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ProStar 510
Column Thermostat

Operation Manual

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Introduction

The ProStar 510 is the column thermostat that provides exact and reproducible temperature control. Large area heating plates guarantee a safe and stable operation at a temperature range from ambient+5°C up to 90°C, while forced air circulation ensures excellent temperature uniformity in the column area.

A temperature controlled column area contributes to the reproducibility of retention times, separations are more consistent at a constant temperature and some separations are more efficient at elevated or sub–ambient temperatures. With a temperature controlled column area room temperature changes will no longer affect your separations.

With the optional Peltier cooling the ProStar 510 allows a temperature range from 5°C up to 90°C and temperature changes are achieved in shorter time.

An injector can be mounted inside the oven to achieve a maximum temperature stability of the HPLC system.

With the ProStar 510 it is possible to perform temperature gradients to optimize a separation.

The ProStar 510 column thermostat is compatible with most HPLC instruments. It has a remote I/O connector for communication with other HPLC components.

Installation

Unpacking

Inspect the ProStar 510 for indications of damage. Damage that occurs to the ProStar 510 in transit, indicated by damaged containers, is the responsibility of the carrier and should be reported to the carrier immediately.

Shipping containers should be inspected by the carrier if a claim is filed.

For contents of shipping containers see packing list in container.

The ProStar 510 is designed to be placed vertically or horizontally, so it can be located either beside, under, or on top of your other HPLC components.

The ProStar 510 is ready to use in a vertical position.

The display/keyboard unit can be rotated 90° counter clockwise by a service engineer or at the factory. Then the ProStar 510 can easy be programmed in a horizontal position.

The ProStar 510 now only needs a power connection to operate.

NOTE: Be sure that the ventilation holes in the rear panel and in the right side panel (ProStar 510 in vertical position) are free of blockage, so that proper functioning of the ProStar 510 is guaranteed. Leave at least 3 centimeters of free space at the right–hand side and 6 cm at the rear side of the ProStar 510.

NOTE: Do not install the ProStar 510 in places subject to excessive dust, direct sunlight or shocks and do not place it near any other source of heat as this will disrupt the cooling of the oven**.**

Power connections

Before plugging in the power cable, check the voltage setting of the ProStar 510 at the input socket on the rear panel. Make sure that the voltage setting is identical with the voltage of your local power supply. If the indicated voltage is not correct, select the proper voltage by removing, inverting, and then re–entering the voltage selector cartridge. Check if the right fuses are installed, if not, replace them with the right fuses.

For 110 V_{AC}, use two 5 AT-fuses (slow).
For 220 V_{AC}, use two 2.5 AT-fuses (slow).

NOTE: All fuses must be UL listed and CSA certified!

WARNING:
FIRE HAZARD

RISK OF FIRE REPLACE FUSES AS MARKED!

When the voltage selection and fuses are correct for your power source, plug in the power cable.

Control I/O

The Remote I/O connector on the rear panel of the ProStar 510 permits communication with other HPLC components. The following list provides pin-out and functional description for the Remote I/O connector inputs and outputs.

Table 1: Remote I/O connector (P1).

Pin no.	Function	
1	GND	
2	INPUT 1	Start temperature program (TTL).
3	INPUT 2	Panic stop (TTL).
4	Not used	
5	COMM 1 Common	Oven Ready
6	COMM 1 NC	
7	COMM 1 NO	
8	COMM 2 Common	Alarm (Vapor and Temperature)
9	COMM 2 NC	
10	COMM 2 NO	

NOTE: All TTL inputs active low, must be low for at least 1 second.
All relay contacts (COMM 1 and COMM 2): V_{max} = 28 V_{DC} / V_{AC} , I_{MAX} = 0.25 A.

The oven ready relay will be activated if the actual temperature is within ±0.5°C of the setpoint temperature. Once the oven ready relay is activated it will stay activated until a new setpoint is activated or the temperature control is switched OFF.

The alarm relay will be activated if a vapor alarm(see page 21), or a temperature alarm (see page 23) is detected.

CAUTION

Varian, Inc. will not accept any liability for damages directly or indirectly caused by connecting this instrument to devices which do not meet relevant safety standards.

Fluid connections

To avoid extra void volumes use short tubing connections. Refer to Figure 1.

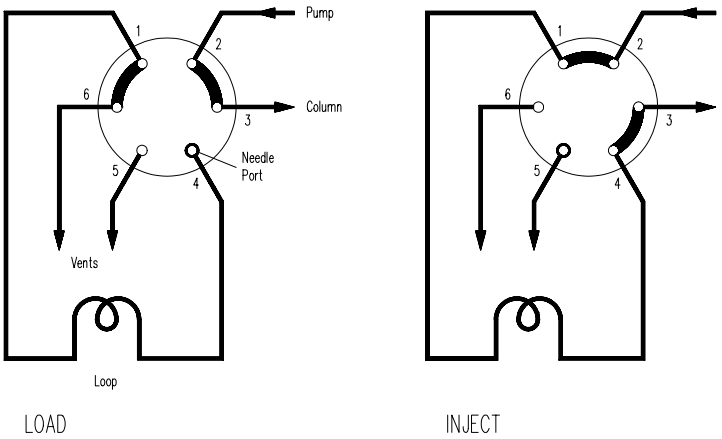


Figure 1 Flow diagram of a manual injection valve

When an injection valve is mounted inside the ProStar 510, connect the column to port 3 of the valve and mount the column with the column fixation springs on the oven door, see Figure 2. Tubing from the pump should be connected to port 2 of the valve. The factory installed loop is connected to port 1 and 4 and has a volume of 20 µl. Other loops can be installed.

Connect two waste lines from port 5 and 6 to prevent leaking of solvent inside the oven.

