UNITEMP
Universal Temperature Processes

Oven-Series

Rapid Thermal Process Oven
Reflow Solder Oven

SPS_Soft

Software for programming SPS based
VPO/VSS/RTP/RSO series

Operation manual

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1. Starting and operation of the SPS Soft software

1.1 Automatic start of controller

After switching on the system (RTP, VPO, RSO, VSS), the SPS module in the control unit and the touch panel are automatically booting. On the touch panel the start screen appears.

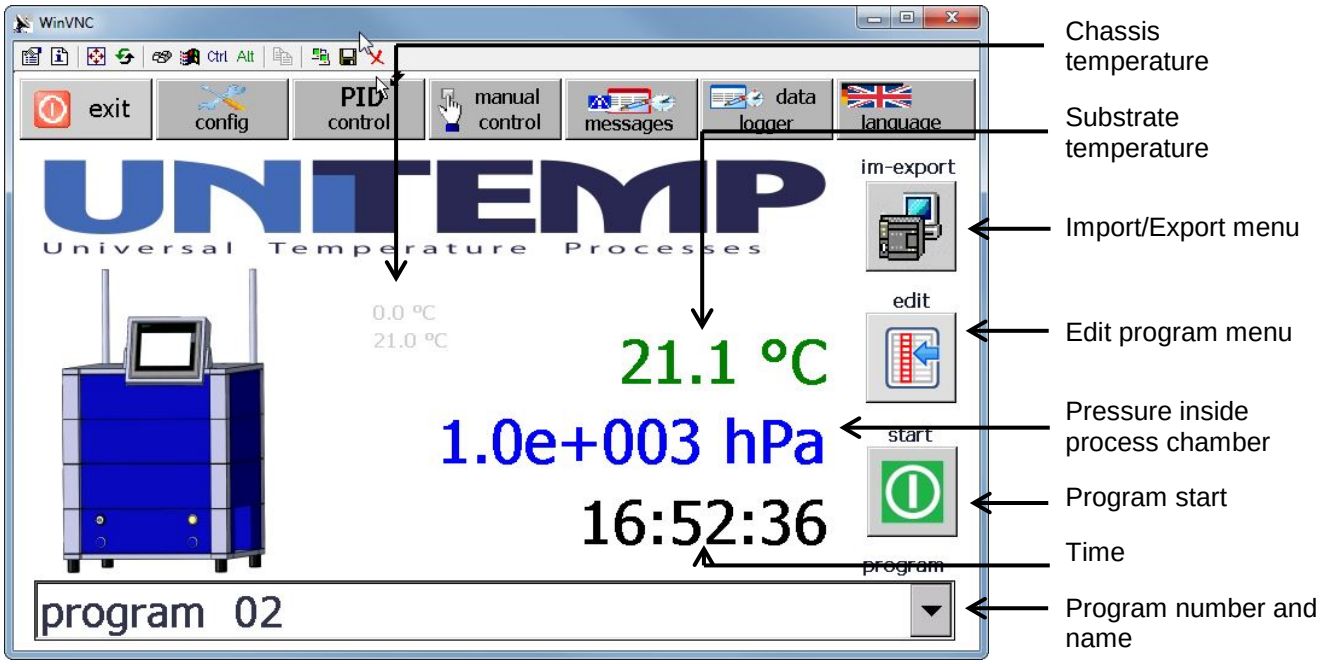


Figure 1: Start screen (after booting of touch panel) with explanation of some touch buttons

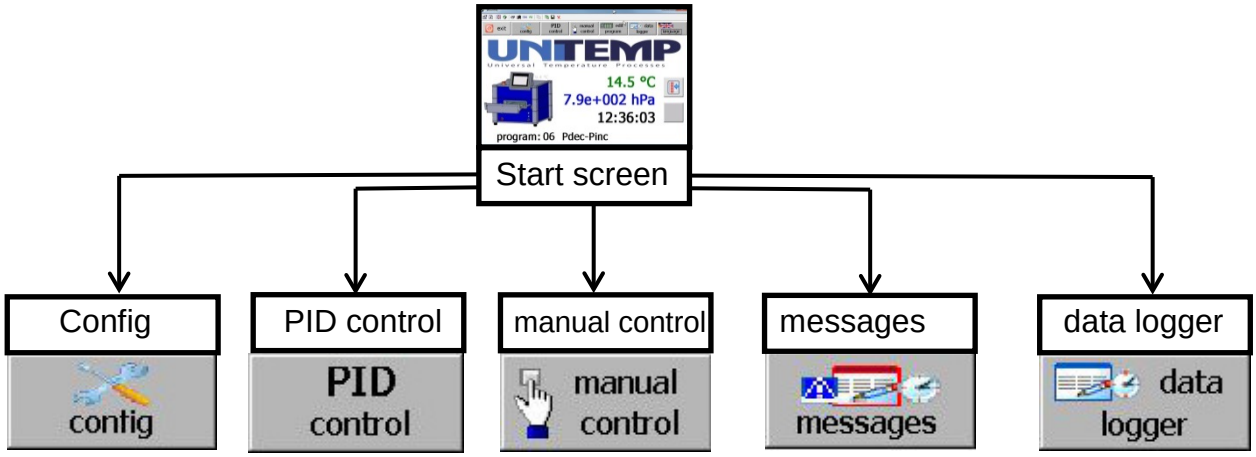
The start screen provides information on the system status (e.g. temperature of substrate (figure in green color), pressure (in hPa) inside process chamber, outside temperature of chassis (small figure)) and also offers several buttons (rectangular icons with grey background color). The action resulting from pushing the button depends on the button:

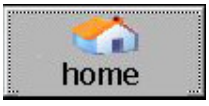
i) "Exit" button. Pushing this button will cause leaving the user interface level.
ii) "Language" button: this allows to select another language (German, English)
iii) Configuration, PID controller, Manual control, Messages, Data logger (top row): this will lead to a different menu (see next chapters)
iv) Im-export: this will enter the import/export menu
v) edit: this will enter the program edit menu
vi) start: this will cause the start of the selected program shown in bottom line
vii) Pull down menu for program selection: this will allow to quickly select the program from a list of 50 programs

Notice: the previous version of SPS_Soft features 12 programs. Here the start screen looks slightly different.

1.2 Menu overview

The following diagram shows the hierarchy between the start screen and the five control menus:
Selecting the respective control menu is done by pushing the respective menu button (config, PID control, manual control, messages, data logger).





Home button:
Each of the control menu screens shows a button “home” in the top line. Pushing the home button will lead back to the start screen.

Language button:
Pushing this button will change the language of the menus from English to German and back.

1.3 Open/close status of front loading system (RTP, RSO)

The status of opened or closed carriage tray is shown by the respective icon (picture symbol).
In case of a closed carriage tray, the program start button is visible and can be pushed (see Figure 2).

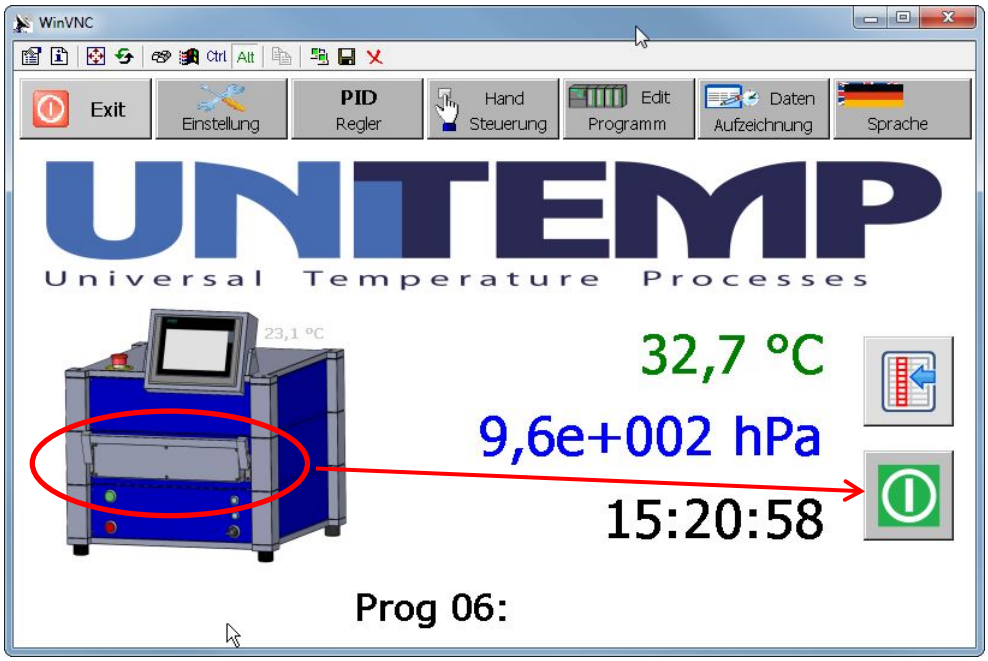


Figure 2: Start screen with closed carriage tray and program start button

In case of an opened carriage tray, the program start button is greyed out and cannot be pushed (see Figure 3) as a result of safety interlock.

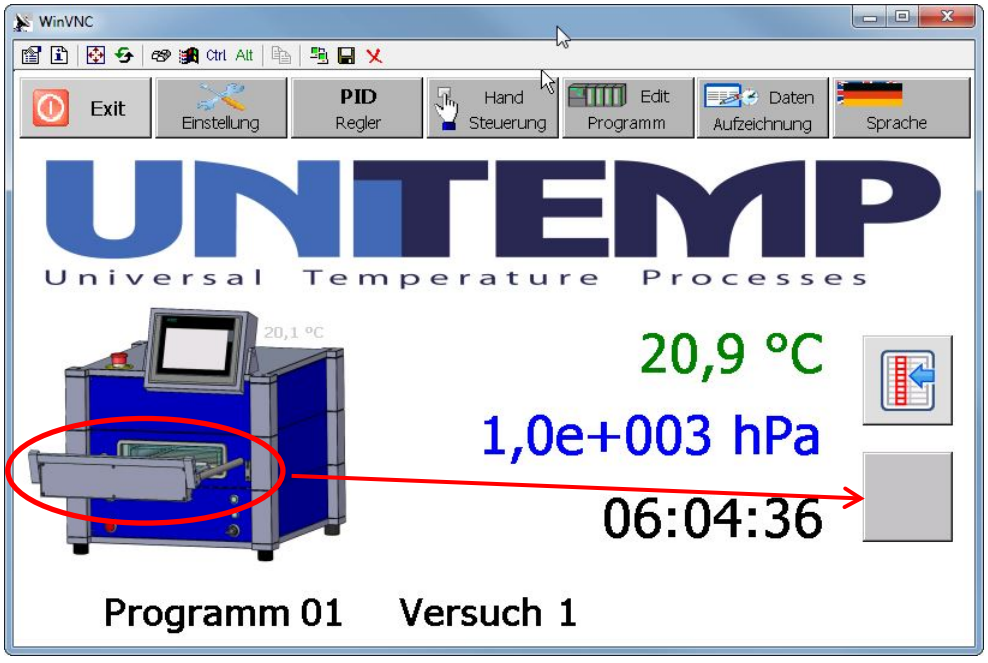


Figure 3: Start screen with opened carriage tray and with disabled program start button

1.4 Open/close status of top loading system (VPO, VSS)

The status of opened or closed top cover is shown by the respective icon (picture symbol).
In case of a closed top cover, the program start button is visible and can be pushed (see Figure 4).

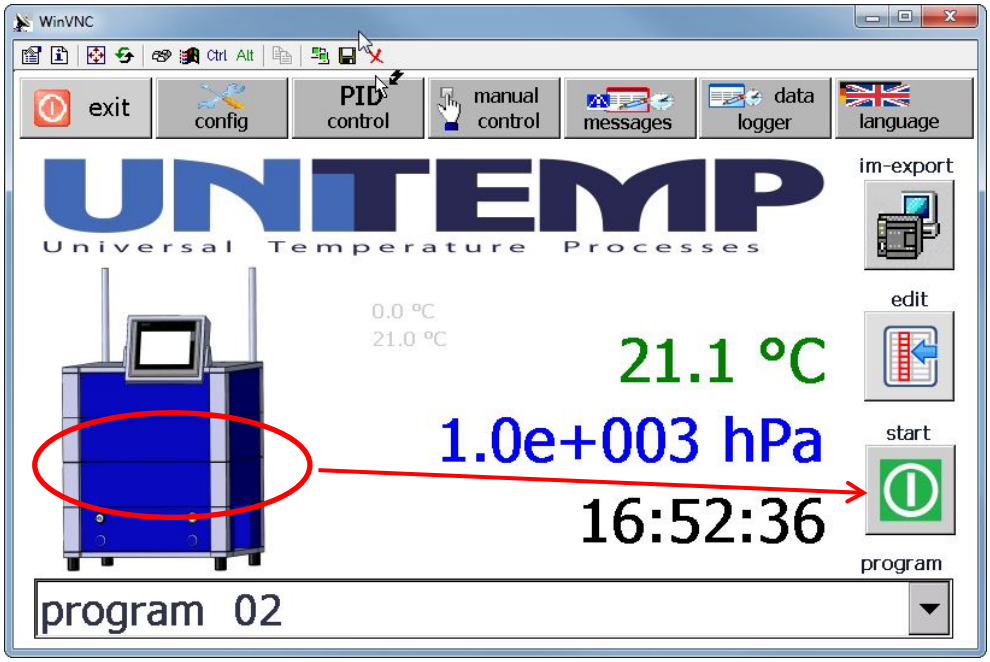


Figure 4: Start screen with closed top cover and program start button

In case of an opened top cover, the program start button is greyed out and cannot be pushed (see Figure 5) as a result of safety interlock.

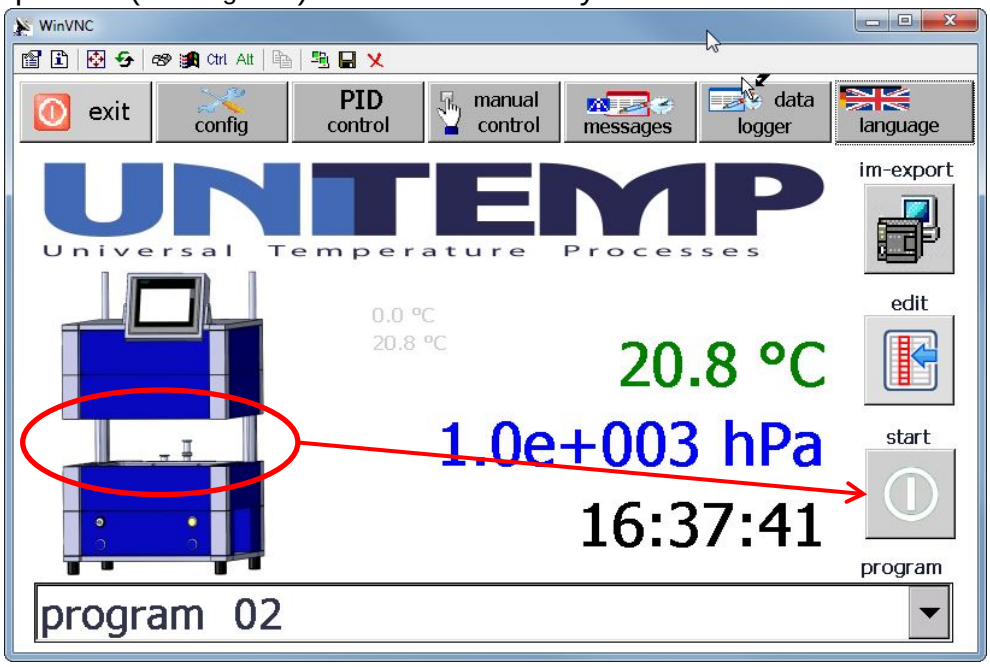


Figure 5: Start screen with opened top cover and with disabled program start button

1.5 Program start

If the process chamber is closed, the program which is shown in bottom line can be started by pushing the program start button.

