

PROTHERM™

Heat Treating Controllers

General Manual for End Users



CONNECT WITH US



MANUAL #: 015

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TECHNICAL ASSISTANCE

For all questions or concerns regarding the operation of a **PROTHERM™ CONTROLLER**, please consult the last page of this manual for contact information.

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1 HARDWARE

1.1 Overview

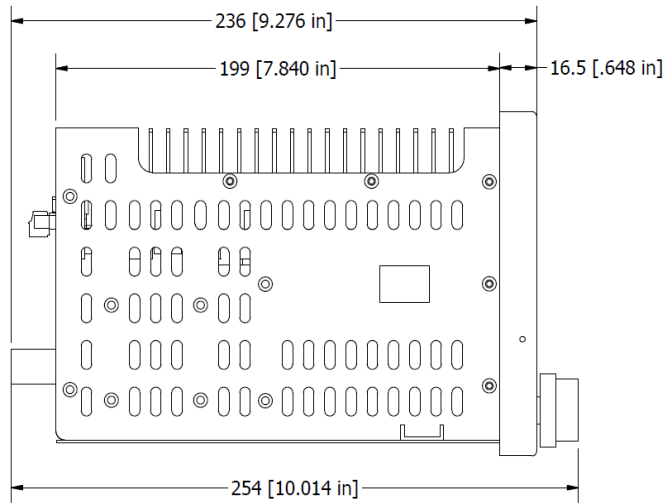
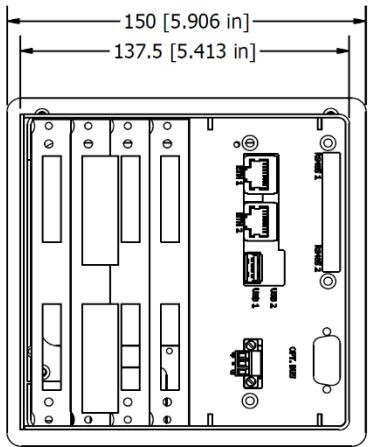
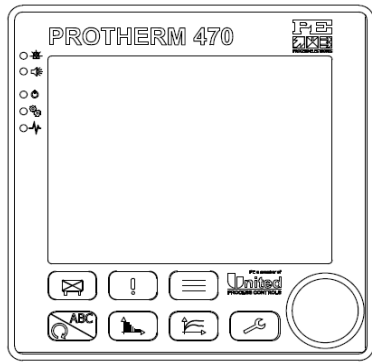
PROTHERM™ CONTROLLERS are designed for the control of industrial heat-treating processes. These controllers are configured with the Protherm500KonfigTool software, which allows them to acquire values from various sensors, operate valves and drives, and use control loops.

1.2 Specifications (all versions)

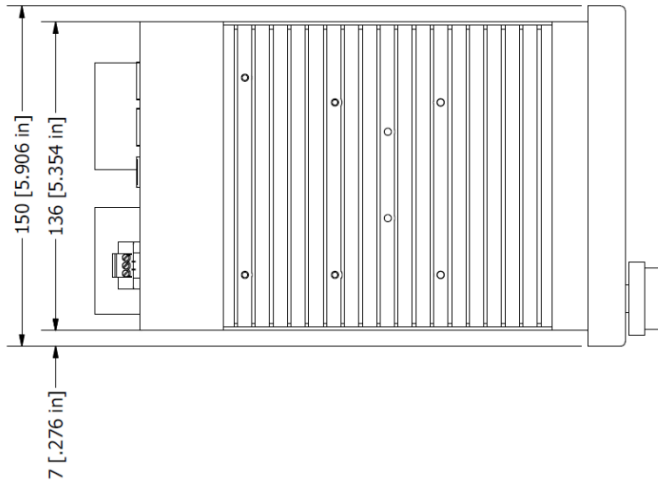
	PT 470	PT 510	PT 610	PT 710
Width / with bezel [mm]	136 / 150	199 / 273	199 / 389	199 / 430
Height / with bezel [mm]	136 / 150	136 / 170	136 / 267	136 / 310
Depth / with bezel + knob [mm]	199 / 254	159 / 182	164 / 187	169
Panel cutout [mm]	140 X 140	246 x 143	363 x 241	404 x 284
Weight [kg]	3.5	3.8	4.0	4.3
Ambient temp:	0 - 55°C non condensing			
Power	24 V DC; 1,5 – 2,0 A, depending on the configuration			

(Includes IO expansion slot)

1.3 PT470 Overall Dimensions:



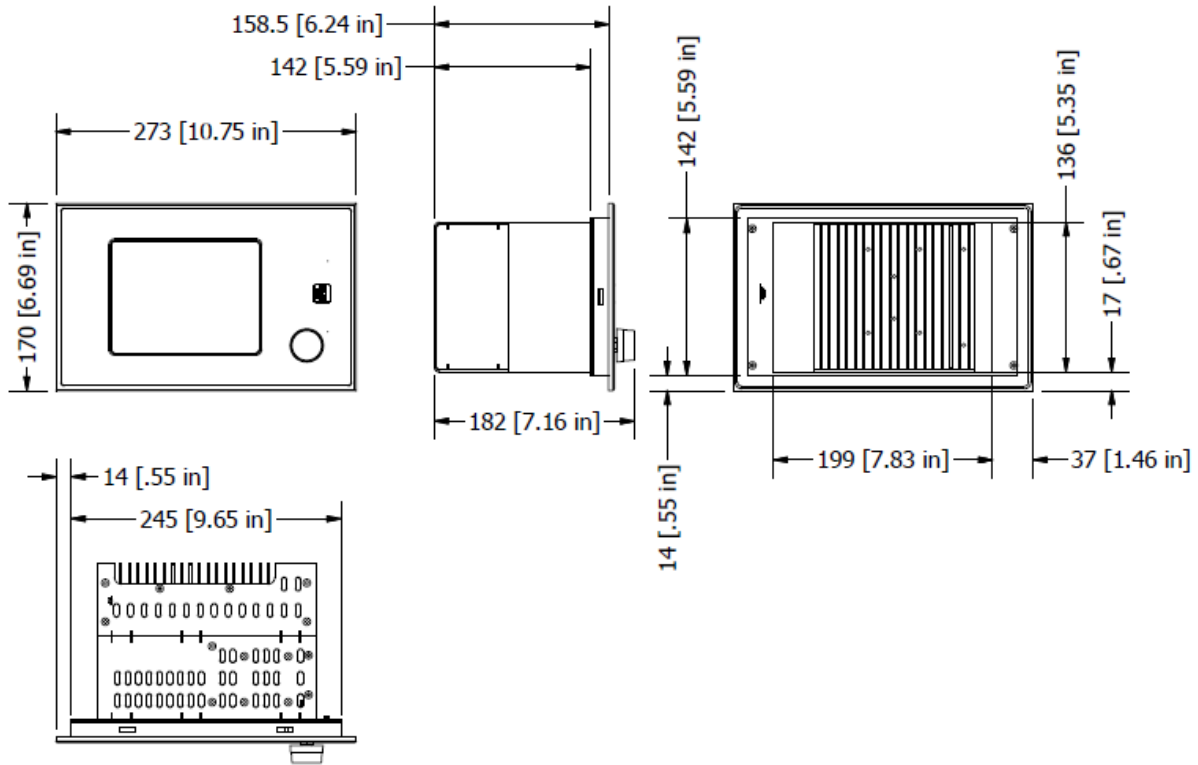
Bottom



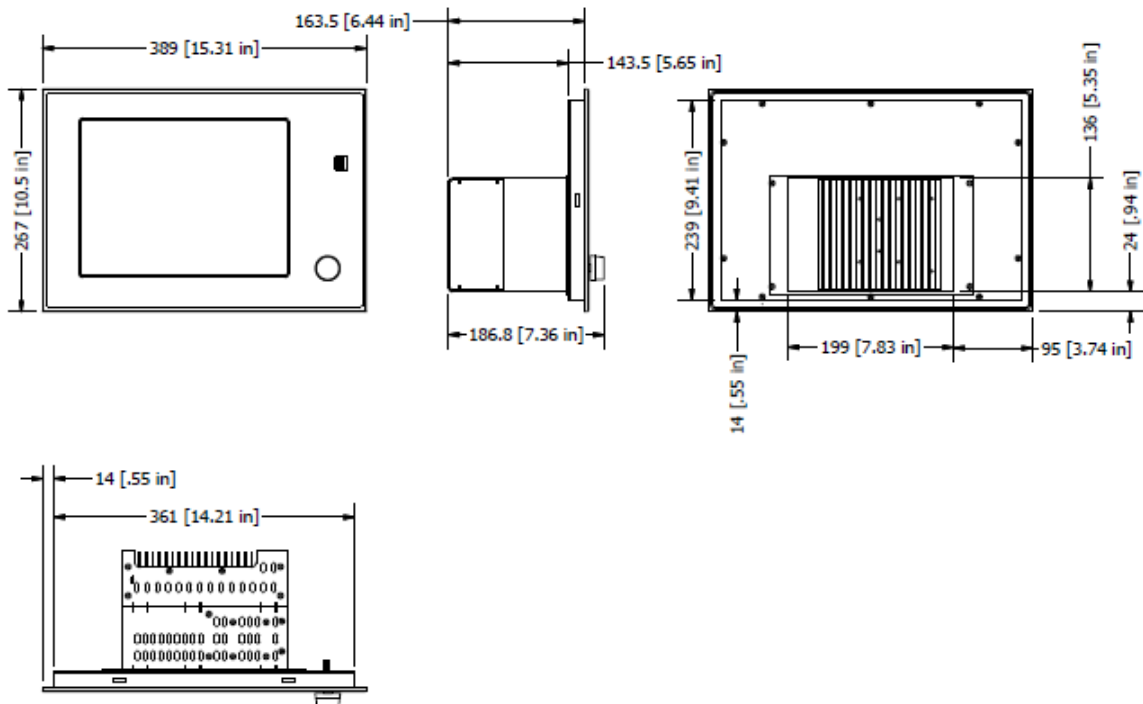
PT470 Panel Cut out:

Square: 140mm [5.5"] X 140mm [5.5"]