If no injection valve is installed, mount the column with the column fixation springs in the oven compartment. Remove the column fixation bridge from the oven door and screw it on the rear side of the oven compartment.

The inlet tubing from the pump, the outlet tubing to the detector and the waste tubing can be positioned between the edges of the oven compartment and the oven door: the flexible rim of the oven door will prevent air and heat leakage from the oven.

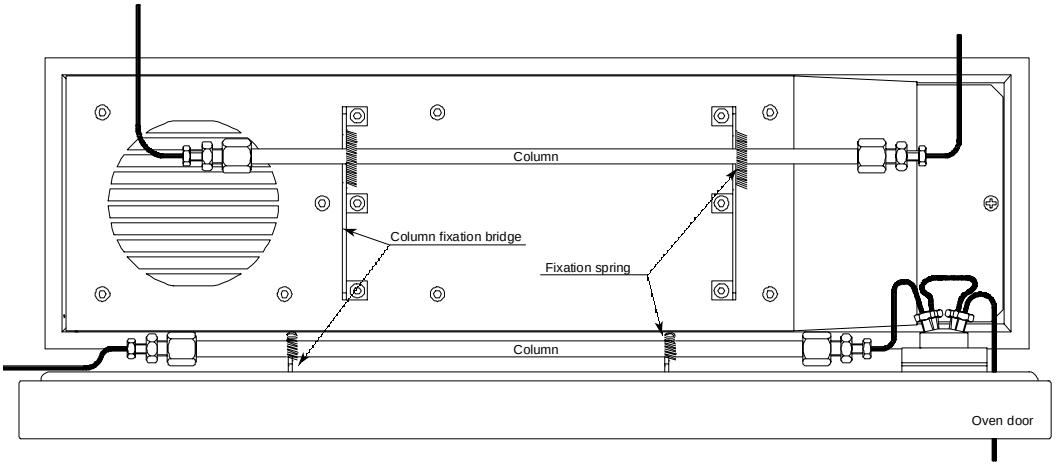


Figure 2 Mounting the column inside the ProStar 510

Instrument Description

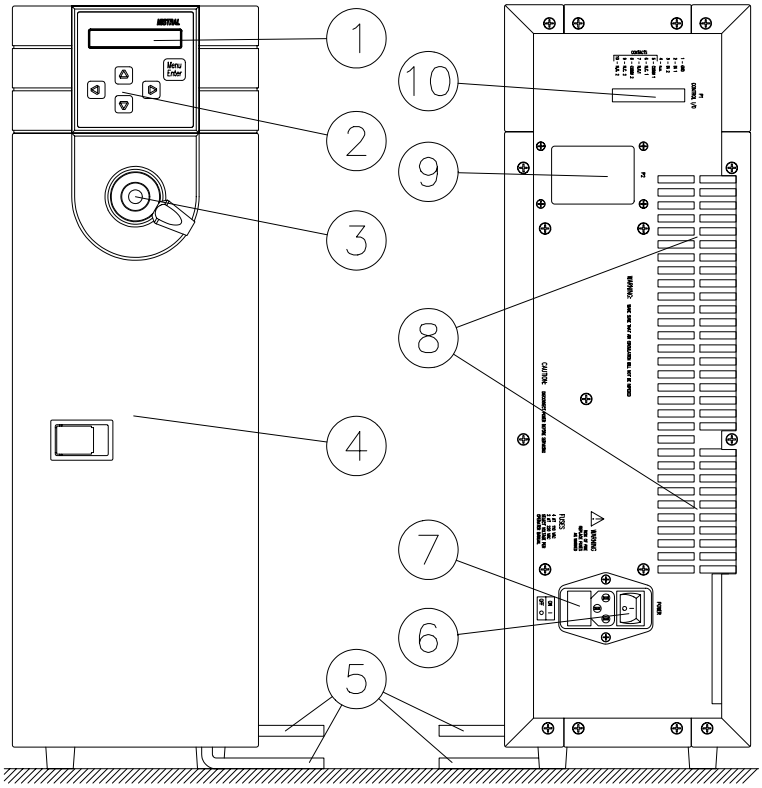
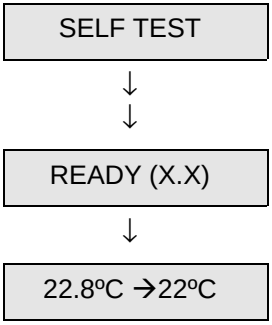


Figure 3 Front and Rear View of the ProStar 510

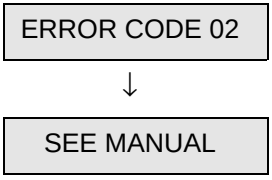
1. Display (adjustable for horizontal and vertical use of the ProStar 510)
2. Keyboard (adjustable for horizontal and vertical use of the ProStar 510)
3. Injection valve (optional)
4. Oven door
5. Waste Tubing
6. Mains switch
7. Fuses and mains voltage selector
8. Ventilation holes (outlet)
9. RS232C connector
10. Remote I/O connector

Operation

After power on, the ProStar 510 will perform a self test. After the self test without error messages the ProStar 510 will show the temperature screen:



If an error is found, the ProStar 510 will give an error code on the display. See Table 2, page 5, for code explanation, press any key to continue.



If necessary the ProStar 510 will automatically go to the SYSTEM SETTINGS (see page 21).

If the error will not affect its functioning, the ProStar 510 will continue the self test.

How to use the keyboard

The ProStar 510 keyboard has five keys to control all its functions: four cursor keys and **[menu/enter]**.

With **[menu/enter]** it is possible to enter a menu or enter a value.

With ◄ and ► it is possible to step horizontally through a line.

A blinking cursor indicates its position in the line.

When the cursor is blinking at the first position of the line, it is possible to step vertically through the lines of a menu with ▲ and ▼.