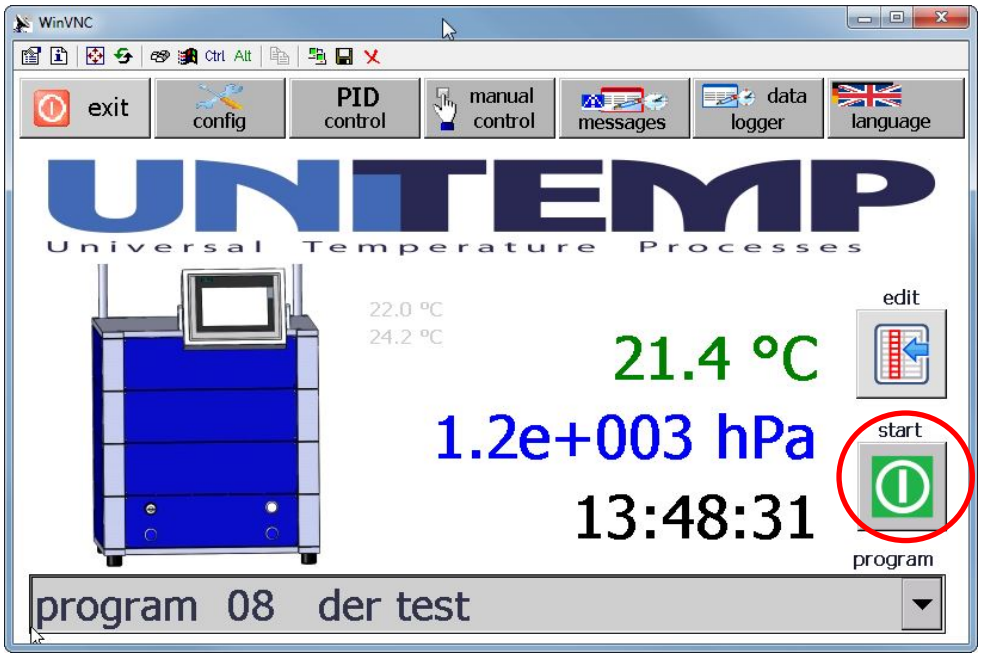


Figure 6: Start screen with marked position of start button.

Then the system starts the program and the touch panel shows the program progress:

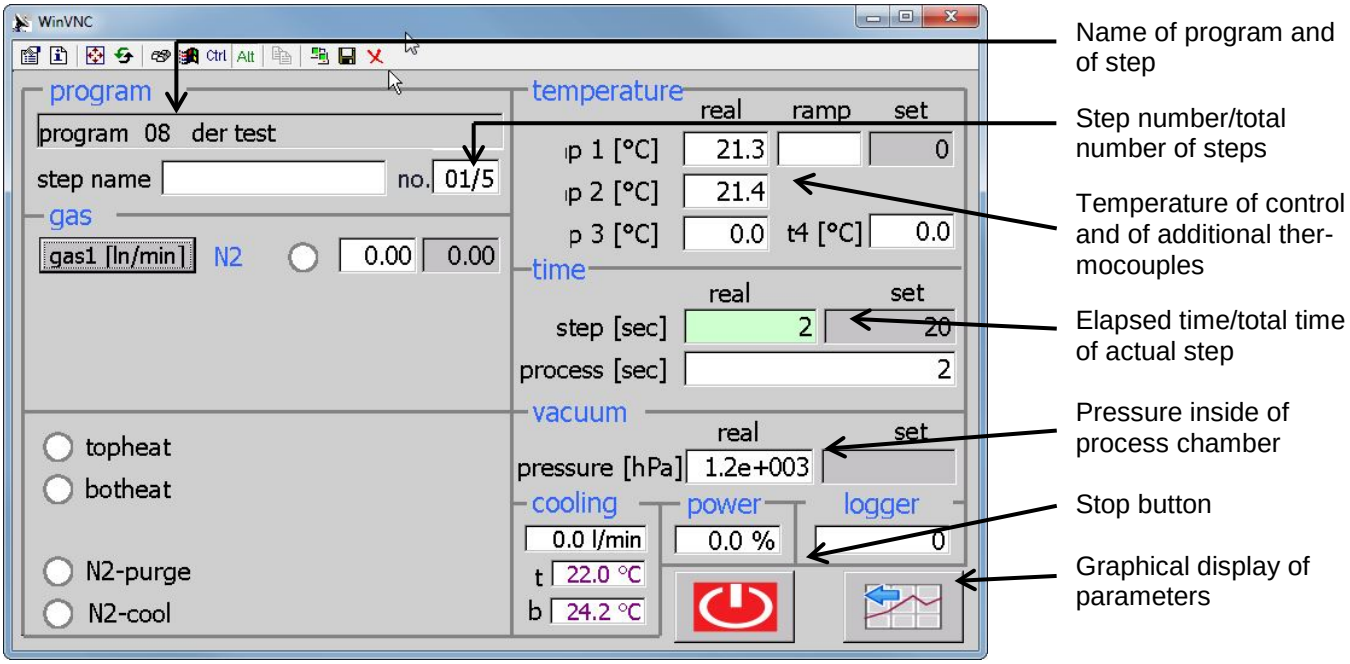


Figure 7: Program screen with display of important process parameters and values

All process relevant parameters and values are displayed in a text oriented screen. In order to visualize the trend of parameters (e.g. growing, falling, staying constantly), this screen can be shown in a diagram oriented way.

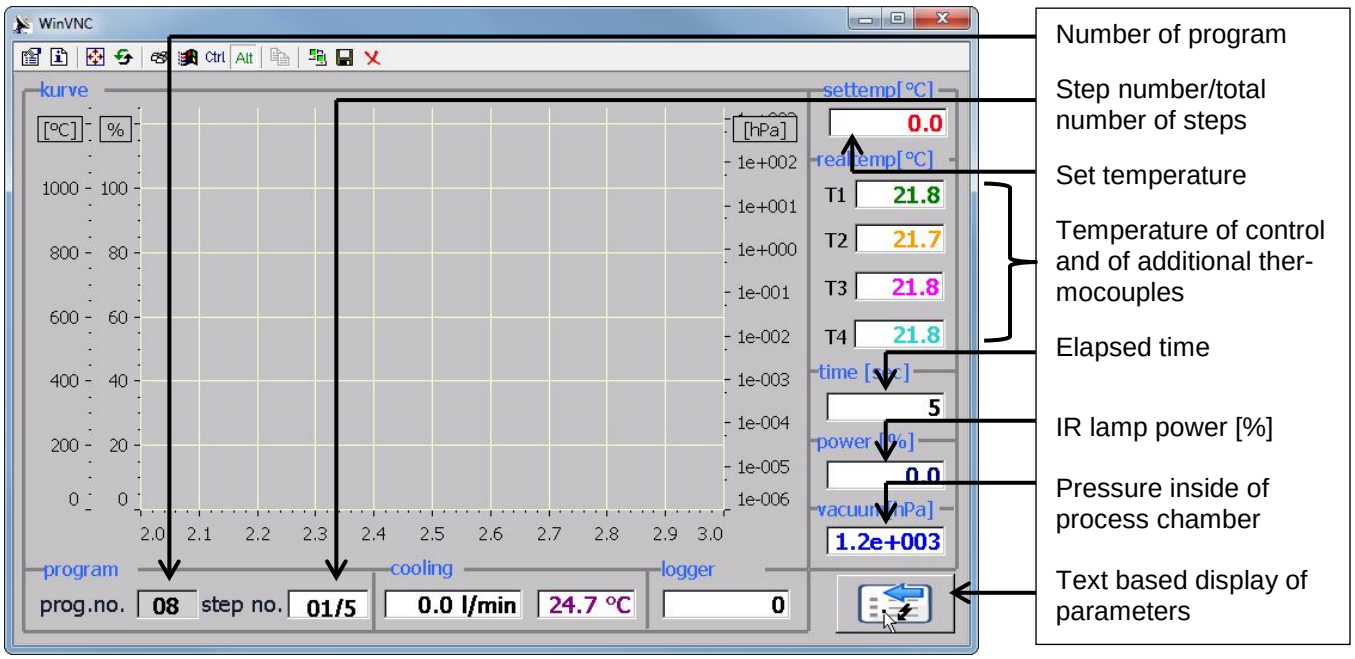


Figure 8: Program screen with graphical display of important process parameters and values

Once the program has reaches the end (last step), the background color of screen will turn to green.

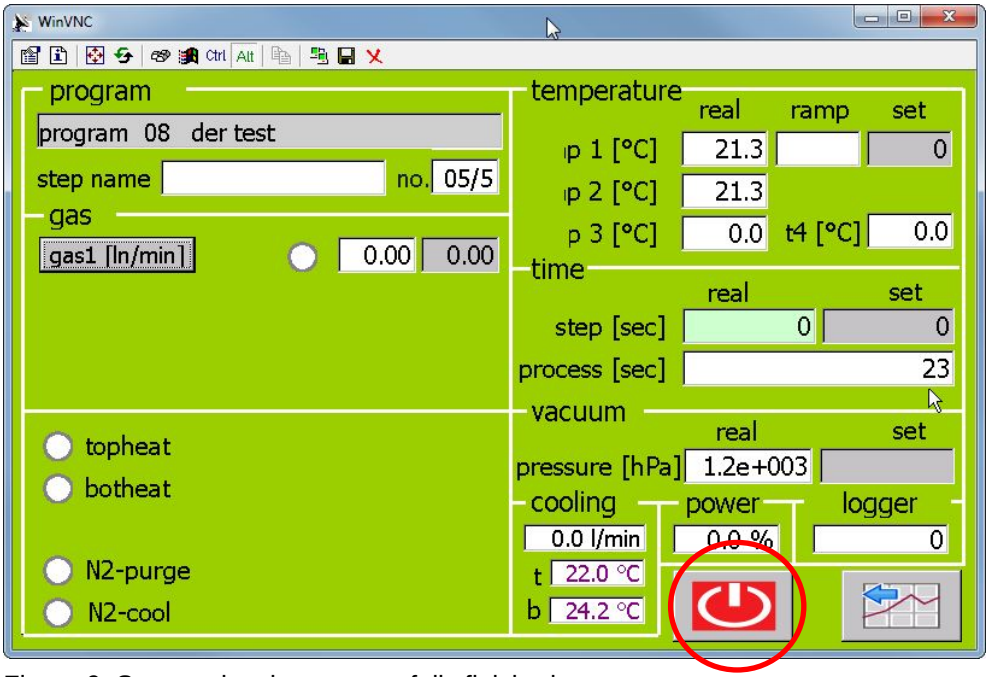


Figure 9: Screen showing successfully finished program

The start screen can be reached by tapping the stop button.

In case of an unexpected interrupt, the screen background color will turn to red.

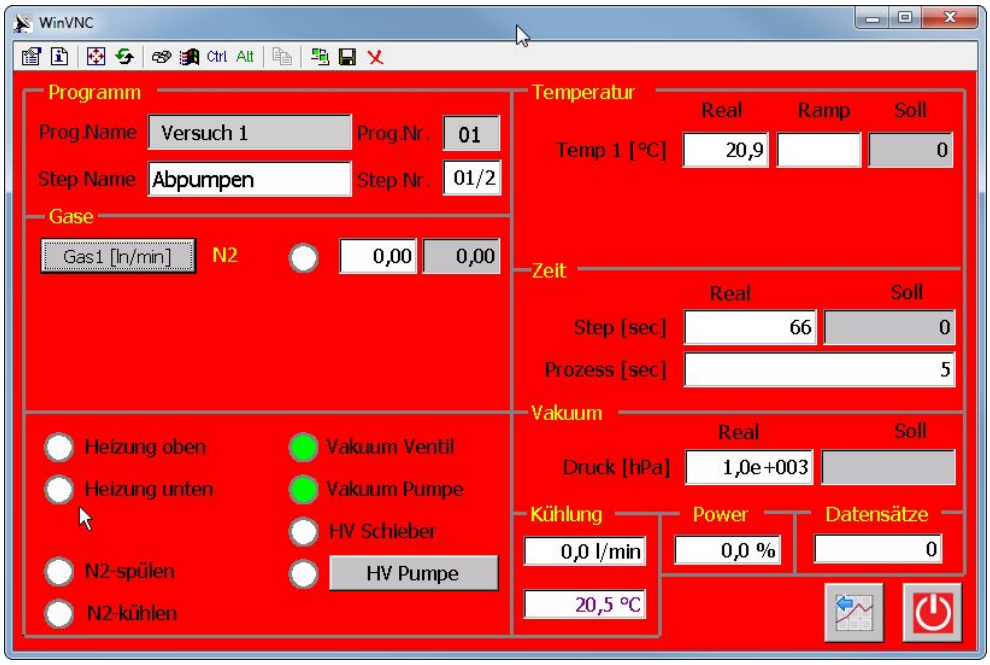


Figure 10: Running process screen with indication of alarm.

1.6 Editing of programs

The creation of recipes requires the login as user level “edit” in case the respective login requirement is not waived.

First select the desired program by tapping on the arrow in the bottom line.

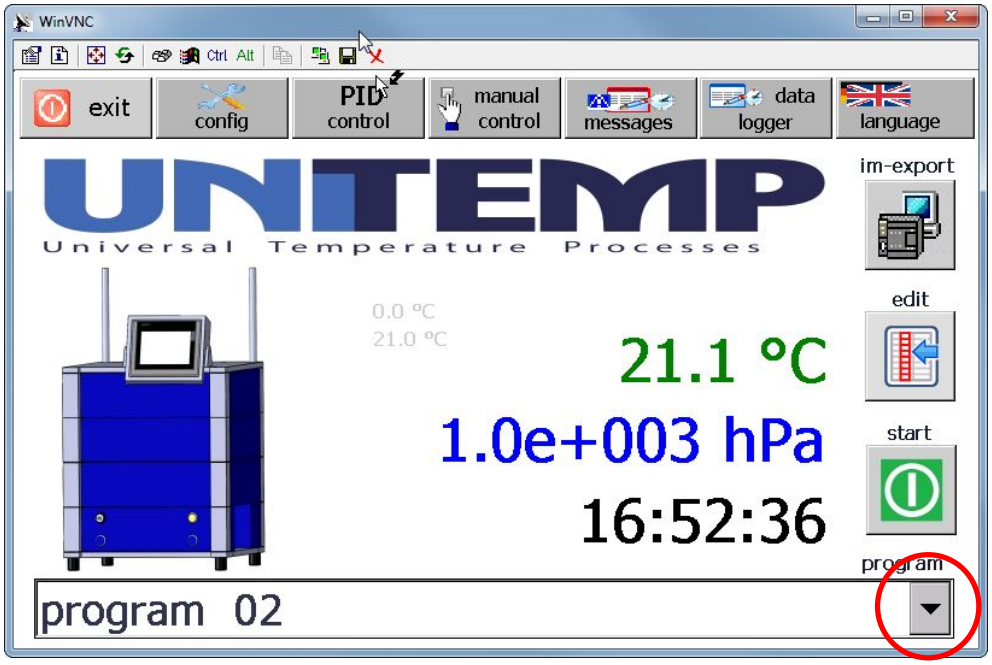


Figure 11: Start screen with marked position of program selection pull-down menu

A pull-down menu appears which allows you to select the program which you like to edit. By grabbing the scroll bar (see Figure 12) you can scroll down the list to reach program number 50. Just again tap the program number you would like to edit.

