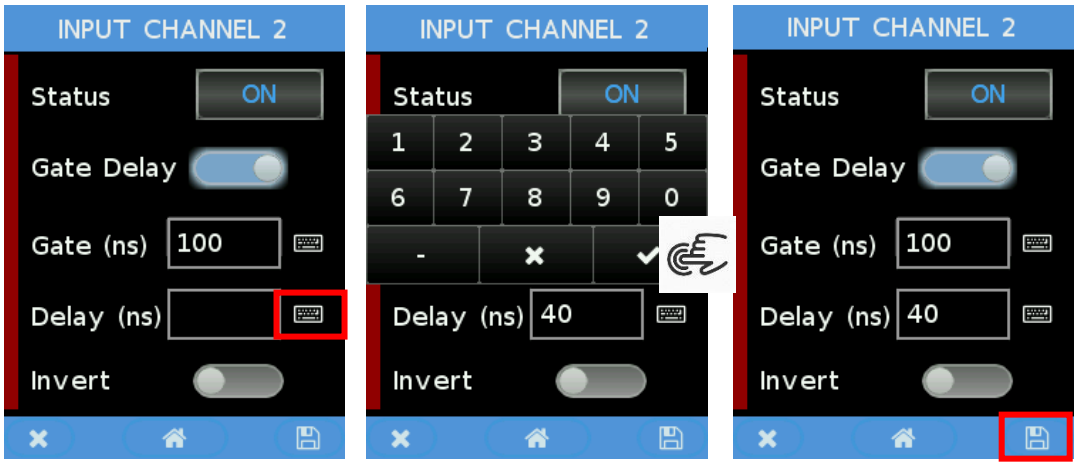
  According to our example, scroll to select TTL and leave 50 Ohm impedance. Tap on the *Save* icon. You should see the diagnostic *TTL* LED of the inputs of section A becoming orange.



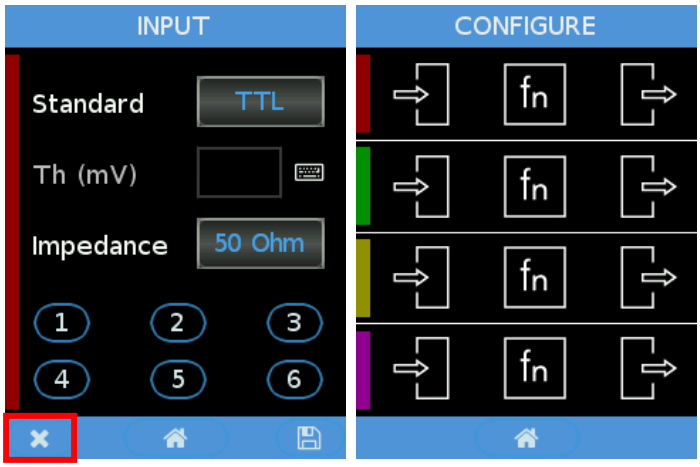
- Now it is possible to set individual parameters for the input channels if needed. By pressing one of the number button, the correspondent input channel view will be opened to set some parameters independently for each input channel. *Status* allows to enable or disable the channel. The lenght and the arrival of the input channel signal could be modified by enabling the *Gate Delay* property and then by defining the *Gate* and the *Delay* values in nanoseconds. The *Invert* property, if enabled, inverts the polarity of the input channel signal.

  According to our example, tap on "2" to set the input parameters for channel 2. In the subsequent tab, enable the *Gate Delay,* and insert 100 ns for the gate and 40 ns for the delay by pressing on the *Keyboard* icon. At the end of the procedure press the *Save* icon.





- It is now possible to close the subsequent tab in order to come back to the CONFIGURE menu.

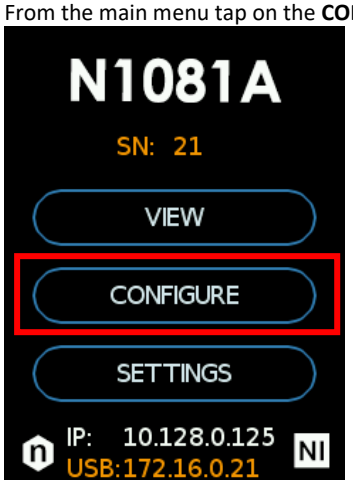


How to set the Output

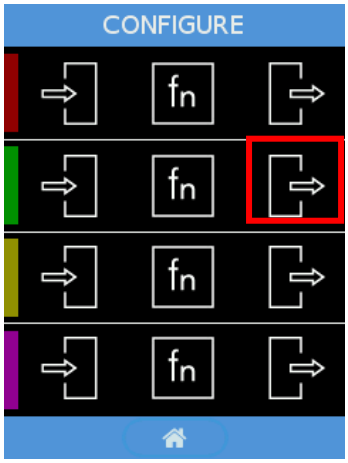
Once the function of a certain section is configured, it is possible to configure outputs accordingly. In the following we refer to section B, configured as a PULSE GENERATOR with fixed statistics, 1900 Hz rate and 150 ns width of the pulses. **We are assuming we want to generate a TTL signal on output 3 with negative polarity**.

Follow this step-by-step procedure to configure the outputs for section B of the N1081A:

- From the main menu tap on the **CONFIGURE** button

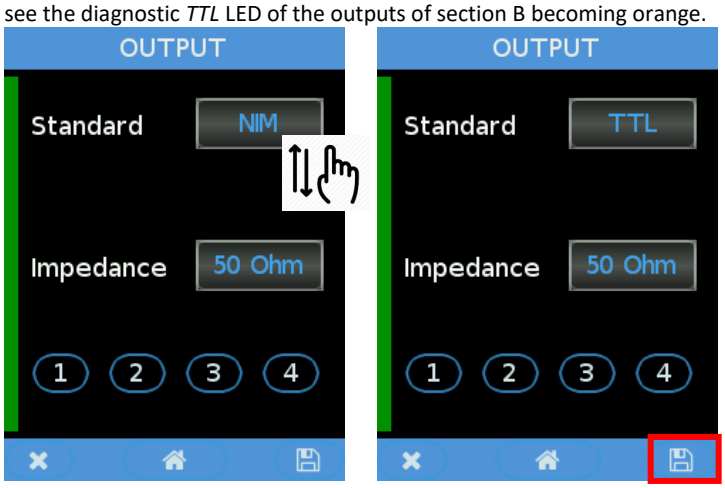


- The subsequent menu is divided in four rows, one for each section of the board, and gives access to the configuration of inputs, function and outputs. Tap on  button in the second row, to configure the outputs of section B.



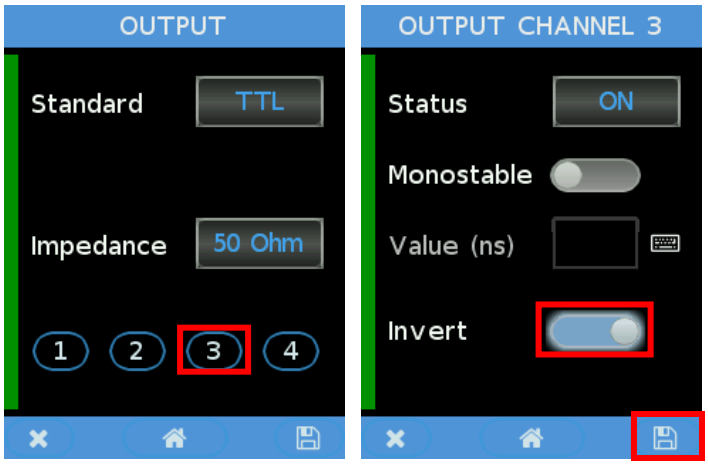
- In the subsequent tab, it is possible to set the general settings for the outputs of section B. It is possible to set the *Standard* (NIM or TTL) and the *Impedance* (50 Ohm or 1 kOhm) for all the corresponding output signals.