When the cursor is blinking at a numeric value, it can be increased with ▲ and decreased with ▼.

Pressing ▲ and ▼ for a longer period will increase the speed.

If the cursor is blinking at a logical value (**ON**/**OFF** or **START**/**STOP**), the value can be toggled with ▲ or ▼.

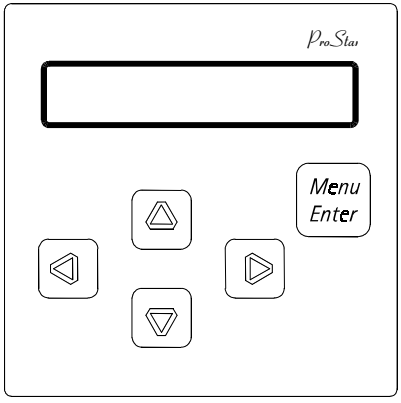


Figure 4 ProStar 510 Keyboard

Programming

After powering up, the ProStar 510 will display the temperature screen:

22.8ºC →25ºC

actual temp. → setpoint

This screen shows the actual temperature and the setpoint temperature.

If the setpoint temperature is blinking (in the temperature screen shown as **25°C**) the temperature control is **OFF**.

The menu screen is entered by pressing **[menu/enter]**:

OFF **P**ROG STOP

The cursor is blinking at the **P** of PROG; with ◂ and ▸ it is possible to highlight one of the other items:

ON/OFF: Activating the temperature control

With the ON/OFF item the temperature control can be turned ON or OFF: this depends on its actual status. The value displayed is the actual status.

PROG: Entering the program menu

Highlight the **PROG** item and press the **[menu/enter]** key. In the program menu it is possible to program the temperature setpoint and the temperature control program.

START/STOP: Starting the temperature program

With the **START/STOP** item the temperature control program can be started or stopped depending on its actual status. The value displayed in the screen is the actual status.

Remember that it takes some time before the oven temperature reaches the setpoint temperature. Programming examples, page 18, shows an example how a temperature program may look and shows the result of the temperature program on the oven temperature.

The temperature program can also be started with an external input (see page 4).

NOTE: At the end of the temperature program the temperature control will return to its initial setpoint temperature, if it was **ON** at the moment of starting.

At the end of the temperature program the temperature control will turn **OFF**, if it was **OFF** at the moment of starting.

Temperature programming

After the program menu has been entered as described in Programming, page 12, you have access to two ways of programming:

1. **FIXED TEMPERATURE**, only the initial temperature has to be entered.

2. **TEMPERATURE PROGRAM**, 10 temperature changes can be programmed in two different modes:

- **STEP/DURATION.** Programming a new temperature setpoint and its duration.

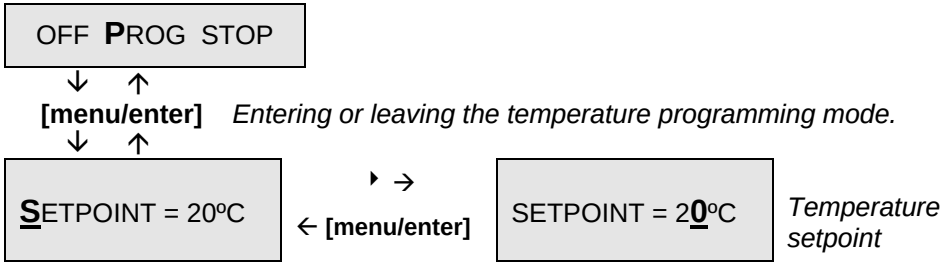
- **RAMP**. Program a new temperature and the temperature ramp, this way of programming exactly defines the temperature change. The ProStar 510 will calculate the time necessary to reach the programmed setpoint with the programmed ramp.

The **STEP/DURATION** and the **RAMP** method can be combined in one temperature program, see "Programming Examples", page 18, the second example.

How to step through the temperature program and editing a value in one programming line is shown on the next pages.

Fixed temperature

The initial temperature is the first line of the program:



After the new temperature setpoint has been programmed press **[menu/enter]** to enter and store the new value. Leave the temperature programming mode by pressing **[menu/enter]** once more.

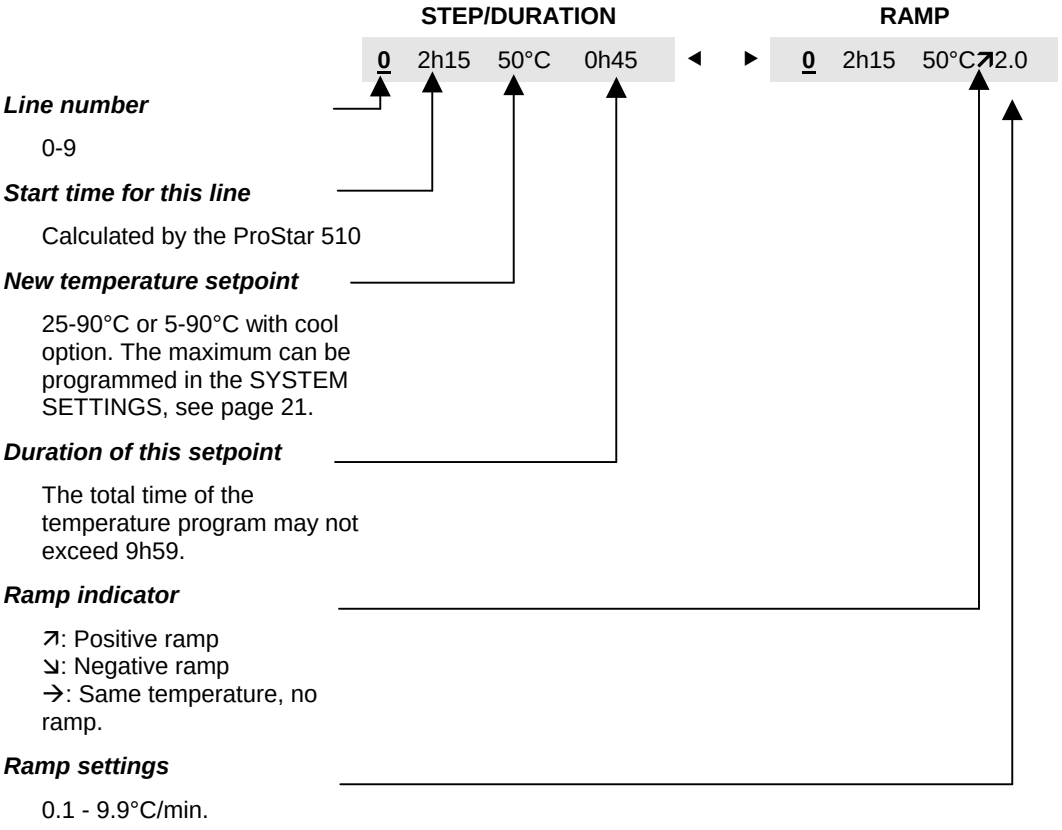
The new programmed temperature setpoint is activated when the temperature control is switched ON from the menu screen, see "Programming", page 12.

