Operating manual

TOMBAK

Pulse Delay Generator

Digital Delay Generator

Pulse Picker

Voltage Converter

Arbitrary Waveform Generator

AERODIODE - Institut d'optique d'Aquitaine - Rue François Mitterrand
33400 Talence - France - Tél.: +33 (0)6 27 69 41 62
www.AeroDIODE.com

GENERAL INTRODUCTION

TOMBAK 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 Pulse Generator**
- **A Digital Delay Generator**
- **A Burst generator**
- **A signal gating module**
- **A Synchronization module**
- **A Voltage level convertor**
- **A Frequency divide**r
- **A Pulse-picker**
- **An AWG (Arbitrary Waveform Generator)**
- **A long delay generator with low jitter with internal clock synchronization**

Contents

1. General information 8
1.1 Definitions 8
1.2 General warning 8
2. Safety Instructions 9
2.1 Wiring 9
2.2 Operating Environment 9
2.3 Contact 9
3. Environmental friendliness 10
4. Package Content 10
5. Product overview 11
5.1. Physical properties 11
5.2. Front-Panel overview 11
5.2.1. Power Supply 12
5.1. Location of the normalization sticker 12
5.2. System Setup 13
5.2.1. Power 13
5.2.2. USB 13
5.2.3. Tools Installation (Windows) 13
5.3. Hardware Setup 17
5.3.1. 1st PCB version 18
5.3.2. 2nd PCB version 19
5.4. Global Architecture 20
5.5. Multi-channel module – Stacked TOMBAK 21
5.6. Front-Panel User Interface 24
5.6.1. Overview 24
5.6.2. Working Mode 24
5.6.3. Input Pulse 25

5.6.4. Output Pulse 26
5.6.5. Synchro Input 26
5.6.6. Synchro Output 28
6. Configuration Example 29
6.1. Using TOMBAK as a pulse generator 29
6.1.1. Mode 1 : Standalone Pulse Generator mode 29
6.1.2. Mode 2 : Synchronized Pulse Generator mode 34
6.1.3. Main features 38
6.2. Using TOMBAK as a Digital Delay Generator 39
6.2.1. Presentation 39
6.2.2. Timing diagram 40
6.2.3. Synoptic 40
6.2.4. Cabling 40
6.2.5. Software configuration 41
6.2.6. Main features 44
6.3. Using TOMBAK as a burst generator 45
6.3.1. Presentation 45
6.3.2. Timing diagram 45
6.3.3. Synoptic 45
6.3.4. Cabling 46
6.3.5. Software configuration 46
6.3.6. Main features 49
6.4. Using the gate feature of TOMBAK 50
6.4.1. Presentation 50
6.4.2. Timing diagram 50
6.4.3. Synoptic 50
6.4.4. Cabling 51
6.4.5. Software configuration 51
6.4.6. Main features 54
6.5. Using TOMBAK as a signal synchronization module 55
6.5.1. Presentation 55

6.5.2. Timing diagram 55
6.5.3. Synoptic 55
6.5.4. Cabling 56
6.5.5. Software configuration 57
6.5.6. Main features 60
6.6. Using TOMBAK as a Voltage Level Converter 61
6.6.1. Presentation 61
6.6.2. Timing diagram 61
6.6.3. Synoptic 61
6.6.4. Cabling 62
6.6.5. Software configuration 62
6.6.6. Main features 65
6.7. Using TOMBAK as a frequency divider 66
6.7.1. Presentation 66
6.7.2. Timing diagram 66
6.7.3. Synoptic 66
6.7.4. Cabling 67
6.7.5. Software configuration 67
6.7.6. Main features 70
6.8. Using TOMBAK as a PULSE-PICKER 71
6.8.1. Introduction / Overview 71
6.8.2. Timing diagrams 71
6.9. Using TOMBAK as an AWG (Arbitrary Waveform Generator) or a “Burst Shaper” 73
6.9.1. Introduction 73
6.9.2. Timing diagrams 73
6.9.3. Synoptic 74
6.9.4. Cabling 74
6.9.5. Software configuration 75
6.10. Using Tombak as a long delay generator with low jitter with internal clock synchronization by an external 10 MHz signal 79
6.10.1. Introduction 79
6.10.2. Synoptic 79

6.10.3. Software configuration 80
6.11. How to use the photodiode input 82
6.12. How to adjust the pulse out relative delay between two Tombak (stacked or separated) ? 83
6.12.1. Introduction 83
6.12.2. Cabling 84
6.12.3. Software configuration 84
7. Technical Specifications 86
7.1. General Data 86
7.2. Detailed data 86
7.3. Outputs/Inputs detailed specifications 86
7.3.1. SMA connectors 86
7.3.2. MOLEX connectors (KK) 87
7.3.3. Photodiode (optional) 87

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 (§ **Erreur ! Source du renvoi introuvable.**)
v1.3	26/02/2018	Add Multiple channel section
v1.4	14/10/2019	Corrected several documentation errors in Remote Communication setpoints
V1.5	26/10/2019	Several modifications for 3 product versions (TOMBAK/DDG/Pulse-picker) – correction of bad pictures for Voltage converter etc.
v1.6	04/11/2019	Add Configuration example for AWG / Burst shaper
V2.0	23/03/2020	AeroDIODE transfer
V2.1	20/04/2020	Added Safety instruction + Layout overhaul
V2.2	23/04/2020	Added Specifications Table
V2.3	30/04/2020	Added multiple notes regarding CE regulations
V2.4	07/09/2020	Added description of PCB version for hardware configuration
V2.5	13/01/2021	Added description for Sync Ext hardware configuration
V2.6	10/08/2021	Remove Remote Communication
V2.7	29/10/2021	Remove mention of mistake on PCB label : obsolete
V2.8	10/06/2022	Add 10 MHz Clock Int features
V2.9	17/06/2022	Add Resynchronization Pulse Out feature
V2.10	21/08/2022	Improvements in the 10 MHz Clock Int feature description
V3.0	06/09/2022	General overhaul / Adding CE details
V3.1	14/06/2023	Add photodiode input, Environnemental friendliness chapter
V3.2	08/08/2023	Correction of several format errors

Disclaimer

Information in this document is subject to change without notice.

Copyright © AeroDIODE
Bât. IOA, rue François Mitterrand - 33400 Talence – France
www.AeroDIODE.com

1. General information

Please read this manual carefully, it describes the hazard the user might be exposed to while using the product. It also explains in details how to use the product in the safest and more efficient way possible.

The safety of any system incorporating the product is the responsibility of the assembler of the system.

Any actions taken by the user that is not clearly described in this user manual might present a risk and is the sole responsibility of said user.

This product is to be used in laboratory or industrial tasks, and only by trained personnel.

1.1 Definitions

Caution : Caution is advised when dealing with hazardous situations, tasks or objects, to prevent harm or death and avoid material damage or failure.

Warning : A warning is given for potentially dangerous situation for people which cause them harm or lead to death

Note : A note is a complementary piece of advice that must be acknowledged by the user.

1.2 General warning

Note
Only use the genuine power supply, and the supplied USB cable

WARNING
Avoid all chocs and strains when handling the TOMBAK

WARNING
Any software settings or hardware tinkering that is not described in this user manual or in the usage recommendation may put the user or its environment at risk.

WARNING
Do not position the product in a way that would prevent the possibility of powering it off.

WARNING
external circuits connected to the device must not present a dangerous voltage on the connected interface even in condition of failure

WARNING
Do not position the product in a way that would prevent the possibility of powering it off.

WARNING
the maintenance and servicing of the TOMBAK should not be executed by the end user : only AERODIODE is able to maintain the TOMBAK.

2. Safety Instructions

2.1 Wiring

Caution

- Be aware that the board and particularly the SMA connectors can get very hot during operation. Therefore, please connect the SMA input/output cables before powering it on
- If the TOMBAK is equipped with a terminal block or MOLEX power connector, connect the input power pin to the TOMBAK before plugging the DC power supply to a power outlet.
- If the TOMBAK is equipped with a jack power connector, plug the power supply to a power outlet and then plug in the power connector.
- Use caution when connecting the Power Supply.
- Protect the power cord from being walked on, pinched or severed
- Only use the supplied power supply and USB cables

2.2 Operating Environment

Caution

- Do not install near any heat sources such as radiators, heat registers, stoves, or other equipment (including amplifiers) that produce heat.
- Place the TOMBAK on a cooling plate to prevent it from overheating
- To reduce the risk of fire or electric shock, do not expose the TOMBAK to rain or moisture.

2.3 Contact

If you have any question about the TOMBAK module, please contact AERODIODE

3. Environmental friendliness

- Electrical consumption

To reduce the impact on the environment, turn off the product when not in use.
When the product is not used for an extended period of time, unplug the power-supply from the wall

- Packaging :

Special care has been taken to properly package the product with an optimized package.
Please keep the packaging for a least one year covering the guarantee.
At the end of this period, we invite you to reuse the packaging.

- End of life :

Do not throw away the product, it must be recycled in a recycling facility.

4. Package Content

The Pulse Delay Generator package comes with:

- 1 TOMBAK board
- 1 EU DC Power Supply (+5V / 2A ⎓)(CE)
- 1 power adaptor (US or UK depending on your location)
- 1 USB-Jack FTDI cable
- 1 Jack to Jack Cable (only if more than one product has been ordered)
- 1 USB Key with “AeroDIODE Control Software Suite”, User Manual, Communication troubleshooting guide and test report

Figure 1 Package Content

Note
No SMA cable are supplied.

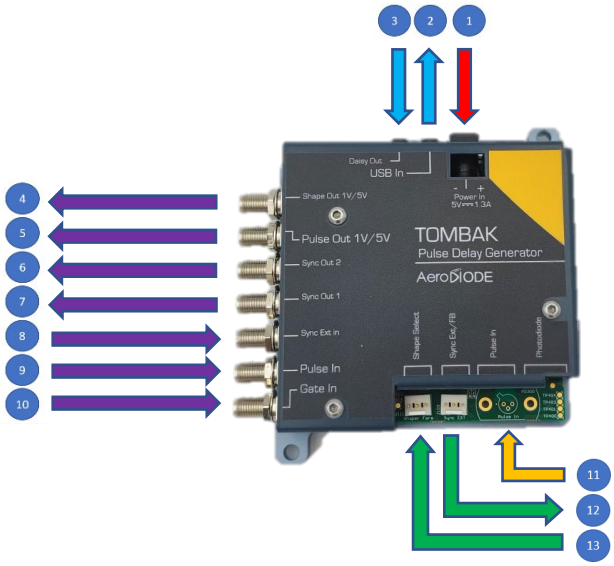
Caution
This product has been tested and found to comply with the limits according to IEC 61326-1 with the use of connection cables less than or equal to 3 meters. We also recommend using fully-shielded, high-quality cables such as ULC-3FT-SMSM+.

5. Product overview

5.1. Physical properties

Length	105	mm
Width	100	mm
Height	30	mm
Weight	210	g

5.2. Front-Panel overview



① - Power connector (Jack, terminal block or Molex)

② - Input Communication Connector (Jack)

③ - Output Communication Connector (Jack)

④ - Analogic Output Signal *(Shaper) (SMA)*

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

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

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

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

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

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

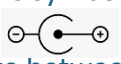
⑪ - Shape Selection Connector (Molex)

⑫ - External Synchronization Connector (Molex)

⑬ - Photodiode (optional) FCAPC

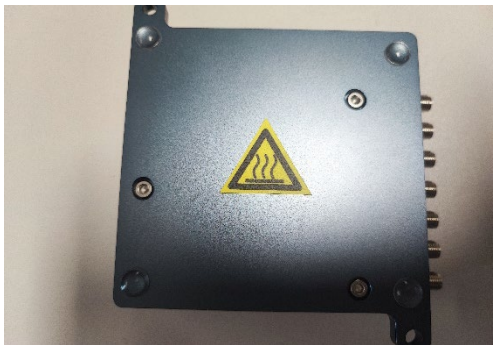
5.2.1. Power Supply

In case of OEM with terminal block power connector, use a class II power supply (double isolation between primary and secondary winding), make sure to respect the specification cited above.

The power supply is a class II power supply, as shown by this symbol :
The jack power connector has a positive tip polarization : 
The power supply will accept as **input** an alternative voltage between 100 and 240 V, at a frequency of 50 or 60 Hz, consuming 0.3 A.
It will then **output** 5V 2A (⎓).
The power supply must not be thrown away but disposed of in accordance with the European regulation (recycling) as shown by the following pictogram
The power supply comply with the European regulation as shown by the CE symbol

For additional information, the datasheet is available by following the link below :
https://www.artesyn.com/assets/da10m_series_ds_1506062033.pdf?a=56af2a34dc7c5776d2b67893d68762a3b325a450

5.1. Location of the normalization sticker



5.2. System Setup

5.2.1. Power

To power TOMBAK module, please use the DC Power adapter provided.
First plug the cables into the power connector (①) of the module.

- Terminal bloc : Red cable in '**+**' and black cable in '**-**' *(polarity is indicated on the product)*.
- Jack : simply insert the tip of the connector
- MOLEX : simply clip the MOLEX in place (keyed connection)

You can then plug the DC Power Adapter to a power outlet.

5.2.2. 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

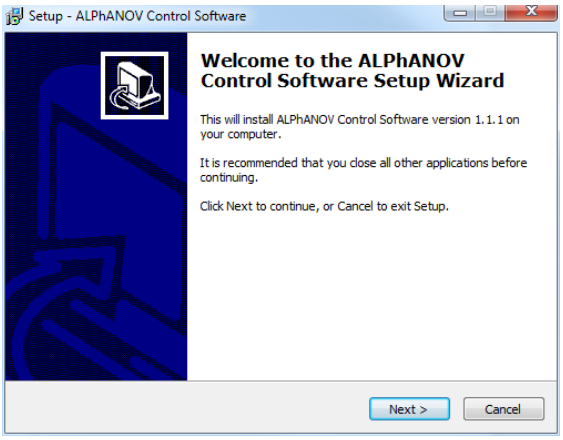
5.2.3. Tools Installation (Windows)

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

5.2.3.1. Software installation

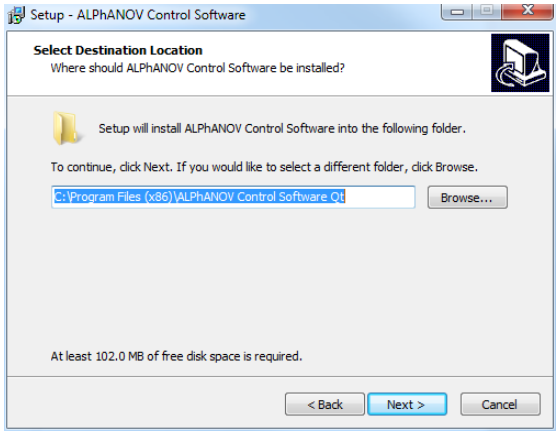
Insert the USB Key provided with the module. Then open an Explorer windows and navigate into "Computer" part. You will see a USB Key with "AeroDIODE" title, open it.

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

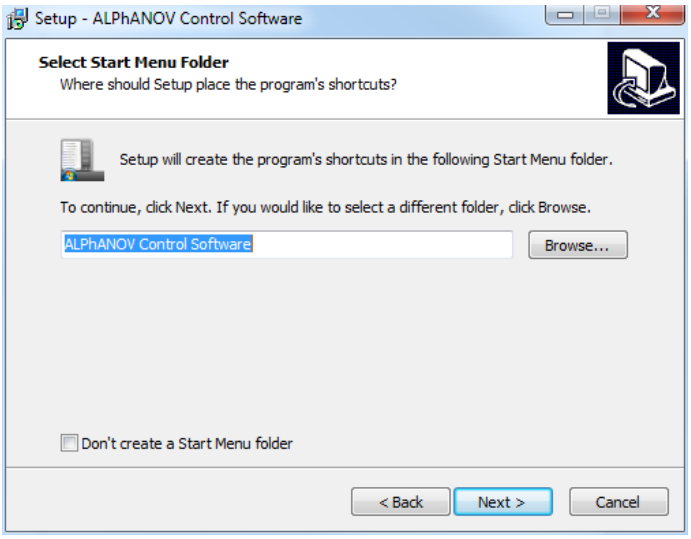


Click on Next;

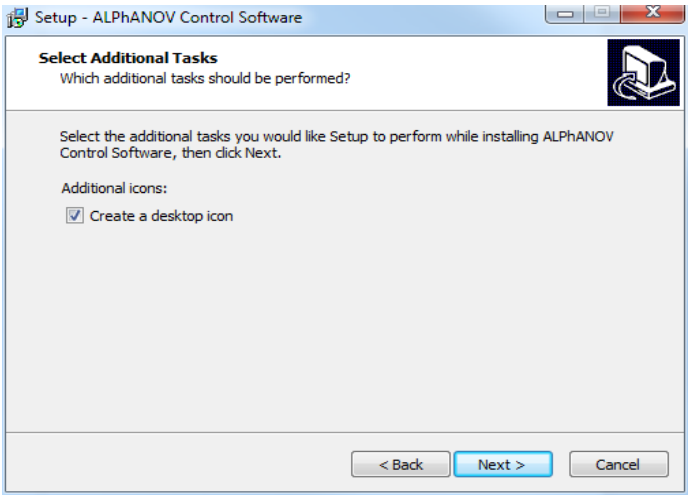
In the following windows, choose a specific installation path or leave default. Then, go to the next section



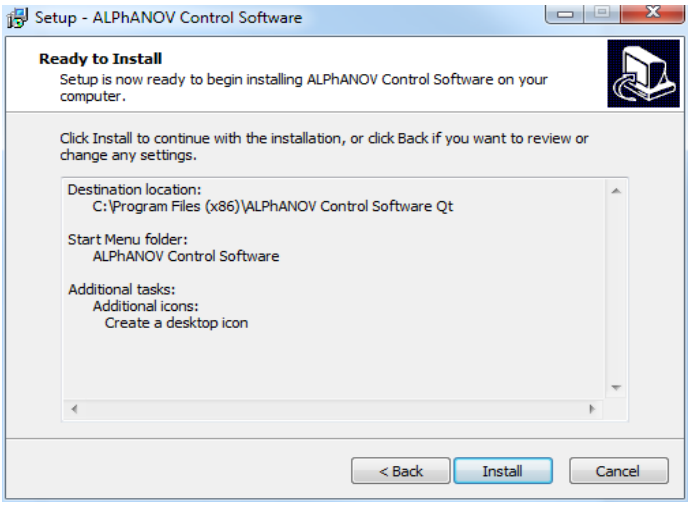
The following window lets you choose the program's shortcut name in the Start Menu folder. Feel free to change it or leave it by default.