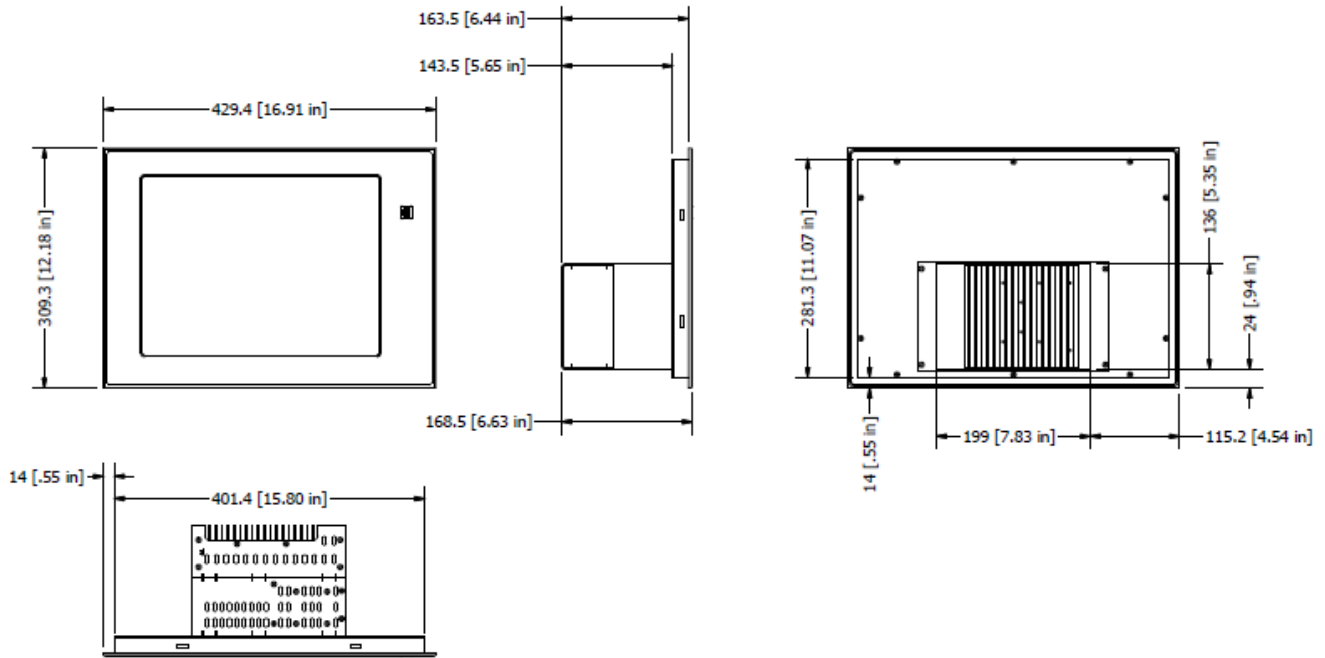
1.4 PT510 Overall Dimensions:



1.5 PT610 Overall Dimensions:



1.6 PT710 Overall Dimensions:



Panel Cut out:

PT510

Rectangular: 246mm [9.69"] X 143mm [5.63"]

PT610

Rectangular: 363mm [14.29"] X 241mm [9.49"]

PT710

Rectangular: 404mm [15.91"] X 284mm [11.18"]

1.7 Electric connections

Connecting digital and analog cards

There are 4 slots to install cards. Digital 8 channel AC, 16 channel DC and analog 4 channel input / 4 channel output cards are available.

Digital channels can be configured as input or output.

ANALOG OUT are located on above. ANALOG IN are located below

Optional I/O cards

(A): Analog IO card		(H): Digital AC card	(D): Digital DC card
4 analog outputs		8 Digital (ON/OFF)	16 Digital (ON/OFF)
4 analog inputs		Each channel is configurable as INPUT or OUTPUT	Each channel is configurable as INPUT or OUTPUT
Each channel has configurable SIGNAL TYPE			
		Universal AC voltage 120 or 230 VAC	24 VDC
OUTPUT SIGNAL TYPE			
0-5 VDC		SCR, high-side, zero crossing	Resistive load only 0.5A rating per channel
0-10 VDC		0.5A rating per channel	
0..20 mA		<3 mA leakage current	
4..20 mA			
INPUT SIGNAL TYPE			
S1 = ON	0..2 VDC (200 MΩ) (O ₂ Probe)	0 = < 40 VAC 1 = > 80 VAC	1 = >15 VDC 0 = <2 VDC
	0.5 VDC 0..20 mA (200 Ω) 4..20 mA		
S1 = OFF	100..398 Ω res. -96..96 mV T/C types J, K, N, S, R, T, E, B, C, M		
S1 jumper must be properly set!			

There are also two USB and two RJ45 ports. Second (lower) RJ45 port is an option.

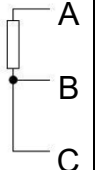
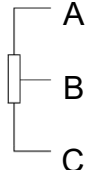
Electric pinout for each card and CPU (card sequence may vary, consult your system integration schematics for details)

Analog IO card			Digital AC card		Digital DC card		CPU																																																																																																																																					
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CH 11	5																																																																																																																																											
CH 12	6																																																																																																																																											
CH 13	7																																																																																																																																											
CH 14	8																																																																																																																																											
CH 15	9																																																																																																																																											
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BUS VCC	6																																																																																																																																											
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CAN***																																																																																																																																												
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CAN L	2																																																																																																																																											
BUS GND	3																																																																																																																																											
NC	4																																																																																																																																											
SHIELD	5																																																																																																																																											
BUS GND	6																																																																																																																																											
CAN H	7																																																																																																																																											
NC	8																																																																																																																																											
BUS VCC	9																																																																																																																																											

top connectors

bottom connectors

*Analog IN details:

T/C: 0..20 mA: 4..20 mA:	A = + B = - C = not used	RTD:		POTENTIOMETER:	
--------------------------------	--------------------------------	------	---	----------------	---

**COM port detail: both four and two wire RS485 are available. For two wire, jumper terminals 1-3, and 2-4.

*** Optional

2 INSTALLATION

2.1 Overview

- The device is designed for installation in a control panel.
- Pay attention to the operating temperature limits, avoid direct heat-up by radiation from hot devices in its immediate surrounding.
- If necessary, provide a panel air conditioning system.
- Don't expose the device to mechanical vibrations and shocks.
- Keep the device away from sources of magnetic fields.
- Wire the device with cables made specifically for industrial use and meeting local safety standards. Unsuitable cables and/or incorrect connections can lead to malfunctioning or damaged equipment.

2.2 Installation in a Control Panel

According to the cut-out dimensions:

1. Mark the corner points.
2. Link the corner points.
3. Drill and detach the cut-out, remove sharp edges and deburr.
4. Place the device in the cut-out and secure it with the brackets.
5. Plug in power and necessary connectors.

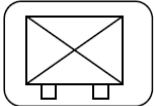
Warning! Do not overtighten the screws!

3 OPERATING THE CONTROLLER

3.1 Protherm Button Defined

On the PT470, 510, and 610 there are buttons and a knob located on the bottom of the front panel. On the PT710, there are buttons located on the bottom of the front panel, a touch screen interface, and four user configurable buttons located on the right side of the front panel.

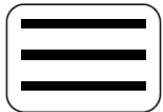
All buttons have a circular behavior. This means that a user can press the button multiple times in order to scroll through the available screens, eventually the cycle starts over from the beginning. Note that some screens may be hidden depending on user access.



Overview: Access user screens, process parameters set points, I/O's. These screens are specific to your configuration / type.



Alarm: Access the alarm management screen to consult, acknowledge and silence alarms whether current or historical.



Recipe: Access the running recipe, the recipe library and methods (templates).



Histogram: Access the pens / trend lines.

TIP: Once in a screen section, hold the screen selection button down to access and choose from a list of screens in that section.



Process Diagram: Access the online metallurgical profile of the recipe (carbon diffusion, phase control, nitriding case depth, required optional modules).



Configuration: Access system settings including USER LOGON. User levels span from 0 (basic) to 5 (full access).



Shift: Used to toggle upper/lower case and change selection from left/right to up/down when in keyboard mode.

Control Knob. The knob is used to scroll the selection to the next available field or to use the virtual keyboard. The knob can be pressed for a select or ENTER function.

The PT710 is equipped with a touch screen. Tap element to select.

TIP: Hold ABC + Wrench to take a screenshot

3.2 Protherm 710 User Buttons

PT710 is equipped in touch screen. Tap element to select. Screen keyboard appears when text or number input field selected.

There are four user buttons described as U1 - U4. Function of these keys depends on prepared configuration. Typically, U4 is to generate a screenshot.

4 QUICK START

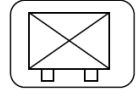
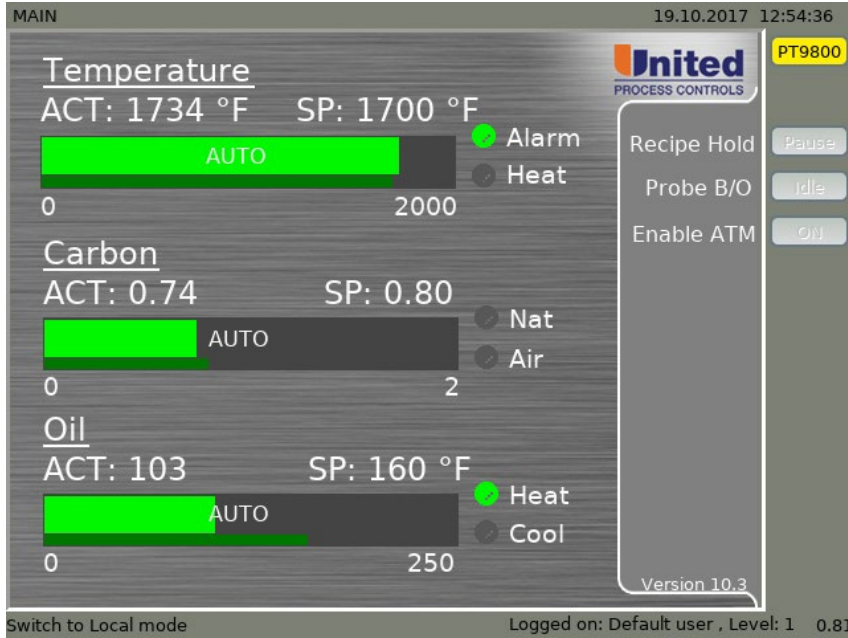
4.1 Setting up a New Protherm Controller

It is assumed that the user has a good knowledge of Protherm controllers and the PT Konfig tool. Begin by starting with the latest firmware version.

1. Update the firmware to the latest build. Instructions and source can be found on our ftp site: /Group-UPC FTP/UPC/PT470_610_710/0_Update/CurrentVersion/(1)FullUpdateUPC
2. RESET the instrument. This will erase the shared memory, the recipes, the PID parameters and any methods from previous configurations/tests.
3. Have a Konfig folder ready on your PC (CFG, INI, PICTURES) and REPLACE the INI folder and with the INI folder fr the PT controller. You should have “old CFG and PT’s INI”.
4. Ensure that you have only one combination: [module.lnk + pt.lnk] OR [moduleInk.cfg + ptInk.cfg] not both. See the Appendix of this document if you have an error.
5. Using the konfig tool, open the config and save it. This will make the CFG + INI’s sync.
6. Set the protherm’s IP address, timezone, etc.
7. Check the error logfiles.

5 USING THE PROTHERM BUTTONS

5.1 Overview Button



The overview button allows the user to scroll through the main operator screens. All screens shown in this manner are specific to your application and contain elements necessary to operate the furnace. These are accessible by user permission. Not all users can see all screens.