Temperature program

The temperature program consists of 10 lines. Each line consists of four parameters: the line number (0-9), the elapsed time, the new temperature setpoint and the **STEP/DURATION** (duration of the setpoint) or **RAMP** parameters.

NOTE: A programming line will be saved with **STEP/DURATION** parameters **OR** with **RAMP** parameters. Both types of parameters can be combined within the temperature program.

Temperature program parameters:



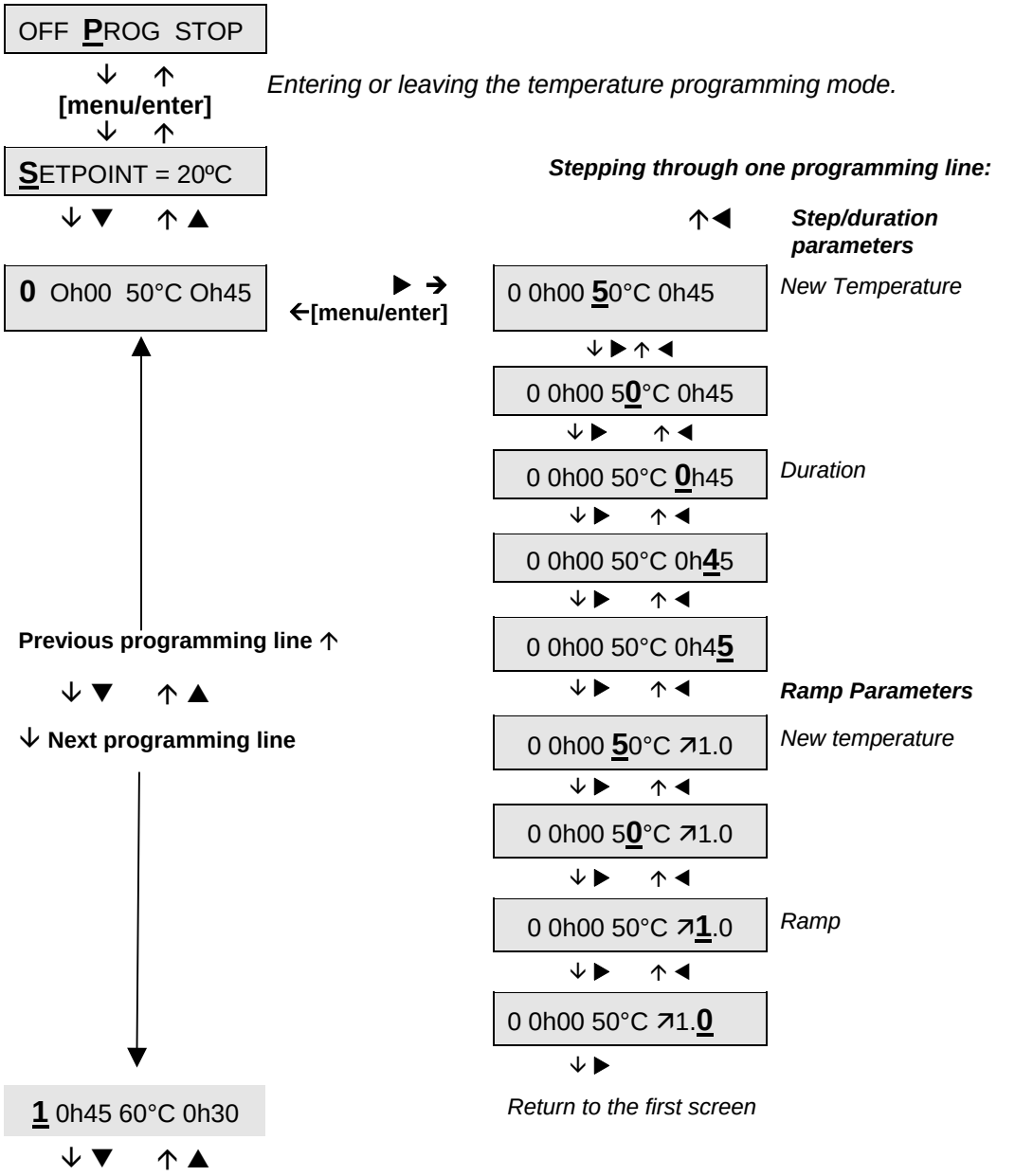
NOTE: Though it is possible to program a ramp up to 9.9°C/min, only the following ramp ranges can be guaranteed:

Ramp up:	0.1 - 5.0°C/min
Ramp down	0.1 - 1.5°C/min (only when cool option is installed)

A negative ramp can only be programmed when the cool option has been installed.

