Signal generator

Users manual

Version 5,0

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INTRODUCTION

Signal generator is a program written in LabView graphical language version 5.1. The aim of the program is to give the user the opportunity to design and generate analogue signals for control of external devices or for stimulation.

The program can generate any kind of signals with any length. Using a second output channel the program can by sending different analogue signal (0 or 5 volts) mark up to ten different events in the first signal profile.

For the program to function properly a Digital Analogue board or an Analogue Digital board with at least two output channel from National Instruments (AT-AO-6/10, Lab-PC-1200, AT-MIO-16E-1, AT-MIO-64E-3) is needed.

START

When the program is started the first information needed is the device number.

A window will open for input of the device number.
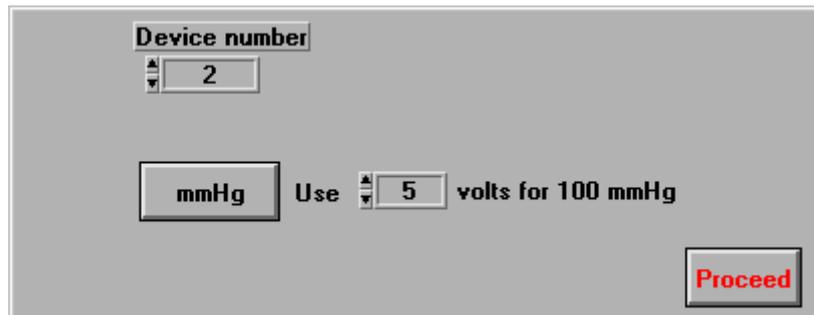
Type the device number used in your computer.

You have the choice to work with volts or with mmHg. In the later case you have to give the value in volts needed for your system to produce a pressure of 100 mmHg. In the CRD system this value is 5 volts.

Click on the "Proceed" button.

A "File management window" will be opened and will ask for the name of the file to save the generated data. All the generated signals will be saved in this file. This file is of interest if a documentation of all generated signals is of importance. If an existing file is chosen the program will append the new generated file to the old ones. By this way all the generated signals in a series of experiments can be documented with time and date stamp.
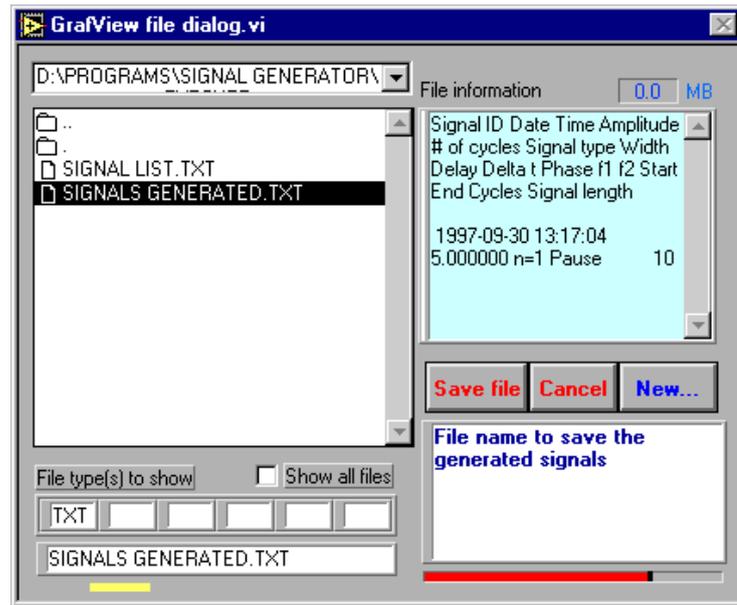
Type a name for the file and click on the "Save file" button two times.

After choosing the file the main signal generator window will be opened.
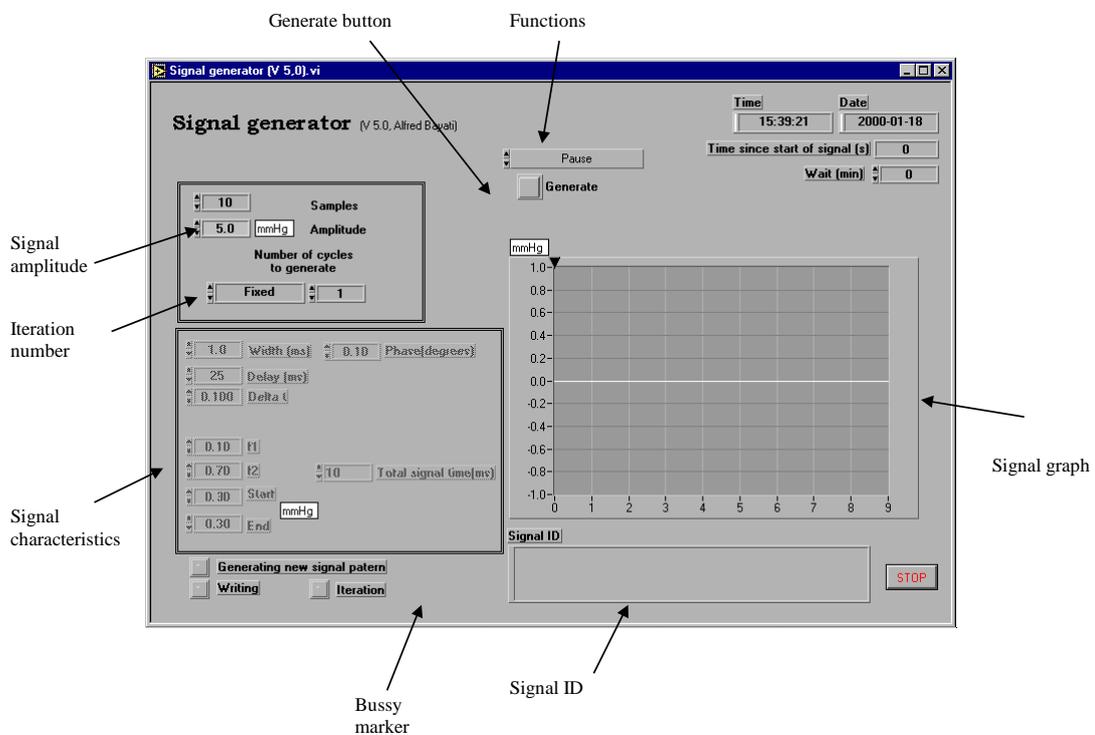
The signals can be generated in two different ways:

DIRECT SIGNAL GENERATION

This the easiest and fastest way to generate a signal.