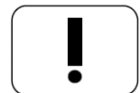
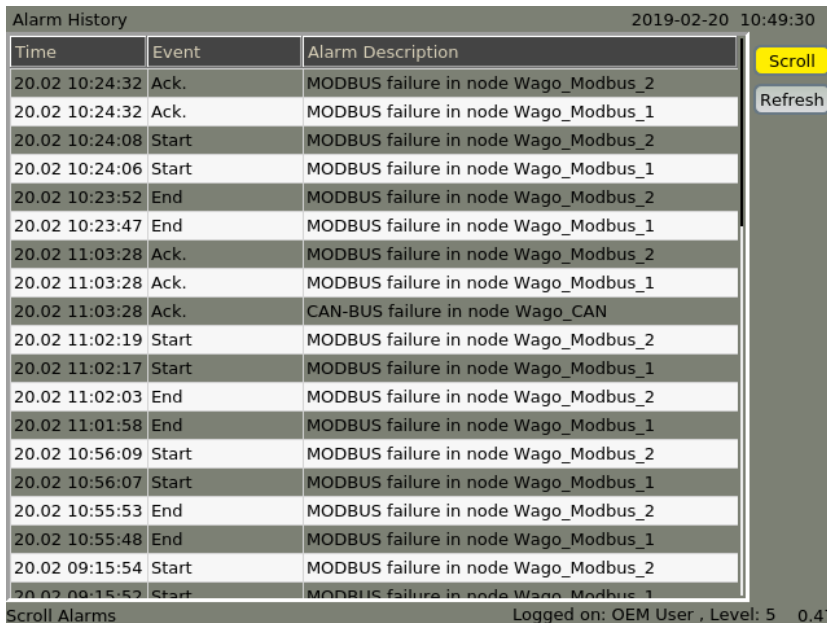
See your project specific manual for details on the specific screens programmed for your system.

5.2 Alarm Button



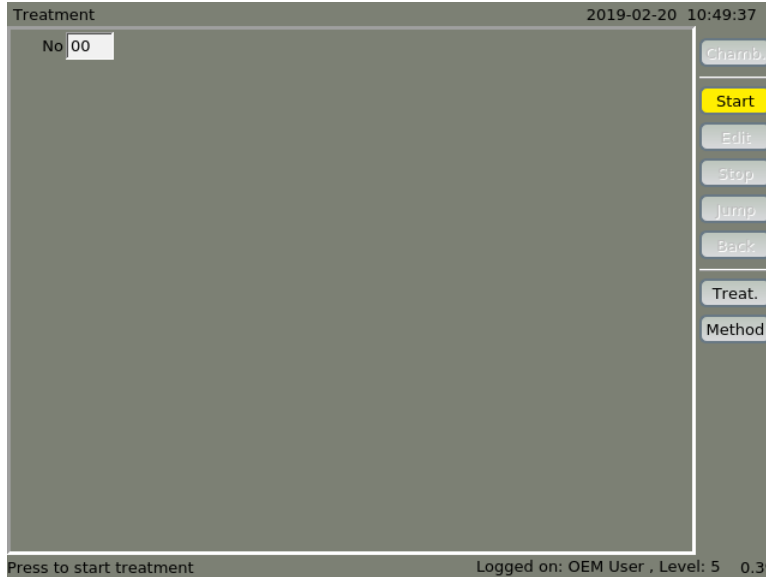
The alarm button allows a user to see present and past alarms.
The first alarm overview shows current alarms

RED = Active and not acknowledged alarms
YELLOW = Active and acknowledged
BLUE = Inactive and not acknowledged
The actual text is custom to your application.



The second alarm overview shows the alarm history with time, event and description.
Alarms are indicated with a top red LED located on the left side of the screen with an alarm light icon; active alarms are indicated additionally with a second red light with a speaker icon (horn or buzzer).

5.3 Treatment or Recipe Button



This screen allows to view and modify treatments (recipes) and methods (templates) for heat treatment programs. Details are described in the Heat treatment chapter.

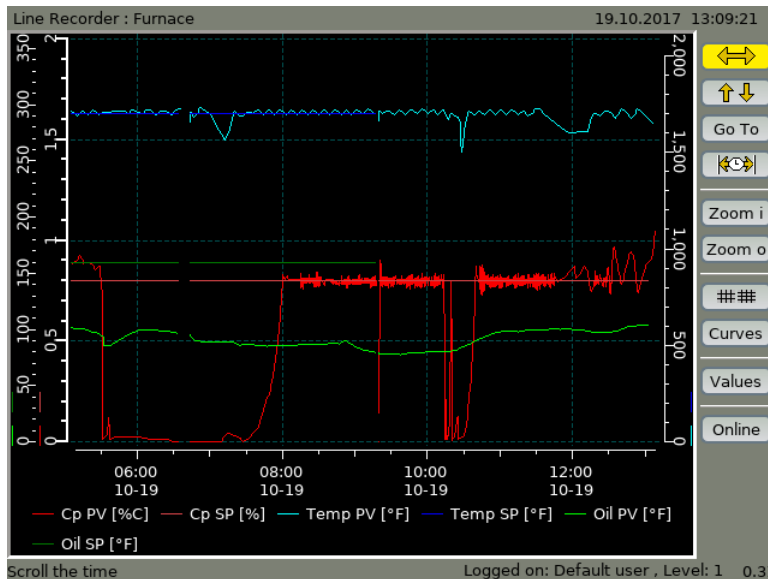
5.4 Process Diagrams Button

These screens present process diagrams.



Section applicable to pertinent optional features such as real-time carbon diffusion in the alloy.

5.5 Histogram Button



Electronic chart recorder for process parameters are custom and done by the system configurator. Every screen represents one History component (one paperless chart).

Buttons on the right of the graph are as follows:

<--> Button: This button is used to scroll back and forth in time;

|<-->| Button (if present): This button is used to scale the time axis as desired;

Zoom i Button: This button is used to zoom into the chart. It can be used multiple times in sequence;

Zoom o Button: This button is used to zoom out to the default view;

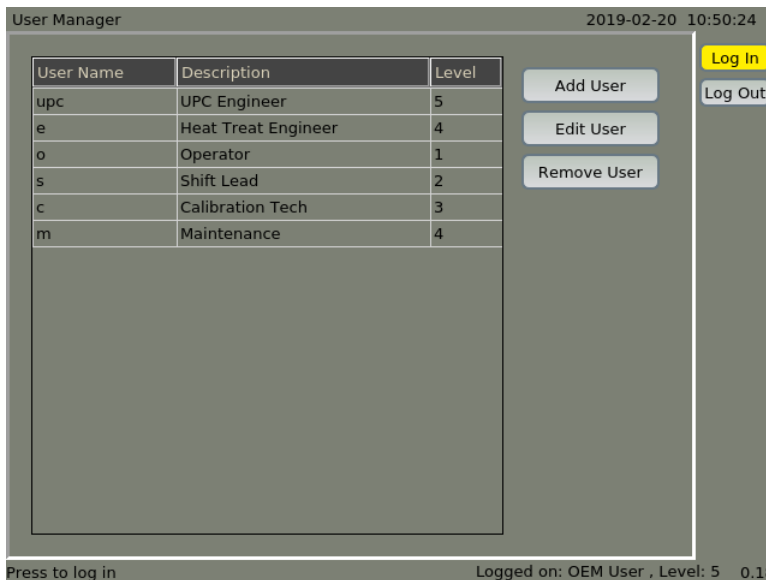
Values Button: This button is used to view the actual values on the graph. The values are shown next to the variable name. These are the values at the user selected time.

Online Button: This button is used to display the chart at the current date and time.

5.6 Configuration Button

There are several configuration screens possible in this section. The first prompts the user to log in. Depending on access level (ranging from 0 – basic access to 5 – full access)

5.6.1 User Manager



The User Manager is used to log in, log out and manage users: Add user, Edit user, Remove user. After logging in to this screen the password can be changed.

Users must have a username, password and access level spanning from 0 (basic) to 5 (UPC/maintenance supervisor). Individual users can be created, and all actions made by the logged in user will be recorded with their user name.

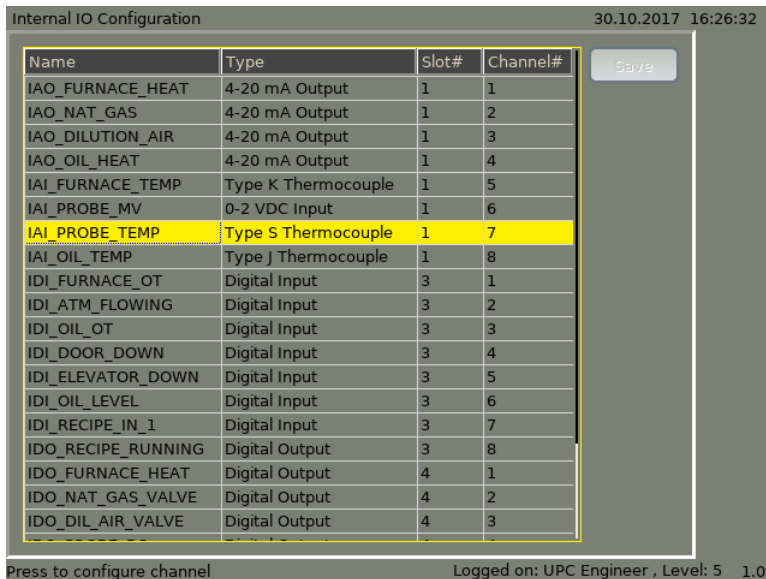
Different access levels are assigned to buttons, and editing functions by the system configurator. Each screen or button with a restriction will pop up for a momentary log in when pushed. If performing multiple operations, a user can log in on the user manager screen. Users can log out from the user manager screen, or they are automatically logged out after five minutes of inactivity.

Protherm Controllers are shipped with the following default users:

Description	Level	Username	Default Password	Modified Password
Operator	1	o	o	
Shift Lead	2	s	s	
Calibration Tech	3	c	c	
Maintenance	4	m	m	
Heat Treat Engineer	5	e	e	

Individual users can be created by pressing the Add User button and filling in the applicable fields. It is strongly suggested that default users are replaced.

