

# PROTHERM 50

Operating Manual



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Protherm 50  
Revision: P68.223 E  
April 2005

## Introduction

PT50 is a measurement and control system for heat-treatment-installations. The device is suitable for the connection of an O<sub>2</sub>-probe and offers the following features:

- Local operation by good readable display and press/turn knob, which reaction can be adopted to the personal wishes of the operator
- local language online selectable between German/English/French
- access protected by two separate password levels for setpoints and configuration.
- The menus for operation and configuration are individually selectable by the service-software.
- operating voltage: 24VDC.
- DIN-cabinet 96x96 with clips and pluggable connections enables exchange without opening the switch-cabinet.
- Measurement of thermo-voltage and e.m.f. of an O<sub>2</sub>-probe and calculation of the temperature TC1 for the thermo-elements PtRh10 (S), PtRh13 (R), (Pt13Rh6(B), from O<sub>2</sub>-partial pressure, carbon-potential Cp, carbon-activity aC, KC-value, water-content H<sub>2</sub>O, nitriding values KN, dew point TP and carbon-potentials Cpl with usage of a Lambda probe.
- Measurement a second thermo-voltage and calculation of the temperature TC2 for the thermo-elements PtRh10 (S), PtRh13 (R), (Pt13Rh6(B), NiCrNi (K), NiCrSi (N) and FeCo (J).
- Regulation the furnace-atmosphere, (control variable Cp, KC, O<sub>2</sub>, LogO<sub>2</sub>, KN, TP and Cpl) by means of PID-controller with Autoident-function and two local set points.
- Regulation of TC1 or TC2 by means of PID-controller with Autoident-function and two local set-points.
- Automatic calculation of the Cp-correction factor from a foil-value.
- Integrated purging automatic for O<sub>2</sub>-probe.
- Versatile limit-functions with classification in warning- or alarm-messages. Warnings will be deleted with disappearance of the cause automatically. Alarms has to be acknowledged.
- 5 relay outputs and 3 digital inputs are standard. Inputs and output signals can be assigned to the functions freely.
- CAN-Bus-Interface for IO- extension is standard.
- Optional MODBUS Interface or PROFIBUS-DP for connection to a process-leading system or PLC.
- Possible system-extension with CANOpen-compatible IO-modules. 4 analog inputs, 4 analog outputs, 16 digital inputs and 16 digital outputs can be used additionally. Outputs and inputs can be assigned to the functions freely.
- Comfortable parameterization and configuration of the device by means of PC through built-in service-interface. The entire configuration can be uploaded, archived and downloaded. The PC-Software necessary for this runs under Win98/NT/2000/XP and offers diverse tools for configuration, start-up, diagnosis and services.
- The appliance-software can be updated without opening the casing.

### Operating mode: Remote or Local

PT50 can operate in two modes:

Operating mode	Function
Remote	The regulators work with remote-setpoints, which are send by a process leading system over one of the interfaces. The local setting of a setpoint is not possible.
Local	The regulators work with the local setpoints. The process leadings system is able to read the actual setpoint values, the remote setpoints will be accepted by the controller but will be ignored.

The selection of the operating modes can be done manually, by a digital input or by process leading system. (exception: PROFIBUS, here the PLC can read the operating mode, but cannot change it.)

## Limits

PT50 makes four all-purpose limit values available, which can be used as single sided or double sided limit comparator. The monitored value can be selected from a list of variables, which includes all important values. The switching threshold can be a fixed value or another value out of the list. With double sided comparator a tolerance band is possible. The deviation alarm can be delayed and activate a relay or assigned to a warning or alarm message.

The regulators in the PT50 features also independent relative and absolute limit values.

## Warning - and alarm-system

Definition: A warning is a message, which will be automatically deleted after the disappearance of the cause. Alarms has to be acknowledged by the operator or a process leading system.

Many functions of the PT50 generate limit - or status-messages, which informs the user. In accordance with the meaning of the individual message, this must either only be taken to the knowledge with further observation, or an immediate intervention is necessary. Since the situation is different in each case, a solution was developed where an allocation of every limit or status message to a summary warning or a summery alarm. A relay can be assigned individually to most of the messages.

A process leading system can read all limit - and status-data in two status-words, independent of their functionality.

In the following description, functions which generates messages which allocation possibility to warn-ings or alarms are marked with WA.

## Allocation of system resources

Because of the many capabilities of the PT50, a fixed allocation of analogue and digital inputs/outputs would waste resources. Therefore, these can be assigned to the functions with PT50 individually.

The allocation happens with the configuration of the functions, multiple-allocations are allowed only with digital inputs.

The resources of the device can be expanded by CANopen – compatible I/O - modules. The corresponding input/outputs are treated like internal resources and appear to the allocation-tables.

### **Names**

<b>Relay</b>	
-----	No relay assigned
IntRL1	Internally in the PT50 available relays
IntRL2	
IntRL3	
IntRL4	
IntRL5	
Gr1RL1	External relays group 1 The allocation depends on the CAN-Bus relay-module
Gr1RL2	
Gr1RL3	
Gr1RL4	
Gr1RL5	
Gr1RL6	
Gr1RL7	
Gr1RL8	

<b>Relay</b>	
Gr2RL1	External relays group 2 The allocation depends on the CAN-Bus relay-module
Gr2RL2	
Gr2RL33	
Gr2RL4	
Gr2RL5	
Gr2RL6	
Gr2RL7	
Gr2RL8	
<b>Analog input</b>	
----	No analogue input assigned
ExtAI1	External analogue inputs The allocation depends on the CAN-Bus analogue input-module
ExtAI2	
ExtAI3	
ExtAI4	
ExtAI4	

The electrical value of an analogue input is transformed to a scale from 0% to 100%. In this manner only the used input module affects the electrical measurement range ( 0 ..20mA, 4 ..20mA, 0 ..10V etc). The PT50 realizes only every measurement range as 0.100% and scales this in accordance with the parameterization to physical values (e.g.: 0... 100% correspond to 0 ..40%CO ).