  According to our example, scroll to select TTL and leave 50 Ohm impedance. Tap on the *Save* icon. You should see the diagnostic *TTL* LED of the outputs of section B becoming orange.

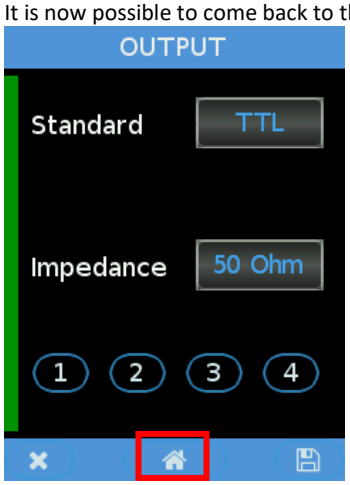


- Now it is possible to set individual parameters for the output channels if needed. By pressing one of the number button, the correspondent output channel view will be opened to set some parameters independently for each output channel. The *Status* allows to enable or disable the channel. The time duration of the output channel signal could be defined by enabling the *Monostable* property and then by inserting the desired time in nanoseconds in the *Value* field. The *Invert* property, if enabled, inverts the polarity of the output channel signal.

  According to our example, tap on "3" to set the input parameters for channel 3. In the subsequent tab, tap on *Invert*. At the end of the procedure press the *Save* icon.



- It is now possible to come back to the main menu by tapping on the *Home* icon.



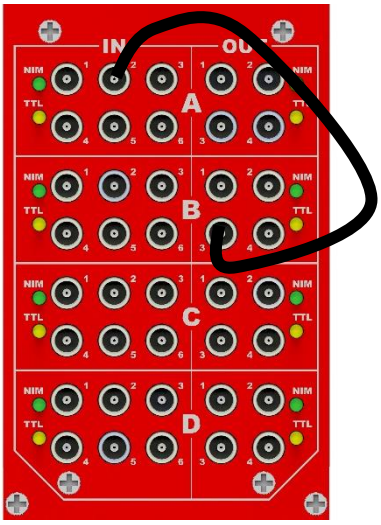
Monitoring the unit

The *VIEW* button in the *Main Menu* allows to access a group of 3 views to obtain an overview of the instrument status: *Functions*, *Activity* and *Monitor*. To navigate among these views the arrows button in the top toolbar should be used.

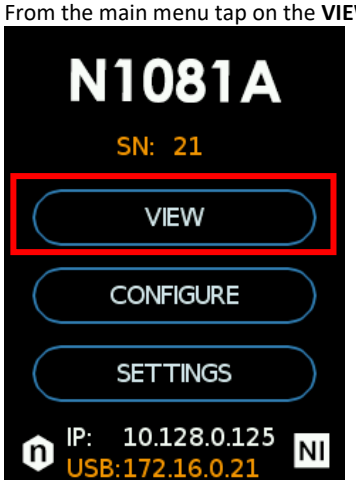
In the following we assume we have set RATE METER function in section A, a PULSE GENERATOR in section B and TTL I/Os, as explained in Secs. **How to configure a function, How to set the Input**, **How to set the Output.** We want to measure the output 3 of section B using the input 2 of section A.

Follow this step-by-step procedure to measure the pulse frequencies with the N1081A and monitor the acquisition:

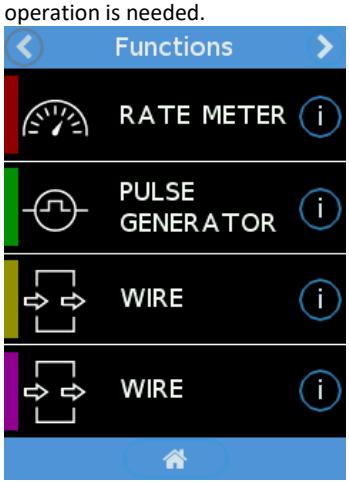
- Connect **OUT3- section B** to **IN 2-section A** with a LEMO-LEMO cable.



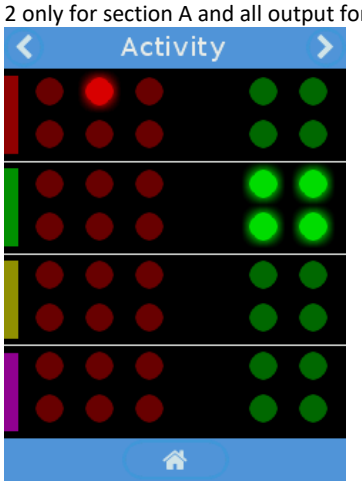
- From the main menu tap on the **VIEW** button



- In the subsequent view, it is possible to see the function set for each section. In particular we have RATE METER for section A and PULSE GENERATOR for section B. The online help can be used if a review of the function operation is needed.



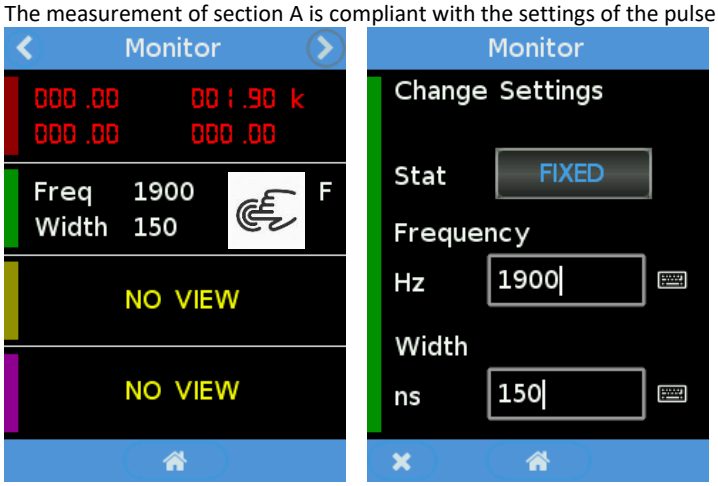
- Tap on the right arrow in top toolbar to view the next monitoring tab. Here is possible to visualize the *Activity* of the unit as ON/OFF LEDs corresponding to the I/Os of the board. If a LED is switched ON, it means that the corresponding channel is active: in case of an input channel (red LED), it is actually receiving a valid signal, in case of an output (green LED) it is generating a signal. According to our example, we see five active I/Os: input 2 only for section A and all output for section B.



- Tap again on the right arrow in top toolbar to view the *Monitor* tab. Here is possible to monitor the results of the measurements and settings. In each of the four parts of the screen, the widget of the corresponding function is shown, reporting the main realtime results of that specific function. Some functions allow to see a big version of the widget by tapping on the correspondent section area. This bigger widget page has a coloured side bar allowing to understand the section it refers to. It can be closed by pressing the *Close* button on the

bottom toolbar. In the cases in which the bigger widget shows counts, times or rates, it is possible to express the numbers in a more compact way by pressing the button: the suffix 'K', 'M' or 'G' indicates that the number has to be multiplied by 1,000, 1000,000 or 1,000,000,000. This settings is maintained in the *Monitor* view when the big widget page is closed. The button resets the corresponding measurements.