If a time of **0h00** is programmed in one of the lines in the temperature program or a ramp of **0.0** is programmed in one of the lines of the temperature program, that line is skipped and the ProStar 510 will not execute this line and go to the next line.

Temperature Programming Structure



NOTE: To switch between the **Step/duration parameters** and the **Ramp parameters** press ◀ or ▶until the required parameters appear in the display.
Only the displayed parameters will be executed in the temperature program, which can be a combination of both parameters.

After the temperature program line, with new temperature setpoint and duration or ramp, has been edited correctly, it is entered and stored by pressing **[menu/enter**]. The cursor will return to the number at the beginning of the line.

When the temperature program is edited correctly press **[menu/enter]** to return to the menu screen.

Programming examples

This section contains two examples of temperature programs. The first is an example of **STEP/DURATION PROGRAMMING**, the second is an example of the combination of **STEP/DURATION** and **RAMP PROGRAMMING**.

Temperature program with STEP/DURATION:

0 0h00 20° 1h00
1 1h00 30° 1h30
2 2h30 05° 2h15
3 4h45 60° 1h30
4 6h15 50° 1h45

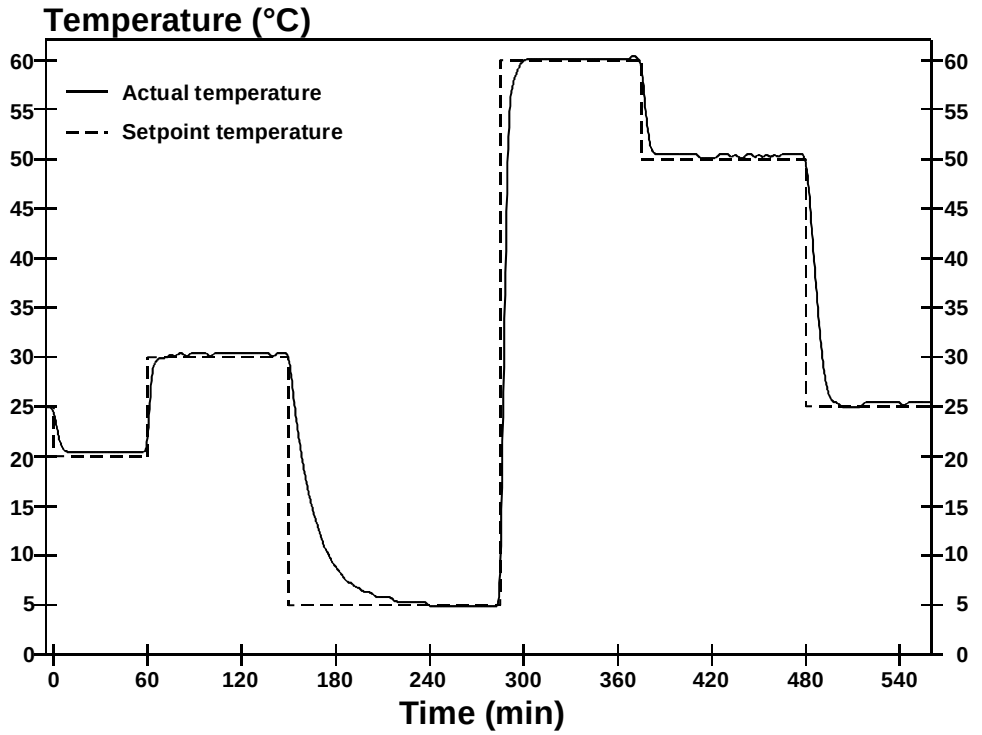


*Figure 5 Temperature diagram with **STEP/DURATION** programming.*

Temperature program with RAMP and STEP/DURATION:

In this example both options are used:

- The **RAMP PROGRAMMING** to control the temperature changes
- The **STEP/DURATION PROGRAMMING** for temperature duration after a change. The temperature setpoint of those lines is equal to the previous setpoint.

0 0h00 25° 0h10

1 0h10 35° ↗0.5

2 2h30 35° 0h20

3 0h50 45° ↗1.0.

4 1h00 45° 0h10

5 1h10 25° ↘1.0

6 1h30 25° 0h10

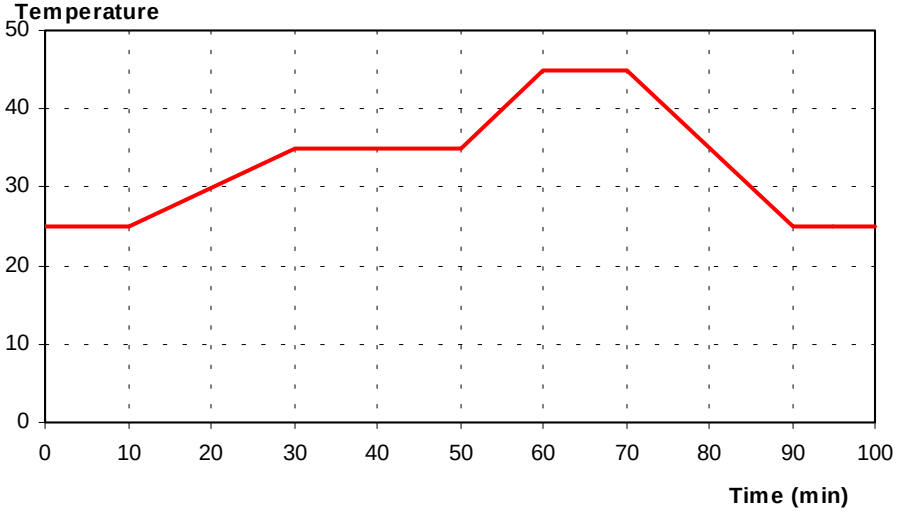


*Figure 6 Temperature diagram with **RAMP** and **STEP/DURATION** programming.*

NOTE: When programming a temperature ramp, insure that the ProStar 510 can reach the previous programmed setpoint. If that is not the case, the ProStar 510 will try to follow the theoretical programmed temperature.

