Pulse-Delay-Generator

TOMBAK

User Manual

ALPhANOV – Optical and Laser Technological Center
Phone: +33 (0)5 24 54 52 00 – Fax +33 (0)5 40 00 64 07 – info@alphanov.com – www.alphanov.com
Bât. IOA, rue François Mitterrand - 33400 Talence – France
SIRET 493 635 817 00031 - N° TVA intracommunautaire : FR 24493635817


Daisy Out
USB In
Power In
5V/0.7A
Shape Out 1V/5V
Pulse Out 1V/5V
Sync Out 2
Sync Out 1
Sync Ext in
Pulse In
Gate In
TOMBAK
Pulse Delay Generator
ALPhA NOV
Shape Select
Sync Ext/FB
Pulse In
Spare

Global Introduction

The Pulse-Delay Generator is a very versatile module, it provides many settings to realize a large set of functions, from the simplest to the very advanced ones:

It can be used as:

- A logical signal delayer: see “Using PDG as a Pulse & Delay Generator” section 2.8.1 (p26).
- A basic frequency generator: see “Using TOMBAK as a standalone generator” section 2.8.2 (p31).
- A burst generator: see “Using the PDG as a burst generator” section 2.8.3 (p36).
- A signal gating module: see “Using the Gate feature of PDG” section 2.8.4 (p41)
- A synchronization module: see “Using PDG as a signal synchronization module” section 2.8.5 (p46)
- A voltage level convertor: see “Using PDG as a Voltage Level Converter” section 2.8.6 (p51)
- A frequency divider: see “Using PDG as a frequency divider” section 2.8.7 (p55)

Revision Sheet

Release No.	Date	Revision Description
v1.0	27/04/17	First version
v1.1	07/12/2017	Add Hardware setup and divider example configuration
v1.2	24/01/2018	Updated the list of instructions (§ 3.2.1)
v1.3	26/02/2018	Add Multiple channel section

Disclaimer

Information in this document is subject to change without notice.

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SIRET 493 635 817 00031 - N° TVA intracommunautaire : FR 24493635817
Phone: +33 (0)5 24 54 52 00 – Fax +33 (0)5 40 00 64 07 – info@alphanov.com – www.alphanov.com
Fax: (408) 744-9049
www.alphanov.com

USER'S MANUAL

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

1.1 Package Content

The Pulse Delay Generator package comes with:

- 1 PDG board
- 1 DC Power Supply (+5V / 2A)
- 1 USB-Jack FTDI cable
- 1 CD-ROM or USB Key with “ALPhANOV Control Software Suite”
- 1 User Manual

Figure 1 - Package Content

1.2 Safety Instructions

1.2.1 Wiring

- Please first connect the input pins to the board and then plug the DC Power Supply.
- Use caution when connecting the Power Supply.
- Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from Tombak.
- Connect the ground completely. Electric shock may occur if the ground is not connected correctly.

1.2.2 Operating environment

- Do not install near any heat sources such as radiators, heat registers, stoves, or other equipment (including amplifiers) that produce heat.
- To reduce the risk of fire or electric shock, do not expose Tombak to rain or moisture.

1.3 Contact

If you have any question about Tombak module, please contact ALPhANOV at info@alphanov.com.

2.0 SYSTEM SUMMARY

2.1 PDG Features and Performance

2.1.1 Features

The Pulse Delay Generator is a multifunctional and high-performance instrument that enables the user to consolidate multiple functions into one compact device.

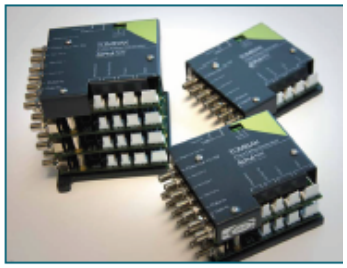
This unit is a great asset to generate high frequency pulses, delays and bursts. It's an ideal testing and timing control instrument for electronics and lasers.

Key features:

- 10 ps delay resolution
- 80 ps RMS jitter
- Min input voltage: 30 mV
- 150 MHz voltage level converter
- 20 MHz standalone generator
- 2 ns pulse resolution
- Burst/Gate generator
- USB interface
- 2 years warranty

Key applications:

- Ideal for OEM integration
- Components test
- Laser timing control
- Laser pulse-picking
- Precision pulse application
- Instrument triggering
- ATE applications



Possibility to stack multiple synchronized modules

The Pulse Delay Generator offers several operating modes including pulse generator, frequency divider, burst and pulse picker. This unit generates accurate pulses with a repetition rate up to 20 MHz, variable pulse widths from 5 ns to 262 ns and pulse delays from 10 ps to 262 ns. Output levels are adjustable between 1 V, 3.3 V and 5 V compatible

PULSE/DELAY GENERATOR:

Adjustable pulse width: 5 ns to 2^{62} ns
Adjustable pulse delay: 10 ps to 2^{62} ns
Width resolution:

- 2 ns for pulse width: 5 to 510 ns
- 5 ns for pulse width: 511 ns to 2^{62} ns

Delay resolution: 10 ps
Jitter:

- <80 ps RMS up to 100 ns delay
- <200 ps RMS up to 500 ns delay
- 1.5 ns RMS otherwise

STANDALONE GENERATOR:

Rate up to 20 MHz
Programmable duty cycle

EXT/INT CLOCK SYNCHRONIZER:

Pulse picking up to
200 MHz input / 20 MHz output

BURST/GATE GENERATOR:

1 to 10^9 pulses (burst)
Adjustable trig to burst delay
Intra burst resolution (internal source): 5 ns
External or internal source generator
External or software trigger/gate

VOLTAGE LEVEL CONVERTER:

Rate: up to 150 MHz
Input Voltage: 30 mV to 3.3 V
Adjustable output level: 1 V/3.3 V/5 V_TTL
<30 ps Jitter

FREQUENCY DIVIDER/PRESCALER:

200 MHz maximum input freq
Division by 1 to 10^9

Electrical:

Pulse_Out Outputs (SMA connector)	
Output Impedance	50 Ω recommended coupling
Adjustable output level	1 V/3.3 V/5 V_TTL
Rise time	<1 ns typical
Max output rate	20 MHz

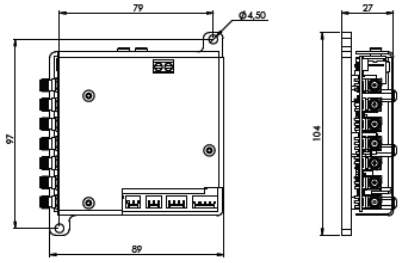
Pulse_In (SMA connector)	
Input voltage	0 to 3.3 V
Threshold	0-3.3 VDC software adjustable (Pulse In)
Max Input rate	200 MHz
Insertion delay	70 ns

Sync Ext/Gate Inputs (SMA connector)	
Input voltage	0 to 3.3 V
Threshold	1.2 V
Max input rate	20 MHz

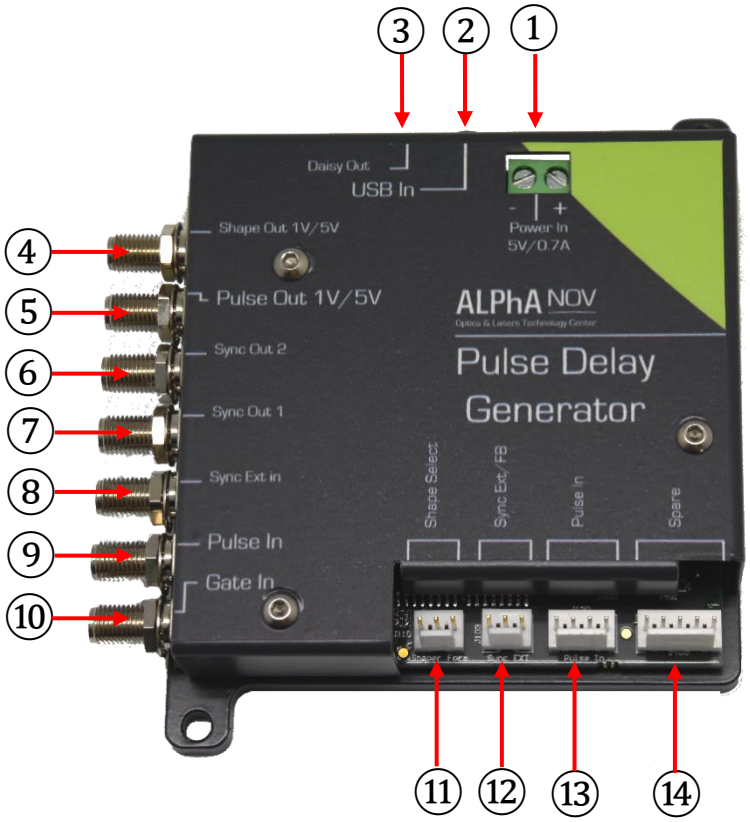
General:

Power voltage/current	+5 VDC/500 mA (charger included)
USB 2.0 (cable included)	
Stackable units	Multiple channel setup using several units (single USB/single power supply/ single synchronization input signal)

Mechanical:



2.2 Front-Panel overview



2.2.1 Power and Communications Connectors

①- Power connector (5V / 0.7A)

② - Input Communication Connector

③ - Output Communication Connector

2.2.2 SMA Output and Input Connectors

④ - Analogic Output Signal *(Shaper)*

⑤- Digital Pulse Output Signal *(Pulse Out)*

⑥ - Synchronization Output Signal 2 *(Sync Out 2)*

⑦- Synchronization Output Signal 1 *(Sync Out 1)*

⑧ - External Synchronization Input Signal *(Sync Ext In)*

⑨ - Digital Pulse Input Signal *(Pulse In)*

⑩ - External Gate Signal Input *(Gate Ext)*

2.2.3 KK Connectors

⑪ - Shape Selection Connector

⑫ - External Synchronization Connector

⑬ - Analogic Pulse Input Connector

⑭ - Spare Connectors *(Factory use only)*

2.3 System Setup

2.3.1 Power

To power Tombak module, please use the DC Power adapter provided.
First plug the cables into the power connector (①) of the module. Red cable in '+' and black cable in '-' *(polarity is indicated on the product)*.

You can then plug the DC Power Adapter to a plug socket.

2.3.2 USB

To communicate with Tombak module, please use included USB → Jack cable provided.
First connect the jack part into Input Communication Connector (②) of the module.

Please install software and pilots before plugging USB cable to computer. See section below

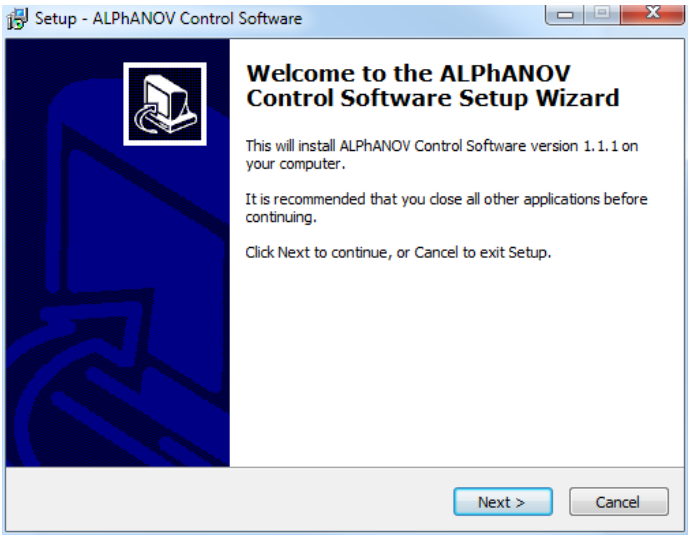
2.3.3 Tools Installation (Windows)

PDG boards works along *"ALPhANOV Control Software"*: this software is unique and compatible with all ALPhANOV electronic modules and boards.

2.3.3.1 Software installation

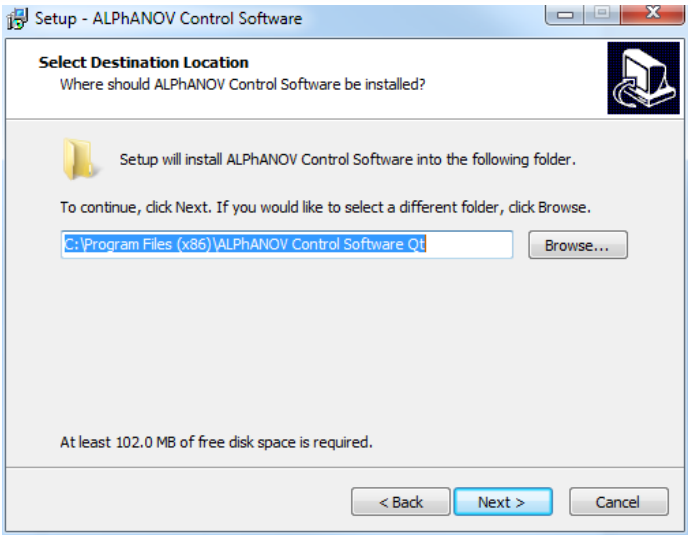
Insert CD-ROM or USB Key provided with the module. Then open an Explorer windows and navigate into "Computer" part. You will either see a CR-ROM or USB Key with "ALPhANOV" title, open it.

Double click on `ControlSoftware_x_x_xx.exe` file name.
The following window will show:

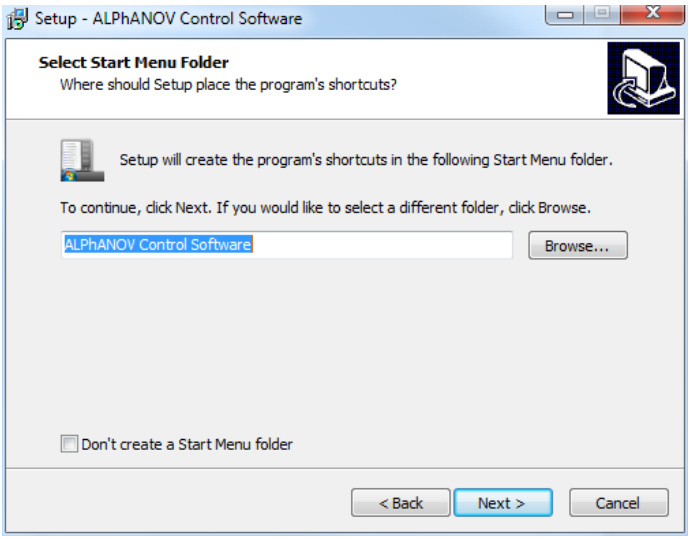


Click on Next;

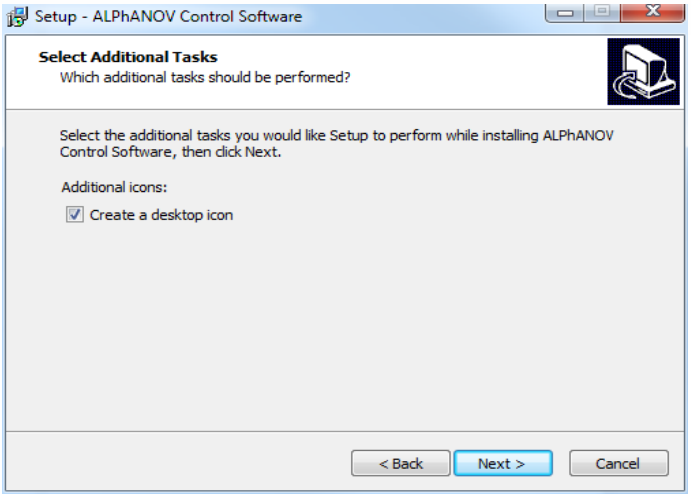
In the following windows, choose a specific installation path or leave default. Then, go to the next section



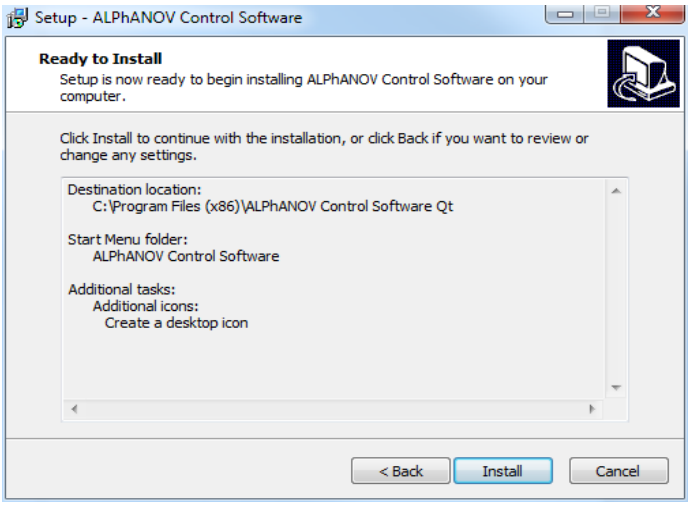
The following window lets you choose the program's shortcut name in the Start Menu folder. Feel free to change it or leave it by default.