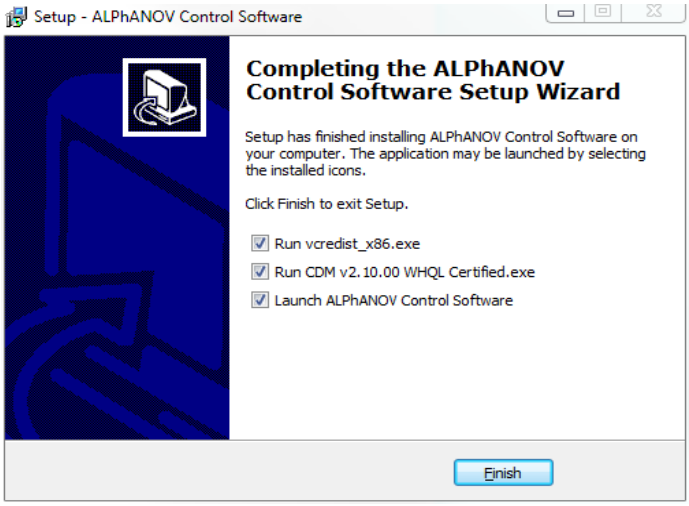
The next part lets you choose if a desktop icon needs to be created. If so, please check the box. Then go to next section.



Finally click on the Install button.



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



5.2.3.2. Driver installation

The driver installation runs through 2 parts:

- Microsoft Runtime installation
- USB Driver installation

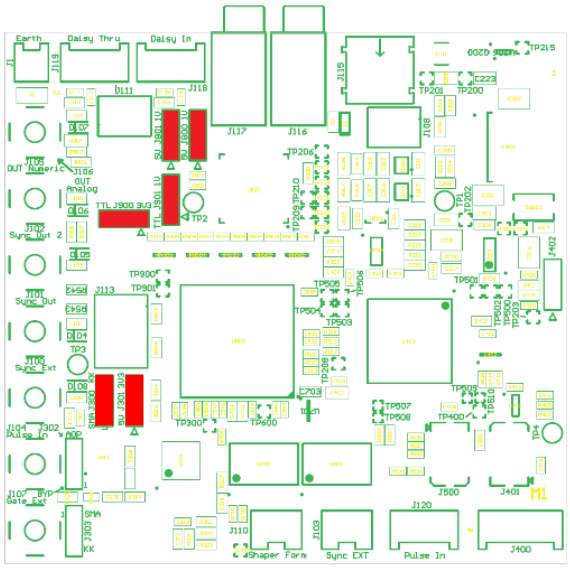
No specific indication here, just click on “Next” and “Install” dialogs and wait until installations are finished.

5.3. Hardware Setup

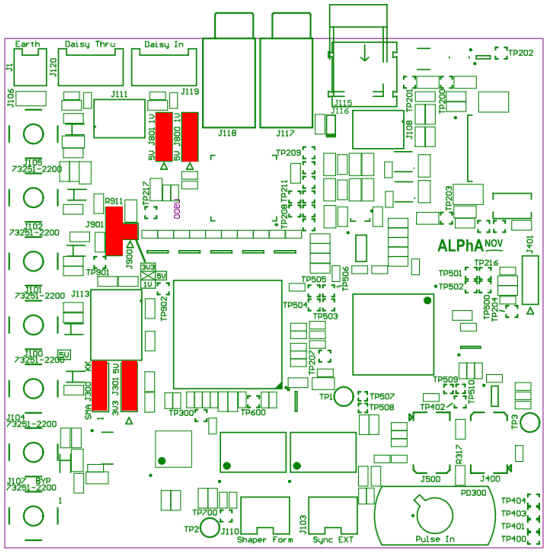
Note
This chapter is for information only. It describes how to change the voltage output (digital and anolog) of the product. You must ask AERODIODE first in order to have the required authorization to change the setup.

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

5.3.1. 1st PCB version



5.3.2. 2nd PCB version



Jumper

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

5.3.2.1. *"Pulse Out" voltage output level*

Voltage level can be adjusted according to the following configuration:

- 1V : Jumper **J900** in position bottom-center
- 3,3V : Jumper **J900** in position top-center
- 5V : Jumper **J900** in position right-center

5.3.2.2. *"Shape Out" voltage output level*

Voltage level can be adjusted according to the following configuration:

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

5.3.2.3. *"Sync Ext" voltage input level*

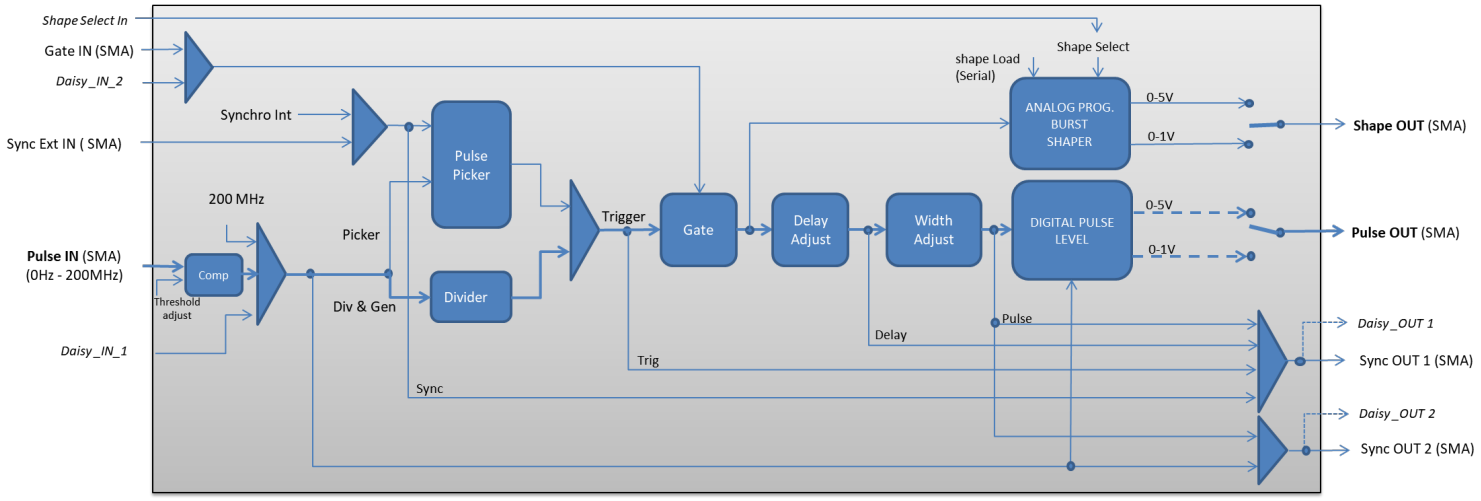
Input maximum voltage level can be adjusted according to the following configuration:

- 3.3V : Jumper **J301** in position **1-2**
- 5V : Jumper **J301** in position **2-3**

The "Sync Ext" signal can come from the SMA or a Molex KK connector for OEM:

- SMA input : Jumper **J300** in position **1-2**
- Molex KK input : Jumper **J300** in position **2-3**

5.4. Global Architecture



5.5. Multi-channel module – Stacked TOMBAK

The 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 TOMBAK internal signals between stacked boards. 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:

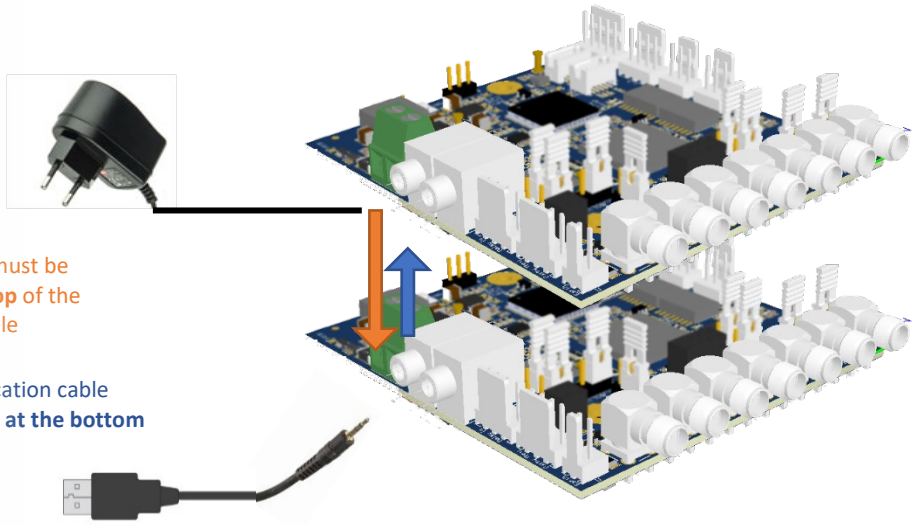
- **Power**: A single power source is needed and should be connected at the top
- **USB Communication cable**: A single USB to Jack cable is needed to access all features of the multi-channel module and should be connected at the bottom.
- **Synchronization signals:**
    - **SyncOut1 & SyncOut2:** Synchronization output signals can support multiple signals such as output pulse, delayed pulsed, internal trigger (see 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 the 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 the 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.

Note :

- The lowest line is always the bottom board and the highest line the top board.



The Power supply must be connected **at the top** of the multichannel module

The USB communication cable must be connected **at the bottom**

TOMBAK 2 : DaisySyncOut1&2 not available

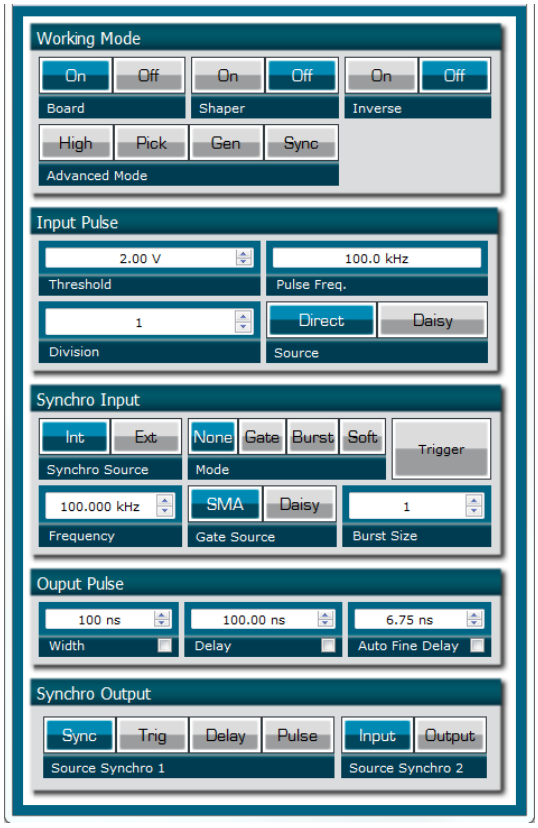
TOMBAK 2 : DaisySyncIn1&2 can be synchronized with TOMBAK1

TOMBAK 1 : DaisySyncOut1&2 can be sent to TOMBAK 2

TOMBAK 1 : DaisySyncIn1&2 not available

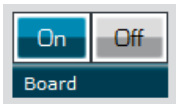
5.6. Front-Panel User Interface

5.6.1. Overview



5.6.2. Working Mode

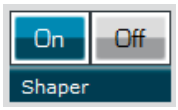
5.6.2.1. Board



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.*

5.6.2.2. Shaper



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

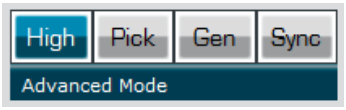
- *In ON position, an AWG signal can be output on SHAPE OUT SMA Connector.*
- *IN OFF position, the AWG signal will be at its default value.*

5.6.2.3. 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.*

5.6.2.4. Advanced Mode

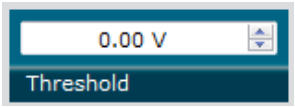


This button is the Advanced mode selection switch

- *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 increased.*

5.6.3. Input Pulse

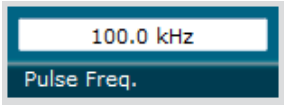
5.6.3.1. Threshold



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.*

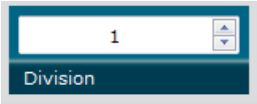
5.6.3.2. Pulse Freq.



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.*

5.6.3.3. Division



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

5.6.3.4. 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 TOMBAK module chained. (Multi-output configuration option).*

5.6.4. Output Pulse

5.6.4.1. Width

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

5.6.4.2. Delay

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

5.6.4.3. 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

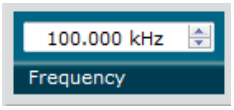
5.6.5. Synchro Input

5.6.5.1. 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.*

5.6.5.2. Frequency



This button allows to set or visualize synchronization signal frequency

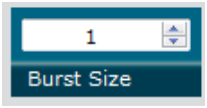
- *When Source button is set to INT: allows to set frequency.*
- *When Source button is set to EXT: shows a measure of external frequency.*

5.6.5.3. 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.*

5.6.5.4. 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.*

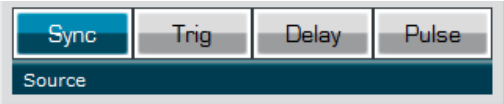
5.6.5.5. Trigger

This button allows to trigger a burst manually

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

5.6.6. Synchro Output

5.6.6.1. 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
- **Global** Architecture diagram *for more information for more information) :*
  - *Sync : the input synchronization signal*
  - *Trig : the signal that triggers the pulse*
  - *Delay : the signal that triggers the pulse after being delayed*
  - *Pulse : the output pulse (same as PulseOut)*

6. Configuration Example

Please note that the USB cable can be removed once the board has been configured.
It will use the set parameters even after complete shutdown.

6.1. Using TOMBAK as a pulse generator

There is 2 ways to drive this product as a Pulse Generator :

- Mode 1 : Standalone pulse generator mode using the internal 200 MHz clock : an internal 200MHz generator is available and does not need any external signal. The board can output an external signal with adjustable pulse width using the internal divider function and the internal pulse width generator. This works up to 20 MHz repetition rate.

- Mode 2 : Synchronized pulse generator mode where a 10 MHz external reference clock is used to generate the 200 MHz internal clock which is then divided and generate pulses using the internal divider function and the internal pulse width generator.

6.1.1. Mode 1 : Standalone Pulse Generator mode

6.1.1.1. Timing diagram

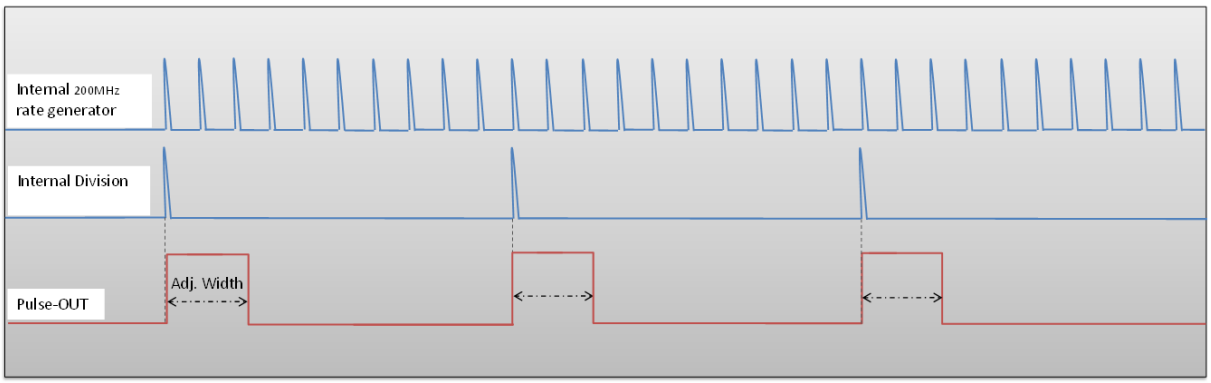


Figure 2: internal 200MHz clock divided by 10 to get a duty cycle software adjustable 20MHz output signal

6.1.1.2. Synoptic

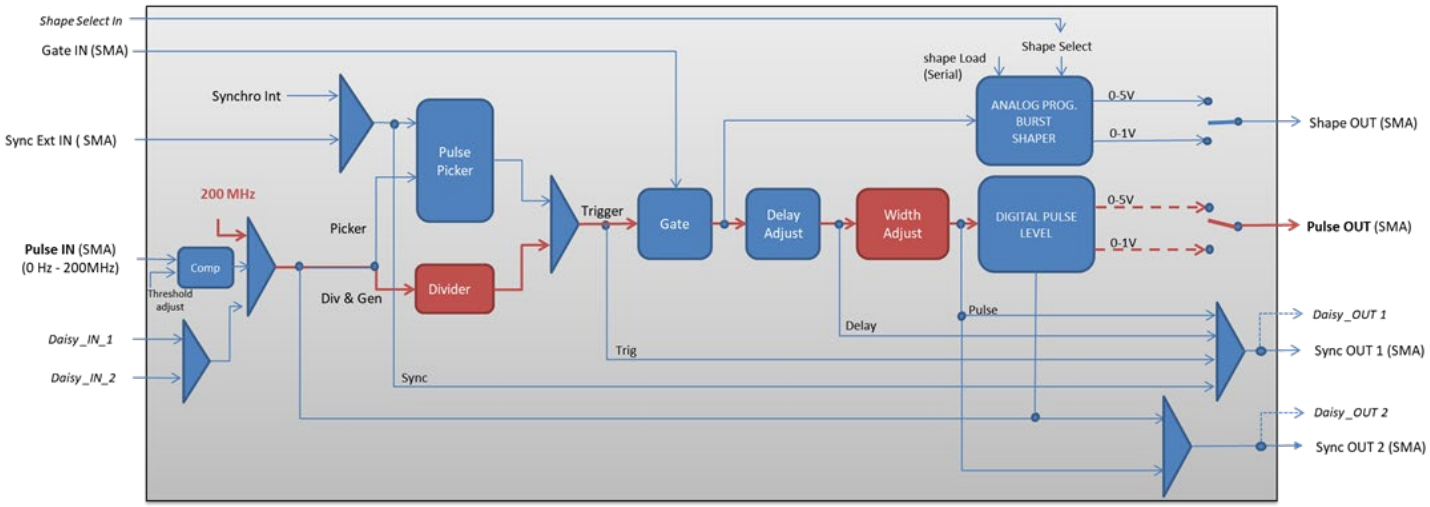
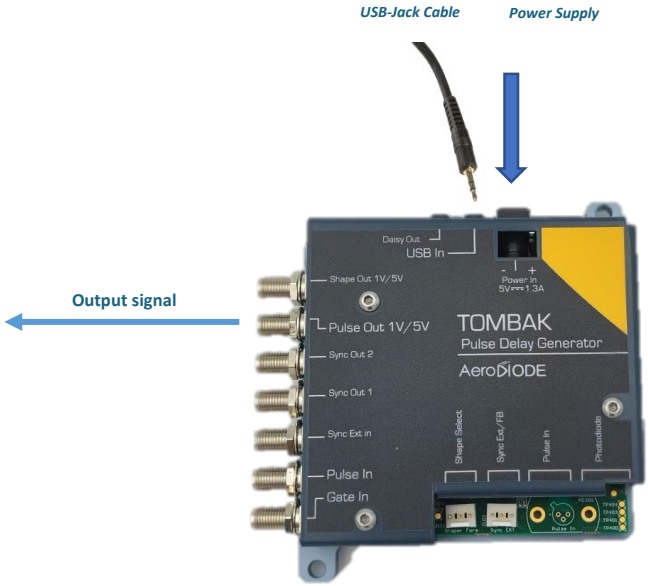


Figure 3 : Main firmware features used in Delay Generator

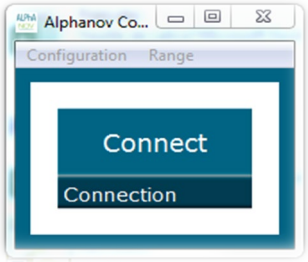
6.1.1.3. Cabling

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



6.1.1.4. Software configuration

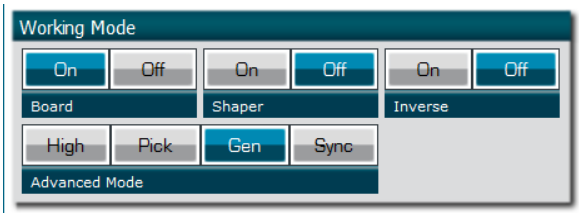
Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.