5.6.2 Internal IO Configuration (if applicable)

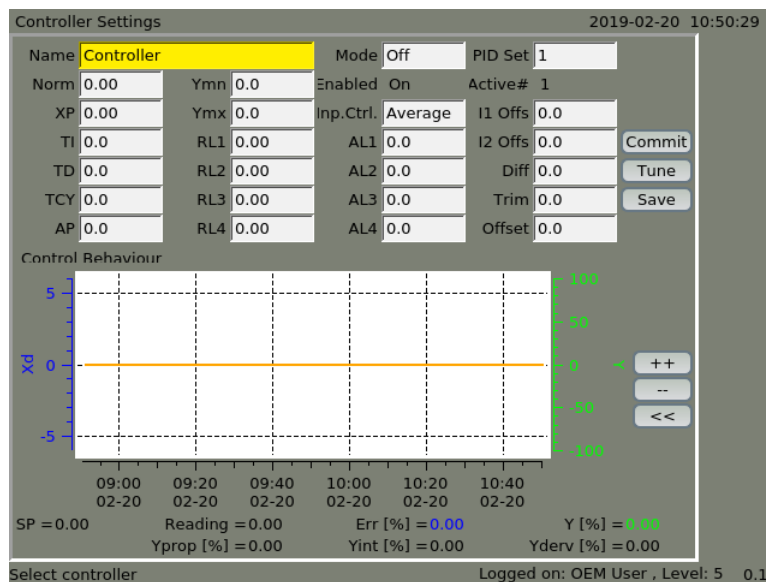


Name	Type	Slot#	Channel#
IAO_FURNACE_HEAT	4-20 mA Output	1	1
IAO_NAT_GAS	4-20 mA Output	1	2
IAO_DILUTION_AIR	4-20 mA Output	1	3
IAO_OIL_HEAT	4-20 mA Output	1	4
IAI_FURNACE_TEMP	Type K Thermocouple	1	5
IAI_PROBE_MV	0-2 VDC Input	1	6
IAI_PROBE_TEMP	Type S Thermocouple	1	7
IAI_OIL_TEMP	Type J Thermocouple	1	8
IDI_FURNACE_OT	Digital Input	3	1
IDI_ATM_FLOWING	Digital Input	3	2
IDI_OIL_OT	Digital Input	3	3
IDI_DOOR_DOWN	Digital Input	3	4
IDI_ELEVATOR_DOWN	Digital Input	3	5
IDI_OIL_LEVEL	Digital Input	3	6
IDI_RECIPES_IN_1	Digital Input	3	7
IDO_RECIPES_RUNNING	Digital Output	3	8
IDO_FURNACE_HEAT	Digital Output	4	1
IDO_NAT_GAS_VALVE	Digital Output	4	2
IDO_DIL_AIR_VALVE	Digital Output	4	3



Internal IO's are shown with their corresponding detail such as type, slot and channel used. I/O's can be modified, i.e. changing the TC type, or changing the address / range. Only experienced users should make these changes.

5.6.3 Controller Settings



Controller Settings 2019-02-20 10:50:29

Name: **Controller** Mode: Off PID Set: 1

Norm: 0.00 Ymn: 0.0 Enabled: On Active#: 1

XP: 0.00 Ymx: 0.0 Inp.Ctrl: Average I1 Offs: 0.0

TI: 0.0 RL1: 0.00 AL1: 0.0 I2 Offs: 0.0

TD: 0.0 RL2: 0.00 AL2: 0.0 Diff: 0.0

TCY: 0.0 RL3: 0.00 AL3: 0.0 Trim: 0.0

AP: 0.0 RL4: 0.00 AL4: 0.0 Offset: 0.0

Control Behaviour

Graph showing Xd vs Time (09:00 to 10:40). Y-axis ranges from -5 to 5. A horizontal line is plotted at 0.00.

SP = 0.00 Reading = 0.00 Err [%] = 0.00 Y [%] = 0.00

Yprop [%] = 0.00 Yint [%] = 0.00 Yderiv [%] = 0.00



PID tuning and monitoring interface. To choose which controller (heat, oil temp, Kn, Carbon Potential etc.) move cursor to the **Name** field and press the knob or select on the touch screen. Select the controller from the displayed list.

To activate PID loop select **Mode** On. It is possible that the configuration has some interlocks to enable the controller. The enable status is shown below the Mode field.

The following buttons are available:

- Commit – Used to save any changed values to the current PID set to this controller. This button must be pressed for tuning modifications to be accepted and put into operation.
- Save – Used to save all PID settings to the system configuration (back ground memory).
- Tune – Used to initiate a self-tuning sequence.

5.6.4 Controller Settings Parameter Description

Parameter name	Description	
Norm	Normalized range [%]	
XP	Proportional range [% of Norm]	
TI	Integration time [s]	
TD	Differentiation time [s]	
TCY	Cycle time [s]	
AP	Differentiation range [%]	
Ymn	Minimum output value [%]	
Ymx	Maximum output value [%]	
RLx	Err relative value to activate controller digital output x	
ALx	Err absolute value to activate controller digital output x	
Mode	On – active Off – inactive	
PID Set	PID set 1-4 selector	
Enable	Status of the configuration Enable input.	
Inp. Ctrl.	Every loop has two measure inputs. Average – average from In1 and In2	In1 – In1 only In2 – In2 only
I1 Offs	Offset for In1	
I2 Offs	Offset for In2	
Diff	Maximum value difference between In1 and In2 which will generate an alarm	
Trim	Adjustment of the cascade output setpoint	
Offset	Adjustment of the setpoint for the controller operating in slave mode	

There are 4 PID parameter sets that can be switched according to the configuration. The switching condition is determined by the system configurator.

To use the auto tune function, the controller must be enabled, select *Mode* Off, and press the *Tune* button. A manual set point must be entered on all the zones and it's best if all zones are tuned together. The system will go through a tuning procedure to determine the PID control parameters of the zones.

The bottom part of this screen shows the PID loop behavior and allows to observe the response change when parameters are modified.

RLx – allows to turn on output when Reading is entered value of SP.

ALx – allows to turn on alarm output Reading is entered value of SP.

Example: SP is 100, RL1 is 1.1. When Reading reaches 110 RL1 signal is TRUE.

Tune function:

When invoking a tune sequence, the controller takes the actual setpoint and sets Y to YMAX. Consequently, the ACT variable will go up and once the ACT variable is greater than 94% of the setpoint plus hysteresis, the controller will set Y to YMIN. Once the ACT variable is again below the 94%-line minus hysteresis, it repeats the previous actions, but this time measures the max ACT variable measured, the min ACT variable measured and the time it takes for the variable to come to max and to min again (this totals to idtimer).

Xp (proportional band in percent) = $100\%/KP$ (with KP = system gain)

TI (integration time in seconds) = $0.5 * idtimer$

TD (derivative time in seconds) = $0.2 * TI$ (suggestion for derivative time) and

$2 \leq TCY$ (cycle time in seconds) = $idtimer/20 \leq 1000$ (in a PT Controller)

AP = approach in percent

Ymn = Minimum % power

Ymx = Maximum % power

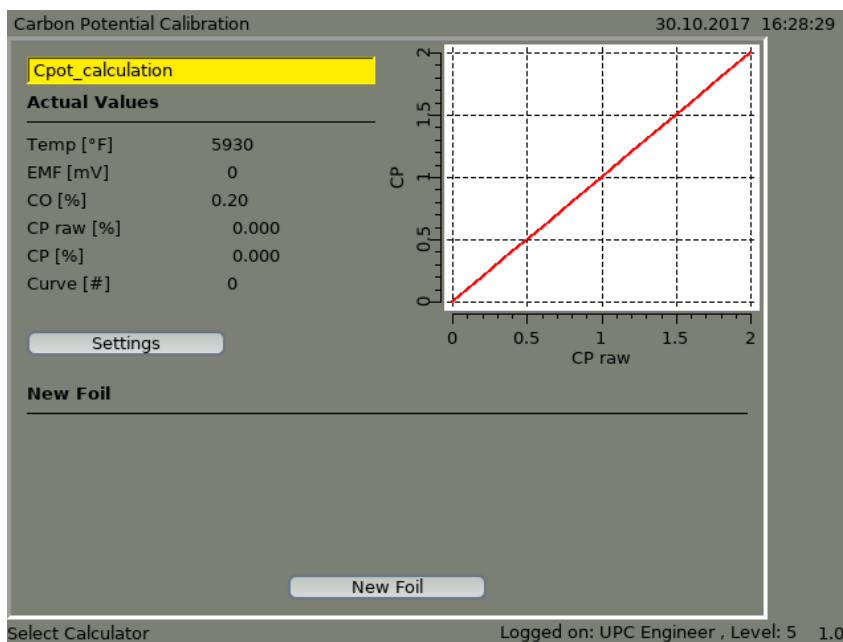
Trim is used to adjust the output cascade setpoint

Offset is used to adjust the active setpoint when the controller is a secondary of a cascaded control system.

When tuning a cascade system, turn OFF all zones, set a manual set point to all the zones then tune them all together. Once the tuning is complete, set all zones to ON. Set the trim to ~5% on the master PID. Turn the main controller OFF, set a manual setpoint on the master loop, then tune.



5.6.5 Carbon Potential Calculation



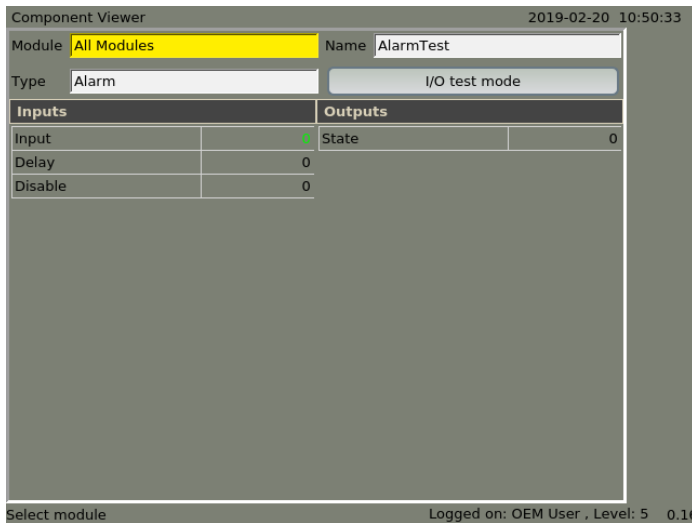
Different furnaces, various probes, variations in controllers, signals and atmosphere force us to normalize control systems such that they control to a known acceptable accuracy. Some controllers call this the “Process Factor”. The Protherm controllers allow you to modify these parameters on a more specific level. For example, instead of just an offset, the Protherm allows the user to apply offsets at various points in the control range.

Available buttons:

- Settings – Used to modify the controller table from a theoretical value to a tested value.
- New Foil – Used to modify the controller during a steady state operation. Example, controlling at 1.0 and a foil test / gas analyzer indicated an actual of 1.06

5.6.6 Component Viewer

 Component Viewer



Normally this interface will be used for troubleshooting with the system configurator. This screen shows all configuration (program) modules. Every module has own inputs and outputs. Inputs displayed in green are connected to other modules. To track this input, move the cursor to the desired field and press the knob. Inputs displayed in black are constants. To modify the constant value, move the cursor to the desired field and press the knob. A dialog box appears. Confirm the new value with the OK button or decline with the Cancel button.

Warning!

Changes affect the process and control. Proceed with caution!

The Component Viewer is a tool that gives maintenance and start-up personnel the possibility to see what the controller is seeing live. This troubleshooting tool is best used by experienced users or while in communication with UPC personnel.



5.6.7 System Settings

System Settings



System Settings 1 2019-02-20 10:50:37

Modbus Delay	20	MB-Speed [kbps]	9.6	MB Parity	EVEN
Modbus Data Bits	8	MB Stop Bit	1		
MB Slave ID	1	MB Slave Bus	4 wire		
CAN Address	2	CAN-Speed [kbps]	125		
MPI Address	20	MPI-Speed [kbps]	Auto	Confirm	
PB Address	4	PB-Speed [kbps]	1500		

Host Name PEP.po PT9800 via IP 192.168.6.210

IP Address	192	168	6	210
IP Netmask	255	255	255	0
IP Gateway	192	168	6	1

Web Server On Confirm

Date [yyyy:mm:dd] 2019 2 20 Time Zone Europe/Berlin

Time [hh:mm:ss] 10 50 36 Confirm

Adjust Modbus-Delay time in ms Logged on: OEM User , Level: 5 0.22

Use this page for setting up the Modbus, CAN and LAN configurations, as well as time and time zone settings. There are three buttons located at the bottom of this screen.

