

# Operating instructions



## Temperature regulator

# SM3S

## Register

### Operating instructions

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## 1. GENERAL

### UNPACKING

1. Indicate visual damages directly to the transporter.
2. Type and notes on the package must agree with the delivery note.
3. Unpack the regulator with the sealed synthetic bag. Open the bag first, when the regulator gets mounted.
4. The type on the unit, the packing and on the delivery note must correspond.
5. Control if there is a fastening bow with the unit.

Please inform us by any irregularity.

### STORING

Electric radiation, electrostatic discharge or strong magnetic fields can damage the mounted microprocessor or other electrical parts.

### STORING CONDITIONS

Protect for	<ul style="list-style-type: none"><li>• possible mechanical damages.</li><li>• humidity</li><li>• Heat and direct insolation.</li></ul>
Store temperature	<ul style="list-style-type: none"><li>• -20°C to +50°C ( - 20 °F until 120 °F).</li></ul>
Store humidity	<ul style="list-style-type: none"><li>• 0 - 85% relative humidity ( Avoid condensation! ).</li></ul>

### DIRECTLY USE

Please follow all instructions in this manual.

### Fabrication date

The unit identifier is written on the type plate. ( Side of the covering).  
The fabrication number is written at the electrical connections.

### DESCRIPTION OF THE PRODUCT

#### TEMPERATURE-REGULATOR WITH DIGITAL DISPLAY

The regulator 'SM3S contains a control loop with PID-Algorithms for Temperature regulation. With this regulator and an adequate temperature sensor it is possible to control a heating or cooling system. The inputs (Sensore) and Alarm types can be adjusted by an intern switch.

The adequate Regulator output is fix and must be point out by order.

As supply you will find an attachment set for easier mounting of the regulator

Additional tool: Ring sealing for IP54 (coming from the switchboard panel)

Guide of Conformation:

Europe: The SM3S is CE checked (EN-61010, EN-50082-1, EN-50082-2, EN-55011, EN-55022) EMC

## 2. GENERAL PLAN

This Discription concerns to the 48 x 48 x 110 mm-Regulator Type SM3S on microprocessor Base.

### Temperature-Regulator with Digital display

Types:	GCS-3A*-R/M**	Regulator output: Relais contact, potential free
	GCS-3A*-S/M**	Regulator: Contact free voltage, Driver for SSR-Relais
	GCS-3A*-A/M**	Regulator: continuous
	* A:	The Alarm type is adjustable via internal switches by the user.
	** M:	The Sensor – input is adjustable via internal switches.

### Input

Thermo elements: E, K, J  
Specific resistance 100  $\Omega$  or less. Sensor break is getting signalized.  
The Regulator is switching off the regulator output.

Pt.100 (IEC-751), 3-Conductor Maximum specific resistance of 10  $\Omega$  per conductor. Sensor break and short circuit are getting signalized, The regulator is switching off the regulator output in both cases.

Display accuracy:  $\pm 0.3\%$  of Scale range  $\pm 1$  Digit

Temperature compensation:  $\pm 1\text{ }^{\circ}\text{C}$  at  $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$  ( $\pm 1\text{ }^{\circ}\text{F}$  at  $75\text{ }^{\circ}\text{F} \pm 50\text{ }^{\circ}\text{F}$ )

Supply voltage: 100 - 240 VAC, 50/60 Hz or 24V AC/DC

Dimensions: 48 x 48 x 110 mm ( B x H x T )

Mounting: Front tableau assembly, minimum space to other units - 30 mm

Covering: non-combustible Polycarbonate / Colour: black or grey

Operation: Front foil

## 3. DISCRPTION, FUNCTIONS AND TECHNICAL DATA

Actual value ( PV )	7 Segment red LED, 4-digit 4 x 8 mm
Theoretical value ( SV )	7 Segment green LED, 4-digit 4 x 8 mm
Actual value accuracy	Within $\pm 0,3\%$ of the scale $\pm 1$ Digit (compensation accuracy $\pm 1\text{ }^{\circ}\text{C}$ to $25\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ ) ( $\pm 1\text{ }^{\circ}\text{F}$ at $75\text{ }^{\circ}\text{F} \pm 50\text{ }^{\circ}\text{F}$ )
Sample time	250 ms