System settings

The system settings contain:

- Temperature calibration parameters
- The sensitivity of the vapor detector.
- The maximum programmable temperature.

To enter the system settings menu press and hold a key during power up.

The moment the screen displays **SYSTEM SETTINGS** release the key and the ProStar 510 is in the **SYSTEM SETTINGS** menu:

SYSTEM SETTINGS

With ▲or ▼ you can move through the **SYSTEM SETTINGS** lines.

After all settings have been entered, press **[menu/enter]** to leave the **SYSTEM SETTINGS**.

Vapor sensor

In the **SYSTEM SETTINGS** menu it is possible to make the vapor sensor more or less sensitive. The vapor sensor has three values: low **(LO)**, standard **(STD)** and high **(HI).**

VAPOR SENSOR HI

The indication **HIGH** represents a very sensitive vapor sensor, which will give a vapor alarm at low vapor concentrations in the oven.

The indication **LOW** corresponds with a less sensitive vapor sensor.

A more volatile eluent will cause the vapor alarm to sound sooner than a less volatile eluent leaking at the same rate. The same applies for

higher temperatures at which a vapor alarm is detected sooner for smaller amounts of eluent leaking into the oven.

To change the vapor sensitivity move the cursor with ◂ or ▸ to the current value and change it to **LO**, **STD** or **HI** with ▲ or ▼. Enter the value by pressing **[menu/enter].**

NOTE: The vapor sensor is not active in the first 2 minutes after power up.

See Vapor alarm, page 25, for the actions the ProStar 510 takes when a vapor alarm occurs.

Temperature calibration

To insure that the programmed temperatures are equal to the actual temperatures in the oven the ProStar 510 has been calibrated at two (ProStar 510 without cool option) or three temperatures (ProStar 510 with cool option).

The calibration can be found on the rear side of the keyboard of the ProStar 510 and in the temperature calibration screens.

NOTE: Changing these values will result in improper temperature control of the ProStar 510.

If the calibration parameters are lost because of a battery back–up error.

Re-enter the calibration values which are on the sticker underneath the keyboard of the ProStar 510.

Temperature calibration screens with default values:

Calibrate 10.0° C	(Only Prostar 510 with cool option.)
Calibrate 30.0° C	
Calibrate 90.0° C	

To re-enter the values, move the cursor with ◀ or ▶to the last digit of the value and change it with ▲ or ▼], Enter the value by pressing **[menu/enter].**

Maximum temperature

Program the maximum allowed programmable temperature of the column. This can be useful when a column is used which may not be heated above a certain temperature.

Max Temp 90.0° C

If the maximum temperature is changed and the maximum temperature is lower than one of the programmed temperatures in the temperature program, the ProStar 510 will display a warning:

CHECK SETPOINTS

All temperatures will be set to the default temperature of 25°C.

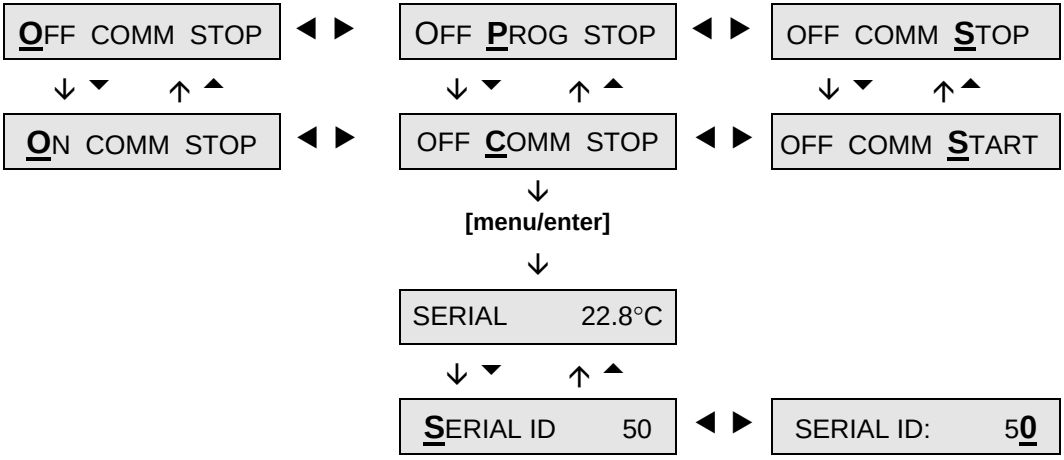
Serial interface

The serial interface enables the ProStar 510 to be controlled via the Varian Star Workstation.

To enter the communication menu and activate the serial interface, you have to toggle from the **PROG** item to the **COMM** items and press **[menu/enter].**

The **SERIAL MODE** is now active.

In the **SERIAL MODE** the device identifier of the ProStar 510 can be changed, see programming chart below.



NOTE*:* While changing the device identifier, serial communication and external I/O control are not possible*.*

NOTE: When the ProStar 510 is 'RUNNING' a temperature program it is not possible to change the device identifier*.*

The **SERIAL MODE** can be exited by pressing **[menu/enter].** The ProStar 510 will return to the menu screen and all running activities of the ProStar 510 will be stopped.

Alarms and warnings

Vapor alarm

When a vapor alarm is detected the ProStar 510 responds with the following action:

- The alarm buzzer will sound.
- A message is displayed:

  VAPOR ALARM !