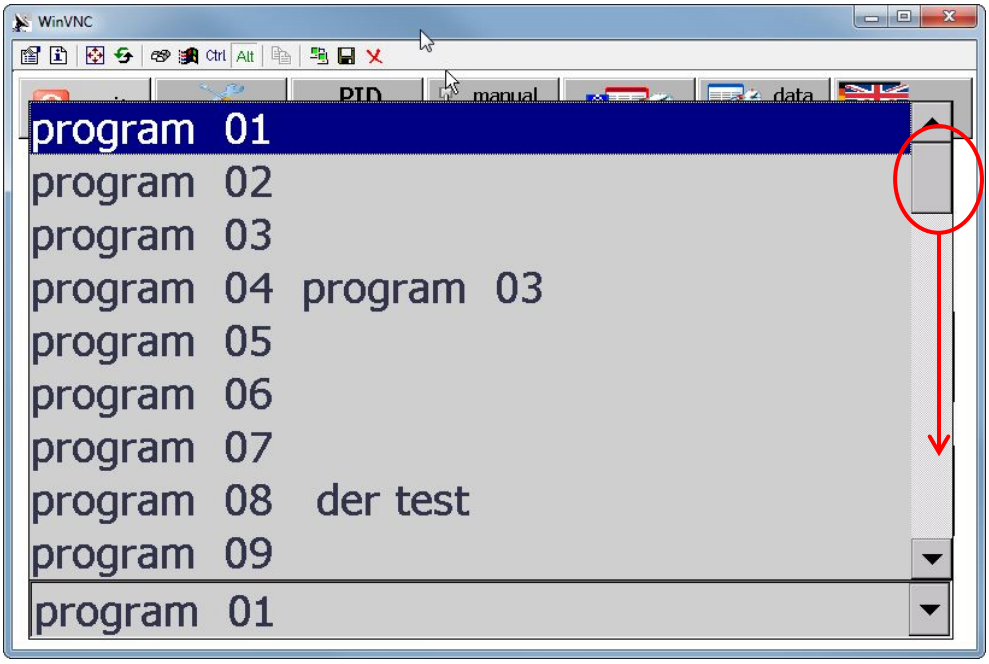


Figure 12: Program selection menu with indication of scroll bar

Remark: the previous version of SPS_Soft allowed selecting one program out of a list of 12 programs.

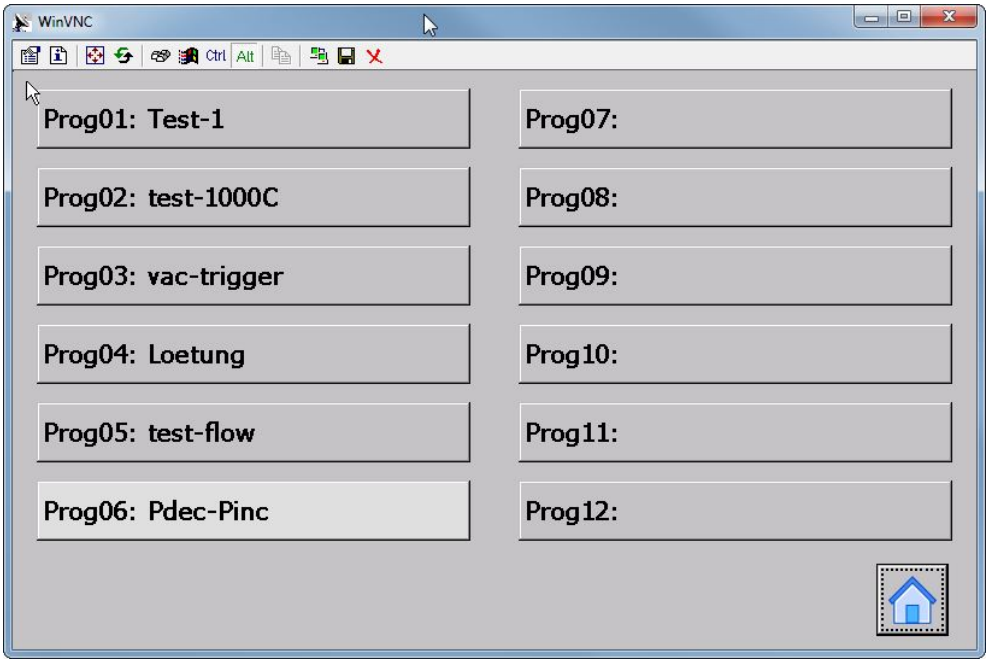


Figure 13: Program selection menu (old version of SPS_Soft)

The first time a program is edited it consists of one step (step 01/1) which cannot be deleted. In order to insert a new step (after the current step), the icon “insert” needs to be pushed (see Figure 14).

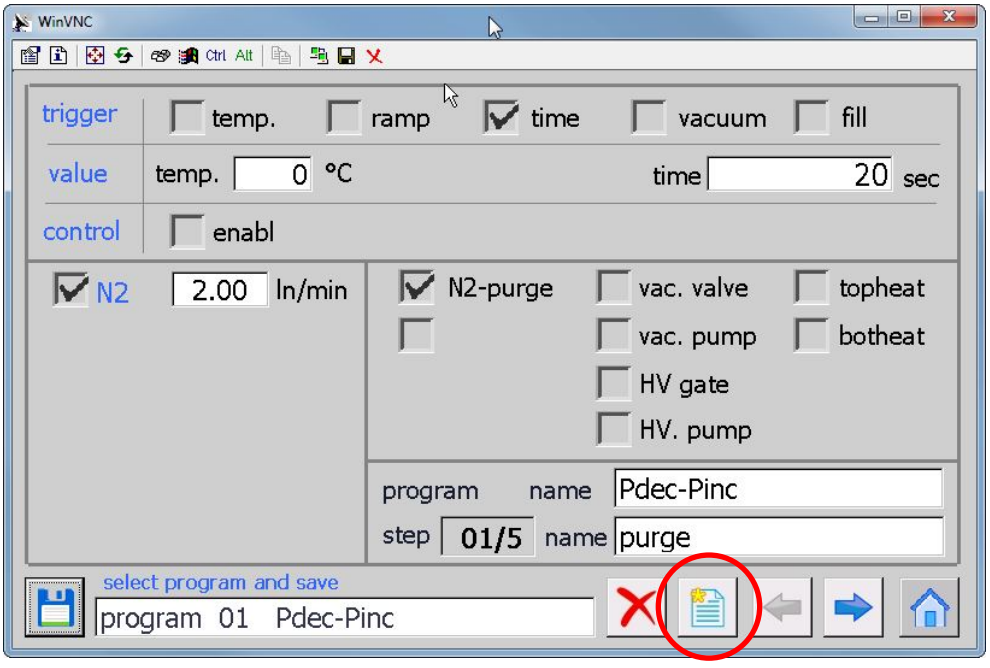


Figure 14: Location of insert icon in program edition menu

In order to delete a step from a program, the icon “delete” has to be pushed. In order to not delete a step unintentional, this deletion has to be confirmed.

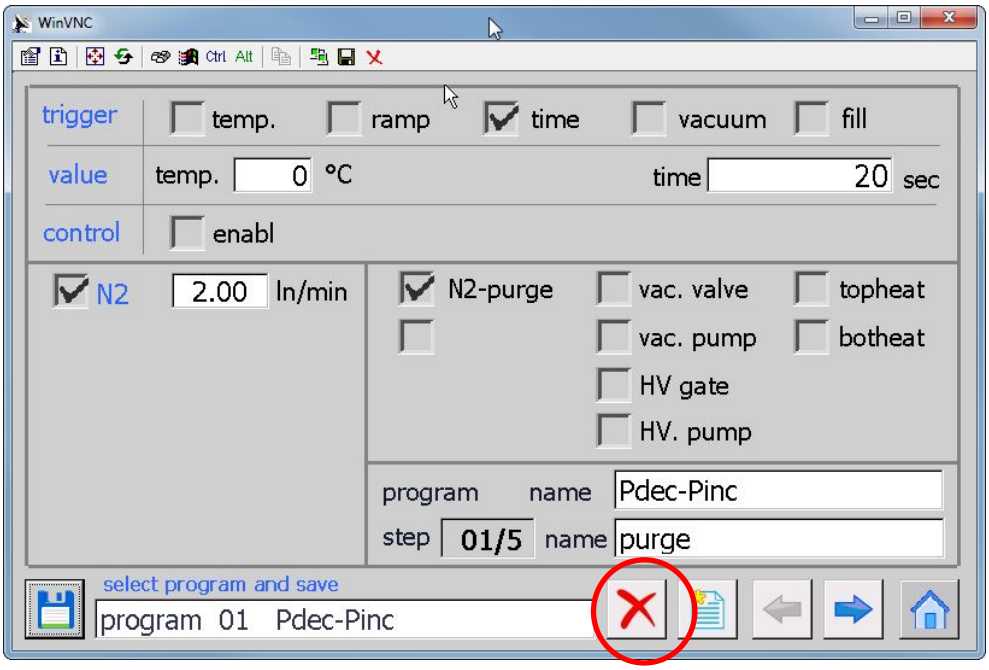


Figure 15: Location of icon delete icon in program edition menu

The question “segment delete?” in the following screen has to be confirmed by tapping the green “yes” button.

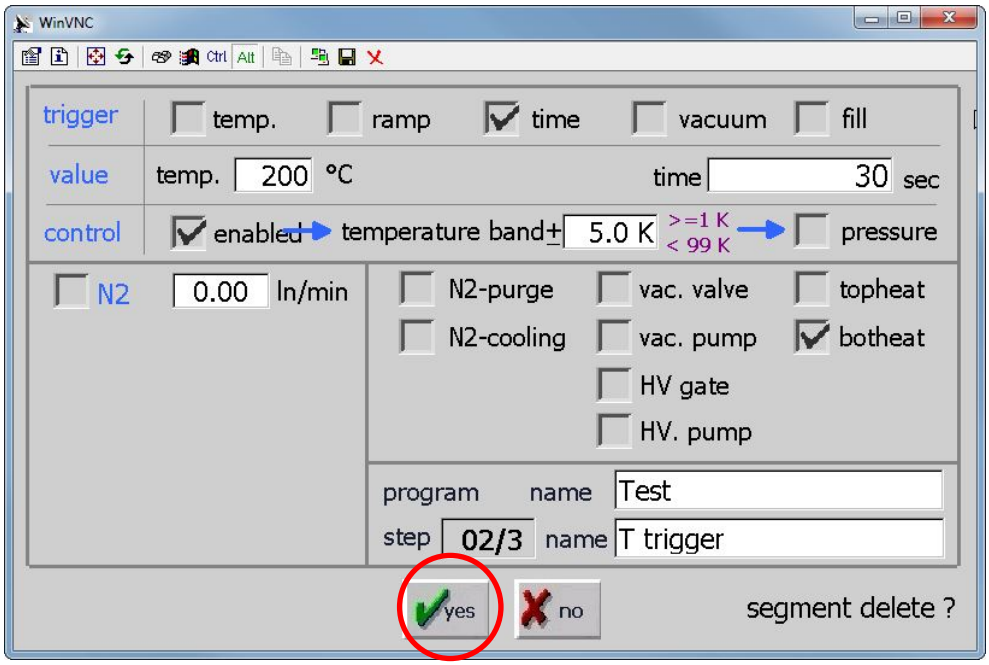


Figure 16: Confirmation of segment deletion

1.6.1 Example program without use of trigger control

The next screenshots show the creation of a program with five steps.

In the first step (no. 01/5) 2.00 standard liters per minute (nlm) of nitrogen gas (N2) are flowing into the process chamber for 20 seconds. In addition, nitrogen gas is purged. As this step defines a process which has to take a fixed time, the trigger “time” is used.

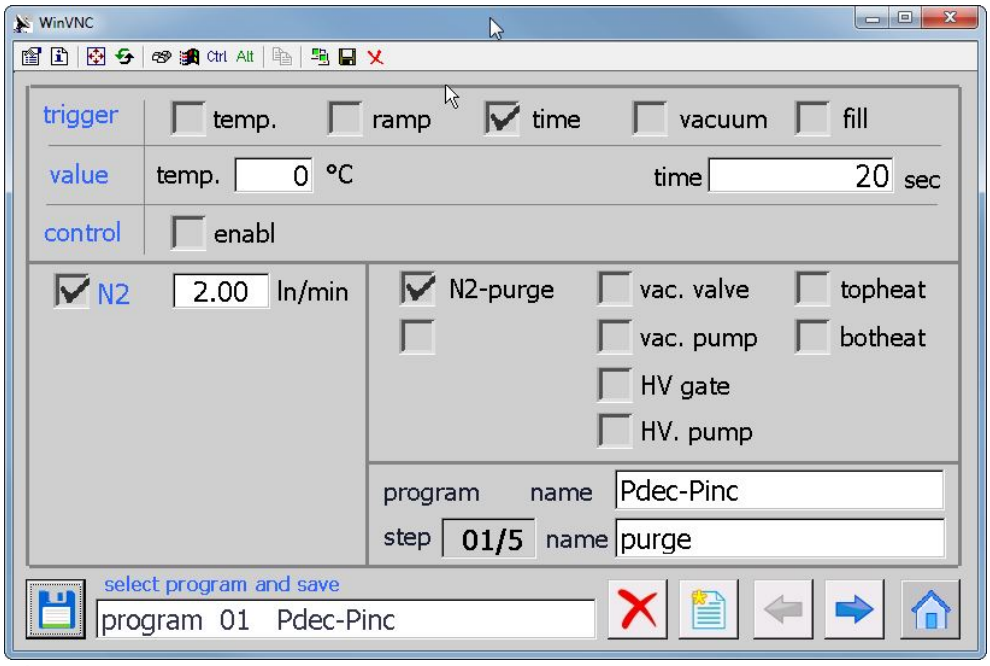


Figure 17: Typical program step for purging with nitrogen gas

The next step (no. 02/5) features the evacuation with rough (rotary vane) pump until a set pressure inside of process chamber (here: 5.0 x 10^{-2} hPa) has been reached. Please note that both boxes (vac. valve, vac. pump) are checked! Once this target pressure is reached, the next step will be performed.

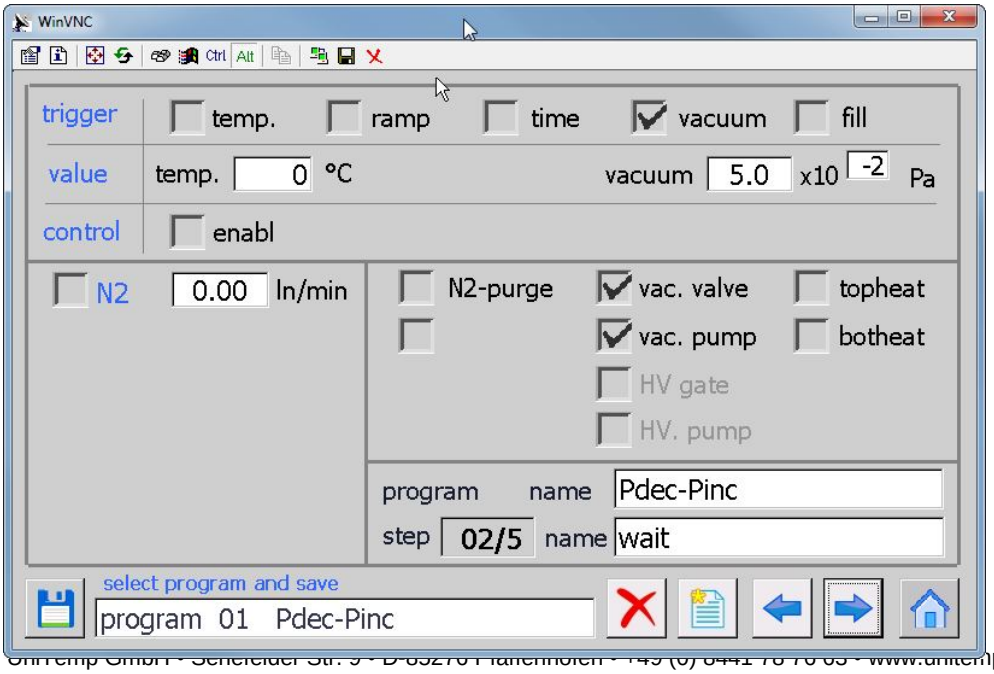


Figure 18: Typical program step for evacuation with vacuum trigger

Step number 3 (no. 03/5) contains an evacuation step (trigger: “time”) of 20 seconds using the rough (rotary vane) pump.