Click on the "Functions" button.

A list of different available signals will be shown. The available signals are:
Sine pattern, Pulse pattern, Impulse pattern, Ramp pattern, Sinc pattern and Chirp pattern.

Chose "pulse pattern"

Two of the variable in the "Signal characteristics" area will be activated.
When ever you chose a function from "Functions" list the appropriate variable/s needed for the chosen function will be activated.
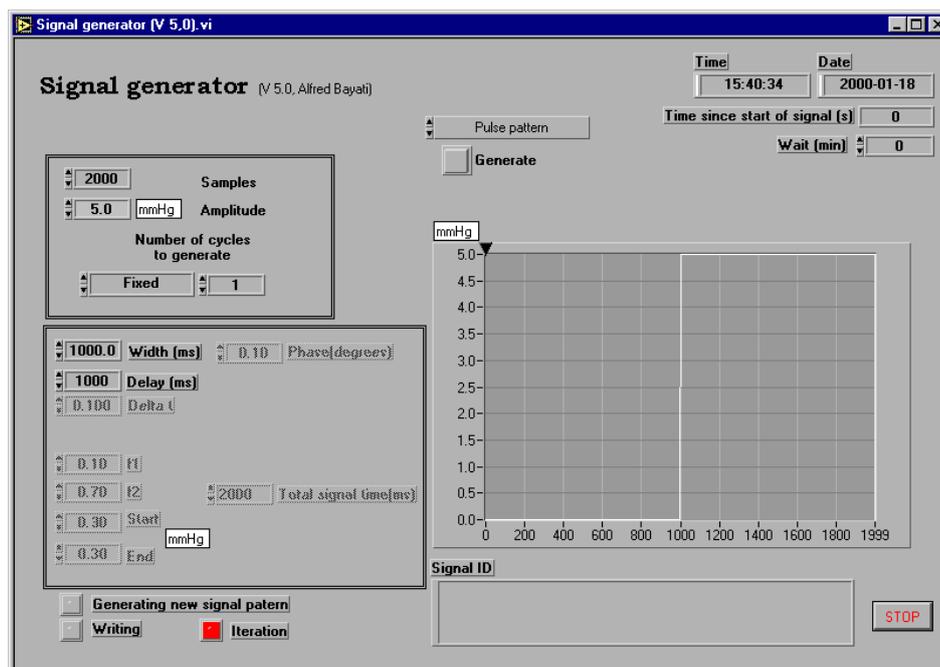
Type the "Width" and "Delay" in milliseconds that you want the pulse to have. Look in the "Signal graph". A graph representing your signal is now seen in this area. This will be the signal generated.

The signal can be generated once, a defined number of times, continuously or a defined number of seconds.
Click on the (Iteration number) and chose one of the possibilities. Change the number of iteration if you have chosen "Fixed" or type the number of seconds if you have chosen (Time).

In this example the signal will be a pulse with 1000 milliseconds delay and a width of 1000 milliseconds and an amplitude of 5 mmHg. The signal will be generated once.

When generated this signal will be saved in the file opened by the user at the start of the program. You can, if you want, give an ID to the signal. This ID can be any text written in the "Signal ID" box.

Click on the "Generate" button

A Red button with the text "Busy" will be visible in the "Busy marker" area during the signal generation.

Chose different functions and experiment by changing the appropriate parameters.

SIGNAL CONSTRUCTION

This is a more complicated way of generating signals. Here the user have the possibility to generate patterns which can be from a few milliseconds to hours with many different functions. Also it is possible to insert up to 10 different markers which through a second channel can generate either zero or 5 Volt signal marking events.
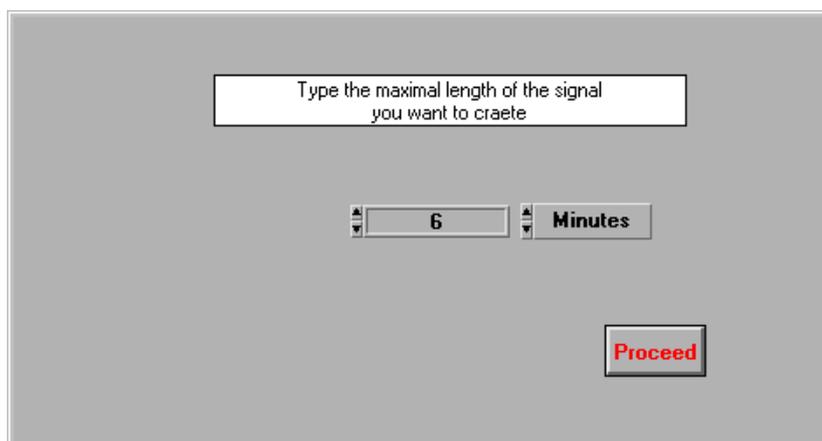
From the "Functions" list chose "Construct"

The first parameter needed is the total length of the signal you want to generate. The time can be mSeconds, Seconds, minutes or hours. The default value is 1000 mSeconds.