<b>Digital Inputs</b>	
-----	No digital input assigned
IntD01	PT 50 Internal digital Inputs
IntD02	
IntD03	
ExtD01	External digital inputs The allocation depends on the CAN-Bus input-module
ExtD02	
ExtD03	
ExtD04	
ExtD05	
ExtD06	
ExtD07	
ExtD08	
ExtD09	
ExtD10	
ExtD11	
ExtD12	
ExtD13	
ExtD14	
ExtD15	
ExtD16	

**Important hint:**

In no case, PT50 can be responsible alone for security-relevant functions within the total-installation.- Especially the **Safety-related recommendations for the usage of industrial-furnaces with gas-atmospheres** of the **AWT committee 8: Accident-prevention in heat-treatment-plants** has to be heeded.

## Operation

The handling of the PT50 takes place over a combined press-turn-button and with the LCD-display. The language can be switched between German, English and French. Through the hierarchical structure of the handling with main- and sub menus, the parameters of every function are easily selectable.

After switch-on the display shows the device name, the software version and the name of the menu layout. A pressure on the knob shows the main menu; turning the knob shows the sub menus. With the pressure of the knob the sub menu will be selected. Within the sub menu the selected parameter can be reached by turning the knob.

The sub menu „back “ leads into the main menu again.

The access to the device is structured in three access-levels:

1. The display-level.  
In this level, each parameter can be shown, with exception of the passwords in the Menu „access-control “. An alteration of setpoint values or configuration-data is not possible.
2. The setpoint-level.  
The setpoint-level allows the display of all parameters exactly like in the display-level, however the regulator-setpoints and some few values used frequently can be adjusted additionally.
3. The configuration-level.  
Additionally to the values of the setpoint-level, all configuration-data and parameters as well as the passwords of the access-control can be adjusted here.

The selection of the different access-levels takes place in the Menu „options “with the parameter „password “. There are different passwords for setpoint- and the configuration-level, which can be set in the configuration-level in the Menu „access-control“. In the delivery status the password is “0” for the setpoint- and “1” for the configuration level.

The password is the only value, which can be entered in the display level. By turning the knob select the “Password” and press the knob. By turning the knob again select the password for the setpoint- or the configuration level. With a press on the knob the password is entered.

The different levels have only a limited lifetime, which starts with every user action. When there is no action within the lifetime, the controller goes to the display level. The lifetime for the configuration level is fixed to 5 minutes. The lifetime of the setpoint-level can be entered in the menu “access control”. With a value of 0 it is possible to disable the lifetime control.

For the setting of the other values use the same procedure as for entering the passwords.

## Structure of the menus

In accordance with the big function-variety of the PT50, there are many parameters for the adaptation of the controller to the tasks. To facilitate the survey the parameters of the same functions are merged in sub menus.

Which submenus are available in each of the main menus can be selected with help of the service-program on the PC. Therefore it is not possible to describe here a main menu layout, but the table below shows all available sub menus.

### Following sub menus can be included in the main menus:

Menu	Function	Font
Overview	Actual values of atmosphere- and temperature controller	large
Atm-Overview	Actual value and setpoint of the atmosphere controller	large
Tmp-Overview	Actual value and setpoint of the temperature controller	large
Sensor-values	actual value of e.m.f. and temperature of the O2-probe	large
Actual values	Display of all calculated values	normal
Probe-purging	Configuration the probe-purging	normal
Atm-controller	Configuration of the atmosphere-controller	normal
Tmp-controller	Configuration of the temperature controller	normal
Measurement input	Configuration of the measurement inputs	normal
Process values	Configuration of the process values CO and H2	normal
Foil	Input of a foil-value with automatic calculation of the KF	normal
Correction	Input of the correction-factors and Offsets	normal
CAN-Bus	Configuration of the CAN-Interface	normal
MODBUS	Configuration of the optional MODBUS-Interface	normal
PROFIBUS	Configuration the optional PROFIBUS DP-Interface	normal
Warning-status	Display of the current warnings	normal
Alarm-status	Display of the current alarms	normal
Warning-config.	Configuration the warning-function	normal
Alarm-configuration	Configuration the alarm-function	normal
Ext. Analog-inputs	Configuration of the external analog inputs *	normal
Analog-output 1	Configuration of the external analog output (channel 1) *	normal
Analog-output 2	Configuration of the external analog output (channel 2) *	normal
Analog-output 3	Configuration of the external analog output (channel 3) *	normal
Analog-output 4	Configuration of the external analog output (channel 4) *	normal
Limit 1	Configuration limit 1	normal
Limit 2	Configuration limit 2	normal
Limit 3	Configuration limit 3	normal
Limit 4	Configuration limit 4	normal
Access-control	Configuration of the access to the user levels	normal
Options	different settings and password setting	normal
O2-values	Display O2 in % and as LogO2	large
Offsets	Input of the offsets for US,, TCS, O2% and LogO2	normal

That with \* marked functions requires additional CANopen-compatible I/O-Module, which are connected via CAN-Bus with PT50.

## **Sub menus**

### **Overview**

Display of the actual values of atmosphere- and temperature controller. Which values are shown, depends on the selection of the control variable.

