Rev. 1 - January 26th, 2022

x1081B

Four-Fold Programmable Logic Unit

CAEN
Tools for Discovery

User Manual
UM8139

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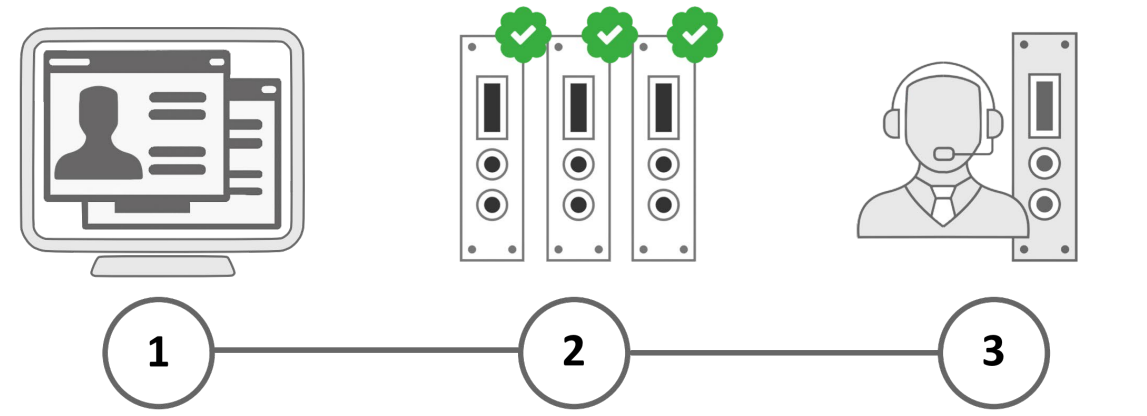
MyCAEN+ dashboard is designed to offer you a direct access to all our after sales services. Registration is totally free, to create an account go to https://www.caen.it/become-mycaenplus-user and fill the registration form with your data.



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Purpose of this User Manual

This User Manual contains the full description of the x1081B Four-Fold Programmable Logic Unit and a guide to the use of its touch-screen interface and web application.

Change Document Record

Date	Revision	Changes
September 13th, 2021	00	Initial release
January 26th, 2022	01	Added Chapters: **Safety Notices** **PID (Product Identifier)** **Cooling Management** **Installing the device** **Instructions for Cleaning** **Device decommissioning** **Disposal** Modified Chapters: **Technical Specifications** **Packaging and compliancy** **Power Requirements** Modified **Figure 14.16**

Symbols, abbreviated terms and notation

FPGA	Field Programmable Gate Array
OS	Operating system

Reference Document

[RD1] DS8138 – x1081B Four-Fold Programmable logic unit datasheet

Manufacturer contact

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

Limitation of responsibility

If the warnings contained in this manual are not followed, CAEN will not be responsible for damage caused by improper use of the device. The manufacturer declines all responsibility for damage resulting from failure to comply with the instructions for use of the product. The equipment must be used as described in the user manual, with particular regard to the intended use, using only accessories as specified by the manufacturer. No modification or repair can be performed.

The information contained herein has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies. CAEN spa reserves the right to modify its products specifications without giving any notice; for up to date information please visit www.caen.it.

MADE IN ITALY: We remark that all our boards have been designed and assembled in Italy. In a challenging environment where a competitive edge is often obtained at the cost of lower wages and declining working conditions, we proudly acknowledge that all those who participated in the production and distribution process of our devices were reasonably paid and worked in a safe environment (this is true for the boards marked "MADE IN ITALY", while we cannot guarantee for third-party manufactures).

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1 Introduction

The **x1081B –Four Fould Programmable Logic Unit** is a laboratory tool that incorporates in a single **NIM** or **Desktop** module the most common functionalities that you need to implement the **logic capabilities** of your experiment.

The device is designed to operate in laboratory environment under the supervision of skilled technicians.

The module is organized in four sections, with 6 inputs and 4 outputs each (selectable impedance) accepting TTL/NIM signals, with the possibility to feed in analog signals and process them through a leading edge discriminator. Each section is configurable independently according to one of the available pre-programmed functions, like scaler, counter, logic AND, time stamping, digital pulse generator, etc. The board configuration can be performed using the 2.8" touch screen display or via the web-interface, accessible via USB or Ethernet. Each section integrates a leading edge discriminator for analog input signals and an asynchronous Gate&Delay with 5 ns resolution. This allows the user to trim at best the needed parameters and to perform accurate measurements using the available logic functions.

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 via USB or Ethernet, monitor the functions output, dump data on file or history chart and access to the most advanced functions. No software installation is required. Using the Web Interface, it 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.

Available board models and accessories are listed below.

Board	Description	Product Code
N1081B	N1081B – Four Fold Programmable Logic Unit	WN1081BXAAAA
DT1081B	DT1081B – Desktop Four Fold Programmable Logic Unit	WDT1081BXAAA

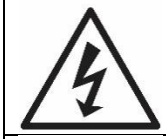
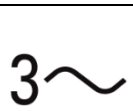
Table 1.1: table of available board models.

x1081B family is developed in collaboration with Nuclear Instruments S.r.L.

2 Safety Notices

N.B. Read carefully the "Precautions for Handling, Storage and Installation" document provided with the product before starting any operation.

The following HAZARD SYMBOLS may be reported on the unit:

	Caution, refer to product manual
	Caution, risk of electrical shock
	Protective conductor terminal
	Earth (Ground) Terminal
	Alternating Current
	Three-Phase Alternating Current

The following symbol may be reported in the present manual:

	General warning statement

The symbol could be followed by the following terms:

- **DANGER**: indicates a hazardous situation which, if not avoided, will result in serious injury or death.
- **WARNING**: indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**: indicates a situation or condition that, if not avoided, could cause physical injury or damage the product and / or its environment.

To avoid potential hazards, use the product only as specified. Only qualified personnel should perform service procedures.
Avoid Electric Overload. To avoid electric shock or fire hazard, do not power a load outside of its specified range.
Avoid Electric Shock. To avoid injury or loss of life, do not connect or disconnect cables while they are connected to a voltage source.

Do Not Operate without Covers. To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.
Do Not Operate in Wet/Damp Conditions. To avoid electric shock, do not operate this product in wet or damp conditions.
Do Not Operate in an Explosive Atmosphere. To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.
Do Not Operate with Suspected Failures. If you suspect this product to be damaged, please contact Technical Support.

THIS DEVICE SHOULD BE INSTALLED AND USED BY SKILLED TECHNICIAN ONLY OR UNDER HIS SUPERVISION

3 Block Diagram

The x1081B unit features 4 independent sections with a leading-edge discriminator input stage. Each section features 6 inputs and four outputs. The inputs can be NIM/TTL or analog signals to be fed to the discriminator stage, while the output can be NIM/TTL. The input signals are processed in the FPGA using an asynchronous **Gate&Delay** and then sent to the **Functions** block, which allows to select the desidered operation mode for each section of the unit (WIRE, AND,OR, COUNTER, ….). Each section of the instrument can implement a different function. The result of the function is sent to the Embedded Linux and to the NIM/TTL output, featuring an asynchronous **monostable** stage which allows to set a given width for the output signal generated by the function. The Embedded Linux is accessible to the user via Touch Screen or Web Interface, and it allows to monitor the results of the acquisitions, dump data on file and configure the board. Moreover the output of each channel is sent to an Activity Monitor and a Logic Analyzer. The Activity Monitor is meant to be used as monitor of the status of each I/O and the Logic Analyzer is a multichannel oscilloscope to see the real time signal on each I/O.

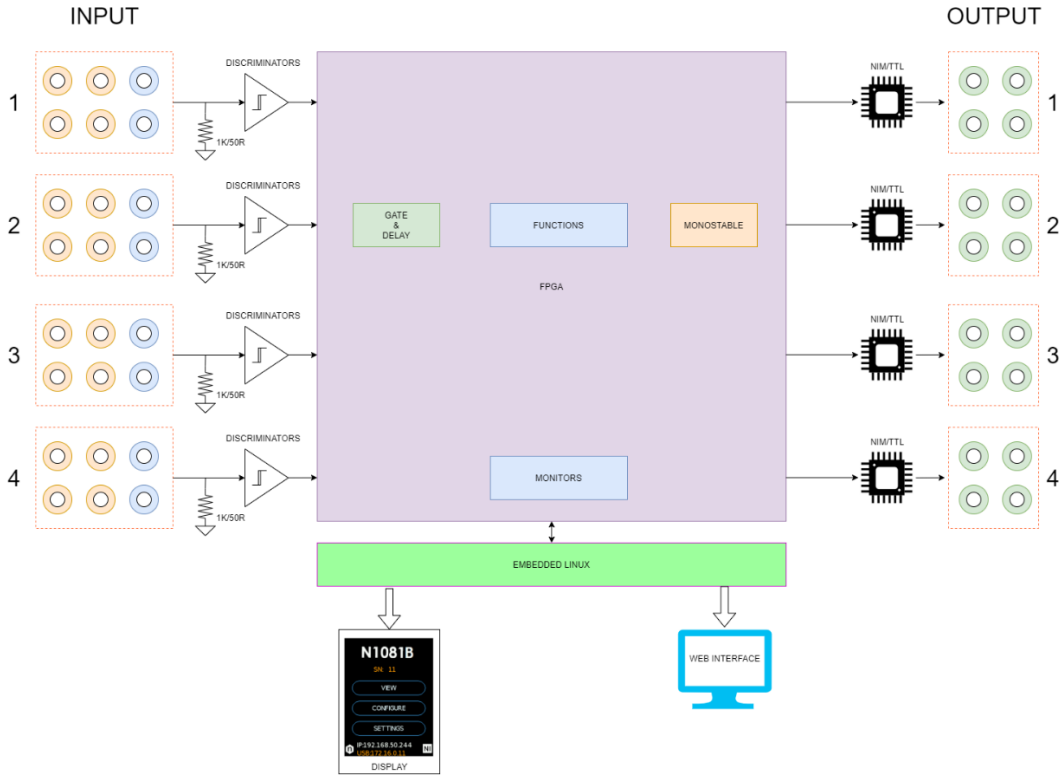


Figure 3.1: general block diagram of the x1081B unit.

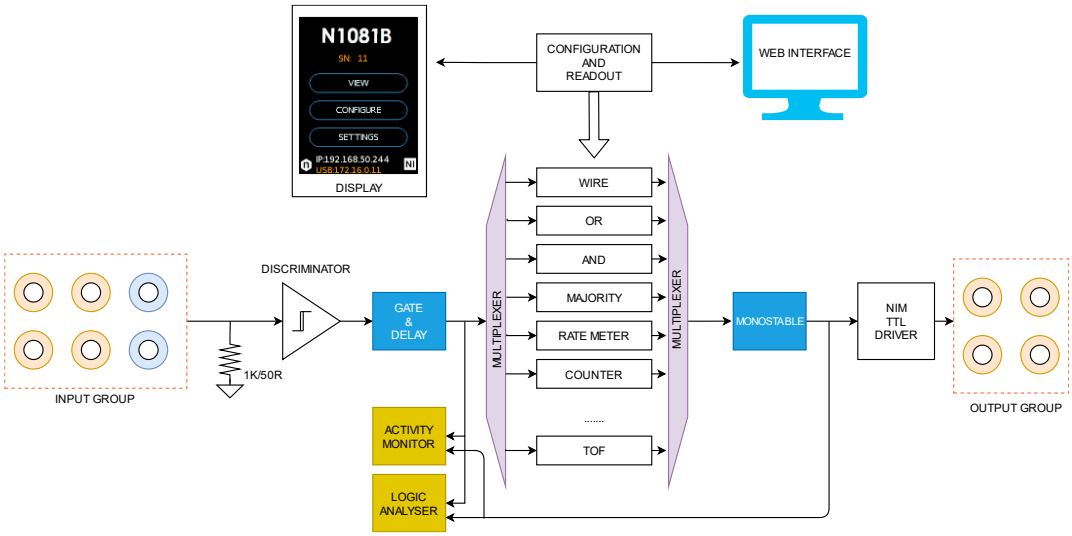


Figure 3.2: block diagram of a single channel of the the x1081B unit.

4 Technical Specifications

TECHNICAL				
POWER REQUIREMENTS	**N1081B** **Voltage:** 12V **Typ. Power consumption:** 1.5A @12V		**DT1081B** **Voltage:** 100-240 V_{ac} ± 10% **Frequency:** 50/60 Hz **Typ. Power consumption**: 0.1 A @ 220 V_{ac} **Fuse**: 2A, 250V – 5 mm x 20 mm	
Functions	**Logic** FANOUT WIRE AND OR OR+VETO MAJORITY MAJORITY+VETO *LUT* *COINCIDENCE*	**Counter** SCALER *COUNTER* *COUNTER TIMER* *CHRONOMETER* *RATE METER*	**Timing** *TIME TAGGING* *ToF* *ToT*	**Generator** *PULSE GENERATOR* DIGITAL GENERATOR *PATTERN GENERATOR*
	Note: functions in *Italic* font are synchronous to the system clock, the other ones are asynchronous			
N. of Sections	4 sections, independently programmable. Possibility to daisy chain more sections to make them operate as a single function with multiple inputs.			
Input	**Nr. of inputs** 6 per section CH 3 and CH 6 may be reserved for special function	**Connector** LEMO	**Input impedance** 50 Ω / 1 kΩ	**Signal type** NIM/TTL/DISCR DISCR is an arbitrary signal fed to the leading-edge discriminator
	Min input width 2 ns		**Min input voltage** ±10 mV in DISCR mode	
	Gate and Delay stage			
	Gate 15ns ÷ 10µs	**Delay** 0 ÷ 10µs	**Step** 5ns	**Resolution** ±1% ±3 ns
Output	**Nr. of outputs** 4 per section	**Connector** LEMO	**Signal type** NIM/TTL	**Min output width** 5.5 ns Measured with -500 mV signal, -200 mV threshold , WIRE function
	Output NIM rise/fall time ≤2.5 ns	**Output TTL rise/fall time** ≤6 ns Measured up to 1 MHz , WIRE function	**Output TTL Amplitude** 3.1 V	
	Monostable stage			
	Width 15ns ÷ 1µs	**Step** 5ns	**Resolution** ±1% ±3 ns	
Minimum I/O delay	30 ns - G&D and Monostable disabled 40 ns- G&D enabled, Monostable disabled 40 ns- G&D disabled, Monostable enabled 55 ns - G&D and Monostable enabled Measured in WIRE mode			
Leading Edge Discriminator	**Operation mode** - Time over Threshold (G&D and Monostable disabled) - Non-updating (when Monostable output is enabled)			
	Min. input voltage ± 10 mV	**Max Input Voltage** ± 5.2V	**Threshold range** [-800 mV ÷ 2.5 V]	**Threshold step** 1 mV
	Non linearity 4% ± 6.5 mV		**Efficiency** 3 mV threshold variation to pass from 0% to 100% of the trig rate Measured with -500 mV signal, WIRE function	
	Double pulse resolution Time over threshold mode, NIM out : 10 ns → 100 MHz Time over threshold mode, TTL out : 12.5 ns → 80 MHz Non-updating mode, 25 ns → 40 MHz			

	Reflections ≤ 2% on input signals (measured with -200 mV_{pp} signal) **Methodology note**: all the technical specifications of the Leading Edge discriminator are based on the x1081B working in WIRE function, to replicate a standard discriminator unit		
Max. sustainable frequency	- Asyncronous functions, NIM out → 100 MHz - Asyncronous functions, TTL out → 80 MHz - Syncronous functions, → 40 MHz - Scaler max. division rate → 130 MHz **Methodology note**: these technical specifications are based on measurements done with 3.3 V pulses, 2 ns width, 400 mV threshold		
AND	**Minimum overlap** 1.5 ns		
VETO	Veto must precede the event by at least 3 ns		
Timing functions	**Minimum detectable time** 13 ns **Bin size** [10 ns ÷ 1s], up to 1024 bins	**Resolution** 10 ns **Time reconstruction** t = 13 ns + bin size*bin number	
Pulse Generator	**Signal type** NIM/TTL	**Max. frequency** 20 MHz	**Min. pulse width** 10 ns
Connectivity	Ethernet (1Gbps) , USB 2.0		
Touchscreen	- 2.8" LCD, Transmissive type		
Software	- **Touch screen** widgets - **Web-based** Graphical User Interface		
MECHANICAL			
FORM FACTOR	**N1081B** 2U NIM module	**DT1081B** **Desktop**	
DIMENSIONS (H/W/L)	Standard 2U NIM module	257x102x331 mm^3 (WxHxD) , excluding the handle bar	
ENVIRONMENTAL			
ENVIRONMENTAL	Indoor use		
OPERATING TEMPERATURE	Operating Temperature -20 °C ÷ 50 °C		
OPERATING HUMIDITY	25% ÷ 95% RH non condensing		
STORAGE TEMPERATURE	-30 °C ÷ +80 °C		
STORAGE HUMIDITY	5% ÷ 90% RH non condensing		
ALTITUDE	≤2000 m		
POLLUTION DEGREE	2		
OVERVOLTAGE CATEGORY	II		
EMC ENVIRONMENT	Commercial and light industrial		
IP DEGREE	IPX0 enclosure, not for wet location		
REGULATORY			
COMPLIANCE	• EMC: CE 2014/30/EU Electromagnetic compatibility Directive • Safety: CE 2014/35/EU Low Voltage Directive		

Table 4.1: technical specifications for the N1081B/DT1081B.

5 Packaging and compliancy

The N1081B is housed in a double-width NIM unit.

The DT1081B is available as Desktop module housed in a 257x102x331 mm^3 (WxHxD) Aluminium case, with a handle bar adjustable in 30 degrees increment by pressing the side mechanical button.

The unit is inspected by CAEN before the shipment, and it is guaranteed to leave the factory free of mechanical or electrical defects.

When receiving the unit, the user is strictly recommended to inspect for any damage which may have occurred during transportation. Particularly, inspect for exterior damages like broken connectors and check that the panel is not scratched or cracked.

All packing material should be held on until the inspection has been completed. If damage is detected, the user must file a claim with the carrier immediately and notify CAEN.

Before installing the unit, make sure to read thoroughly the safety rules and installation requirements (see Sec. **Safety Notices** and **Installing the devic**), then place the package content onto your bench.

The content of the delivered package standardly consists of the part list shown in the table below (**Table 5.1**). All the official documentation, firmware updates, software tools, and accessories are available on *www.caen.it* at the product web page.

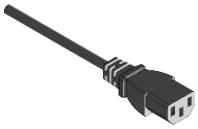
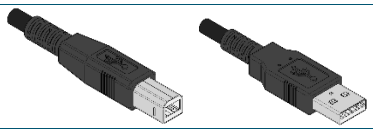
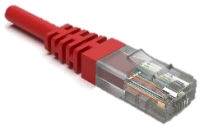
	Part	Description	Qty
	N1081B/DT1081B	NIM/Desktop Four-Fold Programmable Logic Unit	x1
	Power supply cable (DT1081B only)	Standard C13 power supply chord	x1
	USB cable	USB 2.0 141/5HS type A-B I/O cable L=2MT	x1
	Ethernet cable	ETHERNET CAT6 cable L=2MT	X1
	User guide	UM8139 – x1081B User Manual	x1

Table 5.1: delivered kit.

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

It is recommended to:

- Inspect containers for damage during shipment. Report any damage to the freight carrier for possible insurance claims.
- Check that all the components received match those listed on the enclosed packing list. (CAEN cannot accept responsibility for missing items unless we are notified promptly of any discrepancies.)
- Open shipping containers; be careful not to damage contents.
- Inspect contents and report any damage. The inspection should confirm that there is no exterior damage to the unit such as broken knobs or connectors and that the front panel and display face are not scratched or cracked. Keep all packing material until the inspection has been completed.

- If damage is detected, file a claim with carrier immediately and notify CAEN service.
- If equipment must be returned for any reason, carefully repack equipment in the original shipping container with original packing materials if possible. Please contact CAEN service.
- If equipment is to be installed later, place equipment in original shipping container and store in a safe place until ready to install

DO NOT SUBJECT THE ITEM TO UNDUE SHOCK OF VIBRATIONS

DO NOT BUMP, DROP OR SLIDE SHIPPING CONTAINERS

DO NOT LEAVE ITEMS OR SHIPPING CONTAINERS UNSUPERVISED IN AREAS WHERE UNTRAINED PERSONNEL MAY MISHANDLE THE ITEMS

USE ONLY ACCESSORIES WICH MEET THE MANUFACTURER SPECIFICATIONS

CAUTION: N1081B needs proper cooling.

USE ONLY NIM CRATES WITH FORCED COOLING AIR FLOW SINCE OVERHEAT MAY DAMAGE THE MODULE!

CAUTION: N1081B 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!

6 PID (Product Identifier)

PID is the CAEN product identifier, an incremental number greater than 10000 that is unique for each product. The PID is on a label affixed to the product (**Fig. 6.2**) and it is even stored in an on-board non-volatile memory readable via Touchscreen or Web interface (see Chap**. Touchscreen Display Guide** and **Web Interface**).

Fig. 6.1: PID location taking a CAEN NIM unit as an example (the PID in the picture and the device model are purely indicative). The PID can be found on the rear side of the module, above the NIM connector and/or on the front panel.

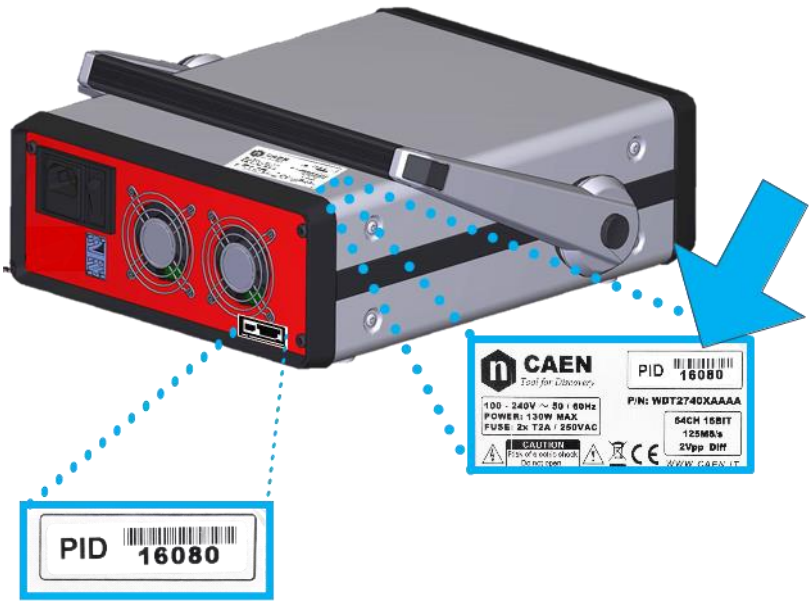


Fig. 6.2: PID location taking a CAEN desktop unit as an example (the PID in the picture and the device model are purely indicative). The PID can be found on the top side of the module, together with the plate date of the module, or on the rear panel.

7 Power Requirements

The N1081B must be powered @12V by a NIM crate with forced cooling air flow.

USE ONLY NIM CRATES WITH FORCED COOLING AIR FLOW SINCE OVERHEAT MAY DAMAGE THE MODULE!

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!

The DT1081B is powered by an internal 100/240V-12V AC/DC stabilized power supply.

The power supply chord is included in the delivered kit and it is connected to equipment using an IEC C14 connector on the back panel. The power chord is a standard wall IEC C13.

8 Cooling Management

The N1081B/DT1081B board can operate in the temperature range -20 + 50 °C. If the board is stored in cold environmental, please check for water condensation before power on.

The board has not been tested for radiation hardness. High energy particles can be source of soft error and can damage the FPGA. If used in strong proton or neutron beams, arrange proper shielding or remote the sensor with a custom cable.

CAUTION: N1081B needs proper cooling.

USE ONLY NIM CRATES WITH FORCED COOLING AIR FLOW SINCE OVERHEAT MAY DAMAGE THE MODULE!

Air flow fans are installed on the DT1081B. The user must take care to provide a proper cooling to the board with external fan if the board is used in an enclosure or if the board is installed in a setup with poor air flow.
Excessive temperature will, in first instance, reduce the performance and the quality of the measurements and can also damage the board.

Please do not close the rear fan holes to avoid unit overheating.

Cleaning the air vents

CAEN recommends to occasionally clean the air vents on all vented sides of the board. Lint, dust, and other foreign matter can block the vents and limit the airflow. Be sure to unplug the board before cleaning the air vents and follow the general cleaning safety precautions.

9 Installing the device

NIM model

- Insert the NIM unit into the crate.
- Power up the crate

Desktop model

- Connect the power supply input of the DT1081B to the delivered C13 chord and connect the chord to the wall plug.
- Set the rear switch to ON position

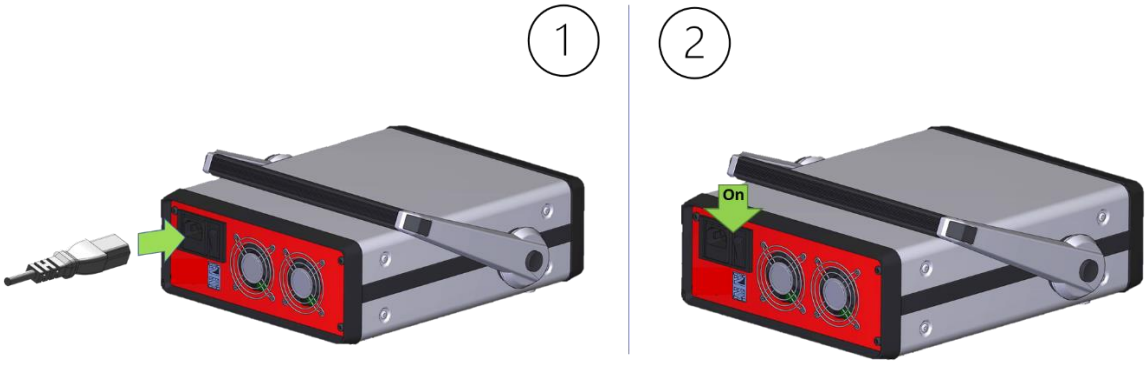


Fig. 9.1: installing the DT1081B. The board shown in the picture is exemplary only.

ONLY QUALIFIED PERSONNEL SHOULD PERFORM INSTALLATION, OPERATIONS

DO NOT INSTALL THE EQUIPMENT SO THAT IT IS DIFFICULT TO OPERATE THE ON/OFF SWITCH ONBOARD

IT IS RECOMMENDED THAT THE SWITCH OR CIRCUIT-BREAKER IS NEAR THE EQUIPMENT

THE SAFETY OF ANY SYSTEM THAT INCORPORATES THE DEVICE IS UNDER THE RESPONSIBILITY OF THE ASSEMBLER OF THE SYSTEM

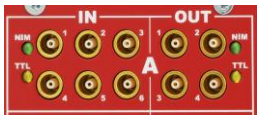
Do not use the device and contact technical support if one of these situations is verified:
- Enclosure integrity is compromised
- Insulation of HV chord is damaged (if present)
- The indication led or display is not performing as required (e.g. led not working, display with incorrect graphic)
- Fans are not working (if present)

10 Panels Description

Figure 10.1: Front, rear and side view of N1081B.

Figure 10.2: Front and rear view of DT1081B.

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

	BOTH OFF (input channels only): arbitrary signal processed by internal leading-edge discriminator with positive threshold **BOTH ON (input channels only):** arbitrary signal processed by internal leading-edge discriminator with negative threshold

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.