### PID Characteristic curve

Proportional band	(P)	0 - 999 $^{\circ}\text{C}$ / 0 - 99,9 $^{\circ}\text{C}$	0 – 210 $^{\circ}\text{F}$
Integral time	(I)	0 - 999 sec	
Differential time	(D)	0 - 300 sec	
Cycle		1 - 120 sec	
Factory adjustment		Solid State Relais	3 sec
Relais			30 sec

### PD Regulation charakteristik

Proportional band	(P)	0 - 999 $^{\circ}\text{C}$ / 0 - 99,9 $^{\circ}\text{C}$	0 – 210 $^{\circ}\text{F}$
Differential time	(D)	1 - 300 sec	

ON / OFF Regulation characteristic Hysteresse 0,1 bis 99,9  $^{\circ}\text{C}$  0 – 210  $^{\circ}\text{F}$

<u>Output</u>	Relais	(-R/M)	250 VAC, 3 A resistance load 250 VAC, 1 A inductive load
	Solid State	(-S/M)	12 VDC, 40mA short circuit safe
	current	(-A/M)	4-20mA insolated
	Load resistor		max. 550 Ohm

#### Heating - defect alarm

The current which is getting used by the consumer is getting measured by the current transformer. The measurement starts only when the unit is switched on. The Alarm is getting released when the input Current limit remains.

Range:	20A (Option W12) or 50A (Option W15)
Adjustment:	0,0 - 20,0 A for range 0-20A 0,0 - 50,0 A for range 0-50A 0,0 switches off the functions
Accuracy:	± 5%
Behaviour:	ON / OFF
Output:	Relais      250VAC 3A resistance load 250VAC 1A resistance load

#### Threaded fastening bow Option BL

Front tableau thickness      1 - 15 mm

### 4. FURTHER FUNCTIONS

Regulator output switch off and Display Off.

All exits are getting switched off. The actual value display shows OFF.

#### Locking functions

Lock 1	Blocking all Parameters (theoretical value, Alarm 1, Alarm 2 and heating defect alarm).
Lock 2	Blocking all Parameters without actual value.

### 5. SAFETY PROCEEDINGS IN NORMAL USE

- Before starting the regulator:
- Check all Safety installation for there function;
- Be sure that nobody is in danger.
- Check regulator at least once at a shift for visual damages and the safety installations for there functionality.

### 6. HAZARDS BY ELECTRICAL ENERGY

- Allow only qualified personnel to work on the electrical supply.
- Check the electrical equipment regularly! Fix loose connections and change burnt parts directly.
- Keep the switchboard door always closed. Allow only qualified personnel to work at the switchboard.

### 7. MOUNTING NOTES

#### Mounting regulations

Avoid following subjection of environmental conditions:

- Soot, Dust and corrosive Gases;
- Air moisture higher than 85% and deeper than 30% relative humidity;
- Condensation;
- Environmental temperature higher than 50°C ( 120 °F )and deeper than 0°C ( 0°F);
- Vibrations or heavy beats;
- EMC-load, Installation close to power supplier and high voltage electrical equipment; splashing with liquids

### Safety regulations

Do not use the regulator in space travel, aviation, atom reactor, medicine and explosive environment

Due to the used Temperature sensor the regulator can regulate temperatures between  $-199^{\circ}\text{C}$  ( $-199^{\circ}\text{F}$ ) and  $+1820^{\circ}\text{C}$  ( $+3300^{\circ}\text{F}$ ). For any risks of producing such temperatures is only the user liable.

When a damage can occur by a mistake of the regulation a safety switch off must be carry out.