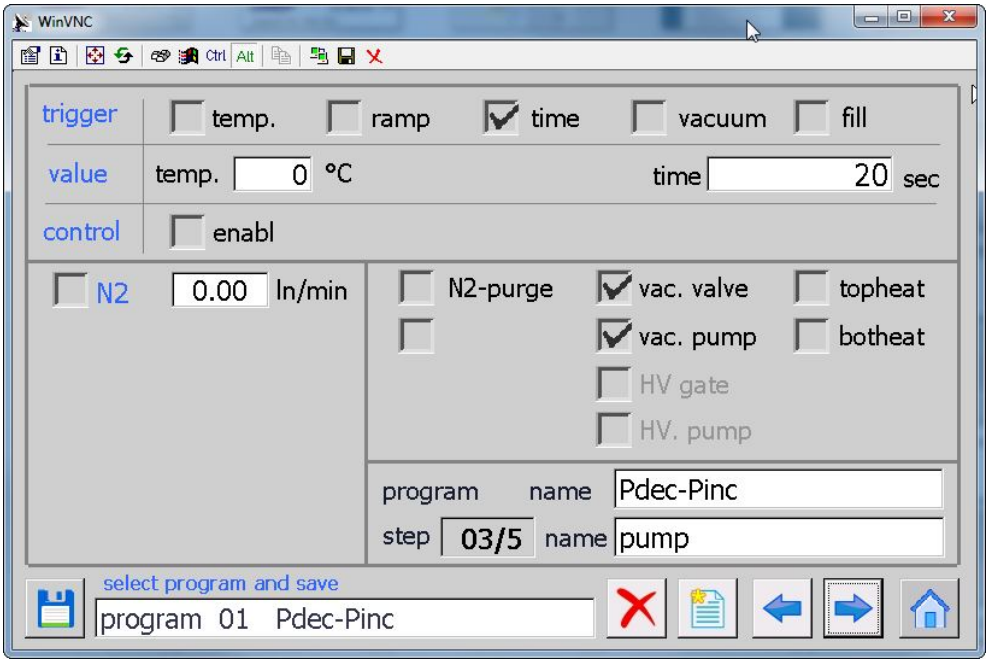


Figure 19: Typical program step for time based evacuation

In step number 4 (no. 04/5), nitrogen gas (N2) flows into the process chamber controlled at a MFC controlled flow rate of 2.00 nlm (ln/min). The trigger “pressure” causes this segment to remain active until a pressure of 1.0 x 10^2 hPa has been reached.

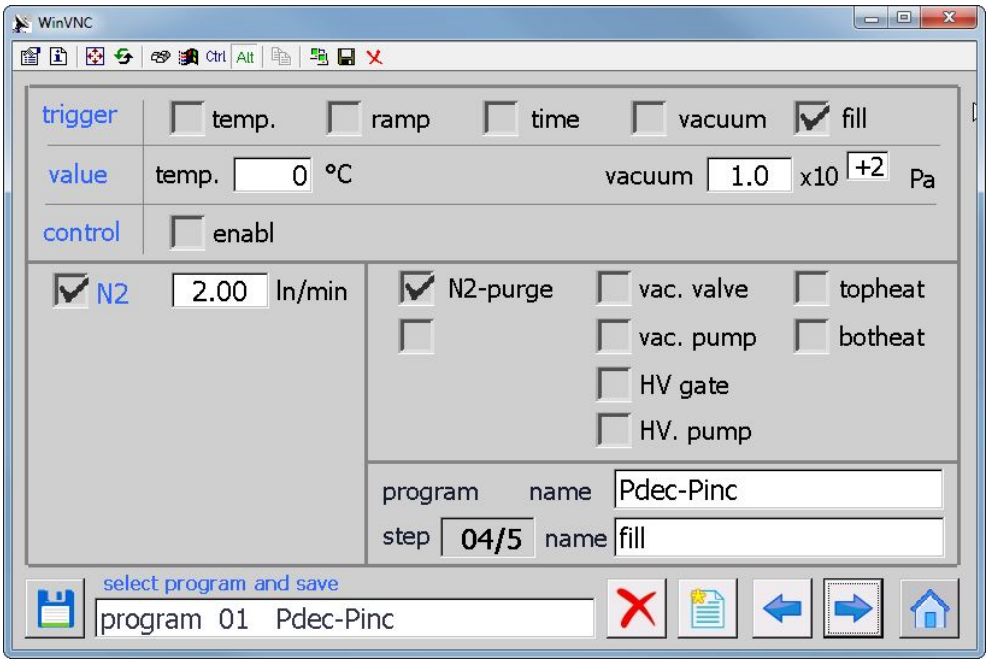


Figure 20: Typical program step for process gas flow with pressure trigger

The last step (no. 05/5) features a hold (pause) for a time of 300 seconds.

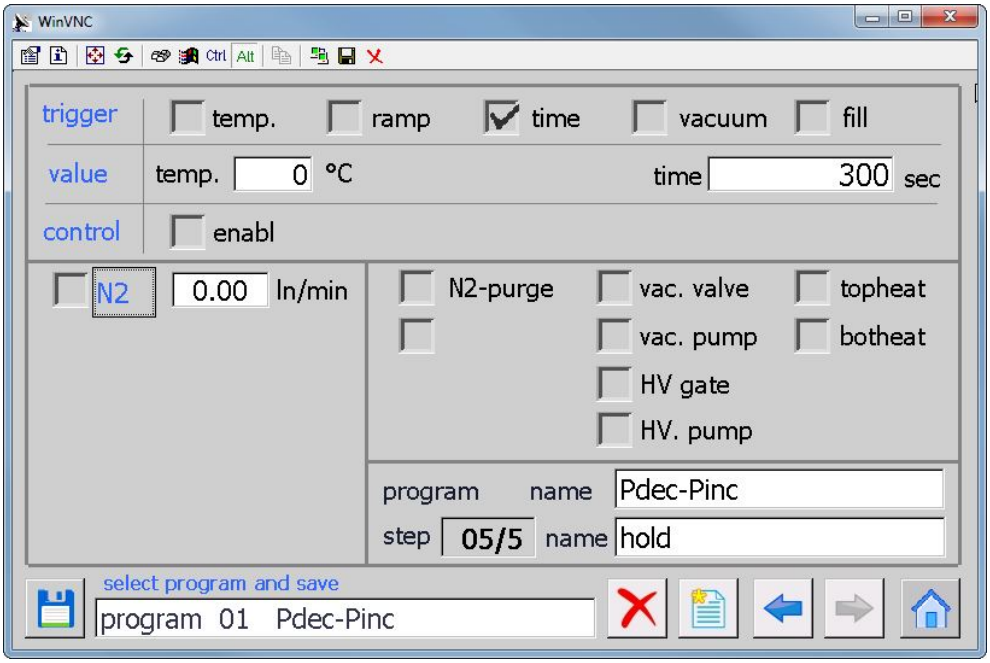


Figure 21: Typical program step for time based hold event

1.6.2 Example program with use of different triggers

The next screenshots show a program with 9 steps making use of different types of triggers.
Step 1 (Figure 22) uses a trigger type “vacuum” with a set value of 5.0 x 10^{-5} hPa by using both fore pump and high vacuum (HV) pump. Once the set pressure is reached the program will continue with next step (Step 2).

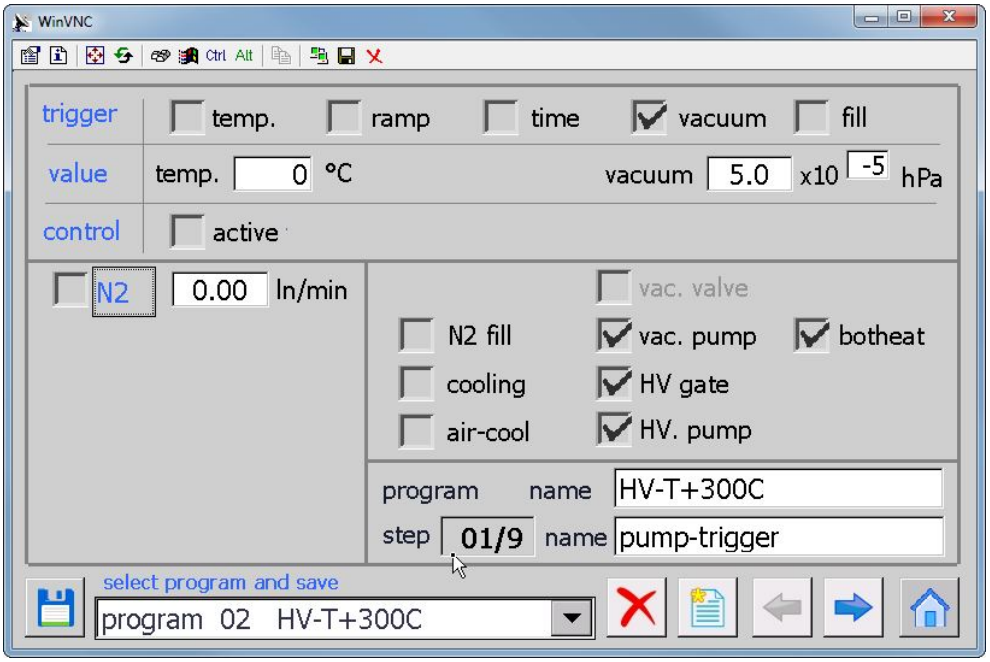


Figure 22: Program step for evacuation using high vacuum pump system

Step 2 is a heat up step (trigger “ramp”) under HV evacuation with a set ramp rate of 0.7 K/sec. Once the set temperature of 265 °C is reached step 3 will continue.

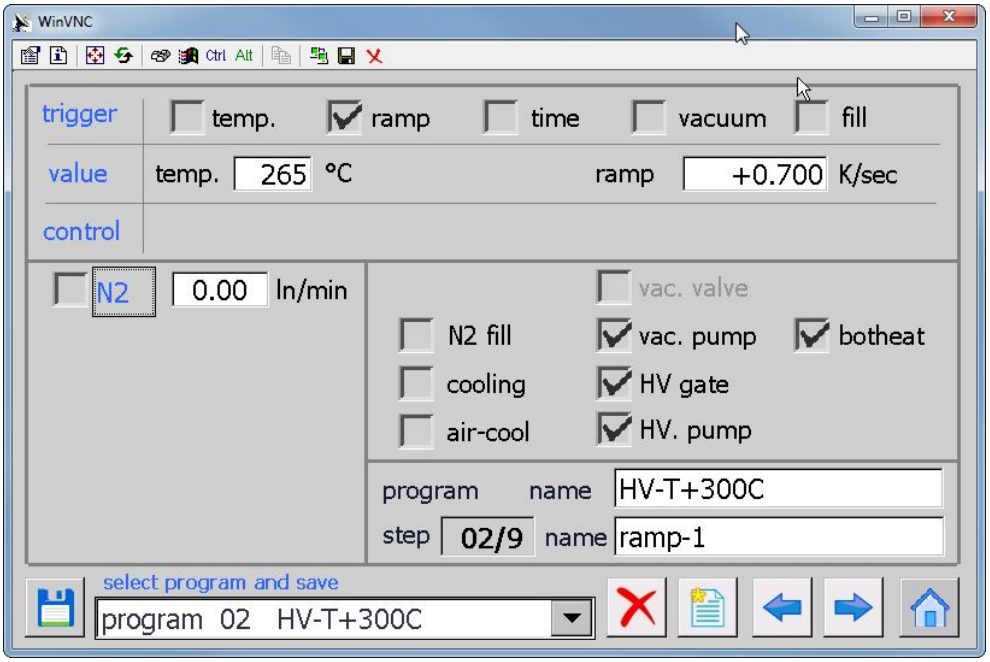


Figure 23: Program step for heating up with fixed ramp up rate

Step 3 defines a heat up step (trigger “ramp”) still under HV evacuation at a smaller rate of 0.1 K/sec. Please notice that a trigger “ramp” does not wait for a certain temperature as start condition. In the present case the smaller ramp (step 3) helps to prevent overshooting of temperature under high vacuum condition.

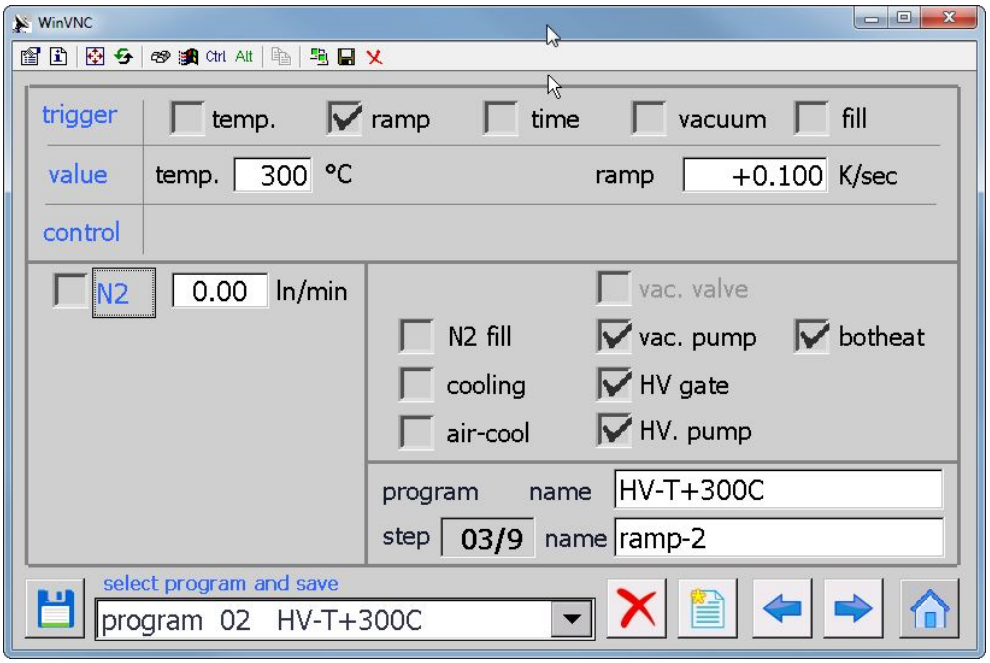


Figure 24: Program step for heating up with smaller fixed ramp up rate

Step 4 using a “time” trigger defines a heating step under high vacuum and a set temperature of 300 °C for a time of 600 sec.