AC 220V and ON/OFF switch (DT1081B only)

FUNCTION

Input connector for the DT1081B main power supply (10-240 V) and ON/OFF switch

ELECTRICAL SPECS

Not available

MECHANICAL SPECS

Series: AC power supply connectors

11 Hardware description

Input stage

Each section of the x1081B unit features 6 inputs on LEMO connectors (CH1…CH6). The inputs can be NIM/TTL or analog signals in the range -800mV ÷ 2.8 V fed to the discriminator stage. In general, input CH 1,2,4,5 are standard inputs, while CH 3,6 are reserved for special signals, depending on the set functionalities of the section (for instance, a GATE signal of a coincidence or a RESET of a timer).

The x1081B features a calibrated double-DAC leading-edge discriminator stage (see **Figure 11.1**). Each input has an independent discrimination line. Input CH 1,2,4,5 share the same comparator threshold, within a tolerance of ±2mV. Input CH 3,6 share the same comparator threshold, within a tolerance of ±2mV. Thanks to this separation, it is possible to use two different discrimination threshold according to the user's needs. For example, CH3 could be a logic TTL signal with its discrimination threshold, while CH1,2,4,5 could be programmed with a different threshold for analog input signals.
In the case that all the inputs are used as standard, the threshold is shared among all 6 inputs, within a tolerance of ±2mV.

The leading-edge discriminator threshold can be set in the range [-800 mV ÷ 2.8 V] on each DAC. When the threshold is set as a negative value, the signal is automatically inverted to match the FPGA logic which relies on positive signal standard. This happens, for example, when selecting the NIM standard for the input.

It is possible to select the common input impedance of each section of the x1081B between 1 kΩ/ 50 Ω. The 50 Ω resistance is realized by a physical resistor and a pass-transistor, therefore little deviations from the 50 Ω nominal values are possible.

After the discrimination stage, the signal goes into a Gate&Delay circuit which allows to modulate the delay and the width of the signal independently for each input channel. Refer to Par. **Gate&Delay** for more details.

It is also possible to invert the logic of the signal after the discrimination, independently from the discriminator threshold value. For example, if the threshold is 1V and Invert option is on, the signal will result in a logic-high for the FPGA when it is lower than 1V. On the other hand, setting the threshold at -100mV with Invert option on, the signal will result in a logic-high for the FPGA if it is more than -100mV.

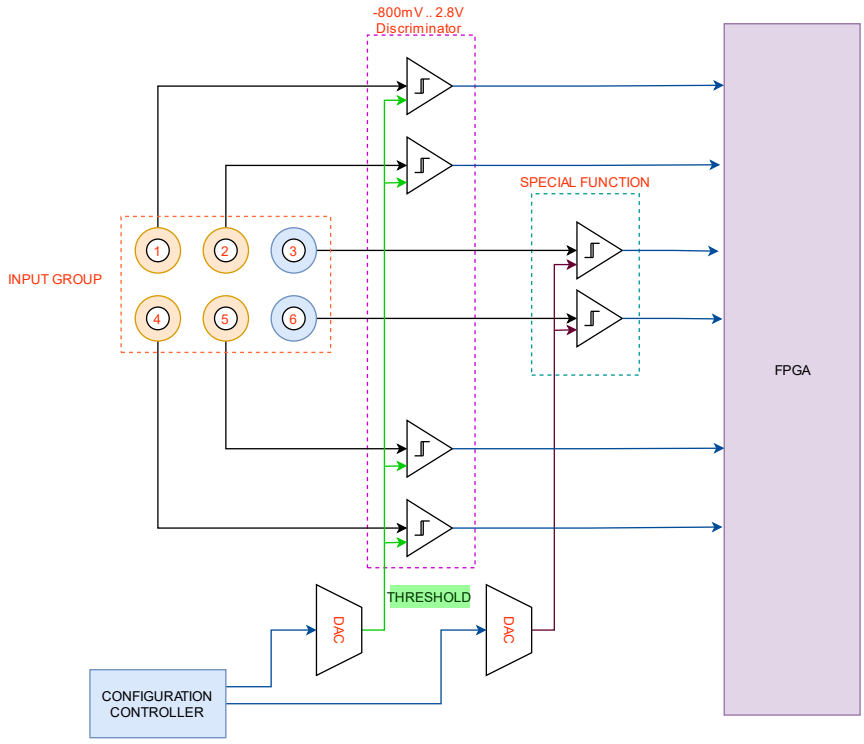


Figure 11.1: block diagram of the input stage.

Gate&Delay

The Gate&Delay (see **Figure 11.2**) of the x1081B is implemented independently on each input channel using an asynchronous logic, in order to minimize the jitter which would be larger in the case of a Gate&Delay synchronous to the 100 MHz clock. It relies upon a ring oscillator, through which it is possible to count a certain amount of time during which the signal is logic-low (DELAY) and another amount of time during which the signal is logic-high (GATE).

The ring oscillator works at a frequency in the range [20 ÷ 33] MHz nearly, depending on the programmable delay lines inside the FPGA. The oscillator frequency also depends on the operating temperature, therefore it is possible to re-calibrate it thanks to a dedicated button in the GUI of the instrument, in order to guarantee a proper generation of the Gate&Delay signal. The oscillator signal is fed to a counter, which counts till the value DELAY and the value DELAY+GATE are reached. The first one leads to the generation of a logic-low signal (DELAY), while the second one generates a logic-high signal (GATE) and rearms the system to be ready to accept a new signal commutation.

The Gate&Delay stage can be totally bypassed, or just the DELAY can be bypassed.

Since the FPGA cannot handle in a deterministic way the values of Gate and Delay set in ns by the user, those values are processed by a neural network inside the instrument, which calculates the best combination approaching the set values. The neural network search for the best Gate&Delay values with a timeout of execution. After the best combination is found, the instrument launches an iterative process to find the combination minimizing the errors, in the very close range of the values extracted by the neural network. The whole process leads to an error in the range of few ns. On the other hand, this also means that the values in ns set by the user cannot be perfectly matched in all cases, since the Gate&Delay in the FPGA works upon integer numbers only, corresponding to the number of oscillations of the ring oscillator.

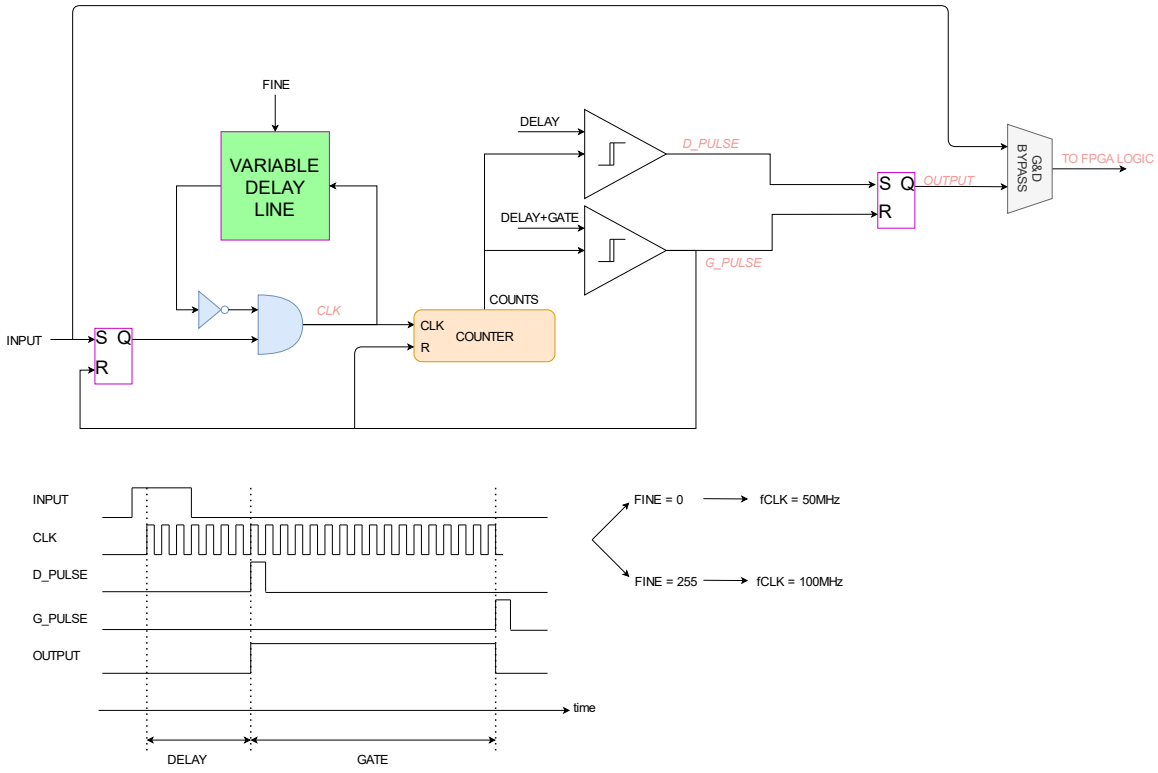


Figure 11.2: block diagram of the Gate&Delay.

Output stage

The output stage (see **Figure 11.3**) can generate NIM/TTL signals and it is common for all the channels of a given section of the unit. It is realized with transistors, in order to minimize the rising/falling time of the signals.

The TTL is realized as a push-up circuit, being able to realize the logic-high signal. The logic-low, instead, is driven by the 50 ohm impedance that it necessarily connected externally to the instrument (e.g. as a cable termination). The NIM is realized as a pull-down circuit, meaning that the logic-low (0 V) is driven by the external 50 ohm impedance, while the logic-high (-800 mV) is driven by the transistors.

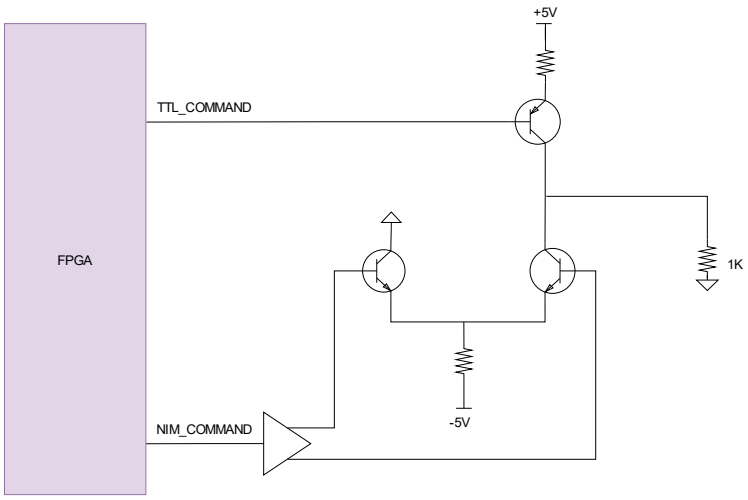


Figure 11.3: block diagram of the output stage.

Output monostable stage

The output monostable stage is implemented exactly in the same way of the input Gate&Delay (refer to Par. **Gate&Delay**), except from the fact that the Delay is always set to 0.

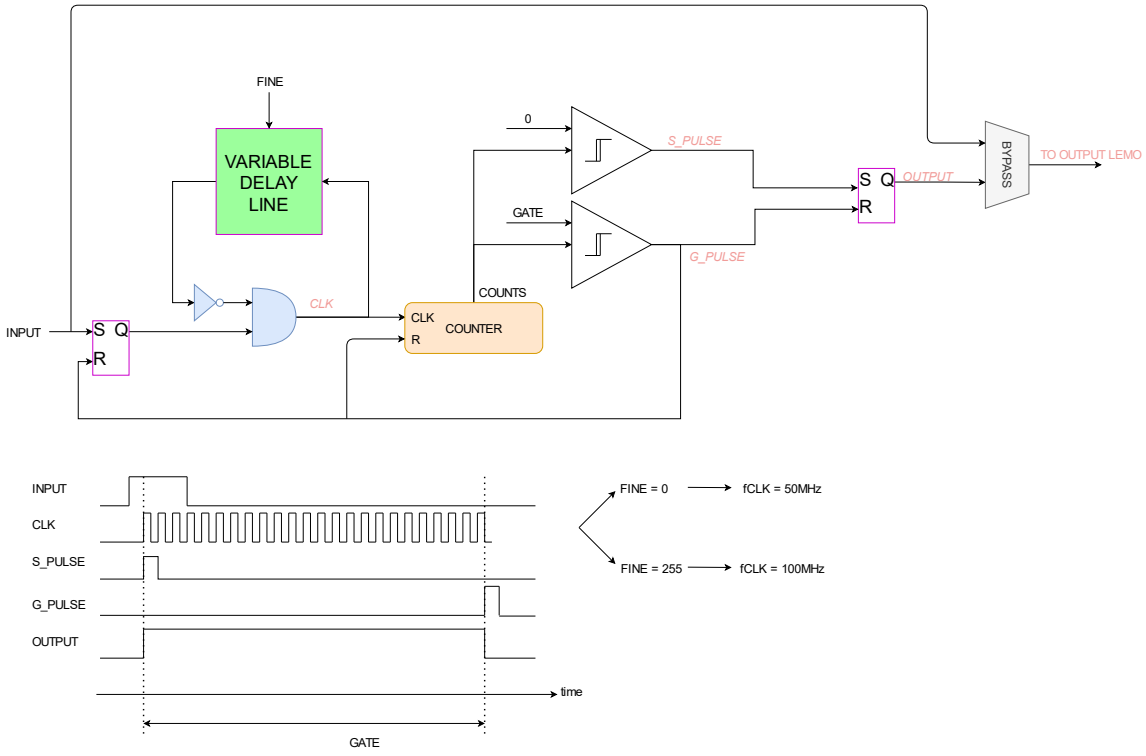


Figure 11.4: block diagram of the Monostable output stage.

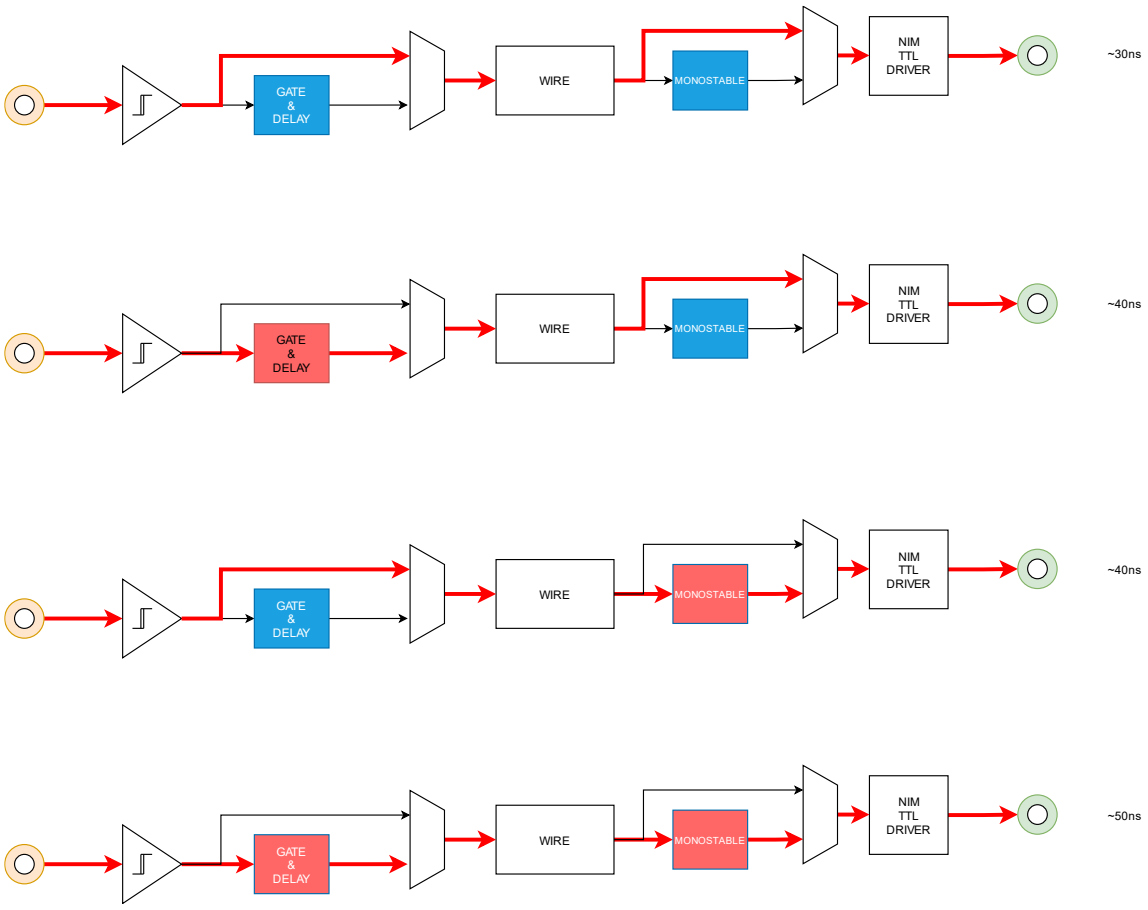


Figure 11.5: general flow of the I/O stages, showing the minum delay depending on the activity of the Gate&Delay and Monostable. Red block means that stage is active, blue means the stage is bypassed.

Activity Monitor

The Activity Monitor is a circuit inside the instruments which allows to show on the Display when each I/Os is commutating. Graphically, the commutation is rendered as a virtual LED switching ON/OFF on the Display.

In order to drive the pixels of the display according to the I/Os signals level, a peak-streatcher circuit is implemented /see **Figure 11.6**). In this way, the probability to detect the high-state of a signal is maximized even for low duty cycle values (for instance, few ms width and 10 Hz frequency). Given this architecture, if the frequency of a signal is less than 3 Hz, the virtual LED will be blinking, while for higher frequencies it will stay fixed ON.

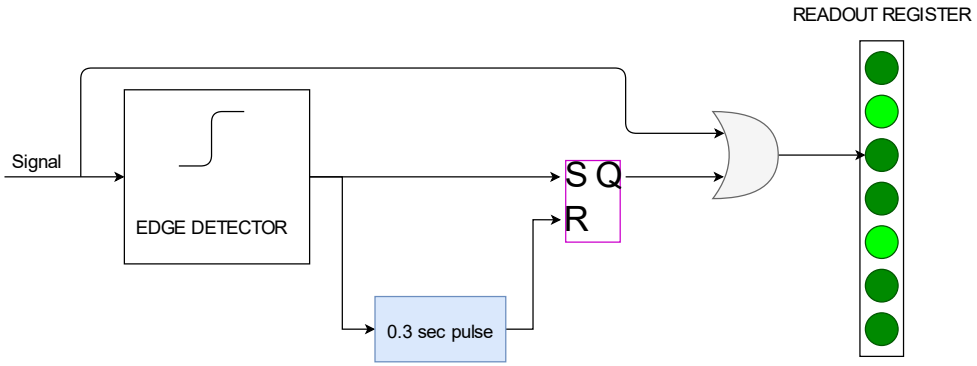


Figure 11.6: block diagram of the Activity Monitor.

Logic Analyzer

The Logic Analyzer allows to plot on a 1024 samples chart the status of all I/Os during the time. The plot is transferred to the Web Interface where it is possible to visualize it. In order to capture the signal status, the Logic Analyzer works upon

the triggering logic shown in **Figure 11.7**. It provides different options, which are selectable from the Web Interface configuration panel. It is possible, for example, to trigger on the OR/AND of all inputs, the OR/AND of all outputs and make the OR between the input and output logic. It is also possible to exclude some given I/Os from the triggering logic.

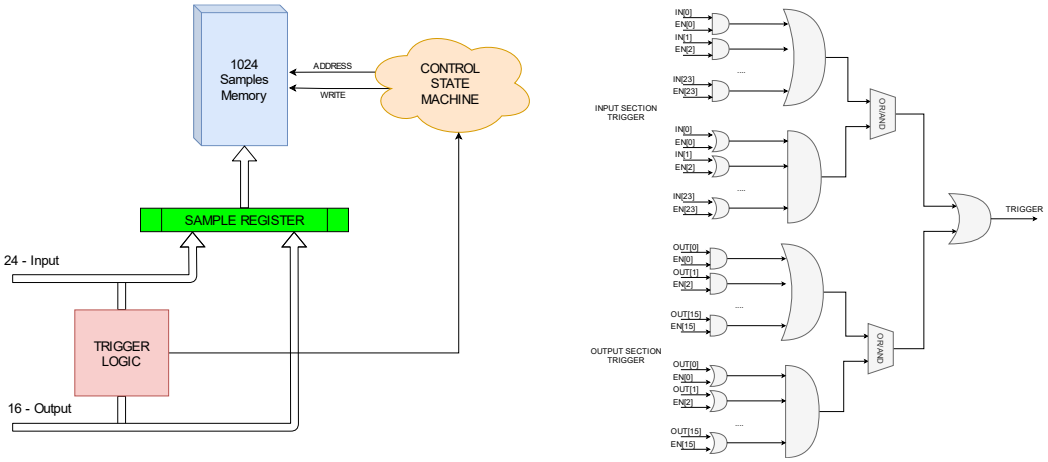


Figure 11.7: block diagram of the Logic Analyzer (left) and its trigger logic (right).

12 Functional Description

The x1081B 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/discriminator 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 x1081B 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 x1081B, with a brief explanation of their operation and a detailed block diagram.

The functions of the x1081B can be synchronous or asynchronous (see **Table 12.1**). The synchronous functions work relying on a 100 MHz clock, while the asynchronous ones do not need any internal FPGA clock, with the advantage of not introducing a jitter due to the signal internal sampling. On the other hand, the synchronous functions use the clock as timebase to correlate the measurements to a time scale. For instance, the timing functions use the clock sampling to define the duration of a signal and the value of a timestamp. The clock can also be fed externally through the rear BNC connector, in order to let the unit operate synchronously to other x1081B or with respect to any other kind of external instrument.

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

LOGIC	COUNTER	TIMING	GENERATOR
FANOUT	SCALER	TIME TAGGING	PULSE GENERATOR
WIRE	COUNTER	TIME OF FLIGHT	DIGITAL GENERATOR
AND	COUNTER TIMER	TIME OVER THRESHOLD	PATTERN GENERATOR
OR	CHRONOMETER		
OR + VETO	RATE METER		
VETO	RATE METER ADV.		
MAJORITY			
MAJORITY + VETO			
LUT			
COINCIDENCE			

Asyncronous logic (there is no clock sampling signal in the function and the propagation delay is proportional to the number of logic element the signal is crossing)

Syncronous to the system 100 MHz clock (the outputs of the function are updated only on rising edge of the clock signal)

Table 12.1: table of the available functions in the x1081B unit. Green functions feature asynchronous logic, meaning there is no clock sampling signal, orange functions are synchronous to the 100 MHz clock.

Each function of the x1081B has 6 inputs, 4 outputs, a clock IN, a register file input for configuration and a readout output, as shown in **Figure 12.1**. Each input goes into an IEC block (Input Enable Control), which allows to enable/disable some given inputs without effects on the logic of the function itself. For example, considering the AND function, a disabled input is forced to be logic-high, while, considering an OR, a disabled input is forced to be logic-low. The output signals pass through an OEC block (Output Enable Control) which always forces the disabled outputs to be logic-low.

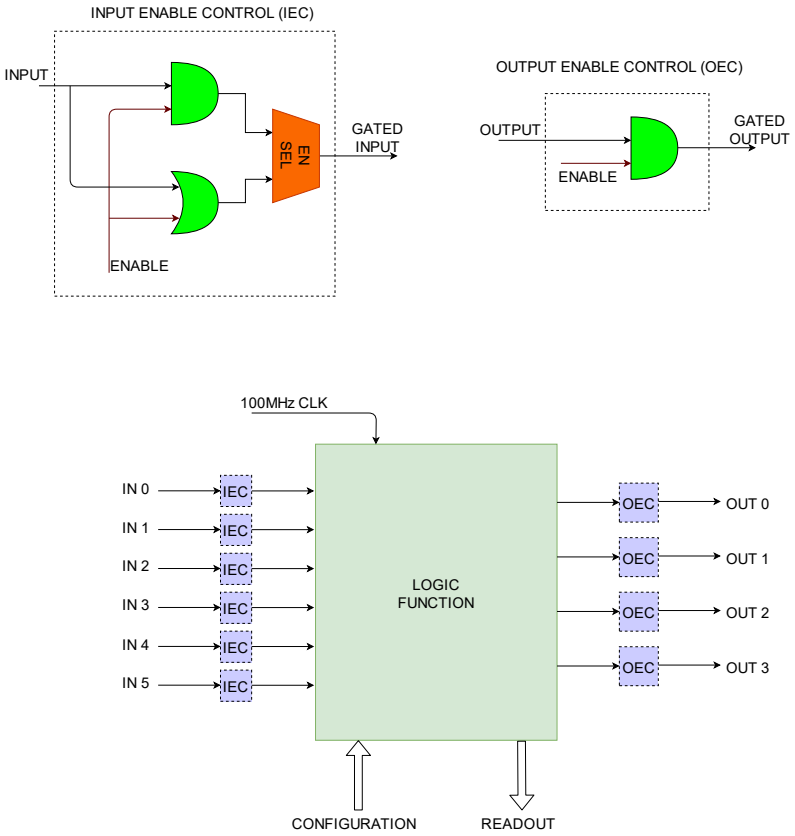
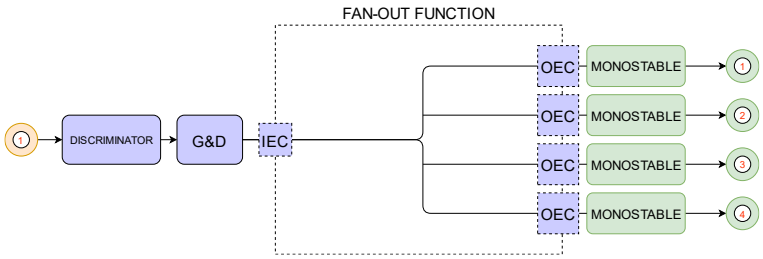


Figure 12.1: general operating mode of the x1081B functions.

Logic functions

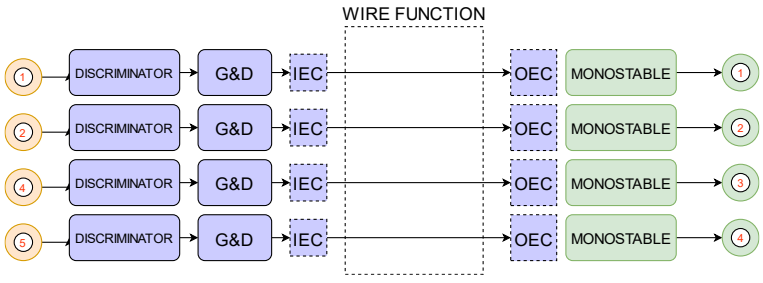
FAN-OUT

The signal on input CH1 is processed by the Discriminator and Gate&Delay stage and it is replicated equally on the four output channels. Output is a NIM/TTL signal.



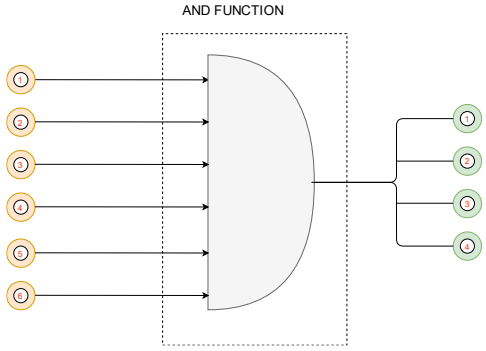
WIRE

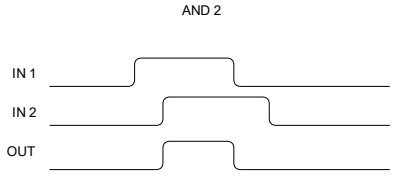
The signal on each input channel is processed by the internal Discriminator and Gate&Delay and replicated to the correspondent output channel. Note that input CH4 is sent to output CH3 and input CH5 is sent to output CH4, due to the fact that only standard inputs are used. The output is a NIM/TTL signal. According to the set configuration, it is possible to use this function as a NIM/TTL translator.