According to our example, we see the input 2 of section A measuring the rate of a TTL signal coming from section B. The widget of the PULSE GENERATOR (section B) can be seen in details, by tapping on section B area. The measurement of section A is compliant with the settings of the pulse generator.



Note: refer to Sec. **Available Functions** and to the online help to understand the parameters of other functions. Some functions are labeled as NO VIEW: these have not significant output to be shown. Some functions are labeled as WEB ONLY: these can be configured only via web interface (refer to **Web Interface**). For a complete list of the available functions, refer to **Table 6.1**, **Table 6.2**, **Table 6.3**, **Table 6.4.**

General Settings

The *SETTINGS* button in the *Main Menu* allows to access a group of 6 tabs to obtain an overview of the instrument general settings: *ETHERNET*, *CONFIGURATION*, *VERSION INFO, SYSTEM and CLOCK SOURCE*. To switch between these views the arrows button on the top toolbar should be used.

Ethernet Settings

The *ETHERNET* view allows to configure the instrument ethernet connection settings. Two possible ethernet configurations are available: dynamic and static IP address. When the DHCP is selected, the system has a dynamic IP address that is automatically assigned at the instrument power on.
When the DHCP is not selected, it is possible to assign a static IP address to the instrument: the instrument IP address ('IP'), the netmask ('NM'), the gateway ('GW') and the DNS ('DNS') could be defined by the user.
Press the *Save* button in the bottom toolbar in order to apply the changes and reset the instrument ethernet connection.

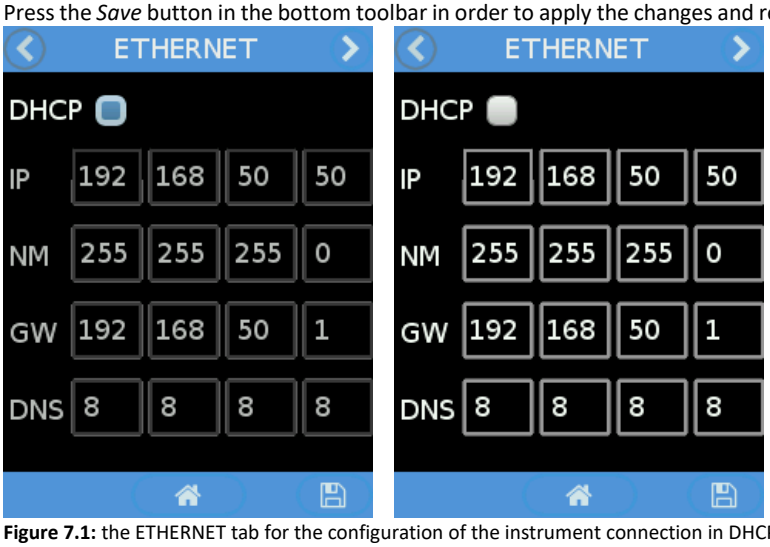


Figure 7.1: the ETHERNET tab for the configuration of the instrument connection in DHCP (left) or static IP (right) mode.

Saving/Loading a configuration

In the *CONFIGURATION* tab it is possible to manage the configuration files. These files contain all the parameters of the input channels, the output channels and the function of each section. The view contains 4 buttons to perform all the possible operation with the configuration files: SAVE, RENAME, LOAD and DELETE.

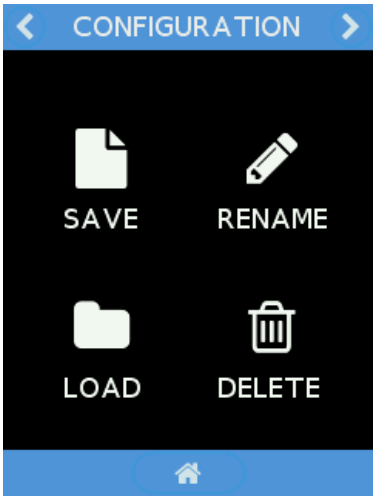


Figure 7.2: the CONFIGURATION tab to manage the configuration files.

The SAVE button allows to save the current instrument configuration. Tapping on SAVE, it opens a view which allows to insert the name of the configuration file to create inside the instrument memory, cointaing the **curren configuration of all N1081A sections**, including functions and I/Os. The file name must contain at maximum 20 characters and the only allowed characters are letters, numbers, the underscore, the plus and the minus symbols. The instrument allows to store at maximum 10 configuration files. If the instrument already contains the maximum number of allowed configuration files a warning message will appear. In this case, in order to save a new configuration file it is necessary to remove an existing file. Another warning message could appear when trying to save a new configuration file with a name of an already existing configuration file. In this case two options are possible: press *Continue* to overwrite the configuration file or *Close* to come to the previous view and change the name of the new configuration file.

Figure 7.3: possible view of the SAVE tab to create a configuration file.

The RENAME button opens a view showing in a roller menu the list of the configuration files stored in the instruments and giving the possibility to change the selected file name. In order to effectively change the configuration filename, press the RENAME button. If the new name is the same of an already existing file a warning message is displayed: it allows to overwrite the configuration file or to cancel the operation and insert a new name.

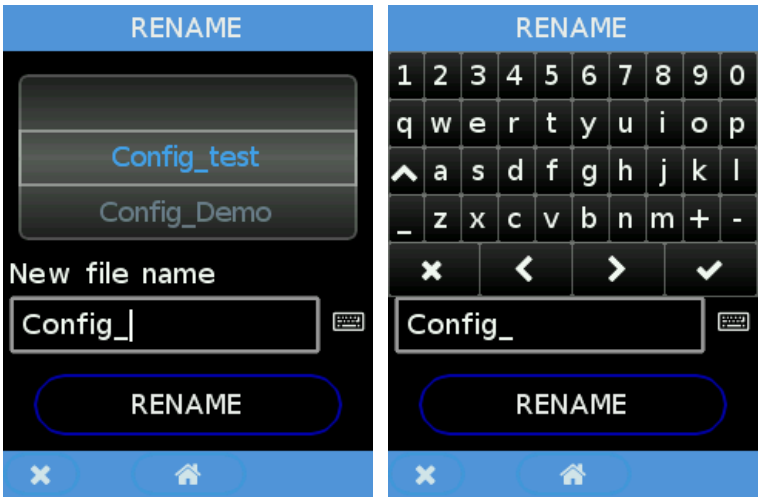


Figure 7.4: possible view of the RENAME tab to rename a configuration file.

Tapping on the LOAD button, the list of all the configuration files stored in the instrument is shown. In order to load the desired configuration it is needed to select the correspondent filename and press the LOAD button. The same list is also shown when the DELETE button is pressed. In this view it is possible to delete the selected configuration file by pressing the DELETE button.

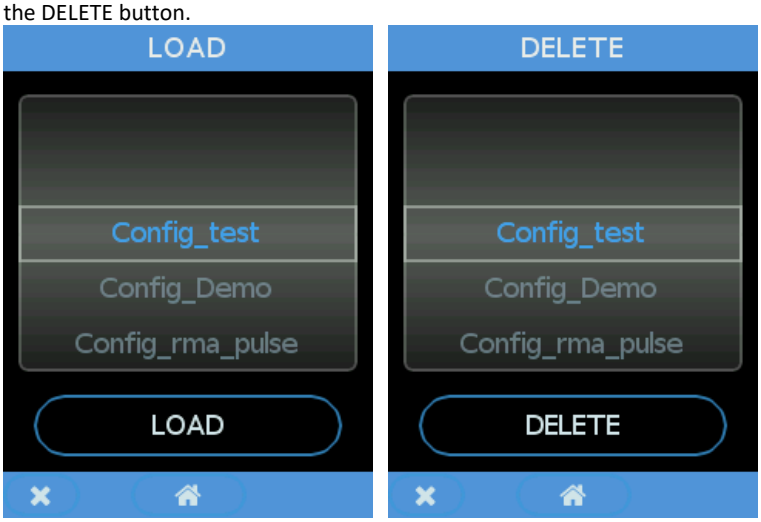


Figure 7.5: the LOAD and DELETE tab to load or delete a previously stored configuration file.