### Regulation range

For adjusting the theoretical value in the provided range, the borders for the minimum and maximum theoretical value must be separated.

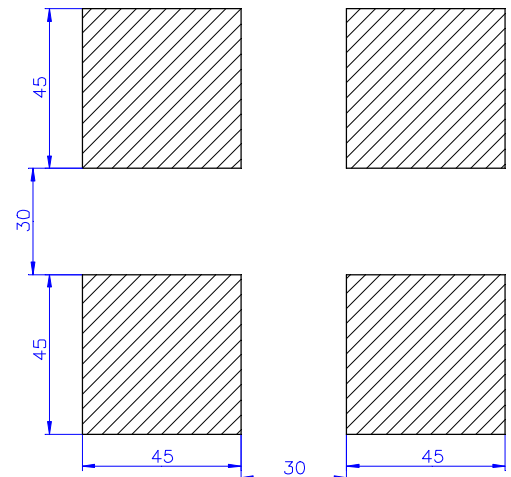
### Instructions, Manipulation at the unit

The user is responsible to understand the operation instructions and to avoid any kind of manipulation which influenced the safety of the unit..

## 8. SWITCHBOARD CUT OUT

The switchboard cut out for the SM3S is  $45 \times 45$  mm.  
The ideal sheet thickness is between 1 - 3 mm.

The minimum distance to other units is 30 mm.



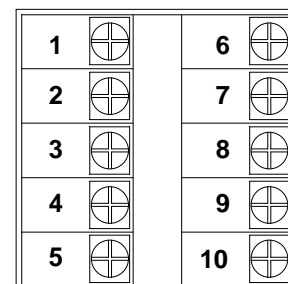
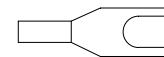
## 9. Connections

The connection wires with  $1\text{mm}^2$  should equipped with according 4 mm Cable lugs.

The cable lugs should fasten from left under the according connecting terminals.

Please see the installation terms.

Mount the touch protecting cap!

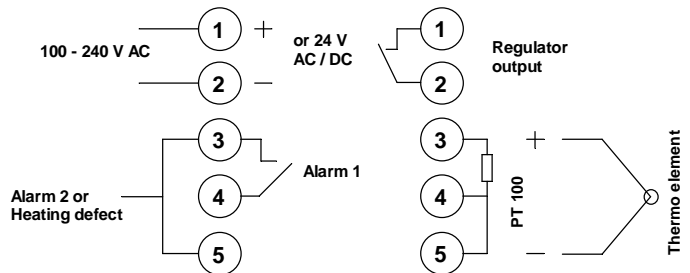


## 10. CONNECTING SCHEMA

Power supply:  
Please see Sticker at the unit.

24 VAC/DC or 100-240 VAC

If the Voltage of a 24V-unit is 230 VAC  
heavy defects appears.

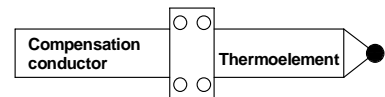


### Sensor connections

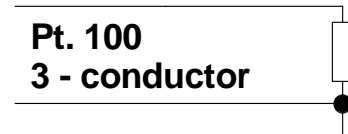
Thermo elements direct.



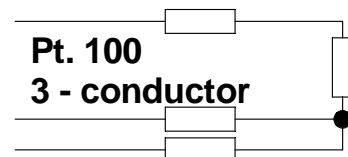
Thermoelement with compensation line und Thermobinders!



Pt.100 3-conductor circuit.  
At a 2-conductor PT 100 a bridge must be wired at the unit.



The connection resistor should not exceed the value of  
10  $\Omega$  for each conductor. Otherwise a higher  
Temperature gets measured.



## 11. GUARANTEED VALUES AND LIABILITY

Basically our Terms of payment and delievery are significant. The manufacturer is by no means liable for any failures at persons or subjects, if they result of following respond:

- No intended purpose of the regulator;
- Inappropriate mounting, initiation, operation and maintenance of the regulator;
- Initiation of the regulator by defect safety installations or inappropriate mounted and not functionable safety and protection installations;
- Not observing the instructions given in the handbook refering transport, mounting, initiation, operation, maintenance and storing the regulator;
- Alterations effected without any authorization;
- Catastrophic cases caused by outside effects and superior force.