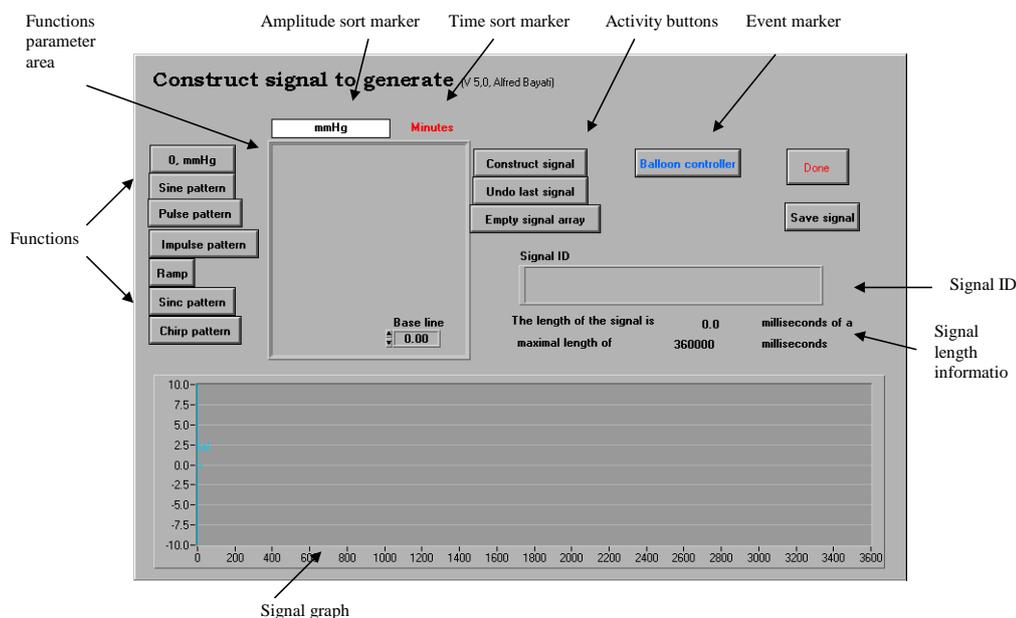*Double click on the time value and type 6.*
From the "Time sort" list chose "minutes"

The window should look like the figure bellow.

Click on the "Proceed" button
 The window will be closed and you will be in the main signal construction window.

Signal graph

A working scenario

We want to inflate a balloon (Distal) during 30 seconds up to a pressure of 50 mmHg. One minute after this another balloon (Proximal) should be inflated to 80 mmHg 4 times 15 seconds each with 15 seconds between two inflation. One minute after the 4X80 mmHg signals the first balloon (Distal) should be inflated again for 45 seconds up to 50 mmHg. The pressure pump gives a pressure of 100 mmHg with an activation voltage of 5 Volts. The air flow from the pump can be directed into two different balloons using an electrical valve with an activation voltage of 5 Volts.

We will try to solve this problem using the construction function.

If you remember we have chosen a total signal length of 6 minutes i.e. 360 seconds.
The signal we need is 315 seconds. This gives us 45 seconds which we can put at the beginning and the end of the constructed signal. Generally it is a good idea to construct somewhat longer signal than what you need and put some Zero signal in the beginning and the end of the signal. We will put 30 seconds before and 15 seconds after the signal.
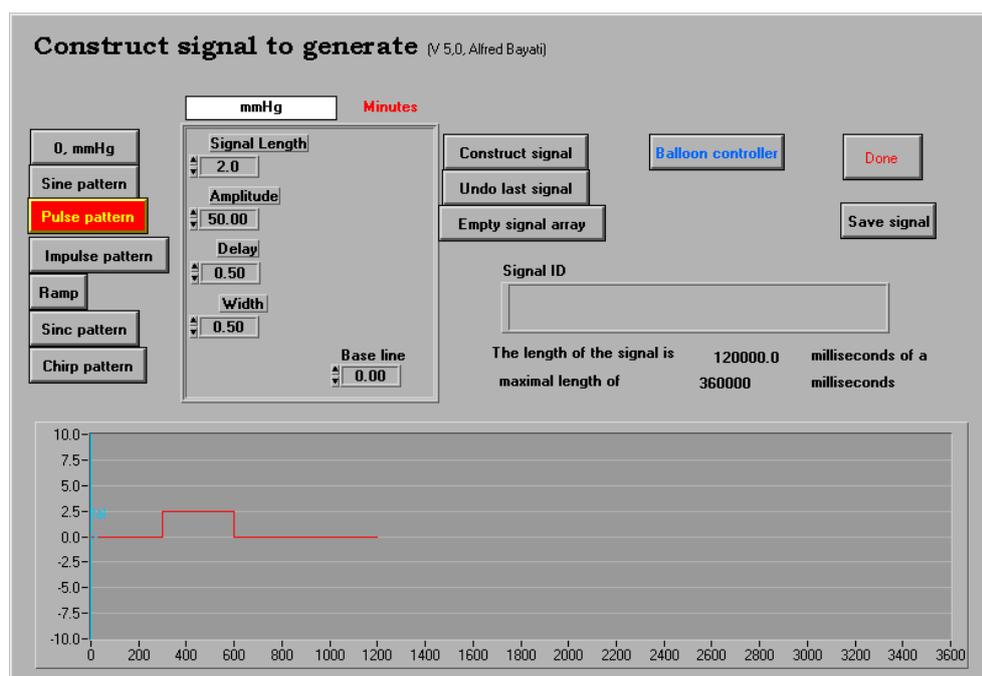
Construct the signal

In the "Functions" click on the "Pulse pattern"
Signal generator (V 5,0)/Astra Hässle/AIB

The button will start blinking and a number of variables will be visible in the "Function parameter area".