Firmware/Software version

The VERSION INFO view shows the version of the software application (SW), the version of the ZYNQ firmware (ZYNQ) and the version of the FPGA firmware (FPGA).

Figure 7.6: the VERSION INFO tab to check current software and firmware version.

System configuration

The SYSTEM tab allows to adjust the volume of the Touch Sound (LOW, MEDIUM, HIGH, OFF) and choose the Screen Saver option (1min, 10 min, 1h, 5h, 12 h, never)

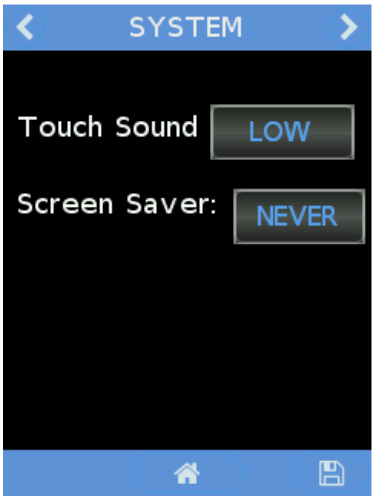


Figure 7.7: the SYSTEM tab adjust touch sound and screen saver

Clock Source

The CLOCK SOURCE tab allows to set the clock signal of the instrument. In particular, it allows to use a 3.3V TTL signal as external clock. It is possible to monitor the Current Source (*Internal* by default) and eventually set an external clock. When setting the external cock, the user is asked to check the source validity. By pressing *CHECK*, the instrument controls the signal and notifies if it is valid using RED (not valid) or GREEN (valid) light of the virtual LED. If valid, it is possible to set it as external clock, the boards reboot and, at next startup, the external clock will be used. After the clock is set as external, each time the clock becomes not valid, a notification appears on the Display, as well as when it returns eventually valid.

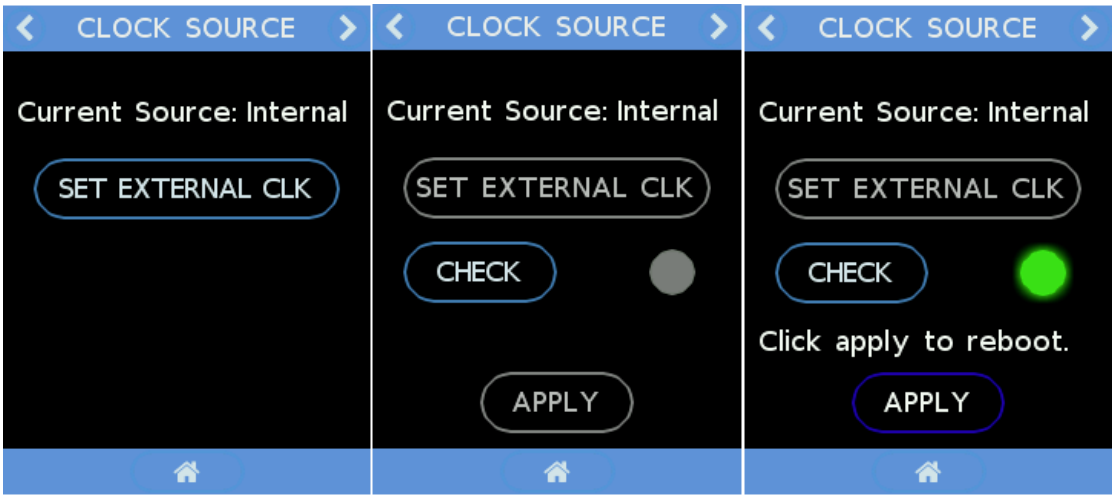


Figure 7.8: how to set an external clock using the CLOCK SOURCE tab.

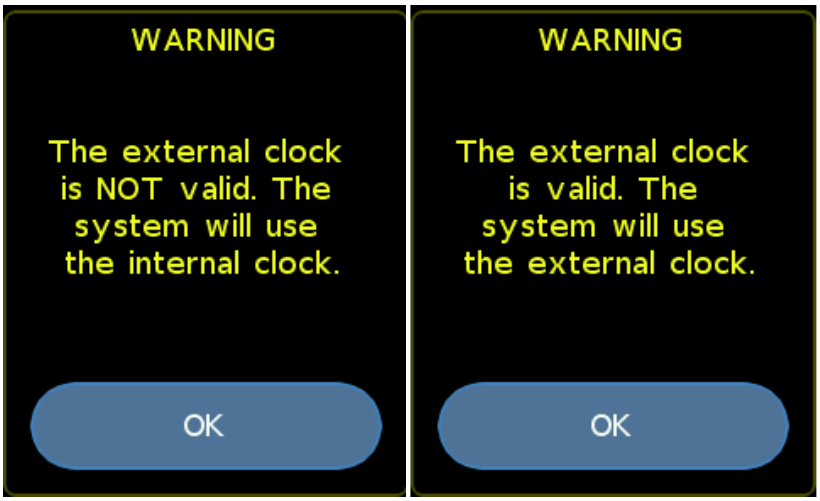


Figure 7.9: notifications on the Display when the clock source becomes valid or not valid during board operation.

8 Web Interface

It is possible to access the N1081A using its embedded Web Interface and configure the advanced function of the instrument, access more monitoring option, download measurement files and set the module general features.

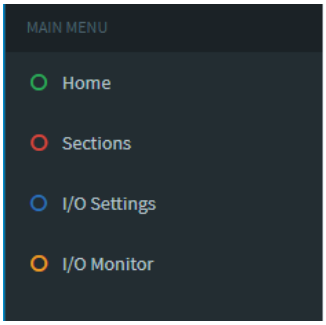
The Web interface is automatically accessible by configuring your PC in order to communicate with the N1081A, according to its IP or USB address (refer to Sec. **Remote Control**). It is sufficient to type the N1081A IP/USB address in a Web Browser search bar and the Web Interface will automatically open.

The Web Interface has a top blue toolbar present in each page of the GUI, with three icons for general commands. It allows to:

- **Collapse** the main menu
- **Remote Screen Control**: surf into the current **view of the touchscreen** display of the N1081A. It is possible to use this function to act remotely on the touchscreen
- Configure **general settings** of the instrument (Ethernet, Firmware upgrade, …). Refer to Sec. **General Settings: system configuration, firmware** upgrade**.**

Main Menu

The Main Menu on the left side contains four items: by clicking one of it, the correspondent page is loaded.



- *Home* is the page to have an overview of the instrument status, including set functions and basic measurements results
- *Sections* is the page to have detailed information about the sections of the instrument, to change the functions and edit the correspondent parameters.
- *I/O Settings* page allows to set input and output channels settings
- *I/O Monitor* page shows the digital state of the signals for each input and output channel with a logic analyser.

Home

The **Home** page (see **Figure 8.1**) allows to have an overview of the instrument status. The page contains four tabs, one for each section, with the number of the section (A, B, C, D) and the function set for that section (for example, Ratemeter, Pulse Generator, Time of Flight and Scaler). In each tab, if the selected function has a graphical widget, it is possible to see in realtime the data acquired and processed by the instrument. The *Reset* button allows to clear and restart the measurement on the correspondent channel.