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**

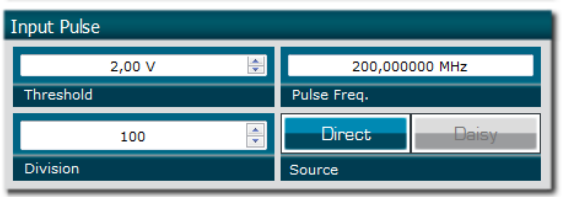


- Input pulse window :
  - **Threshold** input voltage is not used in this configuration, set value to 0V (default settings)
  - **Delay** value is not used in this configuration, set value to 0V (default settings)

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

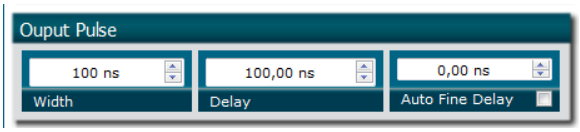
(*) Division must be at least 10 as the maximum output frequency is 20MHz.



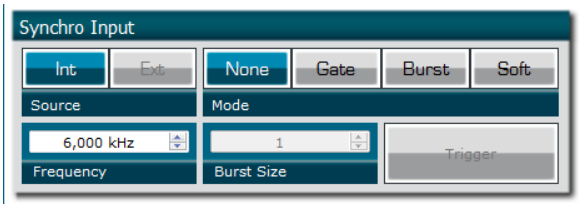
In this example, the division is set to 100 to get a 2Mhz output frequency => 200Mhz/2Mhz = 100

- 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 (*).

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

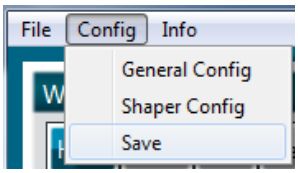


- Synchro input windows :
  - Source : Not used in this mode
  - Mode : None
  - Frequency : Not used in this mode
  - Burst size : Not used in this mode



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

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



6.1.2. Mode 2 : Synchronized Pulse Generator mode

6.1.2.1. Timing diagram

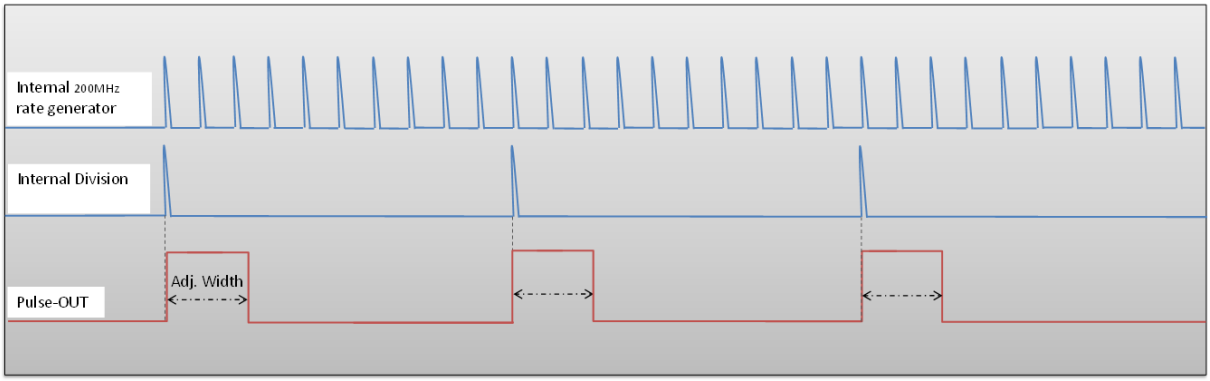


Figure 4 : internal 200MHz synchronized with the clock reference, the signal is divided by 10

6.1.2.2. Synoptic

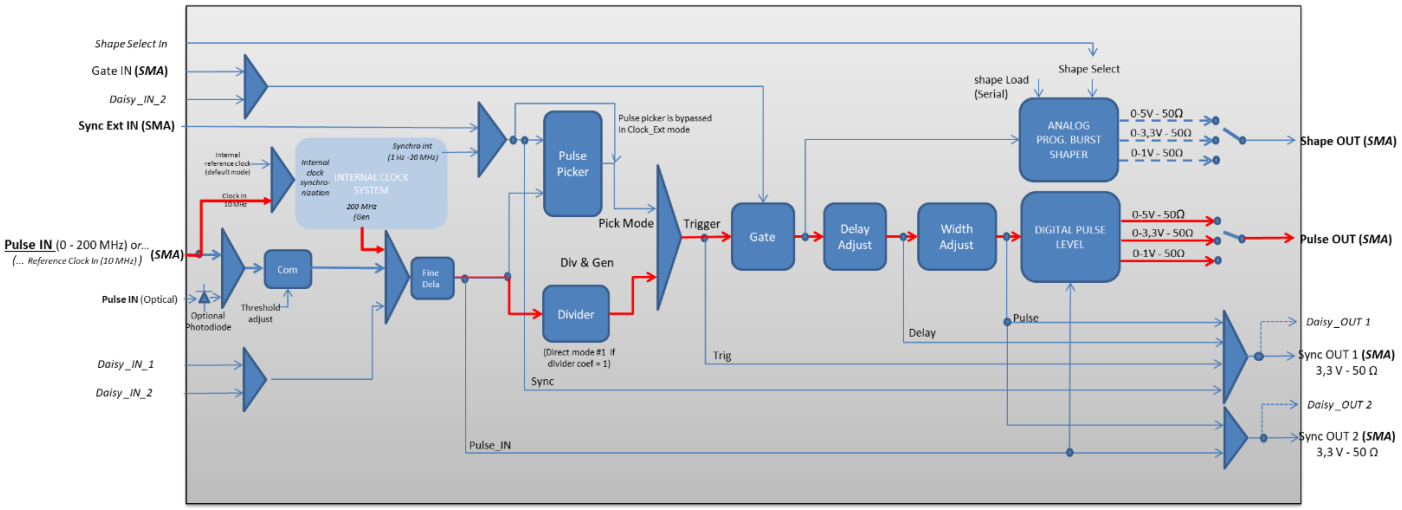
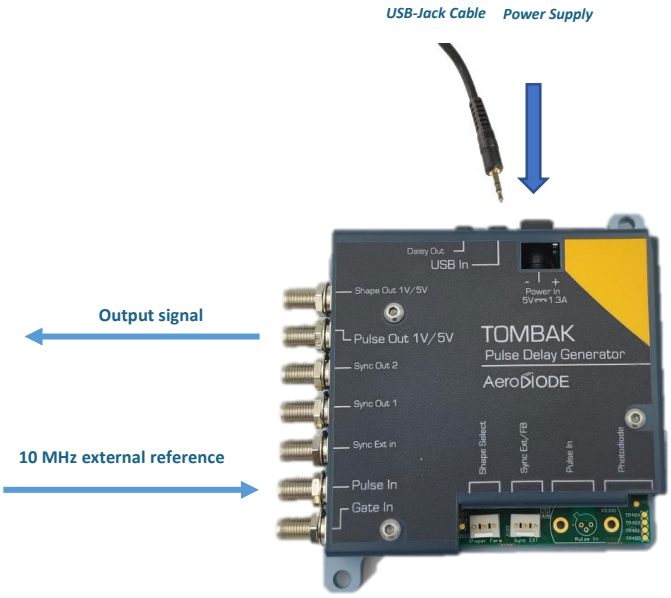


Figure 5 : Main firmware features used in Delay Generator

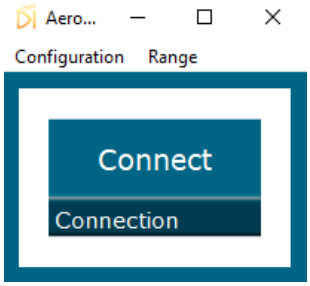
6.1.2.3. Cabling

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. Plug the 10 MHz external reference in the "*Pulse In*" SMA connector
4. Finally, plug the power supply to the "*Power In*" connector to power on the board



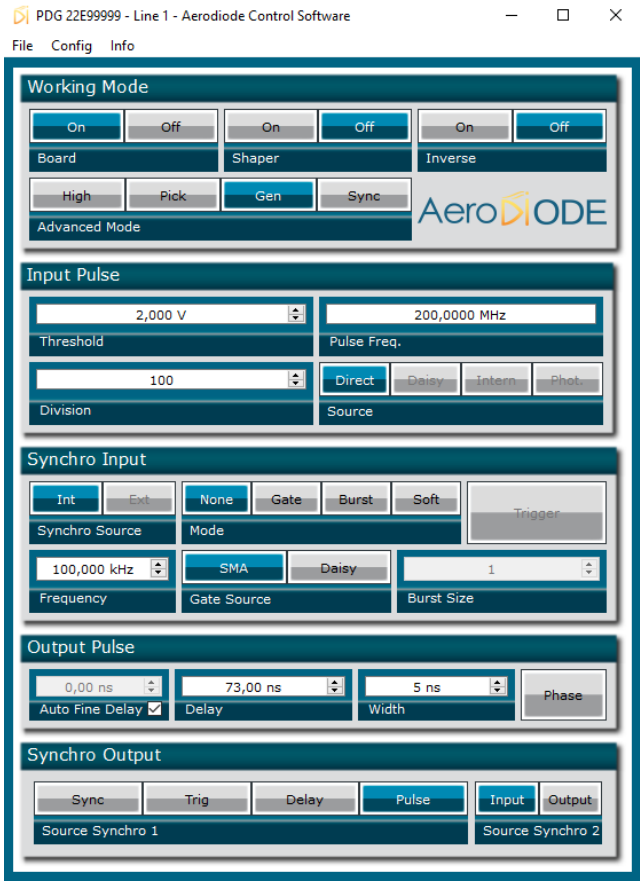
6.1.2.4. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.



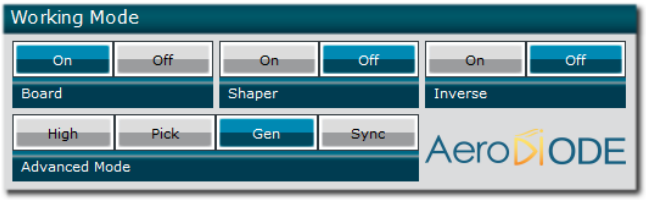
A window will appear for each TOMBAK connected to the computer.

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 :
  - Configure the **Threshold** voltage so that the clock reference is detected
  - **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. **Division** (*) = $\frac{\textbf{Pulse Freq}(\text{Hz})}{\text{Output frequency}(\text{Hz})}$

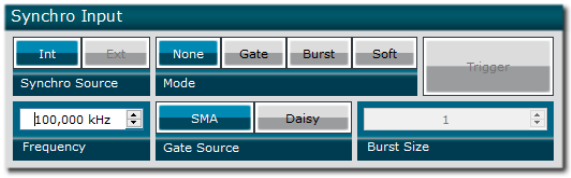
(*) Division must be at least 10 as the maximum output frequency is 20MHz.

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 (*).

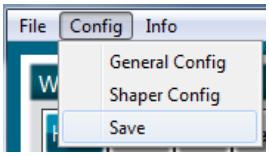
Pulse width (s) (*) = $\frac{\text{DutyCycle}(\%)}{100 * OutputFrequency(Hz)}$

- 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.



6.1.3. Main features

Adjustable output frequency	[0 – 20Mhz]
Frequency resolution (N is an integer in the range [10 – 10^9])	$\frac{\text{Internal 200MHz clock}}{N}$
Adjustable pulse width ▪ resolution (pulse width [5ns – 510ns]) ▪ resolution (pulse width [511ns – 2^62ns])	[5ns – >>1000 s] 2ns 5ns
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Maximum output frequency	20 MHz

6.2. Using TOMBAK as a Digital Delay Generator

6.2.1. Presentation

There are 4 ways to drive this product as a Digital Delay Generator :

- Mode 1 : (Red continuous in Figure 7) :

This mode allows to generate a software configurable delay and pulse width signal from a reference pulse signal. The mode has the following limitations :

  - Insertion delay is ~ 70ns
  - Maximum output frequency is 20MHz
  - Min output Pulse width is 5ns
  - Min output Pulse width resolution is 2ns

- Mode 2 : (Red continuous + Red dotted in Figure 7)

Same mode as above, but the output pulses are the same duration as input pulses. The limitations are the following :

  - Insertion delay is about 50ns
  - Maximum output frequency is 20MHz

- Mode 3 : (Violet in Figure 7)

This mode gives the best performances in term of Jitter, insertion delay, pulse width and output frequency and do not face the limitations above. Its major characteristics are :

  - Minimum insertion delay : 15ns (12ns when fine delay deactivated)
  - Delay range (fine delay) : 0-10ns
  - Max output frequency : 150 MHz

- Mode 4 : Digital Delay Generator with internal clock synchronization for low jitter up to very long delays : see §6.10.

Important note : the description below concerns only Mode 1 and Mode 2. For Mode 3, please refer to §6.6 page 61 : Using TOMBAK as a Voltage Level Converter

6.2.2. Timing diagram

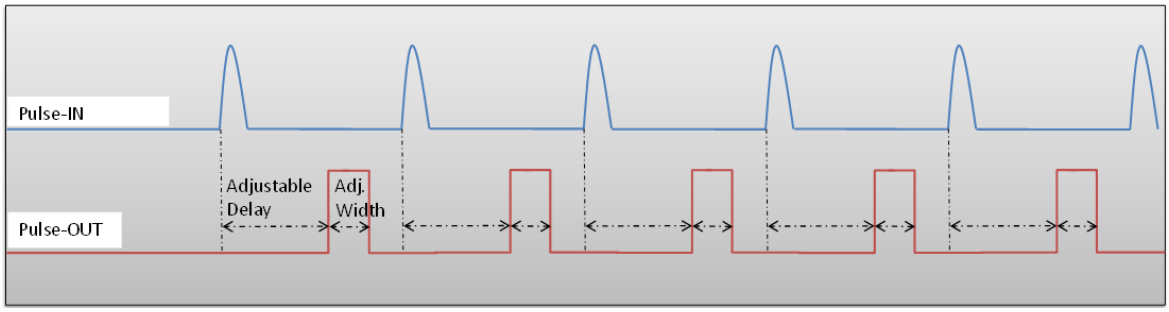


Figure 6 : Delayed and pulse width adjusted signal from input to output

6.2.3. Synoptic

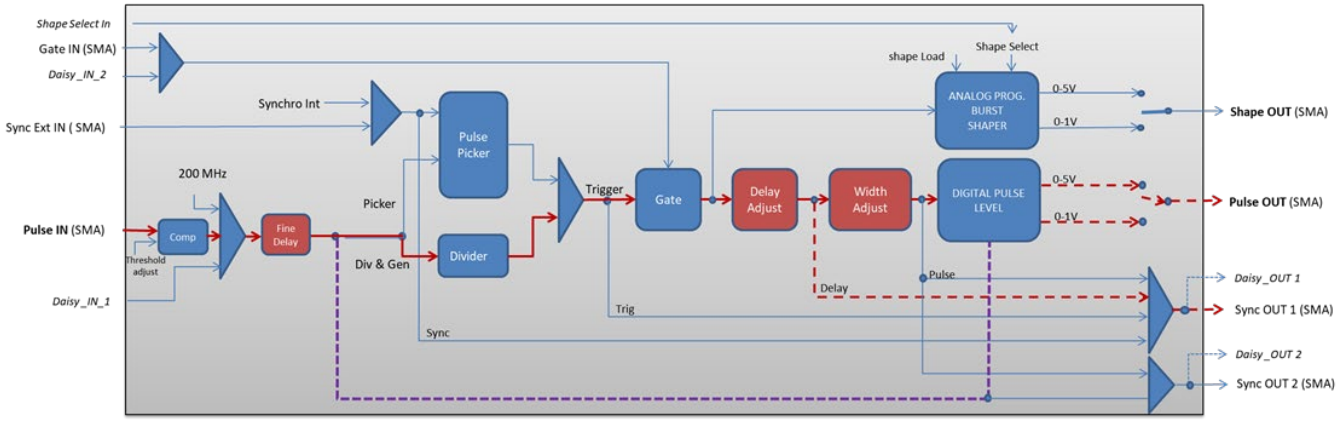
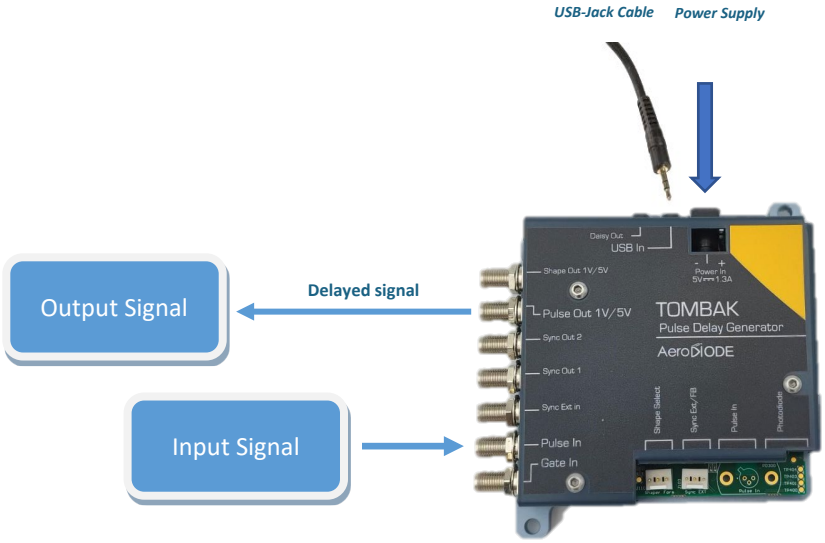


Figure 7 : Main firmware features used in Digital Delay Generator

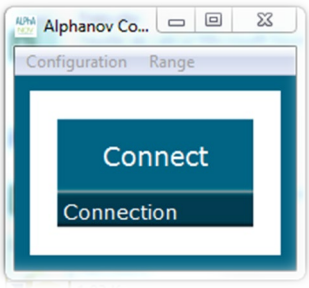
6.2.4. Cabling

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



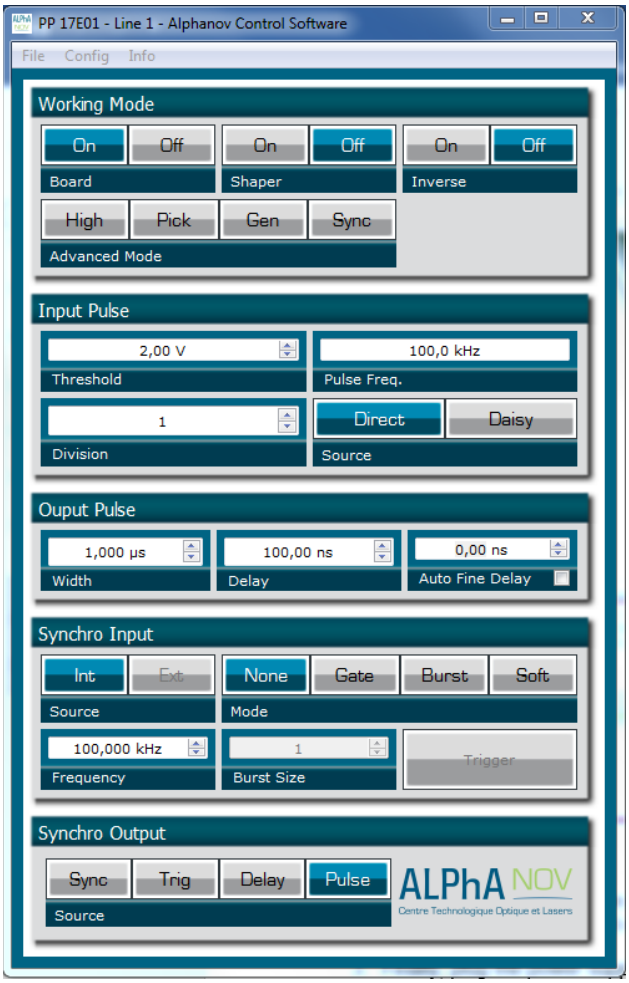
6.2.5. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.