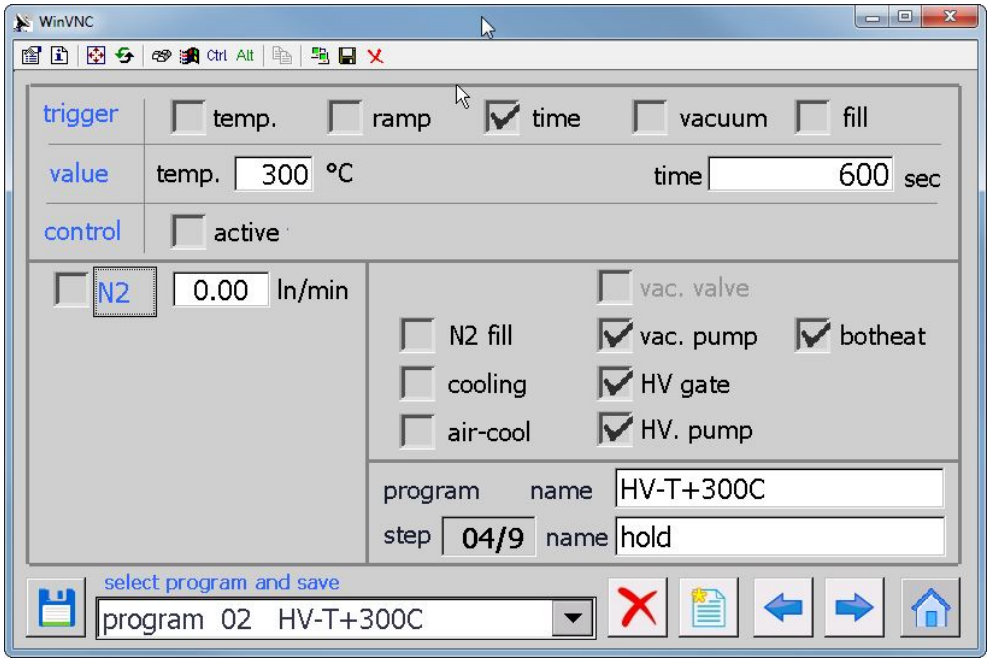


Figure 25: Program step for keeping constant temperature under HV condition

Step 5 (using a “time” trigger) sets the set temperature back to 0 °C, closes the gate valve and switches off the high vacuum pump while keeping the fore pump active.

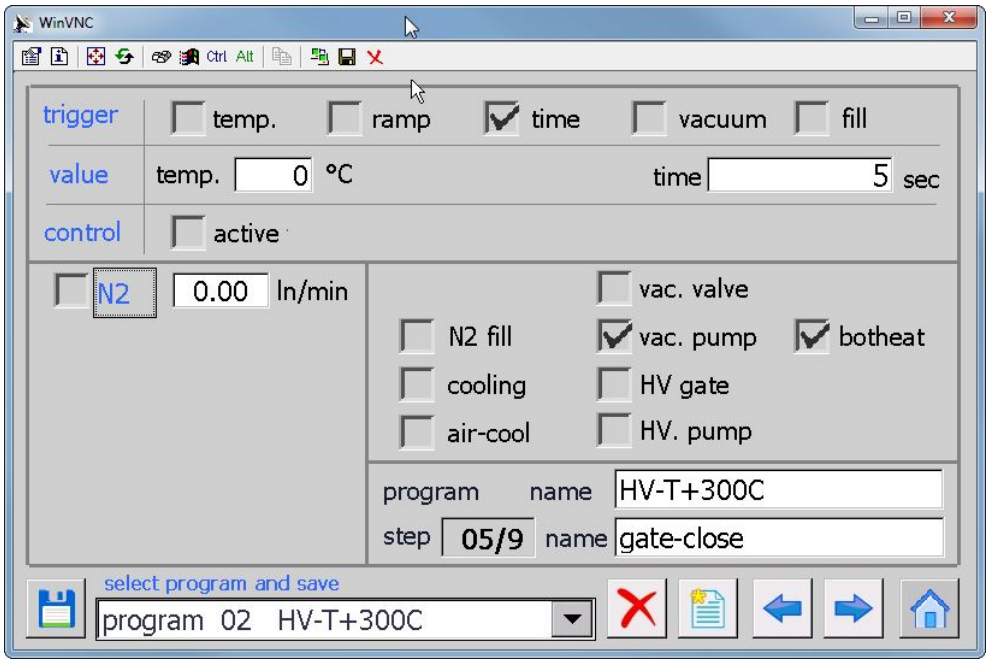


Figure 26: Program step for switching off HV pump

Step 6 uses the “fill” trigger to purge the process chamber with nitrogen gas up to a set pressure of 5.0 x 10^{-1} hPa. It should be noted that depending on the location of the pressure sensor with respect to the process gas inlet the reached pressure can exceed the pressure value specified in field “vacuum”. Note that in present case the step name has been name “fill-3mbar” in order to take this inertia into account.

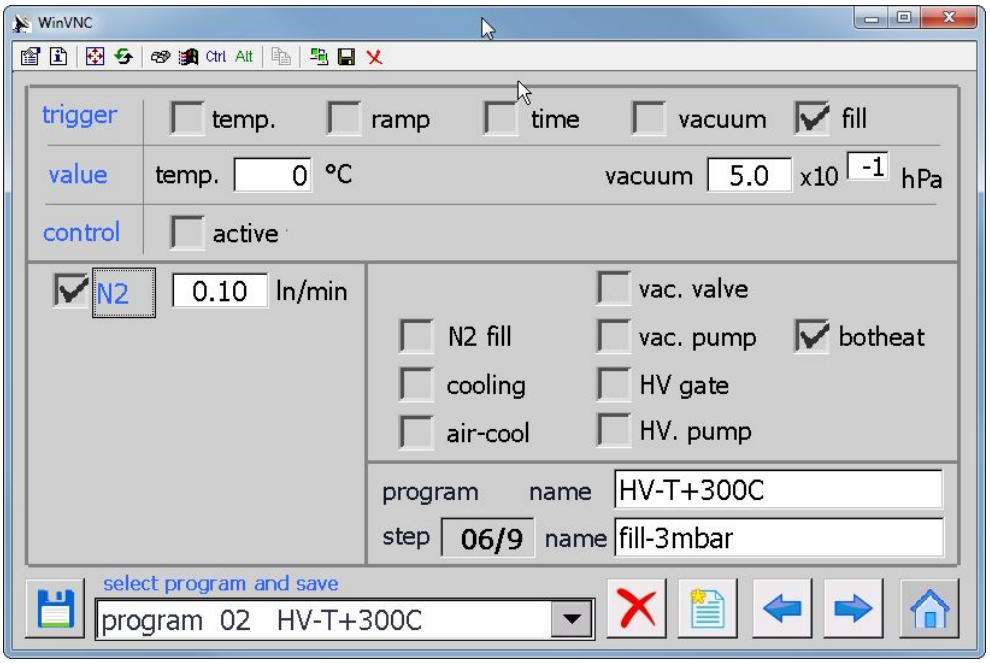


Figure 27: Program step for purging a process chamber up to a trigger pressure

Step 7 uses a “time” trigger for water cooling of the heating plate for a time of 300 sec. After this time step 8 continues.

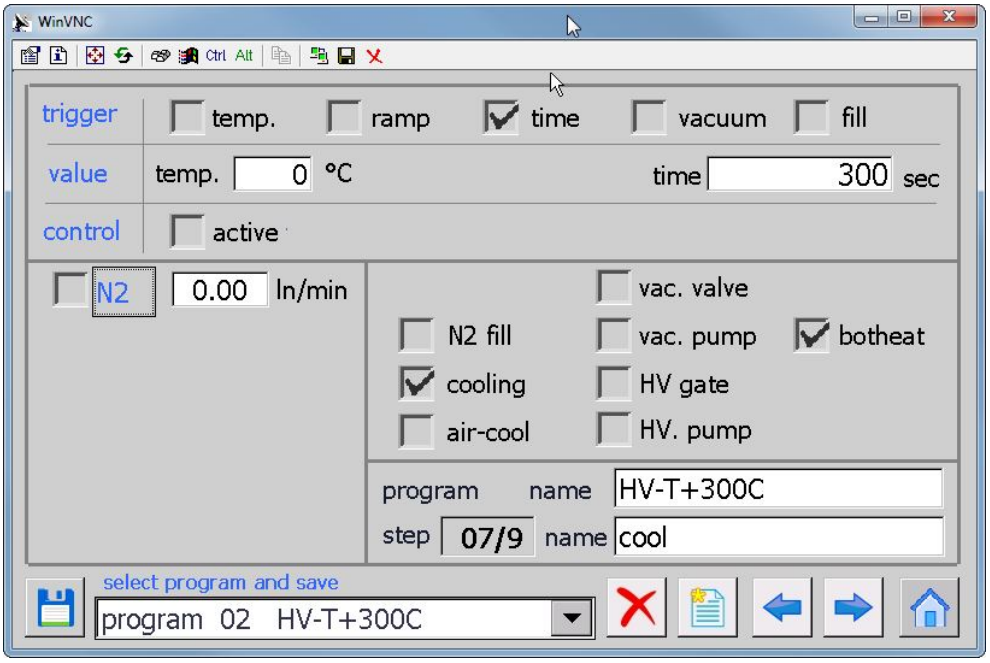


Figure 28: Program step for time based water cooling of heating plate

Step 8 activates a flow of nitrogen gas (2 ln/min) in the process chamber in order to increase the cooling rate.

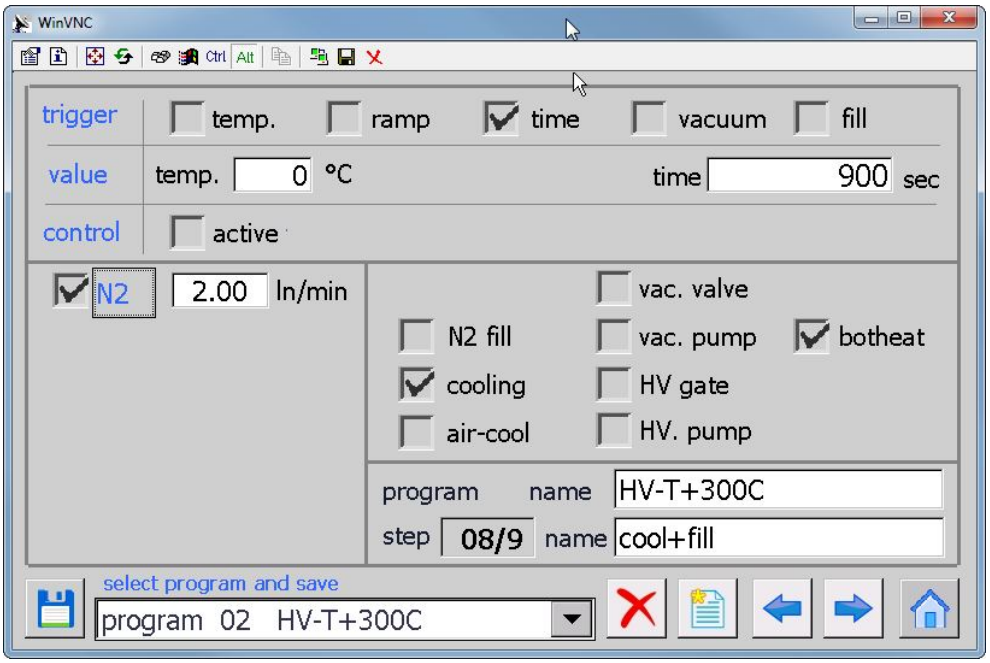


Figure 29: Program step for water cooling and nitrogen assisted cooling using “time” trigger

The last step 9 switches off the water cooling of the heating plate and uses nitrogen gas to cool down the process chamber.

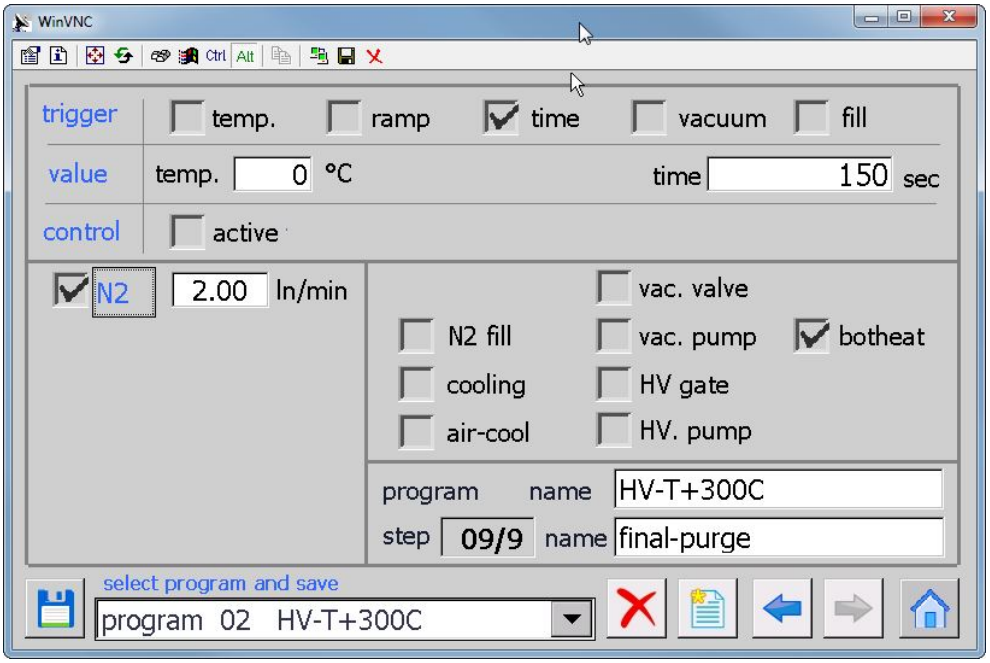


Figure 30: Program step for nitrogen assisted cooling using "time" trigger

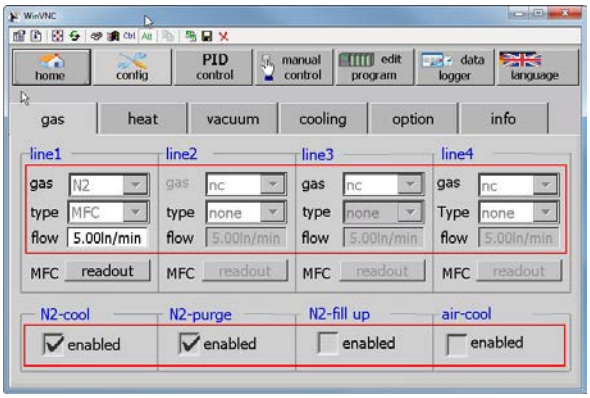
2. Configuration and manual operation of vacuum process system

2.1 Config menu

The Config menu shows the hardware configuration of the respective vacuum process system. It contains the tabs

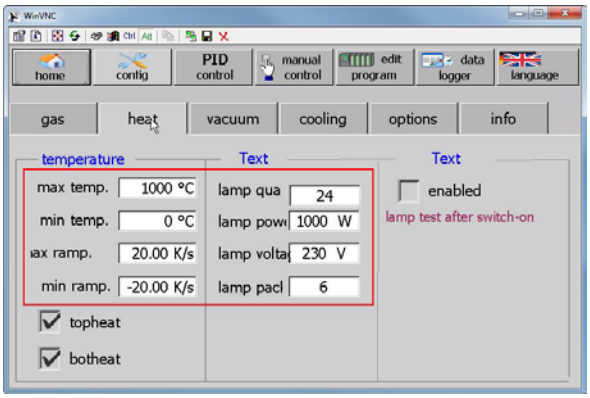
2.1.1 Gas

This tab shows up to four process gas lines with respective gas type and the maximum flow of the MFC (mass flow controller) and the presence of cool and purge gas lines. The push button “readout” next to “MFC” can be pushed in order to show the current gas flow of the respective process gas line.