There are three tool icons on the top right of each group . They allow the user to:

- Access the online help of the function
- Collapse the tab
- Remove the tab

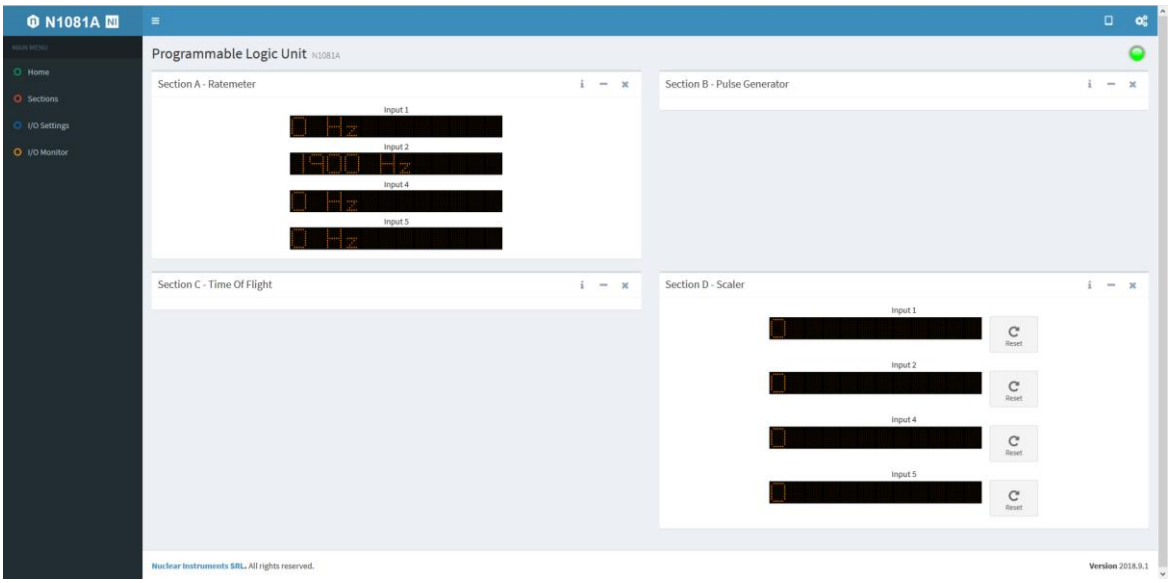


Figure 8.1: general view of the N1081A Web Interface home page, with the four tabs showing the function of each section of the instrument. In this example, Section 3 and Section 4 tabs are collapsed while the full widget is visible for Section 1 and Section 2.

The status of the connection with the N1081A is shown by the led on the top right of the webpage. If the led is dark green the instrument is not connected, if the led is light green the connection with the instrument is successfully established.

Sections

Sections page allows to have an overview of the instrument status as in the Home page, with some more details and with the possibility to change the function of each section and to modify all the corresponding parameters.

The page contains four tabs, one for each section, with the number of the section and the name of the function set for that section. Depending on the set function, the correspondent tab shows the realtime data and allows also to visualize their history through a plot of data acquired as a function of time. For some other functions, the tab contains a graphical widget to save, load and manage input or output files. Otherwise, for the remaining functions, the correspondent tab shows the currently set parameters, by default with read-only permissions.

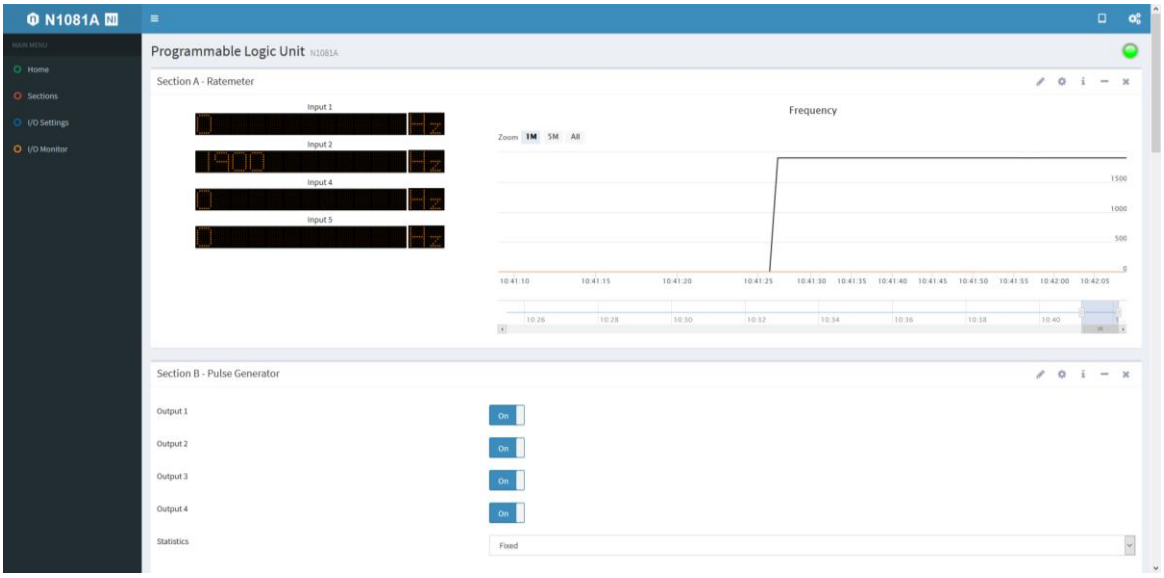


Figure 8.2: general view of the Sections page of the N1081A Web interface.

Five tool icons are placed on the top right of each tab . They allow the user to:

- **change the function** of that section. When clicked, a window containing a drop down list of the available functions is open: select the desired function and click the *Apply* button.
- **change the parameters** of the currently set function. When clicked, the *Apply* button in the section tab is active and it is possible to change the parameters setting. For some other functions a new window is opened and parameters can be edited in the corresponding fields.
- **access the online help** of the current section function
- **enlarge/collapse** the tab
- **remove** the tab

I/O Settings

I/O Settings page contains four tabs (see **Figure 8.3**), one for each section, with settings for Input and Output channels.

Each tab can be collapsed or removed by using the tools icon on its top right. The title of each tab contains the name of the section and the function that has been set.

Each tab is divided in two sections, one for the input and one for the output channel parameters. For both, it is possible to choose the *Standard* used for the signals (NIM or TTL) and the *Impedance* (50 Ohm or High impedance). It is possible to feed in input an analog signal and discriminate it by setting a *Voltage Threshold* (0-1.8 V range) in mV to transform it into a digital signal.