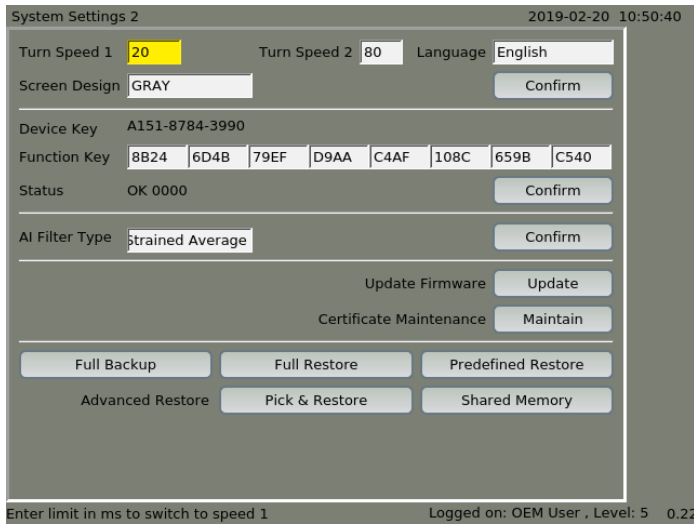
- **Refresh** – restarts the display, control of the system remains running in the background.
- **Reboot** – restarts the entire controller, control is stopped while the controller reboots.
- **Reset** – restore parameters from last saved point (PID parameters, recipes, users) all recorded data is lost, recipes are retained.

The IP configuration is shown for first (upper) LAN port. Second LAN port is an option. When installed second configuration appears on the right.

Warning!

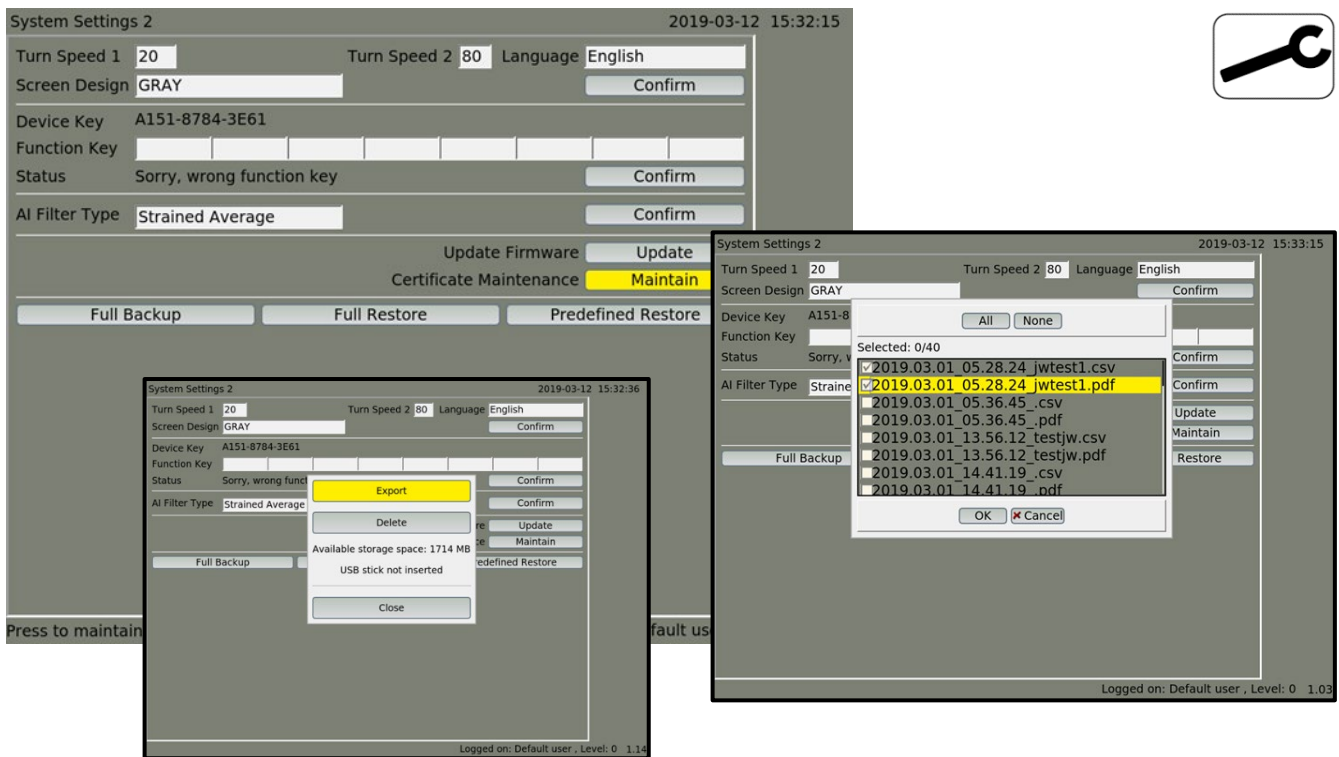
Use these buttons only as directed by the system configurator or UPC personnel. All can cause undesired consequences; (loss of data, implementation of obsolete parameters, loss of communication to furnace, loss of carrier gas, etc.)

5.6.8 System Settings 2



This screen allows to modify the user interface settings, the menu language, create system and logfile backups, and update the system firmware. The device function key (license) is also displayed. There are two buttons located at the bottom of this screen. Full backup – allows to prepare complete backup copy of the device in an internal memory or USB stick. Full Restore – calls backup from the internal memory or a USB stick.

5.6.9 Log File Maintenance:



1. Insert a USB stick into the front of the controller
2. Log in with a level 4 (supervisor) level
3. Navigate to the System Settings 2 screen
4. Press the Certificate Maintenance Maintain button
5. Select the logs to be copied. Logs are available in pdf and csv format. The csv format is useful to import data into Excel or another spreadsheet program. The logs are named by the time the load finished, in YYYY.DD.MM_hh.mm.ss followed by the load descriptor.
6. Press the Export button
7. The logs will be copied to the USB stick and a completion message appears when the copying is complete
8. Press the OK then Close.
9. Remove the USB stock and copy the files to a computer.

5.6.10 System Settings 3

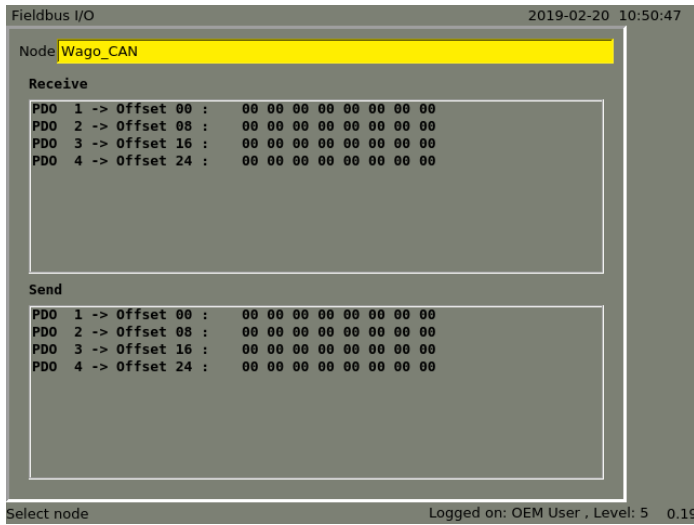


System Settings 3 2019-02-20 10:50:43

DB Type	<input type="text" value=""/>	Charge List	No
SQL Language	English	Simple Charge List	No
DB IP Address	0 0 0 0	Auto Start	No
<input type="button" value="Ping"/>		History	No
Database Name	NoName	App. Encoding	UTF-8
User Name	user	DB Encoding	UTF-8
Password	●●●●●●●●	Verbose Level	0
Customer No.	0	Use 999 Recipes	No
Cluster IP	0 0 0 0	Recipe Sync	Yes
<input type="button" value="Ping"/>		Upload Config	Yes
SQL Mode		Fast Saving Mode	No
<input type="checkbox"/> Write Config	<input type="checkbox"/> AValue	Imperial Units	No
<input type="checkbox"/> Ready/Remote	<input type="checkbox"/> Recipe Data	Recipe Model	Chamber
<input type="checkbox"/> Alarm Handling	<input type="checkbox"/> Load Handling	Show Cursor	No
<input type="checkbox"/> TKomp		Log Interval (sec)	300
		Max Log Days	30

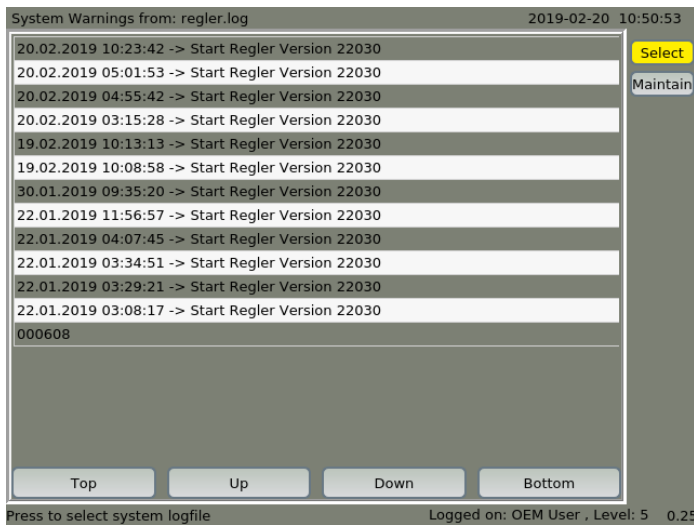
Select type of database Logged on: OEM User , Level: 5 0.20

Fieldbus IO



This screen shows (Canbus, Modbus, Profibus) input and output register block.

5.6.11 System Warnings



This screen shows several types of system warnings and logs. This is generally used to help with troubleshooting.