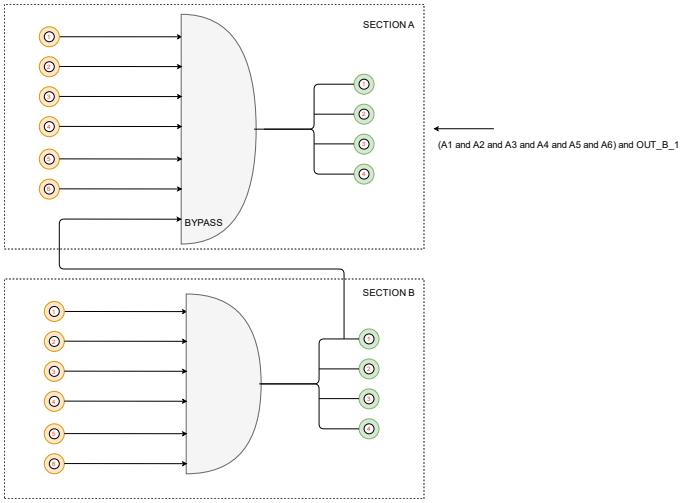
AND

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. Discriminator, Gate&Delay and monostable are omitted in the diagram.



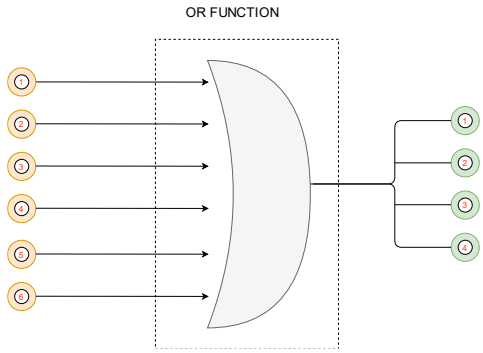


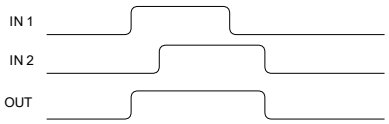
It is possible to concatenate the AND function on two different sections by using the BYPASS option. For example, if BYPASS option is enabled on section B (AND), the output CH1 is bypassed to section A (AND) in order to obtain the AND among the section A inputs and the section B out CH1, practically meaning an AND among all inputs of section A and B.



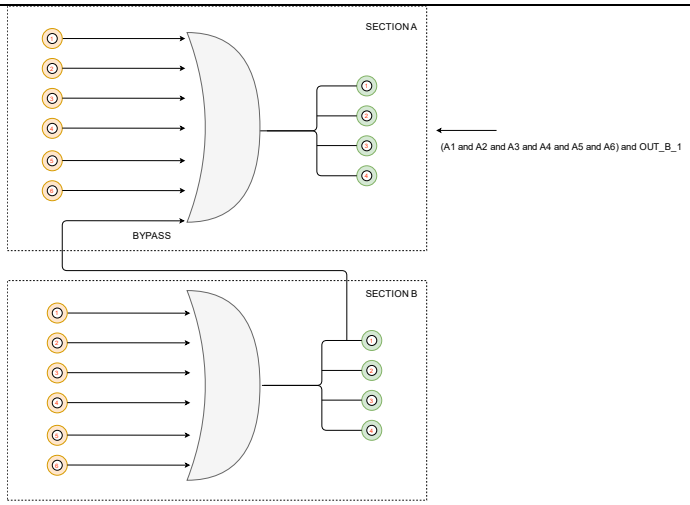
OR

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. Discriminator, Gate&Delay and monostable are omitted in the diagram.





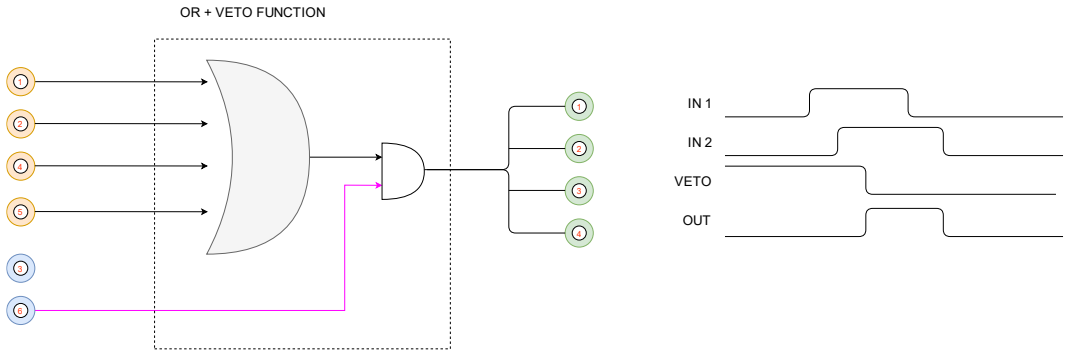
It is possible to concatenate the OR function on two different sections by using the BYPASS option. For example, if BYPASS option is enabled on section B (OR), the output CH1 is bypassed to section A (OR) in order to obtain the OR among the section A inputs and the section B out CH1, practically meaning an OR among all inputs of section A and B.



OR+VETO

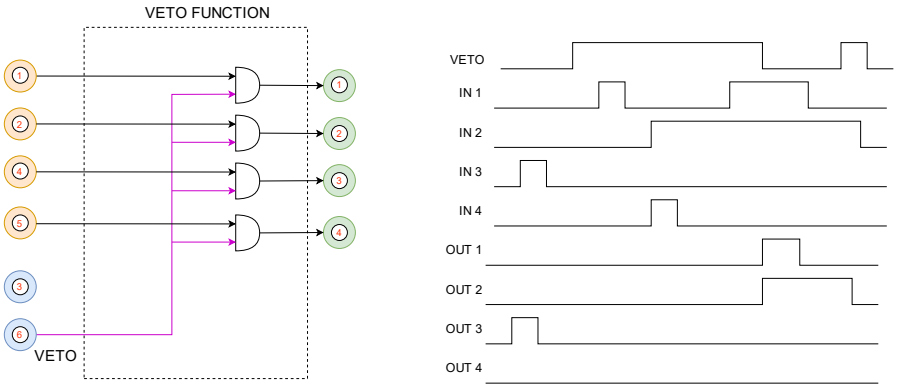
The OR+VETO function generates at the four output channels a signal corresponding to the logic OR of the enabled inputs (CH 1,2,4,5). The output signals are logic high if at least one of the enabled input is a logic-high signal and the VETO signal is a logic-low signal. Input CH 6 is reserved for the VETO signal. Discriminator, Gate&Delay and monostable are omitted in the diagram.

The OR+VETO features the same BYPASS option of the OR function.



VETO

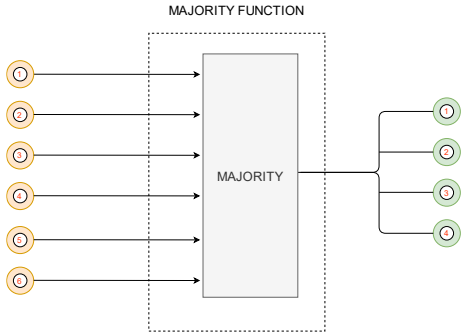
The VETO function is similar to a WIRE conditioned by an AND port. Input CH6 is reserved for the VETO. When the VETO is logic-low, the input is replicated to the correspondent output, while if the VETO is logic-high, the four output are forced to be logic-low signals. Note that input CH4 is sent to output CH3 and input CH5 is sent to output CH4, due to the fact that only standard inputs are used. Discriminator, Gate&Delay and monostable are omitted in the diagram.

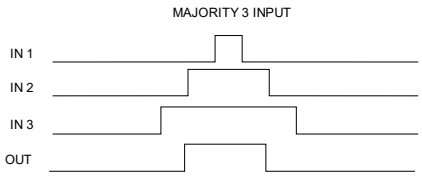


MAJORITY

The MAJORITY function generates at the four output channels a signal corresponding to the logic MAJORITY the inputs. It is possible to enable/disable some given inputs, but the MAJORITY is always performed on the first inputs. For example, to perform the majority

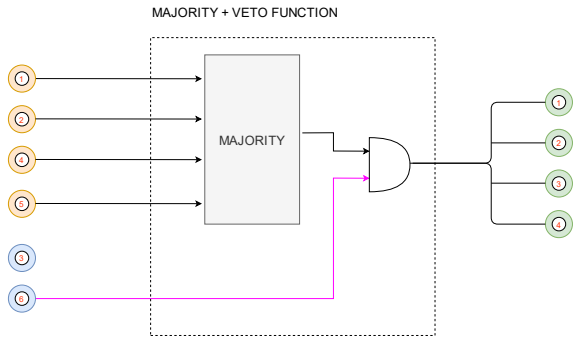
among three channels, input signals must be fed at CH1,2,3. The four output channels are logic-high signals when the majority of the enabled inputs is logic-high. Discriminator, Gate&Delay and monostable are omitted in the diagram.

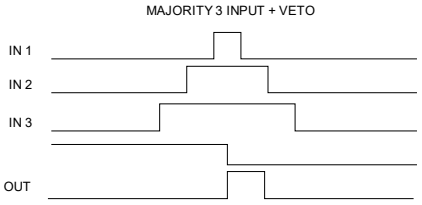




MAJORITY + VETO

The MAJORITY+VETO function generates at the four output channels a signal corresponding to the logic MAJORITY of the enabled inputs (CH 1,2,4,5). It is possible to enable/disable some given inputs, but the MAJORITY is always performed on the first inputs. For example, to perform the majority among three channels, input signals must be fed at CH1,2,4. The four output channels are logic-high when the majority of the enabled inputs is logic-high and the veto is a logic-low signal. Input CH6 is reserved for the VETO. Discriminator, Gate&Delay and monostable are omitted in the diagram.

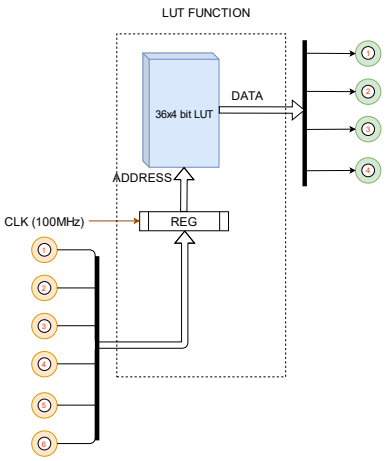




LUT

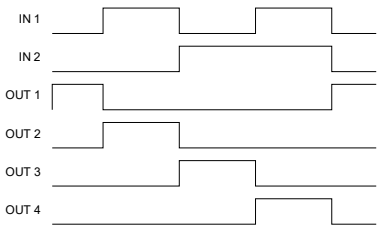
A lookup table (LUT) defined by the user specifies the output signals depending on the input signals. The lookup table can be provided as a file containing a list of all the desired input/output signals combinations. The file can be uploaded from the Web Interface. The LUT is implemented as a RAM relying on a 100 MHz clock to avoid glitches on the output. On the other hand, this introduces a 10ns jitter on the output.

The LUT can be used to implement, for instance, a XOR function, not pre-programmmed in the x1081B unit.



2 BIT LUT CONTENT

0001
0010
0100
1000



COINCIDENCE GATE

The COINCIDENCE GATE function detects and counts the coincidences between input signals (from CH 1,2,4,5). It is possible to set a coincidence window (WIDTH, in steps of 10 ns), with a programmable DELAY (multiple of 10 ns) with respect to an event, or it is possible to use an external GATE signal to be fed at input CH6. The event opening the coincidence could be the first detected commutation on the inputs (FIRST) or the commutation of a specific channel. The channel that leads to the generation of the coincidence window is excluded from the coincidence logic itself. Therefore the coincidence is always to be intended as 1:3, one channel opening the coincidence window and the other ones falling or not inside that window.

The coincidence window can be a fixed value or it can be closed as soon as the first coincidence is detected. This two operating modes apply for different phenomena: the fixed window allows to count the coincidences with respect to the event opening the window, while the variable window allows to identify the first channel in coincidence with the event opening the window.

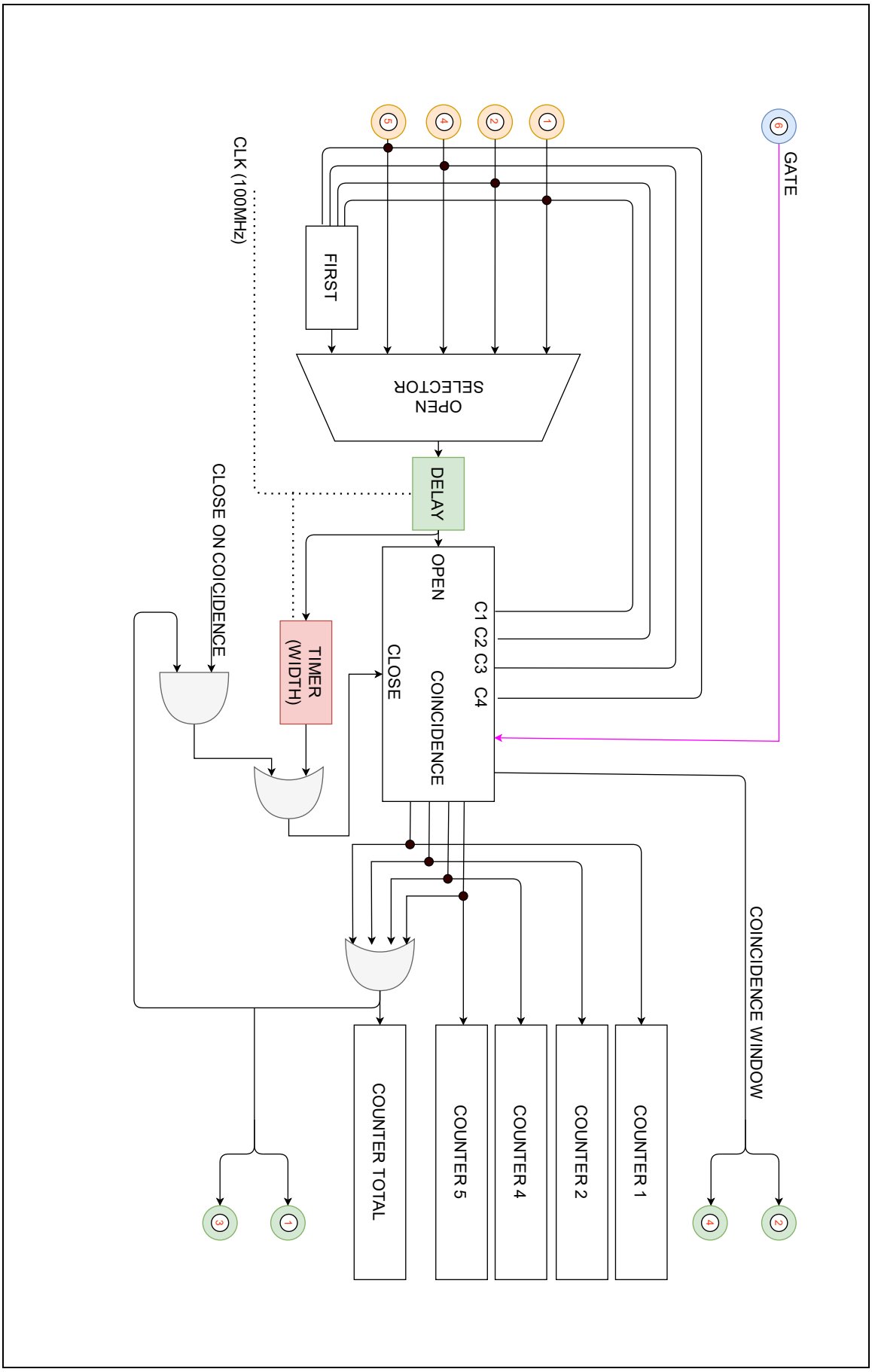
When a coincidence occurs, two different signals are generated as output and duplicated on two channels each. Output CH 2,4 provide a signal equal to the coincidence window width. Output CH1,3, provide a signal which is logic-high each time a coincidence is occurring. The width of CH1,3 output is set by the monostable stage (10 ns if it is bypassed).

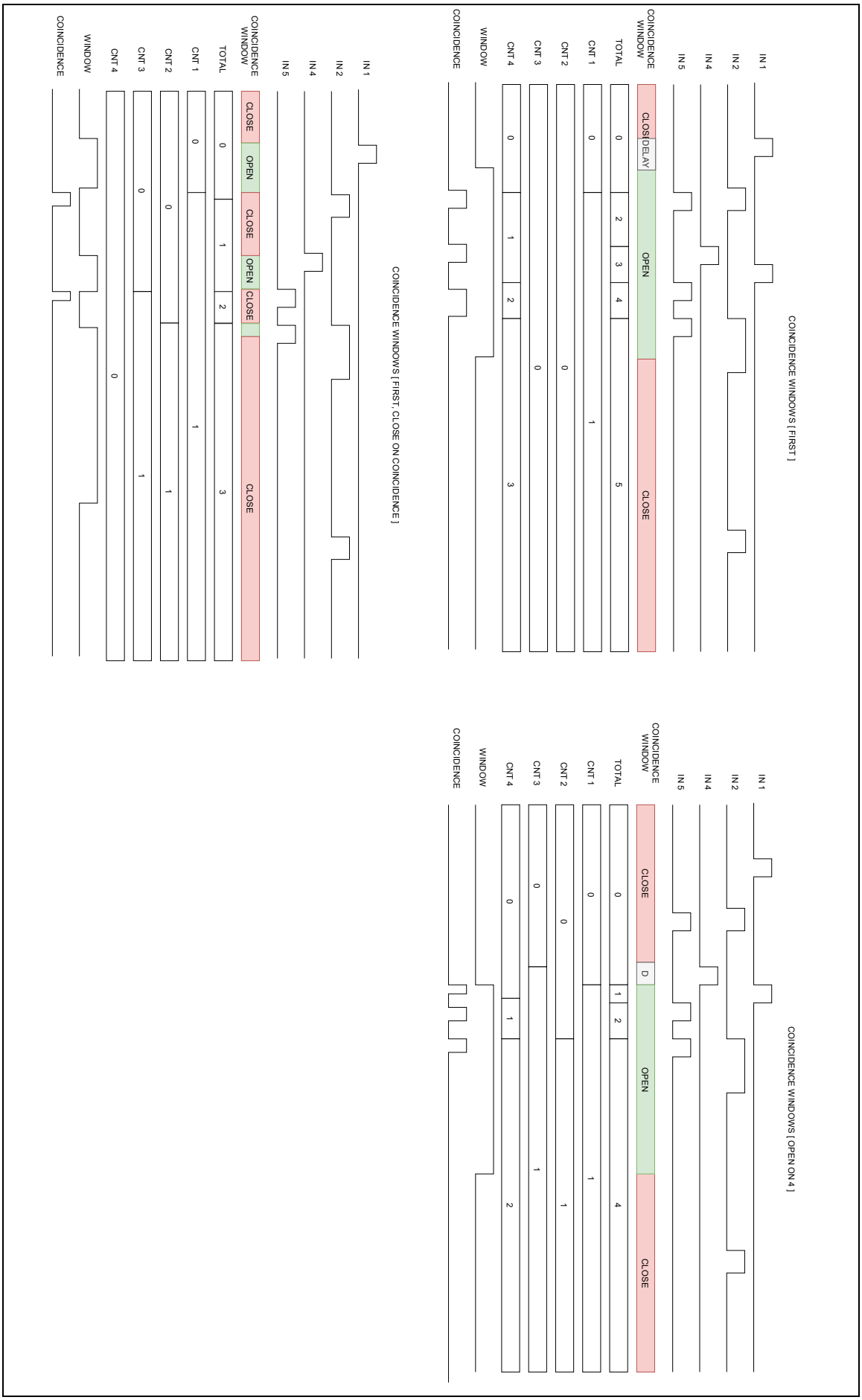
Moreover, the Coincidence Gate function implements five counters: COUNTER TOTAL counts all coincidences, while COUNTER 1,2,4,5 count the coincidences occurring on a specific channel. For example, if CH1 opens the coincidence windows and CH2 falls into that window, COUNTER 2 and COUNTER TOTAL are incremented by one, while the other counters are not incremented. When working in FIRST mode, the counter is incremented basing on the signal opening the coincidence window.

Note: if CH1 opens the coincidence window and CH2,4 falls simultaneously into that window, COUNTER 2 and COUNTER 4 are incremented by one each, but COUNTER TOTAL just counts a single coincidence (i.e. is incremented by one only) and only one output signal is generated at outputs CH1,3.

Note: if simultaneous signals are fed to CH1,2,4,5 , the window is opened by CH1 always, COUNTER 2,4,5 are incremented by one, COUNTER TOTAL is incremented by one.

SCHEME ON THE NEXT PAGES

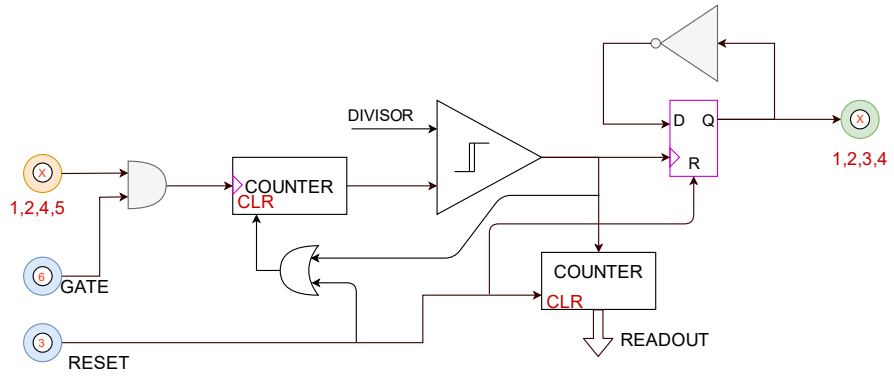

GATE
CLK (100MHz)
FIRST
OPEN SELECTOR
DELAY
CLOSE ON COICIDENCE
TIMER (WIDTH)
OPEN
CLOSE
C1 C2 C3 C4
COINCIDENCE
COINCIDENCE WINDOW
COUNTER TOTAL
COUNTER 5
COUNTER 4
COUNTER 2
COUNTER 1

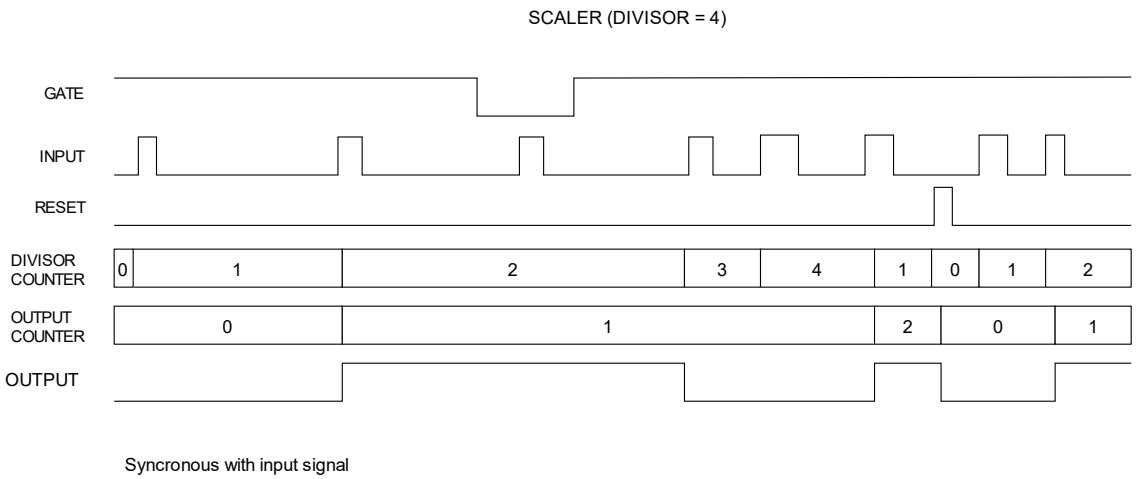

COINCIDENCE WINDOWS [FIRST]
IN 1
IN 2
IN 4
IN 5
COINCIDENCE WINDOW
CLOSE
DELAY
OPEN
CLOSE
TOTAL
0
2
3
4
5
CNT 1
0
1
CNT 2
0
CNT 3
0
CNT 4
0
1
2
3
WINDOW
COINCIDENCE
COINCIDENCE WINDOWS [OPEN ON 4]
IN 1
IN 2
IN 4
IN 5
COINCIDENCE WINDOW
CLOSE
D
OPEN
CLOSE
TOTAL
0
1
2
4
CNT 1
0
1
CNT 2
0
1
CNT 3
0
1
CNT 4
0
1
2
WINDOW
COINCIDENCE
COINCIDENCE WINDOWS [FIRST, CLOSE ON COINCIDENCE]
IN 1
IN 2
IN 4
IN 5
COINCIDENCE WINDOW
CLOSE
OPEN
CLOSE
OPEN
CLOSE
CLOSE
TOTAL
0
1
2
3
CNT 1
0
1
CNT 2
0
1
CNT 3
0
1
CNT 4
0
WINDOW
COINCIDENCE

Counter functions

SCALER

The SCALER function acts on the enabled input channels CH 1,2,4,5 as counter and frequency divider. The SCALER is an asynchronous function, capable of counting up to 130 MHz, with a depth of 32-bit, meaning a total range of nearly $4x10^9$ counts. The frequency of the signal sent to the counter and the correspondent output are equal to the input channel frequency scaled by a user-defined integer even factor. Scaled-down signals are sent to the correspondent output CH1,2,3,4. Input channel CH5 is reserved for the RESET signal: when it is logic-high, all counters are reset. Input channel CH6 is reserved for the GATE: if enabled, the output signals are generated only when the gate is logic-high.