Change "Signal length" to 2, "Amplitude" to 50, "Delay to 0.5 and "Width to 0.5
Click on the "Construct signal" button
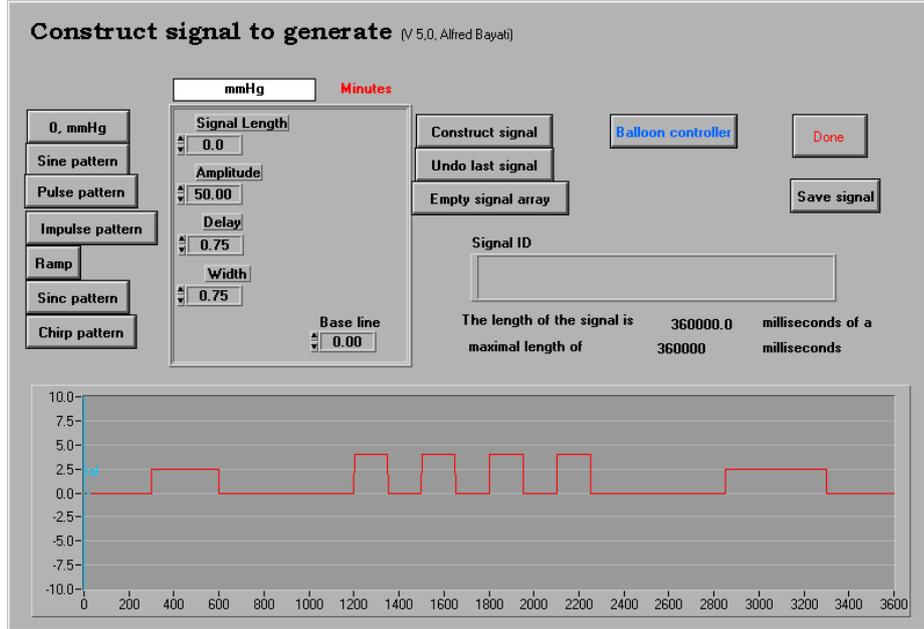
The screen should look like the figure bellow.

The "Base line" value in this case is equal to zero. This means that when the signal is off the voltage generated will be zero. This value can be between zero and 10. If a value of 1 is chosen when the signal is off the voltage generated will be 1.

In the beginning of the "Construct" program we chose 6 minutes. This will put the program in a "Minute mode" that means that all the parameter that we type will be interpreted as minutes i.e. 0.5 minutes, 2 minutes etc. However, if we had chosen 360 seconds in the beginning of the program i.e. the same signal length the program would be in a "Seconds mode" that is all the values would have been interpreted as seconds. In the same way we have chosen mmHg instead of volts.

In our scenario we have chosen a pulse signal with a length of 2 minutes. The amplitude of the signal is set to 50 mmHg. The signal has a delay of 0.5 minute and a width of 0.5 minute. If you add the "Width" and "Delay" values it should not be longer than the "Signal length", if it is, the program will generate an Error and will inform the user about that. However, the sum of "Width" and "Delay" can be less than the "Signal length", if so, the program will fill the rest of the "Signal length" with the value given as "Base line".

Change the "Signal length" to 0.5, "Amplitude" to 80, "Width" to 0.25, "Delay" to 0.0 and click on the "Construct" button 4 times

Signal generator (V 5,0)/Astra Hässle/AIB

The screen should look like the figure bellow.

In order to construct another pulse we did not need to click on the "Pulse" button a second time.
If you click on the "Construct signal" button more than once the signal will be repeated.

In this case we have chosen a value of 0.5 minutes for the "Signal length" i.e. 30 seconds, with a "Delay" of zero seconds and a "Width" of 15 seconds.

Change the "Signal length to 2, "Amplitude" to 50, "Delay" to 0.75, "Width" to 0.75 and click on the "Construct signal" button

The screen should look like the figure bellow.

Signal generator (V 5,0)/Astra Hässle/AIB
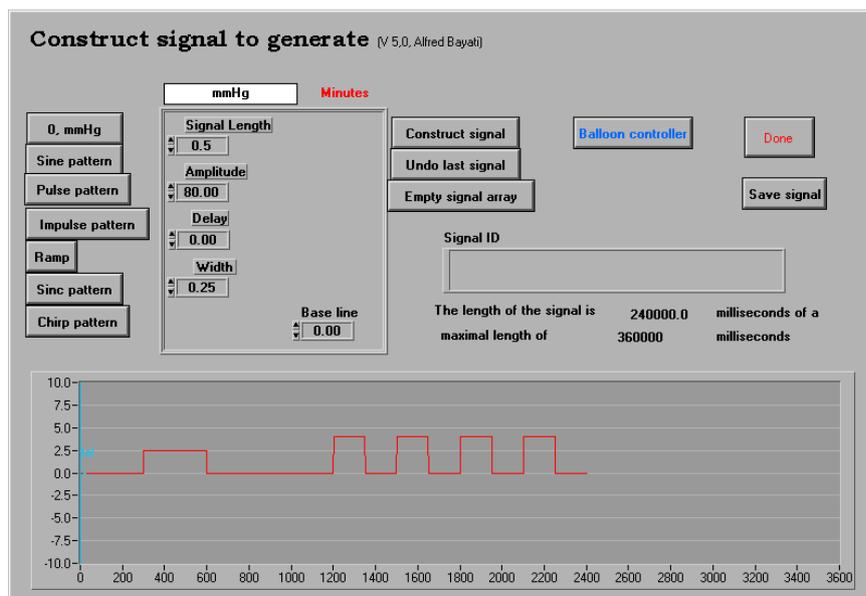
As soon as you click on the "Construct signal" button the "Signal length" will be changed to zero. The reason for this is that this value is an active variable, that is, it will always be less than the total length of the signal left to construct. If the total signal length chosen is 10 seconds and you type 20 seconds as "Signal length" the program will generate an error decreasing the value to 10 seconds. In this case the total signal length is filled as can be seen in the "Signal length information" area. This will force the "Signal length" value to be changed to zero.

Add markers to the signal

We have now constructed the signal needed for our scenario. We will now generate the markers to direct the air flow from the pump to the distal or proximal balloon.