5.6.12 System Information



System Information 2019-02-20 10:50:58

Process	PID	Version	System Information
start	3885	22030	PT470/510
visu32	4033	22030	AT90USB:1.2
schrift	4034	22030	MB:1.4
regler	4035	22030	
can pt470 pic32	4036	22030	CF: 877
isotsapd	0		
pt9pt500d	0		
modbus	4037	22030	

Logged on: OEM User , Level: 5 0.23

This screen shows the system configuration, installed and active system options

5.6.13 About



The screenshot shows an 'About' window with the following content:

2019-02-20 10:51:02

CLIENT SUPPORT

CUSTOMER SUPPORT	Americas	+1-513-772-1000
	Asia	+86-10-82770618
	Europe	+48-32-2966600

SOFTWARE

O.S.	Linux 4.8.17-tinycore
App. Info	Qt 5.5.1 PTController PT470Development 22030
Build Info	Chart: Qt5.5.1 Qwt6.4.0 634 Protherm Controller is based in part on the work of the Qwt project (http://qwt.sf.net) and FreeRTOS (http://freertos.org)

MB:1.4; AT90USB:1.2; CF: 877

Logged on: OEM User , Level: 5 0.21

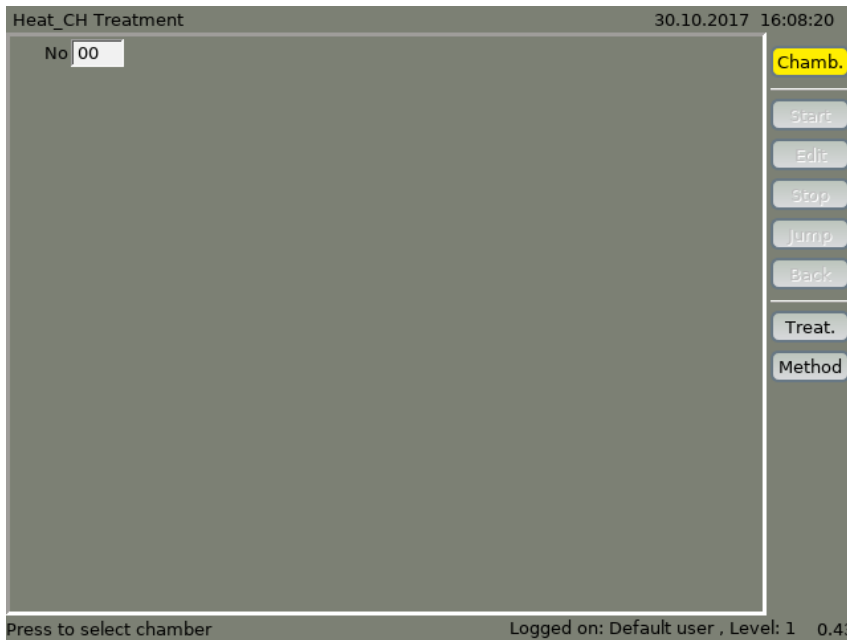
Logos at the bottom: Process Electronic, Wauke Engineering Company, Inc., Furnace Control Corp, Mmi, Atmosphere Engineering.

This screen shows the helpdesk phone numbers and software version and information.

6 MAIN TREATMENT OPTIONS (RECIPE SCREEN)

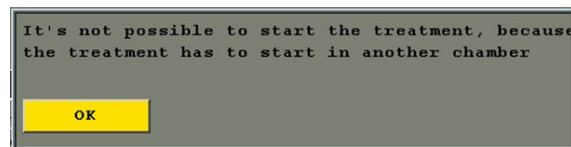
6.1 The Treatment Screen Buttons

The Protherm allows to save up to 99 heat treatment programs. Programs can be created, modified and launched from the treatment screen.



Buttons:

- **Chamb.** – Used to scroll between the programmed chambers. A chamber could be a heat chamber, a quench chamber, or even a vestibule. Every chamber has variables assigned to it.
- **Start** – Used to start a recipe. Note that the recipe's first step must start in the currently selected chamber. Failure to do so, the error shown to the right will occur.
- **Edit** – Used to edit the running recipe.
- **Stop** – Used to stop the running recipe. This action cannot be undone.
- **Jump** – Used to skip over the running step. (won't work on steps that use methods)
- **Back** – Used to restart the previously completed step.
- **Treat.** (treatment) – Allows user to edit the recipe bank – **not the currently running recipe**. A User can modify, copy steps and delete steps. Greater details are explained in the Main Treatment Options section.
- **Method** - A method is the equivalent of a hidden locked building block step that a can be used in a recipe. Example, the recipe calls for a method "Purge" but the user cannot modify the details of purge. The method Purge would be defined as "Purge = 1, safety = 1, Temperature = OK". **Methods are accessible by user level 5 (UPC/maintenance supervisor)**



To select a treatment, press the *Treat.* button. Cursor moves to the *No.* input field. Program can be selected with numbers or from the list by selecting the “..” symbol.

6.2 Recipe Types



Treatment 2019-02-21 11:26:01

No 01 .. Name: _____ Type: Carbonitriding

DIFF Yes Analysis

Core Carbon [%C] ??? Case Depth [mm] 0.00

Alloy Factor C ??? Case Depth at [%C] 0.00

Carbide Limit [%Ac] ??? Alloy Factor N ???

No	Chamber	Name/Method	Setpoint 1	Setpoint 2	Step Time	Runtime
1						

Save Delete Cancel

Select whether you want a diffusion calculation Logged on: OEM User , Level: 5 0.11

Heat treatments can have names that help you identify them. However, types help the controller run them in a specific way: **temperature**, **carburizing**, **carbonitriding** and **nitriding**. The DIFF for the carburizing, carbonitriding and nitriding processes is the real-time diffusion calculation option. Values in the fields: *Core Carbon*, *Alloy factor C*, *Alloy factor N* and *Carbide limit* are calculated automatically according to data entered in the *Analysis* window.

The C content necessary to achieve the required hardness for a given depth is calculated according to the alloy composition and hardening intensity. The calculated value is displayed in the *Case Depth* field as a function of the C content.

Pressing the *Analysis* button will display an additional window in which data concerning the Material to be heat treated should be entered. This data will be used to calculate the alloying factor, carbon content limit, carbon content for a given carburizing depth, and hardness profile.



Analysis									
C	0.000	Mn	0.000	Si	0.000	Cr	0.000	Ni	0.000
Mo	0.000	V	0.000	Al	0.000	Cu	0.000	P	0.000
Quenching Intensity		0.05							
Rep. Part Diameter		5.0						mm	
Effective Case Hardness		0						HV	
Grain Size [ASTM]		1							
Final Temperature		0						°C	
Tempering Temp.		0						°C	
OK		Cancel							
Save		Delete			Cancel				

Enter C content in wt% Logged on: OEM User , Level: 5 0.33

The alloying elements of the Material are expressed as a percentage by weight.

The *Quenching intensity* describes the quenching speed. Typical values are below 0.25 for salt, 0.25 to 0.35 for oil, and 0.35 to 1.0 for cooled oil or water.

The *Representative part diameter* determines the diameter of a cylindrical test sample having the same hardening properties as the workpiece to be machined.

The *Effective Case Hardness* means the required hardness value in HV at a given depth.

The *Grain Size* is a characteristic feature of the metal, it is a value determined at the basis of the evaluation of the test sample.

The *Final temperature* is the lowest temperature reached by the part at the end of the heating, standard at an atmosphere temperature of 20°C. The value is required for calculation of the amount of residual austenite. This value is important for deep cooling.

The *Tempering Temperature* is used to calculate the hardness curve after tempering.

The following are parameters for nitriding processes:

The *Core Hardness* field contains the hardness of the workpiece before the heat treatment process. It is automatically calculated on the basis of the entered chemical composition of the material. If the steel used has been subjected to heat treatment before nitriding (nitriding + carburizing), this value must be changed to the actual value.

The *Special Nitrides* field specifies, based on the alloy information, the value for the additional nitrides (Titanium, Chromium...) that can be formed.

The *Alloy Factor C* corresponds to the alloying factor for carburizing and is necessary for calculations related to the carbonitriding process.

6.3 Recipe Variables Defined

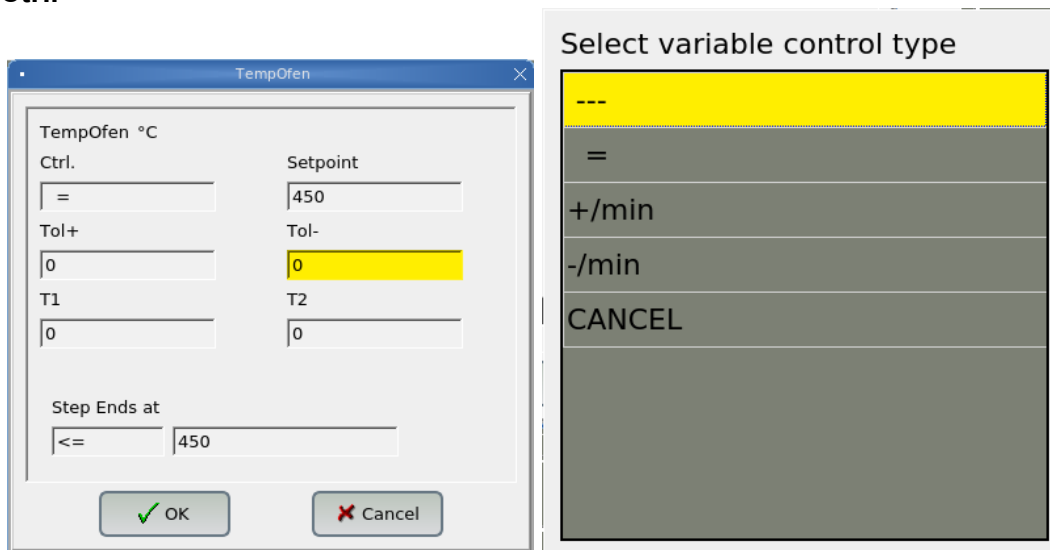
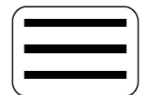
Relationship within recipe variables

Prior to building your own recipes, keep in mind that each variable has a Unit, Ctrl. (control), Set Point, Tol+, Tol-, T1, T2 and “Step Ends at” fields. It is important to understand the function of each field so that you may better construct proper recipe steps that do not cause unnecessary alarms.

Variable	Uni	Ctrl.	*	Tol+	Tol-	T1	T2	Step Ends at
Temperature	°F	+ /min	20.0	0	0	0	0	>= 680

Each recipe variable can be modified in the recipe step by selecting the specific variable with the touch screen or knob. A pop-up screen appears.

Ctrl.