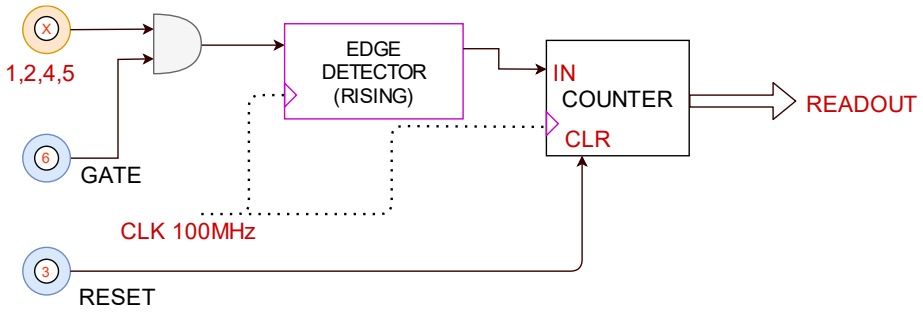


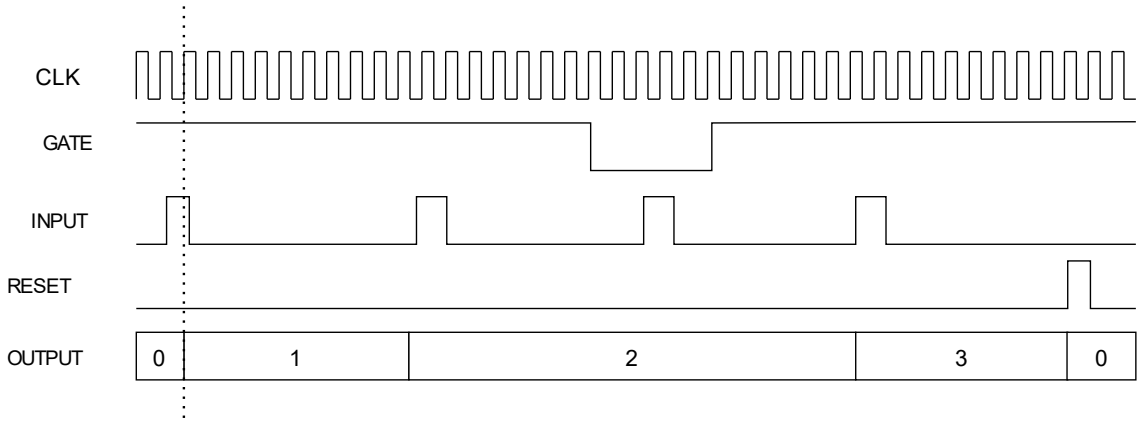


Syncronous with input signal

COUNTER

The COUNTER function counts the pulses on the enabled input channels. It is implemented as a synchronous function relying on a 100 MHz clock and it allows to count up to 40 MHz, with a depth of 64-bit, meaning that the counter never goes in overflow in practical situations. Input CH 3 is reserved for the reset signal: when it is logic-high signal, all counters are reset. Input CH 6 is reserved for the gate: if enabled, the input channels signals are counted only when the gate is logic-high.



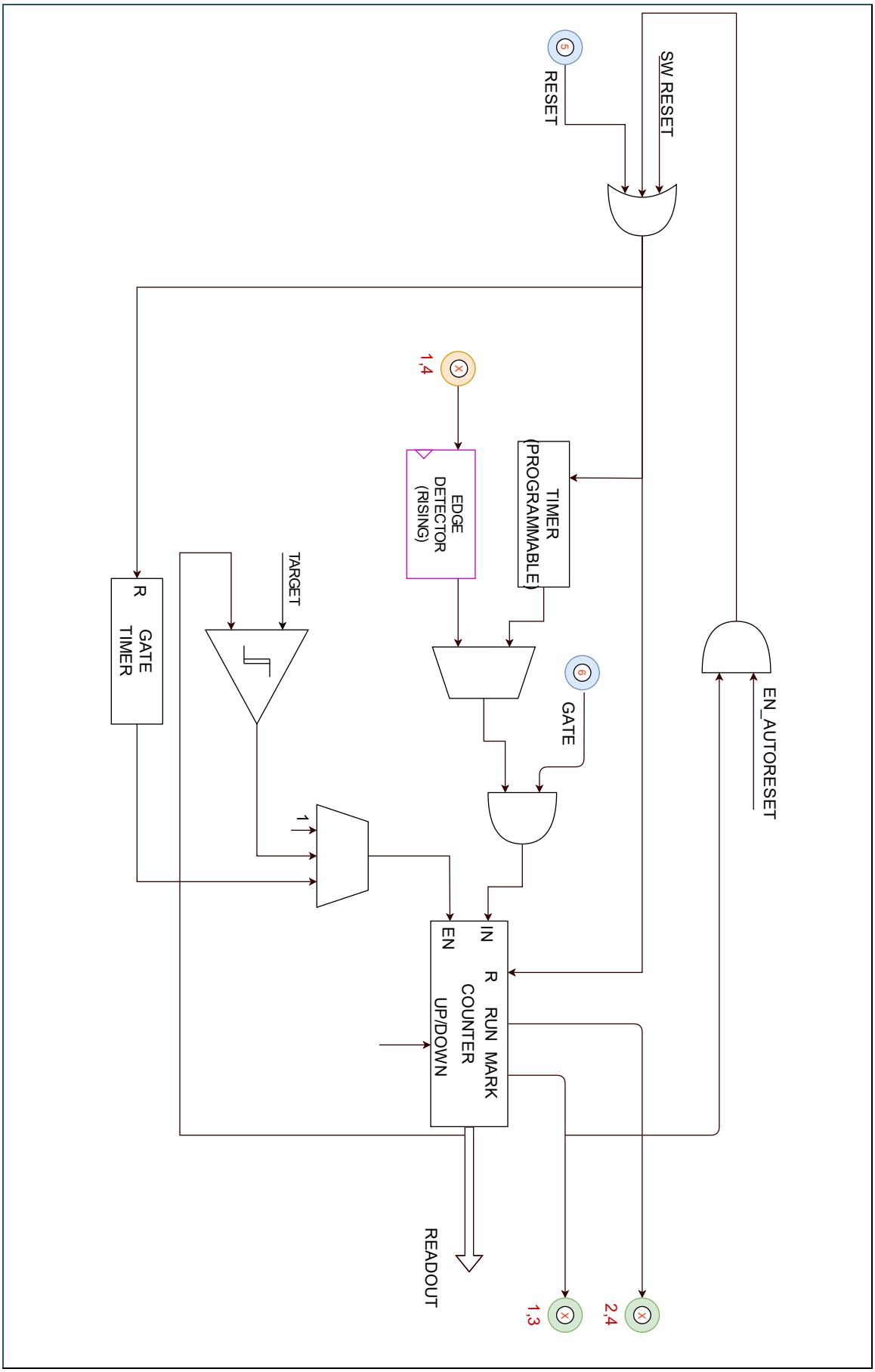


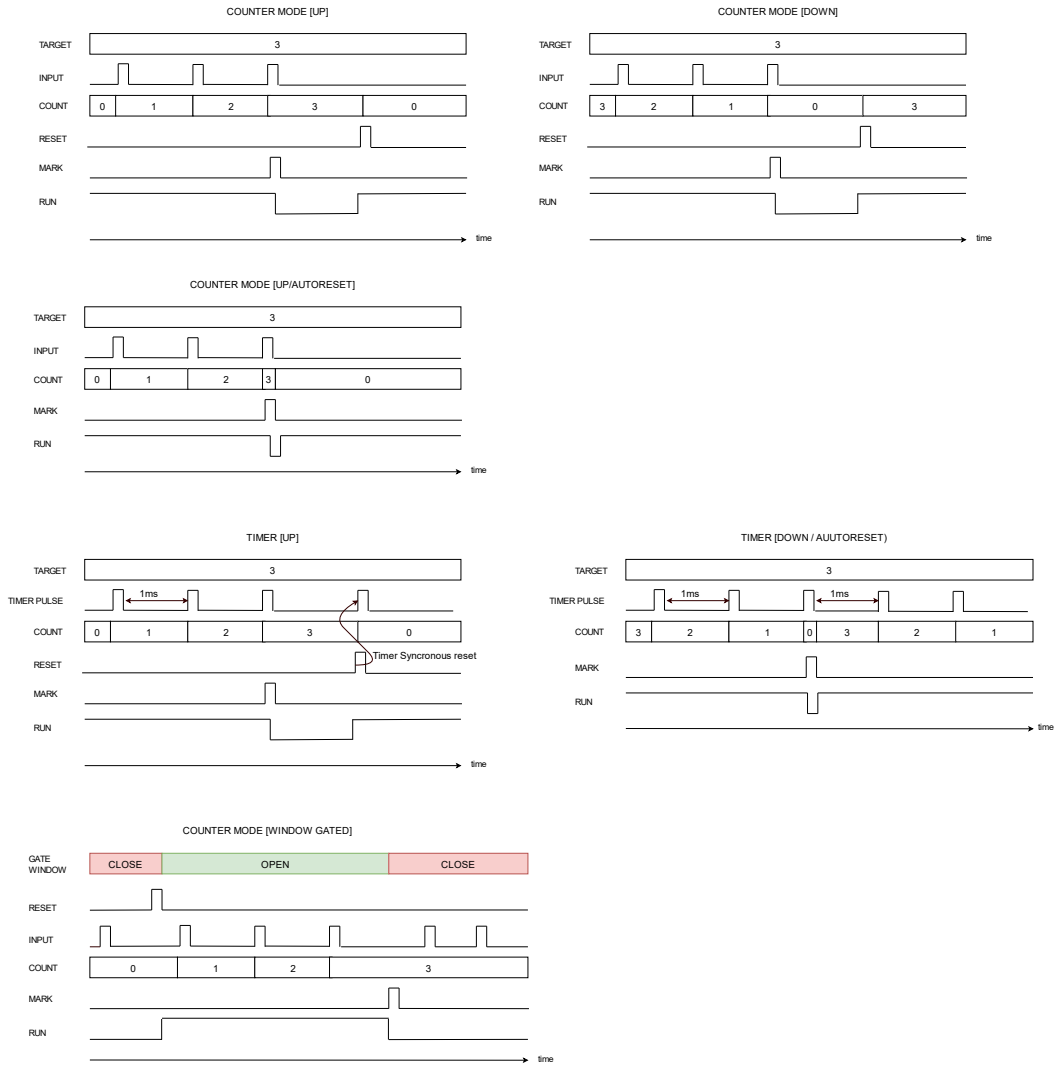
COUNTER TIMER

The COUNTER TIMER function can be used to perform countdown/up counting and timing measurements. The source of the counter can be the internal timer, with selectable period in the range [20 ns ÷ 1 s], or the input CH 1,4. Input CH6 is reserved for the GATE signal, which excludes the timer signals when it is logic-low. A 64-bit counter then measures the number of inputs coming from the timer stage or from the inputs CH 1,4. This counter can be programmed to have a target in time or counts, after which the measurement is reset. It can operate in countup/countdown mode, free running or gate timer. In this latter operating mode, the counts are measured inside a window of specified width (up to 40 s). There is an option to autoreset the counter and timer each time a target is reached, so that the measurement is automatically restarted.

Output CH 1,3 provides the MARK signal, which is logic-high when the counter reaches the preset target. Output CH 2,4 provides the RUN signal, which is logic-high during the counting process.

SCHEME ON THE NEXT PAGES


5
RESET
SW RESET
1,4
EDGE DETECTOR (RISING)
TIMER (PROGRAMMABLE)
TARGET
R GATE TIMER
6
GATE
EN_AUTORESET
1
IN
EN
R RUN MARK
COUNTER
UP/DOWN
READOUT
1,3
2,4



CHRONOMETER

The CHRONOMETER function allows to measure time between events, in different configurations. It relies on a 100 MHz clock in order to count and as a timebase, meaning it has a resolution of 10 ns.

START/STOP mode: the timer counts from the START on input CH1 until the STOP on input CH2.

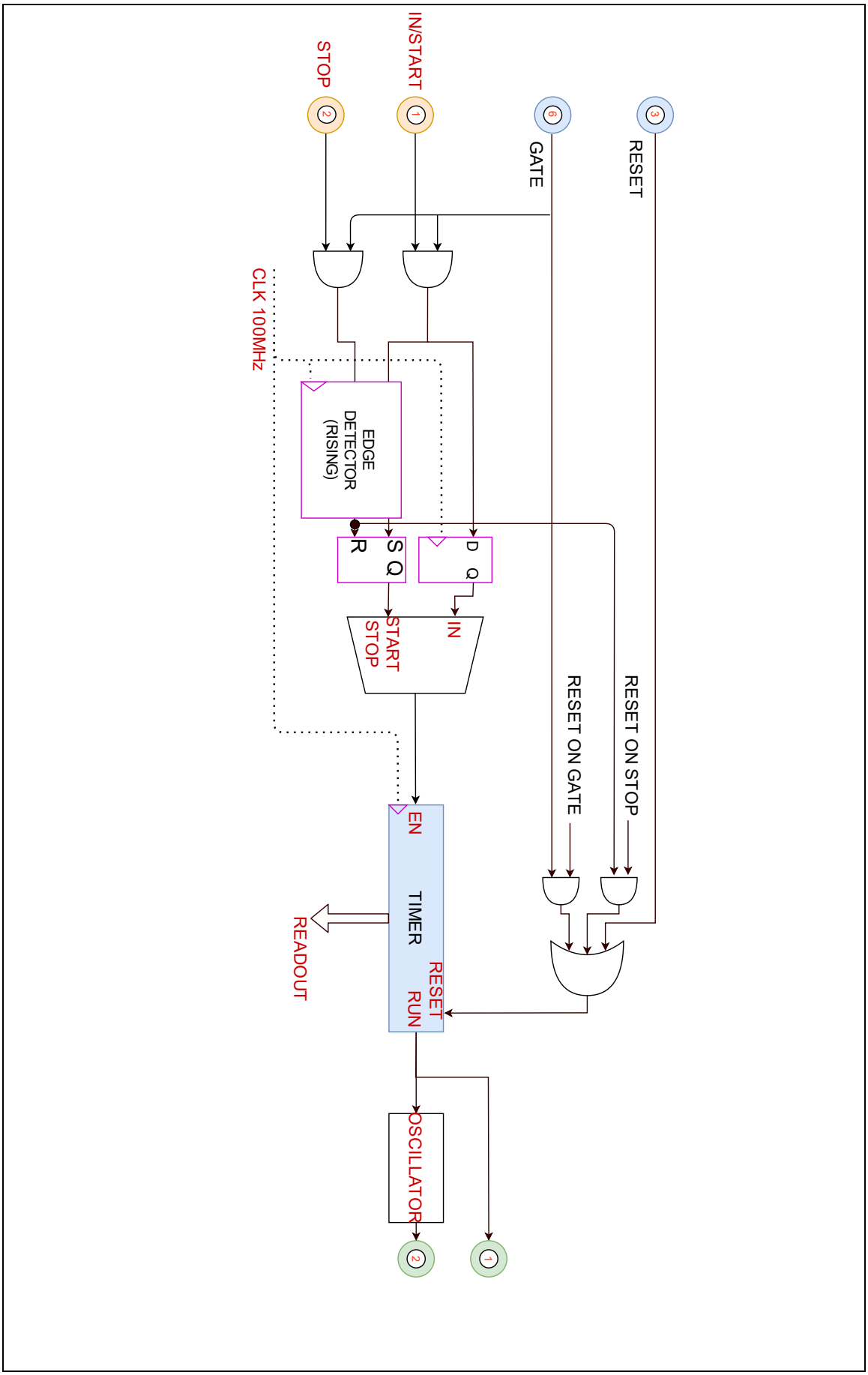
IN mode: the timer counts for all the time that the input CH1 is logic-high.

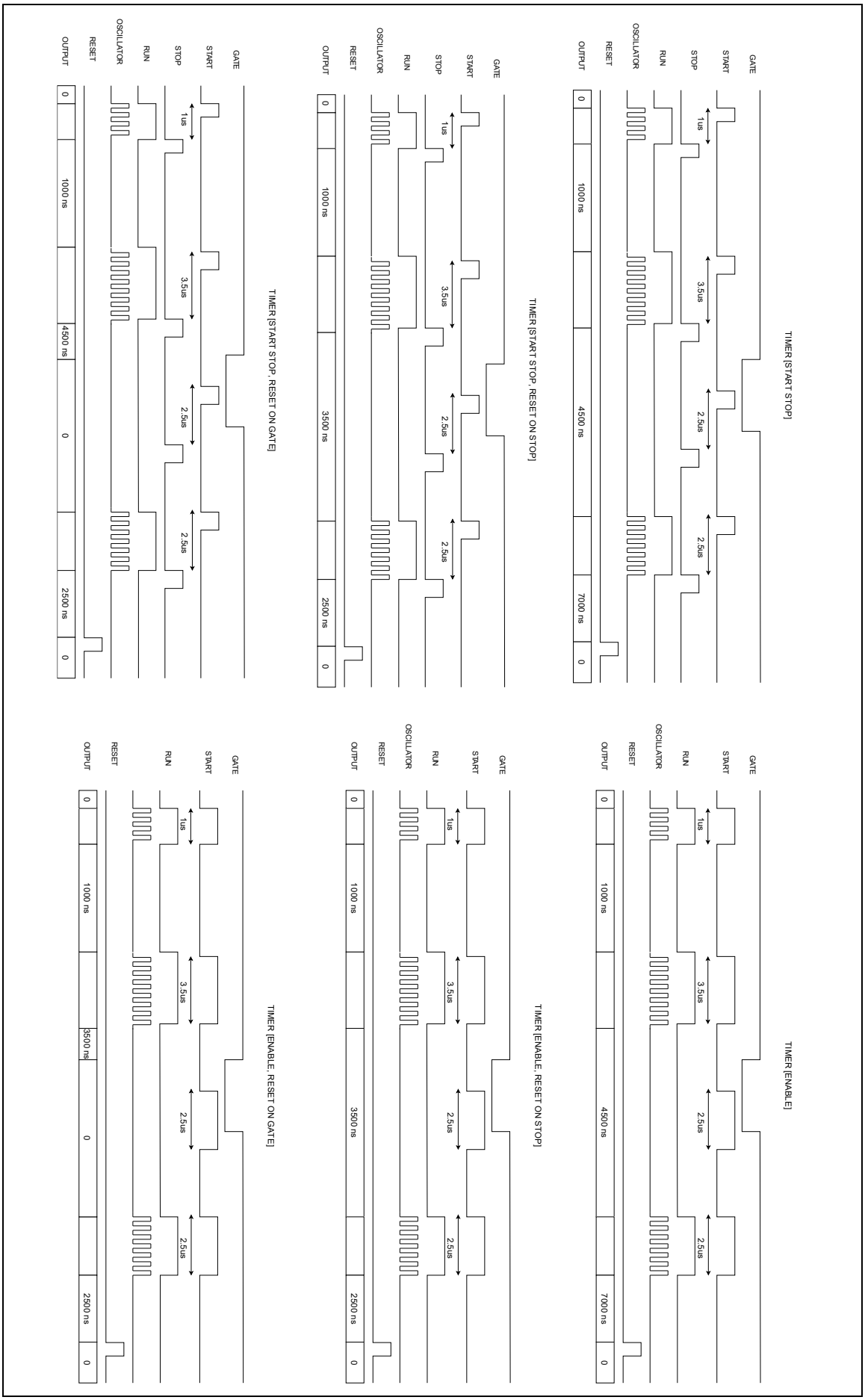
Moreover, the internal TIMER can operate in two different modes: integral counting or reset-on-stop mode. In the first mode, for example, it is possible to sum the time intervals of many START/STOP sequences. In the second mode, the timer is reset every time a STOP signal is detected, so that it restarts from zero at the subsequent START.

Input channel 3 is reserved for the RESET signal: when logic-high, the measured time is set to zero. Input CH 6 is reserved for the GATE signal: when enabled, the time is measured only if the gate is logic-high. It is also possible to enable the RESET ON GATE option to reset the timer on the rising front of the gate.

While the timer is counting, the output CH1 (RUN) is kept logic-high and the output CH2 (OSCILLATOR) generates a signal with user-defined frequency.

SCHEME ON THE NEXT PAGES


STOP
IN/START
GATE
RESET
CLK 100MHz
EDGE DETECTOR (RISING)
S
R
Q
D
Q
START STOP
IN
RESET ON GATE
RESET ON STOP
EN
TIMER
READOUT
RESET
RUN
OSCILLATOR

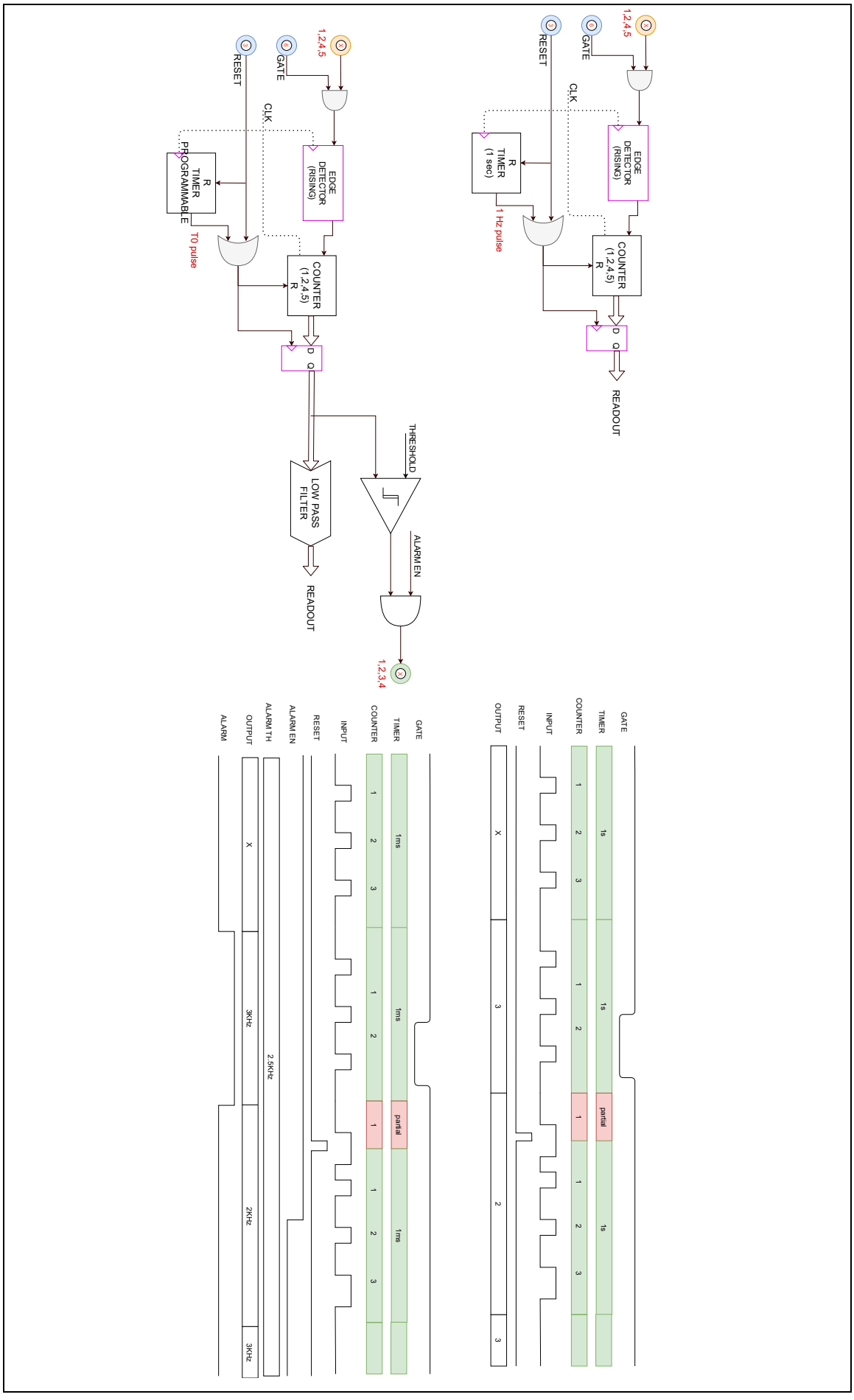

TIMER [START STOP]
GATE
START
STOP
RUN
OSCILLATOR
RESET
OUTPUT
1us
3.5us
2.5us
0
1000 ns
4500 ns
7000 ns
TIMER [START STOP, RESET ON STOP]
3500 ns
2500 ns
TIMER [START STOP, RESET ON GATE]
4500 ns
TIMER [ENABLE]
TIMER [ENABLE, RESET ON STOP]
TIMER [ENABLE, RESET ON GATE]

RATE METER and ADVANCED RATE METER

The RATE METER function measures the frequency of signals on the enabled input channels. It is implemented as a synchronous function relying on a 100 MHz clock and it allows to measure rates up to 40 MHz. It is made of a counter, counting the input signal transitions, and a timer gerating 1Hz pulses that is used to sample and reset the counter. Therefore, counting the number of transitions occuring in 1 sec, it provides directly the frequency in Hz. The measurement on the Display is updated once a second. Input CH 3 is reserved for the RESET signal: when logic-high, the frequency measurement on all input channels is reset. Input CH 6 is reserved for the GATE signal: if enabled, the input frequencies are measured only when the gate is logic-high.

The ADVANCED RATE METER acts exactly as the RATE METER function with additional features. For instance, it helps in situations where the rate is particularly low, allowing to set the time interval for the frequency measurement in the range [1ms ÷ 1hour]. Moreover, it is possible to apply a low-pass filter on the output data to average the rate values. The measurement can be also sent to a comparator to set an alarm on the rate for each input channel.

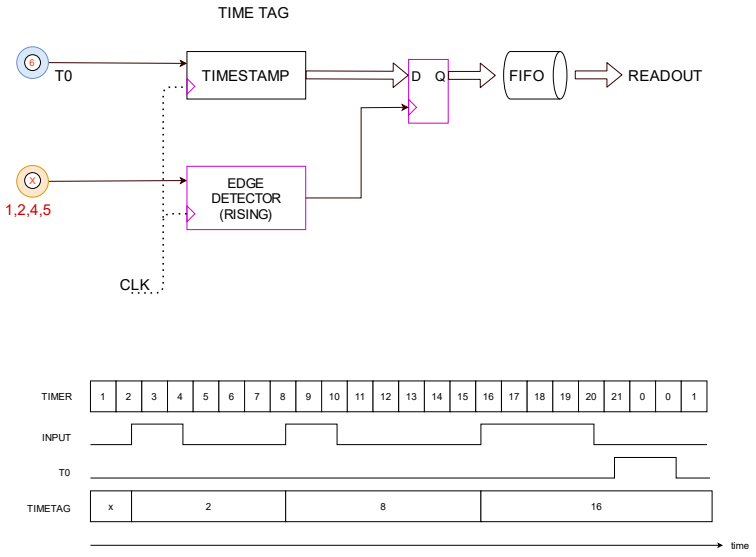
SCHEME ON THE NEXT PAGE


1,2,4,5
GATE
RESET
CLK
EDGE DETECTOR (RISING)
R TIMER (1 sec)
1 Hz pulse
COUNTER (1,2,4,5) R
D Q
READOUT
1,2,4,5
GATE
RESET
CLK
EDGE DETECTOR (RISING)
R TIMER PROGRAMMABLE
T0 pulse
COUNTER (1,2,4,5) R
D Q
THRESHOLD
LOW PASS FILTER
READOUT
ALARM EN
1,2,3,4
GATE
TIMER
COUNTER
INPUT
RESET
OUTPUT
1s
1
2
3
partial
X
2
ALARM EN
ALARM TH
ALARM
1ms
2.5KHz
3KHz
2KHz

Timing functions

TIME TAGGING

The TIME TAGGING function allows to measure the timestamps of the input signals with respect to a common T0 signal. Starting from the T0, a 64-bit counter is incremented in steps of 10 ns. As soon as one of the enabled input CH 1,2,4,5 is commutating, the value of the counter is captured and read out through a FIFO. Data are dumped on a file containing a list of (CH, Timestamp in ns) and it can be downloaded via Web Interface.



TIME OF FLIGHT

The TIME OF FLIGHT function calculates online the ToF spectrum of the events fed to input CH 1,2,4,5, referring to a T0. The T0 can be generated internally or fed externally at input CH 6. Moreover a VETO signal can be fed at input CH 3 to discard timing measurements when the signal is logic-high. The ToF spectrum is calculated independently for each enabled input CH 1,2,4,5, meaning that is possible to have up to 16 ToF measurements on a single x1081B unit, with maximum 10 ns resolution.