Click on the "Balloon controller" button

The screen should look like the figure bellow
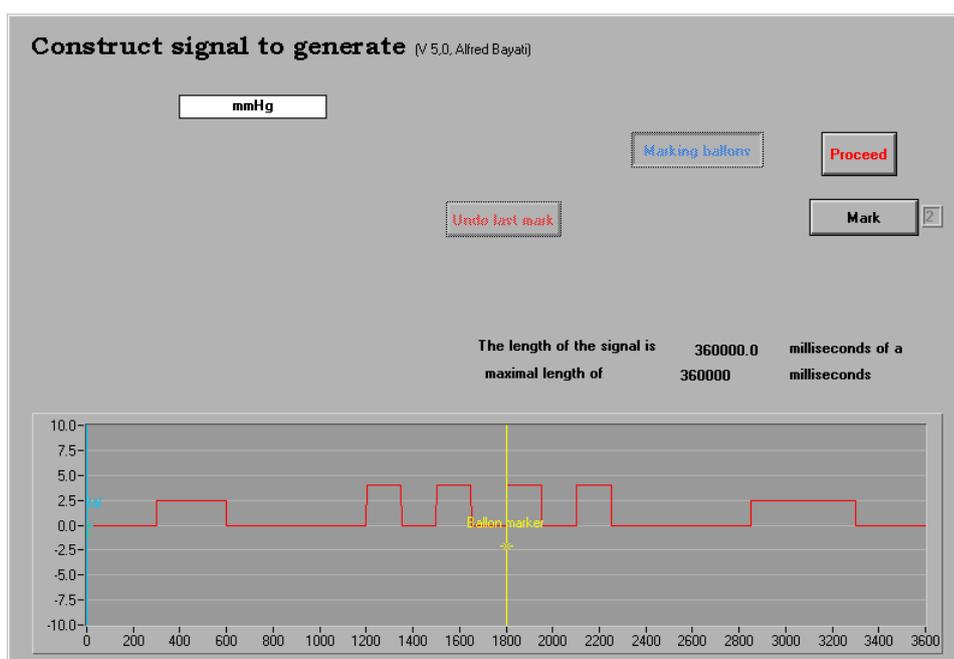
In all the signals constructed the program will automatically put a marker at the start of the signal directing the air to the distal balloon. If you then do not put any markings in the constructed file the air flow will be directed towards the distal balloon which will simulate a one balloon system.

According to the scenario the first pulse should go to the distal balloon so we do not need to change the first marking.
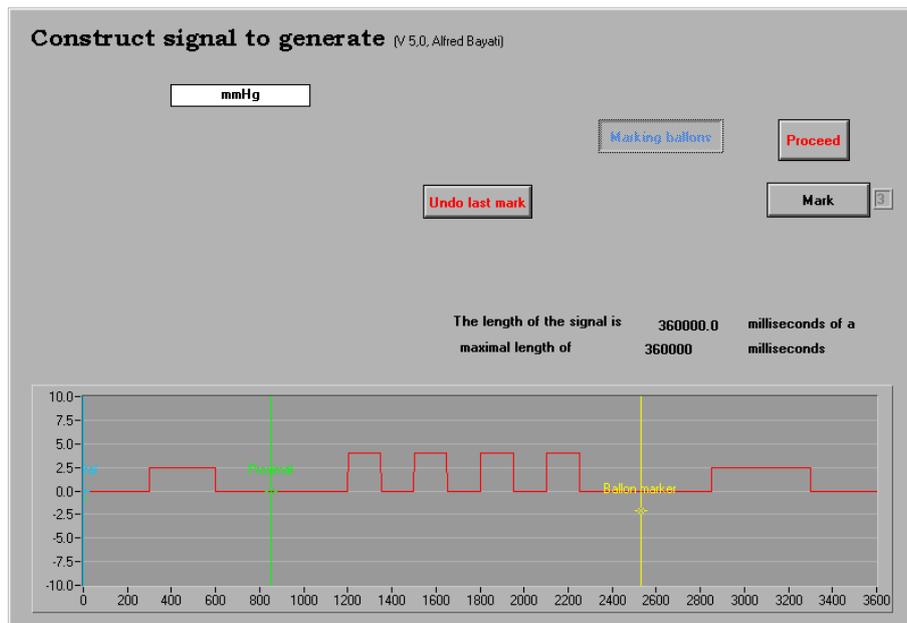
Move the yellow cursor and put it after the first pulse, as shown in the figure bellow and click on the "Mark" button.
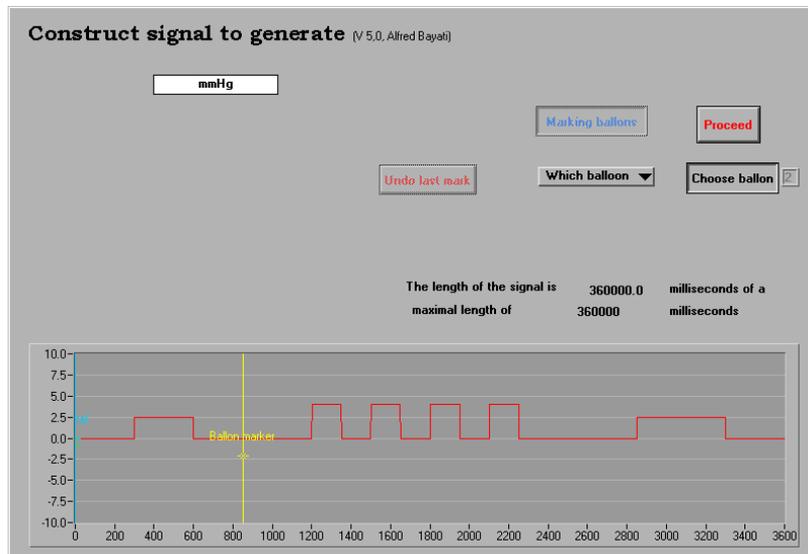
A new button "Which balloon" will be visible and the "Mark" balloon will change to "Chose balloon".