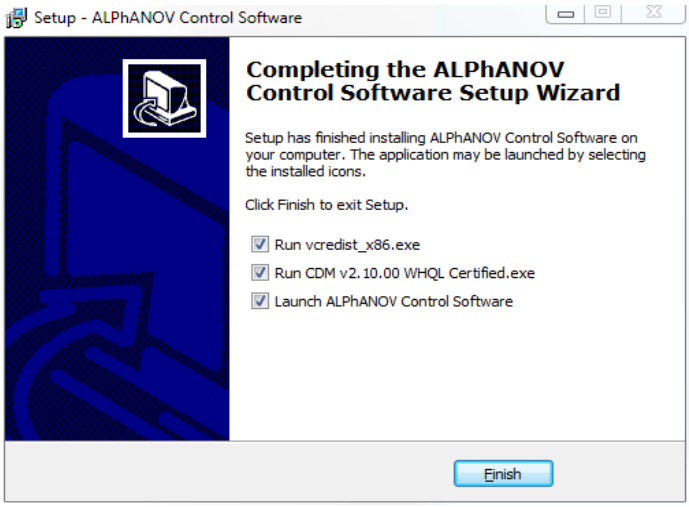
The next part lets you choose if a desktop icon needs to be created. If so, please check the box. Then go to next section.



Finally click on the Install button.



Installation of the software is now completed. To install drivers & tools please let all the box checked and click on “Finish”. You can now move to next section “Driver installation”.



2.3.3.2 Driver installation

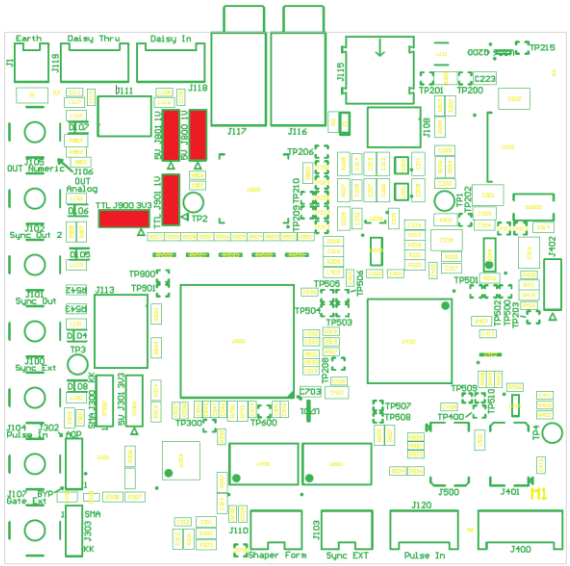
The driver installation runs through 2 parts:

- Microsoft Runtime installation
- USB Driver installation

No specific indication here, just click on “Next” and “Install” dialogs and wait until installations are finished.

2.4 Hardware Setup

Tombak module provides some hardware setup to adjust output voltage level by moving jumpers on electronic board.



Jumper

Pin number 1 is indicated on electronic board by the symbol « ▷ » or by the indicator « 1 ».

2.4.1 “Pulse Out” voltage output level

Voltage level can be adjusted according to the following configuration:

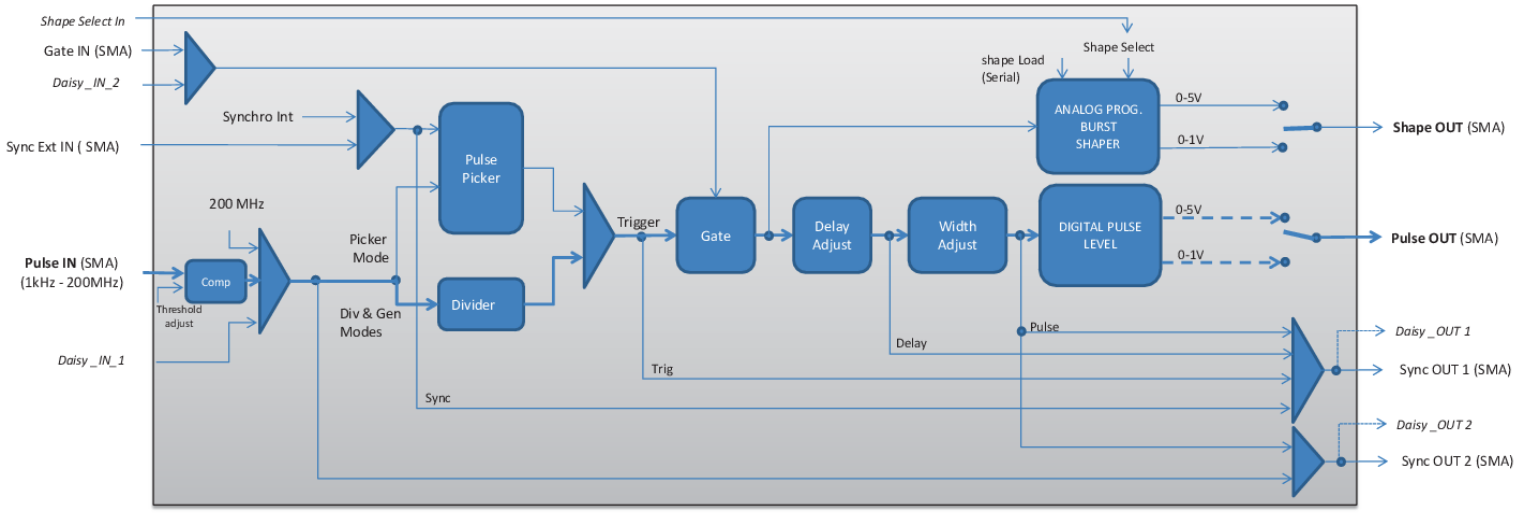
- 1V : Jumper **J901** in position **2-3**
- 3,3V : Jumper **J901** in position **1-2** et **J900** in position **1-2**
- TTL : Jumper **J901** in position **1-2** et **J900** in position **2-3**

2.4.2 “Shape Out” voltage output level

Voltage level can be adjusted according to the following configuration:

- 1V : Jumper **J800** in position **2-3** et **J801** in position **2-3**
- 5V : Jumper **J800** in position **1-2** et **J801** in position **1-2**

2.5 Global Architecture



2.6 Multi-channel module – Stacked TOMBAK

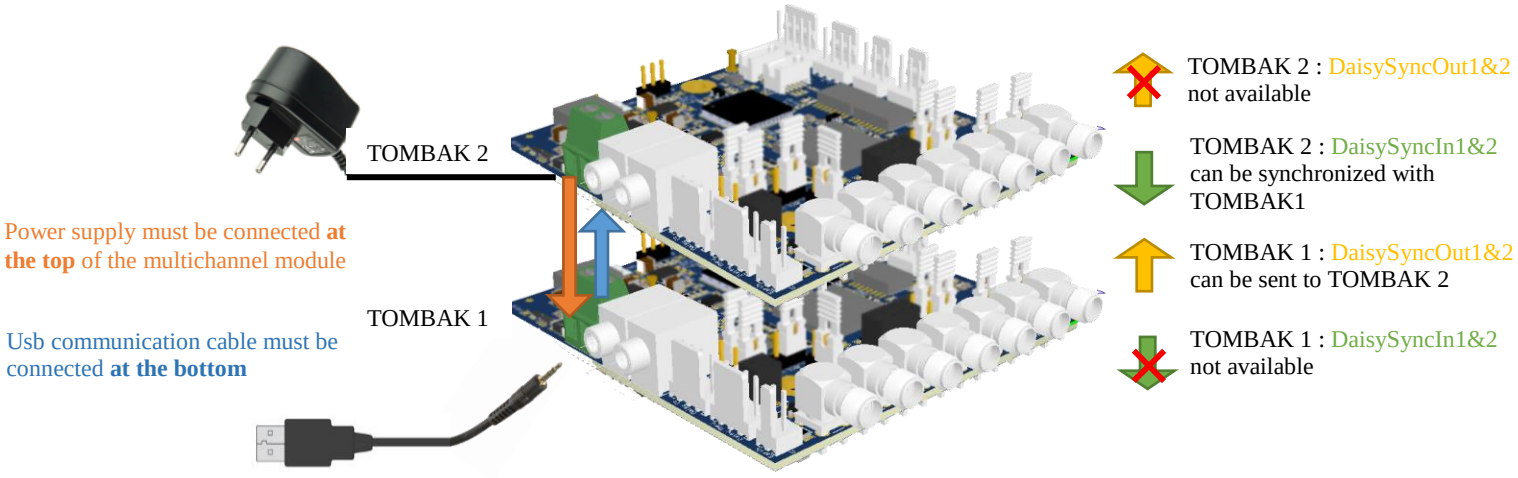
TOMBAK can be delivered in multi-channel version with multiple board stacked in a compact module.

This option allows the user to access multiple output signal while sharing the same power source, the same communication bus and some internal signals between stacked board. For example, output signal from first board can be sent to the second board without any cable thanks to the internal "daisy connector".

The shared features available in stacked module are:

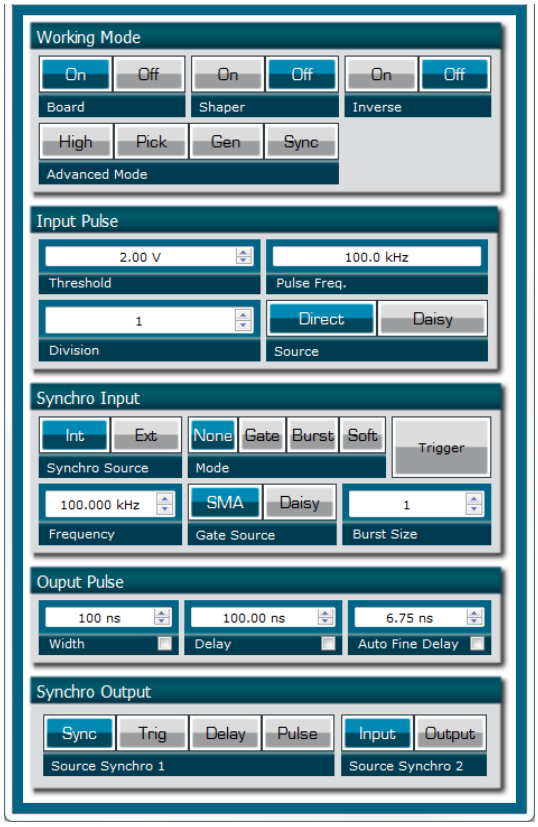
- **Power**: A single power source is needed and should be connected at the top
- **Usb Communication cable**: A single USB to Jack cable is needed to access all features of the multi-channel module and should be connected at the bottom.
- **Synchronization signals:**
  - **SyncOut1 & SyncOut2:** Synchronization output signals can support multiple signals such as output pulse, delayed pulsed, internal trigger (see 2.5. Global Architecture diagram) … These outputs can be synchronized only with the **next upper board**.
  - **DaisyIn1:** Synchronization input signal that can be used as fundamental input signal (same as "Pulse In" from SMA, see 2.5. Global Architecture diagram). This input can be synchronized only **with the board above**.
  - **DaisyIn2:** Synchronization input signal that can be used as gate or burst trigger signal (same as "Gate In" from SMA, see 2.5. Global Architecture diagram). This input can be synchronized only **with the board above**.

For any other combination of signals between stacked board, user can still use SMA cable between the modules.



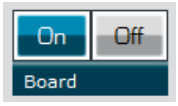
2.7 Front-Panel User Interface

2.7.1 Overview



2.7.2 Working Mode

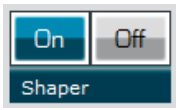
2.7.2.1 Board



This button is the global enable switch of the module

- *In ON position, every feature and signal of the board will be active.*
- *IN OFF position, the board will be in standby mode and output signals will be inactive.*

2.7.2.2 Shaper



This button is the Analogic Output Signal *(Shaper)* enable switch

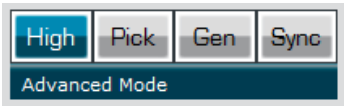
- *In ON position, an AWG signal can be output on SHAPE OUT SMA Connector.*
- *IN OFF position, the AWG signal will be at its default value.*

2.7.2.3 Inverse

This button is the Digital Output Signal *(Pulse Out)* inverter switch

- *In ON position, the digital output signal on PULSE OUT SMA connector will be logically inverted.*
- *IN OFF position, it will be at its normal state.*

2.7.2.4 Advanced Mode

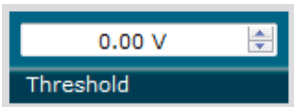


This button is the Advanced mode selection switch

- *In HIGH position, the digital output signal will be continuous at its high level.*
- *In PICK position, the board is set in Picking & Synchronisation Mode: the digital PULSE OUT signal is synchronized with PULSE IN. In this advanced mode, an external or internally generated signal can be synchronized with PULSE IN signal. Delay and pulse width regarding PULSE IN are software adjustable.*
- *In Gen position, the board is a 20MHz standalone generator.*
- *In Sync position, PULSE OUT is synchronized with PULSE IN and voltage level may be upgrade.*

2.7.3 Input Pulse

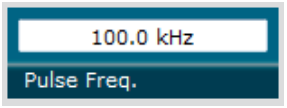
2.7.3.1 Threshold



This setting is the trigger level on Digital Input Signal *(Pulse In)*

- *It should be adjusted so that the frequency read on Pulse Freq. box is correct.*

2.7.3.2 Pulse Freq.



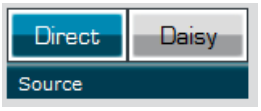
This display box shows a frequency measurement value on Digital Input Signal *(Pulse In)*

- *Threshold setting has to be adjusted to get the correct value in this box.*

2.7.3.3 Division

This setting allows to divide frequency of Digital Input Signal *(Pulse In)*

2.7.3.4 Source



This setting allows to choose Digital Input Signal *(Pulse In)* source

- *In Direct position, the signal input is taken from SMA connector.*
- *In Daisy position, the signal input is taken from another PDG module chained. (Multi-output configuration option).*

2.7.4 Output Pulse

2.7.4.1 Width

This setting allows to modify Digital Output Signal *(Pulse Out)* pulse width

2.7.4.2 Delay

This setting allows to modify Digital Output Signal *(Pulse Out)* delay

2.7.4.3 Fine Delay

This special feature allows to fine adjust the Digital Output Signal *(Pulse Out)* delay up to 10ps

- In Auto mode, the board automatically adjust delay from Delay Box value
- In Manual mode, user can adjust manually delay with 10ps resolution

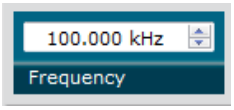
2.7.5 Synchro Input

2.7.5.1 Source

This button allows to select signal source to synchronize with PULSE IN

- *In INT position, signal source is selected from an internal frequency generator. Value can be adjusted with Frequency box.*
- *In EXT position, signal source is selected from external source (SYNC EXT Input Signal). Frequency is shown in Frequency box.*

2.7.5.2 Frequency



This button allows to set or visualize synchronization signal frequency

- *When Source button is set to INT: allows to set frequency.*
- *When Source button is set to EXT: shows a measure of external frequency.*

2.7.5.3 Mode

This button allows to choose internal gating mode

- *When Mode button is set to None: the Digital Output Signal will remain unchanged.*
- *When Mode button is set to Gate, Digital Output Signal will be enabled when External Gate Input Signal is at high level, if this External Gate Input is at low level, no signal will be emitted from Digital Output Signal.*
- *When Mode button is set to Burst: a number of pulse from the Digital Input Signal will be emitted to Digital Output Signal when a rising edge occurs on External Gate Input Signal. The number of pulses emitted can be set using Burst Size box.*

- *When Mode button is set to Soft: a number of pulse from the Digital Input Signal will be emitted to Digital Output Signal when clicking on Trigger button. The number of pulses emitted can be set using Burst Size box.*

2.7.5.4 Burst Size

This button allows to change the number of pulses emitted in a burst

- *This box is only accessible when Mode box is set to Burst of Soft mode.*

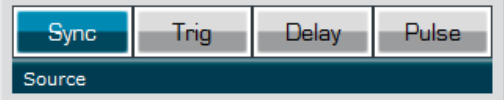
2.7.5.5 Trigger

This button allows to trigger a burst manually

- *This box is only accessible when Mode box is set to Soft mode.*

2.7.6 Synchro Output

2.7.6.1 Source



This button allows to select output synchronization source

- *Depending on what output synchronization source is selected, signal emitted from Synchronization Output Signal 1 will be different. (See **Erreur ! Source du renvoi introuvable.** section **Erreur ! Source du renvoi introuvable.** for more information)*

2.8 Configuration Example

2.8.1 Using PDG as a Pulse & Delay Generator

2.8.1.1 Presentation

The board can generate a software configurable delay and pulse width signal from a reference pulse signal.