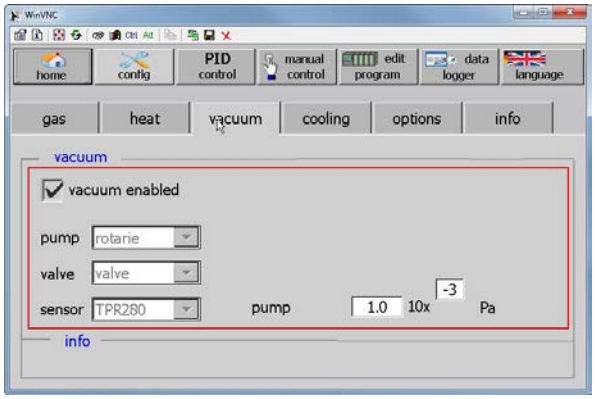
2.1.2 Heat

This tab is showing the values of maximum and minimum temperature, maximum ramp up and maximum cool down rate as well as quantity of IR lamps, lamp power, lamp voltage and lamp packets. When the check box “enabled” is set, a lamp test will be performed after switch on of the vacuum process system.

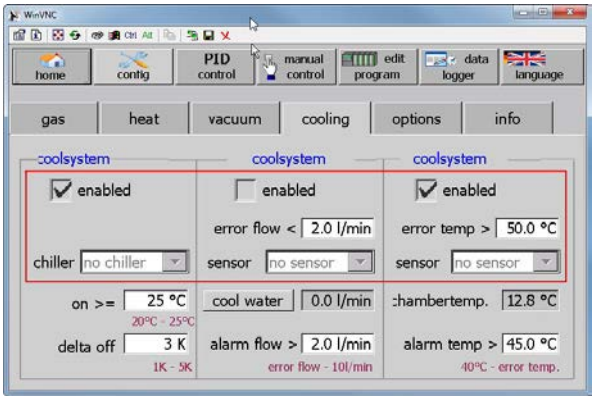


2.1.3 Vacuum

This tab is showing the type of vacuum pump, vacuum valve, pressure gauge and ultimate pressure. The check box “vacuum enabled” needs to be set (checked).

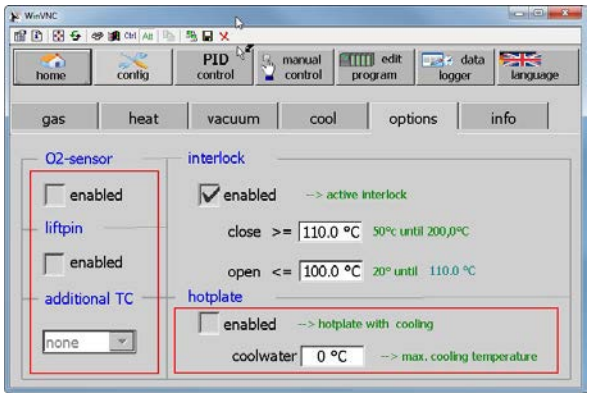


2.1.4 Cooling



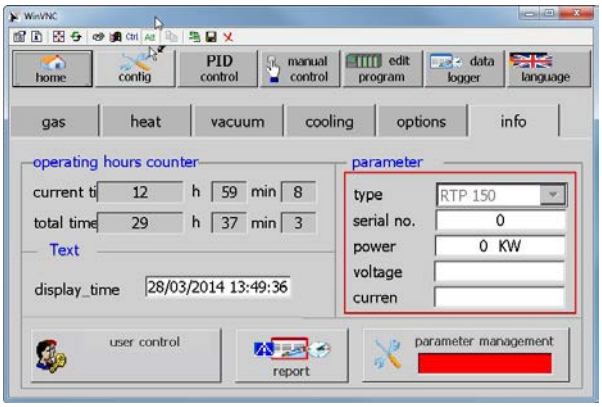
Inside the box with red lines the type of chiller, the type of water flow sensor and the type of temperature sensor is set. Below this box several values can be set: “on >=” is the threshold value of the chassis temperature above which the chiller is activated. The value at “alarm flow” provides a trigger value for alarm (i.e. when the flow of cooling water should be below this value, an alarm is triggered). The value at “alarm temp” provides a trigger value for alarm (i.e. when the chassis temperature exceeds this value, an alarm will be triggered). The values in purple color indicate either a range or a maximum or minimum value.

2.1.5 Options



In case of additional features (“options”) this field shows these options. Examples for options are oxygen sensor and interlock.

2.1.6 Info



This tab provides a counter for operating time (in hours, minutes and seconds), allows setting the time. When logged in as “admin”, hitting the button “user control” allows to administer users (see)

The content inside the box with red line cannot be modified (even with “admin” level) as it is part of the vacuum process (e.g. RTP) system.

2.2 PID control menu

The PID control menu shows the current PID parameters of the process control and offers the chance to improve these parameters by a new tuning. In order to modify the PID parameters, you need to be logged in “control” or “admin” user level.

In the following picture, the PID parameters of the first IR lamp field (zone 1 field) are shown. The value “P” represents the proportional factor, value “I” the integral factor and “D” the derivative factor.

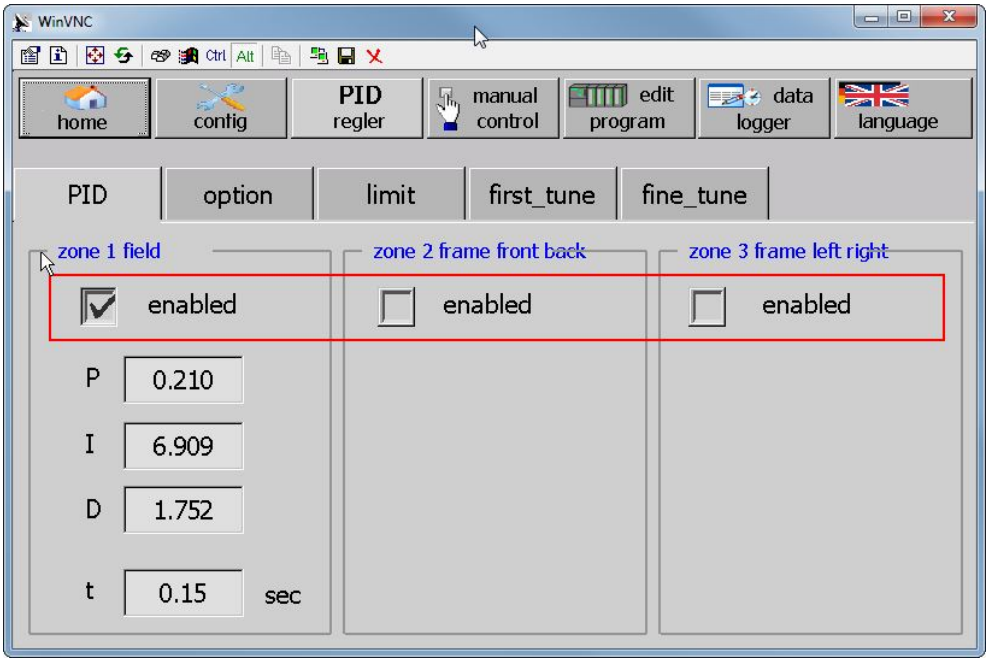


Figure 31: Screen showing the PID parameters of IR lamp control

The tap “option” allows entering other PID relevant factors, e.g. PWM (pulse width modulation) and quantifiers for P (proportional) and D (differential).

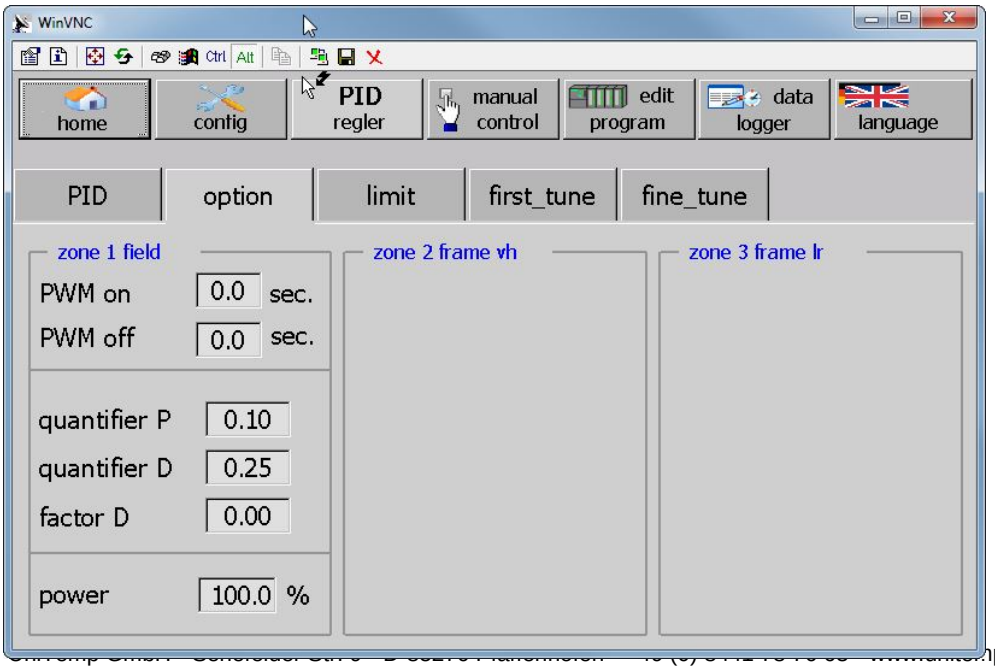


Figure 32: PID option tab allowing entering of other PID relevant factors

The submenu “limit” shows the settings of the respective vacuum process system. The values “max. temperature” and “min. temperature” define the operating temperature range.
Exceeding the value stated in “max. warning” or underrunning the value stated in “min. warning” will lead to a warning message. This warning message has to be prompted by checking a check box.
In case the value stated in “max. error” is exceeded or the value stated in “min. error” is underrun, an error will be triggered. As this error could have some quite severe root causes, it leads to the abortion of program.

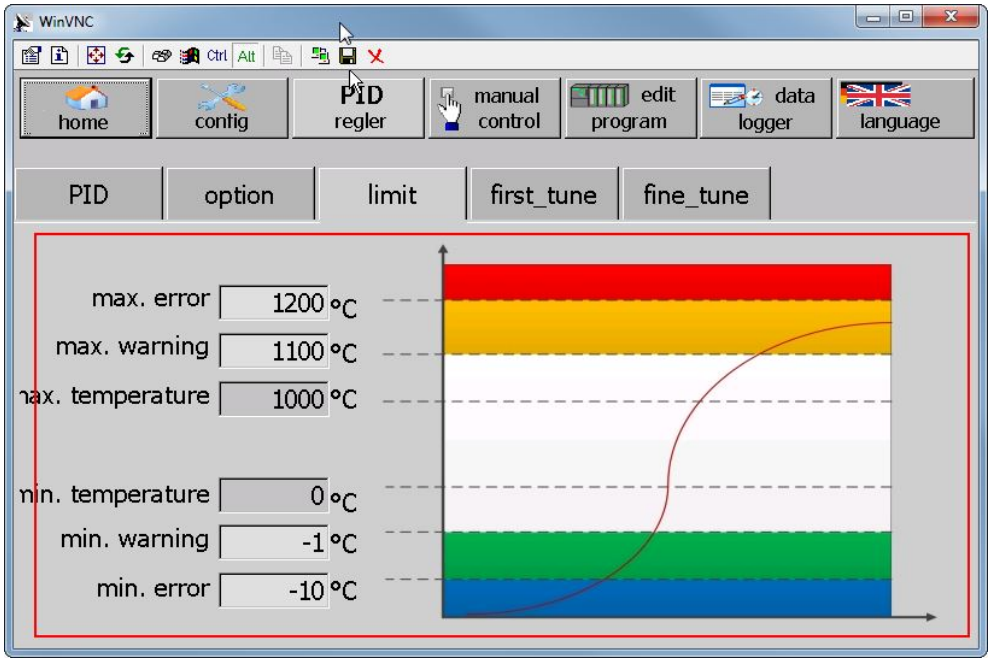


Figure 33: Settings of temperature limits

The submenu “first_tune” allows a rough tuning of PID parameters.
The desired temperature (in degrees centigrade, °C) and lamp power (in percent) have to be entered in the fields with light background color. After pushing the “start” button, the rough tuning of PID parameters starts with respect to the entered temperature and IR lamp power. The rough tuning usually takes about 20 seconds but can be interrupted by pushing the “stop” button.

First enter desired temperature and IR lamp power

Then push start to run the PID tuning process

A blue progress bar will indicate the tuning status

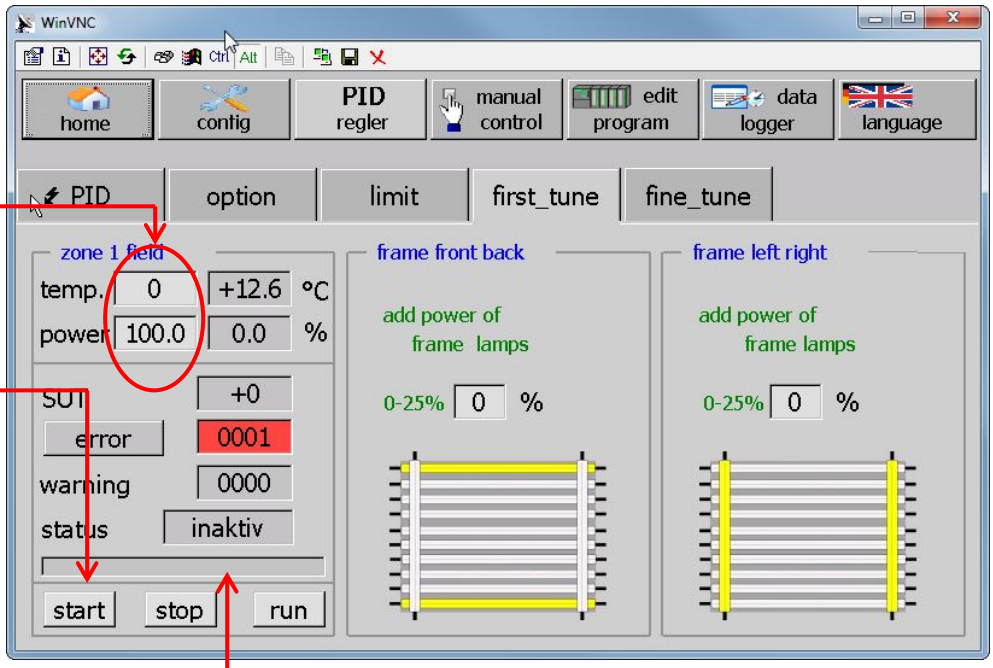


Figure 34: Menu for rough tuning of PID parameters

The submenu “fine tune” allows a finer tuning of PID parameters.

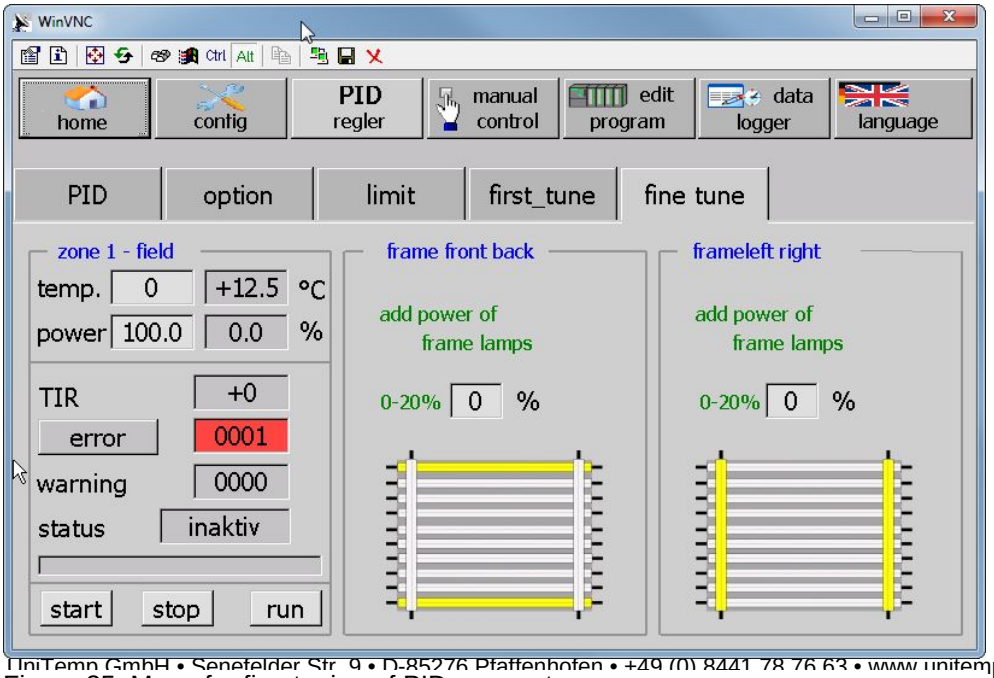


Figure 35: Menu for fine tuning of PID parameters

2.3 Manual control

The manual control menu allows the interactive (i.e. not automated) operation of the vacuum process system. In order to use this option, you need to be logged in either as “admin” or as “control” user level.
There are four submenus (tabs) which refer to “gas”, “temperature”, “vacuum” and “logger”.