## 12. NOTES

- Basically for the safe handling and trouble free use of this regulator is the knowledge of safety instructions.
- This operation manual, specially the safety instructions, must be observed by all persons working with this regulator.

Also all laws and rules for accident prevention at the working place must be observed.

### Hazards by handling of the regulator

The regulator type SM3S correspond to the actual stand of the art and the official safety specification. But the possibility of hazards for persons and the machine is still existing. Use the regulator only:

- for its intended purpose
  - in perfect conditions
- all hazards which are influencing the safety of the unit must be erased.

### Safety rules

- Organisatoric proceedings.
- All existing safety installations must be controlled permanently.

### Safety installations

- Before starting the regulator all safety installations must be mounted in accordance with regulations and operative.
- Remove safety installations only, when the regulator is:
  - Out of gear;
  - Safe against reinitiation.

### Safety arrangements

- The operation instructions must be placed permanently at the working place.
- Additional to the operating instructions all general valid and local laws and reglementations for accident prevention and environment protection must be observed.

### Training of personnel

- The regulator is only to be operated by well skilled and instructed personnel.
- The responsibility of the personnel for the mounting, initiation, operation, maintenance and repair-work must be strictly appoint.

## Operators manual SM3S

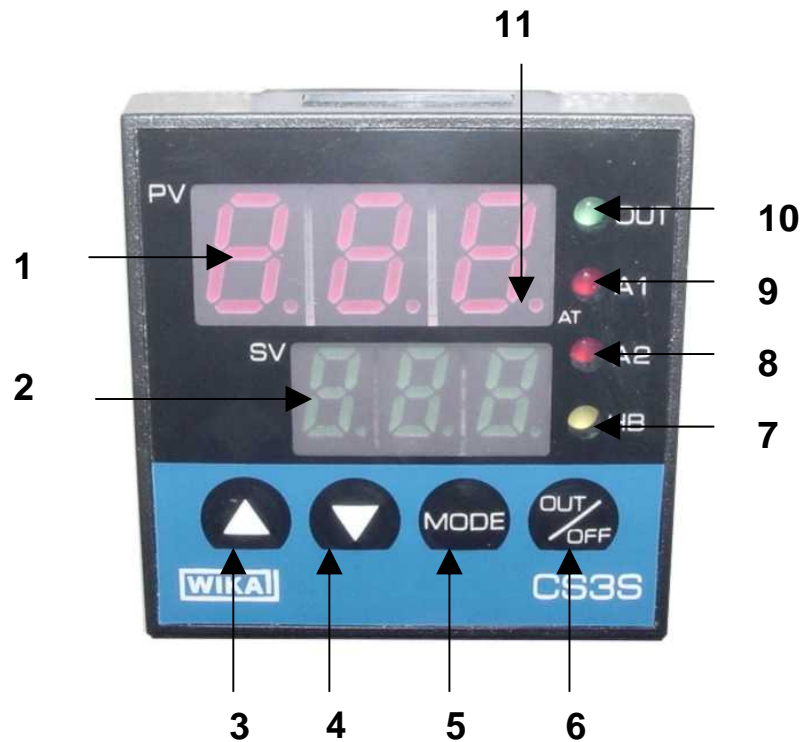


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## 13. DISPLAY AND OPERATORS CONTROL