2.8.1.2 Timing diagram

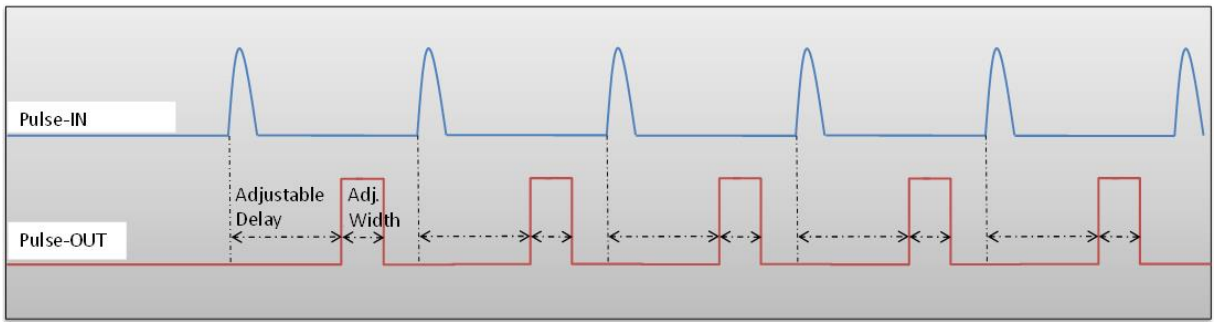


Figure 2 : Delayed and pulse width adjusted signal from input to output

2.8.1.3 Synoptic

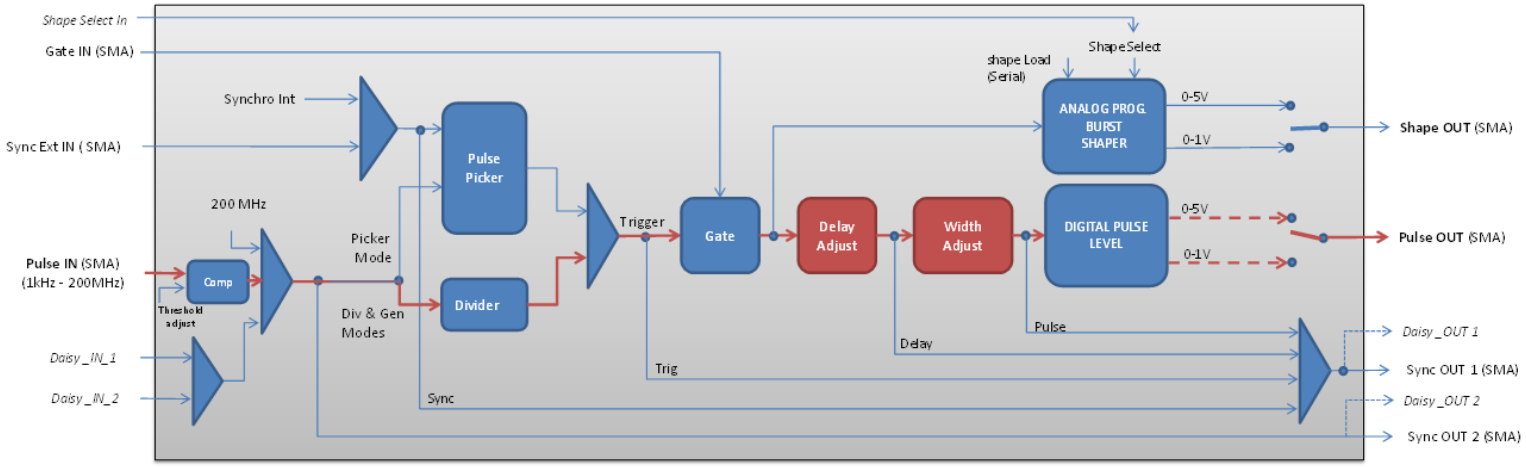
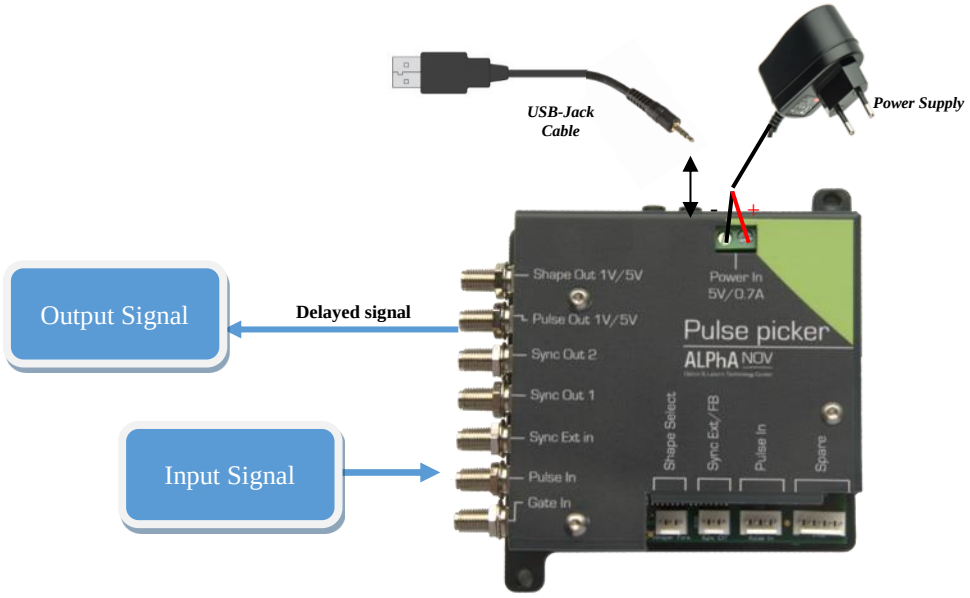


Figure 3 : Main firmware features used in Delay Generator

2.8.1.4 Cabling

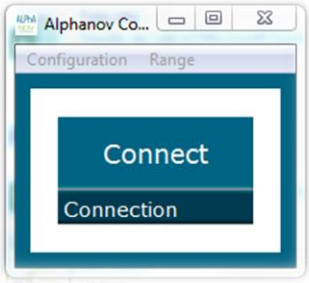
1. Plug the USB-Jack cable in the "*USB In"* connector
2. Plug the signal generator (i.e. the signal you want to delay) in the "*Pulse In"* SMA connector

3. The software adjustable delay and pulse width signal will output on the "*Pulse Out*" SMA connector
4. Finally, plug the power supply to the "*Power In*" connector to power on the board



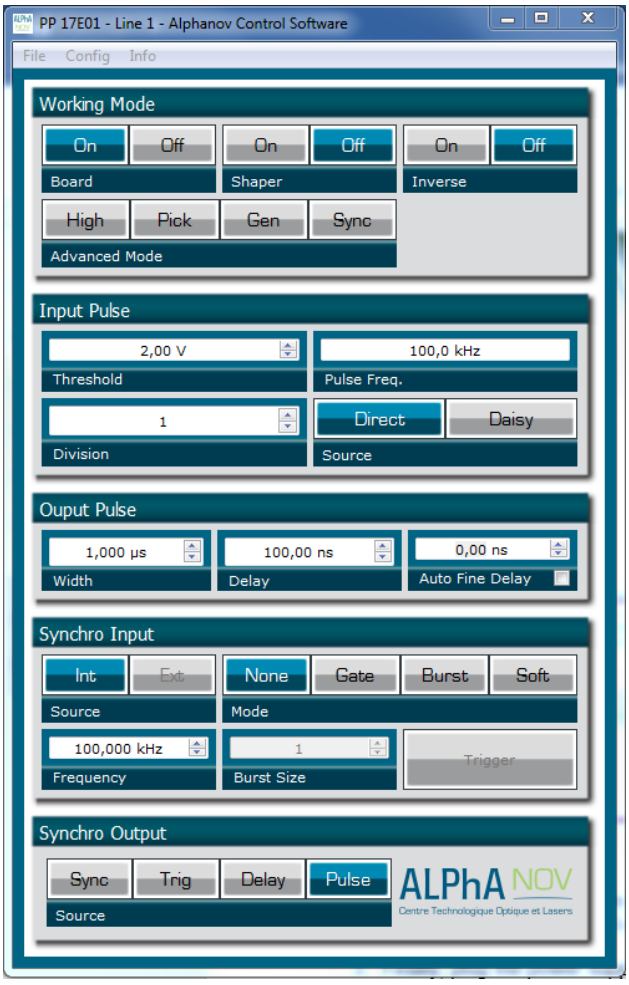
2.8.1.5 *Software configuration*

Launch the ALPhANOV Control Software and click on *Connect* to start the Tombak hardware detection. The software automatically detects the Pulse-Picker board.

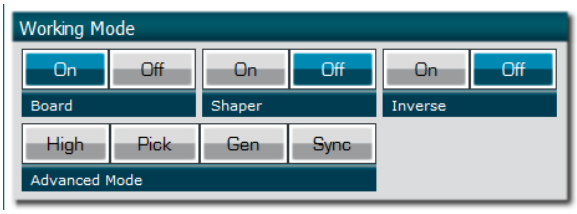


A window will appear for each Tombak connected to the computer.

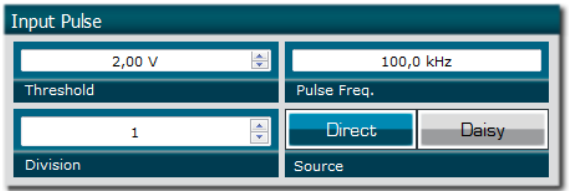
The main configuration windows must be configured as follow :



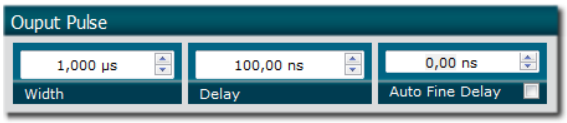
- Working Mode window :
  - Set the **Board On**
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Unset all **Advanced Mode**



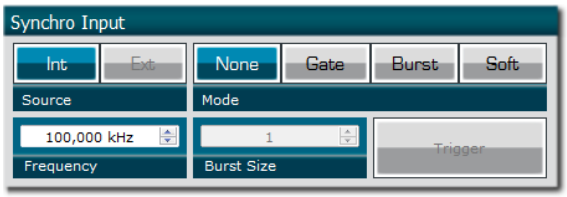
- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**



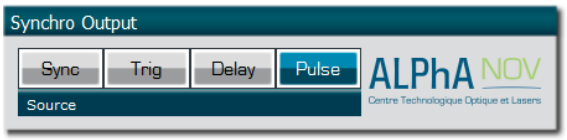
- Output Pulse window :
  - Choose the output **delay** value
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



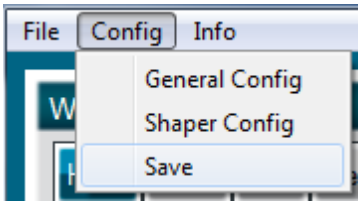
- Synchro input windows:
  - Source : not used in this mode
  - Mode : None
  - Frequency : not used in this mode
  - Burst size : not used in this mode



- Synchro ouput window (default settings) :
  - Source : Pulse



Don't forget to save the settings by clicking on the "Save" button in the bar menu.



2.8.1.6 Main features

Adjustable pulse width ▪ resolution (for pulse width [5ns – 510ns]) ▪ resolution (for pulse width [511ns – $2^{\wedge 62}$ns])	[5ns – $2^{\wedge 62}$ns] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – $2^{\wedge 62}$ns] 10ps
Jitter ▪ for delay < 570ns & pulse width < 510ns ▪ for any other delay & pulse width	 <200 ps RMS 1.5 ns RMS
Input PulseIn voltage	30 mV – 3,3V
Input maximum frequency	200 MHz
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Output maximum frequency	20 MHz

2.8.2 Using TOMBAK as a standalone generator

2.8.2.1 Presentation

An internal 200MHz generator is available and does not need any external signal. The board can output an external signal up to 20Mhz with adjustable pulse width.