Click on the "Which balloon" button and chose Proximal. Move the yellow cursor to se the new marker.

A new green cursor with the text "proximal" will be visible under the yellow cursor as shown in the figure bellow.

Move the yellow cursor and position it after the 4 narrow pulses before the last pulse. Click on the "Mark" button, click on the "Which balloon" button and chose "distal". Move the yellow cursor to se the new marker.

A new blue cursor with the text distal will be visible under the yellow cursor. Move the yellow cursor. The screen should look like the figure bellow.
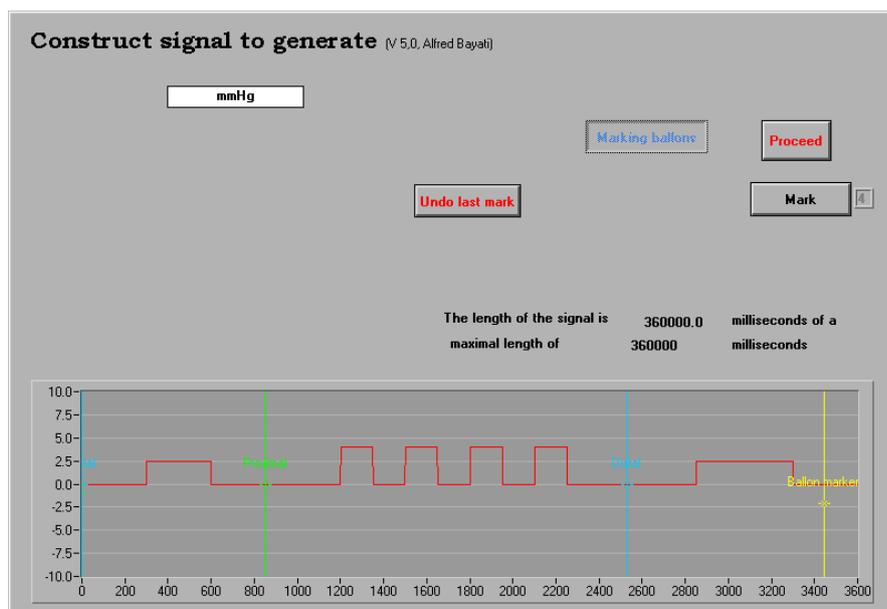
We have inserted two markers in the signal. As it was mentioned the program will automatically insert a distal cursor at the beginning of the signal. This means that all the signals after this cursor should influence the distal balloon. i.e. the first pulse inflates the distal balloon.

After the first pulse a "Proximal" marker is inserted into the signal. This means that all the signals after this marker should inflate the proximal balloon. i.e. the four narrow pulses will inflate the proximal balloon.

Another marker is inserted after the four narrow pulses with the text "Distal". This means that all the signals after this marker should inflate the distal balloon i.e. the last pulse will inflate the distal balloon.

This will complete the construction of the signal and will produce the signals needed to the two balloons as described in the scenario.

Click on the "Proceed" button

This will get you back to the main signal construction window.
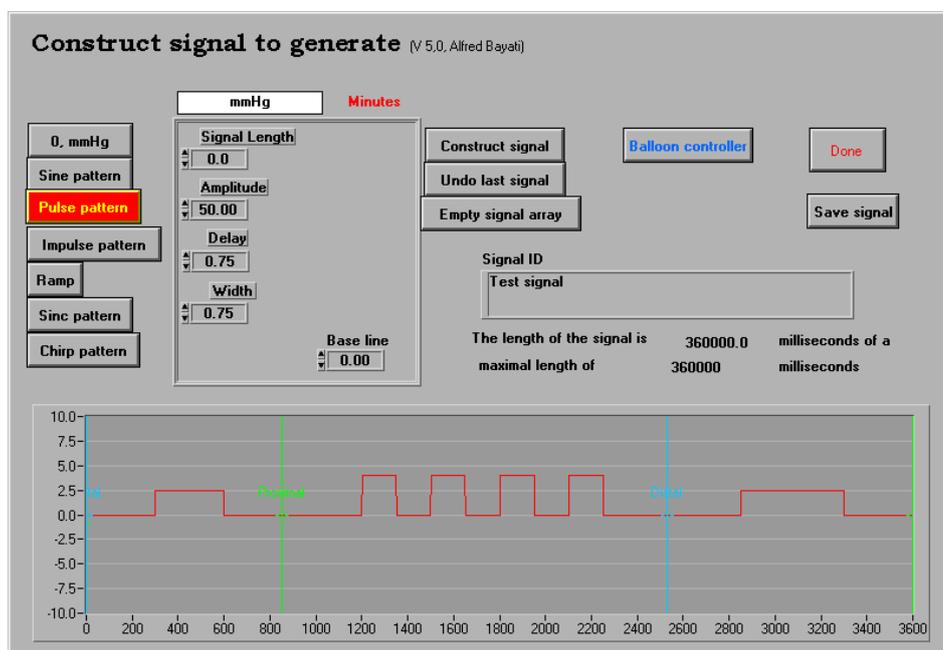
SAVE THE SIGNAL