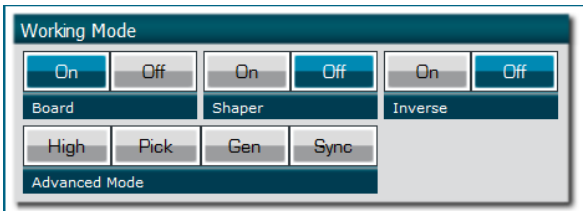


A window will appear for each TOMBAK connected to the computer.

The main configuration windows must be configured as follow :

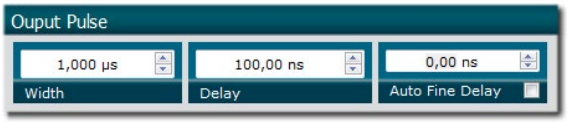


- Working Mode window :
    - Set the **Board On**
    - Set the **Shaper** button to **Off**
    - Set the **Inverse** button to **Off** unless you need to invert the output signal
    - Unset all **Advanced Mode**

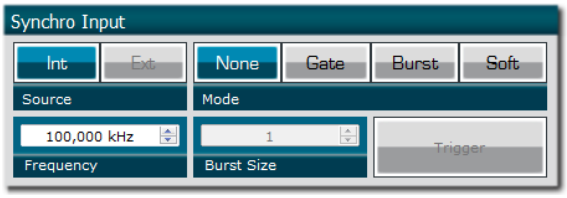


- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**

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

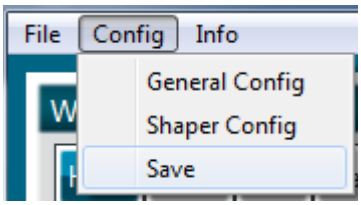


- Synchro input windows:
  - Source : not used in this mode
  - Mode : None
  - Frequency : not used in this mode
  - Burst size : not used in this mode



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

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



6.2.6. Main features

Adjustable pulse width ▪ resolution (for pulse width [5ns – 510ns]) ▪ resolution (for pulse width [511ns – $2^{\wedge 62}$ns])	[5ns – >>1000s] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – >>1000s] 10ps
Jitter ▪ for delay <10ns ▪ for delay < 570ns & pulse width < 510ns ▪ for any other delay & pulse width	 few ps rms <200 ps RMS 1.5 ns RMS
Input PulseIn voltage	30 mV – 3,3V
Input maximum frequency	20 MHz (mode 1 & 2) 150 MHz (mode 3)
Output Voltage	1 / 3,3 / 5 Volts (hardware setup)
Output maximum frequency	20 MHz in mode 1 & 2 150 MHz in mode 3

6.3. Using TOMBAK as a burst generator

6.3.1. 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.

6.3.2. Timing diagram

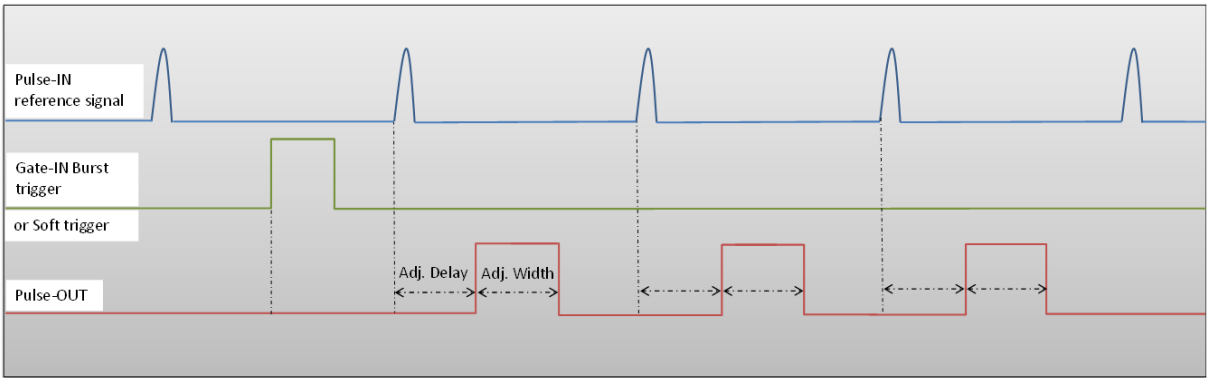


Figure 8 : Burst signal of 3 pulses, “Gate-IN” or Soft triggered and “Pulse-In” synchronized

6.3.3. Synoptic

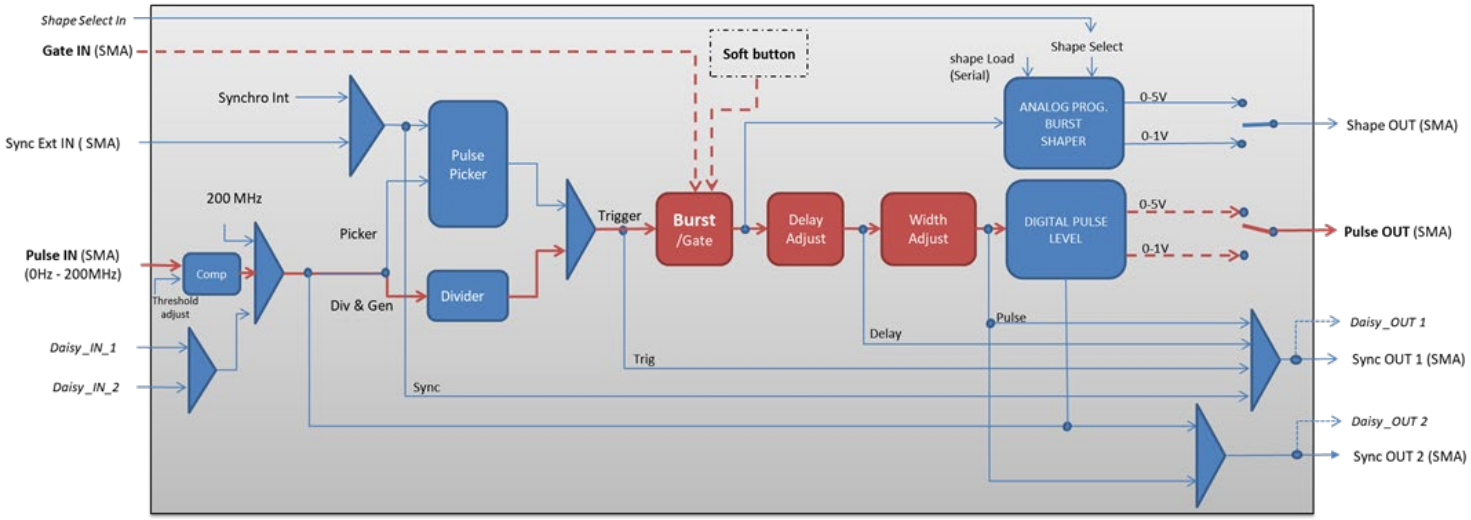
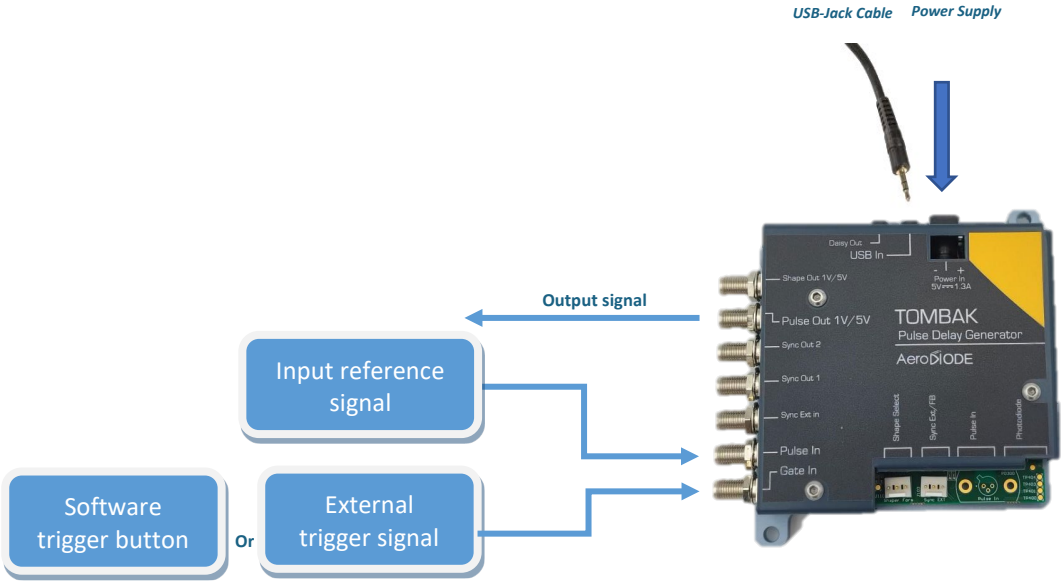


Figure 9 : Main firmware features used in Delay Generator

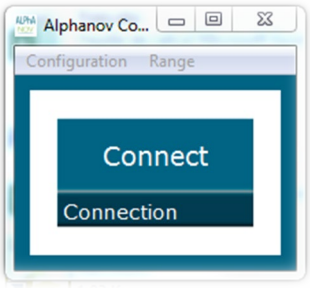
6.3.4. Cabling

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.



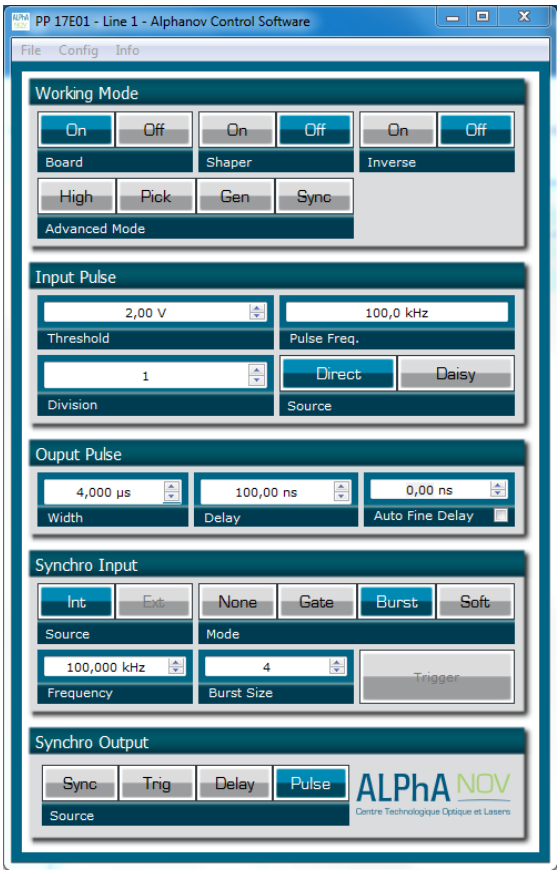
6.3.5. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.

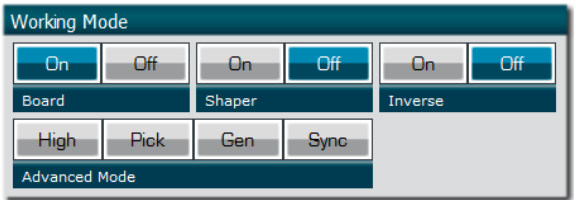


A window will appear for each TOMBAK connected to the computer.

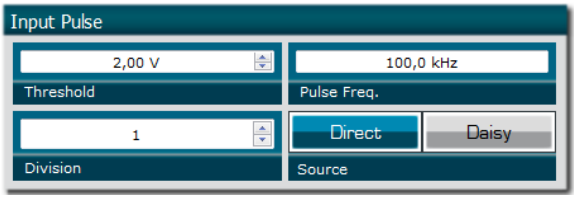
The main configuration windows must be configured as follow :



- 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**

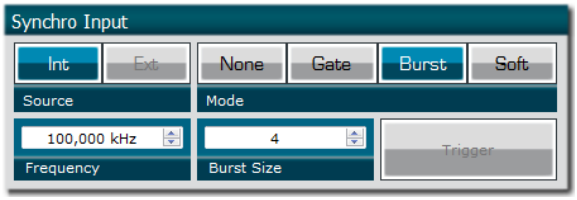


- Input pulse window :
  - Configure the **Threshold** voltage so that the input pulse frequency is detected and equal to your pulse generator system
  - Set the **Division** factor to **1** (default settings). Division value may be ajusted to divide the input reference signal frequency.
  - Set the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



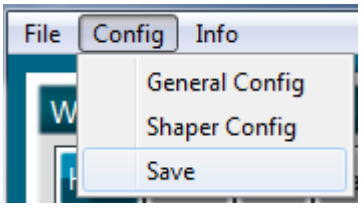
- Output Pulse window :
  - Set the output pulse **Width**
  - Set the **Delay** between output and input signals
  - **AutoFineDelay** may be let in auto mode

- 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.



6.3.6. *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

6.4. Using the gate feature of TOMBAK

6.4.1. 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.

6.4.2. Timing diagram

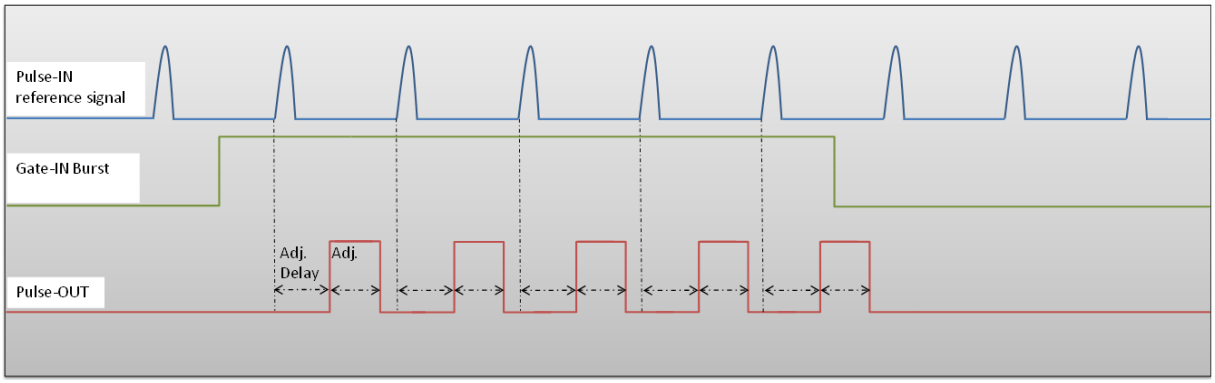


Figure 10 : Gated output from Gate-IN external signal

6.4.3. Synoptic

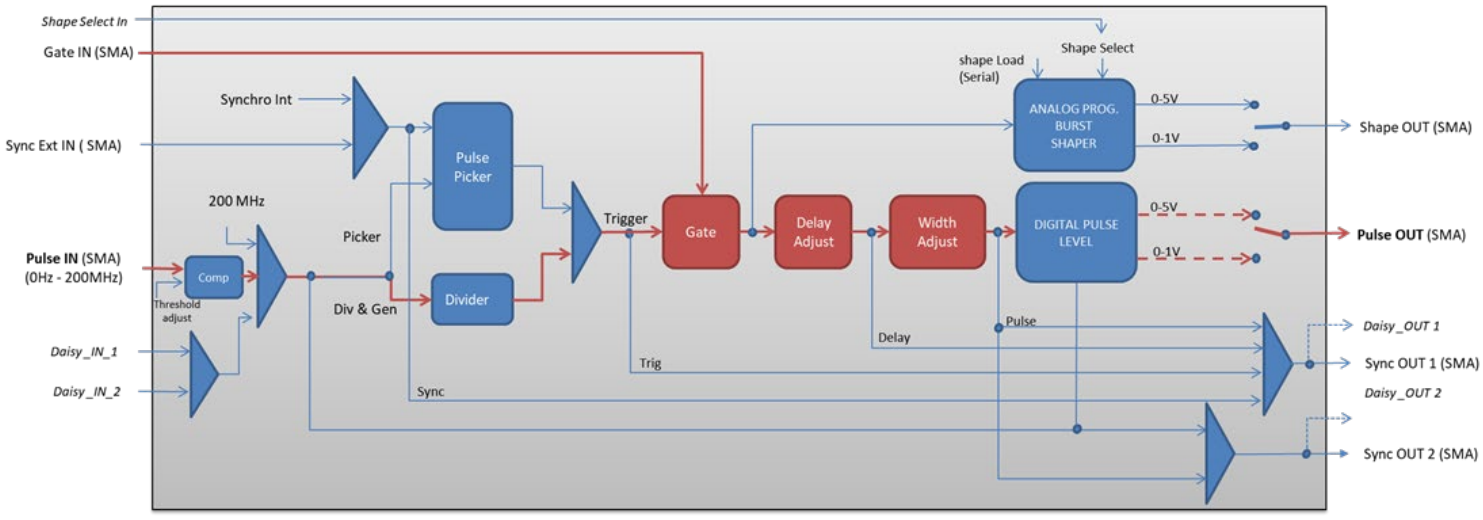
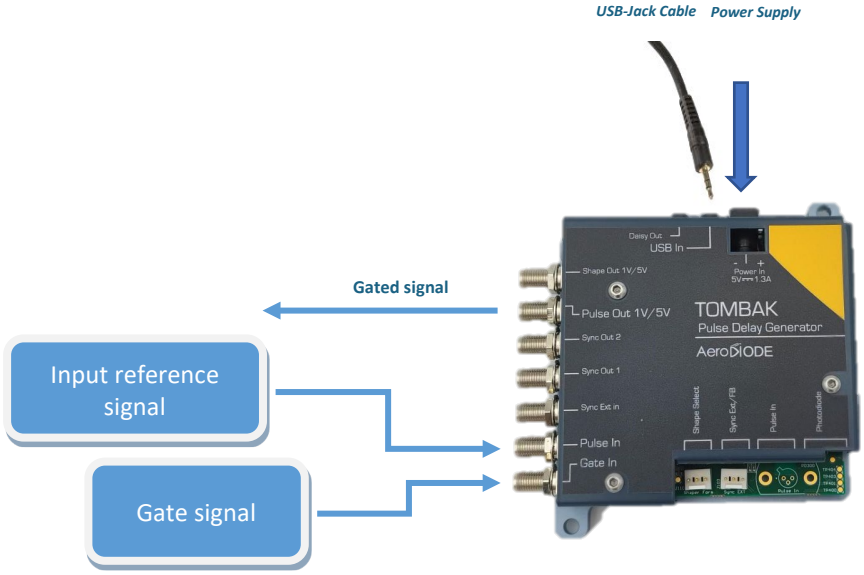