2.8.2.2 Timing diagram

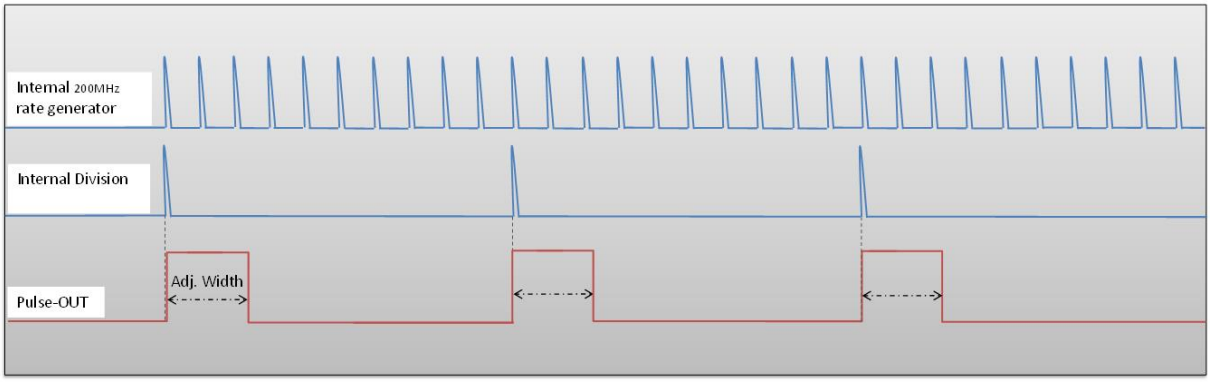


Figure 4 : internal 200MHz clock divided by 10 to get a duty cycle software adjustable 20MHz output signal

2.8.2.3 Synoptic

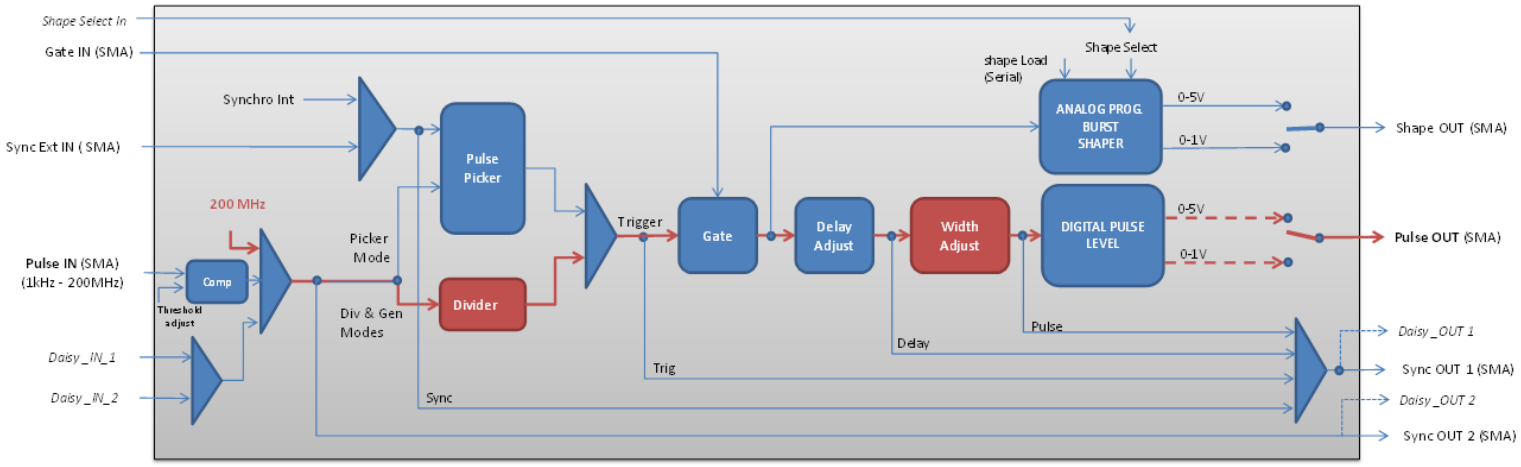
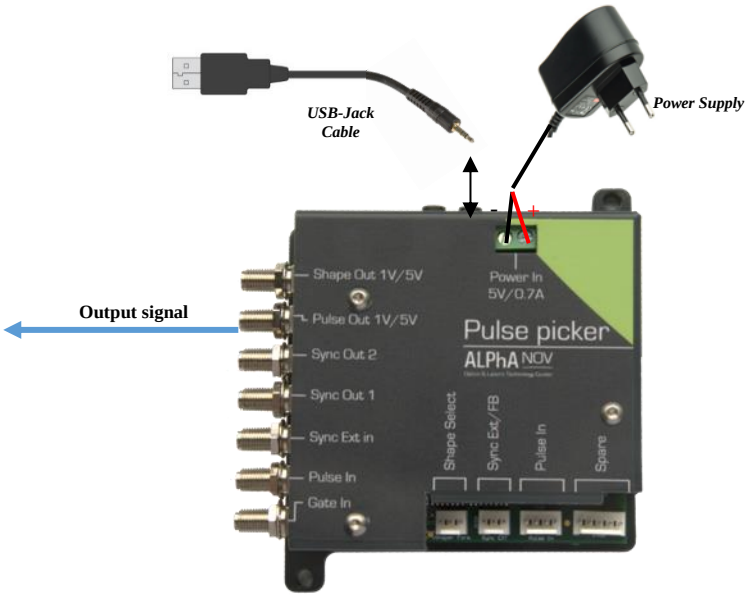


Figure 5 : Main firmware features used in Delay Generator

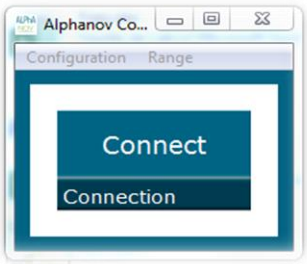
2.8.2.4 Cabling

1. Plug the USB-Jack cable in the "*USB In"* connector
2. The software adjustable signal will output on the "*Pulse Out*" SMA connector
3. Finally, plug the power supply to the "*Power In*" connector to power on the board



2.8.2.5 Software configuration

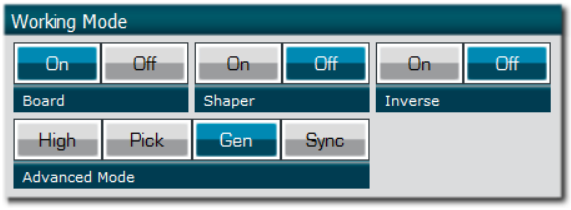
Launch the ALPhANOV Control Software and click on *Connect* to start the Tombak hardware detection. The software automatically detects the Pulse-Picker board.



A window will appear for each Tombak connected to the computer.

The main configuration windows must be configured as follow :

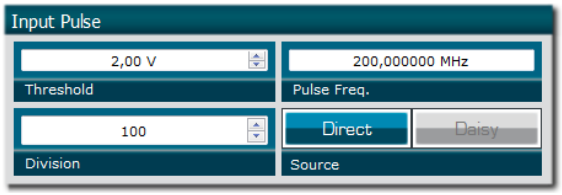
- Working Mode window :
  - Set the B**oard On**
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Select **Gen** mode in **Advanced Mode**



- Input pulse window :
  - **Threshold** input voltage is not used in this configuration, set value to 0V (default settings)
  - **Delay** value is not used in this configuration, set value to 0V (default settings)
  - Set **Source** to **Direct** (default settings)
  - **Pulse Freq.** indicator give the internal rate generator. The output frequency is related to this primary value.
  - Set the **Division** factor according to the following definition :

i. $$\textbf{Division}\ ^{(*)} = \frac{\textbf{Pulse Freq}(\text{Hz})}{\text{Output frequency}(\text{Hz})}$$

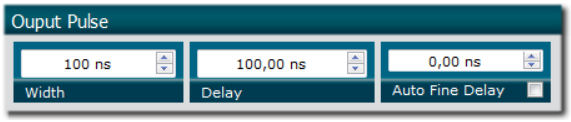
(*) Division must be at least 10 as the maximum output frequency is 20MHz.



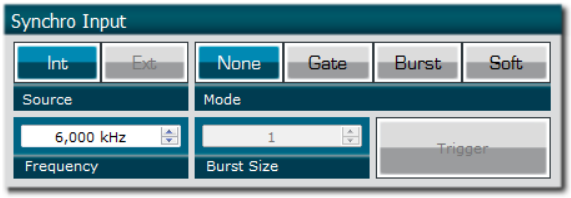
In this example, the division is set to 100 to get a 2Mhz output frequency => 200Mhz/2Mhz = 100

- Output Pulse window :
  - **Delay** value is not used in this mode
  - **Auto Fine Delay** is not used in this mode
  - Choose the output **Pulse width** to get a specific duty cycle (*).

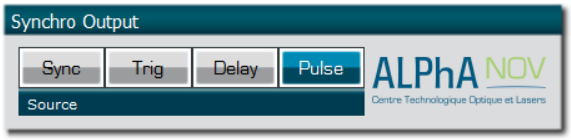
$$\textbf{Pulse width}\ (\text{s})\ (*) = \frac{\text{DutyCycle}(\%)}{100 * OutputFrequency(Hz)}$$



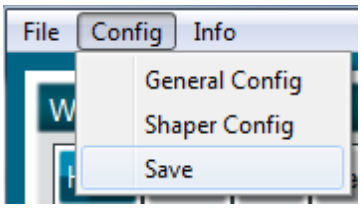
- Synchro input windows :
  - Source : Not used in this mode
  - Mode : None
  - Frequency : Not used in this mode
  - Burst size : Not used in this mode



- Synchro ouput window (default settings) :
  - Source : Pulse



Don’t forget to save the settings by clicking on the “Save” button in the bar menu.



2.8.2.6 Main features

Adjustable output frequency	[0 – 20Mhz]
Frequency resolution (N is an integer in the range [10 – $10^{\wedge 9}$])	$\frac{\text{Internal 200Mhz clock}}{N}$
Adjustable pulse width ▪ resolution (pulse width [5ns – 510ns]) ▪ resolution (pulse width [511ns – $2^{\wedge 62}$ns])	[5ns – $2^{\wedge 62}$ns] 2ns 5ns
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Maximum output frequency	20 MHz

2.8.3 Using the PDG as a burst generator

2.8.3.1 Presentation

The board can generate a burst signal from an external trigger or from a software trigger.
The burst consist of a specific software adjustable number of pulses.
When triggered, the board output a burst signal with an adjustable pulse width, a specific delay and a frequency related to the "PulseIn" input signal.

2.8.3.2 Timing diagram

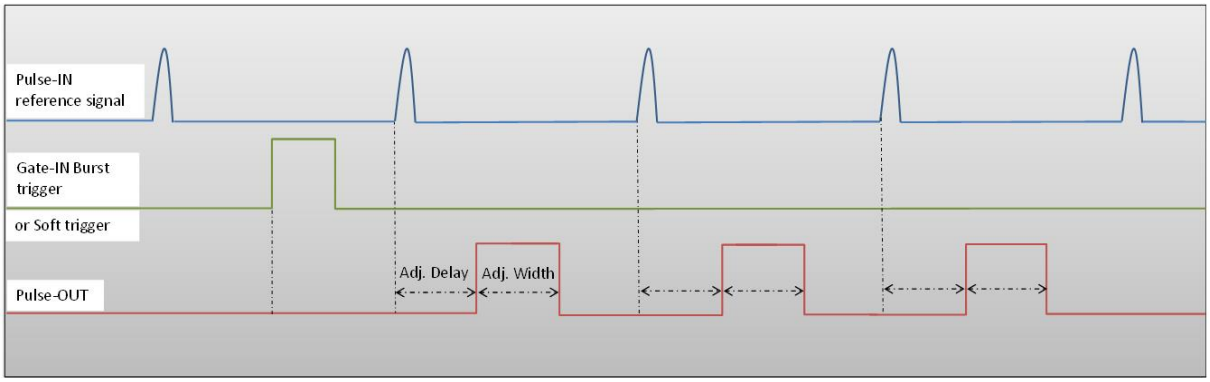


Figure 6 : Burst signal of 3 pulses, "Gate-IN" or Soft triggered and "Pulse-In" synchronized

2.8.3.3 Synoptic

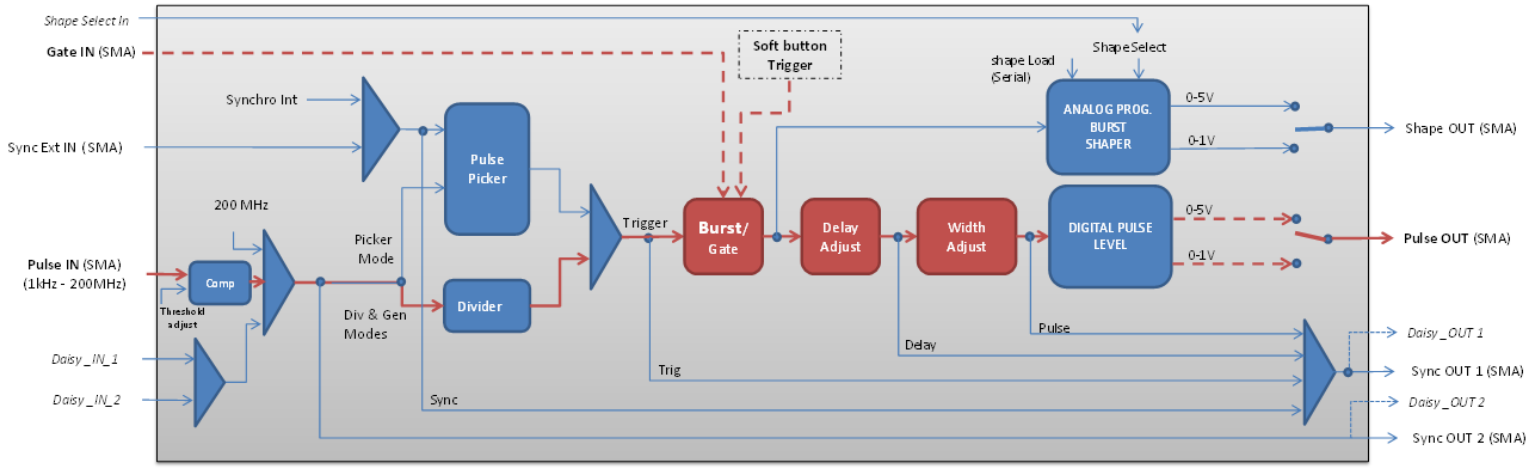
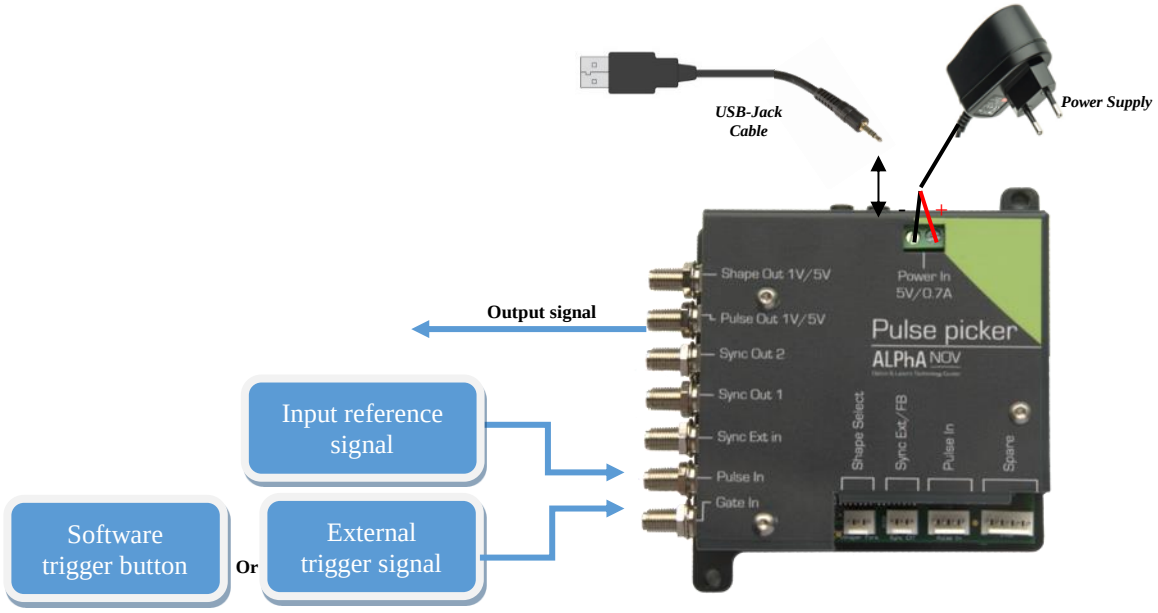


Figure 7 : Main software features used in Burst Generator

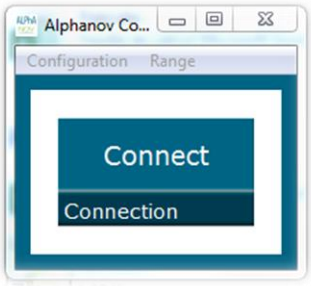
2.8.3.4 Cabling

1. Plug the USB-Jack cable in the "*USB In"* connector
2. Plug the power supply to the "*Power In*" connector to power on the board
3. Burst signal will output on the "*Pulse Out*" SMA connector
4. Connect the trigger signal that will start the burst to "*Gate In*" SMA connector
5. Connect the reference signal (i.e. the signal that will drive the burst when triggered) to "*Pulse In*" SMA connector.