### **Atm-Overview**

Display and respectively setting of the atmosphere-controller. The displayed setpoint depends on the operating mode (Local/Remote). In "Local" mode the local setpoint is shown and may be changed. In "Remote" mode the remote setpoint is display and cannot be changed locally. To alter the setpoint the PT50 must be in the setpoint- or configuration-level.

### **Tmp-Overview**

Display and respectively setting of the temperature-controller. The displayed setpoint depends on the operating mode (Local/Remote). In "Local" mode the local setpoint is shown and may be changed. In "Remote" mode the remote setpoint is display and cannot be changed locally. To alter the setpoint the PT50 must be in the setpoint- or configuration-level.

### **Sensor-Values**

Display of the e.m.f. (electromotive force) and temperature of the O2-probe.

### **Probe-Purging**

The function probe purging provides a cyclic purging or a purging which is started by a process leading system. Purging the probe makes only sense with carburizing processes.

During a probe purging, the calculation of the actual value as well as the setpoint of the atmosphere-controller are frozen in order to minimize the influence of the process through the purging. The values still remain frozen after completion of the purging for a refresh time, during which the probe can come back to the correct measurement value again.

Also the measurement of probe voltage and probe-temperature can be frozen additionally.

The values for purging time, refresh time and in the case of the cyclic purging the interval time can be configured.

#### **Interval**

The interval time between two cyclically purging actions in minutes. A "0" means that no cyclic purging is caused. But a purging can be started from a process leading system or with the service-program.

#### **Delay**

With the use of several PT50 at a furnace it may happen that all PT 50 start the purging simultaneously, because with same interval all devices behave equal after power up. In order to avoid this, a different value can be set in each PT50 for the delay. Delay [min] is the time, that passes after switching on the PT50 up to the first cyclic probe-purging. The delay shall 0 or bigger than the sum of purging- and refresh time.

#### **Duration**



Duration of purging time in minutes

### **Refresh timer**

Refresh time in minutes

### **Measurement enable/hold**

The setting MW will hold also the measurements of probe-voltage and probe-temperature.

## **ATM-Controller**

According to selection of the parameters, the algorithm can work as P -, PI -, PD - or PID-controller.

The controller considers the properties of the actuator.

A function for the automatic identification of the control loop is available, which determines the optimal parameter set.

Two relative-limits are available, whose switching-points can be set to a fixed distance to the setpoint. debit-value, stand. The effective direction (active on or active off) is selectable.

Two absolute-limits are available, whose switching-points can be set to a fixed value of the control variable. The appropriate relays switch with exceeding of the switch-point (WA).

### **Act.SP**

Display of the effective setpoint (regardless from local/remote mode)

### **Active local SP**

Selection of the local setpoint 1/2. In operating mode Remote, „Remote “ is displayed and the setpoint is not selectable.

### **Loc SP1, Loc SP2,**

Setting of the local setpoints, which are only effective in local mode.

### **Cycle**

Interval, after which the regulator calculates a new control value.

### **Xp**

Proportional band of the regulator in % the standardization-value.

### **Ti**

Integral element of the regulator in sec.

### **Td**

Differential-element of the regulator in sec.

### **Ap**

Approach. Area of the regulator-deviation (as factor of Xp) in which the Td of the regulator is effective.

### **Ymax**

Maximum value of control variable Y of the regulator in%.

### Ymin

Minimal value of the control variable Y of the regulator in%.

Ymax and Ymins define the work-range of the control variable  $\dot{Y}$ . Ymax is normally set to +100%. The setting of Ymin depends on the control loop and the actuator. The following table gives some hints.

Actuator	Structure	Ymin
continuous, proportional-valve	only enriching gas, no air,	0%
continuous, proportional-valve	enriching gas and air	-100% *
Magnetic-valve	only enriching gas, no air,	0%
Magnetic-valve	enriching gas and air	-100% *
Servomotor		-100%

\* To avoid undershooting with negative setpoint steps, Ymin may be set to values in the range of -10%.. -100%.

### RelLimit1, RelLimit2,

Relative-limits in units of the control variable.

All limits are activated if the actual values of the controller exceeds the limit. The effective limit of a relative-limit results from the **setpoint + relative-limit**.

#### Example:

Control variable Cp, setpoint: 1,00%, RL1: 0,05%. The limit becomes active if the actual value of Cp exceeds 1,05%.

(WA)

### Rg1Relay, Rg2Relay,

effective direction of a relatively-limit. Rg1Relay active ON means that the Rg1Relay will be closed when the limit becomes active. Active OFF means that the Rg1relay will be closed, when the limit becomes inactive.

### AbsLimit1, AbsLimit2,

Absolute-limit in units of the control variable. The limit actively becomes and the corresponding relay closes if the actual value of the regulator exceeds the absolute-limit (WA).

### TSave

Security-temperature of the atmosphere-regulator.

The regulator is released, if  $TCS \geq TSave$  or control variable is not Cp and the TCS-element is not broken. A not released regulator behaves like a turned off regulator.

Refer to the security-hint at the beginning of this manual.

## Control Variable

Selection the control variable of the Atm-controller. The standardization-value of the regulator is dependent from the selection of the control variable:

control variable	Standardization-value
Cp	1.00%C
KC	5.0
O2absolut	1e-20

O2%	100% O2S
O2ppm	100PPM O2S
LogO2	-20.0
KN	1.0
TP	100°C

## **Actuator**

Selection of the actuator for the regulator.