- The alarm relay is activated.
- The temperature control is turned OFF
- The temperature program is stopped if running.

After pressing a key the ProStar 510 will reset the alarm and return to the temperature menu. The vapor sensor is again disabled for 2 minutes.

See also page 21, Vapor sensor.

Temperature alarm

The ProStar 510 has a protection against incorrect functioning of the oven. This temperature alarm will not be activated if the maximum temperature settings (see “System Settings”**,** page 23) are exceeded, but it detects any irregularities in the temperature control.

The alarm will be activated when any of the following phenomena occurs:

- The actual temperature drops below 2°C.
- The actual temperature rises above 95°C.
- When the temperature control is on full power and no temperature change of more than 2°C occurs within 1 minute (e.g., if the oven door is not closed).

When a temperature alarm is detected the ProStar 510 responds with the following actions:

- The alarm buzzer will sound.
- The temperature alarm screen is displayed

  TEMP ALARM!

- The alarm relay is activated.
- The temperature control is turned OFF and the temperature program is stopped if running.

After pressing a key, the ProStar 510 will reset the alarm and return to the temperature menu.

Error codes

Error codes displayed during power up:

ERROR CODE 02

An error is found, the ProStar 510 will give an error code on the display. See Table 2 for code explanation, press any key to continue.

Table 2: Error codes of ProStar 510.

Error code:	Cause	Action
01	Battery power low - potential data loss	No action required, ProStar 510 will continue with self test after pressing a key.
02	Battery back–up error - all values reset to default	Check temperature calibration values. If the error happens frequently, call service engineer.
03	RAM test error	Call service engineer.
04	EPROM test error	Call service engineer.
05	Reserved	
06	Reserved	

Warnings

When programming a new temperature setpoint the following messages may be displayed:

MINIMUM = 5°c

You are trying to program a temperature value which is below 5°C, in case of a ProStar 510 with cool option.

MINIMUM = 25°c

You are trying to program a temperature value which is below 25°C, in case of a ProStar 510 without cool option.

MAXIMUM = 90°c

You are trying to program a temperature value which exceeds the maximum temperature programmed in the **SYSTEM SETTINGS** (default 90°C).

When programming a duration the following message may be displayed:

MAXIMUM VALUE!

You are trying to enter a duration with which the total time of the ten lines exceeds 9h59. Increase the temperature duration to reduce the total time of the temperature program.

When programming a ramp the following messages may be displayed:

EXIT RAMP RANGE!

You are entering a positive ramp larger than 5.0°C/min or a negative ramp larger than 1.5°C/.min. Larger values are allowed but it is not guaranteed the ProStar 510 can perform the programmed ramp.

MINIMUM = 0.1!

MAXIMUM = 9.9!

You are trying to enter a ramp smaller than 0.1°C/min or larger than 9.9°C/min, the ProStar 510 will not allow it.

MAX TIME> 9h59!

You are trying to enter a ramp which result in a total time which exceeds 9h59, the ProStar 510 will not allow it. Increase the temperature ramp to reduce the total time.

NO COOL NO RAMP

You are trying to program a negative ramp when there is no cool option installed.

NO RAMP IF <25°C

You are trying to program a negative ramp to a temperature setpoint lower than 25°C, this is not allowed.

Warning when programming a maximum temperature in the SYSTEM SETTINGS:

CHECK SETPOINTS

The maximum temperature is changed and the maximum temperature is lower than one of the programmed temperatures in the temperature program.

All temperatures will be set to the default temperature of 25°C.

Appendices

Specifications

Temperature Control

Temperature range:	+5°C up to 90°C, with 1°C increments, with cool option, (18°C below ambient). Ambient + 5°C up to 90°C, with 1°C increments, without cool option.

NOTE: The ambient temperature and humidity directly influences the lower temperature limit of the ProStar 510. When the temperature and/or the humidity rises, the lower temperature will also rise. Typically a –T of 18°C is possible.

Temperature accuracy:	better than 0.1°C, measured at 30°C in the center of the compartment
Temperature stability:	better than 0.1°C, measured at 30°C in the center of the compartment
Temperature reproducibility:	better than 0.1°C, measured in the center of the compartment
Temperature gradient:	better than 0.2°C, measured in the column area.

Temperature change ProStar 510 with cool option:

Up:	10°C/min up
Down:	3 °C/min down from 70°C to 30°C.

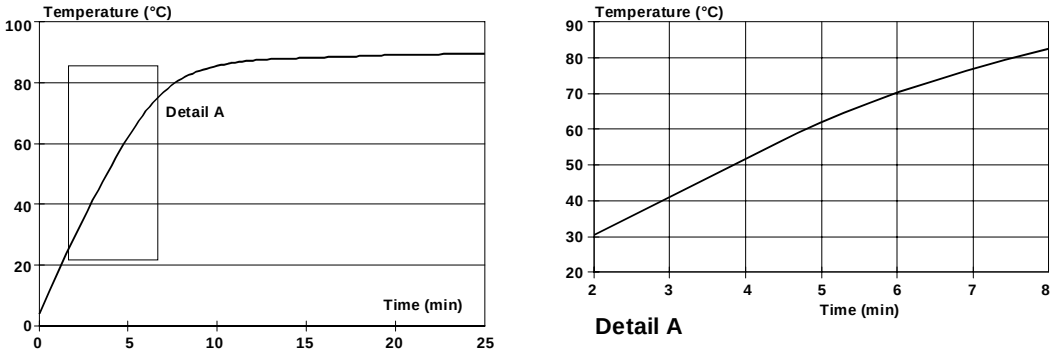


Figure 7 Temperature from 5°C up to 90°C, measured in ProStar 510 with cool option.