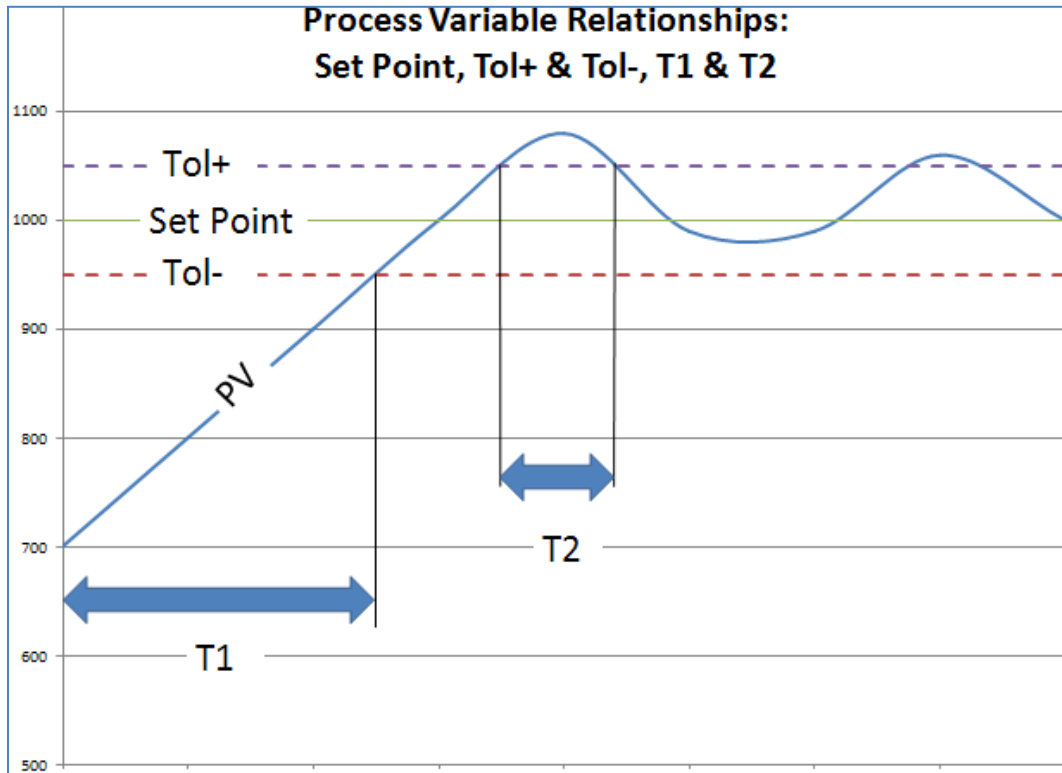
The control field is used to designate the target for the variable. The choices available depend on the type of furnace and/or the options purchased. Here are a few of the most used examples.

- = (equals) This is used when a variable has a definite set point. (ex. Temperature = 2000°F)
- (dashes) This is used when a variable is defined as “don’t care” or “disregard”. The previous set point is still in effect.
- + /min (ramp up) This is used to ramp up a variable at a certain rate. (ex. Heat 5°F/min)
- /min (ramp down) This is used to ramp down a variable at a certain rate. (ex. Cool 5°F/min)

Set Point

If the control option =, + /min, or - /min are selected, several options are displayed. The set point is the target you wish to achieve. Temperature, Pressure, KN, cooling ramp rate, etc. are all valid set point variables.

(Tol+, Tol-) and (T1, T2)



Each variable may have a plus and/or minus tolerance. This tolerance defines a band above and below each set point in which the variable is considered within band. In turn the tolerance has two trigger timers, T1 and T2. T1 is the timer that is valid at the beginning of the step. For example, the step begins from cold to an ultimate set point of 1000°F, with a T1 of 90 minutes (knowing that the equipment should be at temperature in that 90 minutes). On the other hand, if your step is a hold temperature stage after the heat-up, i.e. Temperature = 1000°F for some fixed duration, then T1 could be 1 minute, since the furnace should already be at that temperature prior to this step. T2 comes in effect after T1 expires or the variable is normal in band. To elaborate the 90-minute example above, if the furnace heats to 1000°F in 78 minutes then T1 will expire without sounding an alarm. Should the variable surpass that band for more than T2 minutes, then an alarm will sound.

It is worth noting that a time (T1 or T2) of zero will disable the feature – despite the fact that Tol+ and Tol- may have been set.

Step Ends at

This field may be blank or it may hold the end condition for that step.

Example 1, if you want to hold 1400°F for X hours, then the Step Ends at will be blank.

Example 2, if you want to heat at a rate of +5°F/minute, then the Step Ends at >= (greater or equal to) 650°. The ramping will continue at that 5°F/minute until the furnace temperature surpasses 650°. Please note that if cooling, the Step Ends at should be <= (less or equal to) before the trigger temperature.

6.4 Create (or Modify) a Recipe



No	Chamber	Name/Method	Setpoint 1	Setpoint 2	Step Time	Runtime
1	GK	S1 heat-up	450			
2	GK	S2 hold	450		15	
3	GK	S3 heat-up 2	950			
4	GK	S4 Cpot		0.80	90	
5	GK	S5 cooling	750		90	

It is generally recommended to copy a sample recipe as left on startup rather than creating a recipe from scratch. This ensures that the sequence or any critical steps such as purges, automation handshaking, etc. are maintained as intended.

To create a new heat treatment first choose the chamber with the *Chamb.* Button. The chamber name is displayed over the *No* input field. Then press the *Treat.* button and set the number in the *No* field or press the double dot (..) button and select it from dropdown list.

In the *Name* field input the Treatment name, press the *Save* button and confirm the treatment number. You can also save the selected treatment with a different number and then modify it. In the next field you can choose to generate an alarm or end step after a desired time.

To define a heat treatment step, move the cursor to the desired step field and press the knob or simply select it. Now choose modify to change values in selected step, copy to copy step and save it with the modified number or delete to remove the step. To enter new parameters choose modify.

You can confirm these changes, select another variable and select a behavior in this step or confirm changes with the *OK* button.

To create the next step, select the first one and choose copy on the pop-up screen. Now select the new step and modify it in the same manner as first one.

Example.

Each step of the recipe must have an end point. Typical soak stages have a determined duration (time) such as 45 minutes or four hours. This value would be entered in the Step End field. For stages where you wish to exchange atmospheres or a ramp to temperature, leave Step End as zero. Note that a step end must be defined within the variables. See recipe variables defined.

Note, should you wish to add an alarm to this step, change the Step End field to Alarm and enter the alarm time. Example, consider that the heating always takes less than 2 hours, you may wish to select Alarm = 140 minutes. If the recipe doesn't jump to the next step within 140 minutes, then an alarm will sound.

Estimated duration is the calculated estimated time of the step. For steps where the time is fixed (soak) then estimated = actual. For steps where heating is involved, the estimated time is based upon configured and calculated values. This estimation should be taken loosely.

6.5 Starting a Treatment

When the desired chamber for starting the treatment has been selected, position the cursor over the [Start] button. The cursor will spring into the field Nr. Activate the field by pressing the turn and press button. By turning the turn and push button the desired treatment can be selected and loaded. By pressing the [Start] button at the bottom of the screen, the treatment will be started.

6.6 Displaying a Running Treatment

Running the treatment screen is similar to the edit screen.

The green line highlights the actual program step the charge is currently in. The Protherm controller also displays how long the current program step has been running in minutes. A paused treatment will show the presently running step in yellow rather than green.

6.7 Viewing a Running Treatment

By pressing the third function key again, the display changes to the treatment step.

In this screen, all the relevant set points and actual values for the current program step are displayed. With one view it is possible to determine whether the end criteria have been fulfilled, or if parameters exceed the defined tolerance bands.

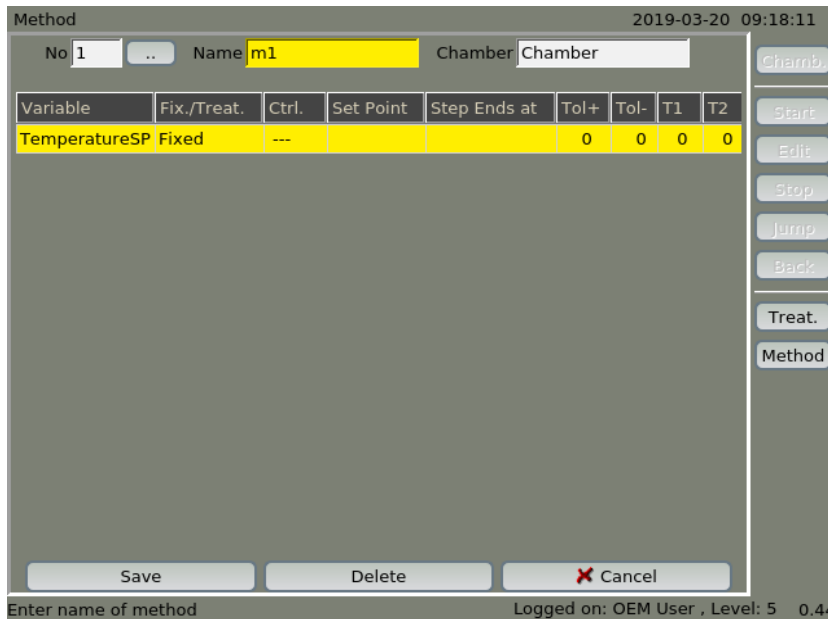
6.8 Modifying a Running Treatment

By pressing the third functions key again, the screen will display the treatment window. If a green line can be seen, then there is an active program running. By selecting the [Edit] button, all the program steps that have not yet been completed can be modified. An explanation of how to edit a step can be found in the chapter Creating and Modifying Treatments.

6.9 Method Definition

Generally, methods are set by the start-up personnel or system configurator. To create a new method, press the [Method] button and set the number in the No field or press the double dot (..) button and select the method from the dropdown list.

In the Name field input Method name, select chamber in the Chamber field and press the Save button.



To define the method, select the first line and press the knob. A dialog box appears. Editing a method is similar to a treatment, however there are options for the variable settings.

Fixed – Variable is set in the method and cannot be modified in the recipe step.

Treatment – Variable details can be set in the treatment.

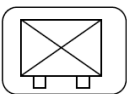

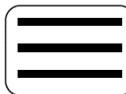
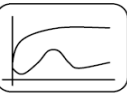


7 VNC CONNECTION

Protherm controller offers remote **desktop** connection. Client software is available at <https://www.realvnc.com>.

To add new connection choose File / New connection... (Ctrl+N)

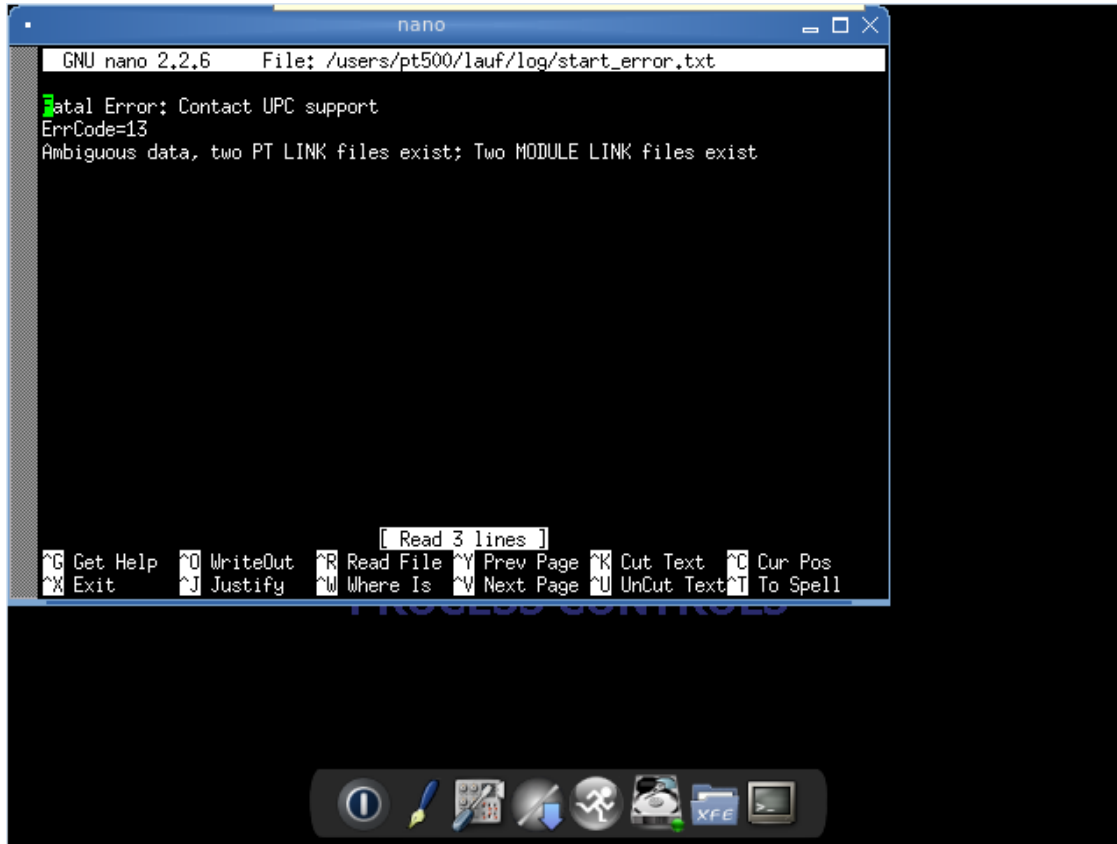
In VNC Server field enter Protherm's IP address, in Name field enter description and press OK button.