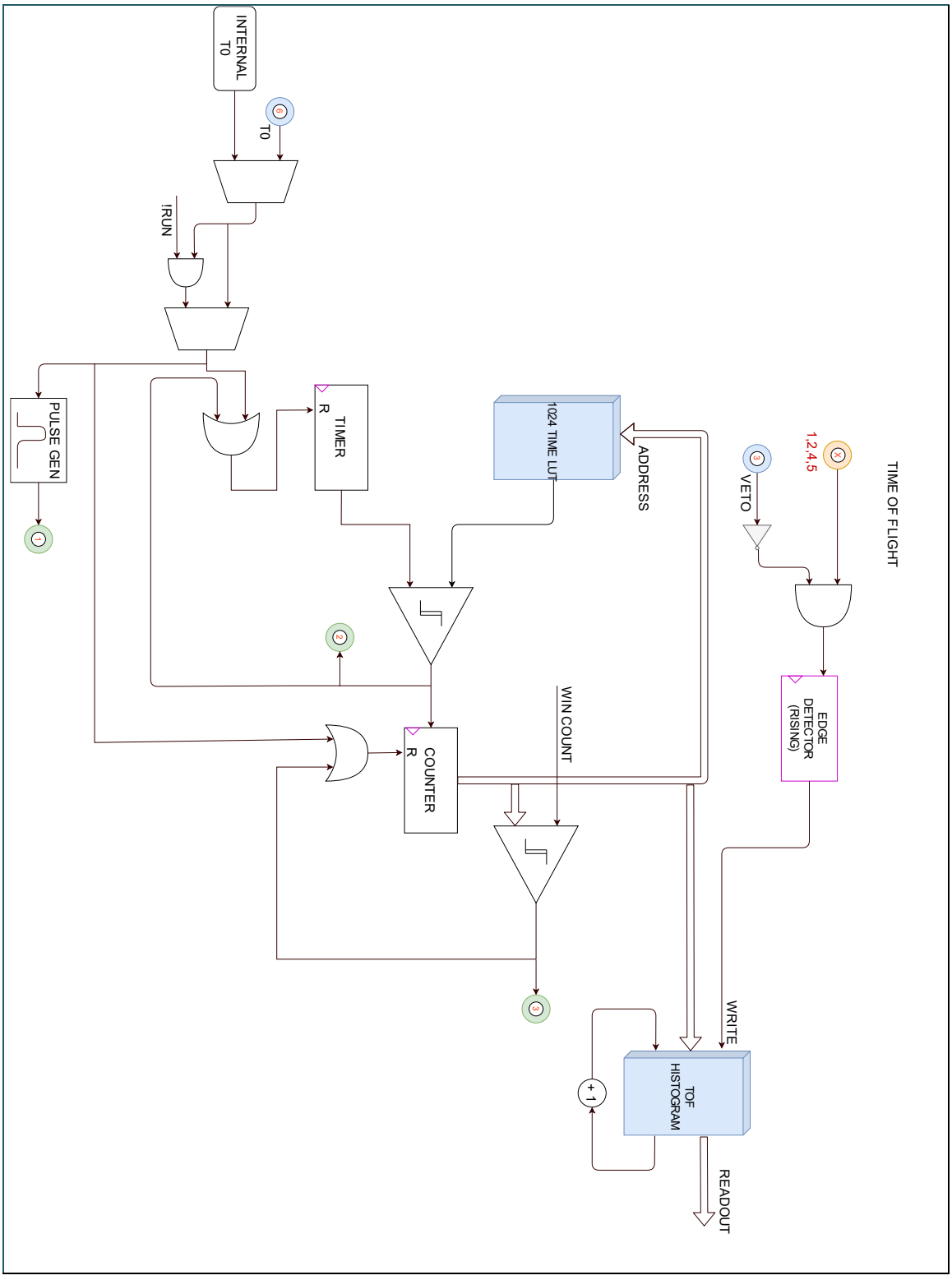
The ToF spectrum is 1024 bins and it can be rebinned into windows whose width can be in the range 10 ns ÷ 1 s. It is also possible to load a file to set a sequence of different arbitrary windows, in order to maximize the resolution in the part of interest.

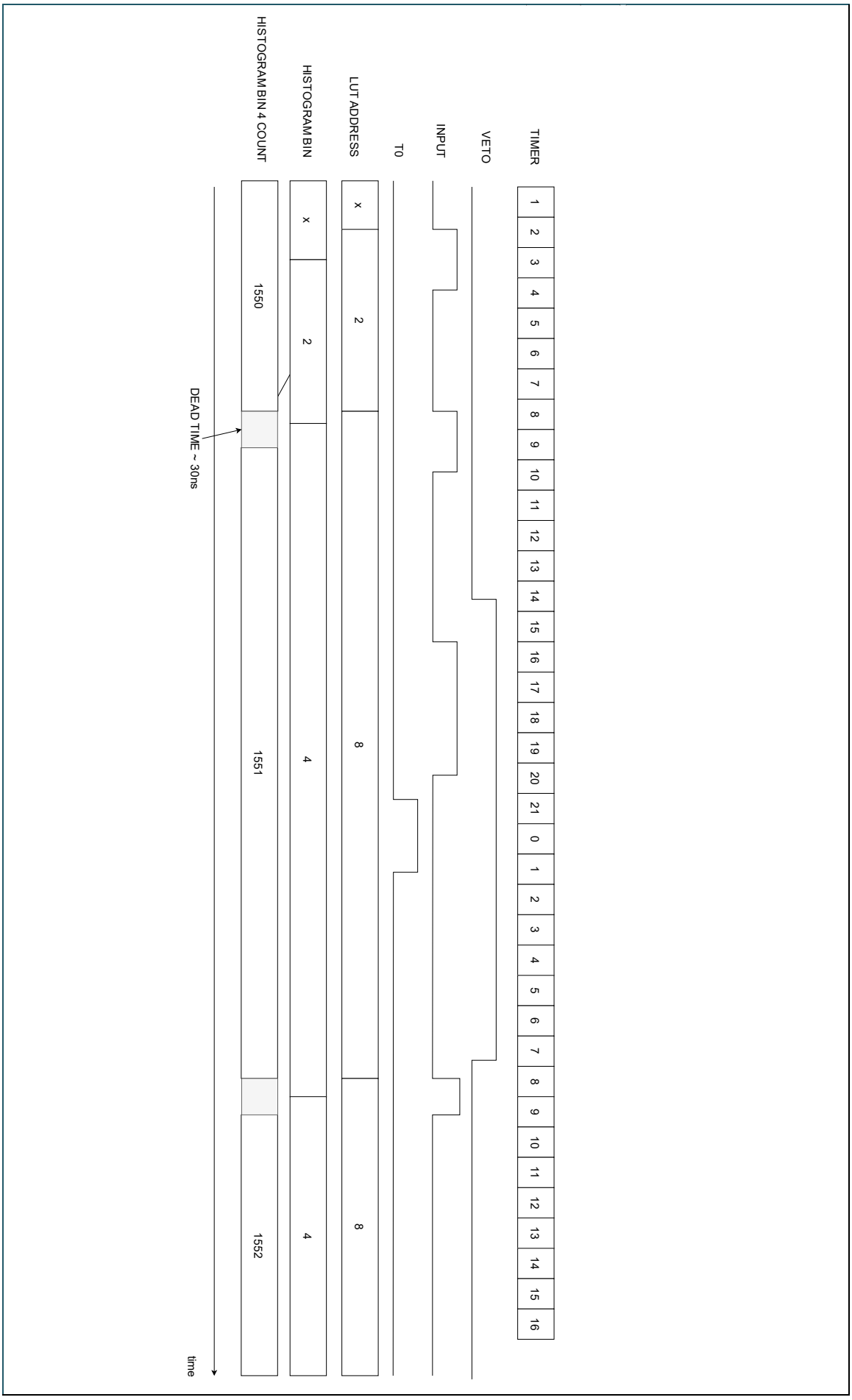
It is implemented as a counter starting with T0 and ending at the end of the first window available into the 1024 bins. At the end of the first window another special counter is incremented by one and it shifts a register to scan the LUT containing the information on the binning of the ToF spectrum: in this way, the second window is opened and the counts measurement is replicated for each window defined in the LUT. The scan ends at the end of the 1024 bins. There is an option available to reset the ToF measurement upon T0 arrival. The dead time between consecutive measurements is 30 ns.

Exploiting this process, the TIME OF FLIGHT function generates, for each input channel CH 1,2,4,5, a histogram of the signal time of arrival with respect to a common T0 signal.

Output CH 1 provides a 10 ns pulse when a T0 is detected. Output CH 2 provides a pulse when a time window ends. Output CH 3 provides a pulse at the end of the last timing window.

SCHEME ON THE NEXT PAGES


INTERNAL T0
T0
!RUN
PULSE GEN
R
TIMER
1024 TIME LUT
ADDRESS
VETO
1,2,4,5
TIME OF FLIGHT
EDGE DETECTOR (RISING)
WIN COUNT
R
COUNTER
WRITE
+ 1
TOF HISTOGRAM
READOUT

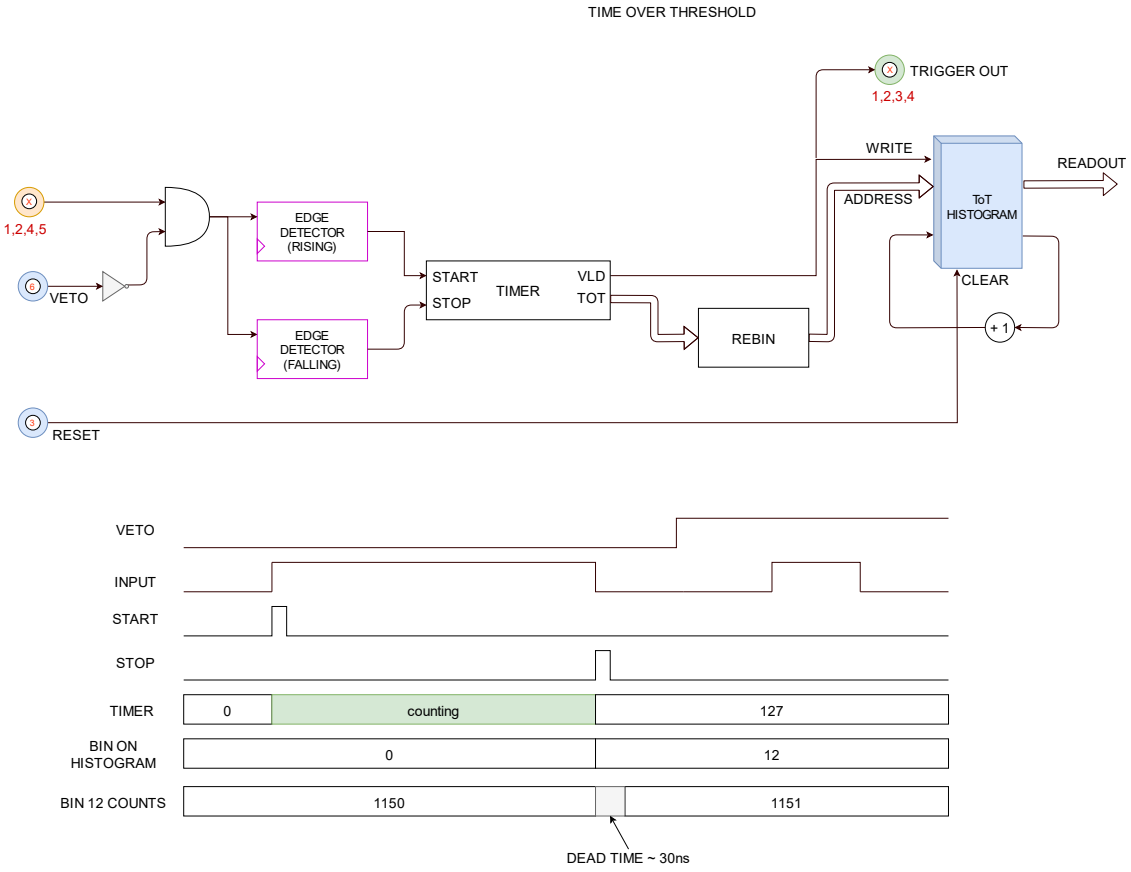

TIMER
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
VETO
INPUT
T0
LUT ADDRESS
x
2
8
8
HISTOGRAM BIN
x
2
4
4
HISTOGRAM BIN 4 COUNT
1550
1551
1552
DEAD TIME ~ 30ns
time

TIME OVER THRESHOLD

The TIME OVER THRESHOLD function allows to measure the time during which a signal on input CH 1,2,4,5 is logic-high. It is implemented as an edge detector and a timer, in order to measure the time between the positive and the negative edge of the signal. The timer output is sent to a rebinning block which allows to extend the dynamic up to few s. The ToT spectrum is calculated independently for each enabled input CH 1,2,4,5, meaning that is possible to have up to 16 ToT measurements on a single x1081B unit, with maximum 10 ns resolution. The dead time between consecutive measurements is 30 ns.

Moreover a VETO signal can be fed at input CH 6 to discard timing measurements when the signal is logic-high. Input CH 3 is reserved for a reset, which acts as a clear of the ToT spectrum when the signal is logic-high.

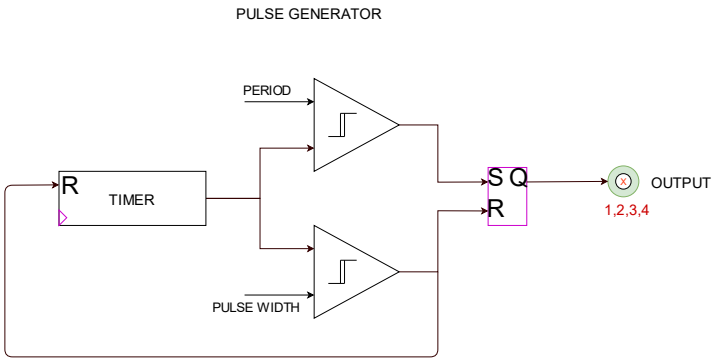
Output CH 1,2,3,4 provides a TRIGGER OUT signal each time the negative edge of the correspondent input signal is detected. Note that input CH4 corresponds to output CH3 and input CH5 is sent to output CH4, due to the fact that only standard inputs are used.



Generator functions

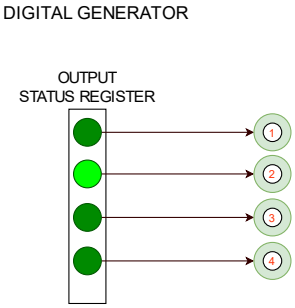
PULSE GENERATOR

The PULSE GENERATOR allows to generate logic pulses with user-defined frequency and width. It is implemented as a synchronous counter relying on a 100 MHz clock, meaning that the period and the width can be set with a resolution of 10 ns. When the counter reaches the period value, it drives a logic-high signal, while reaching the width value causes a reset and, therefore, the signal is forced to logic-low state again.



DIGITAL GENERATOR

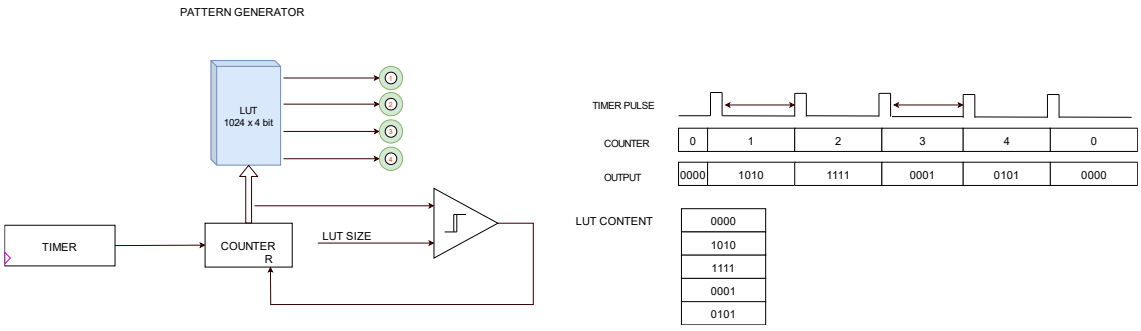
The DIGITAL GENERATOR function allows to manually set a logic state (high or low) of each enabled output.



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 is provided by a 1024 LUT, which can be uploaded a file through the Web Interface. Each line of the file contains the information on the desired logic status of the outputs in the format 0/1 (for example 0010 means all output are logic-low except for CH 3 which will be logic-high). At the end of the pattern (i.e. at the end of the file) the sequence restart from the beginning.

A timer generates the timebase on which the patter generator relies. This timer can be therefore used to select the speed at which the LUT must be scanned, defining the frequency of the pattern. The period can be set in the range [10 ns ÷ 40 s].



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 N1081B in a powered NIM crate or after plugging the power chord in the DT1081B, it is possible to switch it on. At power on, the x1081B 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 12.2: the touchscreen display of the N1081B during boot process (left) and programming process (right).

When the instrument startup is finished, the *Main Menu* view is displayed (see Figure 12.3). 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 x1081B 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.

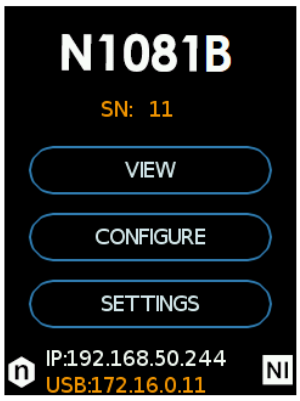


Figure 12.3: the *Main Menu* of the N1081B on the Touchscreen Display.

For more information about how to use each tab of the touchscreen to set the module I/Os and functions, refer to Chap. **Touchscreen Display Guide.**

Remote Control

Alternatively to the usage of the touch screen display, it is possible to set and monitor the x1081B 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 12.3**). 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 192.168.50.244, the Ethernet port of the PC could be set with static IP 192.168.50.10

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.

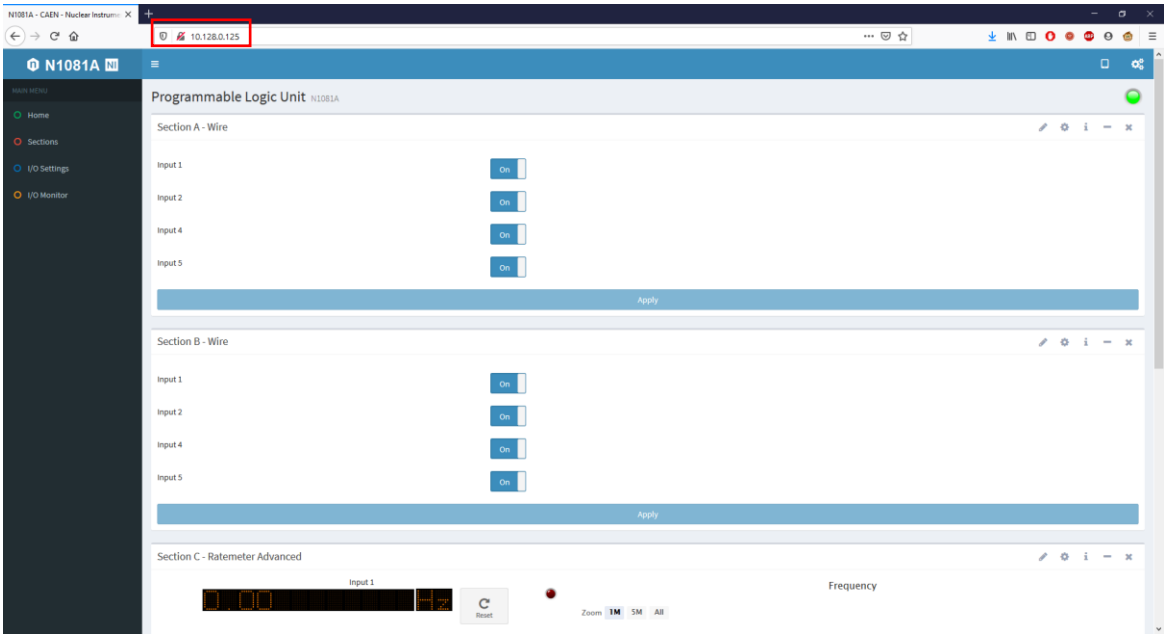


Figure 12.4: general view of the x1081B Web Interface home page. In the Web Browser search tab, the IP address of the x1081B is highlighted.

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

13 Quick Start

In this chapter we describe an operative procedure to use the x1081B 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 x1081B needs to be configured in three aspects:

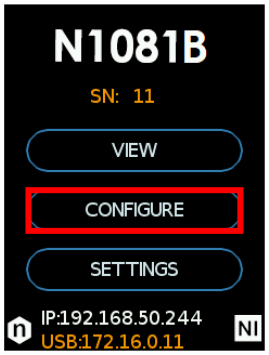
- Function configuration
- Input settings
- Output settings

We take the N1081B as example for this Quick Start Guide.

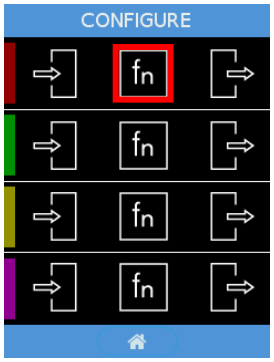
How to configure a function

Follow this step-by-step procedure to configure, for example, a RATE METER for section A of the N1081B:

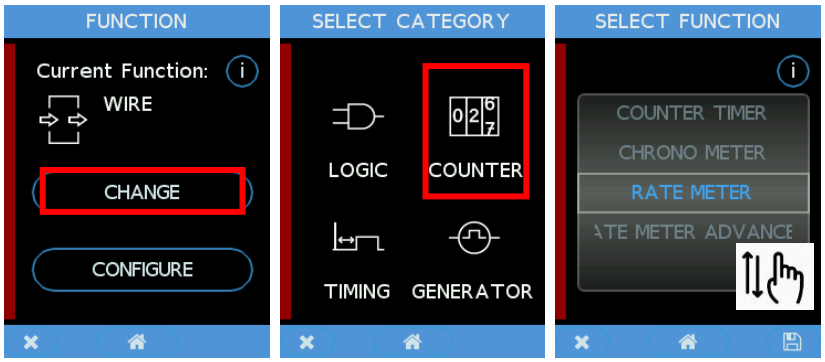
- From the main menu tap on the **CONFIGURE** button



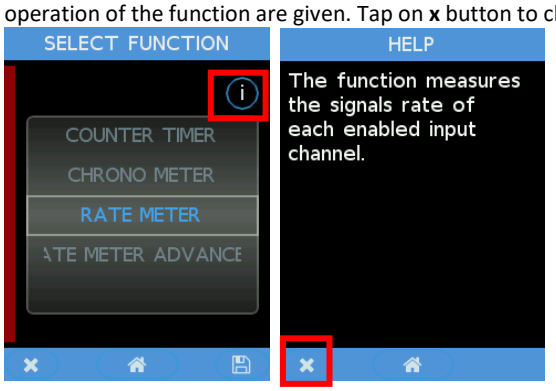
- The subsequent menu is divided in four rows, one for each section of the board, and gives access to the configuration of inputs, function and outputs. Tap on fn button in the top row, to choose a function for section A.



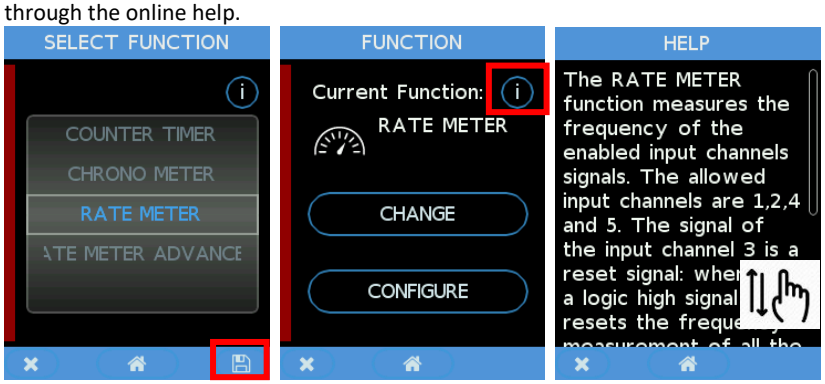
- The currently set function is showed (in this case a WIRE function). It is possible to read the online help about that function, change it or configure the parameters of the currently set function. In this example we want to change it to RATE METER and set the parameters for this function. In order 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.



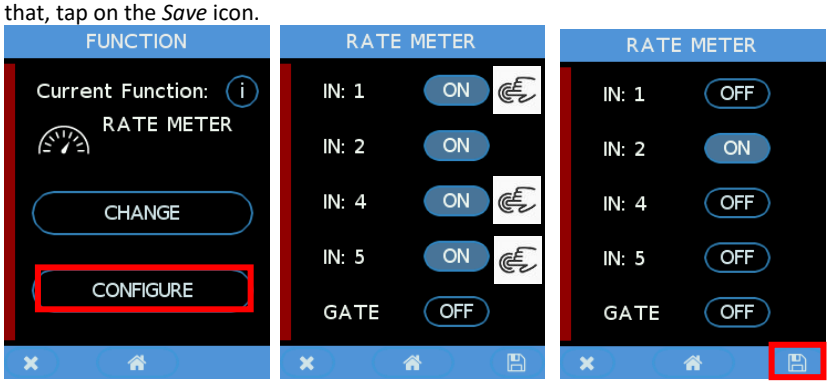
- Before going ahead, it is possible to have a look at the online help for this function. Press the info button to access the online help (scroll on the touchscreen to read all the text if needed). Basic information about the operation of the function are given. Tap on **x** button to close it.



- 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

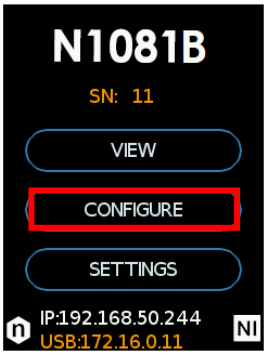
Note: refer to Sec. **Available Functions** and to the online help to understand the operation and the parameters of other functions. Some functions are labeled as WEB ONLY: these can be configured only via web interface (refer to **Web Interface**).

How to set the Input

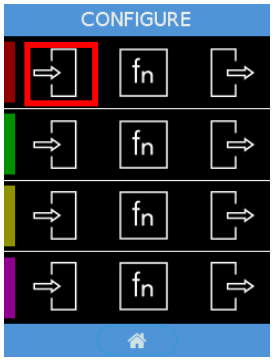
Once the function of a certain section is configured, it is possible to configure the inputs accordingly. In the following we refer to section A, configured as a RATE METER. We are assuming we want to measure TTL signals on input 1 only.

Follow this step-by-step procedure to configure the inputs for section A of the N1081B:

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

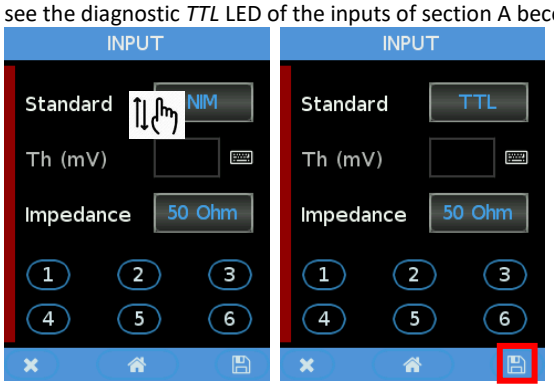


- The subsequent menu is divided in four rows, one for each section of the board, and gives access to the configuration of inputs, function and outputs. Tap on  button in the top row, to configure the inputs of section A.



