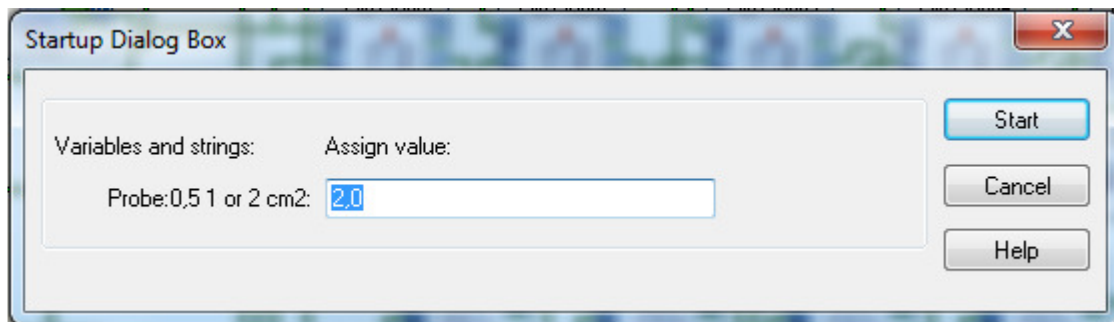


## 1. Starting the program

In order to start the control software for the APA device press “APAxX” shortcut located on the desktop of the supplied computer. XX corresponds to the current software version.

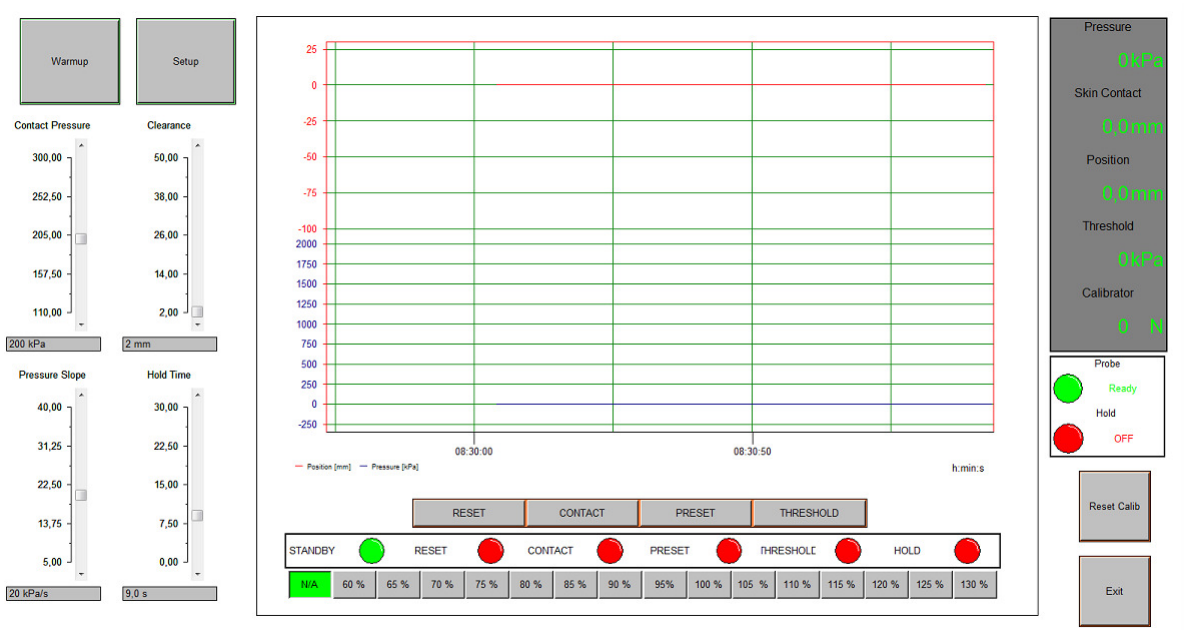
When asked to fill in the area of the probe write one of the values 0,5; 1 or 2. This value should correspond to the area of currently attached probe in cm<sup>2</sup>. Use a comma as the decimal sign.



After filling out the probe area proceed to the control program by pressing the “Start”-button.

## 2. User Interface

When the program starts the control panel will be displayed. At the same time the probe is reset to its starting position, the calibrator is reset as well as internal calculations. The control panel, directly after the start of the program, will have a look as displayed below.



Each of the fields on the panel is further discussed below.