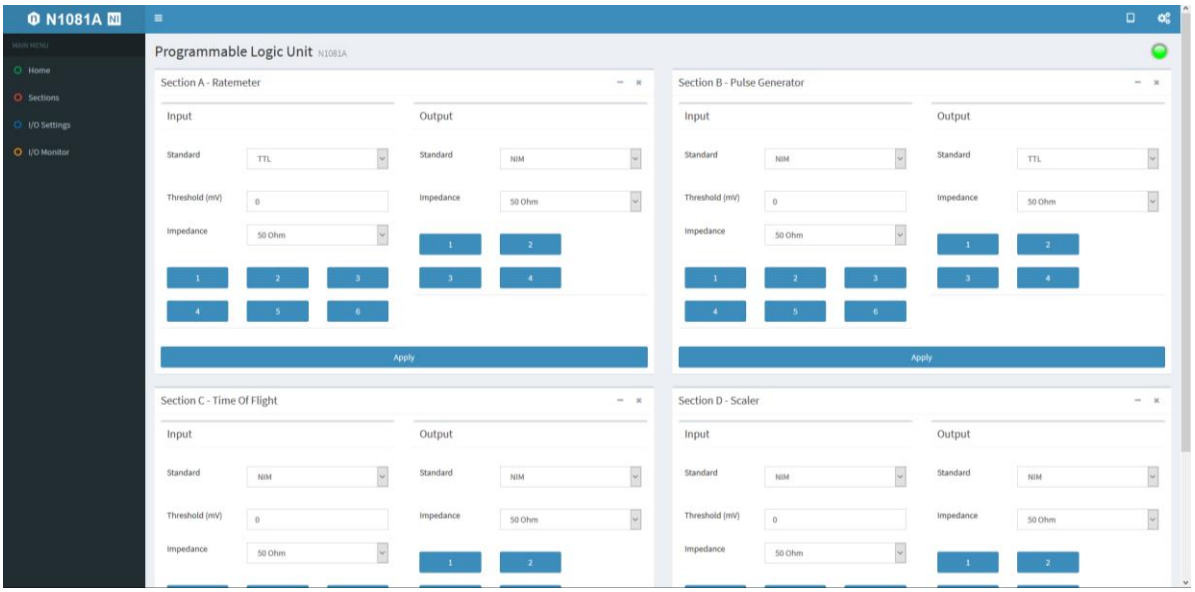


Figure 8.3: general view of the I/O Settings page of the N1081A Web interface.

Moreover, it is possible to set some parameters independently for each input and output channel. By clicking one of the numbered button, the correspondent channel window will open (see **Figure 8.4**).

For each input/output channel, it is possible to enable or disable it by setting its *Status*. The lenght and the arrival time of the input channel signal could be modified by enabling the *Gate and Delay* property and then by setting the *Gate* and the *Delay* values. The *Invert* property, if enabled, inverts the polarity of the input channel signal.
For the output channels instead, it is possible to enable or disable the *Monostable* feature to change the time duration of the output signal by specifying the correspondent *Value* field.
In order to save the changes, click the *Apply* button. The button will become green to confirm the parameters application.

Close the window or click outside it to return to the I/O Settings page.

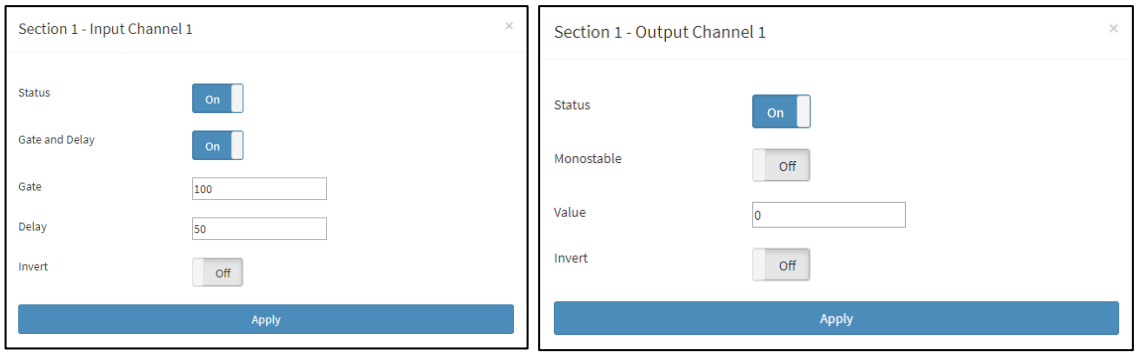
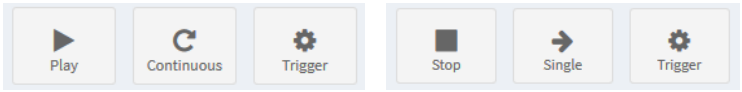


Figure 8.4: view of the windows to set independently each I/Os of the N1081A.

I/O Monitor

I/O Monitor page (see **Figure 8.5**) shows the digital state of the signals for each input and output channel. The signals are sampled and plotted with different colors, according to the color defined for the sections.

It has a toolbar 

hosting three buttons:

- The *Play* button allows to perform a single-shot acquisition
- If the *Continuous* button is pressed, the data acquisition continues until the *Stop* button is clicked. It is possible to restore the single-shot acquisition by pressing on *Single*
- The *Trigger* button opens a window to set the channels to refer the trigger of the logic analyzer to. It is possible to set the trigger as AND/OR of the enabled I/Os and if triggering on the RISING/FALLING edge of signals.

It is possible to zoom all traces together by clicking and keeping pressed the left-click of the mouse and move it. When the mouse button is released, the selected time portion of the plot will be the zoomed region. Press the *Reset Zoom* button on the top right of the plot to restore the original zoom.

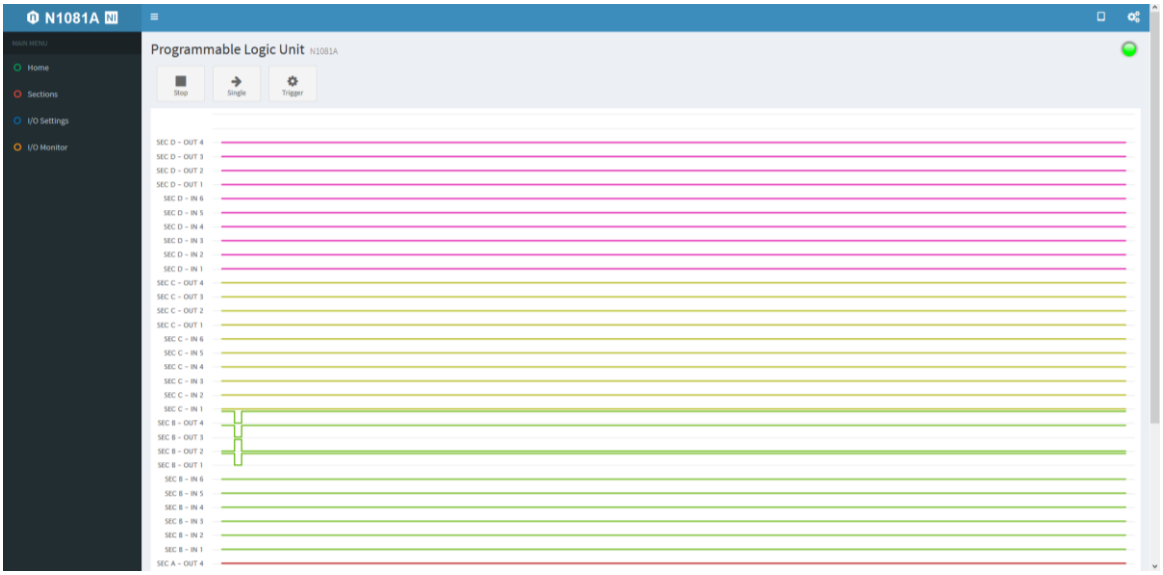


Figure 8.5: general view of the I/O Monitor page of the N1081A Web interface.