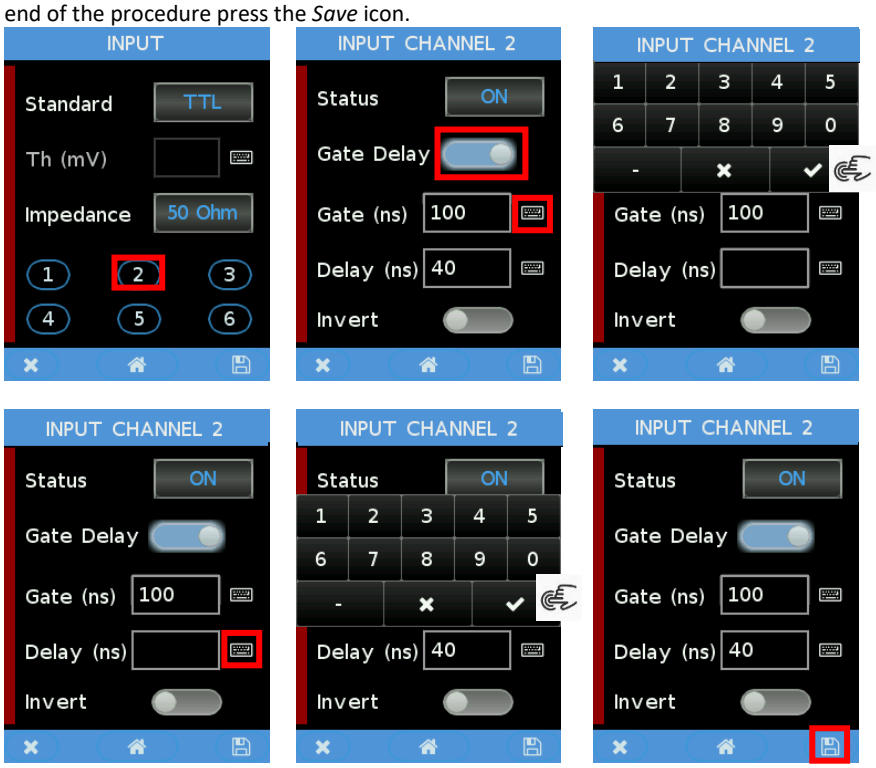
- In the subsequent tab, it is possible to set the general settings for the inputs of section A. It is possible to set the *Standard* (NIM, TTL , DISC) and the *Impedance* (50 Ohm or 1 kOhm) to be used for the input signals. The DISC option allows to discriminate the input signal with a programmable voltage threshold (0-1.8 V range with 25 mV sensitivity) 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.

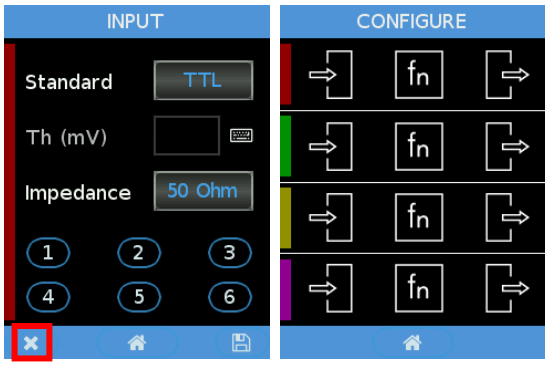


- Now it is possible to set individual parameters for the input channels if needed. By pressing one of the number button, the correspondent input channel view will be opened to set some parameters independently for each input channel. *Status* allows to enable or disable the channel. The lenght and the 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.

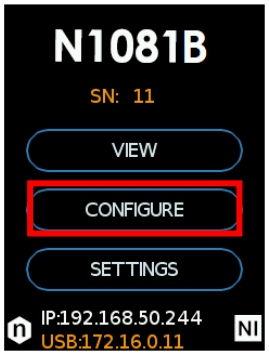


How to set the Output

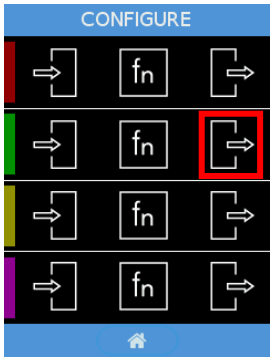
Once the function of a certain section is configured, it is possible to configure outputs accordingly. In the following we refer to section B, configured as a PULSE GENERATOR with fixed statistics, 1900 Hz rate and 150 ns width of the pulses. **We are assuming we want to generate a TTL signal on output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

Follow this step-by-step procedure to configure the outputs for section B of the N1081B:

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

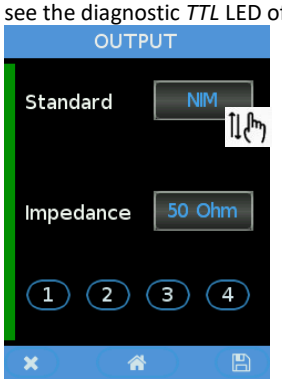


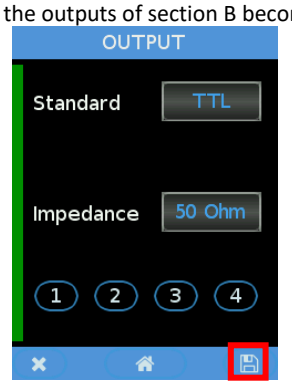
- The subsequent menu is divided in four rows, one for each section of the board, and gives access to the configuration of inputs, function and outputs. Tap on  button in the second row, to configure the outputs of section B.



- 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.

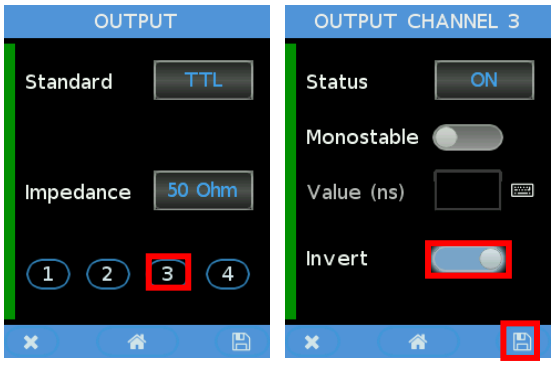
  According to our example, scroll to select TTL and leave 50 Ohm impedance. Tap on the *Save* icon. You should see the diagnostic *TTL* LED of the outputs of section B becoming orange.



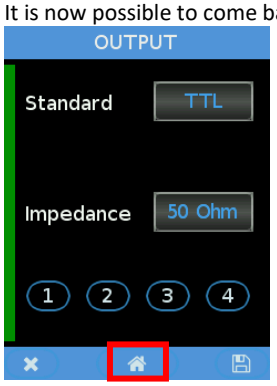


- Now it is possible to set individual parameters for the output channels if needed. By pressing one of the number button, the correspondent output channel view will be opened to set some parameters independently for each output channel. The *Status* allows to enable or disable the channel. The time 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.



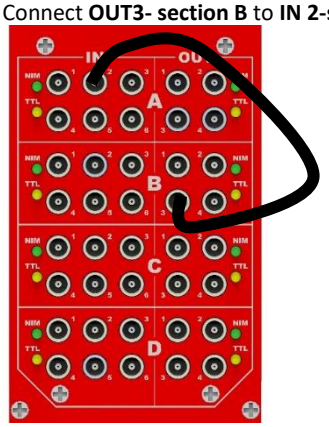
Monitoring the unit

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.

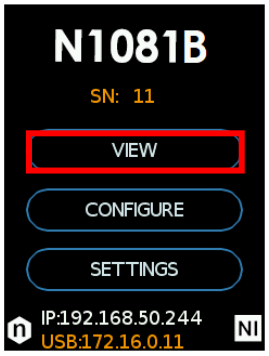
In the following we assume we have set RATE METER function in section A, a PULSE GENERATOR in section B and TTL I/Os, as explained in Secs. **How to configure a function, How to set the Input**, **How to set the Output.** We want to measure the output 3 of section B using the input 2 of section A.

Follow this step-by-step procedure to measure the pulse frequencies with the N1081B and monitor the acquisition:

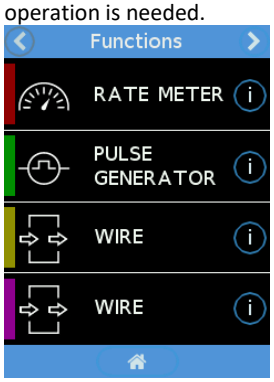
- Connect **OUT3- section B** to **IN 2-section A** with a LEMO-LEMO cable.



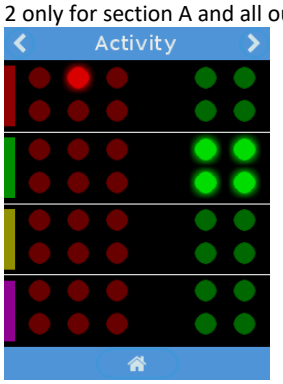
- From the main menu tap on the **VIEW** button



- 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.

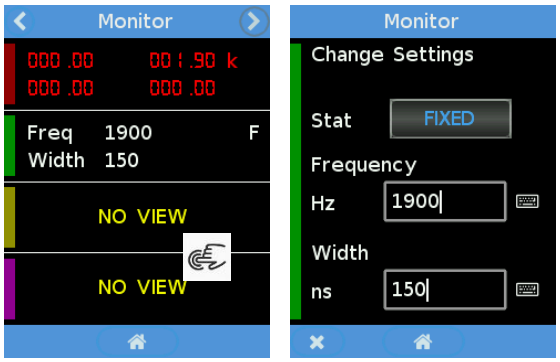


- Tap on the right arrow in top toolbar to view the next monitoring tab. Here is possible to visualize the *Activity* of the unit as ON/OFF LEDs corresponding to the I/Os of the board. If a LED is switched ON, it means that the corresponding channel is active: in case of an input channel (red LED), it 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 Chap. **Touchscreen Display Guide** and to the online help to understand the parameters of the 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 Par.**Available Functions.**

14 Touchscreen Display Guide

After insertion of the N1081B in a powered NIM crate or after plugging the power chord in the DT1081B, it is possible to switch it on. At power on, the x1081B 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.

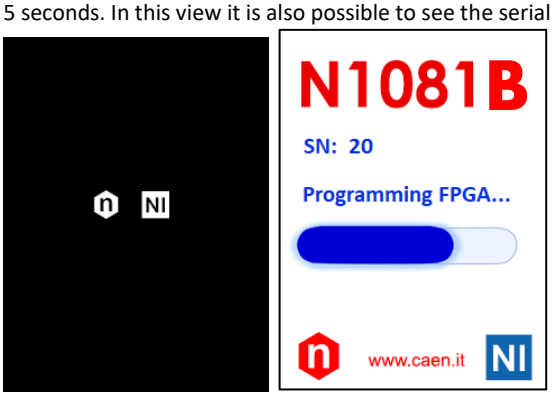


Figure 14.1: the touchscreen display of the N1081B during boot process (left) and programming process (right).

When the instrument startup is finished, the *Main Menu* view is displayed (see **Figure 12.3**). On top, the module serial number or PID 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 x1081B 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.

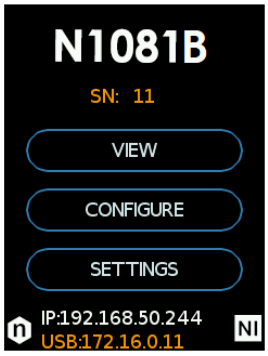


Figure 14.2: the *Main Menu* of the N1081B on the Touchscreen Display.

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 14.3: 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 x1081B, 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.

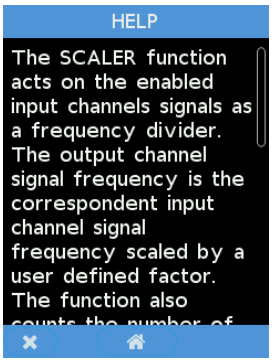


Figure 14.4: the online Help accessible from a configuration tab, explaining briefly how to use the SCALER function

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.

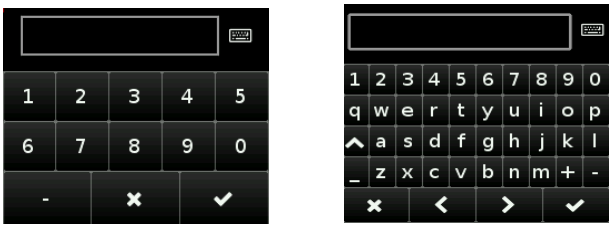


Figure 14.5: keyboards available for some tabs of the touchscreen GUI.

Setting the unit

The *CONFIGURE* button in the *Main Menu* allows to access the main settings menu, where it is possible to configure the parameters for the I/Os and for a given function on each of the four section of the x1081B. The *CONFIGURE* menu is divided in four rows, one for each section of the board, and gives access to the configuration of **inputs** (left), **function** ( )and **outputs** (right).

Tapping on , it is possible to choose a function for that section among the ones available in the scroll-down menu and set its parameters.

In order to set a function on a given section, tap on → CHANGE → select the category of interest → select the function in the scroll-down menu → Save , as shown in **Figure 14.6.**

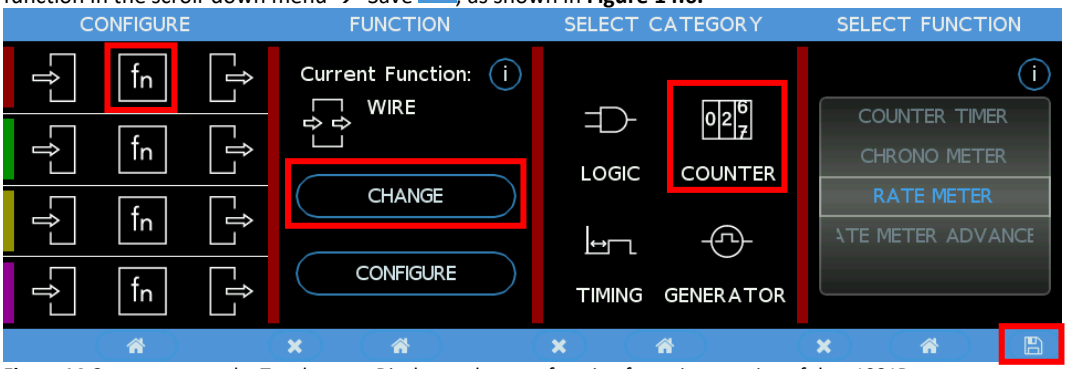


Figure 14.6: sequence on the Touchscreen Display to choose a function for a given section of the x1081B.

In order to configure the function set on a given section, tap on → CONFIGURE to access the settings menu. It is also possible to read the online help about that function, by tapping on . After settings the desired parameters, tap on Save button.

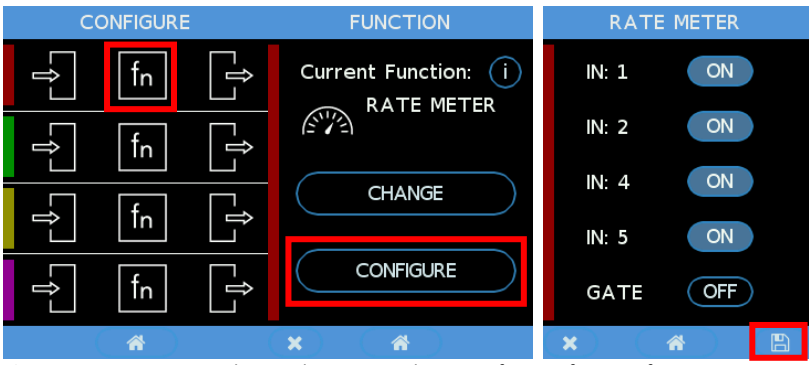


Figure 14.7: sequence on the Touchscreen Display to configure a function for a given section of the x1081B

Tapping on right and left buttons on the *CONFIGURE* menu it is possible to access respectiveyl the input and output configuration.

Note: Some functions are labeled as WEB ONLY: these can be configured only via web interface (refer to **Web Interface**).

For a detailed description of the available parameters for each function and for the I/Os, refer to Par. **Function settings and monitor.**

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 can be used.

Functions tab allows to see the function set for each section

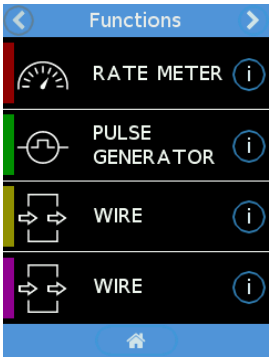


Figure 14.8: the Functions tab.

Activity tab allows to see virtual 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. Refer to Par. **Activity Monitor** for more details.

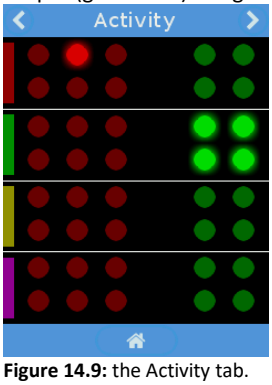


Figure 14.9: the Activity tab.

Monitor tab allows to monitor the results of the measurements and settings of a set function. 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, and it allows to view measurements details or some of the function settings without having to pass through the *Configuration* main menu. 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.

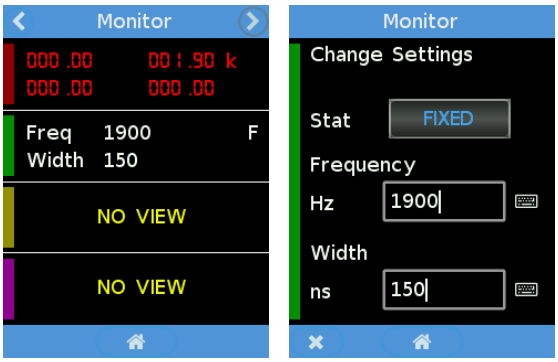


Figure 14.10: the Monitor tab. On the right, example of the monitor bigger widget for the pulse generator function, where the set parameters are shown.

Note: Some functions are labeled as NO VIEW: these do not have significant output results to be shown on the Display.

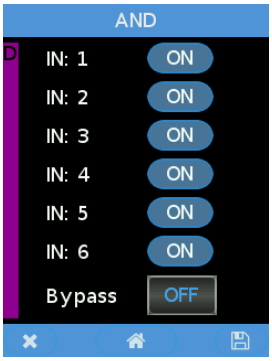
For a detailed description of the available measurements for each function and for the I/Os, refer to Par. **Function settings and monitor.**

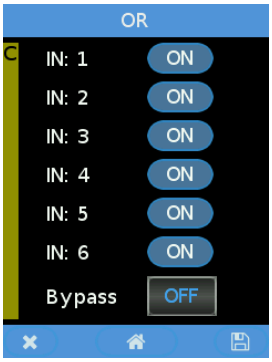
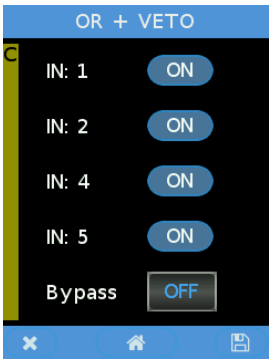
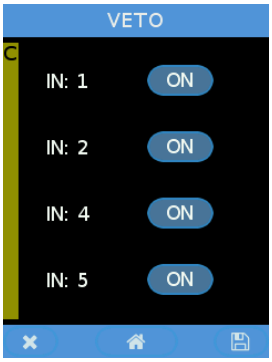
Function settings and monitor

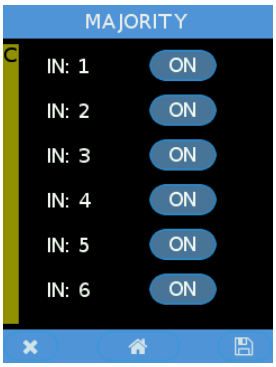
In the following we describe the settings available on the Touchscreen Display for each of the available functions of the x1081B and for the I/Os. In each table, corresponding to the four available function category, we show the configuration parameters (left column) and the correspondent monitor view (right column) on the Touchscreen Display. In a separate table, we show the configuration parameters for the input and output stage.

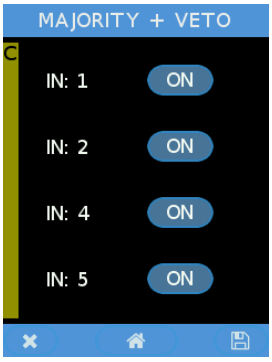
In this paragraph we only describe the TouchScreen interface for each function, referring to possible parameters' settings. For a more detailed description of the function operation itself, refer to Chap. **Functional Description.**

Logic Functions

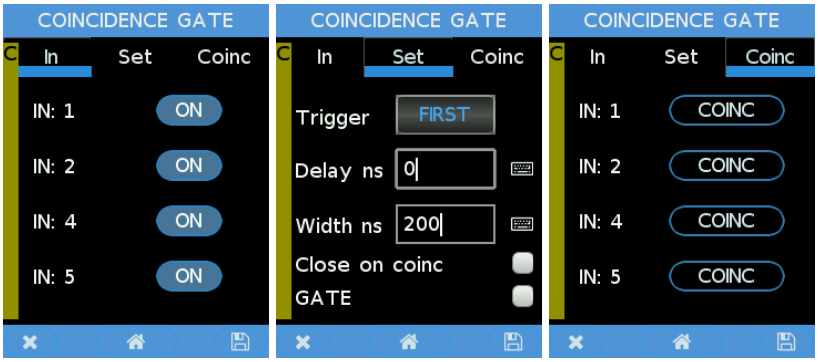
FAN-OUT	
No configuration needed	No monitor view
WIRE	
No configuration needed	No monitor view
AND	
 It is possible to switch **ON/OFF** input channel CH1…6.	No monitor view

The **BYPASS** option allows to concatenate different sections, by sending output CH1 of the current section to the previous section of the x1081B, and combining it with the the inputs of the previous section.	
OR	
 It is possible to switch **ON/OFF** input channel CH1…6. The **BYPASS** option allows to concatenate different sections, by sending output CH1 of the current section to the previous section of the x1081B, and combining it with the the inputs of the previous section.	No monitor view
OR+VETO	
 It is possible to switch **ON/OFF** input channel CH1,2,4,5. The VETO can be fed at CH6. The **BYPASS** option allows to concatenate different sections, by sending output CH1 of the current section to the previous section of the x1081B, and combining it with the the inputs of the previous section.	No monitor view
VETO	
 It is possible to switch **ON/OFF** input channel CH1,2,4,5. The VETO can be fed at CH6	No monitor view

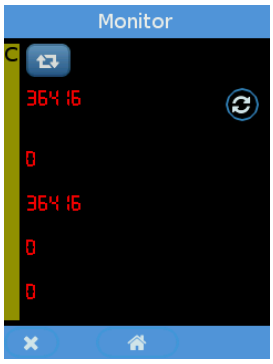
<table>
<tr><th colspan="2">MAJORITY</th></tr>
<tr><td> 

It is possible to switch ON/OFF input channel CH1…6</td><td>No monitor view</td></tr>
<tr><th colspan="2">MAJORITY + VETO</th></tr>
<tr><td> 

It is possible to switch ON/OFF input channel CH1,2,4,5. The VETO can be fed at CH6</td><td>No monitor view</td></tr>
<tr><th colspan="2">LUT</th></tr>
<tr><td>WEB ONLY

Refer to Chap. Web Interface for more details.</td><td>No monitor view</td></tr>
<tr><th colspan="2">COINCIDENCE GATE</th></tr>
<tr><td> 

It possible to switch ON/OFF input channel CH1,2,4,5 and set the Trigger mode to open the coincidence window (FIRST detected signal or open on INx) as well as the Delay and Width of the coincidence window. There is an option to enable CLOSE ON COINCIDENCE mode (dynamic window width) and to enable a GATE to be fed externally at input CH 6.

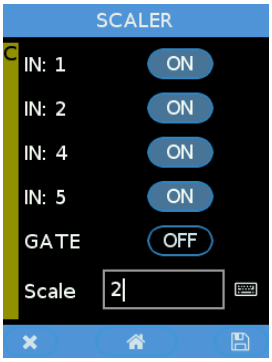
It is possible to select among COINCIDENCE/ANTICOINCIDENCE for each of the standard input.</td><td> 

It is possible to monitor the COUNTER TOTAL (top) and COUNTER 1,2,4,5 , measuring how many coincidences are detected on each channel and globally.</td></tr>
</table>

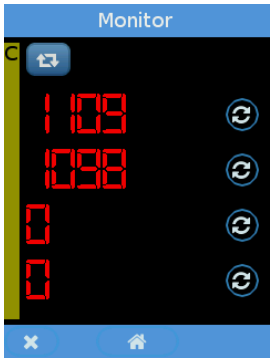
Table 14.1: Logic functions settings and monitor view on the Touchscreen Display.

Counter Functions

SCALER

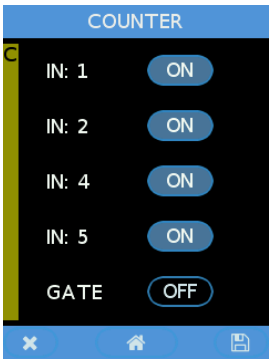


It is possible to switch ON/OFF input channel CH1,2,4,5, to enable a gate to be fed at input CH6 and to define the frequency divisor factor (SCALE, only even integers).

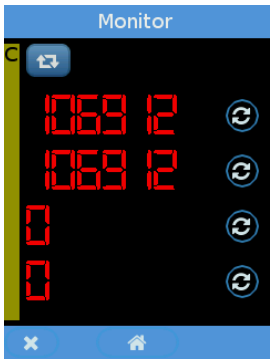


It is possible to monitor the counts detected on the inputs. The scaled-down signal is available at output CH 1,2,3,4

COUNTER



It is possible to switch ON/OFF input channel CH1,2,4,5 and to enable a gate to be fed at input CH6.

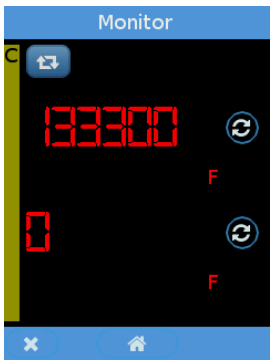


It is possible to monitor the counts detected on the inputs

COUNTER TIMER

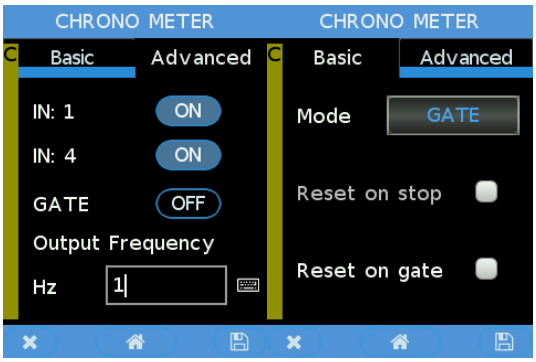
It is possible to switch ON/OFF input channel CH1,4 and to enable a gate to be fed at input CH6 . The Source of the counter can be the internal timer (**Timer** option, with selectable **Time** period in the range [20 ns ÷ 1 s]) or the input CH1,4 (**In** option).

It is possible to set the **Mode** (FREE, TIME TARGET, COUNT TARGET), to define a **Target** value and to set a **Width** to define a window (up to 40 s) inside which the counts are measured. There is an option to autoreset the counter and timer each time a target is reached, so that the measurement is automatically restarted.



It is possible to monitor the counts detected on the inputs.

CHRONOMETER



It is possible to switch ON/OFF input channel CH1,4 and to enable a gate to be fed at input CH6. It is also possible to set the **Output Frequency** of the Oscillator output CH2, which remains active as long as the chronometer is measuring. **Mode** can be GATE (when input CH6 is active), START/STOP or IN.

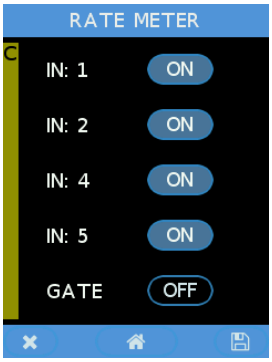
START/STOP mode: the timer counts from the START on input CH1 until the STOP on input CH2. It is possible to enable the **RESET ON STOP** option to reset the timer on the rising front of the stop signal.