<b>actuator</b>	<b>type of control</b>
Continuous	The regulator switches no actuator relay. The analog output is used for an actuator
Magnetic-valve	The actuator relay corresponds to the control values. The ON/OFF relation correspond to the Y-value: Y = 30% >> the UP-relay is switched on 30% of the cycle. Y = -60% >> the DOWN-Relay is switched on 60% of the cycle.
Servomotor	The actuator relay generates adjustment pulses for a servomotor, the regulator takes the integral behavior of the actuator into account.
Cact , changeover actuator,	This setting is used if a proportionally-valve or a mass-flow-controller acts as actuator. The actuator relays switch the release-valves for gas (UP-Relay) as well as air (DOWN-Relay), the proportionally-valve or the mass-flow-controller is controller from the analog output.

### **Controller ON/OFF**

Operating state of the controller.

### **DigIn LocSP**

Allocation of a digital input for the selection of the local setpoint.

### **DigIn RefAir**

Allocation of a digital input for the supervision of the reference-air of the O2-probe (WA).  
If a digital input is assigned to this function, so the Atm-controller will stop if this signal is missed.

## **Relay-allocation**

<b>Relay-name</b>	<b>Function</b>
UP-Relay	actuator relay for $Y > 0$ , with Cact release-relay for $Y > 0$
DOWN-Relay	actuator relay for $Y < 0$ , with Cact release-relay for $Y < 0$
Rg1Relay	output-relay for relative-limit 1, active ON or OFF
Rg2Relay	output-relay for relative-limit 2, active ON or OFF
AG1-Relay	output-relay for absolute-limit 1, actively ON,
AG2-Relay	output-relay for absolute-limit 2, actively ON,

## **IDENT**

The IDENT-function facilitates an automatic optimization of the settings of the controller.

Requirements for the ATM controller:

1. The furnace is on working temperature.
2. The flow rates of the regulation- and base gassing are set. An alteration of these quantities after the optimization usually makes a readjustment of the parameters necessary.
3. For best results, the furnace must contain a charge.

Procedure:

1. manage the requirements, see above.
2. turn the regulators off (the identification works only with a turned off regulator).
3. set a setpoint at the low end of the working - area.
4. start the identification and wait for the results. After the end of the process, the regulator calculates the matching parameters, switches itself on and approaches the setpoint.
5. Through observation verify that control behavior is satisfactory.

## **TMP-Controller**

According to selection of the parameters, the algorithm can work as P -, PI -, PD - or PID-controller.

The controller considers the properties of the actuator.

A function for the automatic identification of the control loop is available, which determines the optimal parameter set.

Two relative-limits are available, whose switching-points can be set to a fixed distance to the setpoint. debit-value, stand. The effective direction (active on or active off) is selectable.

Two absolute-limits are available, whose switching-points can be set to a fixed value of the control variable. The appropriate relays switch with exceeding of the switch-point (WA).

### **Akt.SP**

Display of the effective setpoint (regardless from local/remote mode)

### **Active local SP**

Selection of the local setpoint 1/2. In operating mode Remote, „Remote “ is displayed and the setpoint is not selectable.

### **Loc SP1, Loc SP2,**

Setting of the local setpoints, which are only effective in local mode.

## Cycle

Interval, after which the regulator calculates a new control value.

## Xp

Proportional band of the regulator in % of the standardization –value 1200°C.

## Ti

Integral element of the regulator in sec.

## Td

Differential-element of the regulator in sec.

## Ap

Approach. Area of the regulator-deviation (as factor of Xp) in which the Td of the regulator is effective.

## Ymax

Maximum value of control variable Y of the regulator in%.

## Ymin

Minimal value of the control variable Y of the regulator in%.

Ymax and Ymin define the work-range of the control variable Y. Ymax is normally set to +100%. The setting of Ymin depends on the control loop and the actuator. The following table gives some hints.

Actuator	Structure	Ymin
continuous, thyristor controller	only heating, no cooling	0%
magnetic-valve	heating and cooling	-100% *
Servomotor	gas heating	-100%

\* To avoid undershooting with negative setpoint steps, Ymin may be set to values in the range of –10%.. -100%.

## RelLimit1, RelLimit2,

Relative-limit in °C.

All limits are activated if the actual values of the controller exceeds the limit. The effective limit of a relative-limit results from the **setpoint + relative-limit**.

Example:

Control variable TC2, setpoint: 900°C, RL1: +5°C. The limit becomes active if the actual value exceeds 905°C.

(WA)

## Rg1Relay, Rg2Relay,

effective direction of a relatively-limit. Rg1Relay active ON means that the Rg1Relay will be closed when the limit becomes active. Active OFF means that the Rg1relay will be closed, when the limit becomes inactive.

## AbsLimit1, AbsLimit2,

Absolute-limit in units of the control variable. The limit actively becomes and the corresponding relay closes if the actual value of the regulator exceeds the absolute-limit (WA).

## control variable

### Actuator

Selection of the actuator for the regulator.

<b>actuator</b>	<b>type of control</b>
Continuous	The regulator switches no actuator relay. The analog output is used for an actuator
Magnetic-valve	The actuator relay corresponds to the control values. The ON/OFF relation correspond to the Y-value: Y = 30% >> the UP-relay is switched on 30% of the cycle. Y = -60% >> the DOWN-Relay is switched on 60% of the cycle.
Servomotor	The actuator relay generates adjustment pulses for a servomotor, the regulator takes the integral behavior of the actuator into account.

## Controller ON/OFF

Operating state of the controller.

## DigIn LocSP

Allocation of a digital input for the selection of the local setpoint.