## 2.1 Setup and settings

In this part of the panel the user can adjust the measurement and stimulation settings as well as run the Warmup routine. The calibration values for the system can be changed in the Setup menu. However this should not be required except when the maintenance is performed.

- Warmup

Runs the warm up routine. Should be run before the stimulations start in order to get the most accurate stimulation and measurement results. Do not hesitate to run the routine several times if the APA system has not been in use a longer period of time.

- Setup

Toggles to the setup screen where calibration parameters are set and internal data is displayed. The setup screen is further discussed in 2.5.

- Contact Pressure

The pressure that the probe applies during “Contact” and “Hold” instructions before and just when contact with skin is made.

- Clearance

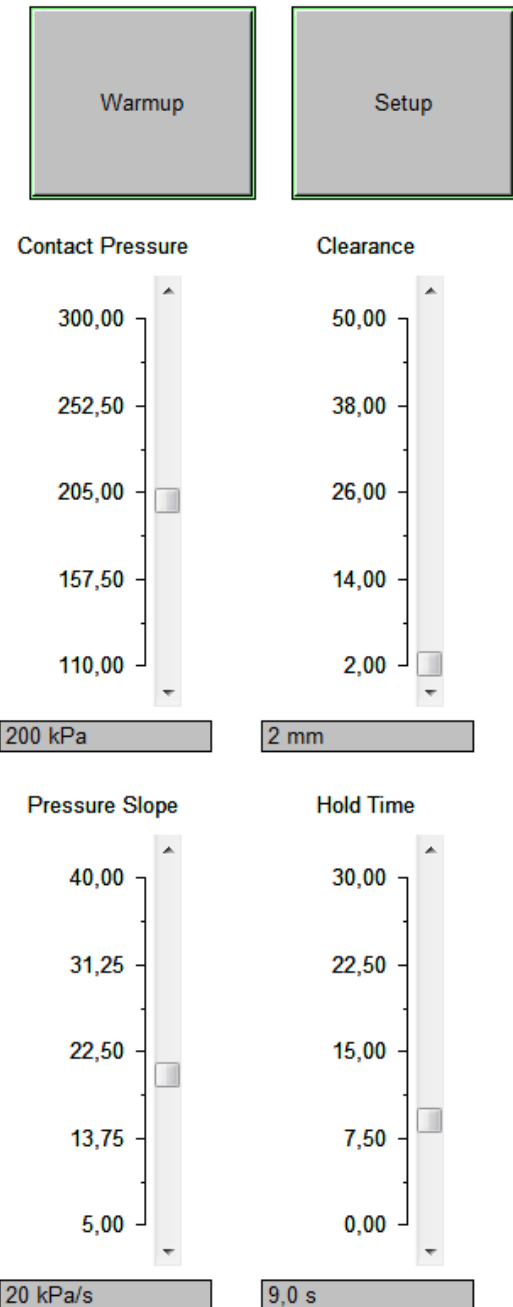
The distance between the probe and skin after “Preset” instruction is performed.

- Pressure Slope

The speed of pressure increase after the “Threshold” instruction is performed.

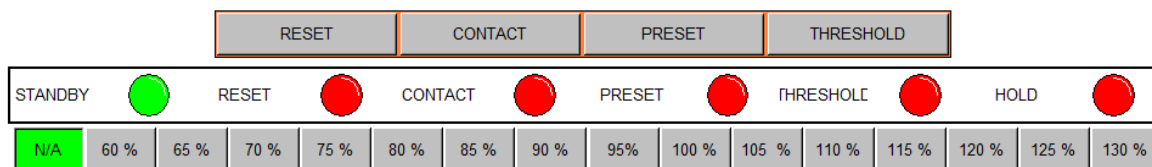
- Hold Time

The amount of time the pressure is applied during the “Hold” instruction. The timer starts running when the probe reaches the skin.



## 2.2 Control buttons and Current action display

In this part of the control panel user selects what instructions to run and can survey the process while an instruction is being executed.



- Reset

Resets the probe to the upper position and cancels other instructions. The instruction can be triggered in three ways: through pushing the button on the control panel, through patient response ball and from an external machine using the D-SUB connector.

If an instruction needs to be cancelled, the patient experiences discomfort or pain due to, for example, study of pain threshold, or APA displays unexpected behaviour – the reset instruction should be run.

- Contact

Starting from its current position the probe is lowered until contact with skin is made. When contact is made the distance travelled is saved and the probe returns to starting position.

- Preset

The probe is lowered towards the skin, but stops when clearance distance remains until contact. The clearance can be set using a slider scale in settings.