Figure 11 : Main software features used in Gate Mode

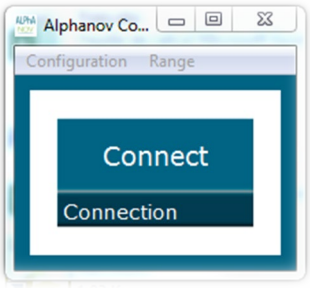
6.4.4. Cabling

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



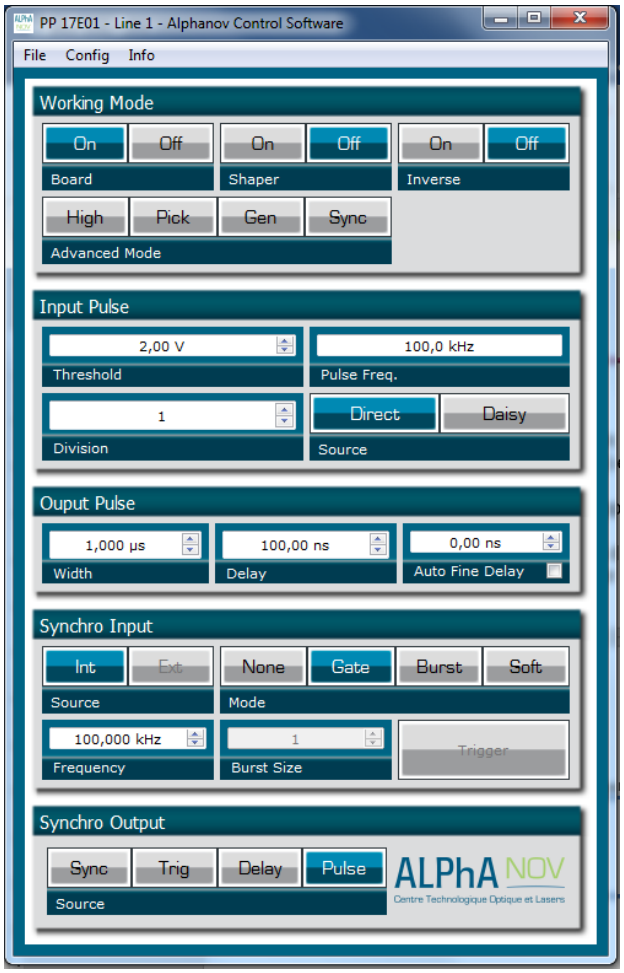
6.4.5. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.

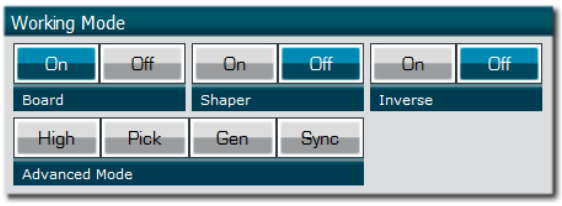


A window will appear for each TOMBAK connected to the computer.

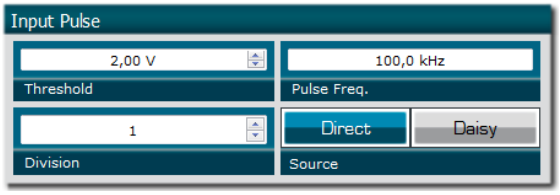
The main configuration windows must be configured as follow :



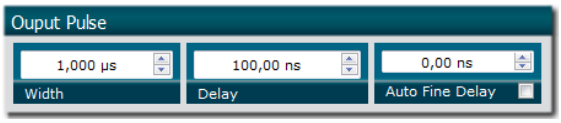
- Working Mode window :
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Unset all **Advanced Mode**
  - Finally set the **Board** On



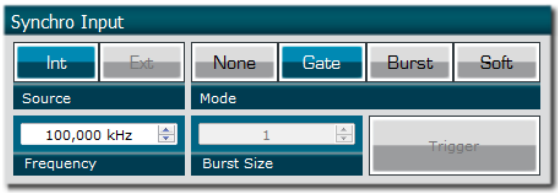
- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**



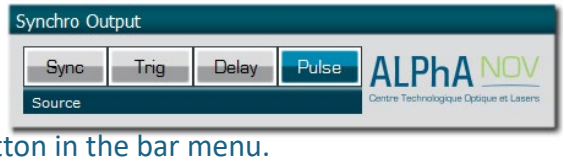
- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



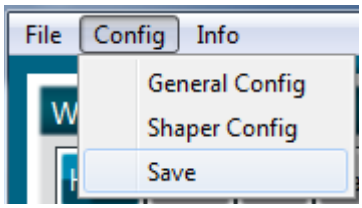
- Synchro input windows:
  - Source : not used in this mode
  - Mode : Gate
  - Frequency : not used in this mode
  - Burst size : not used in this mode



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



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



6.4.6. Main features

Adjustable pulse width ▪ resolution (pulse width [5ns – 510ns]) ▪ resolution (pulse width [511ns – 2^62ns])	[5ns – >> 1000 s] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – >> 1000 s] 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

6.5. Using TOMBAK as a signal synchronization module

6.5.1. 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.

6.5.2. Timing diagram

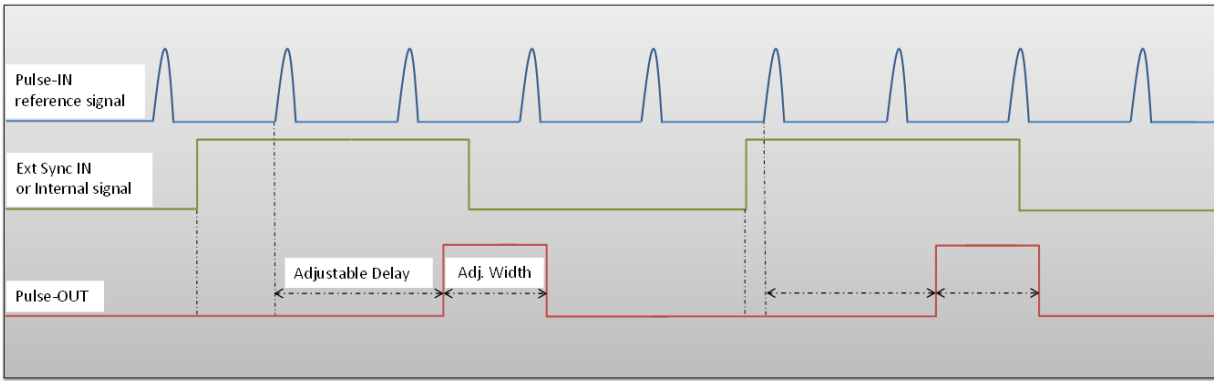


Figure 12 : External or internal signal synchronized with Pulse-In signal.

6.5.3. Synoptic

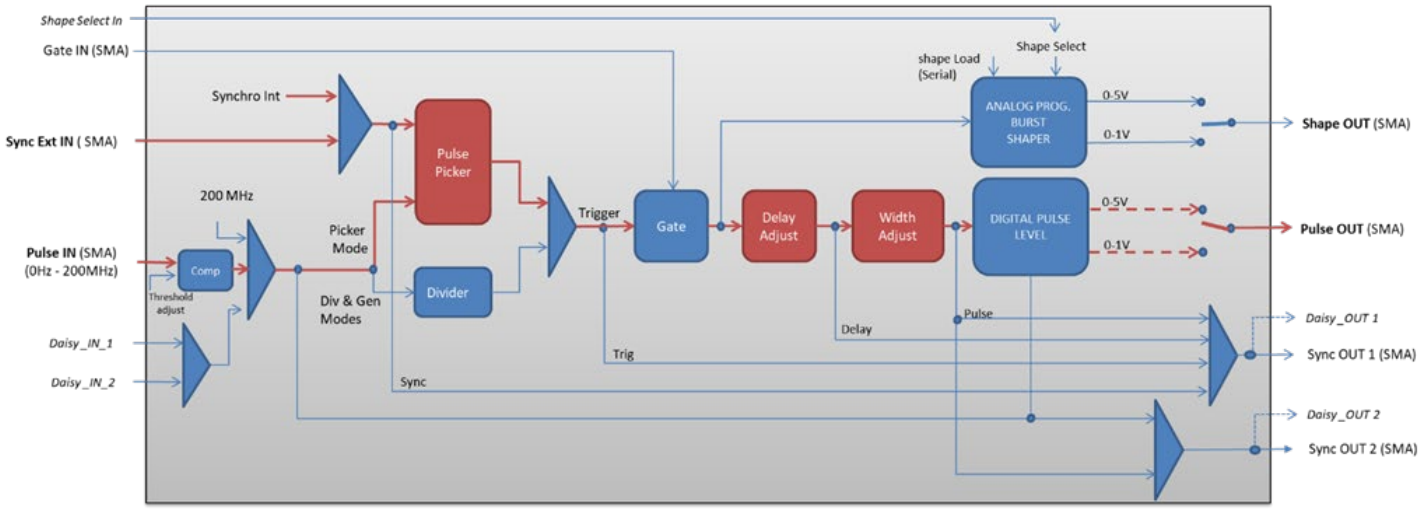
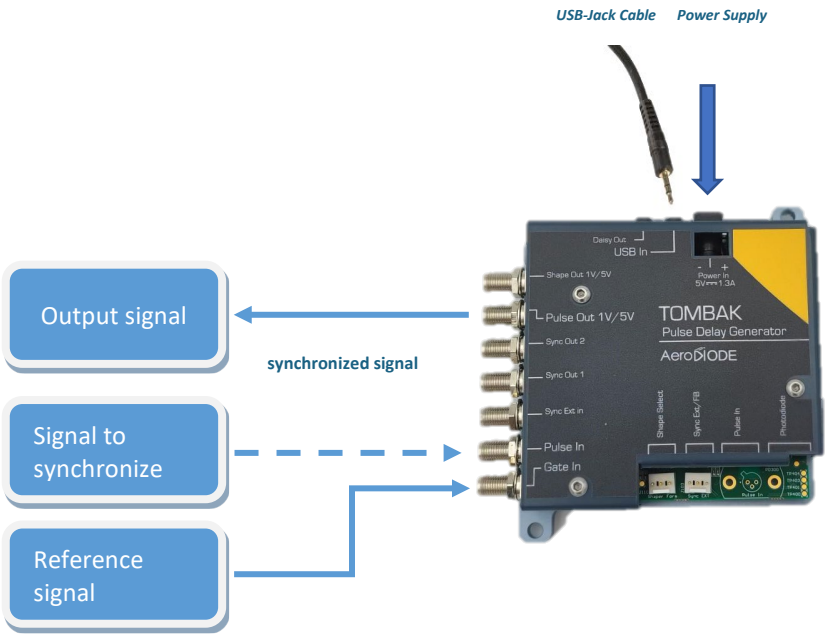


Figure 13 Main firmware features used in synchronization mode

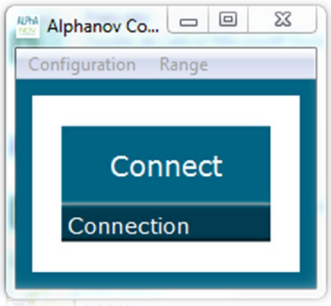
6.5.4. Cabling

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



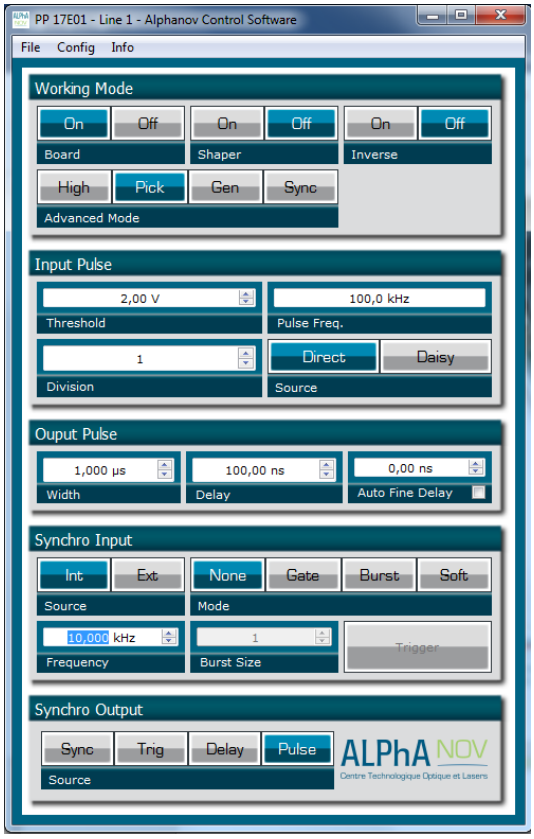
6.5.5. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.

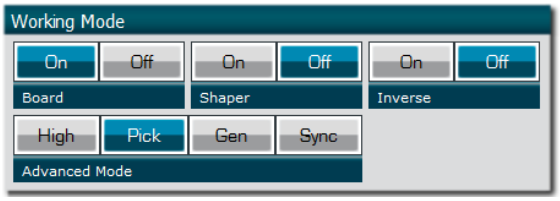


A window will appear for each TOMBAK connected to the computer.

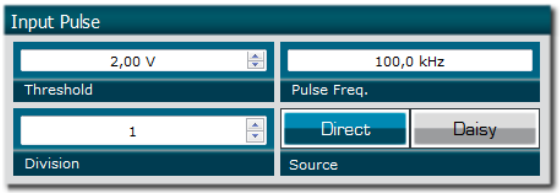
The main configuration windows must be configured as follow :



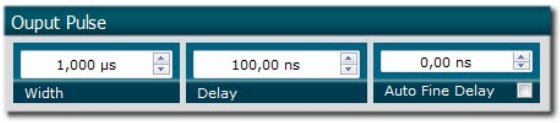
- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Pick**



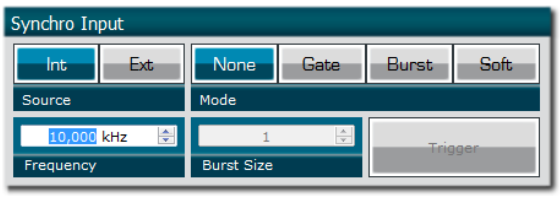
- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**

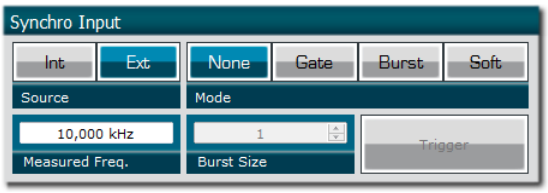


- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode

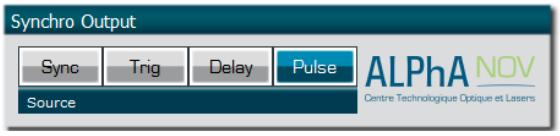


- Synchro input windows :
  - Source :
    1. Set **Int** to synchronize an internal generated signal with Pulse-In signal.
    2. Set **Ext** to synchronize an external signal (connected to Ext-In connector) with Pulse-In signal.
  - Mode : None
  - Frequency :
    1. If internal source is selected, 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

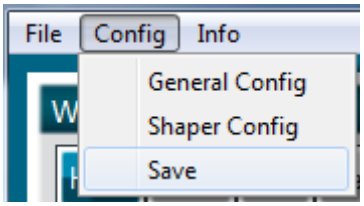




- Synchro ouput window (default settings) :
  - Source : Pulse



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



6.5.6. Main features

Adjustable pulse width ▪ resolution (for pulse width [5ns – 510ns]) ▪ resolution (for pulse width [511ns – 2^62ns])	[5ns – >>1000s] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – >>1000s] 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

6.6. Using TOMBAK as a Voltage Level Converter

6.6.1. 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 insertion delay** …).

An additional “Autofine delay” can be added which adds a 0-10ns delay while keeping a very short insertion delay and ultra-low Jitter.