To give an example of the operation of the logic analyser, we assume that we set section A as a rate meter, with only input channel 2 active, and section B as a TTL pulse generator with negative signals on output channel 3. Connecting OUT 3-section B to IN 2- section A, it is possible to measure the pulse generator signals frequency. In the logic analyser, it is possible to trigger on the falling edge of OUT3-section B. The settings and results for this example are shown in **Figure 8.6.**

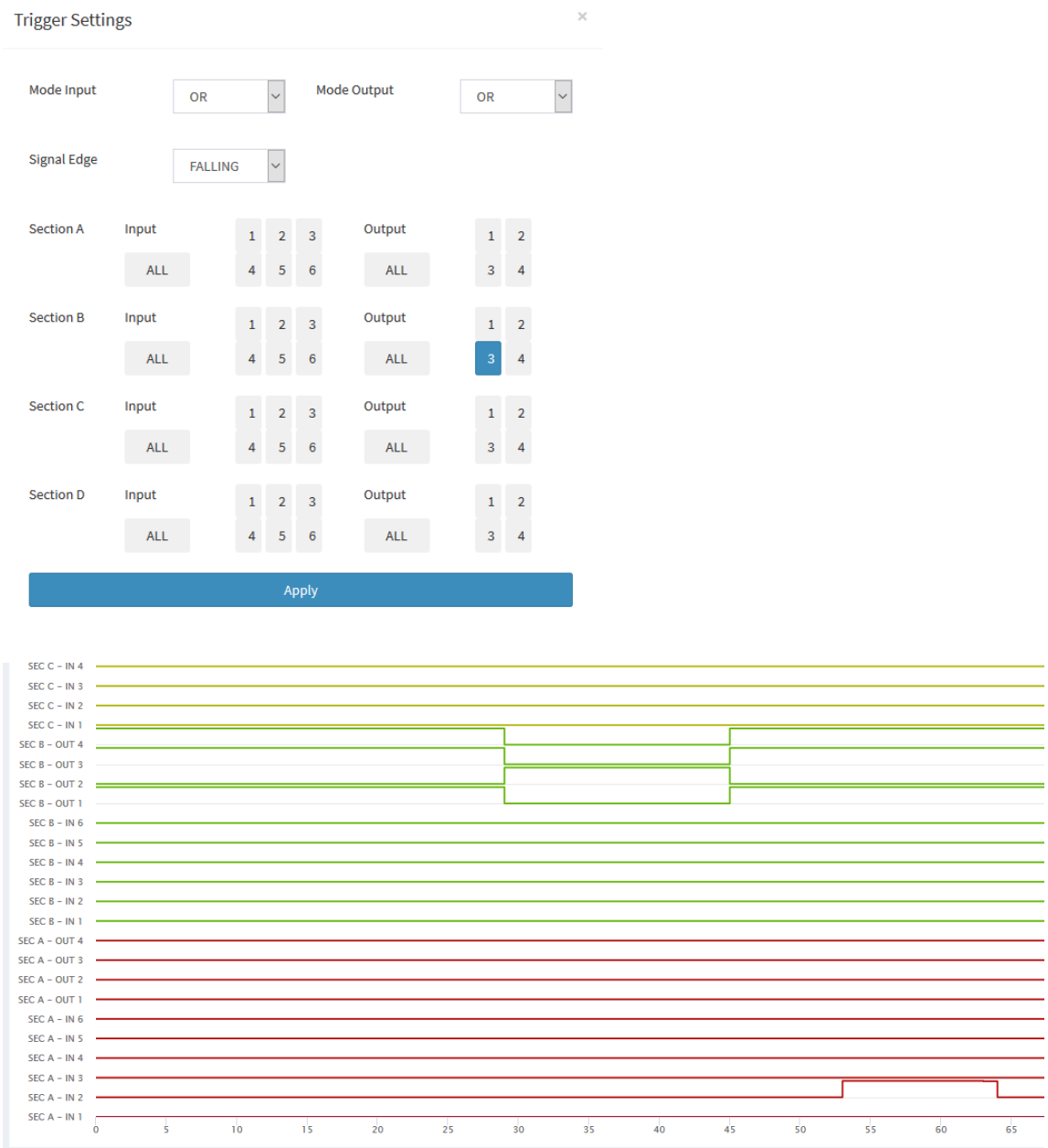


Figure 8.6: Top: trigger settings of the logic analyser set to trigger on the falling edge of output channel 3 of section B, which is set as a pulse generator of negative TTL signals. **Bottom**: traces on the logic analyser, showing the TTL signals generated by section B and the logic status of input channel 2 of section A, set as a rate meter. The delay of the red trace with respect to the green ones is due to the length of the LEMO-LEMO cable connecting the two sections.

General Settings: system configuration, firmware upgrade and clock signal

From each page of the Web Interface, it is possible to access the **General Settings** page by clicking  button in the top right corner. This page is divided in 4 tabs: *Ethernet*, *Configuration*, *Firmware Upgrade* and *Version Info*.

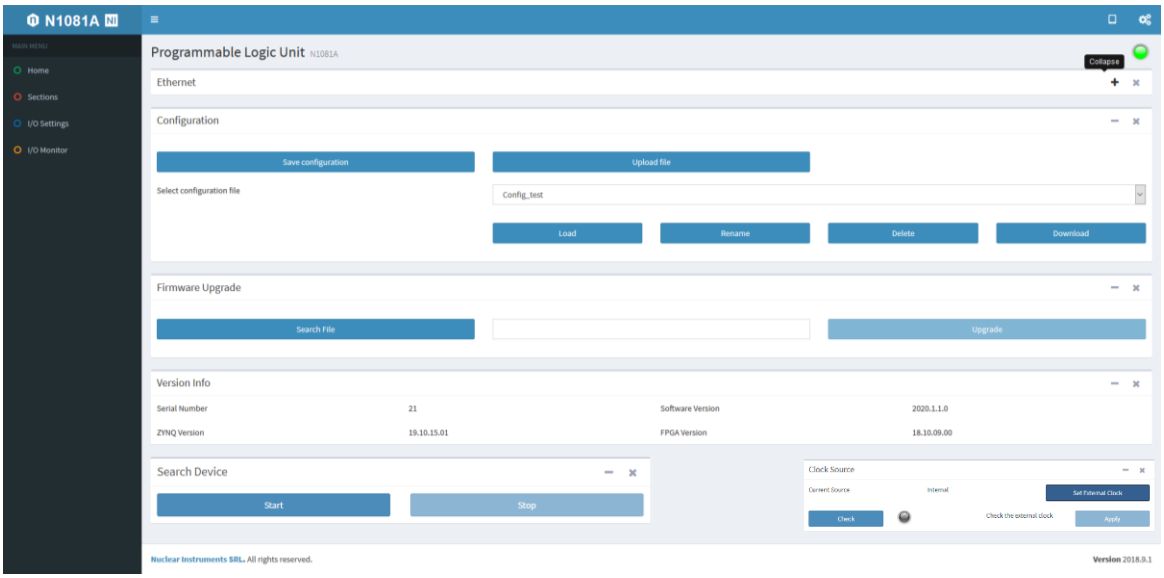


Figure 8.7: general view of the General Settings page of the N1081A Web Interface. *Ethernet* tab is collapsed in this view.

Two possible **ethernet configurations** are available: dynamic and static IP address. When the DHCP is switched on, the system has a dynamic IP address that is automatically assigned at the instrument power on. All the other ethernet parameters field are disabled. When the *DHCP* is switched off, the instrument IP address, Netmask, Gateway and DNS could be defined by the user. The paramters are applied by clicking the *Apply* button and the instrument ethernet connection is reset.