- Threshold

Continuously increases the pressure that the probe applies with a speed as selected through “Pressure Slope” slider scale in setting. When the desired threshold is reached, the instruction should be interrupted, for example, using the patient response ball. The maximal applied pressure is then saved.

- N/A, 60% - 130%

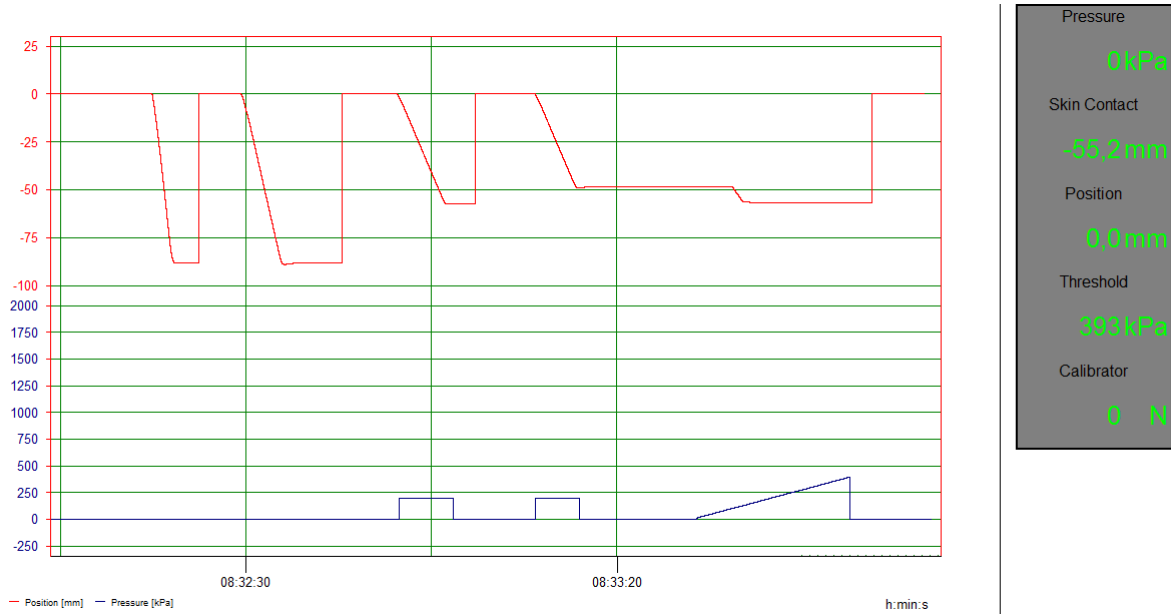
If a threshold pressure is available select one of the buttons 60%-130% to apply corresponding percent of the measured threshold. The probe starts with lowering down to the surface of the skin, then the selected pressure is applied for the time selected through “Hold Time” slider scale in settings.

- Current action indicators

Current instruction being performed is indicated through a green light being lit to the right of the instruction text. The instruction texts are Standby, Reset, Contact, Preset, Threshold and Hold.

## 2.3 Displays

The results and stimulation history are found in this part of the control panel.



- Graph

In the graph the probe position is displayed in red (mm) and pressure applied by the probe is displayed in blue (kPa). The graph is continuously updated with latest movements and applied pressures. Note that the position is accurately updated on the way down, the movement back to start position is not of interest and is displayed as a vertical step.

- Measurement Values

**Pressure:** The current pressure applied by the probe.

**Skin Contact:** The distance at which contact with skin was made during latest “Contact” instruction.

**Position:** The current position of the probe.

**Threshold:** The latest threshold value acquired through “Threshold” instruction.

**Calibrator:** The force currently applied to the surface of the calibrator device.

## 2.4 Status displays and buttons

This part of the control panel displays current status of the APA device and provides buttons to manipulate the state of the program.

- Status Lights

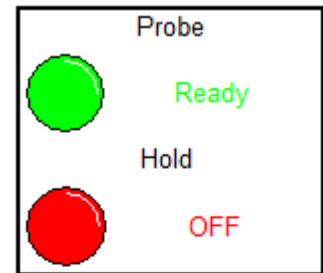
**Probe status light** is either Green/Ready or Red/Busy and indicates if the APA device is ready to receive next instruction through button push or externally through D-SUB connector.

**Hold status light** is either Green/On or Red/Off. During “Hold” instruction it indicates if the probe has found the skin surface and is currently applying the selected pressure.