### **Relay-allocation**

<b>Relay-name</b>	<b>Function</b>
UP-Relay	actuator relay for $Y > 0$
DOWN-Relay	actuator relay for $Y < 0$
Rg1Relay	output-relay for relative-limit 1, active ON or OFF
Rg2Relay	output-relay for relative-limit 2, active ON or OFF
AG1-Relay	output-relay for absolute-limit 1, actively ON,
AG2-Relay	output-relay for absolute-limit 2, actively ON,

## **IDENT**

The IDENT-function facilitates an automatic optimization of the settings of the controller.

Requirements for the TMP controller:

1. The furnace temperature is minimum 200°C below the desired setpoint or is cold.
2. For best results, the furnace must contain a charge.

Procedure:

1. manage the requirements, see above.
2. turn the regulators off (the identification works only with a turned off regulator).
3. set a setpoint at the low end of the working - area.
4. start the identification and wait for the results. After the end of the process, the regulator calculates the matching parameters, switches itself on and approaches the setpoint.
5. Through observation verify that control behavior is satisfactorily.

## **Measurement Input**

PT50 possesses three analog measurement inputs for Sensor – e.m.f. U.S. and the temperature inputs TC1 and TC2. TCS is used for the calculation. For TCS, As alternative TC1 or TC2 can be used. The regulators heed the thermo-break-supervision of that for the regulation responsible thermocouple. Each measurement input contains an adjustable digital filter for the absorption of fast fluctuations of the measurement value. In this menu, the filter-time-constant can be set for each input in s. A “0” turns the filter OFF.

The inputs for TC1 and TC2 can become parameterized for the linearization and compensation of different thermo-couple-types.

### **U.S.**

Display of the Sensor – e.m.f. in mV

### **UTH1**

Display of the thermo voltage of the TC1 input in mV

### **TC1**

Display of TC1 in °C

### **UTH2**

Display of the thermo voltage of the TC2 input in mV

### **TC2**

Display of TC2 in °C

### **TCS**

Display of TCS in °C. This is the value which is used for the calculation of the actual value (e.g. Cp, O2,..)

### **TCS = TC1/TC2**

Selection of TCS.

### **TCUS**

Filter-time-constant of the US-input in sec.

### **TCTCS**

Filter-time-constant of the TCS-input in sec.

### **ThEL TC1**

Selection of the thermocouple type for TC1.  
available are: PtRh10s (S), PtRh13 (R) and, Pt13Rh6(B).

### **TCT2**

Filter-time-constant of the TC2-Eingangs in sec.

### **THEL TC2**

Selection of the thermocouple type for TC2.  
available are: PtRh10 (S), PtRh13 (R), Pt13Rh6(B), NiCrNi (K), NiCrSi (N), FeCo (J),

## **Prozess Values**

<b>Parameter</b>	<b>Meaning</b>
CO [%]	CO value which is used for the calculation of the process values
Analn CO	To take the CO-value of an analyzer a ext. analog input can be used. In this case the scaling must be set in the next two columns. With Analn CO = ---- the CO has to be set manually or by a process leading system.

0% = CO	CO-value at 0% analog input value
100% = CO	CO-value at 100% analog-input value.
H2 [%]	H2 value which is used for the calculation of the process values
AnaIn H2	To take the H2-value of an analyzer a ext. analog input can be used. In this case the scaling must be set in the next two columns. With AnaIn H2 = ---- the H2 has to be set manually or by a process leading system
0% = H2	H2-value at 0% analog input value
100% = H2	H2-Wert at 100% analog input value.

## **Foil**

In order to calculate automatically the accurate correction-factor for a foil-measurement, PT50 requires two information:

1. The measured Cp at the time of the foil-measurement.
2. determination of the Cp-value of the foil

The first two lines in the submenu foil serve for the setting of this information.

### **Foil standby/ready !**

When the foil is extracted during a foil-measurement out of the furnace, the PT 50 must be informed by setting this line to "foil ready!". The PT50 remembers the corresponding Cp-value in order to use it for the calculation of the correction-factor.

### **Foil-value**

The Cp-value from the analysis has to be entered here. The enter-function can only be called if PT50 was told before that a foil has been extracted. After end of the input, the PT50 calculates the new correction-factor.

### **KF**

Shows the last entered or automatically calculated Cp-correction-factor. Hint: the correction-factor can be set manually in the submenu „correction “.

## **Correction**

If for an input an offset  $\neq 0$  is parameterized, then the mark OFFSET! appears in the overview-windows beside the corresponding value. Through pointing to this mark the value of the offsets will be shown.

### **US-Offset**

corrective offset for the US-input in mV

### **TCS-Offset**

corrective offset for the TCS-input in °C

### **TC2-Offset**

corrective offset for the TC2-input in °C

### **Correction-factor**



Correction-factor for the Cp-calculation. The Cp-value = calculated Cp \* correction-factor

**O2%-Offset**

Corrective offset for O2%.

**O2ppm-Offset**

Corrective offset for O2ppm.

**LogO2-Offset**

Corrective offset for LogO2.

Attention! The corrective offsets for the different representations of the O2 partial pressure are independent from each other. If all three O2-oOffsets are not 0, is not guaranteed that the representation-forms are consistent among each other!

**K1, K2,**

The calculation of the C-potential with application of a lambda probe (result Cpl) , uses beside the the CO-value the coefficients K1 and K2. Default values are:

K1 907.0  
K2 0.2145

By means of these coefficients, corrections can be made for the calculation of Cpl. It is recommended however not to change K1 and K2. It is better to do corrections with USOFS and the correction-factor (see above).

## **CAN-Bus**

**Attention! Changes in this menu become effective not until the PT50 is switched off and on**

PT50 is equipped with a CAN-Bus-Interface as standard. Two operating modes are available:

1. CANBUS Slave: The module corresponds to the CANopen-Standard (implements not yet completely)
2. CANBUS Standalone: The module works as masters for I/O modules according the CANopen-Standard and sends when switching on " Node start" commands.