IN mode: the timer counts for all the time that the input CH1 is logic-high.

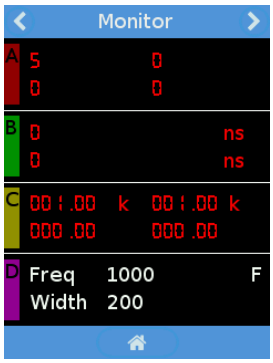
GATE mode: when GATE is ON, the time is measured only if the gate at input CH6 is logic-high. It is possible to enable the **RESET ON GATE** option to reset the timer on the rising front of the gate.

It is possible to monitor the timer measurements for the input CH 1,4

RATE METER

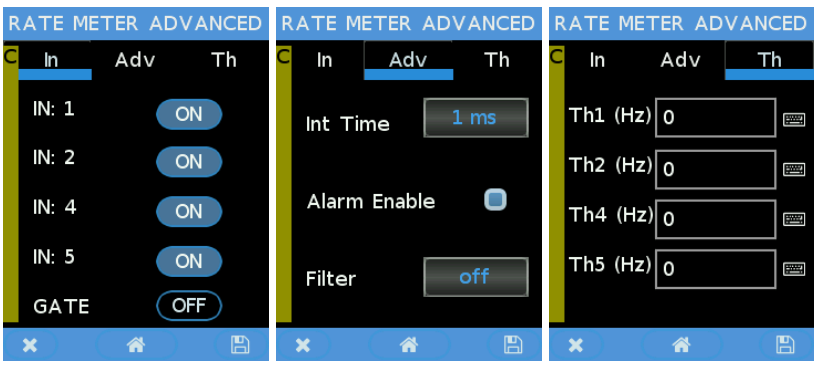


It is possible to switch ON/OFF input channel CH1,2,4,5 and to enable a gate to be fed at input CH6

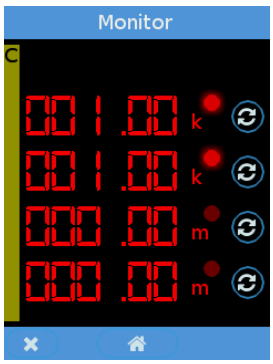


It is possible to measure the signal rate detected on the inputs (see section C/yellow)

RATE METER ADVANCED



It is possible to switch ON/OFF input channel CH1,2,4,5 and to enable a gate to be fed at input CH6. It is also possible to set **In Time** for the frequency measurement in the range [1ms ÷ 1hour]. Moreover, it is possible to switch ON/OFF a **Filter** on the output data to average the rate values.



It is possible to measure the signal rate detected on the inputs and monitor the Alarm status thanks to the virtual red LED (the

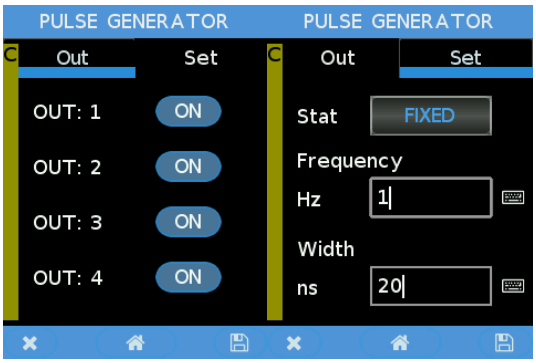
There is the possibility to enable an **Alarm** and set an alarm threshold **Thx** on the rate for each input channel.	LED ON means that the set threshold has been overcome).

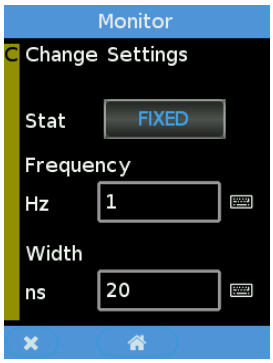
Table 14.2: Counter functions settings and monitor view on the Touchscreen Display.

Timing Functions

All timing functions can be set from the WEB ONLY and they have NO VIEW on the Touchscreen Display. Refer to Chap**. Web Interface** for more details.

Generator Functions

<table>
<tr><th colspan="2">PULSE GENERATOR</th></tr>
<tr><td> 

It is possible to switch ON/OFF output channel CH1,2,3,4. It can be set a FIXED or POISSON statistics (Stat) for the generated pulses as well as their Frequency and Width.</td><td> 

It is possible to view the set parameters.</td></tr>
<tr><th colspan="2">DIGITAL GENERATOR</th></tr>
<tr><td> 

It is possible to set output channel CH1,2,3,4 to be logic HIGH or LOW.</td><td> 

It is possible to view the set parameters.</td></tr>
<tr><th colspan="2">PATTERN GENERATOR</th></tr>
<tr><td>WEB ONLY

Refer to Chap. Web Interface for more details.</td><td>NO VIEW

Refer to Chap. Web Interface for more details.</td></tr>
</table>

Table 14.3: Generator functions settings and monitor view on the Touchscreen Display.

Input/Output settings

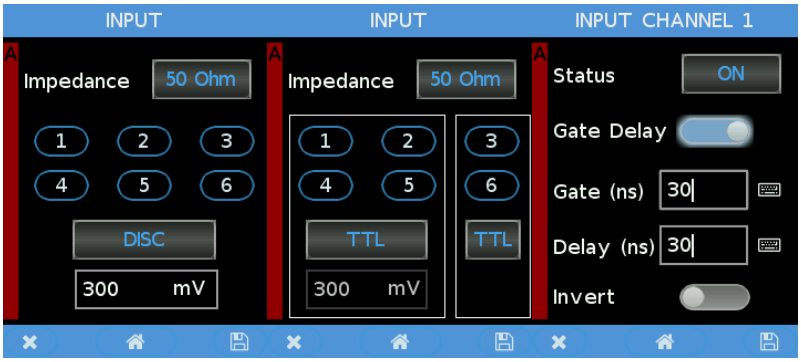
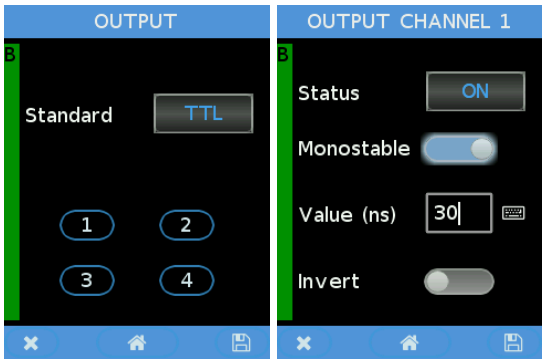
INPUT
 It is possible to set the common **Impedance** of the input section (50ohm/HIGH) and the standard of the inputs (**NIM/TTL/DISC**). When selecting DISC, the leading edge discriminator is active and it is possible to set a threshold value in mV. For those functions with special inputs CH3,6, it is possible to set NIM/TTL/DISC on CH1,2,4,5, while CH3,6 can be NIM/TTL only. Individually for each channel (tap on the corresponding number) it is possible to switch it **ON/OFF**, enable and set the **Gate&Delay** and enable/disable the **Invert** on the input signals.
OUTPUT
 It is possible to set the common **Standard** of the output section (NIM/TTL). Individually for each channel (tap on the corresponding number) it is possible to switch it **ON/OFF**, enable and set the **Monostable** and enable/disable the **Invert** on the output signals.

Table 14.4: I/Os settings on the Touchscreen Display.

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.

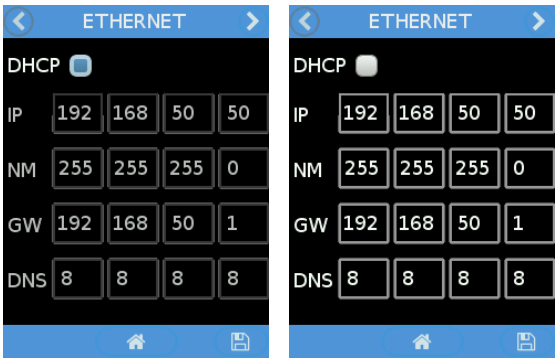


Figure 14.11: the ETHERNET tab for the configuration of the instrument connection in DHCP (left) or static IP (right) mode.

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.

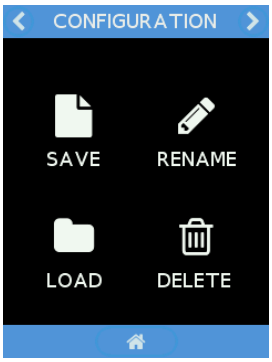


Figure 14.12: the CONFIGURATION tab to manage the configuration files.

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 x1081B 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.

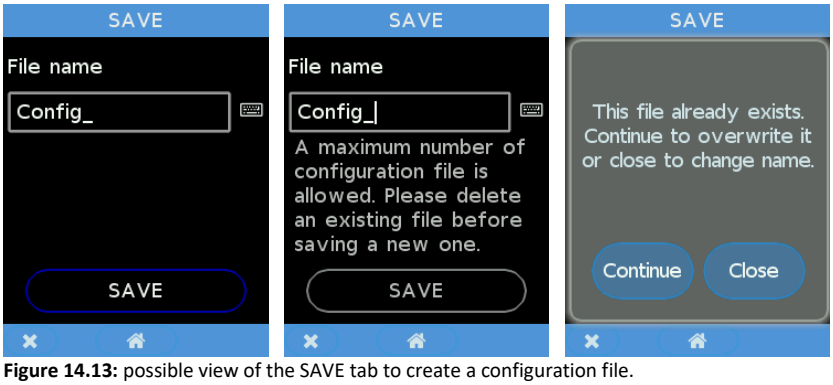


Figure 14.13: possible view of the SAVE tab to create a configuration file.

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 14.14: 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.

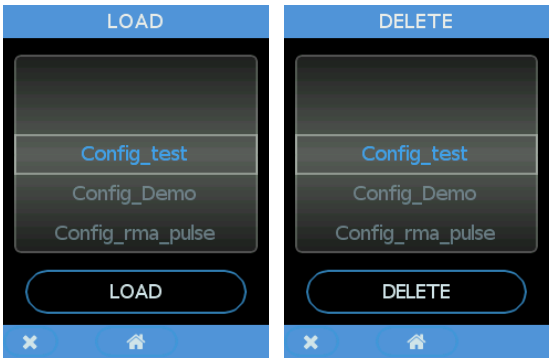


Figure 14.15: the LOAD and DELETE tab to load or delete a previously stored configuration file.

Firmware/Software version

The VERSION INFO view shows the MAC address of the module, the Software Version and FPGA version.

Figure 14.16: the VERSION INFO tab to check the MAC address and 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)

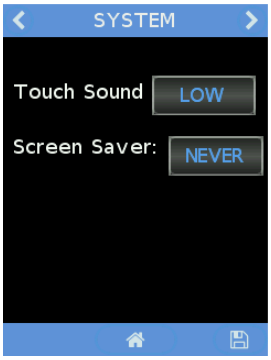


Figure 14.17: the SYSTEM tab adjust touch sound and screen saver

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.

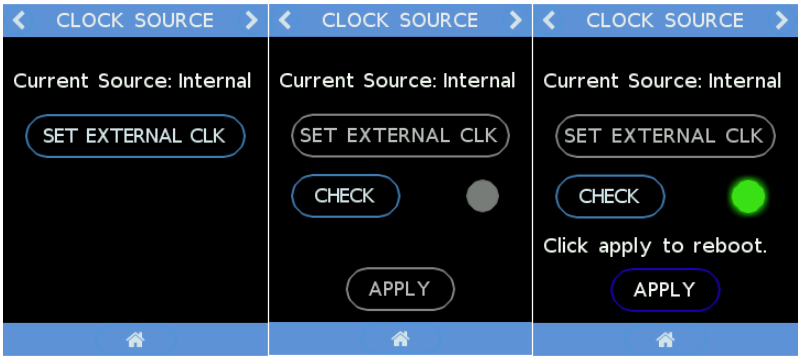


Figure 14.18: how to set an external clock using the CLOCK SOURCE tab.

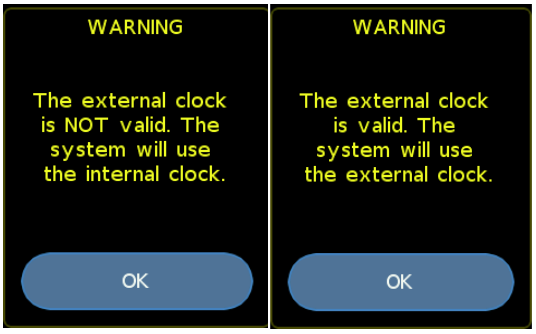


Figure 14.19: notifications on the Display when the clock source becomes valid or not valid during board operation.

15 Web Interface

It is possible to access the x1081B 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.

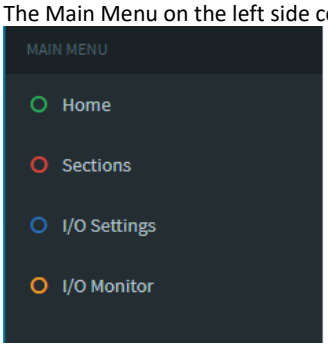
The Web interface is automatically accessible by configuring your PC in order to communicate with the x1081B, according to its IP or USB address (refer to Sec. **Remote Control**). It is sufficient to type the x1081B IP/USB address in a Web Browser search bar and the Web Interface will automatically 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 x1081B. 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 15.1**) 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

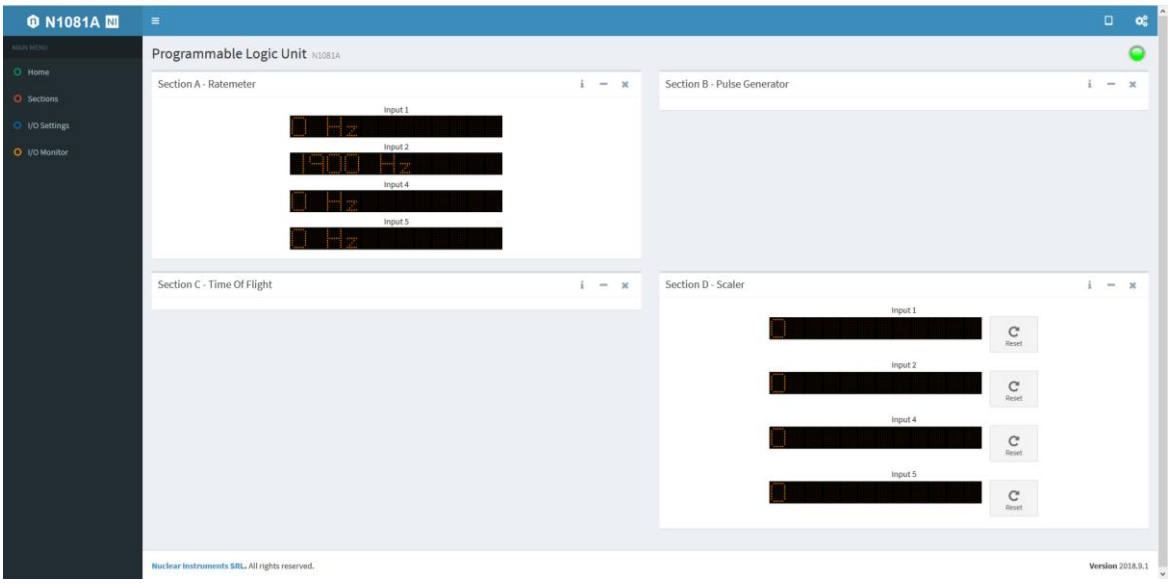


Figure 15.1: general view of the x1081B Web Interface home page, with the four tabs showing the function of each section of the instrument. In this example, Section 3 and Section 4 tabs are collapsed while the full widget is visible for Section 1 and Section 2.

The status of the connection with the x1081B 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.

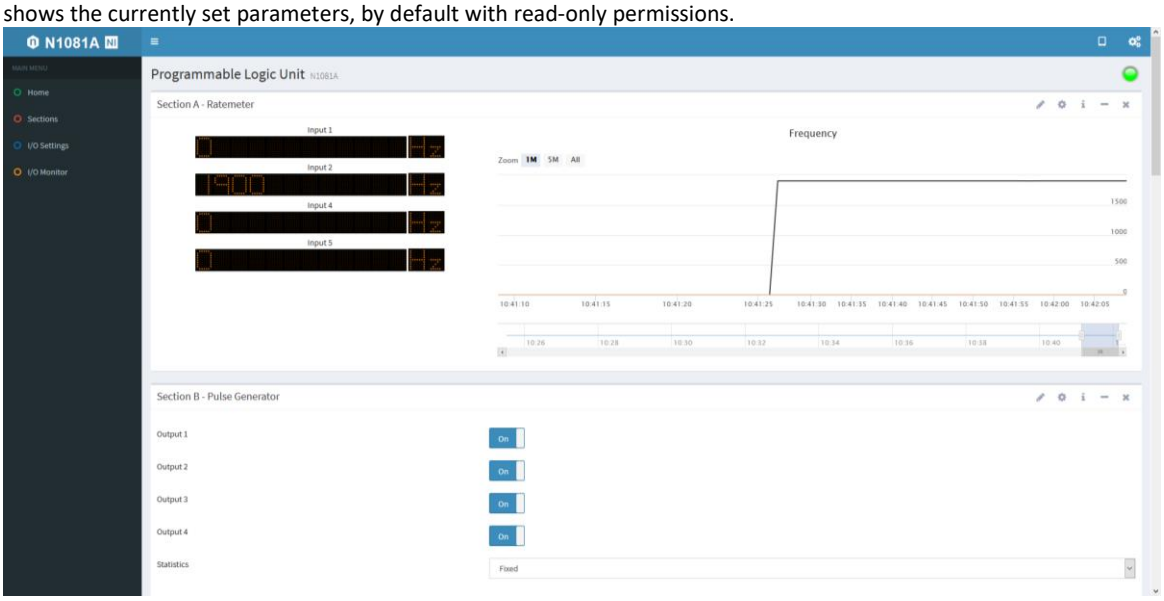


Figure 15.2: general view of the *Sections* page of the x1081B Web interface.

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

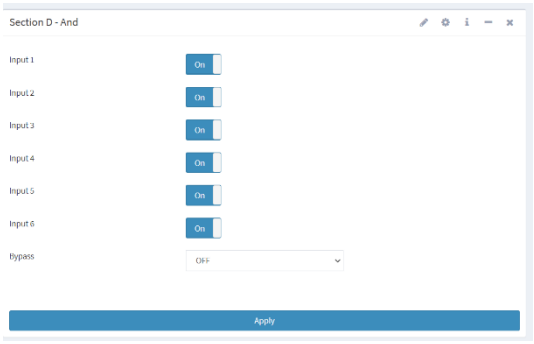
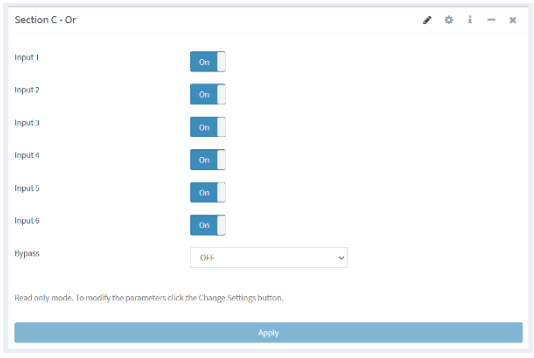
- **change the function** of that section. When clicked, a window containing a drop down list of the available functions is open: select the desired function and click the *Apply* button.

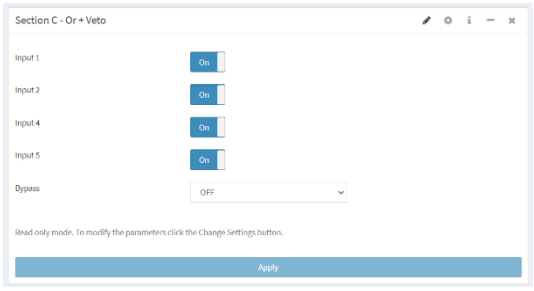
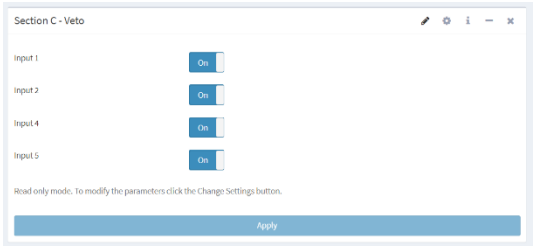
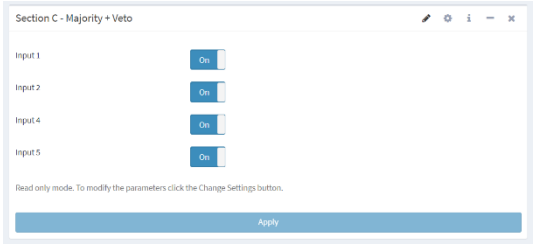
- **change the parameters** of the currently set function. When clicked, the *Apply* button in the section tab is active and it is possible to change the parameters setting. For some other functions a new window is opened and parameters can be edited in the corresponding fields.
- **access the online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

In the following we describe the settings available on the Web Interface for each of the available functions of the x1081B. In each table, corresponding to the four available function category, we show the configuration parameters (left column) and the correspondent monitor view (right column) in the *Sections* tab.

In the following we only describe the Web interface for each function, referring to possible parameters' settings. For a more detailed description of the function operation itself, refer to Chap. **Functional Description.**

Logic Functions

FAN-OUT	
No configuration needed	No monitor view
WIRE	
No configuration needed	No monitor view
AND	
 It is possible to switch **ON/OFF** input channel CH1…6. The **BYPASS** option allows to concatenate different sections, by sending output CH1 of the current section to the previous section of the x1081B, and combining it with the the inputs of the previous section.	No monitor view
OR	
 It is possible to switch **ON/OFF** input channel CH1…6	No monitor view

The **BYPASS** option allows to concatenate different sections, by sending output CH1 of the current section to the previous section of the x1081B, and combining it with the the inputs of the previous section.	
OR+VETO	
 It is possible to switch **ON/OFF** input channel CH1,2,4,5. The VETO can be fed at CH6. The **BYPASS** option allows to concatenate different sections, by sending output CH1 of the current section to the previous section of the x1081B, and combining it with the the inputs of the previous section.	No monitor view
VETO	
 It is possible to switch **ON/OFF** input channel CH1,2,4,5. The VETO can be fed at CH6	No monitor view
MAJORITY	
 It is possible to switch **ON/OFF** input channel CH1…6	No monitor view
MAJORITY + VETO	
 It is possible to switch **ON/OFF** input channel CH1,2,4,5. The VETO can be fed at CH6	No monitor view

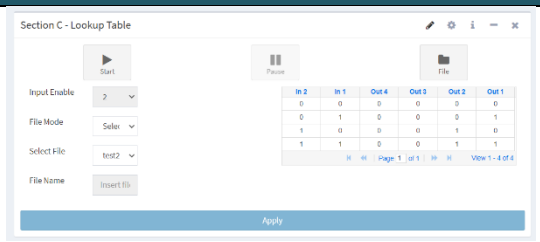
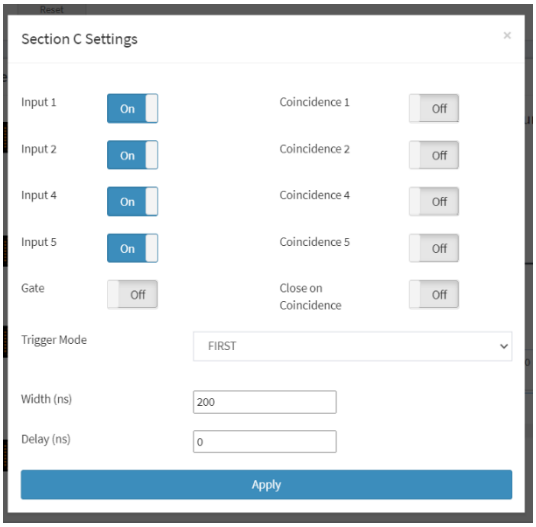
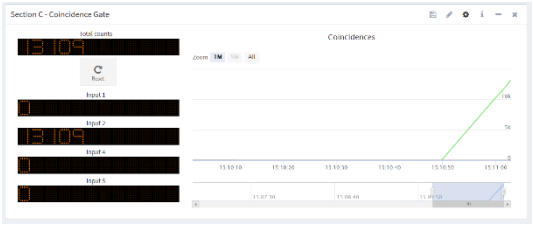
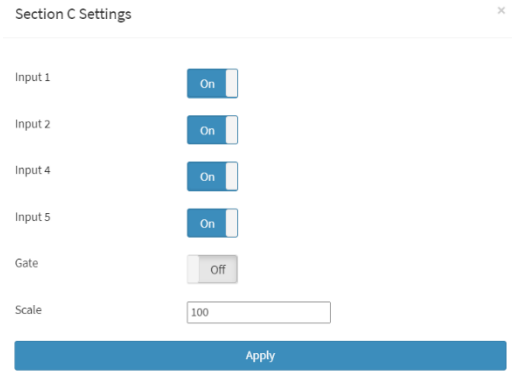
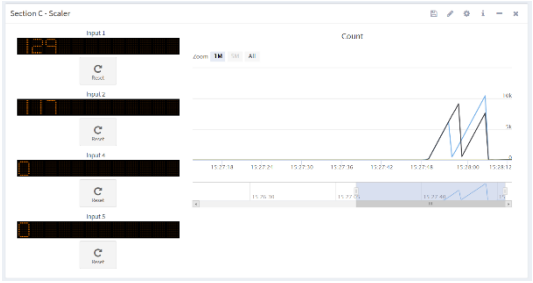
LUT	
 It is possible to set the number of **enabled inputs** (CH1…6), to **create a new LUY** using the 0/1 available to define the status of the output for each possible combination of the inputs, and to retrieve a LUT from file. Press **Start** to load the LUT.	No monitor view
COINCIDENCE GATE	
 It possible to switch **ON/OFF** input channel CH1,2,4,5 and set the **Trigger** mode to open the coincidence window (FIRST, OPEN on CHx) as well as the **Delay** and **Width** of the coincidence window. There is an option to enable **CLOSE ON COINCIDENCE** mode and to enable a **GATE** to be fed externally at input CH 6. It is possible to select among **COINCIDENCE/ANTICOINCIDENCE** for each of the standard input.	 It is possible to monitor the **Total counts** and counts on **Input 1,2,4,5** , measuring how many coincidences are detected on each channel and globally. Results are also plotted on chart.

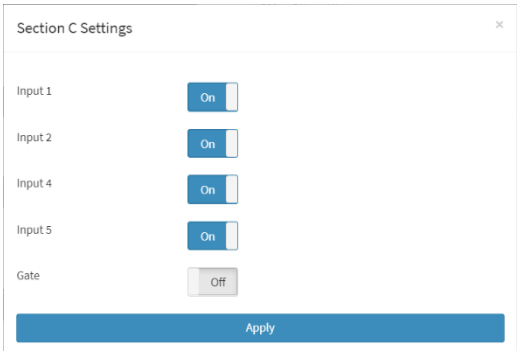
Table 15.1: Logic functions settings and monitor view on the Web Interface.

Counter Functions

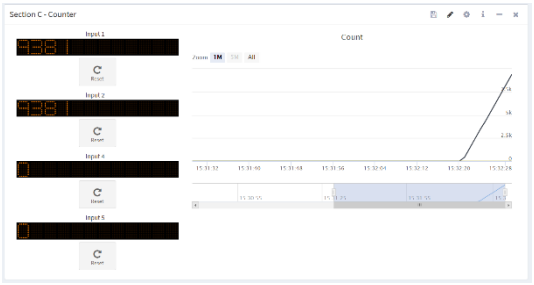
SCALER	
	 It is possible to monitor the counts detected on the inputs. Results are also plotted on chart. The scaled-down signal is available at output CH 1,2,3,4

It is possible to switch **ON/OFF** input channel CH1,2,4,5, to enable a gate to be fed at input CH6 and to define the frequency divisor factor (**SCALE**, only even integers).