Front view of SM3S

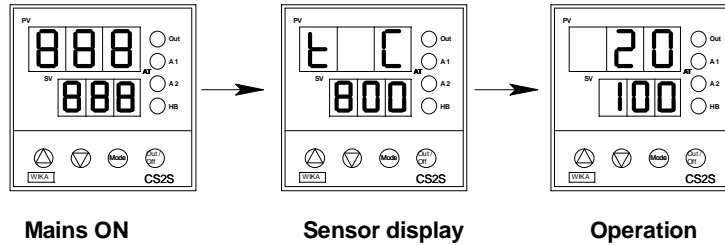


1. Actual value (PV)
2. Theoretical value (SV)
3. UP key
4. DOWN key
5. MODE-key
6. ON/OFF key

### LED-DISPLAY

7. Option Heating interrupt alarm
8. Option Alarm 2
9. Alarm 1
10. Regulation output
11. Display for Auto tuning

#### 14. MESSAGE BY SWITCH-ON OF THE REGULATOR



When the power supply of the regulator is getting switched on, the unit carries out a self-test. If the regulator is recognising an internal error, the display is blinking. In this case send the unit back to the manufacturer.

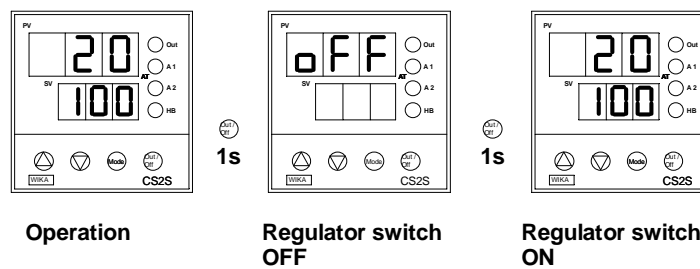
t C	Thermoelement Type K °C	JP°C	Japan ( JIS ) with point °C
J C	Thermoelement Type J °C	t F	Thermoelement Type K °F
E C	Thermoelement Type E °C	J F	Thermoelement Type J °F
Pt C	Pt. 100 IEC-751 without point °C	E F	Thermoelement Type E °F
JPC	Japan ( JIS ) Pt. 100 °C	Pt F	Pt. 100 IEC-751 with point °F
Pt°C	Pt. 100 IEC-751 without point °C	JPF	Japan ( JIS ) Pt. 100 without point °F

The Sensor display shows, which probe type is getting installed. This is very important to control, because the connection of a wrong thermoelement causes defects.

By operation the theoretical value ( lower display ) and the actual value ( upper Display ) are indicated.

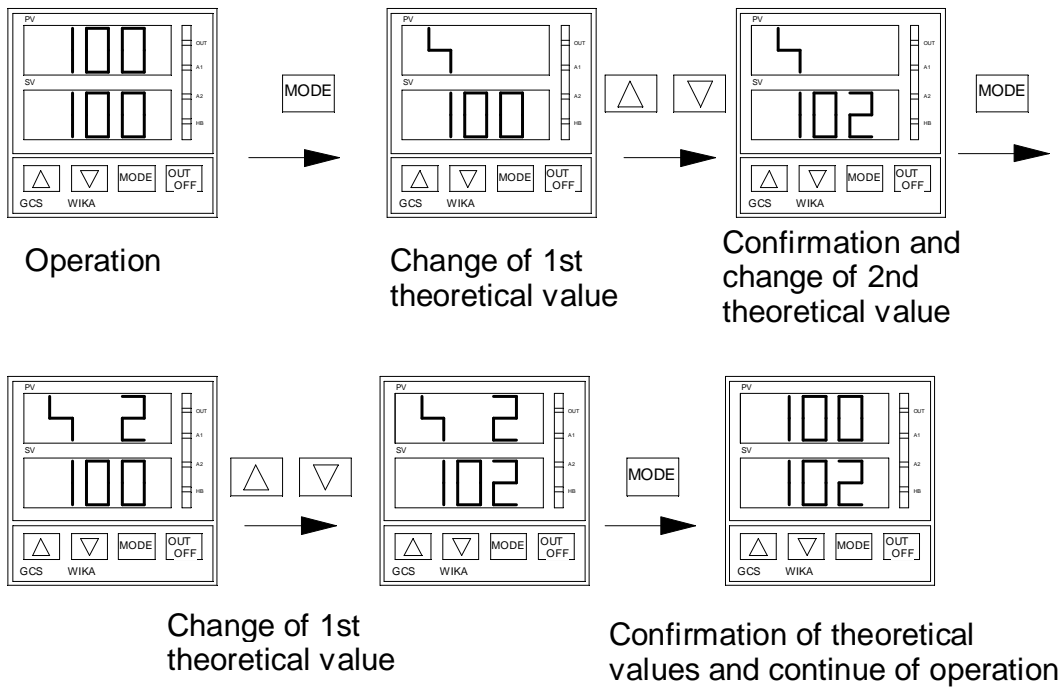
The regulator starts to work directly.