In operating mode „Standalone “ the connection between PT50 and the I/O-modules are watched by nodeguarding ( WA)

Further information about the operation of the PT50 with CAN-Bus-Interface is available in a separate document.

### **Baud rate**

Baud rate of the CAN-connection

### **NodeID**

CANopen-NodeID of the PT50

### **IO-MODUL ID**

CANopen-NodeID of the I/O-modul in Standalone-mode. If 0, then the module is not spoken to.

### **CATSENSOR ID**

CANopen-NodeID of an additional Catsensors with Standalone-operation. If 0, then the module will be not addressed.

### **Autosend**

Reserved for future enhancements. Must be set always to 0.

### **Operating mode**

Selection of CANBUS Slave / Standalone

The following two submenus are displayed alternatively, because only one of the optional interfaces can be installed. Without installed interface the main menu shows „----- „.

## **MODBUS**

**Attention! Changes in this menu become effective not until the PT50 is switched off and on**

PT50 can be equipped optionally with a RS485-Interface with MODBUS-driver. The interface can operate in 2-wire or in the 4-wire mode. The selection is done by software.

The MODBUS-driver supports only the RTU-Mode and requires a sign-length of 8 bits.

Further information to the operation of the PT50 with MODBUS-Interface is available in a separate document.

### **Address**

MODBUS-address of the module, allowed range: 1 ... 247

### **Baud rate**

Baud rate, values are possible between 300Bd and 38400Bd.

### **Sign-length**

7 bits or 8 bits

### **Parity**

possible settings: even, odd, mark, none

### **Stopbits**

1 or 2 stop bits

Attention: With baud rates over 9600Bd some communication partners requires 2 stop bits in order to be able to read the messages correctly.

### **Mode**

2-wire-interface or 4-wire-interface

## **PROFIBUS**

PT50 can be equipped optionally with a PROFIBUS-DP-Interface. The necessary GSD-file for development tools is available as PEH\_002.gsd.

PT50 represents a modular Profibus-DP-Slave at the PROFIBUS. It can be configured either in i\_CS (carburizing) or in i\_NS (nitrating) mode., Nitrocarburieren, can be driven. The data structure is dependent on the selected configuration.

Properties:

- The Profibus-address is set manually at the PT50 or with help of the service-program.
- The baud rate is recognized automatically, the profibus standard values are in the range from 9600Bd ... 12 Mbauds..
- Freeze - and Sync-operation are not supported because these are not meaningful for PT50.
- With the project planning by means of a GSD-file, the configurations „i\_CS “and „i\_NS “ are selectable. PT50 gets ready automatically in the Configuration-phase for the chosen configuration.
- The SPS can always read the at the input values from the PT50. Output data (setpoints and process parameters) will be adopted only in Remote mode.
- faults are transferred as external diagnostics.

Attention! Because Input and output data are transferred constantly with profibus, the master must always prepare all output data comprehended in the chosen configuration (setpoints and process parameters), even if is they are constant. The take over of the setpoints requires Remote operating mode.

Further information to the operation of the PT50 with MODBUS-Interface is available in a separate document.

### **DP-Status**

Shows the status of the PROFIBUS-DP connection:

<b>Status</b>	<b>Explanation</b>
Wait_PRM	The PROFIBUS-DP-Interface waits for the information of the communication-parameters from the busmaster..
Wait_CFG	The PROFIBUS-DP-Interface waits for the selection and checkup of the data-configuration through the Busmaster.
DATA_EX	The connection was built up successfully, data are exchanged.

### **Baud rate**

Baud rate of the PROFIBUS-DP – connection

### **Act.Config.**

From the Busmaster ordered and from the PT50 of confirmed data-configuration.

<b>Configuration</b>	<b>Application</b>
i_CS	carburizing furnaces with Cp-control or similar
i_NS	Nitrating- and nitrocarburizing furnaces

### **Address**

Address of the PT50 in the PROFIBUS network.

## **Warning- and Alarm-Status**

Warnings or alarms are shown in this menu with their appearance.

## **Warning- and Alarm-Configuration**

The different messages of the functions, that is marked in this document with WA, can be assigned to the summary-warning as well as to the summary-alarm. In the menu „alarm-configuration “ alarms can be acknowledged after discontinuation of the underlying message. Same action is possible with the digital input „DigIn AlrRes “.

## **Ext. Analog Inputs**

Display of the 4 analog inputs in the range from 0% to 100%. These are the raw values of the optional CANopen moduls before the scaling to a physical measurement value.

## **Analog Outputs 1 ..4**

PT50 provides four drivers for external analog outputs which are accessed via CAN-Bus. The selection of output values and scaling is done in this menu. The electric output range of the module is seen with it as 0 ..100%, the real electric output-value is dependent on the type of the output-module, for example 0 ..20mAs, 4 ..20mAs (0 ..10VS).

### **Act. Value [%]**

Display of the actual output value in %.

### **Variable**

Selection the output variable. If „variable = external “is chosen, then the output can be provided by a process leading system as 0 ..100%.

### **0% =**

Value of the output variable for 0% output.