It is possible to store in the instrument 10 **configuration files** at maximum, indicating all the parameters of the input channels, of the output channels and of the function of each section. The *Save configuration* button allows to insert the name of the configuration file and to create it inside the instrument memory by clicking the *Create* button. The filename must contain at maximum 20 characters and the only allowed characters are letters, numbers, the underscore, the plus and the minus symbols. The *Upload file* button allows to select a configuration file from the computer and upload it to the instrument by clicking the *Upload* button. By clicking the *Load* button it is possible to set all the instrument parameters with the values reported in the correspondent selected configuration file. The *Rename* button opens a new window which allows to change the name of the selected configuration file. The *Delete* button removes the selected configuration file from the instrument while the *Download* button allows to save on the computer the selected configuration file.

The **configuration file** has to specify for each section the general parameters of the input and output channels, the specific settings of each input and output channel, the name of the function and the configuration parameters of the function (the parameters are different for each function). It should be a **.json** file and should have the following structure:


```
{ "Section_0":{
        "input_general":{
"standard":1,
"threshold":0,
"imp":true},
"input_channel_0":{
"status":true,
"enable_gd":false,
"gate":0,
"delay":0,
"invert":false},
"input_channel_1":{ },
"input_channel_2":{ },
"input_channel_3":{ },
"input_channel_4":{ },
"input_channel_5":{ },
"output_general":{
"standard":1,
"imp":true},
"output_channel_0":{
```

```
"status":true,
"enable_mono":false,
"mono_value":0,
"invert":false},
"output_channel_1":{ },
"output_channel_2":{ },
"output_channel_3":{ },
"function_name":"counter",
"function_configuration":{
            "lemo_enables":[
{"lemo":0,
"enable":true},
{"lemo":1,
"enable":true},
{"lemo":2,
"enable":true},
{"lemo":3,
"enable":true}
],
            "gate":false
            }
},

"Section_1":{ },
"Section_2":{ },
"Section_3":{ }
}
```


It is possible to **upgrade the N1081A firmware** using the **Settings** page. The *Search file* button opens a resource explorer window to select a firmware file from the computer. Once selected, the name of the selected file appears in the correspondent field and the *Upgrade* button is enabled. By clicking it, the firmware upgrade procedure starts.

Version Info tab shows the current versions of the software application (SW), the version of the ZYNQ firmware (ZYNQ) and the version of the FPGA firmware (FPGA).

Thanks to the *Search Device,* it is possible to search for the device the user is connected to. When the user press *Start*, the board emits an acoustic signal and the touchscreen becomes red and shows its Serial Number (see **Figure 8.8**). In the top right bar of the web interface, the *Search* icon (see **Figure 8.8**) starts blinking. It is possible to stop searching via web interface or via Touch Screen Display.

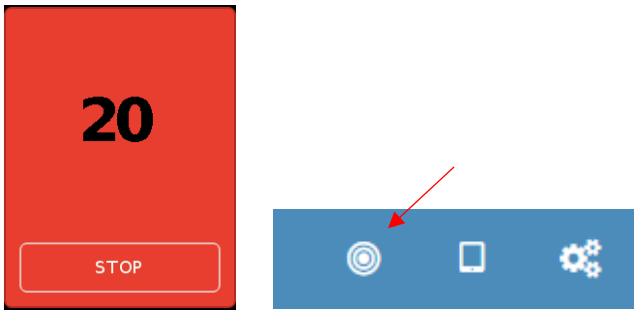


Figure 8.8: the Touch Screen Display and the Web Interface bar during instrument *Search.*

The *Clock Source* tab allows to set the clock signal of the instrument. In particular, it allows to use a 3.3V TTL signal as external clock. It is possible to monitor the Current Source (*Internal* by default) and eventually set an external clock.
When setting the external cock, the user is asked to check the source validity. By pressing *Check* button, the instrument controls the signal and notifies if it is valid using RED (not valid) or GREEN (valid) light of the virtual LED. If valid, it is possible to set it as external clock, the boards reboot and, at next startup, the external clock will be used. After the clock is set as external, each time the clock becomes not valid, a notification appears, as well as when it returns eventually valid.
The current clock status (INT or EXT) is notified in the top right corner of the Web Interface, next to the Connection LED status 

.

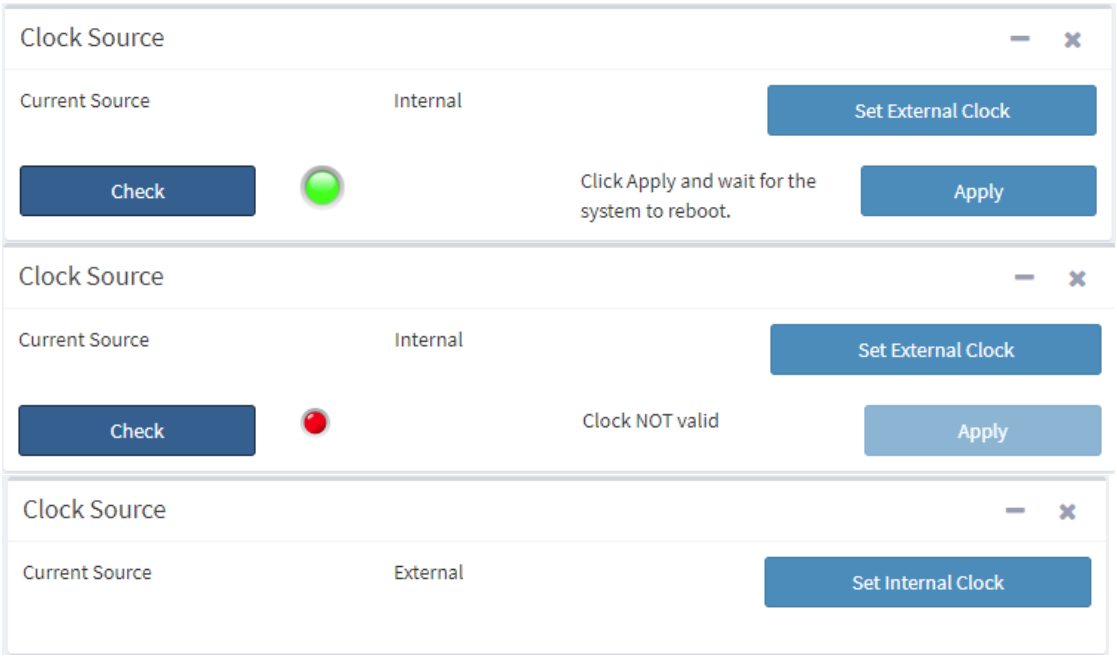


Figure 8.9: different views of the *Clock Source* tab while setting internal or external clock.

9 Technical Support

CAEN makes available the technical support of its specialists for request concerning the software and the hardware. Use the support form available at the following link:

https://www.caen.it/support-services/support-form/

CAEN GmbH
Brunnenweg 9
64331 Weiterstadt
Germany
Tel. +49 (0)212 254 4077
Mobile +49 (0)151 16 548 484
info@caen-de.com
www.caen-de.com

CAEN Technologies, Inc.
1 Edgewater Street - Suite 101
Staten Island, NY 10305
USA
Phone: +1 (718) 981-0401
Fax: +1 (718) 556-9185
info@caentechnologies.com
www.caentechnologies.com

CAEN S.p.A.
Via Vetraia 11
55049 - Viareggio
Italy
Phone +39 0584 388 398
Fax +39 0584 388 959
info@caen.it
www.caen.it

CAENspa INDIA Private Limited
B205, BLDG42, B Wing,
Azad Nagar Sangam CHS,
Mhada Layout, Azad Nagar, Andheri (W)
Mumbai, Mumbai City,
Maharashtra, India, 400053
info@caen-india.in
www.caen-india.in