6.6.2. Timing diagram

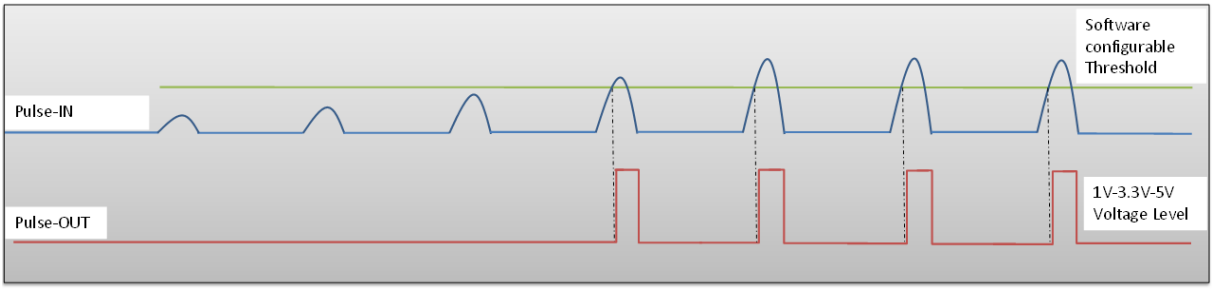


Figure 14 : Pulse In detection signal with software adjustable threshold

6.6.3. Synoptic

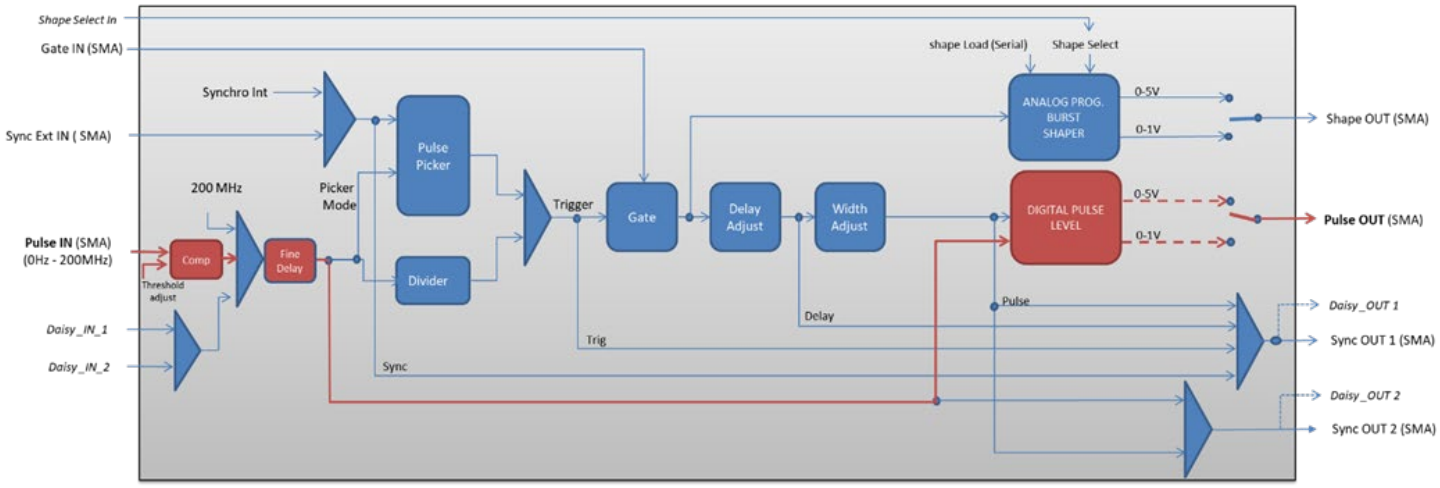
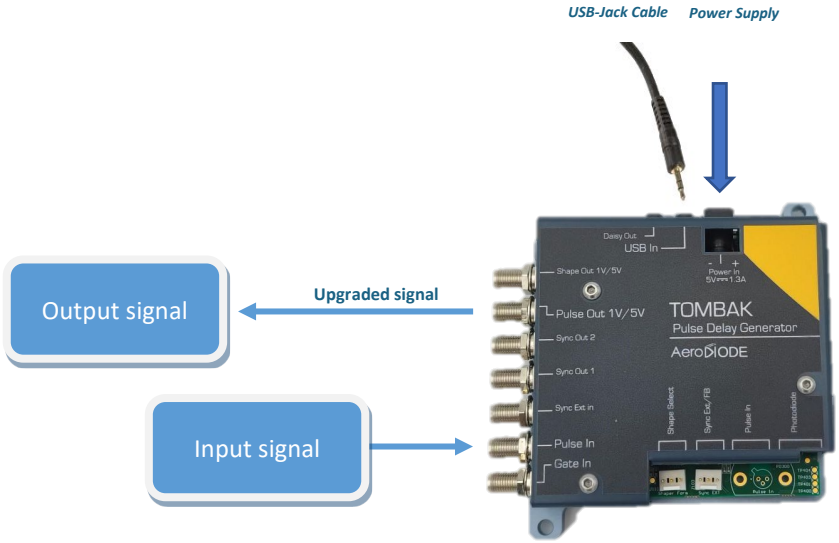


Figure 15 : Main firmware features used in Voltage Level Converter

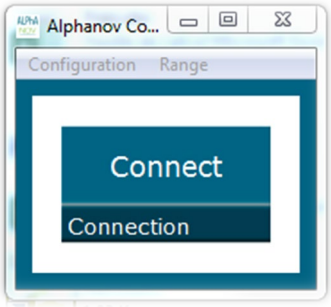
6.6.4. Cabling

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



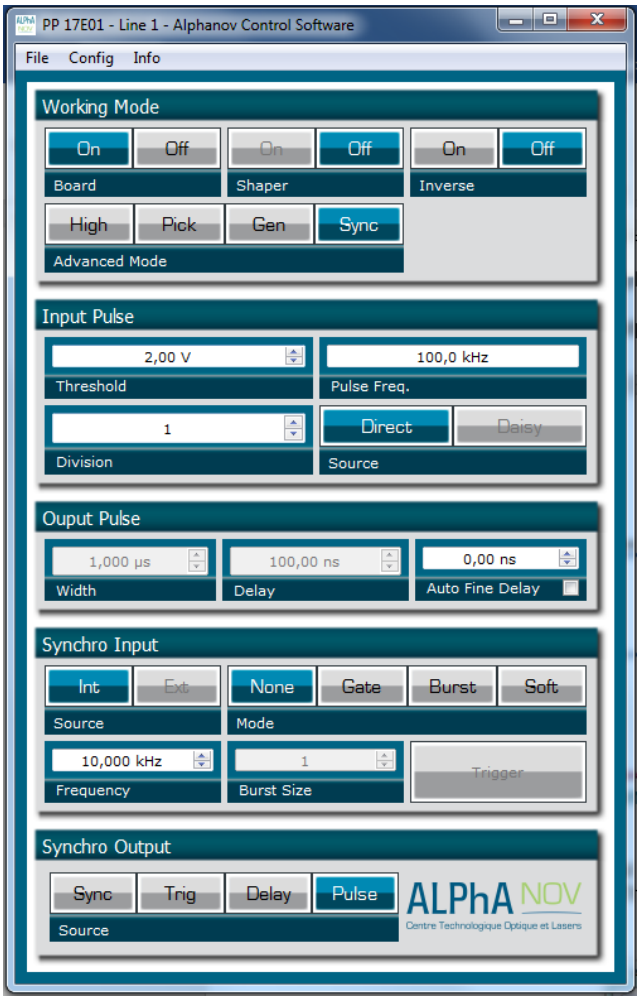
6.6.5. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.

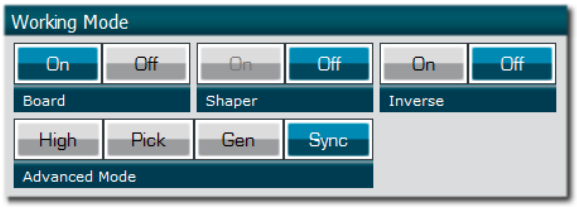


A window will appear for each TOMBAK connected to the computer.

The main configuration windows must be configured as follow :

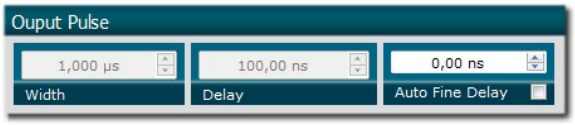


- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Sync**

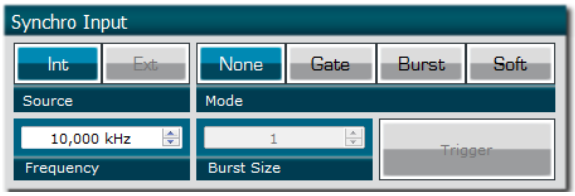


- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor to **1**
  - Set the input pulse **Source** to **Direct**
  -

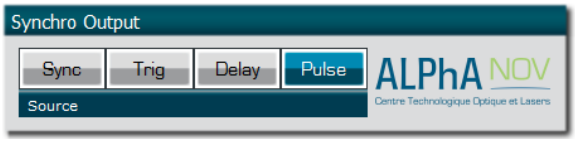
- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



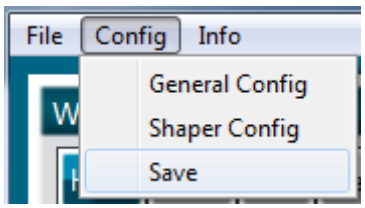
- Synchro input windows (default settings) :
  - Source : not used in this mode
  - Gate Mode : None
  - Frequency : not used in this mode
  - Burst size : not used in this mode



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



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



6.6.6. Main features

Input PulseIn voltage (software adjustable threshold)	30 mV – 3,3V
Input/output maximum frequency	150 MHz
Minimum insertion delay (fine delay deactivated) (see fig 2)	12 ns
Minimum insertion delay (0-10ns fine delay) (see fig 2)	15 ns
Output Voltage	1 / 3,3 / 5 Volts (hardware setup – see user manual for selecting it)

6.7. Using TOMBAK as a frequency divider

6.7.1. Presentation

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

6.7.2. Timing diagram

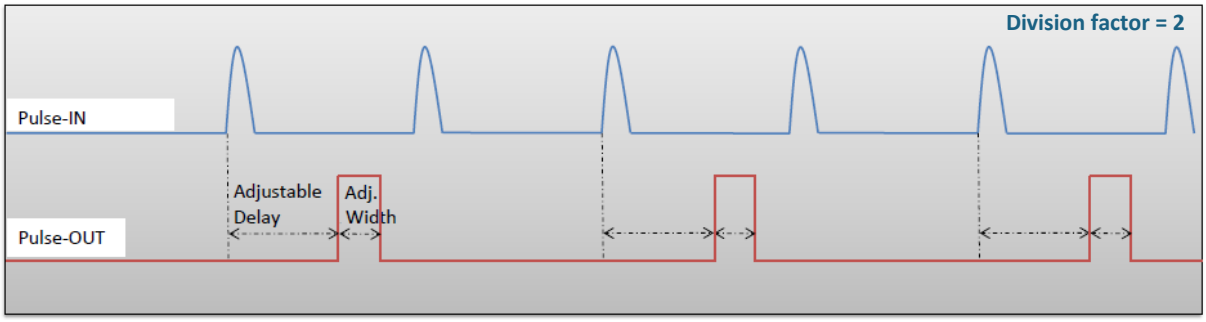


Figure 16 : Frequency divided, delayed and pulse width adjusted signal from input to output

6.7.3. Synoptic

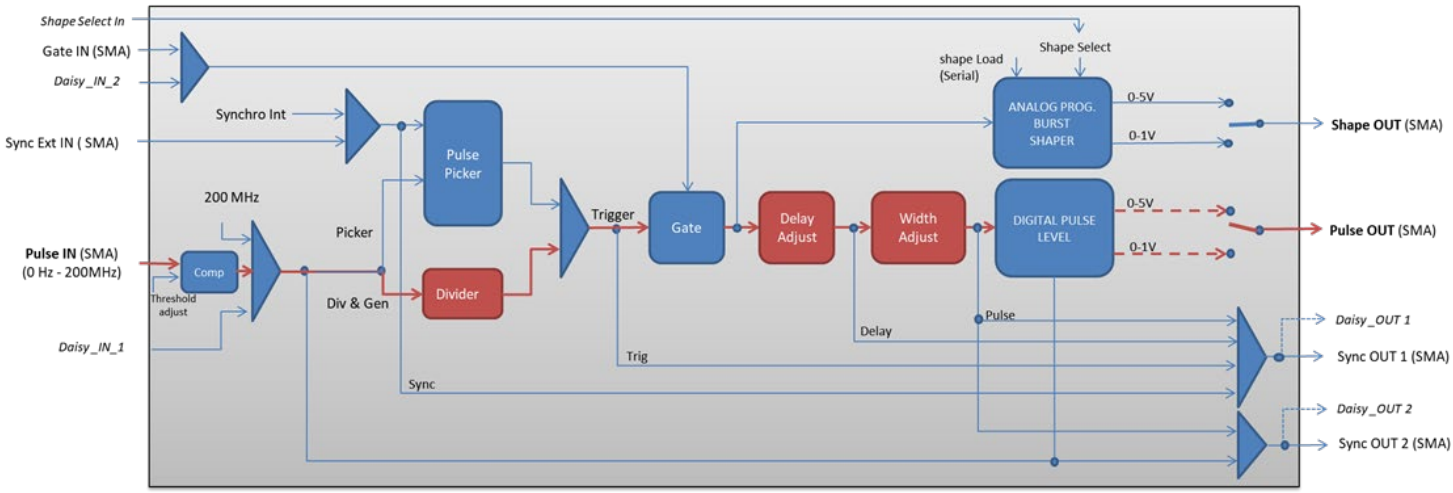
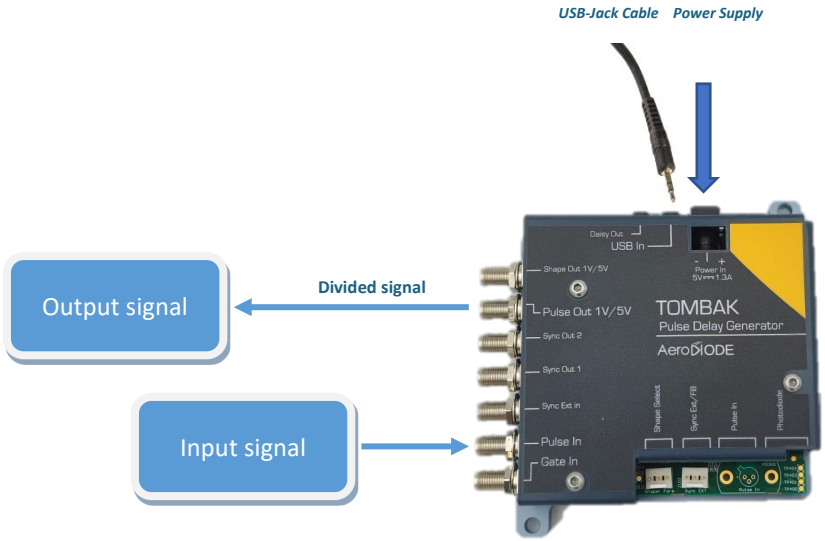


Figure 17 : Main firmware features used in frequency divider mode

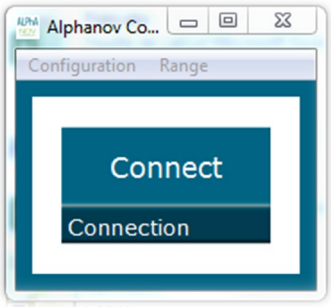
6.7.4. Cabling

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
5.



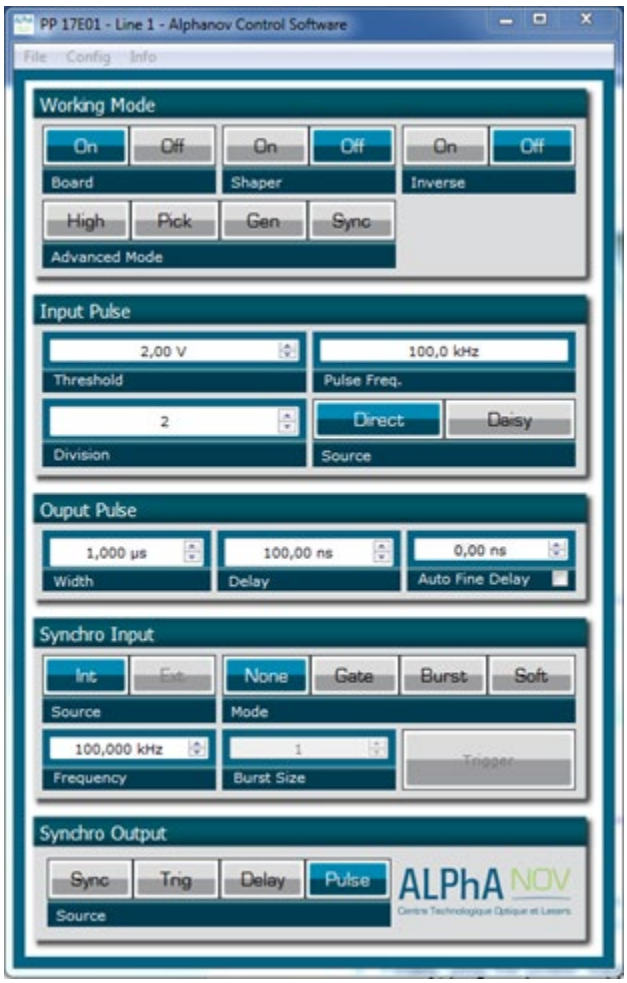
6.7.5. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.

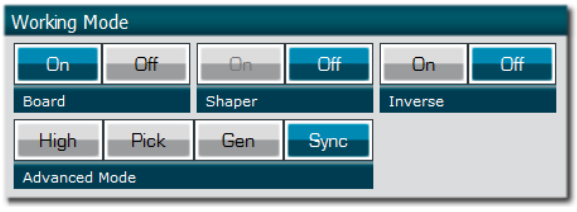


A window will appear for each TOMBAK connected to the computer.