Double-click new connection, enter password: **x11vncpwd** and mark checkbox Remember password if necessary. You are connected now. Your keyboard function keys will activate the Protherm buttons as follows:

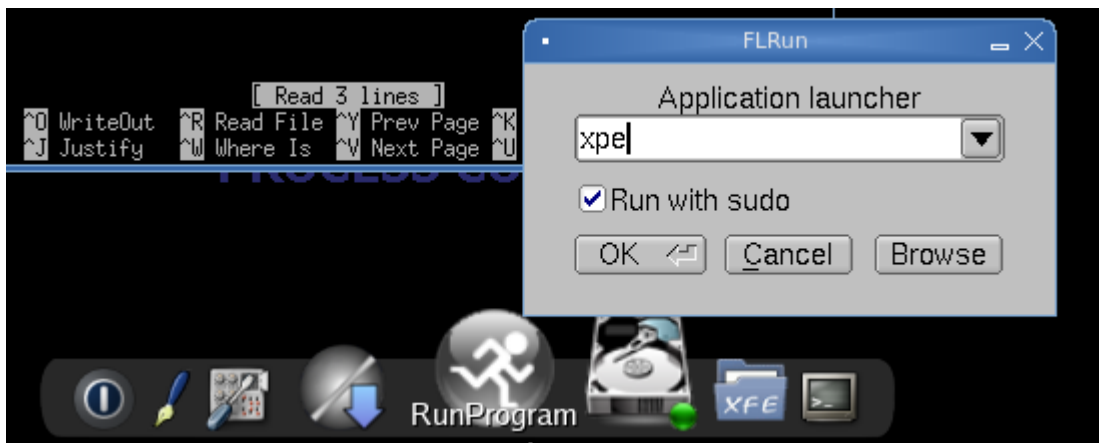
<p>F1:</p>  <p>OVERVIEW</p>	<p>F2:</p>  <p>ALARM</p>	<p>F3:</p>  <p>RECIPE</p>
<p>F4:</p>  <p>HISTOGRAM</p>	<p>F5:</p>  <p>PROCESS DIAGRAM</p>	<p>F6:</p>  <p>CONFIGURATION</p>

8 APPENDIX 1: TWO PT LINK FILES EXIST

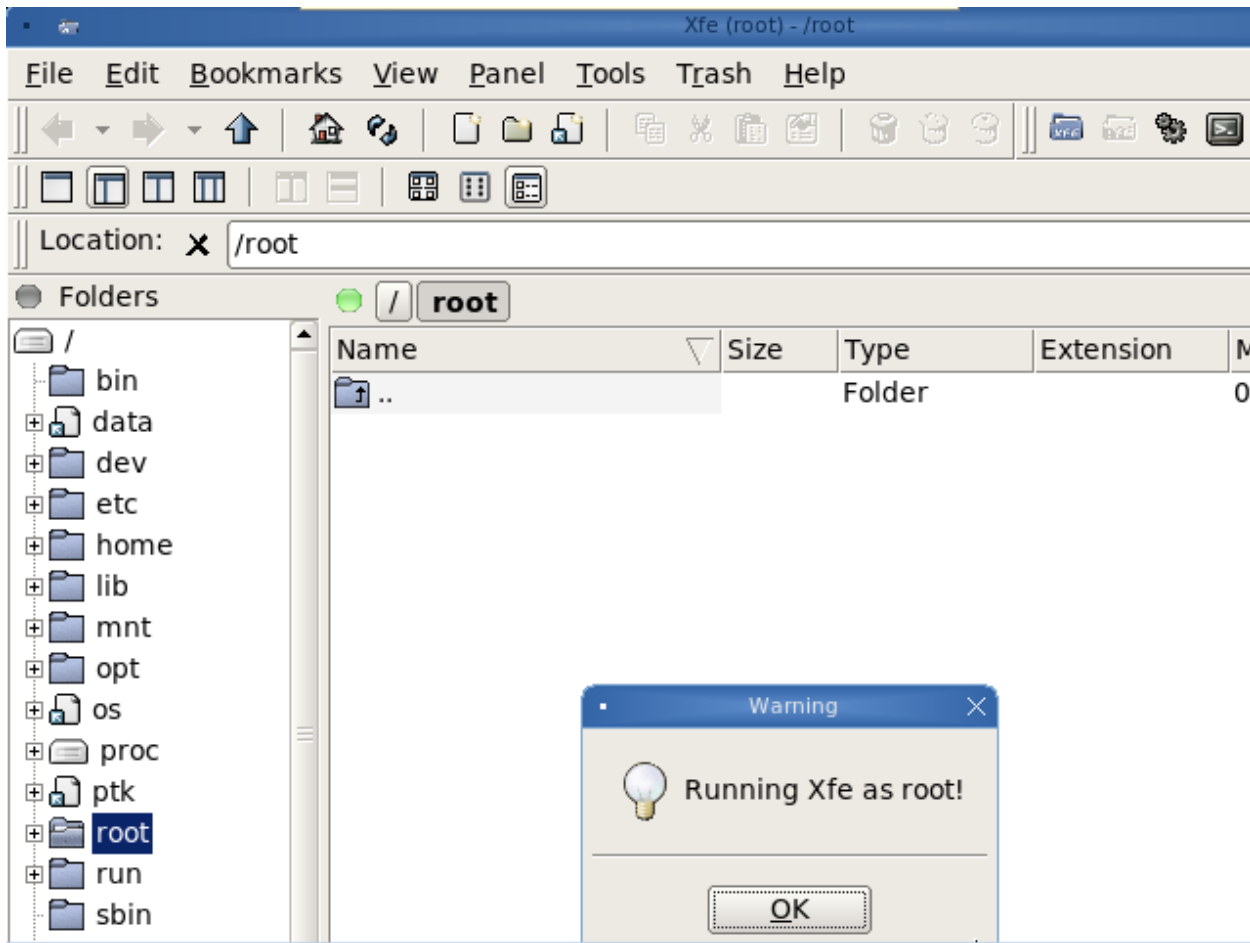
It is possible where a config was added with both PT.LNK and PTLNK.CFG? If so, you will need to delete one of the two...



Connect a USB keyboard and mouse and select RunProgram, select Run with sdo, type xfe, OK



Ensure that you see Running Xfe as root!

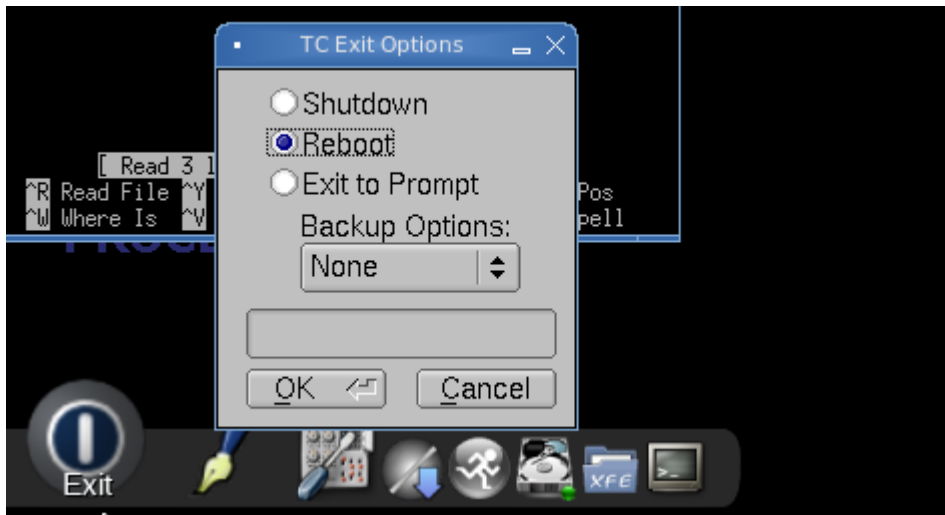


Navigate to /mnt/sdb1/users/pt500/lauf/config/cfg
Delete ptlnk.cfg (new) or pt.lnk (old)
And
modulelnk.cfg (new) or module.lnk (old)

propventil.~cfg	105 b...	Document	~cfg	0.
pt.lnk	0 byte...	Document	lnk	0.
pt.~lnk	0 byte...	Document	~lnk	0.
ptlnk.cfg	36.8 K...	Document	cfg	0.
ptlnk.cfg~	36.8 K...	Document	cfg~	0.
ptlnk.~cfg	36.8 K...	Document	~cfg	0.
redundancy.cfg	39 byt...	Document	cfg	0.

modbuswert.~cfg	947 b...	Document	~cfg	0
module.lnk	20 byt...	Document	lnk	0
module.~lnk	20 byt...	Document	~lnk	0
modulelnk.cfg	4.5 K...	Document	cfg	0
modulelnk.cfg~	4.5 K...	Document	cfg~	0
modulelnk.~cfg	4.5 K...	Document	~cfg	0

Select File > Quit and
Select Exit > Reboot > OK



9 CUSTOMER SUPPORT

Reach us at www.group-upc.com

United Process Controls brings together leading brands to the heat-treating industry including Atmosphere Engineering, Furnace Control, Marathon Monitors and Process-Electronic, and Waukee Engineering. We provide prime control solutions through our worldwide sales and services network with easy-to-access local support.



Americas

support.na@group-upc.com

USA: +1 414 462 8200

Canada: +1 514 335-7191

Asia

service@mmichina.cn

Shanghai: +86 21 3463 0376

Beijing: +86 10 8217 6427

Europe

support.eu@group-upc.com

France: +33 3 81 48 37 37

Germany: +49 7161 94888-0

Poland: +48 32 296 66 00