The constructed signal can be saved in a file for later use. Type an ID for the signal in the "ID box" and click on the "Save signal" button. A "File manager window" will be opened. Type a name and click on the "Save file" button two times. If you chose an existing file the program will append the new constructed signal to that file. A file can contain unlimited number of constructed signals.
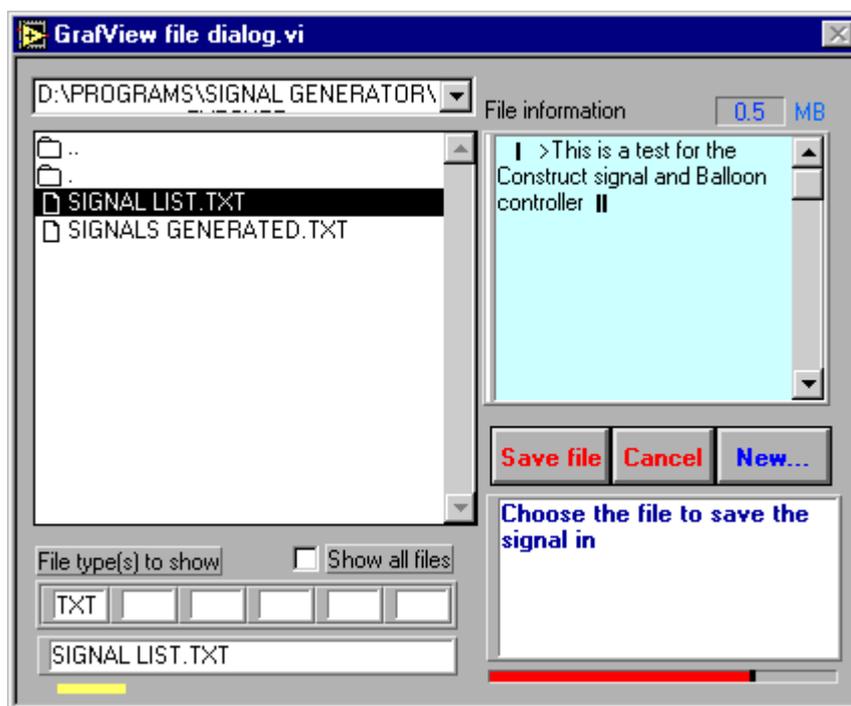
It is important to mention that this file is different from the first file which was opened at the beginning of the program. The first file is a file containing all the **GENERATED** signals while this file contains all the **CONSTRUCTED** signals.

Click on the "Done" button

The window will be closed and you will be back in the main signal generator window. You can know click on the "Generate" button to start generating the signal

WAIT

Signal generation can be delayed and repeated after a pause period using this function.

By giving a value of 100 to "Wait (min)" variable you can force the program to start generation of the signal 100 minutes after you have pushed the ""Generate" button. If you combine this function with "Iteration number" the signal will then automatically will be regenerated 100 minutes later. This process will be continued until you stop the process by choosing pause from the "Functions" button.
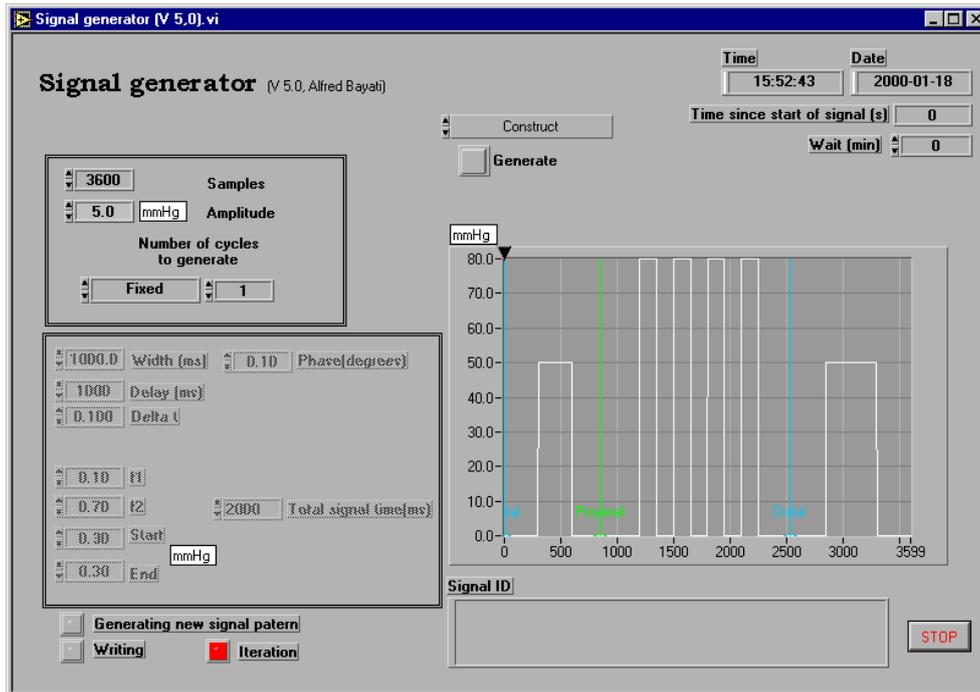
READ AN OLD SIGNAL

The signal that you have constructed and saved can be recalled from the file.

Click on the "Functions" and chose "Pause"
The "Signal graph" area should contain a straight horizontal line at zero.
Click on the "Functions" and chose "Signal list"
A "File management window" will be opened. Find and chose the file name you used for saving the signal.

Click on the "Open file" button.
Click once more on the "Functions" button and chose "Signal list" a second time