The main configuration windows must be configured as follow :

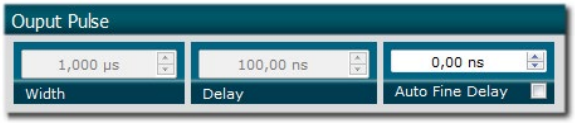


- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Sync**

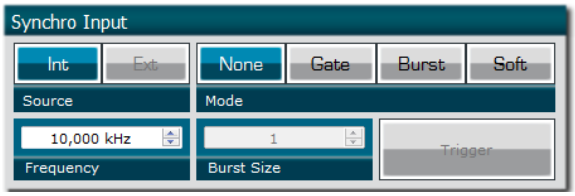


- Input pulse window :
  - Configure the **Threshold** voltage so that the input **pulse frequency** is detected and equal to your pulse generator system
  - Set the **Division** factor **according to your application**
  - Set the input pulse **Source** to **Direct**

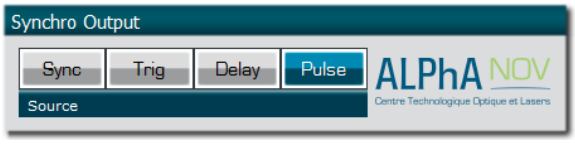
- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



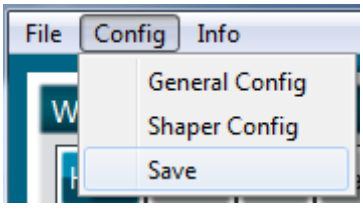
- Synchro input windows (default settings) :
  - Source : not used in this mode
  - Gate Mode : None
  - Frequency : not used in this mode
  - Burst size : not used in this mode



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



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



6.7.6. 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 – >>1000s] 2ns 5ns
Adjustable pulse delay ▪ resolution	[70ns – >>1000s] 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

6.8. Using TOMBAK as a PULSE-PICKER

6.8.1. Introduction / Overview

When one wants to generate a pulse (open a time domain door) at a low repetition rate (for example Hz/kHz range) which must be synchronized with a high frequency signal/clock (for example 100MHz range), There is two solutions :

1. The most immediate solution is to divide the clock signal frequency. Using the TOMBAK for that is described in the first part of this document. See **§ 6.7 p 66**

2. When the low frequency pulse/door must also be synchronized with a low frequency external or internal signal (in other word, when we want a low repetition rate pulse at a repetition rate of a low repetition rate trigger BUT synchronized with a high frequency clock), the solution is to use the PICK mode of the TOMBAK. Note that in this last case, if the low frequency trigger is not synchronized with the high frequency clock, there will be an unavoidable Jitter which value is 1/clock frequency. **See §6.5 p 55**

3. Another using case is relevant when multiple pulses (Burst) are isolated (pulse picked) and one wants to adjust the power intensity of every pulse independently : When used as an AWG, TOMBAK can generate special pulse waveforms with up to 4000 steps of down to 5 nanosecond. TOMBAK, can also be used to generate Burst pulses with non-repetitive frequency and/or with adjustable amplitude. The Shape-OUT SMA connector can be connected to the analog input of a dedicated external modulation instrument like an AOM (acousto-optic modulator), an EOM (electro-optic modulator), a SOA, a scanning system or a laser…It is thus possible to create some Burst with nearly any shape and number of pulses up to 4000 pulses per Burst. This is particularly interesting within a mode locked laser with MOPA configuration when someone wants to generate some burst from the oscillator part. Generating special exponential Burst shape can pre-compensate the deformation of the burst through the amplifiers and help maintaining a nice shape at the output of the MOPA laser. See page 13

In all case above, the TOMBAK opens a door with adjustable delays and adjustable width which can be used to synchronize external optical device, such as an AOM, EOM or SOA.

6.8.2. Timing diagrams

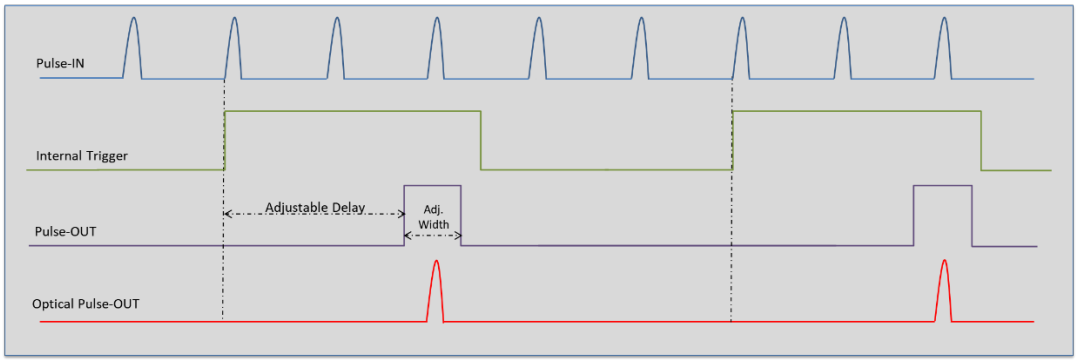


Figure 18 : Pulse-picking using the Frequency divider mode (division per 6 here) see § 6.7 p 66

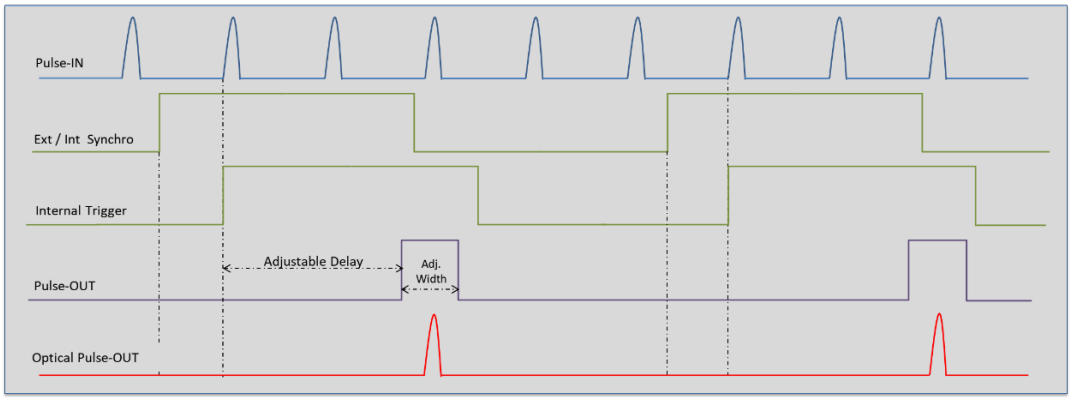


Figure 19 : Pulse-picking using the Synchronization mode described §6.5 p 55

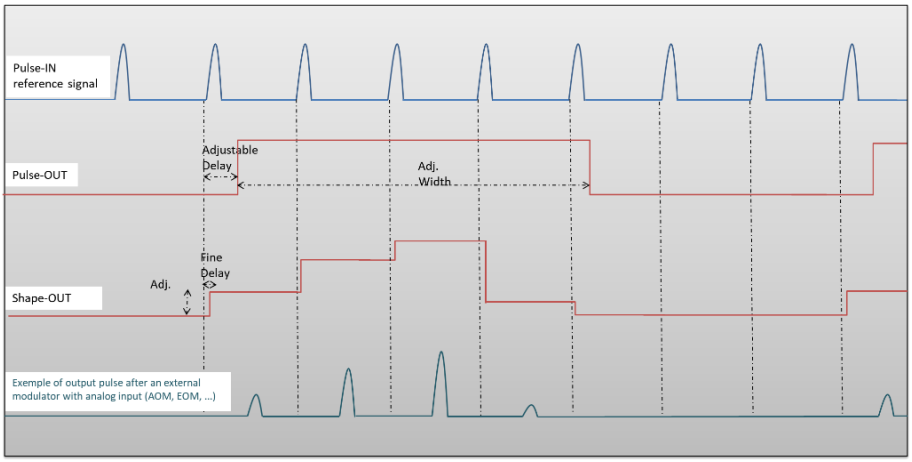


Figure 20 : Pulse picking a burst and generate adjusted intensity pulses described §6.9 p73

6.9. Using TOMBAK as an AWG (Arbitrary Waveform Generator) or a "Burst Shaper"

6.9.1. Introduction

When used as an AWG, TOMBAK can generate special pulse waveforms with up to 4000 steps of down to 5 nanosecond.

TOMBAK can also be used to generate Burst pulses with non-repetitive frequency and/or with adjustable amplitude.

The Shape-OUT SMA connector can be connected to the analog input of a dedicated external modulation instrument like an AOM (acousto-optic modulator), an EOM (electro-optic modulator), a SOA, a scanning system or a laser…

It is thus possible to create Burst with nearly any shape and number of pulses up to 4000 pulses per Burst.

This is particularly interesting within a mode locked laser with MOPA configuration when one wants to generate burst from the oscillator part. Generating special exponential Burst shape can pre-compensate the deformation of the burst through the amplifiers and help maintaining a nice shape at the output of the MOPA laser.

6.9.2. Timing diagrams

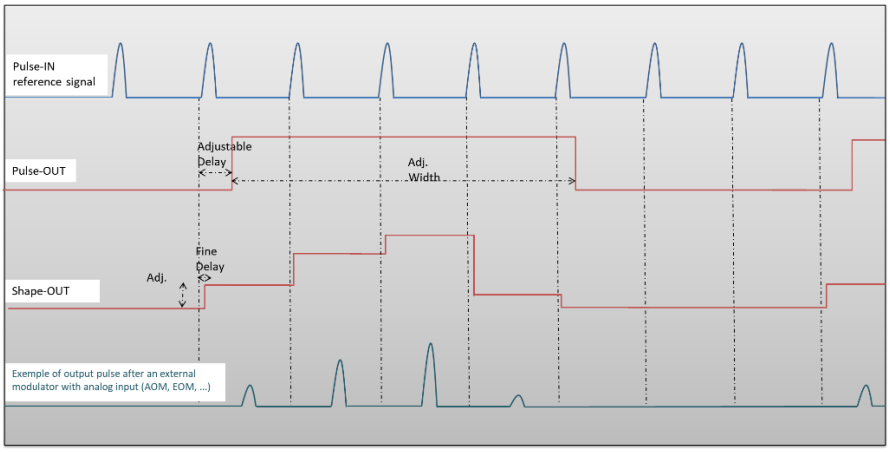


Figure 21 : Analog (Shape-OUT) and digital (Pulse-Out) outputs with amplitude, delay and pulse width adjusted signals from input

6.9.3. Synoptic

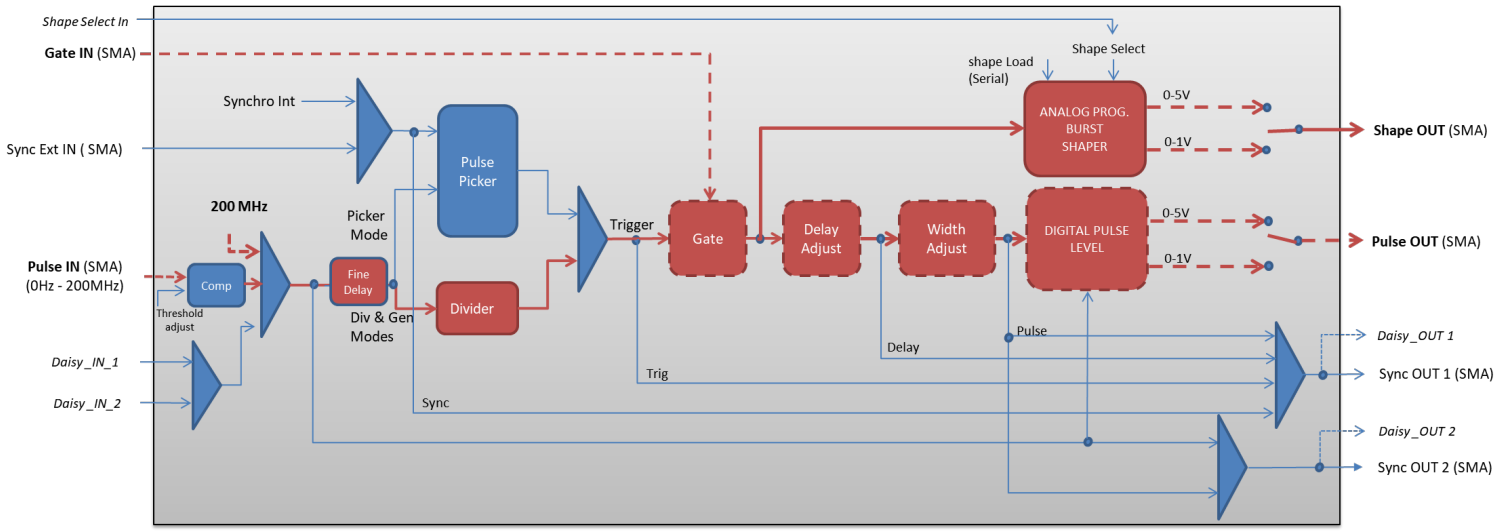
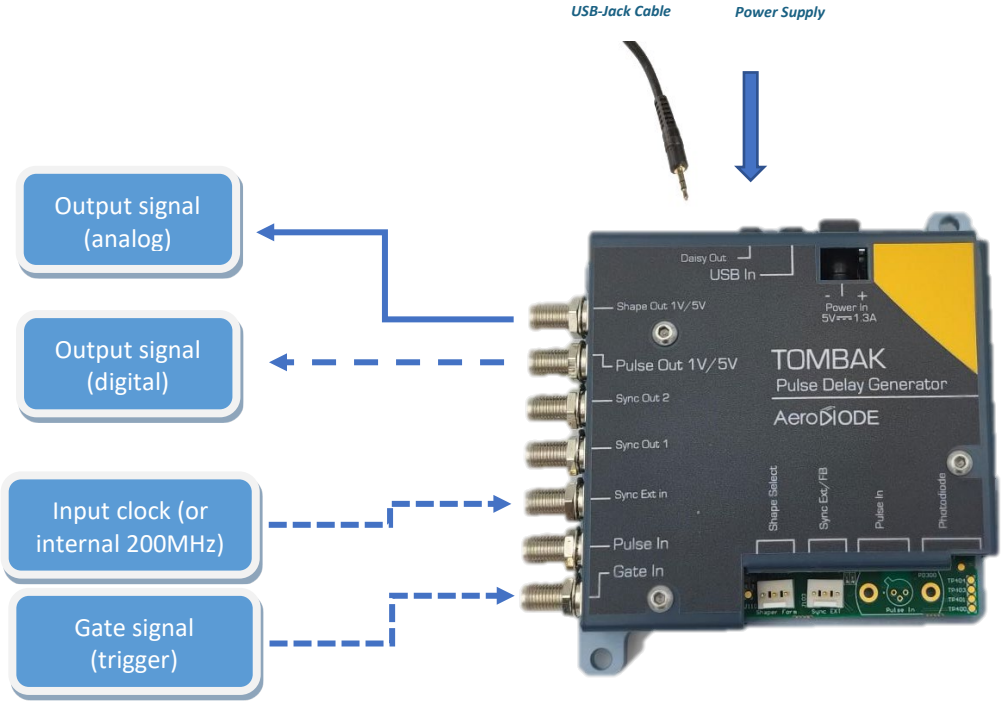


Figure 22 : Main firmware features used in AWG / Burst shaper mode (dashed lines are optional)

6.9.4. Cabling

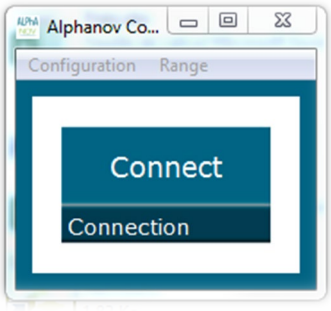
The steps given below are optional and link to previous configuration described in **§6.4 p. 50** (Gate feature), in **§ 6.3 p. 45** (Burst generator using the Gate input), and in **§ 6.7 p. 66** (Frequency divider).

1. Plug the USB-Jack cable in the "*USB In*" connector
2. (Plug your reference signal (clock) in the "*Pulse In*" SMA connector)
3. (Plug your trigger/gate signal in the "*Gate In*" SMA connector)
4. The signal will output on the "*Shape Out*" SMA connector
5. Finally, plug the power supply to the "*Power In*" connector to power on the board



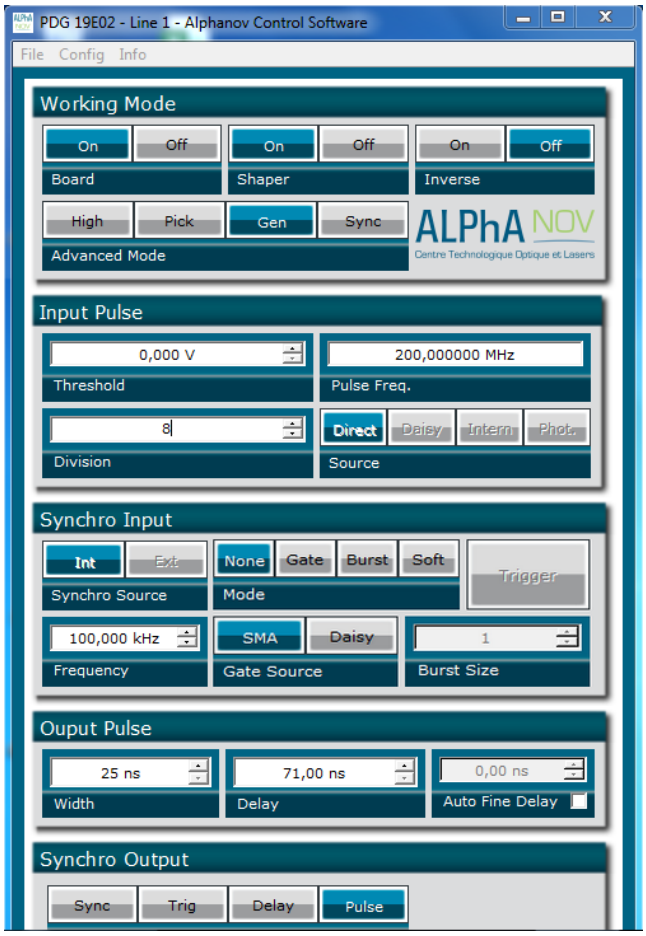
6.9.5. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.



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

The main configuration windows must be configured as follow :



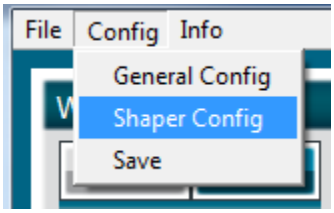
- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **On**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Nothing** (use external clock) or **Gen** (use 200MHz internal frequency)

- 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**

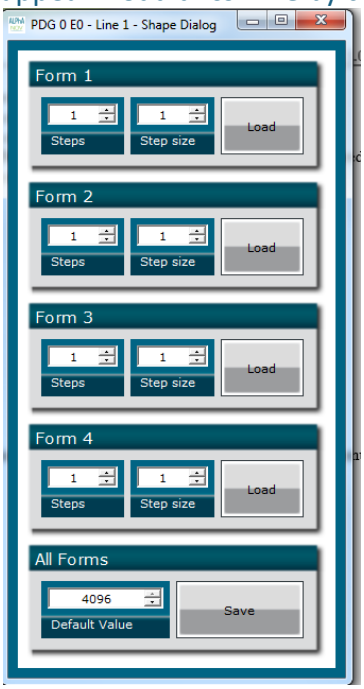
- Output Pulse window :
  - Choose the output **delay value**

- Choose the output **pulse width**
- **Auto Fine Delay** may be let in auto mode or manual if you need to adjust the fine delay from reference signal to each shape point (see Figure 20).

- Configure shape :
  - Open the **shaper config** window by clicking on the “Shaper Config” in the bar menu



  - The following window will appear. **Load a .csv file** by cliking on Load



  - The **.csv file** should be like this (example and explanation) :

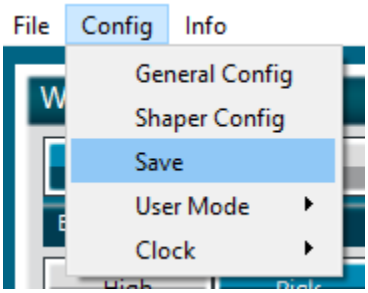
```
4
1000
3000
4095
500
0
```

```
Number of points - 1
Value in bit for 1st point (from 0 to 4095)
Value in bit for 2nd point  (from 0 to 4095)
Value in bit for 3rd point  (from 0 to 4095)
Value in bit for 4th point  (from 0 to 4095)
...
```

Please note that repetitive values of 0 could be used to make non-uniform period between pulses.
The maximum number of points is 4000.