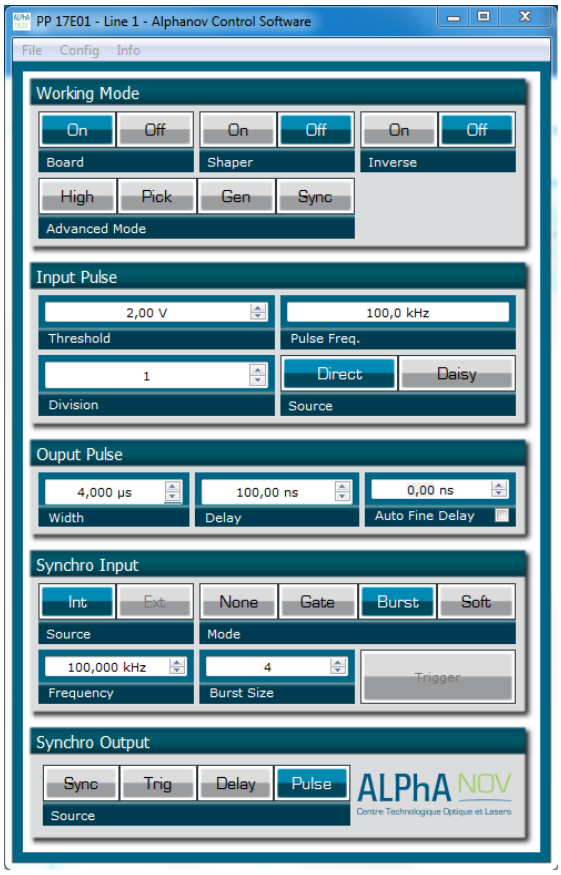
2.8.3.5 Software configuration

Launch the ALPhANOV Control Software and click on *Connect* to start the Tombak hardware detection. The software automatically detects the Pulse-Picker board.

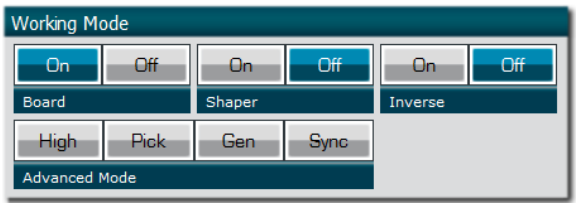


A window will appear for each Tombak connected to the computer.

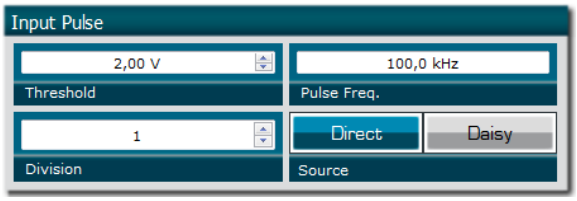
The main configuration windows must be configured as follow :



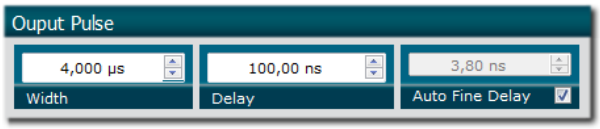
- Working Mode window :
  - Set the **Board** button to **ON**
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off**
  - Unset all **Advance Mode**



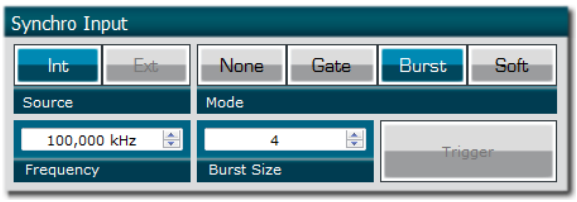
- Input pulse window :
  - Configure the **Threshold** voltage so that the input pulse frequency is detected and equal to your pulse generator system
  - Set the **Division** factor to **1** (default settings). Division value may be ajusted to divide the input reference signal frequency.
  - Set the input pulse **Source** to **Direct**



- Output Pulse window :
  - Set the output pulse **Width**
  - Set the **Delay** between output and input signals
  - **AutoFineDelay** may be let in auto mode

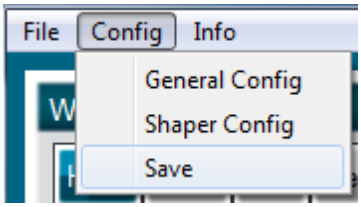


- Synchro input windows:
  - **Source** synchronisation is not used in this mode
  - Set **Mode** to Burst
  - **Frequency** is not used in this mode
  - Set the **Burst Size** value to configure the number of pulse triggered



- Synchro ouput window (default settings) :
  - Source : Pulse

Don’t forget to save the settings by clicking on the “Save” button in the bar menu.



2.8.3.6 Main features

Burst size range	[1 - 10^9] pulses
Adjustable pulse width ▪ resolution (pulse width [5ns – 510ns]) ▪ resolution (pulse width [511ns – $2^{\wedge 62}$ns])	[5ns – $2^{\wedge 62}$ns] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – $2^{\wedge 62}$ns] 10ps
Input Trigger Voltage ▪ Logic Low ▪ Logic High	 [0-0.8V] [1.7-3.3V]
Input PulseIn voltage	30 mV – 3,3V
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Output maximum frequency	20 MHz

2.8.4 Using the Gate feature of PDG

2.8.4.1 Presentation

Signal gating allow user to enable output for a specific time windows. Input signal frequency is then reproduced on the output with a software programmable delay and pulse width.

2.8.4.2 Timing diagram

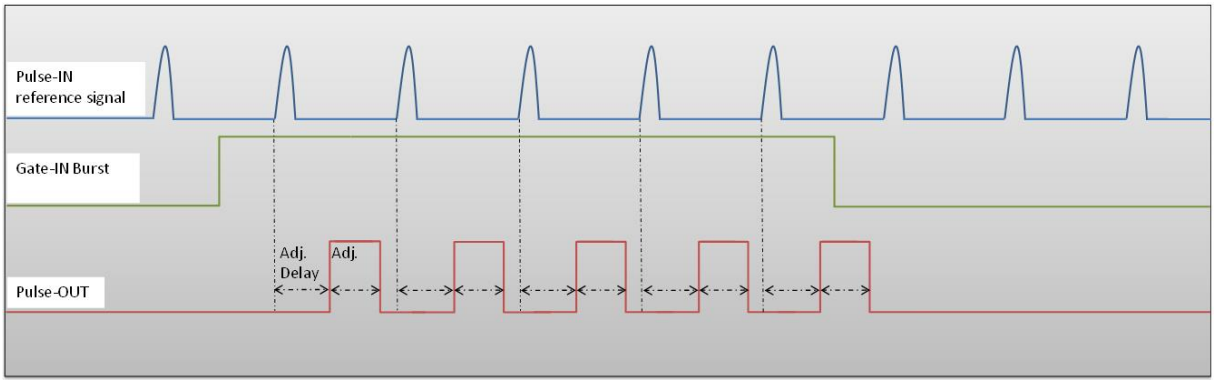


Figure 8 : Gated output from Gate-IN external signal

2.8.4.3 Synoptic

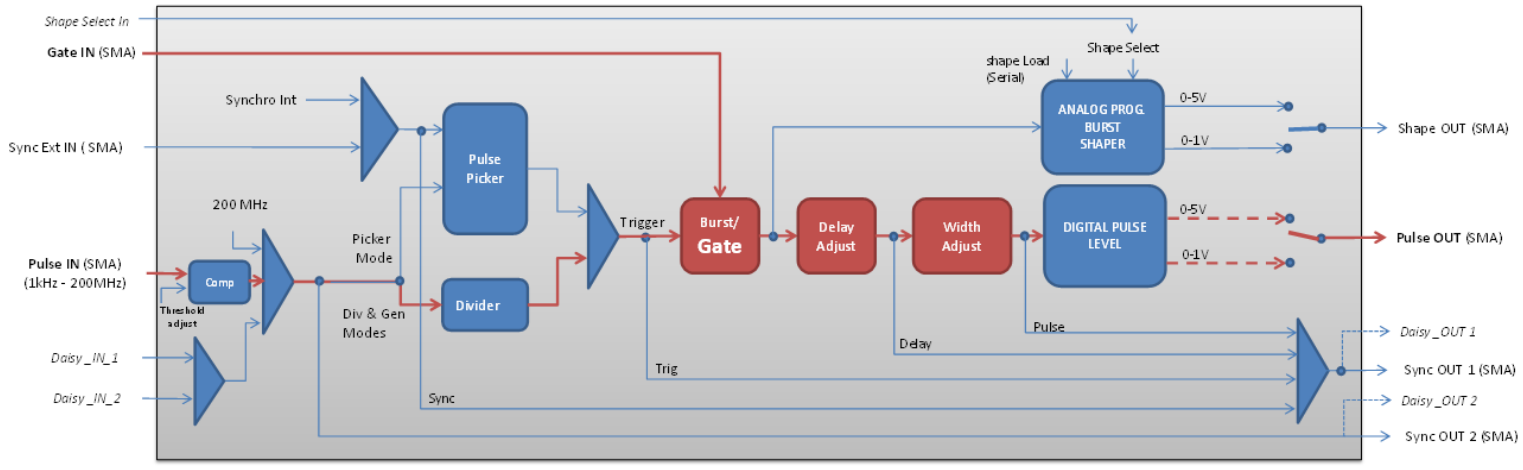
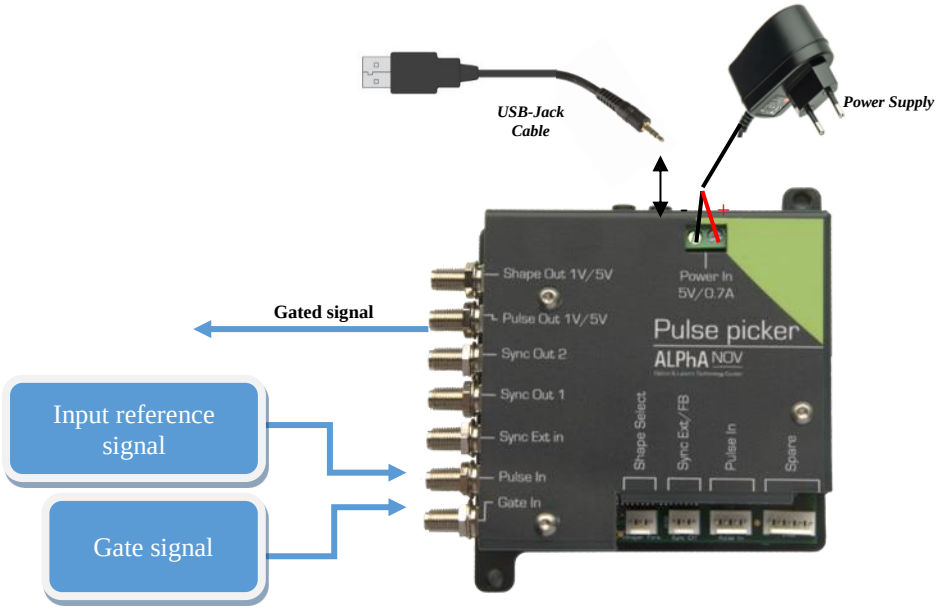


Figure 9 : Main software features used in Gate Mode

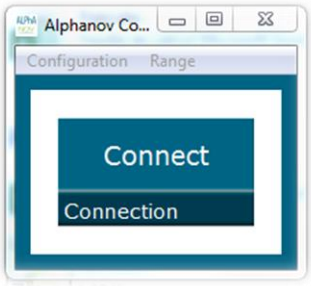
2.8.4.4 Cabling

1. Plug the USB-Jack cable in the "*USB In"* connector
2. Plug the power supply to the "*Power In*" connector to power on the board
3. Connect the Gate signal that will enable the output to Gate-In connector
4. Connect the reference signal (i.e. the signal that will drive the output when Gate-In signal is high level) to "*Pulse In*" connector
5. Gated signal will output on the "*Pulse Out*" connector



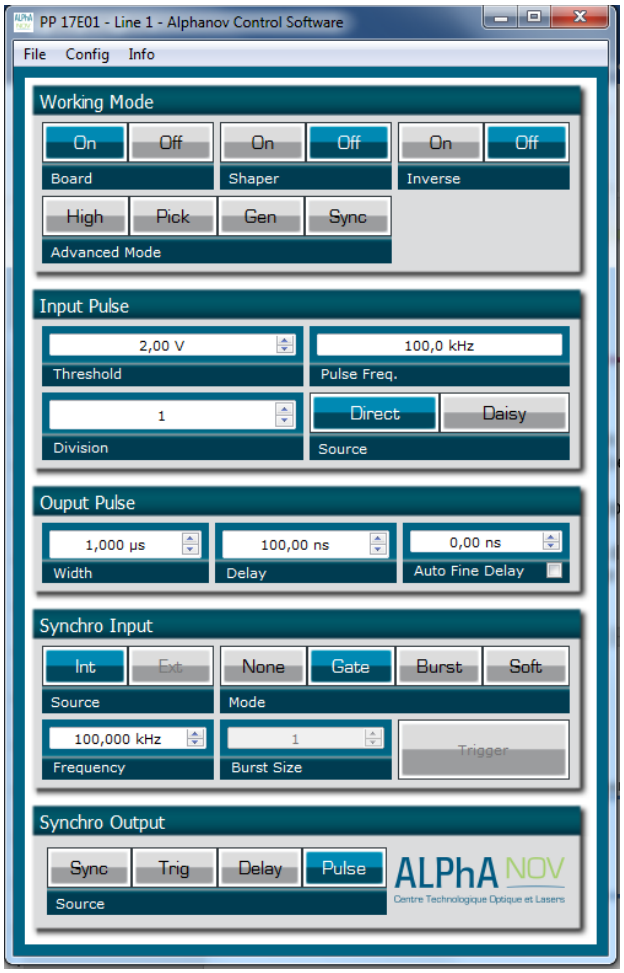
2.8.4.5 Software configuration

Launch the ALPhANOV Control Software and click on *Connect* to start the Tombak hardware detection. The software automatically detects the Pulse-Picker board.

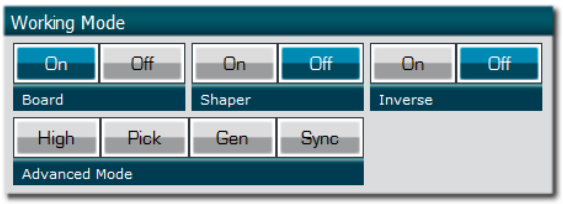


A window will appear for each Tombak connected to the computer.

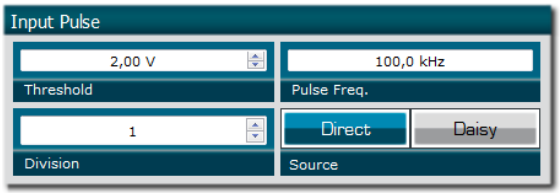
The main configuration windows must be configured as follow :



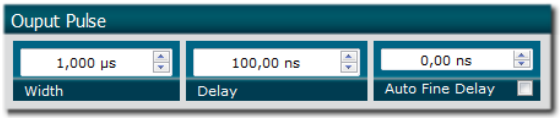
- Working Mode window :
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Unset all **Advanced Mode**
  - Finally set the **Board** On



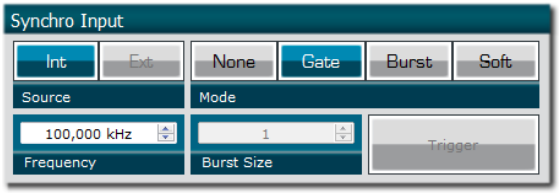
- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**



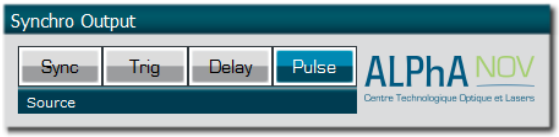
- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



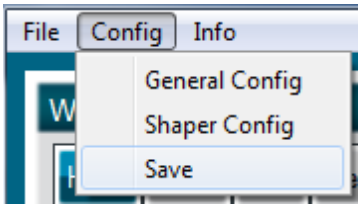
- Synchro input windows:
  - Source : not used in this mode
  - Mode : Gate
  - Frequency : not used in this mode
  - Burst size : not used in this mode



- Synchro ouput window (default settings) :
  - Source : Pulse



Don't forget to save the settings by clicking on the "Save" button in the bar menu.