- Exit and Reset Calib Buttons

**Reset Calib:** Sets Calibrator value to zero in the Measurement Values. This can be utilized to set alternative baseline or reset calibrator after a significant force was applied.

**Exit:** Moves the probe to its starting position, stops measurement and closes the program, then returning to the Windows desktop.



## 2.5 Setup Screen

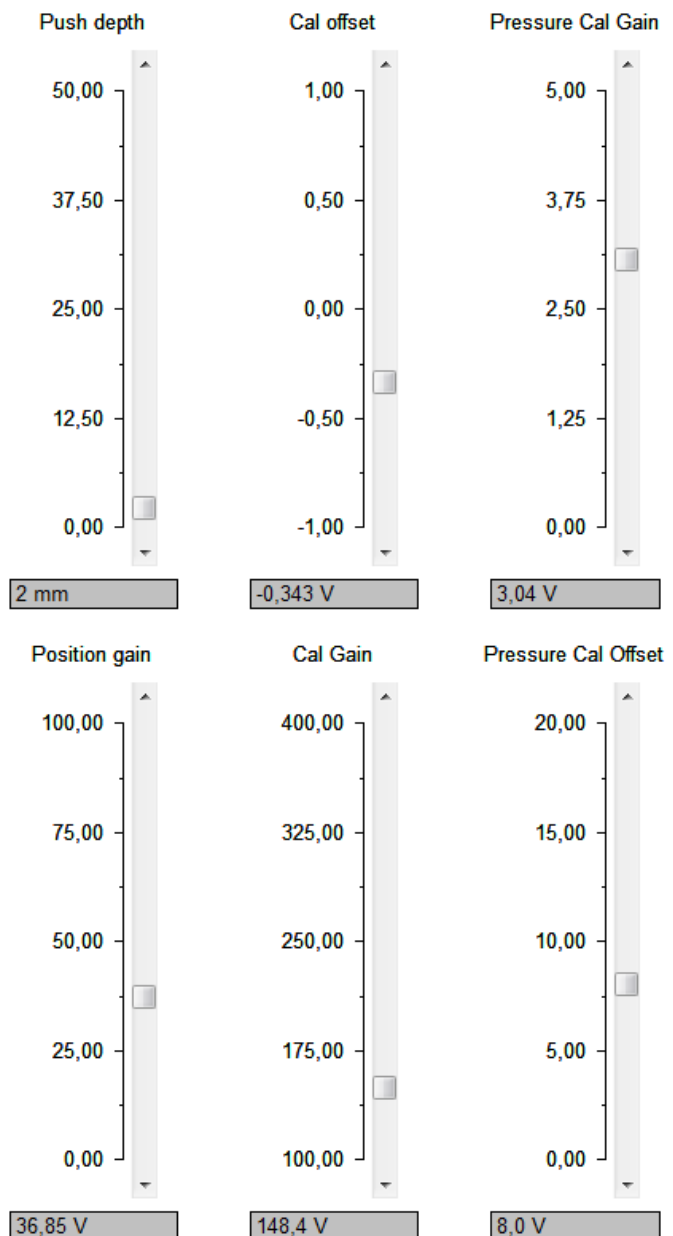
Setup screen is used to calibrate the APA device and control its functionality. The user is advised to change only the “Push Depth” parameter, if needed. Other parameters are changed only during calibration of the device, which requires in-depth understanding of its function.

- Push depth

A parameter that should be set depending on how soft the skin and underlying tissues are in order to adjust the positioning during “Preset”. Under normal circumstances 2mm is a good estimation for this parameter. For very soft tissue it might be increased to 5-10mm or even more.