The submenu “gas” allows the manual control of inlet gas lines. This control covers opening of process gas, cooling or purging gas lines as well as of chamber valve, setting of process gas flow and checking of the MFC status.

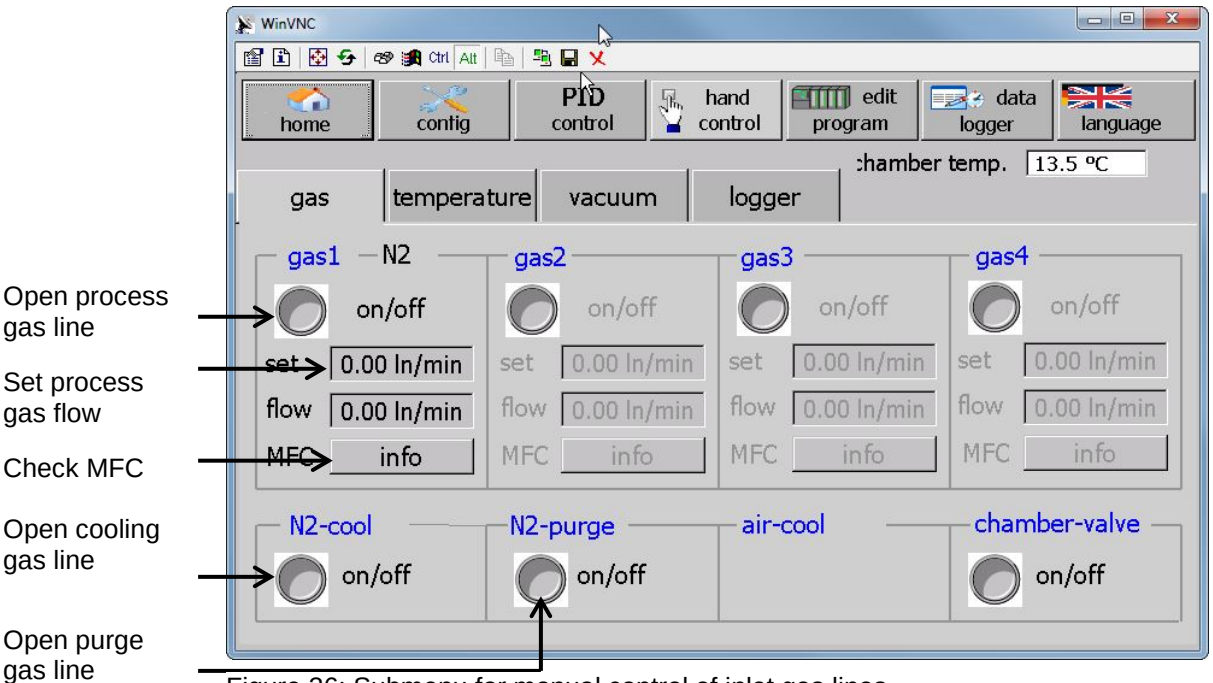
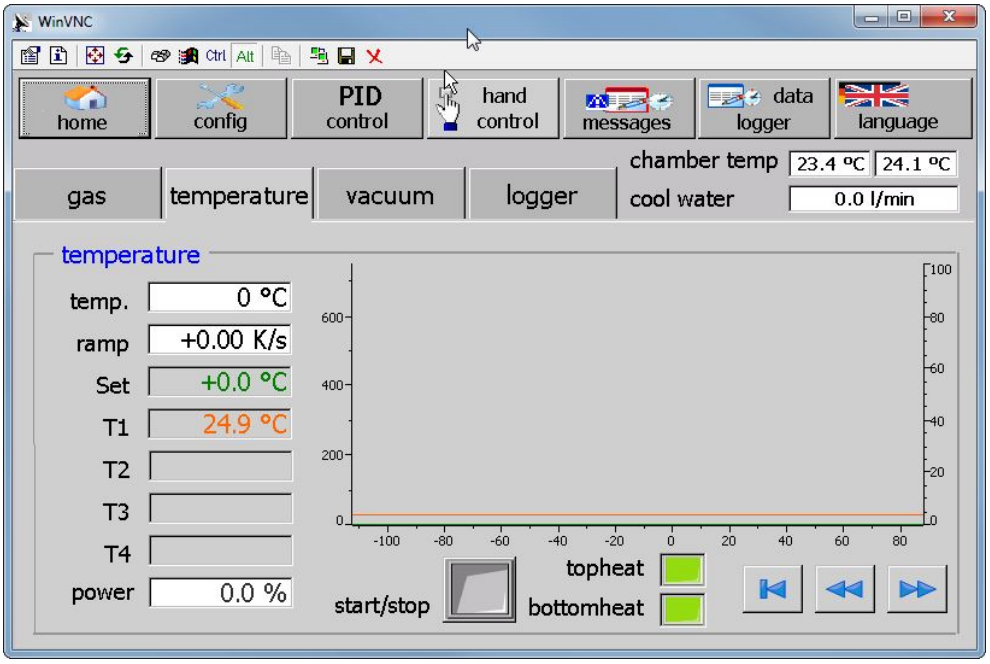


Figure 36: Submenu for manual control of inlet gas lines

The submenu “temperature” allows to manually switch on the IR lamps of the respective vacuum process system.



2.4 Data logger

The data logger option allows storing of process data as csv (comma separated values) data on external storage media.

2.4.1 Setting of storage path

The process data can be stored either

i) On SD card (located in the rear side of the touch panel)
ii) On USB 2.0 memory stick (located in the top cover of the vacuum process oven), and
iii) On network folder.

If the storage path is set for the first time or if it has been changed (1.), the new storage path has to be confirmed by tapping the “test” button (2.). Then the new (and current) storage path is shown in the respective field right to the “test” button (3.).

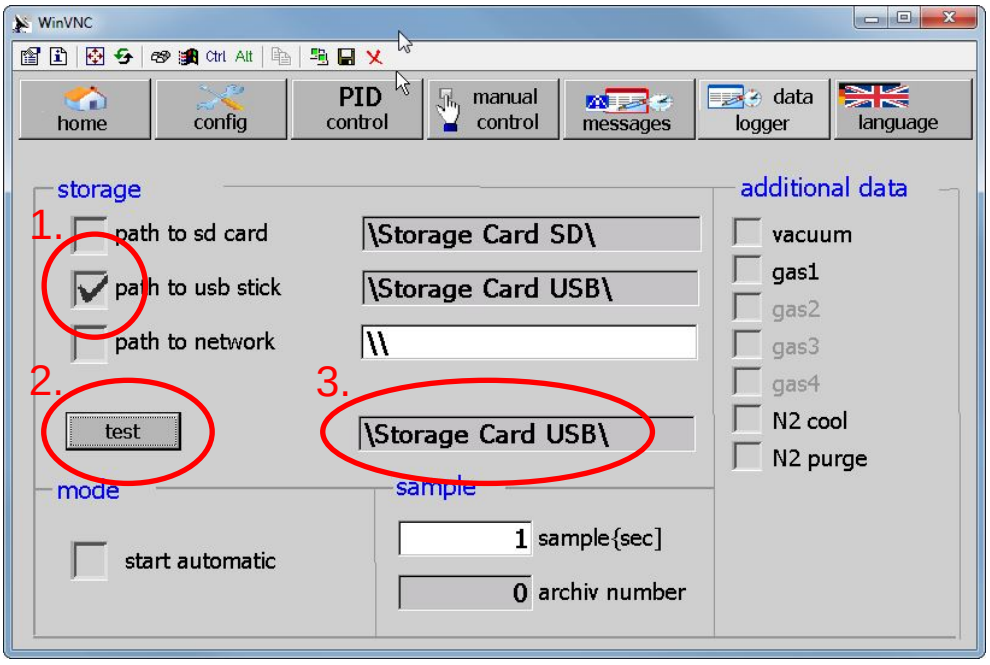


Figure 37: Data logger menu with order of setting storage path

In case that the selected storage path is not available (e.g. missing connection to computer network), there will be a red bar in the field right to “test” button.

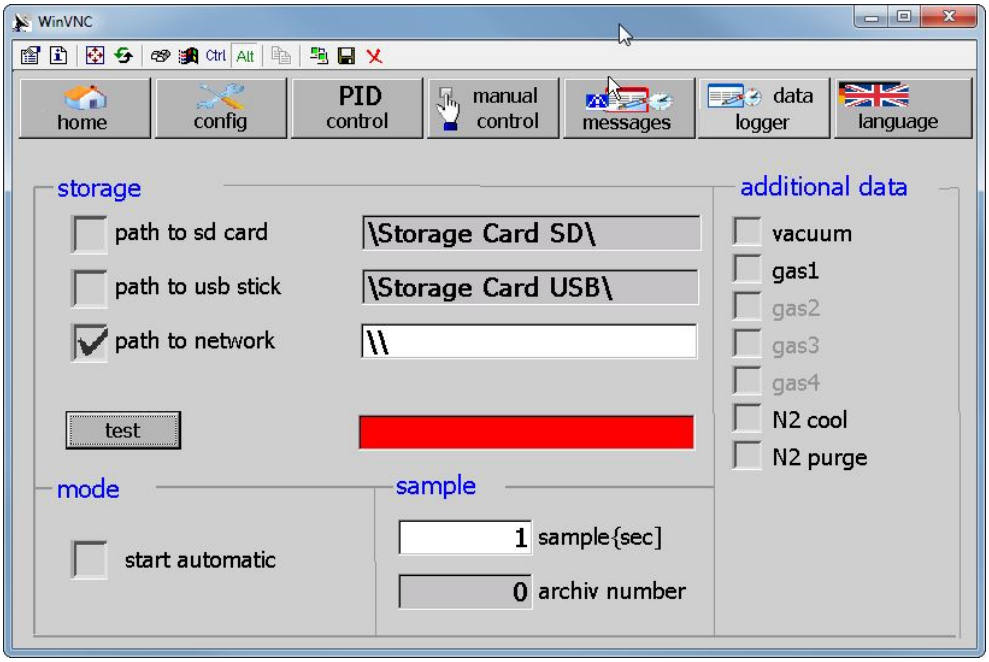


Figure 38: Data logger menu with unavailable storage path

2.4.2 Selection of process data

Typically the process data cover time, set temperature, actual temperature, power, temperature of cooling water, flow of cooling water, pressure inside of process chamber.

TIME[sec]	SET[°C]	TEMP[°C]	Power[%]	Water [°C]	Water [l/mi	Pressure[hf	V_valve	V_pump	Gas1	Flow1[l/mir	N2_cool	N2_purge	Error	Warning	Init
0	20,6715	20,6	2,10E-02	15,06438	0	1000	False	False	True	0,180484	False	False	0	0	0
1	20,78851	20,6	6,43E-02	15,18012	0	1000	False	False	True	0,3859565	False	False	0	0	0
2	20,91201	20,6	0,1174808	15,19459	0	1000	False	False	True	0,4717351	False	False	0	0	0
3	21,04852	20,6	0,1851521	15,24523	0	1000	False	False	True	0,4962643	False	False	0	0	0
4	21,17202	20,6	0,2544425	15,1982	0	1000	False	False	True	0,5065982	False	False	0	0	0

If required, flags indicating the status vacuum valve, of vacuum pump and of process gas flow, the value of process gas flow, flags for the flow of cooling and of purging gas as well as codes for errors, warnings and initialization can be shown in the process data.

In order to have additional values and flags logged in the process data file, the respective check boxes need to be checked (see Figure 39).

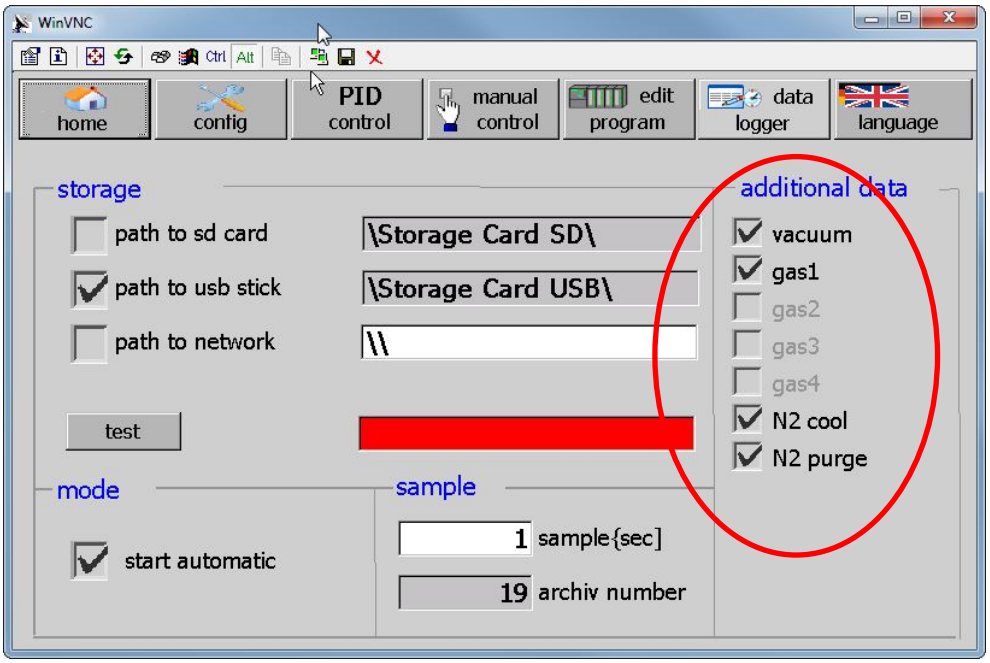


Figure 39: Checked boxes in frame "additional data"

2.5 Export and import of programs

All programs stored on the touch panel can be exported to different storage media. By pushing the button “im-export” on the start screen (see Figure 40) the import/export menu is selected.