2.8.4.6 Main features

Adjustable pulse width ▪ resolution (pulse width [5ns – 510ns]) ▪ resolution (pulse width [511ns – 2^62ns])	[5ns – 2^62ns] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – 2^62ns] 10ps
Input Gate Voltage ▪ Logic Low ▪ Logic High	 [0-0.8V] [1.7-3.3V]
Input PulseIn voltage	30 mV – 3,3V
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Output maximum frequency	20 MHz

2.8.5 Using PDG as a signal synchronization module

2.8.5.1 Presentation

Synchronization signals is available on this module. A signal (internally generated or external) can be synchronized with an external reference signal connected to Pulse-In connector.

The output delay from input and the pulse width are software adjustable.

2.8.5.2 Timing diagram

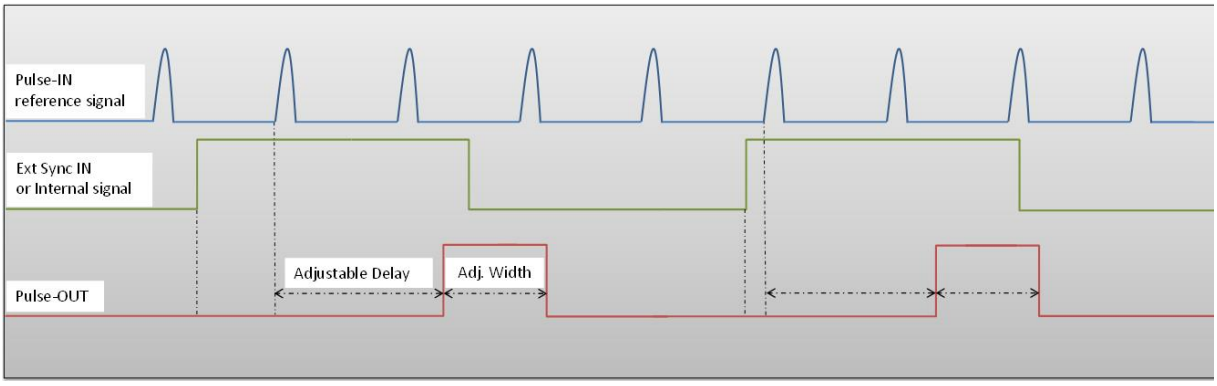


Figure 10 : External or internal signal synchronized with Pulse-In signal.

2.8.5.3 Synoptic

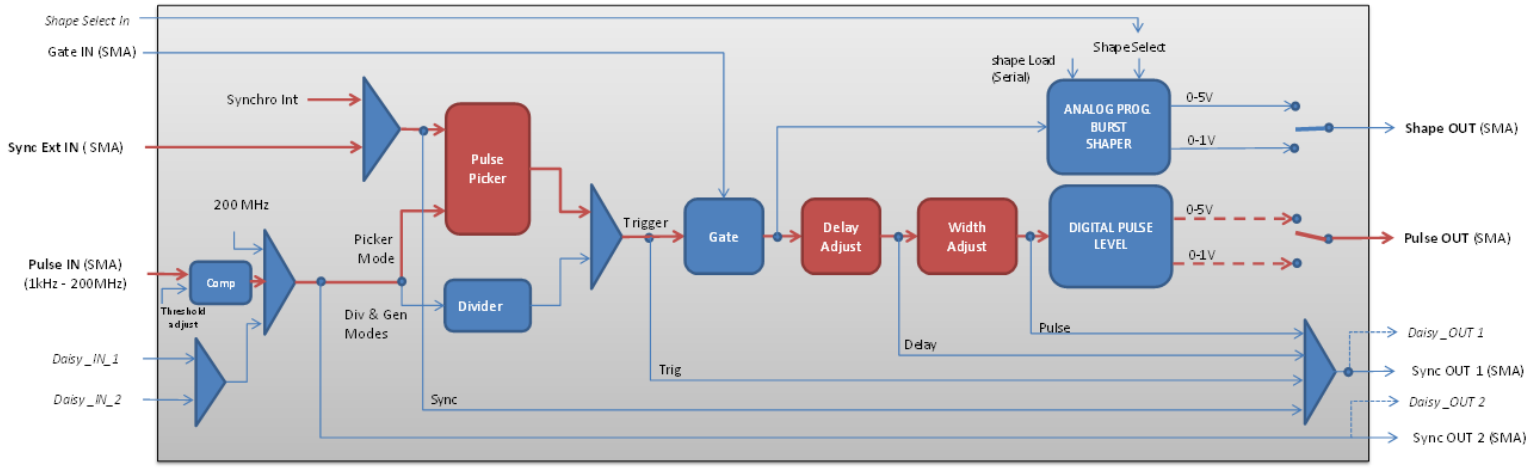
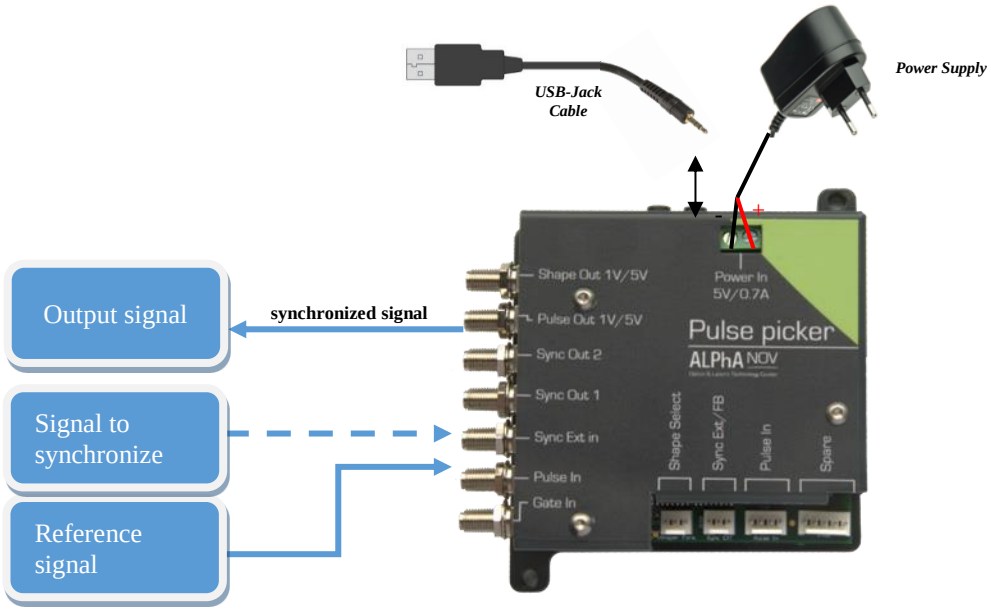


Figure 11 : Main firmware features used in synchronization mode

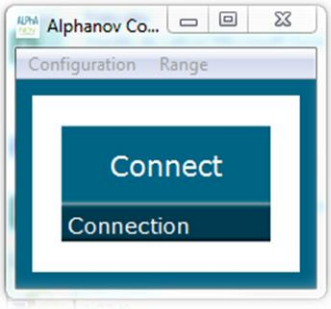
2.8.5.4 Cabling

1. Plug the USB-Jack cable in the "*USB In"* connector
2. Plug the signal to synchronize in the "*Sync Ext in"* SMA connector. (only for external signal synchronization). If signal to synchronize is internally generated, no signal needed on "*Sync Ext in"*.
3. Plug the reference signal (i.e. the signal on which "Sync Ext In" signal or "internal signal" will be synchronized with) in the "*Pulse In"* SMA connector
4. The synchronized signal will output on the "*Pulse Out*" SMA connector
5. Finally, plug the power supply to the "*Power In*" connector to power on the board



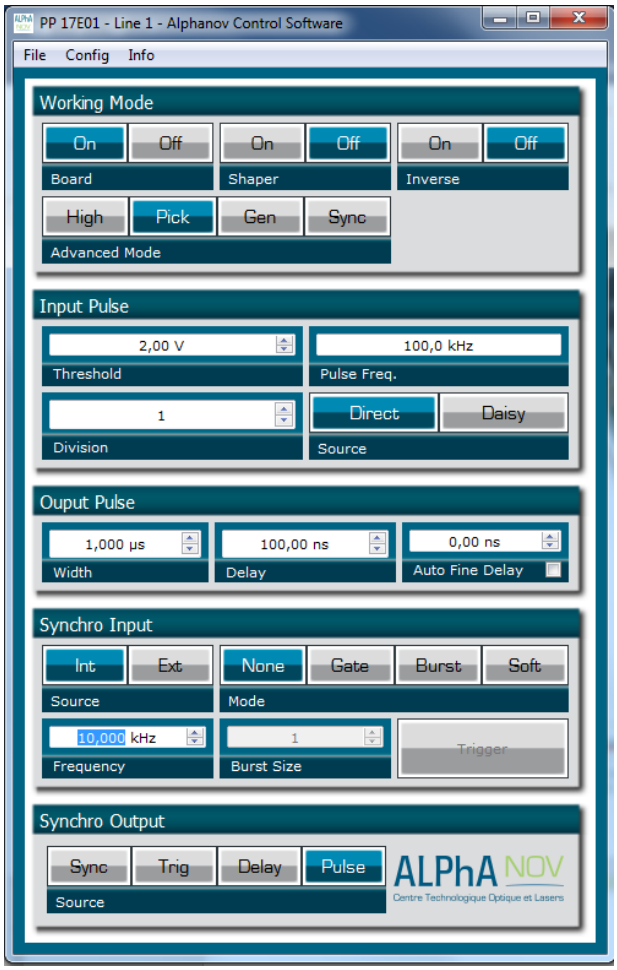
2.8.5.5 Software configuration

Launch the ALPhANOV Control Software and click on *Connect* to start the Tombak hardware detection. The software automatically detects the Pulse-Picker board.

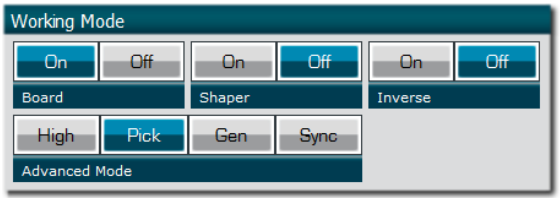


A window will appear for each Tombak connected to the computer.

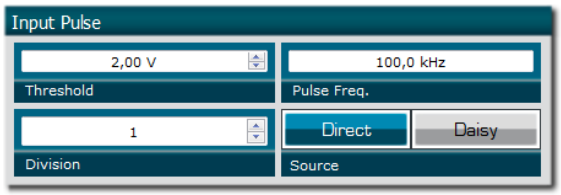
The main configuration windows must be configured as follow :



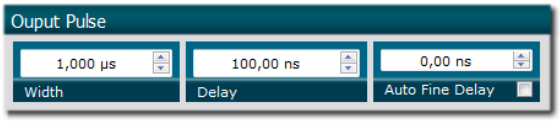
- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Pick**



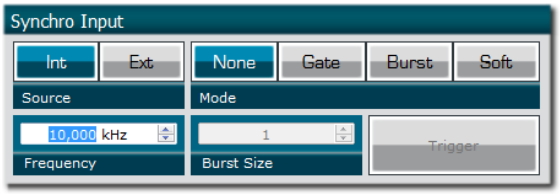
- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**

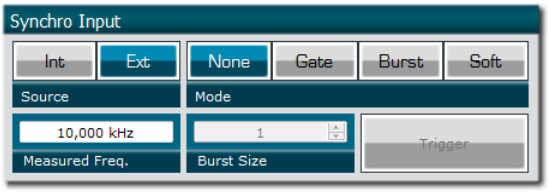


- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode

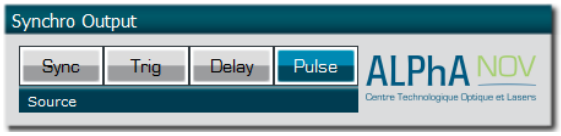


- Synchro input windows :
  - Source :
    1. Set **Int** to synchronize an internal generated signal with Pulse-In signal.
    2. Set **Ext** to synchronize an external signal (connected to Ext-In connector) with Pulse-In signal.
  - Mode : None
  - Frequency :
    1. If internal source is selected, set the output signal **Frequency** you need to synchronize.
    2. If external source is selected, **Frequency** shows the input Ext-In signal frequency
  - Burst size : not used in this mode

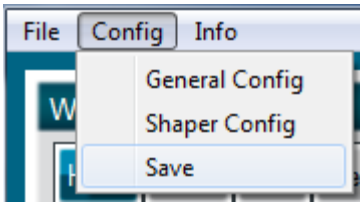




- Synchro ouput window (default settings) :
  - Source : Pulse



Don’t forget to save the settings by clicking on the “Save” button in the bar menu.



2.8.5.6 Main features

Adjustable pulse width ▪ resolution (for pulse width [5ns – 510ns]) ▪ resolution (for pulse width [511ns – $2^{\wedge 62}$ns])	[5ns – $2^{\wedge 62}$ns] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – $2^{\wedge 62}$ns] 10ps
Input Ext-In Voltage ▪ Logic Low ▪ Logic High	 [0-0.8V] [1.7-3.3V]
Input PulseIn voltage	30 mV – 3,3V
Input maximum frequency	200 MHz
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Output maximum frequency	20 MHz

2.8.6 Using PDG as a Voltage Level Converter

2.8.6.1 Presentation

The board can be used as a voltage level converter in every mode that used the PulseIn signal as a reference signal. However, SYNC mode is a specific mode that gives extended performance to the voltage converter feature (higher frequency, lower jitter, lower delay …).

2.8.6.2 Timing diagram

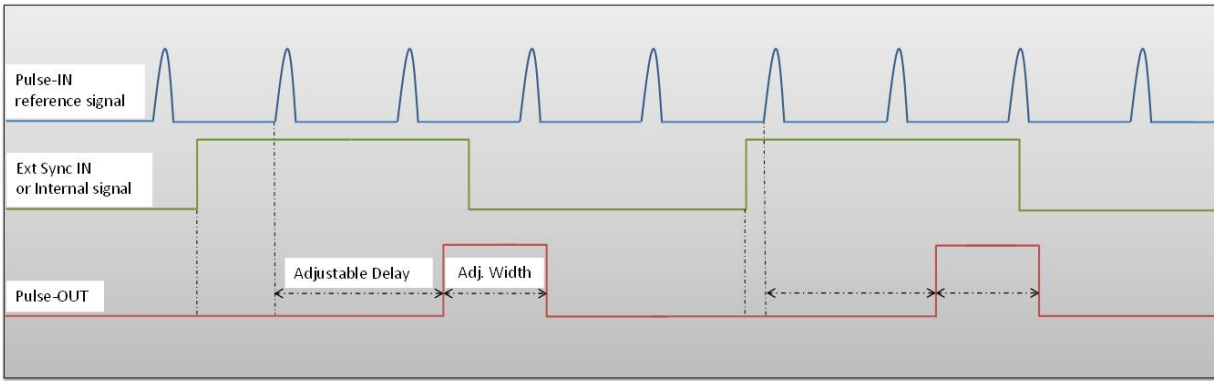


Figure 12 : External or internal signal synchronized with Pulse-In signal.