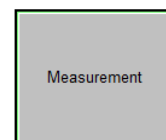
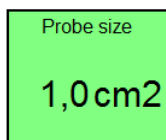
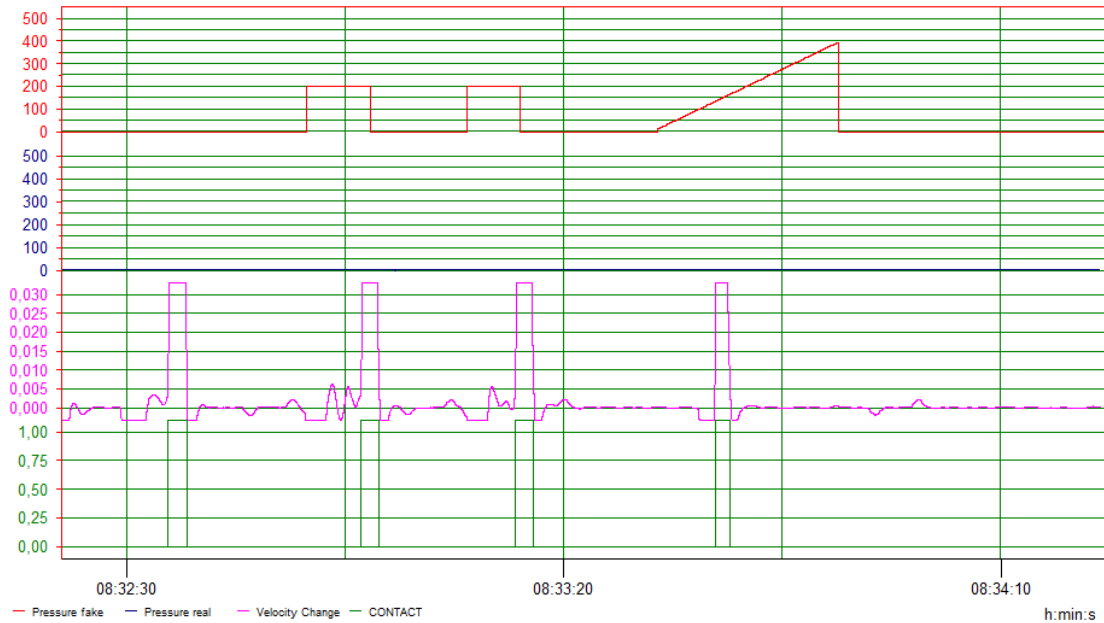
- Offsets and Gains

These parameters are used in order to calibrate the APA software’s internal functions against the calibrator.



The graphs in Setup display are:

- pressure applied by the probe (red, kPa),
- pressure applied to the calibrator by 1cm<sup>2</sup> probe (blue, kPa),
- average velocity of the probe minus current velocity (pink, m/s)
- internal signal indicating skin contact (green).



- Probe Size

Displays what probe size was chosen during the start-up of the program and is currently used for the calculations. If probe is changed, the program must therefore be restarted.

- Measurements

Button that returns user to the control panel.

### 3. Additional Notes

- Usage guidelines not covered by basic instructions

In order to apply small pressures accurately it is beneficial to use the probe with maximal area, i.e. 2cm<sup>2</sup>. When studying pressures below 200-300kPa this option should always be considered.

It is essential that Contact Pressure parameter is lower than applied percentage of the threshold, in other case the initial touch of the probe will surpass the stimulation pressure. This might interfere with the study method and provide incorrect results in terms of the sensation the test subject experiences.

The distance measuring algorithms might produce small errors, if it is essential that the probe should not touch the skin before "Threshold" or "Hold" instructions, select slightly higher Clearance.

If one of the percentage buttons is selected before threshold is found nothing will happen. However in order to proceed it is advised to press the reset button before selecting next instruction.



## 4. Connections to the APA remote control connector:

Connected through a standard 15 pin D-SUB connector. There is a male connector on the APA front, a connecting cable need thus to have a female connector.

Connections:

Pin	Function	Remark
1	Ground	Connected to APA and computer ground through USB port.
2	Preset	Set probe to Preset position.
3	Hold 1	Least significant bit of Remote HOLD command.
4	Hold 2	2 <sup>nd</sup> bit of Remote HOLD command.
5	Hold 4	3 <sup>rd</sup> bit of Remote HOLD command.
6	Hold 8	4 <sup>th</sup> bit of Remote HOLD command.
7	READY	High when OK to give new command, low when probe is active or in WAIT state.
8	+ 5 Volt	From USB interface, use as voltage reference for digital signals.
9	CONTACT	Probe in contact with skin.
10	PPB/RESET	High when PPB not activated. Ground set's APA in RESET state.
11	not used	
12	not used	
13	not used	
14	Ana gnd	Analog ground
15	P OUT	Pressure reference output.

PPB = Patient push-button = The rubber ball for patient response.

Remote HOLD command is constructed from the function  $IF (H1+H2+H3+H4)>0$  then  $HOLD = 55 + (H1*1 + H2*2 + H4*4 + H8*8)*5\%$  of last measured pressure threshold. Else HOLD is set by front panel switches.

Check for READY high before setting a Remote HOLD or PRESET command. Reset the command(s) as READY goes low.

RESET is always possible to set => probe pressure stops and probe returns to retracted position. The same action if PPB is pressed.