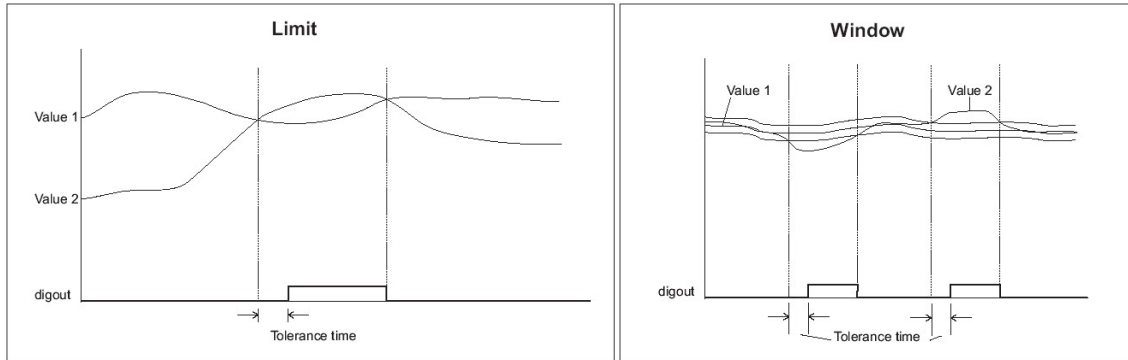
### **100% =**

Value of the output variable for 100% output.

## Comparator 1..4

PT50 provides 4 independent, versatile comparators, which integrate the functionality of a limit comparator and a window comparator with adjustable tolerance time.

Both compare variables may be picked from a general variable table. The comparator mode ("limit/window") specifies, whether the comparator performs a simple limit compare ("value 1 is less than/greater than value2") or a window compare ("value 1 is within/outside value 2 +/- tolerance band")  
The diagrams below show the details:



### Limit mode

At the moment when value 1 climbs above value 2, the tolerance timer starts. If the limit violation persists during the entire tolerance time, the internal limit flag is raised. If, during the tolerance time, the value 1 falls below value 2, the tolerance timer is reset and a new limit violation has again to exist for the whole tolerance time in order to raise the limit flag.

### Window mode

Around the value 2, there is a symmetrical tolerance window, which is twice the tolerance band wide. At the moment when value 1 leaves this tolerance window, the tolerance timer starts and if value 1 stays outside the window for the entire tolerance time, the limit flag is raised. If value 1 returns to the tolerance window within the tolerance time, the timer is reset, a new violation must again exist for the whole tolerance time to raise the limit flag.

If the tolerance time is set to zero, any limit violation raises the limit flag immediately.

The limit flag may be used to activate a relays directly or it may be assigned to the alarm or alert system.

In the table of comparable values, there is an entry called „fixed lim“. This refers to a variable, that may be set to a fixed value by the user. If „fixed lim“ is selected as one of the compare values, a classical limit compare function with a fixed compare limit results.

A good example for the use of the window comparator mode is a regulator band alarm with delayed action. Set the comparator mode to "window", select the real value of a regulator as value 1 and the setpoint of that regulator as value 2. Then set the tolerance band and the tolerance time to the desired settings, assign the limit flag to the alarm system and you will have a comparator function, that raises an alarm if the real value stays outside the tolerance band for longer than the tolerance time.

The tolerance band is expressed in the units of the compared variables.

## **Access-control**

### **Access-level**

Display of current access-level

### **Password SP**

In the access-level CFG, the password can be entered here for the setpoint-value-level. The number is visible only in the enter-mode, only stars are shown in the normal mode.

### **Password CFG**

In the access-level CFG, the password can be entered here for the configuration-level. The number is visible only in the enter-mode, only stars are shown in the normal mode.

The configuration-level is left 5 minutes after the last service of the appliance automatically.

### **Acc.time[min]**

The access-time of the setpoint level. The setpoint-level is left when this access-time is expired since the last manipulation. If this value is set to 0, the PT50 remains in the setpoint-level after the first access with the password.

## **Options**

In this menu all settings which do not belong to other menus are summarized.

### **Operating mode**

Selection the operating mode Local/Remote, sees above.

### **DIGIN REMLOC**

Allocation of a digital input to the switch the operating mode Remote/Local.

### **Intdig[0x], Extdig[0x]**

For diagnosis-purposes, the state of the internal as well as external digital inputs are shown here, independently from the allocation to the functions.

### **Probe motor [%]**

Some sensors contain a probe-motor, that provides a perfect contact to the zircon-element of the sensor.

This probe-motor can be driven in intervals of 100 seconds with different pulse control factors.

on-circumstances. In this menu the factor can be set in the range of 0% ..100%.

If this value is set to 101%, so the probe-motor is always switched on for the duration of the probe-purging.

### **DrmRelais**

choose the relay for the activation of the probe-motor.

### **LCD-contrast**

With this menu the contrast of the LCD-display can be adopted to the viewing angle.

### **Language**

Selection of the language of the PT50: German, English and French  
The selection can take place anytime and doesn't disturb the operation of the PT50.

### **Jogdial (turning knob)**

Adaptation the reaction-speed of the jogdial with the entering numbers to the individually taste of the operator. Selectable are: slow , normal, fast

### **Password**

Input of the password to change the access levels. After entry of the password it is always shown "0".

### **O2-actual values**

This sub menu shows the O2-partial pressure in percent and the LogO2 in big letters.

### **Offsets**

If PT50 uses for the O2-measurements, it is inexpedient to use the menu „correction “, because this shows insignificant correction-values.

This menu „Offsets “summarizes the correction offsets which are important for O2-operation.

#### **US-Offset**

correction offset for the US-Input in mV

#### **TCS-Offset**

correction offset for the TCS-input in °C

#### **O2%-Offset**

correction offset for O2%.