2.8.6.3 Synoptic

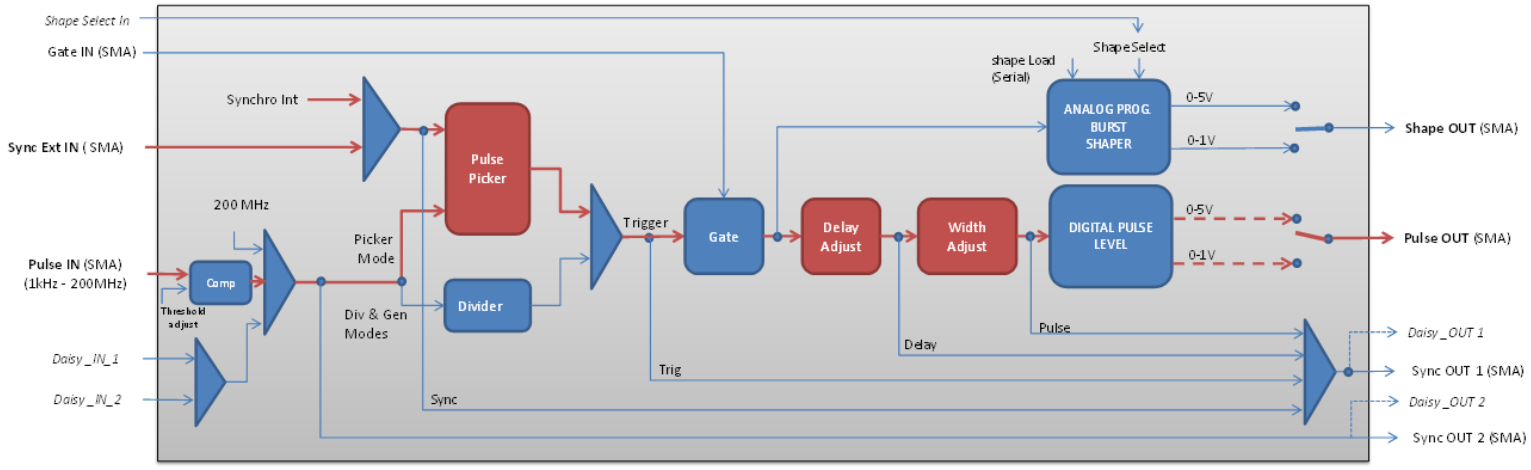
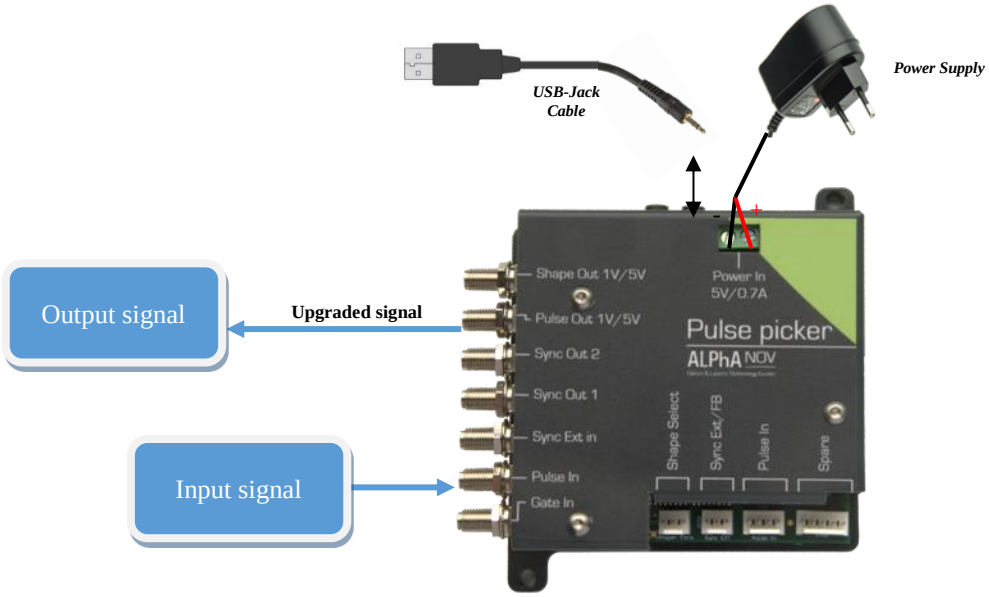


Figure 13 : Main firmware features used in synchronization mode

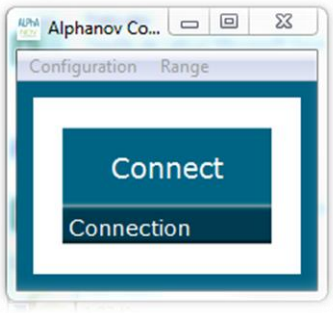
2.8.6.4 Cabling

1. Plug the USB-Jack cable in the "*USB In"* connector
2. Plug the signal you want to convert in the "*Pulse In"* SMA connector
3. The upgraded signal will output on the "*Pulse Out*" SMA connector
4. Finally, plug the power supply to the "*Power In*" connector to power on the board



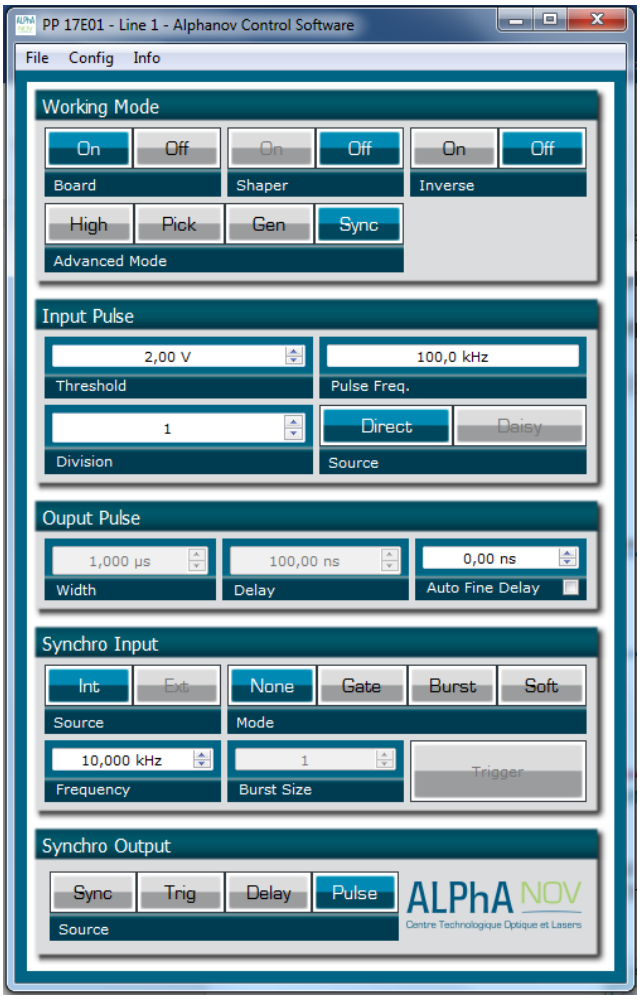
2.8.6.5 Software configuration

Launch the ALPhANOV Control Software and click on *Connect* to start the Tombak hardware detection. The software automatically detects the Pulse-Picker board.

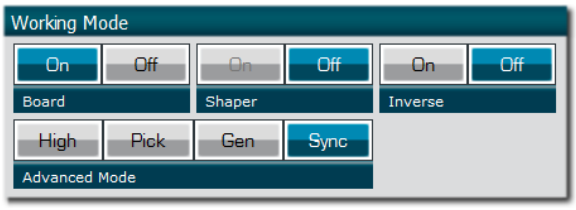


A window will appear for each Tombak connected to the computer.

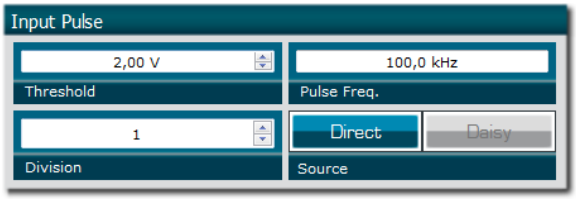
The main configuration windows must be configured as follow :



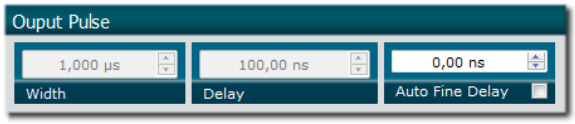
- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Sync**



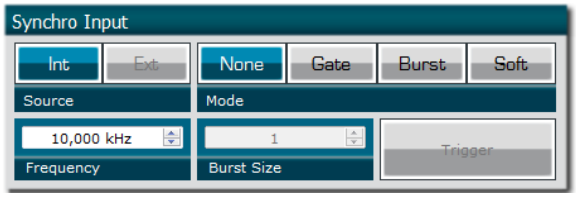
- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**
  -



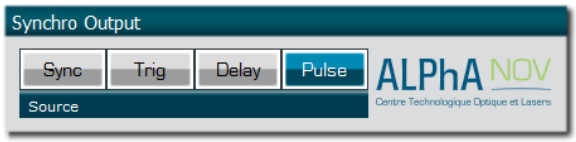
- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



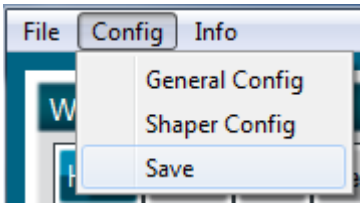
- Synchro input windows (default settings) :
  - Source : not used in this mode
  - Gate Mode : None
  - Frequency : not used in this mode
  - Burst size : not used in this mode



- Synchro ouput window (default settings) :
  - Source : Pulse



Don't forget to save the settings by clicking on the "Save" button in the bar menu.



2.8.6.6 Main features

Input PulseIn voltage (software adjustable threshold)	30 mV – 3,3V
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Input/**output** maximum frequency	150 MHz

2.8.7 Using PDG as a frequency divider

2.8.7.1 Presentation

The board provides a software configurable frequency divider with specific delay and pulse width signal from a reference pulse signal.

2.8.7.2 Timing diagram

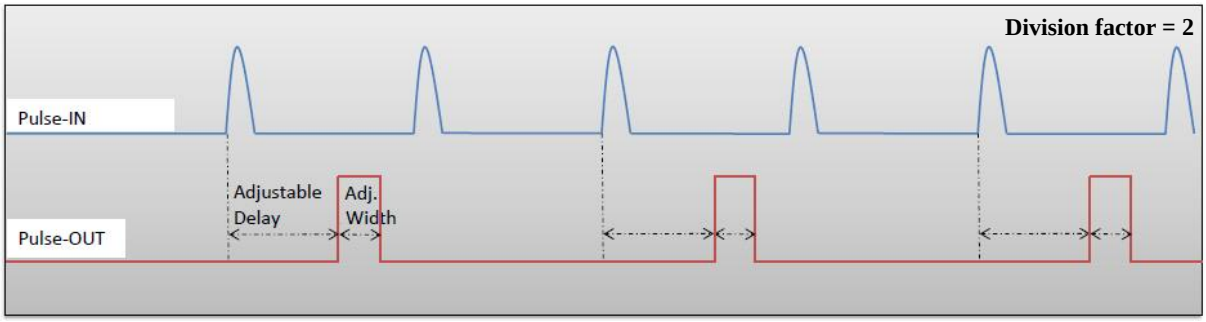


Figure 14 : Frequency divided, delayed and pulse width adjusted signal from input to output

2.8.7.3 Synoptic

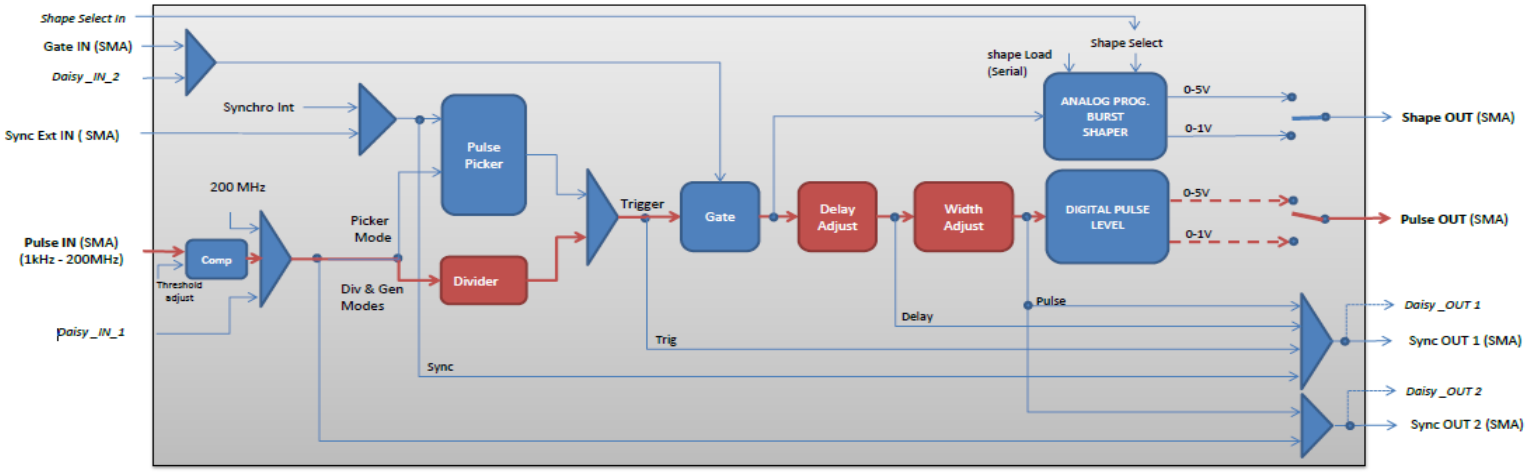
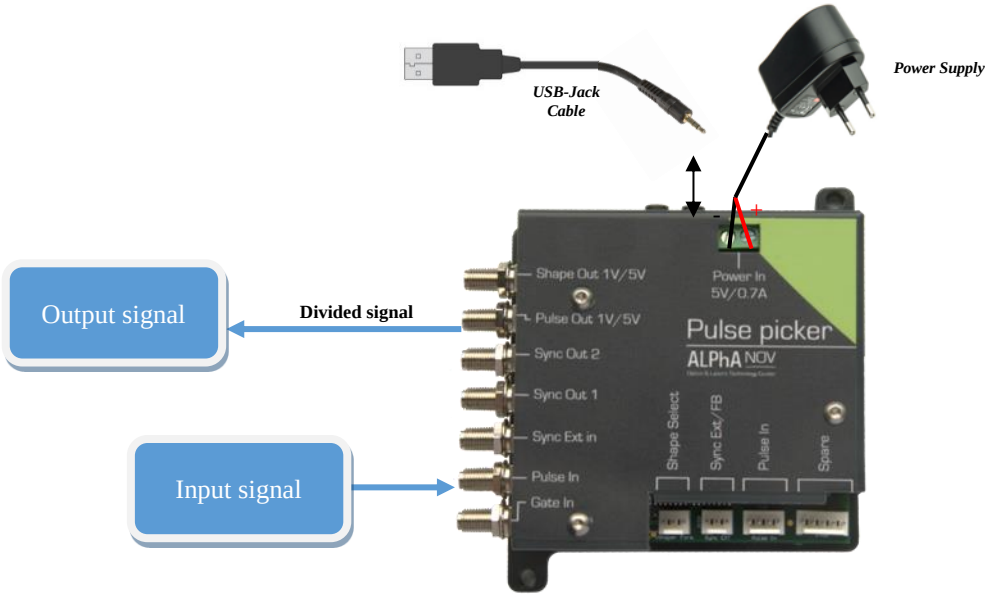


Figure 15 : Main firmware features used in frequency divider mode

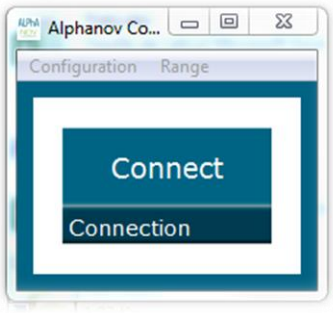
2.8.7.4 Cabling

5. Plug the USB-Jack cable in the "*USB In"* connector
6. Plug the signal you want to convert in the "*Pulse In"* SMA connector
7. The upgraded signal will output on the "*Pulse Out*" SMA connector
8. Finally, plug the power supply to the "*Power In*" connector to power on the board



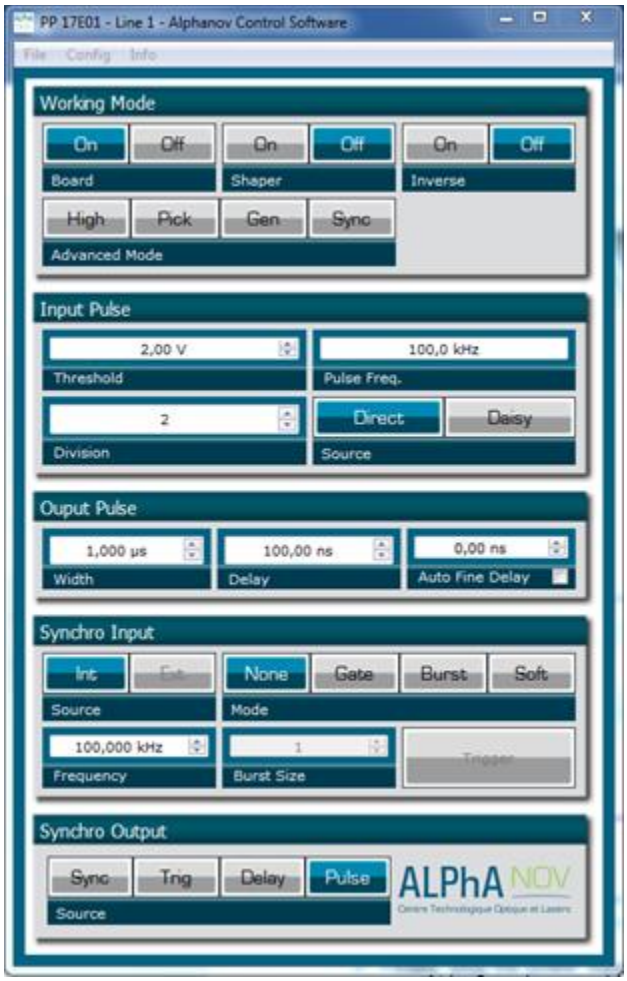
2.8.7.5 Software configuration

Launch the ALPhANOV Control Software and click on *Connect* to start the Tombak hardware detection. The software automatically detects the Pulse-Picker board.