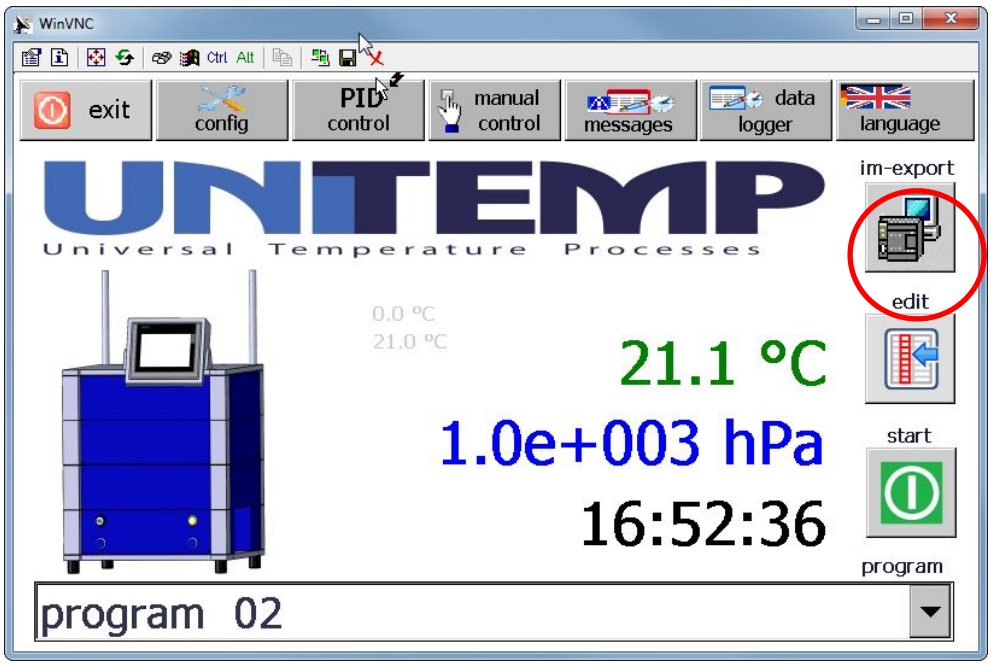


Figure 40: Location of push button "im-export" on start screen

The import/export menu (see Figure 41) clearly defines the steps required for importing programs from external storage media or for exporting programs to external storage media.

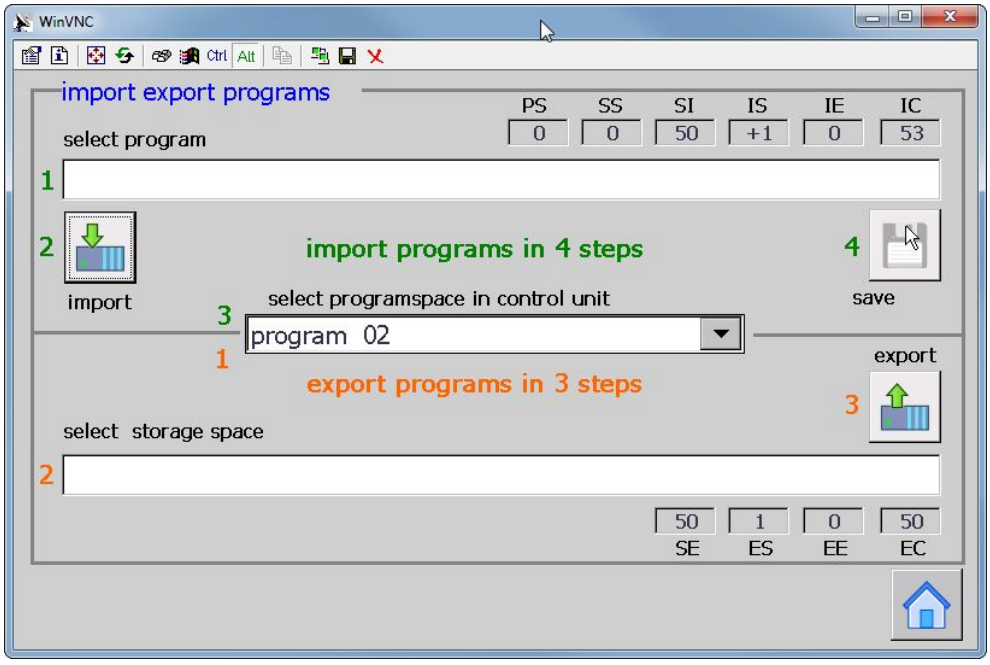


Figure 41: Import/Export menu

The three steps for export of a program to external storage media is explained in the next figures:
First the program to be exported has to be selected through the pull down menu.

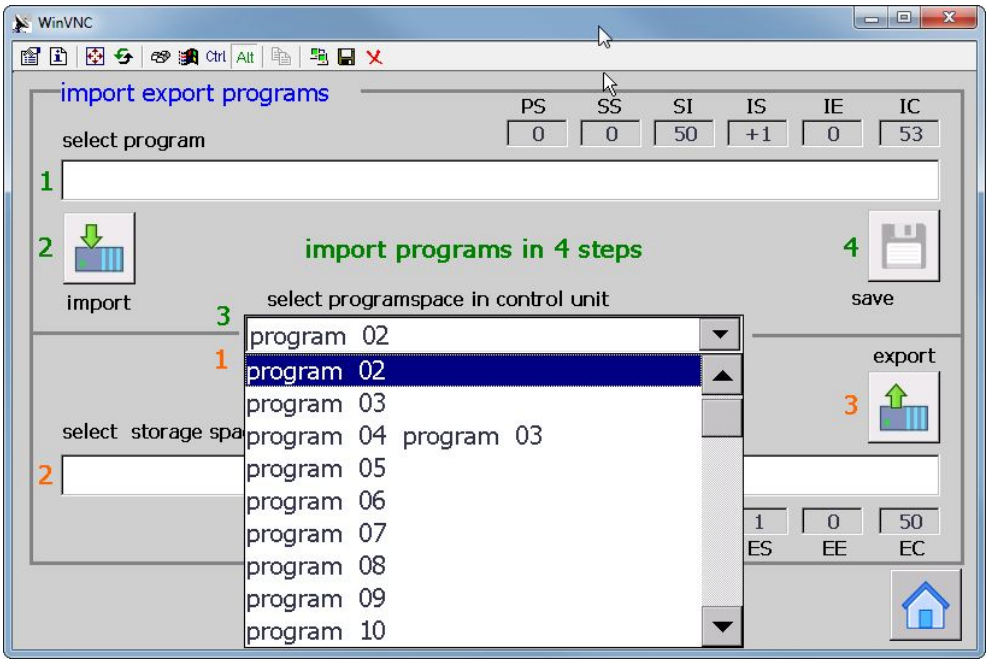


Figure 42: Selection of program to be exported through pull down menu

As next step the storage destination has to be chosen (see Figure 43). In the present case the USB memory stick shall be selected. After selecting the destination “Storage Card USB” the “OK” button has to be entered.

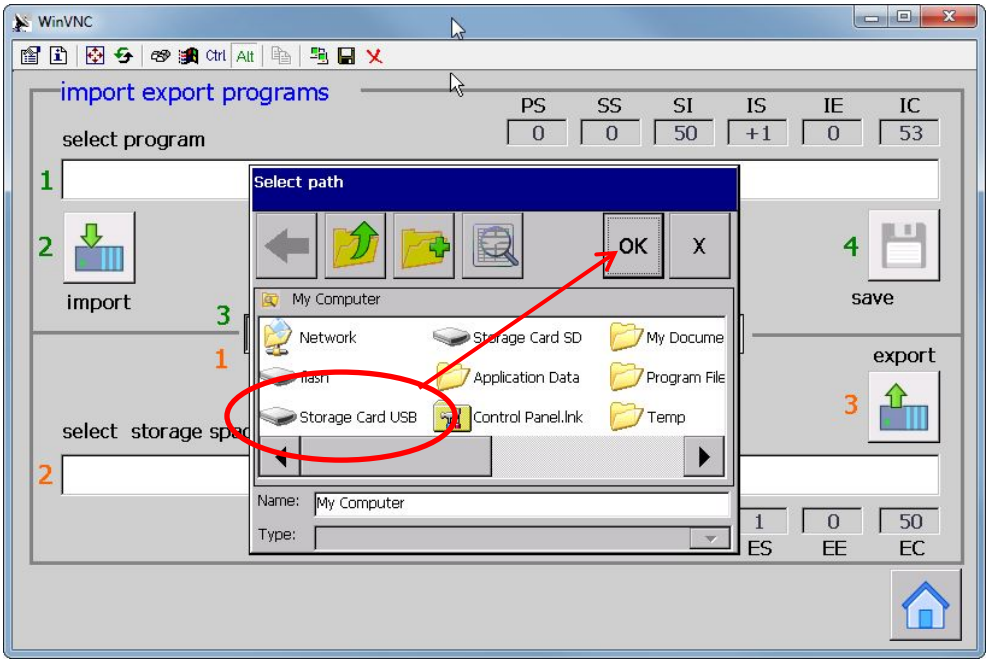


Figure 43: Selection of destination path for program export

The selected path appears in the line “select storage space” (see Figure 44).

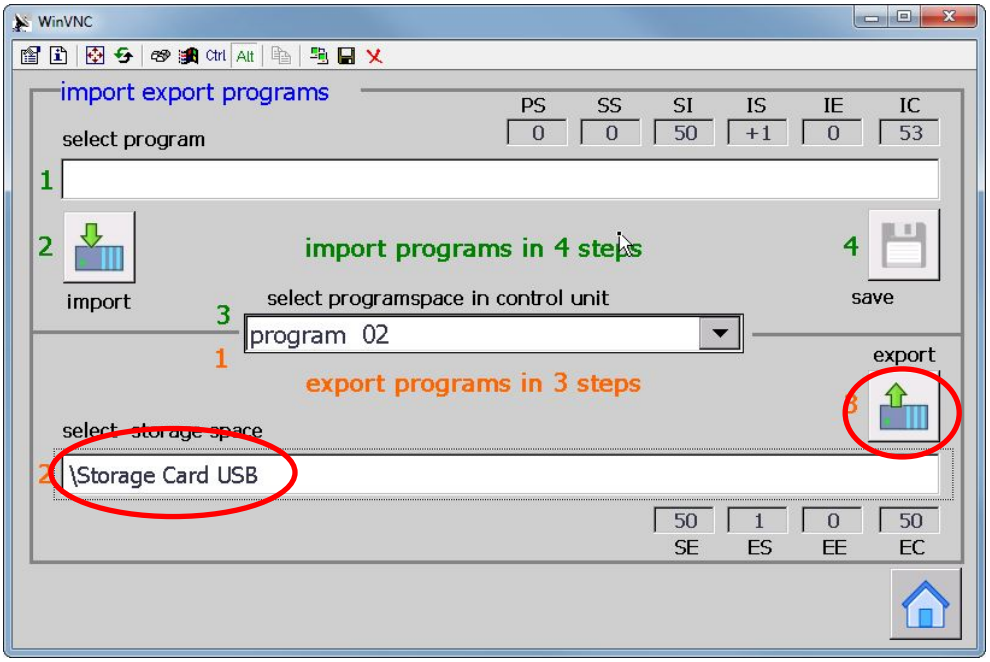


Figure 44: Confirmation of destination path for export

The process of program export is started by pushing the “export” button.

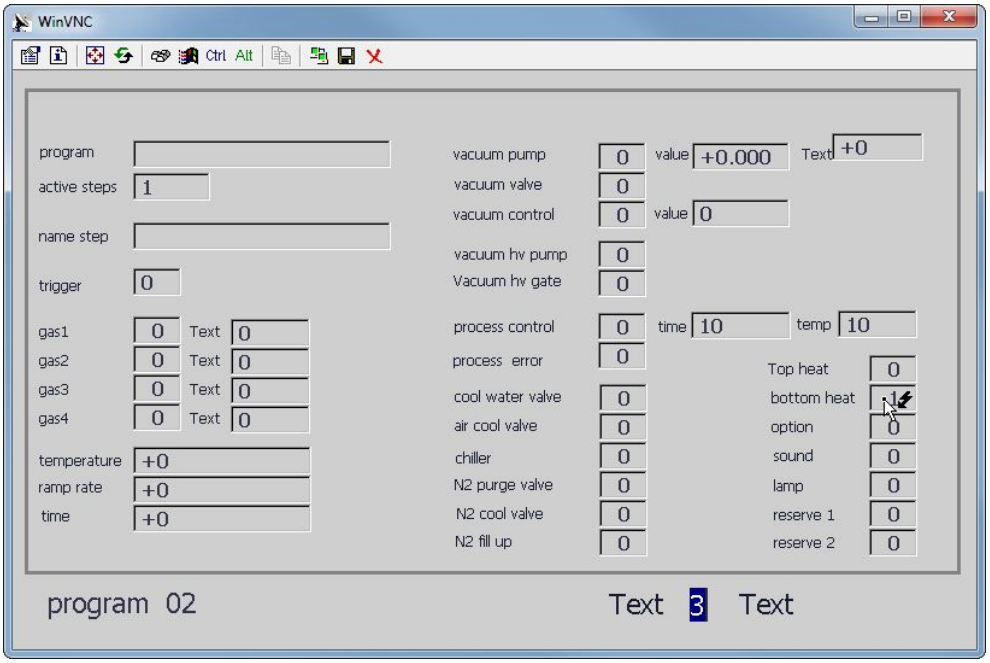


Figure 45: Operation of program export

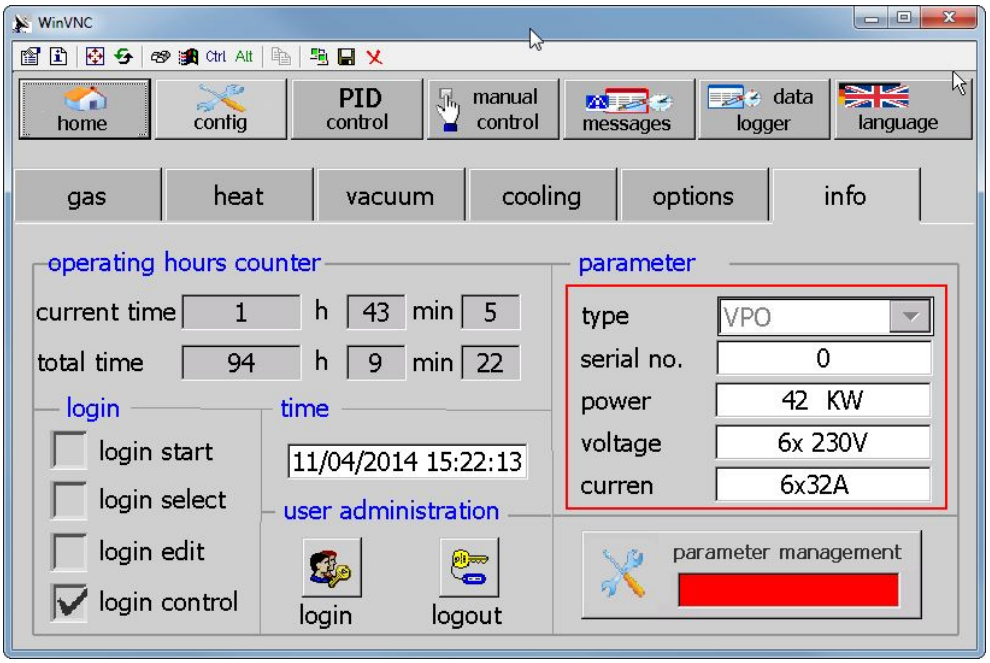
The progress of program export might take some time (it cannot be shortened). At the end of program export, the import/export menu reappears. By pushing the home button the start screen can be reached.
As the import of programs is similar to the export of programs it will not be described in further detail.

2.6 Access management

There are five user levels which define the available user rights. The following matrix shows the available rights of each user level:

Available Rights / Login name:	Start of process	Selection of recipe	Edition of recipes	Manual control	Change of PID parameters and control process settings	Administration of users
admin	X	X	X	X	X	X
control	X	X	X	X	X	
edit	X	X	X	X		
select	X	X				
start	X					

The login requirement for the four lowest levels (select, start, edit, control) can be waived by the system administrator (login: “admin”). In Figure 46 the login requirements for user levels “start”, “select” and “edit” have been waived (the respective check boxes are unchecked).



Unchecked boxes, i.e. waived log-in requirements for user levels start, select and edit

Figure 46: Configuration information screen with waived login requirements

Each login (for all five user levels) expires after a certain time (which can be set by system administrator).