COUNTER

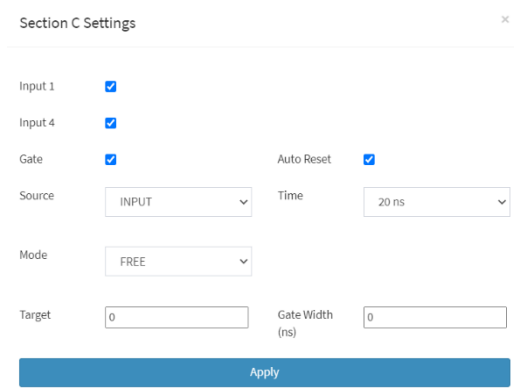


It is possible to switch **ON/OFF** input channel CH1,2,4,5 and to enable a gate to be fed at input CH6



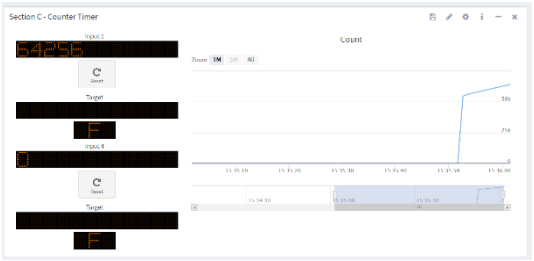
It is possible to monitor the counts detected on the inputs. Results are also plotted on chart

COUNTER TIMER



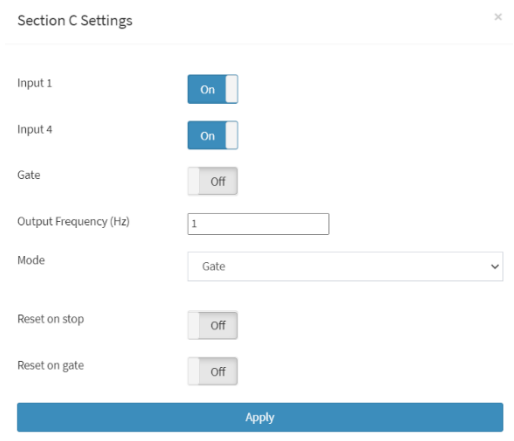
It is possible to switch **ON/OFF** input channel CH1,4 and to enable a gate to be fed at input CH6 . The Source of the counter can be the internal timer (**Timer** option, with selectable **Time** period in the range [20 ns ÷ 1 s]) or the input CH1,4 (**Input** option).

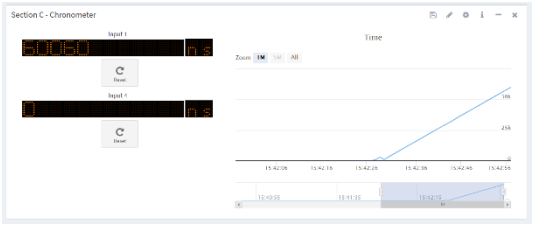
It is possible to set the **Mode** (FREE, TIME TARGET, COUNT TARGET), to define a **Target** value and to set a **Width** to define a window (up to 40 s) inside which the counts are measured. There is an option to autoreset the counter and timer each time a target is reached, so that the measurement is automatically restarted.



It is possible to monitor the counts detected on the inputs. Results are also plotted on chart.

CHRONOMETER



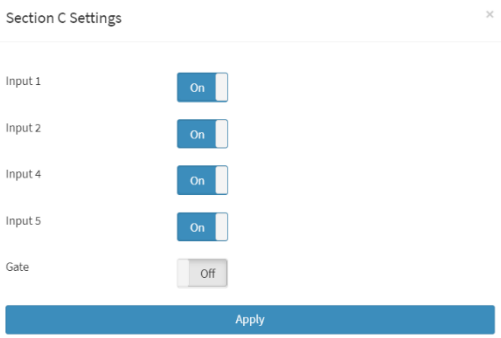


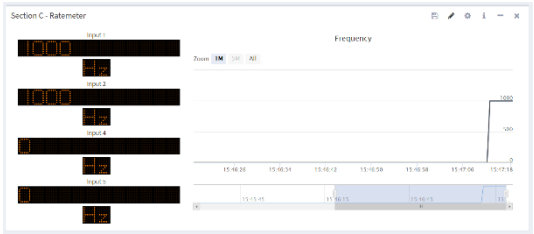
It is possible to monitor the timer measurements for the input CH 1,4. Results are also plotted on chart.

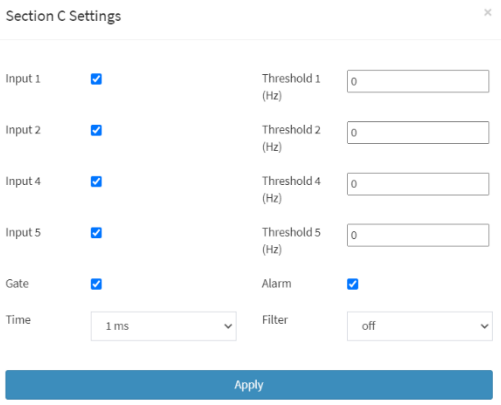
<table>
<tr><td>It is possible to switch ON/OFF input channel CH1,4 and to enable a gate to be fed at input CH6. It is also possible to set the Output Frequency of the Oscillator output CH2, which remains active as long as the chronometer is measuring. Mode can be GATE (when input CH6 is active), START/STOP or IN.

START/STOP mode: the timer counts from the START on input CH1 until the STOP on input CH2. It is possible to enable the RESET ON STOP option to reset the timer on the rising front of the stop signal.

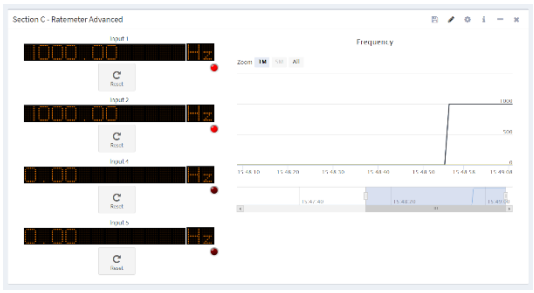
IN mode: the timer counts for all the time that the input CH1 is logic-high.

GATE mode: when GATE is ON, the time is measured only if the gate at input CH6 is logic-high. It is possible to enable the RESET ON GATE option to reset the timer on the rising front of the gate.</td><td></td></tr>
<tr><th colspan="2">RATE METER</th></tr>
<tr><td> 

It is possible to switch ON/OFF input channel CH1,2,4,5 and to enable a gate to be fed at input CH6.</td><td> 

It is possible to measure the signal rate detected on the inputs. Results are also plotted on chart.</td></tr>
<tr><th colspan="2">RATE METER ADVANCED</th></tr>
<tr><td> 

It is possible to switch ON/OFF input channel CH1,2,4,5 and to enable a gate to be fed at input CH6. It is also possible to set In Time for the frequency measurement in the range [1ms ÷ 1hour]. Moreover, it is possible to switch ON/OFF a Filter on the output data to average the rate values.

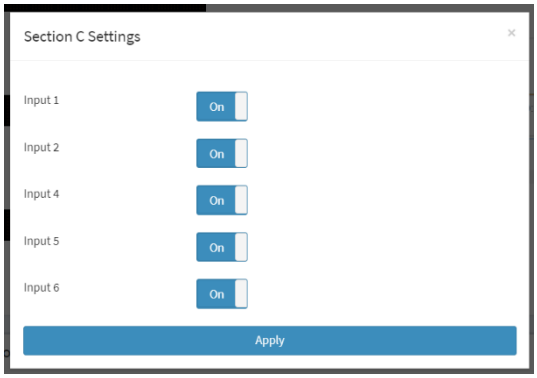
There is the possibility to enable an Alarm and set an alarm threshold Thx on the rate for each input channel.</td><td> 

It is possible to measure the signal rate detected on the inputs and monitor the Alarm status thanks to the virtual red LED (the LED ON means that the set threshold has been overcome). Results are also plotted on chart.</td></tr>
</table>

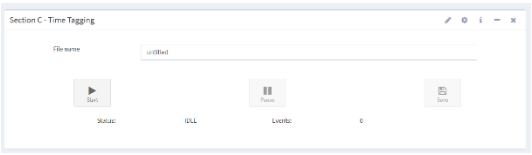
Table 15.2: Counter functions settings and monitor view on the Web Interface.

Timing Functions

TIME TAGGING



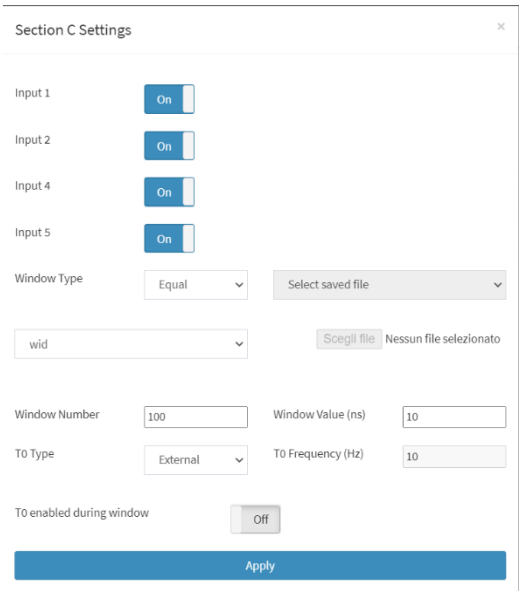
It is possible It is possible to switch **ON/OFF** input channel CH1…6



It is possible to **Start** an acquisition and **Save** timestamps on file. The output file is in the format (CHx, timestamp), as shown below. Timestamps are expressed in ns and the events are not ordered in the file.

```
1  1 82527249248120
2  1 82527250248120
3  1 82527251248120
4  1 82527252248120
5  1 82527253248120
6  1 82527254248120
7  1 82527255248120
8  1 82527256248120
9  1 82527257248120
10 1 82527258248120
11 1 82527259248120
12 1 82527260248120
```

TIME OF FLIGHT

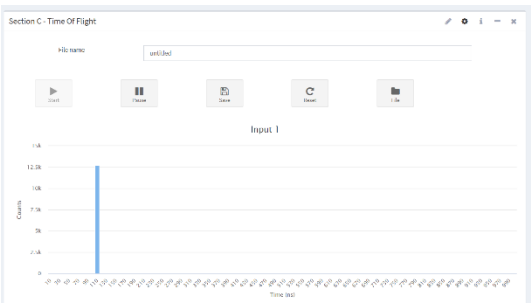


It is possible to switch **ON/OFF** input channel CH1,2,4,5.

The **T0** can be generated internally or fed externally at input CH 6. When generated internally, it is possible to set its **T0 Frequency**. There is also an option (**T0 enabled during window**) to reset the ToF measurement upon T0 arrival inside a specified timing window.

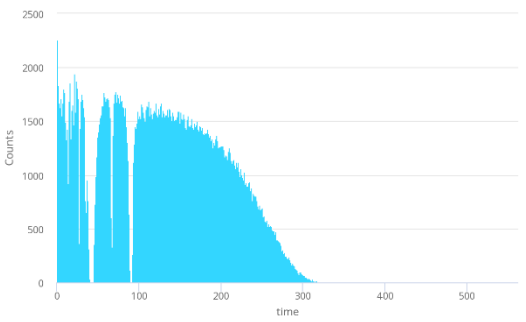
Moreover a VETO signal can be fed at input CH 3 to discard timing measurements when the signal is logic-high.

It is possible to rebin the ToF spectrum into windows, selecting **Window Type: Equal or File.**



It is possible to **Start/Reset/Pause** an acquisition **Save** spectra to file. The ToF spectrum is calculated independently for each enabled input CH 1,2,4,5 and all are shown in the GUI.

Example of a Cadmium ToF spectrum, where absorption lines are clearly visible.



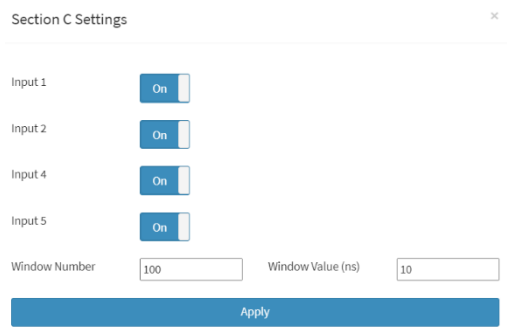
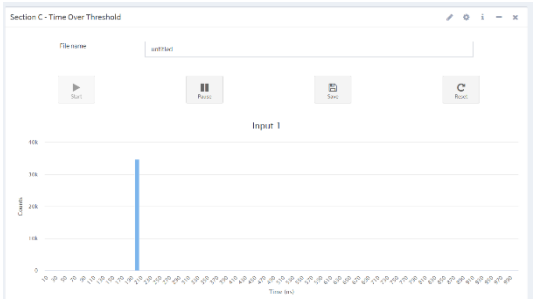
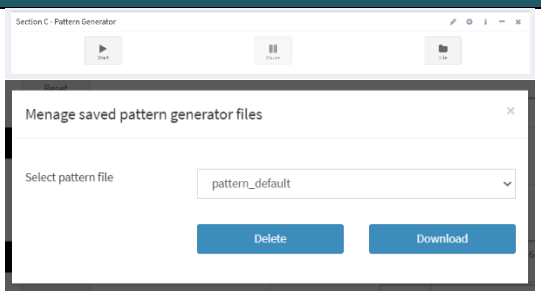
Equal means the ToF spectrum is rebinned in a number of equal windows specified in the **Window Number** with a width specified in the **Window Value**. • Window Number • Window value: width of a single ToF bin in the range 10 ns ÷ 1 s. **File** means the rebinning is arbitrarly set by loading/selecting a file defining each window. • **File format**: the rebinning file must be written in the following format: 1 100 2 200 3 150 4 1000 5 346 Each line is a bin of the ToF histogram and it defines the width of a window in 10 ns steps (writing 100 means 1µs). The minimum bin is 20 ns (i.e. 2 in the file)	
TIME OVER THRESHOLD	
 It is possible to switch **ON/OFF** input channel CH1,2,4,5. Moreover a VETO signal can be fed at input CH 6 to discard timing measurements when the signal is logic-high. Input CH 3 is reserved for a reset, which acts as a clear of the ToT spectrum when the signal is logic-high. It is possible to rebin the ToT spectrum by specifying: • **Window number** • **Window value**: width of a single ToT bin in the range 10 ns ÷ 1 s.	 It is possible to **Start/Reset/Pause** an acquisition **Save** spectra to file. The ToT spectrum is calculated independently for each enabled input CH 1,2,4,5 and all are shown in the GUI.

Table 15.3: Timing functions settings and monitor view on the Web Interface.

Generator Functions

PULSE GENERATOR	
 It is possible to switch ON/OFF output channel CH1,2,3,4. It can be set a FIXED or POISSON **Statistics** for the generated pulses as well as their **Frequency** and **Width**.	It is possible to view the set parameters.

<table>
<tr><th colspan="2">DIGITAL GENERATOR</th></tr>
<tr><td> 

It is possible to set output channel CH1,2,3,4 to be logic HIGH (ON) or LOW (OFF).</td><td>It is possible to view the set parameters.</td></tr>
<tr><th colspan="2">PATTERN GENERATOR</th></tr>
<tr><td> 

It is possible to load/select a pattern file and Start the output generation.

File format: the pattern file must be written in the following format:

1 1111
2 0000
3 1010
4 1010
5 1100
6 1001
7 1100
8 1100
9

Each line is a generated output pattern for the 4 outputs (1 means logic-high, 0 means logic-low) with LSB on the right.</td><td>No view</td></tr>
</table>

Table 15.4: Generator functions settings and monitor view on the Web Interface.

I/O Settings

I/O Settings page contains four tabs (see **Figure 15.3**), 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.

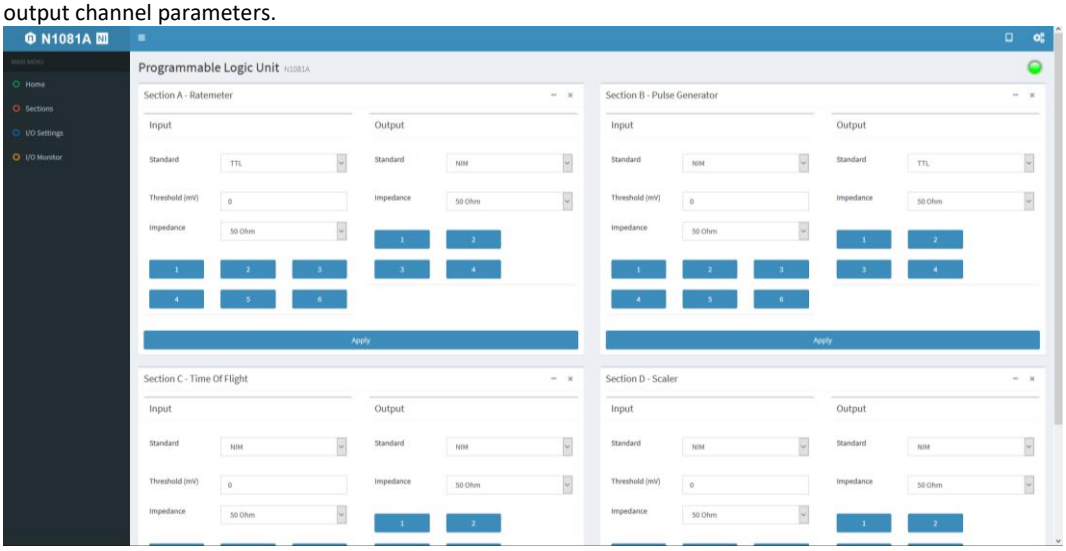


Figure 15.3: general view of the I/O Settings page of the x1081B Web interface.

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.

In **Table 15.5** we described the possible settings available for inputs and outputs of the x1081B from the Web Interface.

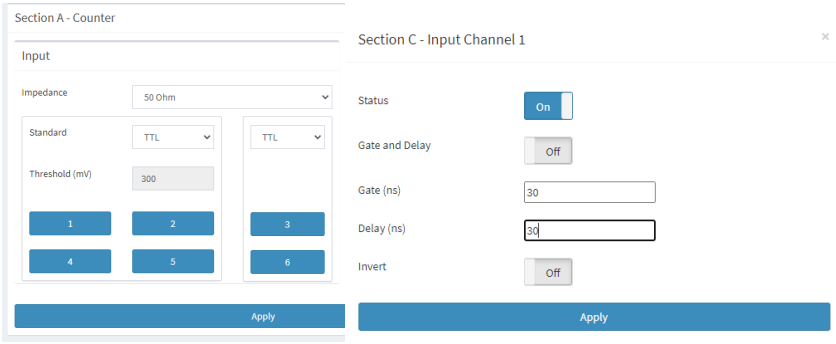
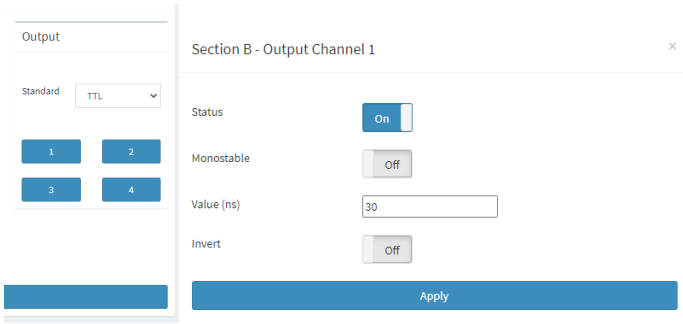
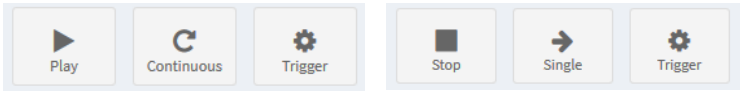
INPUT
 It is possible to set the common **Impedance** of the input section (50ohm/HIGH) and the standard of the inputs (**NIM/TTL/DISC**). When selecting DISC, the leading edge discriminator is active and it is possible to set a threshold value in mV. For those functions with special inputs CH3,6, it is possible to set NIM/TTL/DISC on CH1,2,4,5, while CH3,6 can be NIM/TTL only. Individually for each channel (click on the corresponding number) it is possible to switch it **ON/OFF**, enable and set the **Gate&Delay** and enable/disable the **Invert** on the input signals.
OUTPUT
 It is possible to set the common **Standard** of the output section (NIM/TTL). Individually for each channel (click on the corresponding number) it is possible to switch it **ON/OFF**, enable and set the **Monostable** and enable/disable the **Invert** on the output signals.

Table 15.5: I/Os settings on the Web Interface.

I/O Monitor

I/O Monitor page (see **Figure 15.4**) 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.

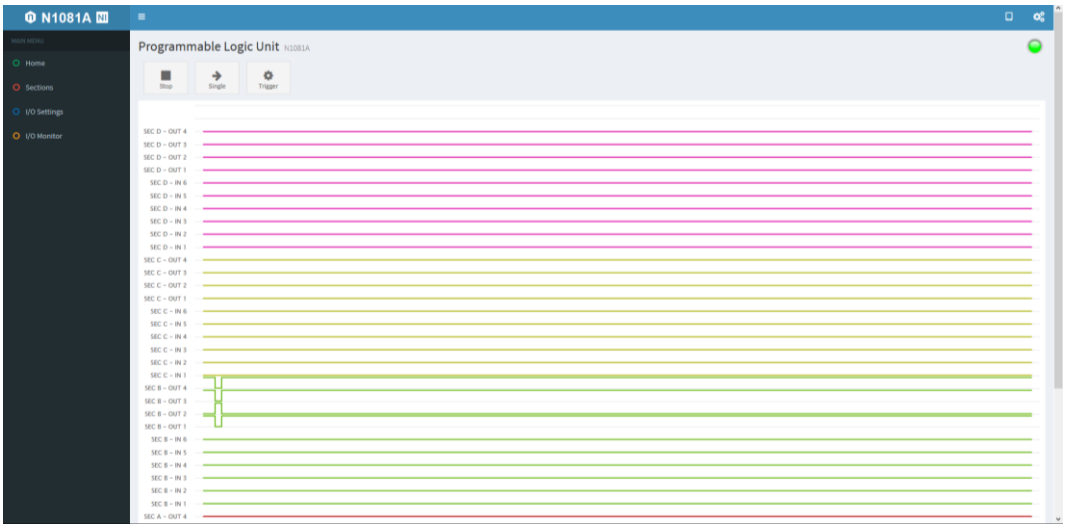


Figure 15.4: general view of the I/O Monitor page of the x1081B Web interface.

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 15.5.**

Figure 15.5: 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 15.6: general view of the General Settings page of the x1081B Web Interface.

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 x1081B 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 15.7**). In the top right bar of the web interface, the *Search* icon (see **Figure 15.7**) starts blinking. It is possible to stop searching via web interface or via Touch Screen Display.

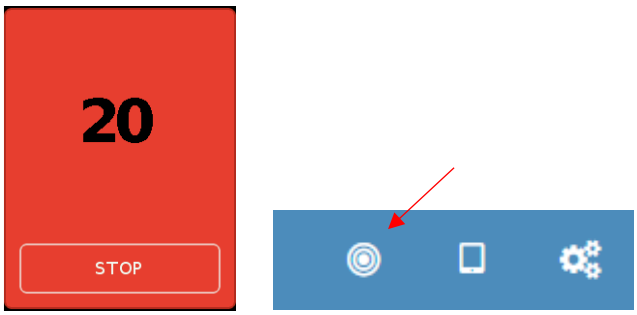


Figure 15.7: the Touch Screen Display and the Web Interface bar during instrument *Search.*

The *Clock Configuration* 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 

.

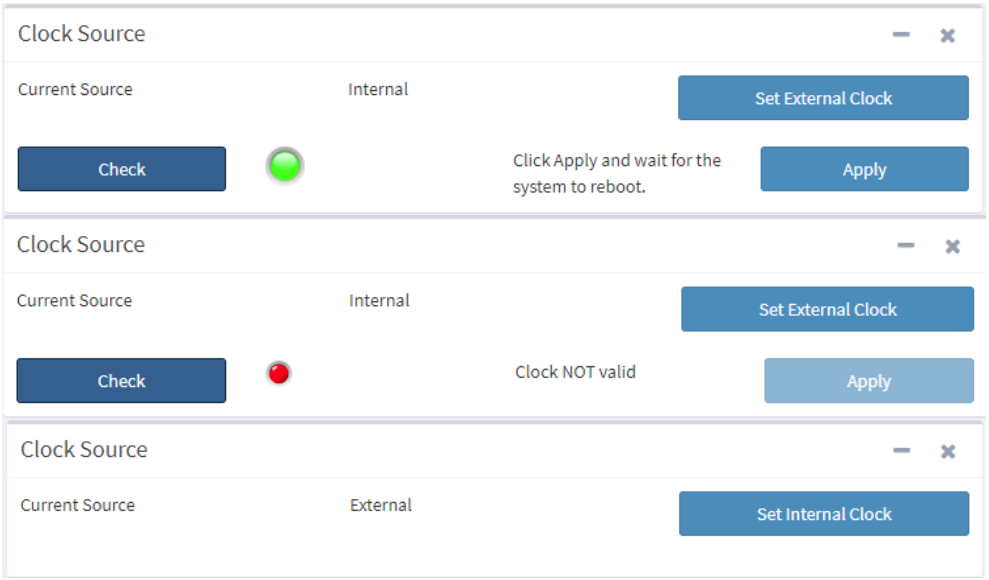


Figure 15.8: different views of the *Clock Source* tab while setting internal or external clock.

16 Instructions for Cleaning

The equipment may be cleaned with compressed air spray, isopropyl alcohol or deionized water and air dried.

Cleaning the Touchscreen

In order to clean the touchscreen (if present), wipe the screen with a towelette designed for cleaning monitors or with a clean cloth moistened with water.
Do not use sprays or aerosols directly on the screen; the liquid may seep into the housing and damage a component. Never use solvents or flammable liquids on the screen.

Cleaning the air vents

It is recommended to occasionally clean the air vents (if present) on all vented sides of the board. Lint, dust, and other foreign matter can block the vents and limit the airflow. Be sure to unplug the board before cleaning the air vents and follow the general cleaning safety precautions.

General cleaning safety precautions

CAEN recommends cleaning the device using the following precautions:

1) Never use solvents or flammable solutions to clean the board.
2) Never immerse any parts in water or cleaning solutions; apply any liquids to a clean cloth and then use the cloth on the component.
3) Always unplug the board when cleaning with liquids or damp cloths.
4) Always unplug the board before cleaning the air vents (if present)
5) Wear safety glasses equipped with side shields when cleaning the board

17 Device decommissioning

After its intended service, it is recommended to perform the following actions:

- Detach all the signal/input/output cable
- Wrap the device in its protective packaging
- Insert the device in its packaging (if present)

THE DEVICE SHALL BE STORED ONLY AT THE ENVIRONMENT CONDITION SPECIFIED IN THE MANUAL, OTHERWISE PERFORMANCE AND SAFETY WILL BE NOT GUARANTEED

18 Disposal

The disposal of the equipment must be managed in accordance with Directive 2012/19 / EU on waste electrical and electronic equipment (WEEE).

The crossed bin symbol indicates that the device shall not be disposed with regular residual waste.

19 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