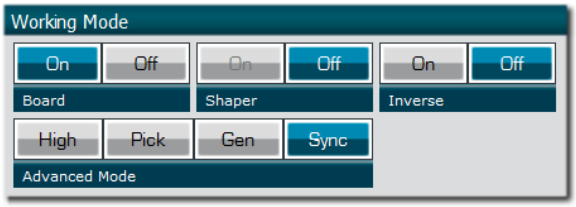


A window will appear for each Tombak connected to the computer.

The main configuration windows must be configured as follow :

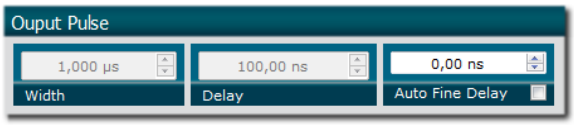


- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Sync**

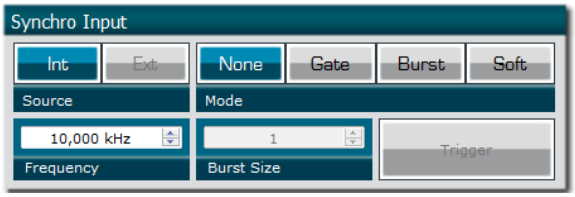


- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor **according to your application**
  - Set the input pulse **Source** to **Direct**
  -

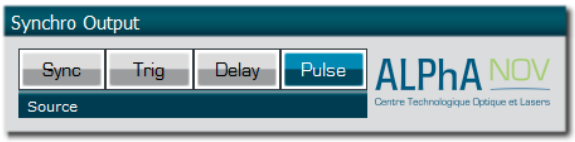
- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



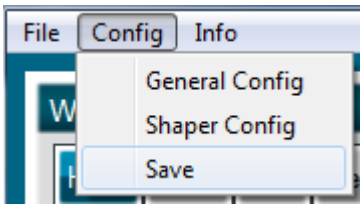
- Synchro input windows (default settings) :
  - Source : not used in this mode
  - Gate Mode : None
  - Frequency : not used in this mode
  - Burst size : not used in this mode



- Synchro ouput window (default settings) :
  - Source : Pulse



Don't forget to save the settings by clicking on the "Save" button in the bar menu.



2.8.7.6 Main features

Frequency divider factor	[1 – 10^9]
Adjustable pulse width ▪ resolution (for pulse width [5ns – 510ns]) ▪ resolution (for pulse width [511ns – 2^62ns])	[5ns – 2^62ns] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – 2^62ns] 10ps
Jitter ▪ for delay < 570ns & pulse width < 510ns ▪ for any other delay & pulse width	 <200 ps RMS 1.5 ns RMS
Input PulseIn voltage	30 mV – 3,3V
Input maximum frequency	200 MHz
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Output maximum frequency	20 MHz

3.0 REMOTE COMMUNICATION

3.1 Protocol Description

3.1.1 Getting started: configure UART

The communication between the computer and the product is done by a serial link (RS232) with a physical USB link (virtual COM port).

The COM port needs to be configured as:

- 125000 bauds
- 8 data bits
- None parity
- 1 stop bit

3.1.2 Protocol

3.1.2.1 Sequence

The communication principle between the computer and the product is **query/response**. The computer can't do multiple queries without response, except in case of **timeout**. The maximal authorized treatment time is **500ms**.

3.1.2.2 Notation

The data are prefixed by a type, with the followed notation:

- U08/U16/U32/U64 : unsigned 8/16/32/64-bit integer
- S08/S16/S32/U64 : signed 8/16/32/64-bit integer
- F32 : 32-bit float (IEEE 754 Single precision)

3.1.2.3 Query

The coding is a « **big endian »** type.
The maximum length of queries/responses is 256 octets (4 octets for LEN, ADD, CMD and CHK) and 252 octets for data

A query is of the form:

Byte0	Byte1	Byte2	Byte3	…	Byte n-1	Byte n
U08_LEN	**U08_ADD**	**U08_CMD**	**DATA0**	**…**	**DATAm**	**CHK**

With:
U08_LEN : Total length of the query (from LEN to CHK)
U08_ADD : Address of the product
U08_CMD : Command ID
DATA[0..m] : Data
CHK : Checksum

3.1.2.4 Response

A response is of the form:

Byte0	Byte1	Byte2	…	Byte m-1	Byte n

U08_LEN	U08_STS	DATA0	…	DATAm	CHK

With:
U08_LEN : Total length of the query (from LEN to CHK)
U08_STS : Status of the response
DATA[0..m] : Data
CHK : Checksum

3.1.2.5 Status

The octet of the status response may have the following values:

STS	***Description***
0x00	Ok
0x01	Timeout
0x02	Unknown command
0x04	Query error
0x08	Bad length
0x10	Checksum error

3.1.2.5.1 Ok status

If the return status is ok, the DATA[0..n] octets correspond to the response. Is the status isn't ok, the response doesn't contain data and the response is given in next paragraphs.

3.1.2.5.2 Timeout status

In case of a timeout error (number of received octets inferior to number of octets indicated in the LEN), the response is:

LEN	STS	CHK
0x03	**0x01**	**CHK**

3.1.2.5.3 Unknown command status

If the ID of the command is unknown, the response is:

LEN	STS	CHK
0x03	**0x02**	**CHK**

3.1.2.5.4 Query error status

In case of a treatment error, the response is:

LEN	STS	CHK
0x03	**0x04**	**CHK**

The error type must be read with the Query « Read error code ».

3.1.2.5.5 Bad length status

The length of the query is not valid (< 2 (LEN+CMD), superior to the maximum number of octets or incoherent with the expected command).
The response is:

LEN	STS	CHK
0x03	**0x08**	**CHK**

3.1.2.5.6 Checksum

The checksum is used to verify the integrity of the physical link. The checksum is the result of Exclusive Or of the octets minus 1.

The formula for a query is:

$$CHK = (LEN \oplus CMD \oplus DATA0 \oplus ... \oplus DATAn) - 1$$

The formula for a response is!

$$CHK = (LEN \oplus STS \oplus DATA0 \oplus ... \oplus DATAn) - 1$$

3.1.3 Messaging

This paragraph describes command lists (Query + Response). The given responses correspond to a good execution of the query. In case of bad query, the return response is a status type ($3.1.2.5).
The table below gives a list of possible commands:

CMD	***Description***
0x00	Write the equipment address
0x01	Read the equipment address
0x02	Read protocol version
0x03	Read error code
0x04 .. 0x0F	Reserved
0x10	Write instruction
0x11	Read instruction
0x12	Apply all instructions
0x13	Save all instructions
0x14	Read measure
0x16	Write shaper values
0x17	Save shaper values
0x18	Software Trigger
0x19 … 0xFF	*Reserved*

3.1.3.1 Write equipment address

This command allows configuring equipment address. To do this the address is 0x00.
Query:

LEN	ADD	CMD	DATA0	CHK
0x05	**0x00**	**0x00**	**U08_ADD**	**CHK**

With:
U08_ADD : Equipment address

Response:

LEN	STS	CHK

0x03	**0x00**	**CHK**

3.1.3.2 Read equipment address

This command allows reading equipment address. To do this the address is 0x00.

Query:

LEN	ADD	CMD	CHK
0x04	**0x00**	**0x01**	**CHK**

Response:

LEN	STS	DATA0	CHK
0x04	**0x00**	**U08_ADD**	**CHK**

With:
U08_ADD : Equipment address

3.1.3.3 Read protocol version

This command is used for reading the protocol version of communication. The format is X.Y.

Query:

LEN	ADD	CMD	CHK
0x04	**ADD**	**0x02**	**CHK**

Response:

LEN	STS	DATA0	DATA1	CHK
0x05	**0x00**	**U08_X**	**U08_Y**	**CHK**

With
U08_X : Major number version
U08_Y : Minor number version

3.1.3.4 Read error code

This command allows reading the last communication error.

Query:

LEN	ADD	CMD	CHK
0x04	**ADD**	**0x03**	**CHK**

Response:

LEN	STS	DATA0	DATA1	CHK
0x05	**0x00**	**U08_MODULEID**	**U08_ERRORID**	**CHK**

With:

U08_MODULEID : Number of the failed unit
U08_ERRORID : Error number

3.1.3.5 Write instruction

This command allows writing an instruction in volatile memory. This instruction will be effective only after calling the apply request (Apply all instructions).

Query:

LEN	ADD	CMD	DATA0	DATA1	DATA2	…	DATAN	CHK
0x06+N	**ADD**	**0x10**	**U16_CONSIGNEID**		**XNN_VALUE**			**CHK**

With:
U16_ CONSIGNEID : ID of the instruction
XNN_VALUE : Value of the instruction (format depends on instruction)

Response:

LEN	STS	CHK
0x03	**0x00**	**CHK**

3.1.3.6 Read instruction

This command allows reading an instruction in volatile memory.

Query:

LEN	ADD	CMD	DATA0	DATA1	CHK
0x06	**ADD**	**0x11**	**U16_ CONSIGNEID**		**CHK**

With:
U16_CONSIGNEID : ID of the instruction

Response:

LEN	STS	DATA0	…	DATAN	CHK
0x03+N	**0x00**	**XNN_VALUE**			**CHK**

With:
XNN_VALUE : Value of the instruction (format depends on instruction)

3.1.3.7 Apply all instructions

This command applies all configured instructions.

Query:

LEN		ADD	CMD	CHK
0x04		**ADD**	**0x12**	**CHK**

Response:

LEN	STS	CHK
0x03	**0x00**	**CHK**

3.1.3.8 Save instructions

This command saves all instructions. The saved instructions will then be loaded and apply at each boot of the product.

Query:

LEN	ADD	CMD	CHK
0x04	**ADD**	**0x13**	**CHK**

Response:

LEN	STS	CHK
0x03	**0x00**	**CHK**

3.1.3.9 Read measure

This command allows reading a measure.

Query:

LEN	ADD	CMD	DATA0	DATA1	CHK
0x06	**ADD**	**0x14**	**U16_ MESUREID**		**CHK**

With:
U16_ MESUREID: ID of the measure

Response:

LEN	STS	DATA0	…	DATAN	CHK
0x03+N	**0x00**	**XNN_VALUE**			**CHK**

With:
XNN_VALUE : Value of the instruction (format depends on instruction)

3.1.3.10 Write shaper values

This command writes shaper values.

Query:

LEN	ADD	CMD	DATA0	DATA1	DATA2	DATA3	…	DATA N	CHK
0x07+N	**ADD**	**0x16**	**U08_ID**	**U16_OFFSET**		**PU16_VALUE[120]**			**CHK**

With:
U08_ ID : ID of the shaper (0 to 3)
U16_OFFSET : Offset for the first value
PU16_VALUE[120] : Values between 0 and 4095. Maximal number of values is 120.

Response:

LEN	STS	CHK
0x03	**0x00**	**CHK**

3.1.3.11 Save shaper values

This command saves all shaper values into nonvolatile memory.

Query:

LEN	ADD	CMD	CHK
0x04	**ADD**	**0x17**	**CHK**

Response:

LEN	STS	CHK
0x03	**0x00**	**CHK**

3.1.3.12 Software trigger

This command send a gate trigger when the gate control is in burstSerial mode.

Query:

LEN	ADD	CMD	CHK
0x04	**ADD**	**0x18**	**CHK**

Response:

LEN	STS	CHK
0x03	**0x00**	**CHK**

3.2 List of Instructions and measures

3.2.1 Instructions

Consigne	***Description***	***Unité***	***Format***	***Défaut***	***Min***	***Max***
10	Functioning mode 1 : Divider 2 : Pulse-picker 3 : Pulse generator 4 : Pulse shape - Divider 5 : Pulse shape – Picker 6 : Pulse shape – Generator 7 : High	-	U08	0	0	5
11	PulseIn Threshold	V	F32	0	0	5
13	PulseIn source 0 : Direct 1 : Daisy SyncIn	-	U08	0	0	2
15	PulseIn Frequency divisor	-	U32	1	1	1^E9
16	PulseOut delay	0.1ns	U64	0	0	$(2^{55}-1)/5$

Consigne	*Description*	*Unité*	*Format*	*Défaut*	*Min*	*Max*
17	PulseOut width	ns	U64	5	5	(2E60-1)/5
18	Burst size	-	U32	1	1	1^E9
19	Trigger source 0 : Int 1 : Ext	-	U08	0	0	1
20	Internal trigger frequency	Hz	U32	100.1^E3	1	200.1^E6
21	SyncOut source 0 : Sync 1 : Trigger 2 : Delay 3 : PulseOut	-	U08	0	0	3
22	Gate Control 0 : NoGate 1: Gate 2 : BurstGate 3 : BurstSerial	-	U08	0	0	3
23	SyncOut2 source 0 : Pulse direct 1 : Null	-	U08	0	0	2
24	PulseOut inversion - 0 : positive logic - 1 : negative logique	-	U08	0	0	1
28	External Gate source - 0 : GATE_EXT - 1 : Daisy_SyncIn2	-	U08	0	0	1
30	Shape1 : steps number	-	U16	1	1	4000
31	Shape1 : step size	-	U16	1	1	4000
32	Shape2 : steps number	-	U16	1	1	4000
33	Shape2 : step size	-	U16	1	1	4000
34	Shape3 : steps number	-	U16	1	1	4000
35	Shape3 : step size	-	U16	1	1	4000
36	Shape4 : steps number	-	U16	1	1	4000
37	Shape4 : step size	-	U16	1	1	4000
38	Default Offset	-	U16	0	0	4095

3.2.2 Measures

Mesure	*Description*	*Unité*	*Format*
0	PULSE_IN frequency	Hz	U32
1	SYNC_EXT frequency	Hz	U32

3.3 Example

Give Address 1 to the product: $05$00$00$01$03
Check by reading the address: $04$00$01$04
Set functioning mode to divider:$07$01$10$00$0A$01$1C$
Apply: $04$01$12$16