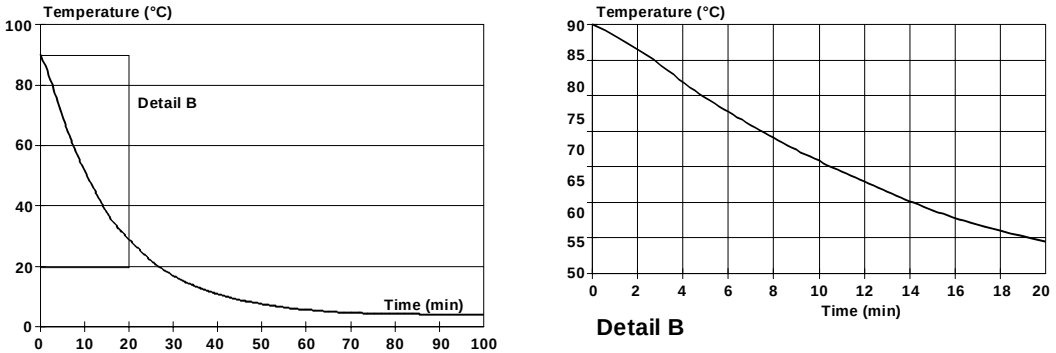


Figure 8 Temperature from 90°C down to 5°C, measured in ProStar 510 with cool option.

Temperature change ProStar 510 without cool option:

Up: 7°C/min up

Down: 0.5 °C/min down from 70°C to 30°C.

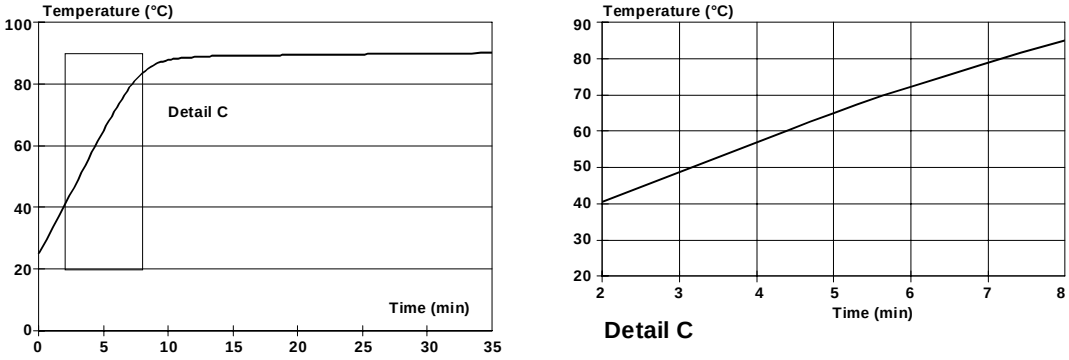


Figure 9 Temperature from 25°C up to 90°C, measured in ProStar 510 without cool option.

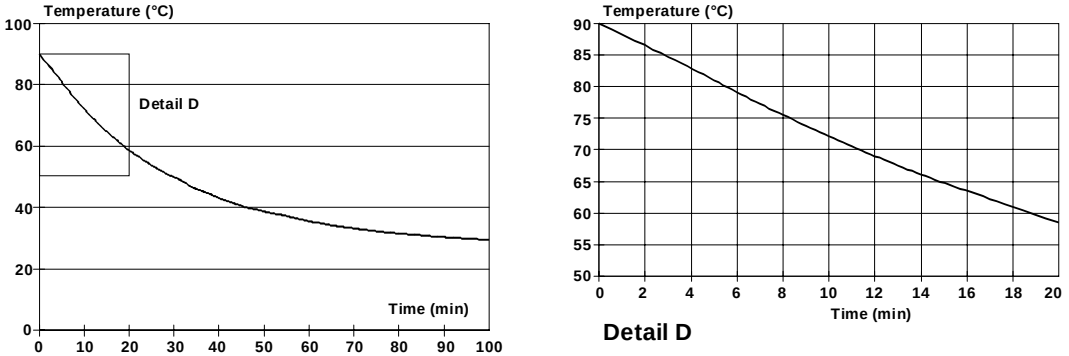


Figure 10 Temperature from 90°C down to 30°C, measure in ProStar 510 without cool option.

Time programmable temperature change:

Time base, 9hr59 total time with 1 minute increments. Maximal 10 programmable lines.

Programmable temperature ramp:

Up: 0.1 - 5.0°C/min

Down: 0.1 - 1.5°C/min, 90°C to 25°C (Only possible if cool option is installed).

NOTE: It is possible to program a ramp up to 9.9°C/min. Only the above listed ramp ranges can be guaranteed.

Memory: Battery back–up memory for programmable parameters.

Safety

Detection: Vapor sensor with selectable alarm settings.

Limiter: Temperature limit switch at 125°C.

Electronics: Watchdog circuit for microprocessor check.

Electrical

Electronics:	68000 microprocessor system	
Communication:	RS232C	
	Outputs:	Relay alarm output temperature or vapor sensor.
		Relay oven ready.
		Buzzer alarm temperature or sensor.
	Inputs:	
		Start temperature program.
		Emergency shut–down.
Power requirements:	220 V_{ac} ±10%, 50 Hz 110 V_{ac} ±10%, 60 Hz	
Power consumption:	400 VA_{max}	

Display

Displayed parameters:	Actual temperature in 0.1°C.
	Setpoint temperature in 1°C.
	Elapsed time in hours and minutes.

Dimensions (in vertical position)

Dimensions (HxWxD):	514 x 170 x 325 mm, (20.5 x 6.8 x 13.0 in.) usable in horizontal or vertical position.
Oven dimensions (HxWxD):	400 x 110 x 50 mm, (16.0 x 4.4 x 2 in.)
Weight:	16 kg (35.2 lb.)

Programming Chart