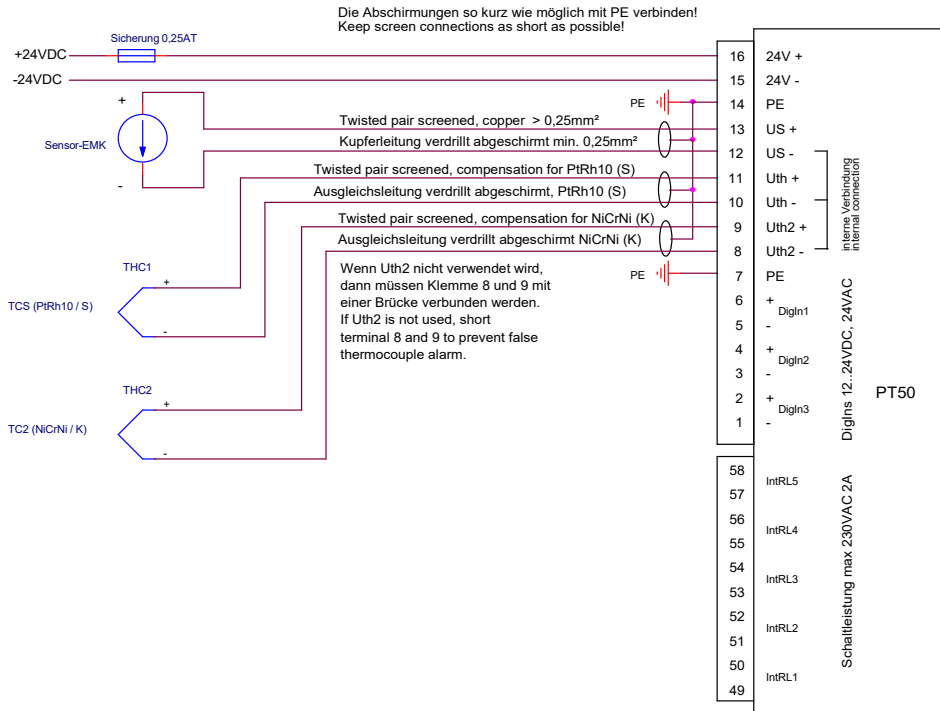
#### **LogO2-Offset**


correction offset for LogO2.

Attention! The correction offsets for the different representations of the O2 partial pressure are independently of each other. If all three O2-offsets are not 0, is not guaranteed that the representation-forms are consistent among each other!



# Connection diagram



 Für größtmögliche EMV-Sicherheit PE so kurz wie möglich mit der Schaltschrankfrontplatte verbinden!  
 For max. EMI protection connect PE as short as possible with the compartment front panel!

Dipl.-Ing. Volker Leverkus Industrie-Elektronik GmbH & Co. KG		
Title PT50 Anschlußplan		
Size A	Document Number 68.03.200.1	Rev 0
Date: Tuesday, May 21, 2002	Sheet 1 of 1	

## **Option PROFIBUS-DP interface**

### Installation

For the installation, only cables and plugs are allowed which are expressly admitted for the application in PROFIBUS-networks.

Recommended plugs:

Siemens 6GK1500-0EA02

Recommended cables (cable type A according IEC61158):

Siemens 6XV1830-0EH10

At both ends of the bus cable (and only there) a termination resistor must be applied.

### Application of OLPs for fiber-optic-data-transfer

The interface provides on pin 4 of the plug the RTS-signal, which is necessary for the application of OLPs. The power supply for the OLPs must be external because the interface cannot supply 24 V DC.

## Option RS485 interface with MODBUS-driver

### Installation and connector pin assignment

For the cable the usage of in twisted pairs with shield is recommended. which are expressly allowed for RS485-wiring. In strongly disturbed surroundings, double shielded cables should be used.

**unshielded cables cannot be used.**

### 2-wire-operation

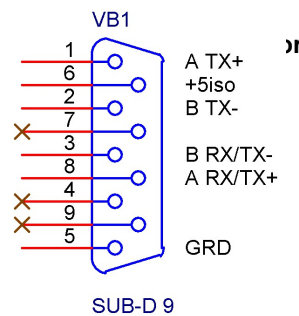
Only the pins 3 and 8 are used.  
Cables with single shield, for example Belden 9841

### 4-wire-drove

the receive direction uses the pins 3 and 8, the transmit direction the pins 1 and 2.  
Cables with single shield, for example Belden 9842

### Bus-termination

At the end of the cable a resistance of 121R has to be connected between TX+ and TX - as well as RX/TX+ and RX/TX -.



**The shield has to be connected with the plug-case.**  
**With double shielded cables, the outer shield has to be connected with the plug-casing and the inner shield with GRD (pin 5).**

## Mounting-dimensions

Front panel cutout: 92x92mm

Depth behind front-panel 135mm without plugs

## Appendix 1: CE-Conformity

### CE- Conformity

System **PROTHERM 50**

The device fulfils the requests of following regulations of electromagnetic compatibility:

- 89/336/EWG from 3. May 1989 within following modifications (Guideline 92/31/EWG from 28. April 1992 and guideline 93/68/EWG from 22. July 1993 )

because it was developed in accordance to following norms:

- EN 50081-2 ( electromagnetic compatibility- basic norm emission of distributions Part 2: industrial area );
- EN 50082-2 (electromagnetic compatibility- basic norm distribution firmness Part 2: industrial area ).

**The conformity with the upper mentioned requests is proved by the CE- sign placed on the device.**

The CE- mark was introduced in 2002

signed by Volker Leverkus

We want to point out, that following actions can affect the proved conformity and the characteristics of the product.

- Installation- and operating errors that can occur by non respecting the references of this operating manual, which is delivered with this product.
- Changing of components and original accessories through unauthorised persons, or by replacing parts of the device without acknowledge of the producer.