The screen should know look like the figure bellow
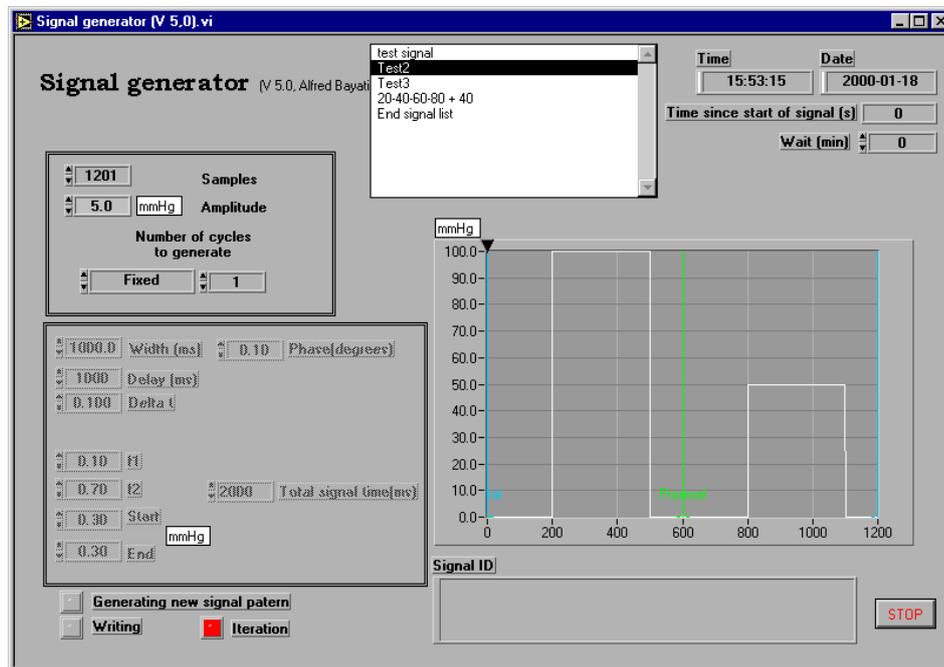
The first time you chose "Signal list" the program will only read the file and will not show it. The second time you chose "Signal list" the list will be shown.

If you have saved more than one signal in the file you can then chose between the signals. Each time you chose a signal from the list the "Signal graph" area will be updated with the new signal. To generate the signal click on the "Generate" button.
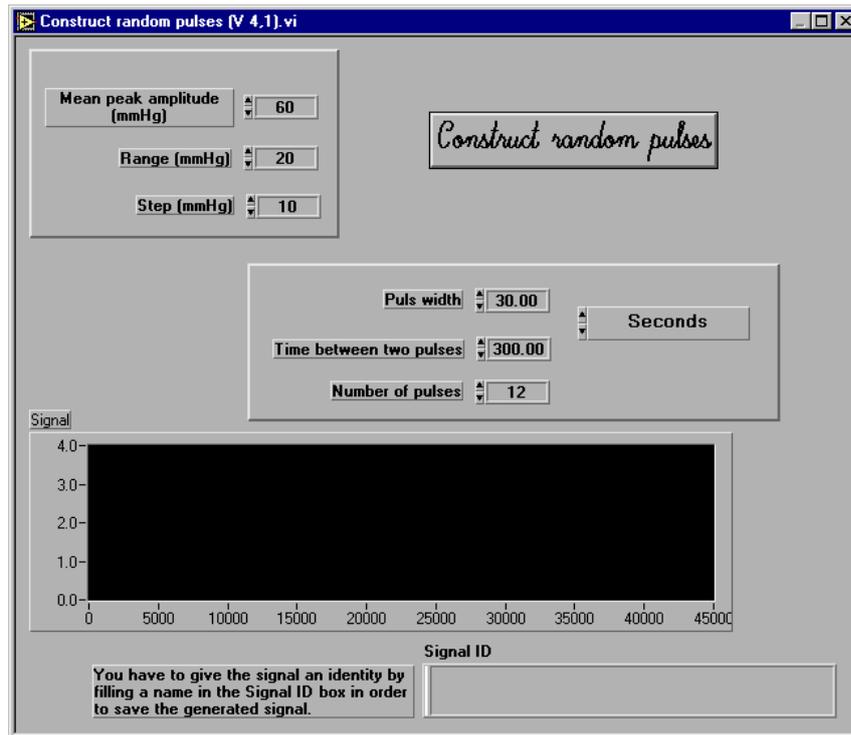
GENERATE RANDOM PULSES

Signal generator is capable to generate random pulse signals.

Click on the "End signal list"

Click on the "Functions" and chose "Generate random pulses"

A new window will open as shown bellow.

Type in the parameters to use and click on the "Construct random pulses" button. The program will know generate a random pulse series correspondent to the initial parameters you have filled in and will go back to the main window, as shown bellow.
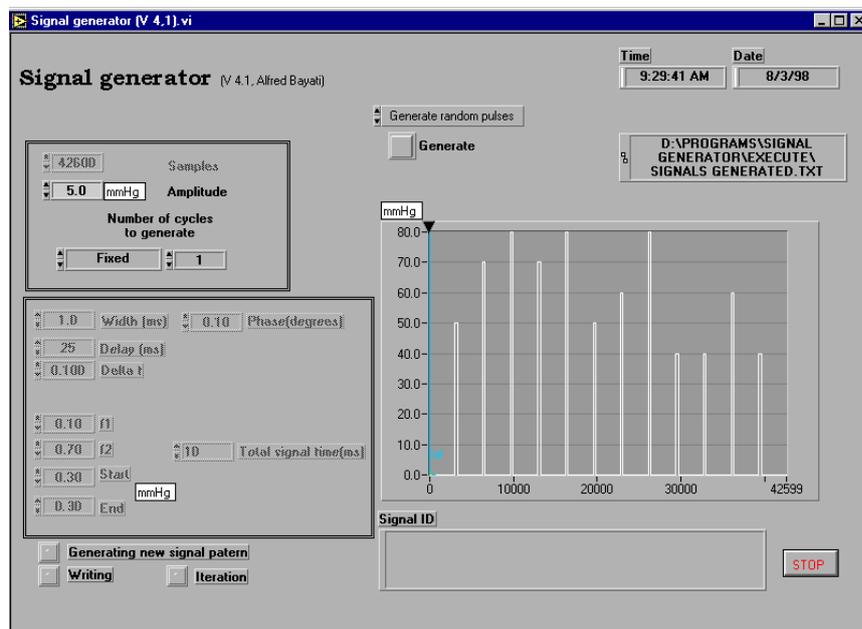
Click on the "Stop" button to quit the program.

END

END