- The **number of points, called steps**, should be automatically detected after uploaded the file
- The step size should be leave to 1 or could be higher if you want to change the point after several reference pulses (for example a step size of 2 will change the level one time for two pulses

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



6.10. Using Tombak as a long delay generator with low jitter with internal clock synchronization by an external 10 MHz signal

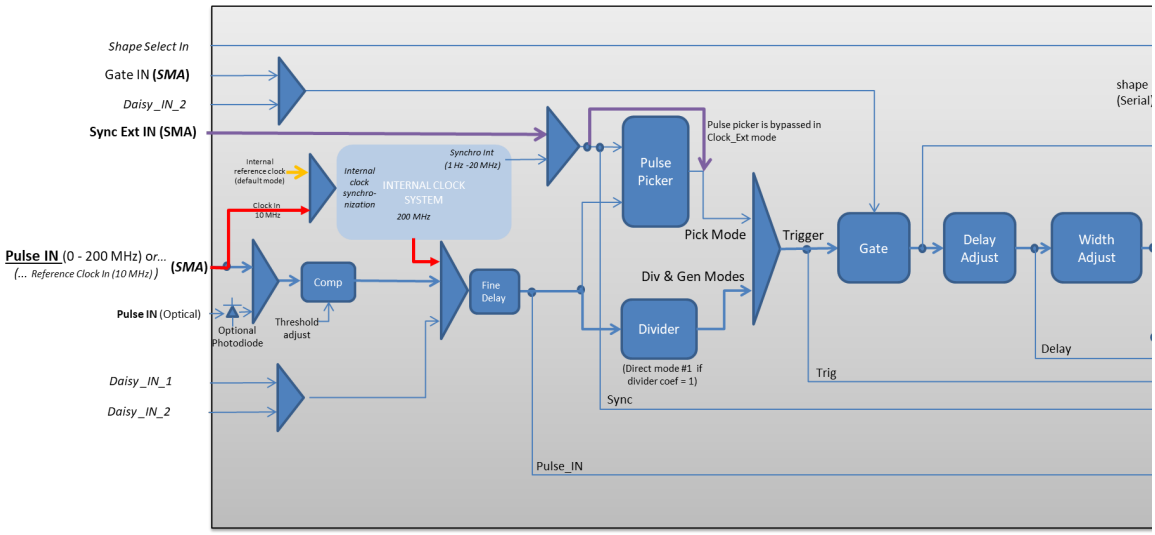
6.10.1. Introduction

TOMBAK generates a 200 MHz internal clock signal which synchronizes the internal FPGA (Yellow arrow in the synoptic below).

The FPGA is involved for digital delay > 500 ns. As external trigger and internal clock are not synchronized, this generates a **± 2,5 ns peak-peak jitter** between the input trigger and the output signal (note : for digital delays < 500 ns an internal system avoids this additional Jitter and the Jitter is in the ps range for such short delays).

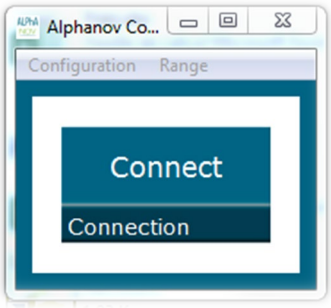
It is possible to avoid this ± 2,5 ns peak-peak jitter if a **10 MHz clock synchronization signal** is available within the customer system. In this case, this 10 MHz signal enters via the "Pulse_In" connector and is used to generate a 200 MHz internal synchronization signal within the internal clock system (Red arrows in the synoptic below). In this case, the input trigger can enter the Tombak through the "Sync Ext In" SMA connector and the pulse picker functionality is shunted (violet curve in the synoptic below)

6.10.2. Synoptic



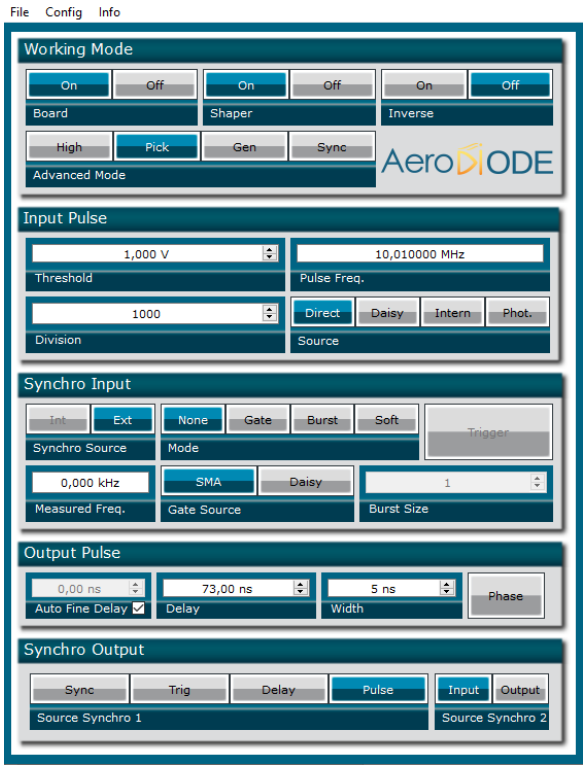
6.10.3. Software configuration

Launch the AeroDIODE Control Software and click on *Connect* to start the TOMBAK hardware detection. The software automatically detects the TOMBAK board.



A window appears for every TOMBAK connected to the computer.

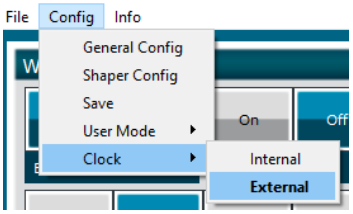
The main configuration windows must be configured as follow :



The next steps describe the digital delay mode with internal clock synchronization mode with a 10 MHz external clock synchronized with an external trigger.

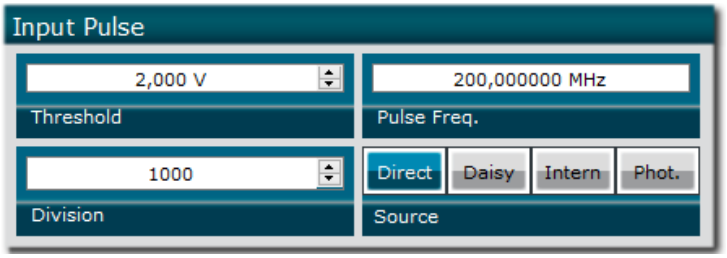
- Configuration windows :

- Select the Clock External

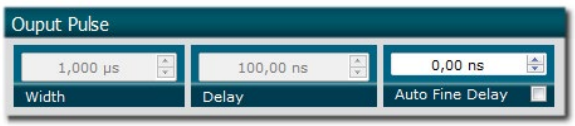


- Working Mode window :
  - Set the **Board** On
  - Set the **Shaper** button to **Off**
  - Set the **Inverse** button to **Off** unless you need to invert the output signal
  - Set **Advanced Mode** to **Pick**

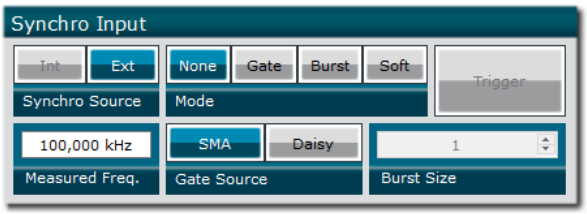
- Input pulse window :
  - Configure the **Threshold** voltage so that the 10 MHz input **frequency** is well detected.
  - Set the input pulse **Source** to **Direct**



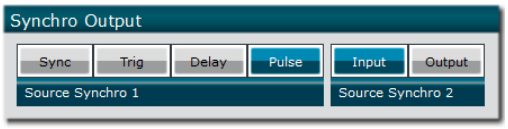
- Output Pulse window :
  - Choose the output **delay value**
  - Choose the output **pulse width**
  - **Auto Fine Delay** may be let in auto mode



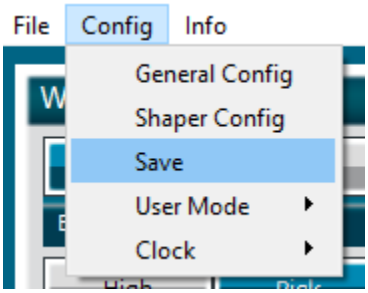
- Synchro input windows (default settings) :
  - Source : Ext
  - Gate Mode : None
  - Frequency : read the external source



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



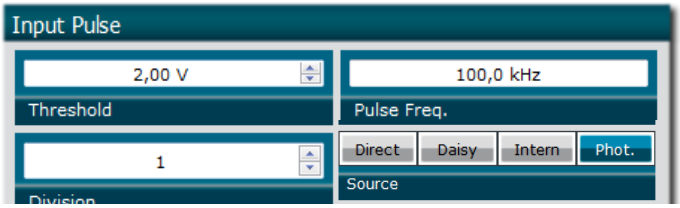
Don't forget to save the settings by clicking on the "Save" button in the bar menu.



6.11. How to use the photodiode input

The photodiode have the same role as the "Pulse In" input, by converting an optical pulse into an electrical one.
To use it, connect a LASER fiber to the photodiode (The signal must be below10mW of average power, make sure the connector is clean)

In the user interface, in the "Input pulse" section, select "Phot.". Adjust the trigger level in the same section until the TOMBAK triggers correctly (Frequency read = optical pulse frequency). You can now use this signal as you would a "Pulse In" signal.



6.12. How to adjust the pulse out relative delay between two Tombak (stacked or separated) ?

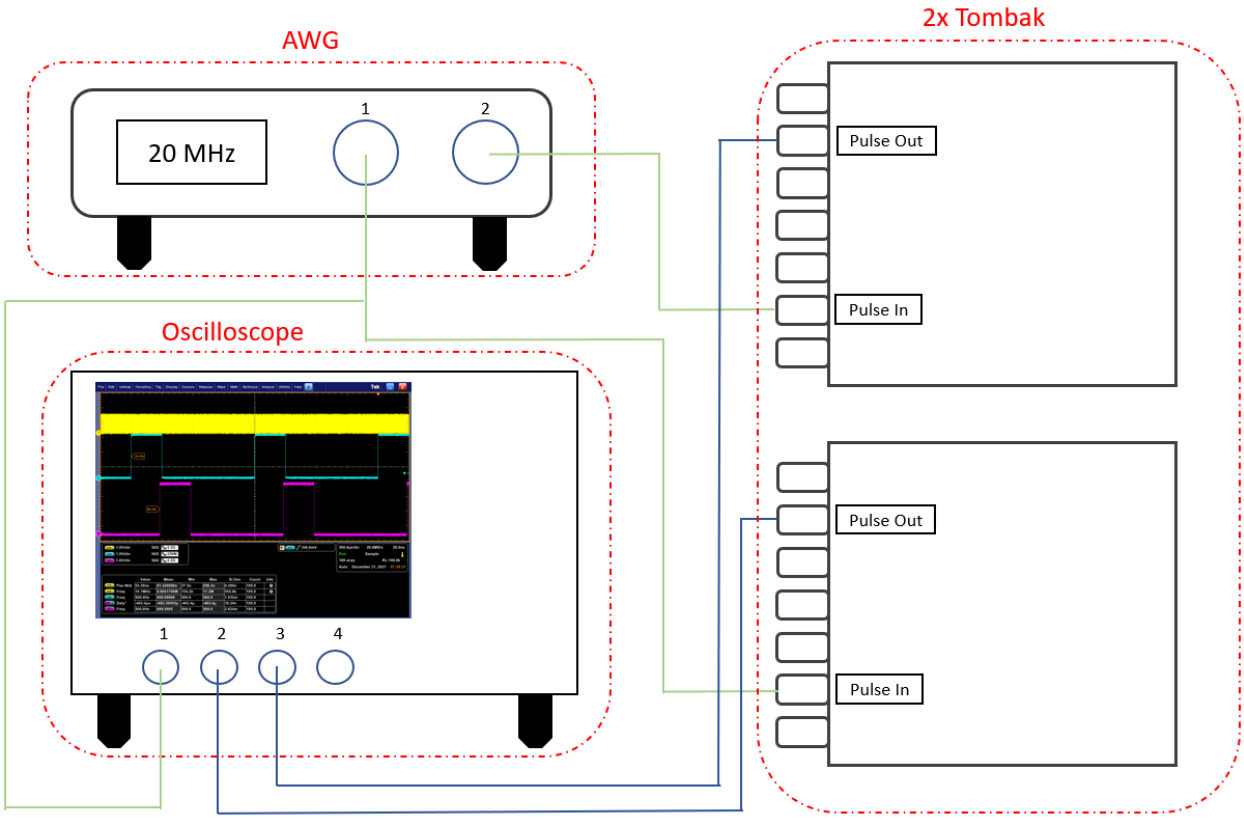
6.12.1. Introduction

When running two Tombak in digital delay or divider mode, a delay is naturally present between the Pulse_Out of stacked Tombak as we can see in the following picture.

Figure 23 : Two non-synchronous pulse out of two Tombak

It is possible to adjust the relative phase between the two signals with a special command.

6.12.2. Cabling



6.12.3. Software configuration

First, you need to determine the delay between the signals. In this example (Figure 22), we can observe a 840 µs delay.

We change the “resynchronization delay” value on the control software.

Note :

The ratio between the delay and the clock period (50 ns here) must be an integer. In this case, we have a 20 MHz clock so the delay can be for example :

Clock Period (ns)	Delay (ns)	Ratio (Delay/Period)
50	50	1
	300	6
	18000	360

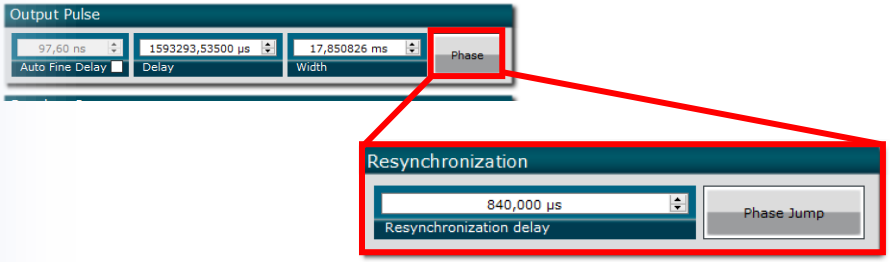
But you cannot set this kind of delay, the ratio will not be an integer :

Clock Period (ns)	Delay (ns)	Ratio (Delay/Period)
50	5	0,1
	156	3,12
	1663	33,26

The software will adjust automatically your delay if you do not respect that step.

The “Jump phase” button will apply the delay on the signal.

In our example, we just enter 840 µs and the 2 signals are now synchronized. You may have to adjust the delay several times before the signals are synchronized.



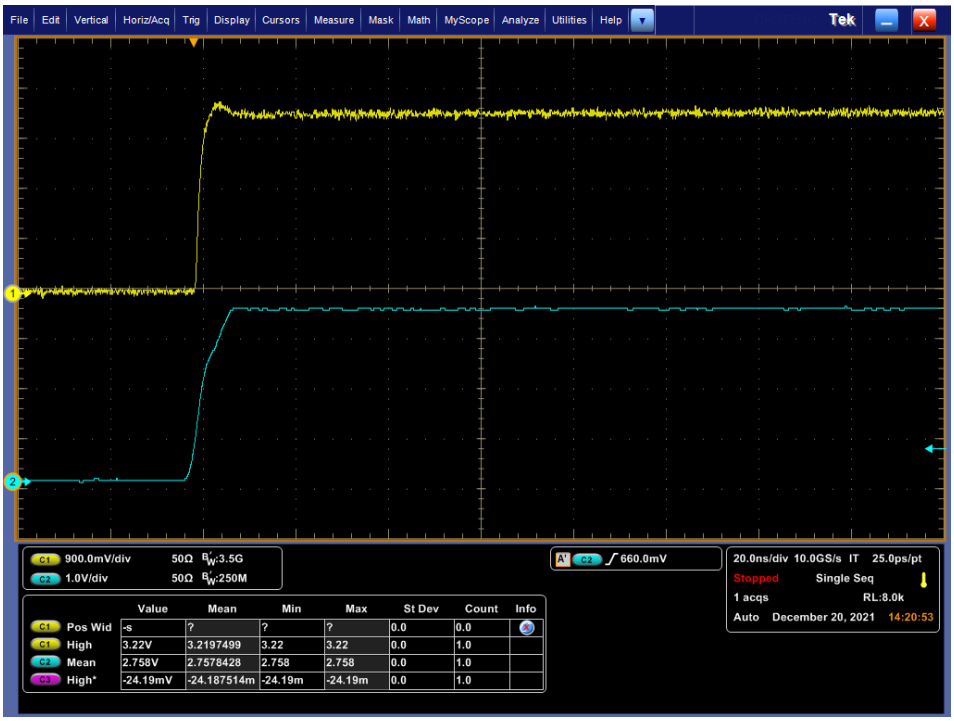


Figure 24 : Signals synchronized

7. Technical Specifications

7.1. General Data

Length	105	mm
Width	100	mm
Height	30	mm
Weight	210	g
Power connector (Jack, positive tip)	9	mm
Power supply (DC)(CE)	5V / 2A	

7.2. Detailed data

TOMBAK	Min	Max
Operating temperature	+15°C	+40°C
Storage temperature	-20°C	+70°C
Operating Altitude	_	2000m

7.3. Outputs/Inputs detailed specifications

7.3.1. SMA connectors

Connector	Input voltage (V)	Output voltage (V)	Frequency (Hz)	Impedance (Ω)
Shape OUT	na	0 - 1 / 0 - 5	$1.82x10^{-4} – 20x10^{6}$	50
Pulse OUT	na	1 / 3.3 /5	$1.82x10^{-4}$ - $20x10^{6}$ ($150 x10^{6}$)*	50
Sync OUT 1	na	3.3	$1.82x10^{-4}$ - $20x10^{6}$	50
Sync OUT 2	na	3.3	$1.82x10^{-4}$ - 20	50
Sync EXT	3.3 / 5	na	$0 - 20x10^{6}$	50
Pulse IN	0.03 - 3.3	na	$0 - 200x10^{6}$	50
Gate IN	0.3 – 0.8 / 1.7 – 3.3 (mode dependent)	na	$0 - 20x10^{6}$	50

*Maximum frequency for the digital delay generator

7.3.2. MOLEX connectors (KK)

Connector	Input voltage (V)	Output voltage (V)	Frequency (Hz)	Impedance (Ω)
Sync EXT	3.3 / 5	na	0 - $20x10^6$	50
Shape select	3.3	na	na	50

7.3.3. Photodiode (optional)

Photodiode (optional)	min/max Input power (W)	Frequency (Hz)	Wavelength range (nm)	connector
InGas	$2x10^{-6}$ / 10mW	0 - $200x10^6$	800 - 1700	FC/PC or APC
Silicium	$2x10^{-6}$ / 10mW	0 - $200x10^6$	300 - 1100	FC/PC or APC