#### Regulator switch ON / OFF



By operation the regulator can be switched on or off by the key ON/OFF. This key must be pushed for 5 seconds.

## Changing the 1<sup>st</sup> and 2<sup>nd</sup> theoretical value



1. Push the MODE key.
2. The first theoretical value can be adjusted by the UP/DOWN key.
3. Acknowledge with the MODE key. The new theoretical value appears on the display. The display flips over to the set up of the second theoretical value.
4. The second theoretical value can be adjusted by the UP/DOWN key.
5. Confirmation with the MODE key.

## 15. Sublevel

By pushing the buttons



The display flips into the sublevel

### Self optimization (AT=Autotuning)

The self optimization can be released in the start- and stop phase. Please see, that the regulator switches two times. First up to 0%, then to 100% power. Between this time the optimal parameters P, I and D are getting calculated.

### Proportional band range 0 – 999 K / 0 - 99,9 °C

The Proportional band works proportional to the actual- and theoretical value at the regulation output. (Factory Adjustment (Factory adjusting FA = 10°C )

### Integral time range 0 - 999 Seconds

The integral time appoints the time of the output to change the power from 0 to 100% and reverse. (FA = 200 sec.)

ATTENTION: I : D at least 4 : 1!

### Differential time range 0 - 300 Seconds

The differential time appoints, in which time distance to the actual- and theoretical value a reaction should happens. (FA = 50 sec.)

ATTENTION: I : D at least 4 : 1!

### CYCLE TIME

The cycle time appoints, in which time distance the regulation output should be switched. ( FA = 1 sec )

Relais= 30 Seconds

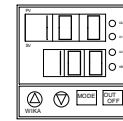
SSR = 1 - 3 Seconds

### CYCLE TIME

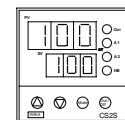
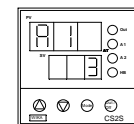
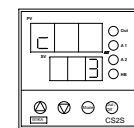
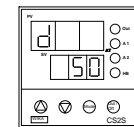
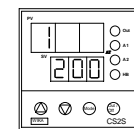
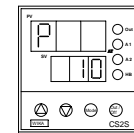
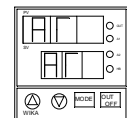
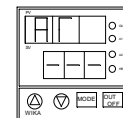
The cycle time appoints, in which time distance the regulation output should be switched. ( FA = 1 sec )

Relais= 30 Seconds

SSR = 1 - 3 Seconds



Operation



Rücksprung

Now the regulator parameters are adjusted. If the results will not meet the requirements we suggest to start first the autotuning. The system should be levelled out new. If the results are deficient again, we suggest following:

1. Double Proportional band

Reduce 2 x Integral- and Differential time. Please see Formula, that I:D should be at least 4:1. By faster Systems you can adjust following ratio: 5:1; 6:1; 7:1

By starting the regulator the upper LED Display shows the adjusted Sensor.

After approx. 2 sec. the actual value and the theoretical value are shown. The unit is now ready for regulation.

The control is divided into three levels.

1. Level ( main level ):

- Adjust theoretical value like Flow chart.
- Switch ON/OFF the regulation.

Set-up theoretical value:

1. Push MODE key.

2. Adjust the new theoretical value with the UP and DOWN key. Acknowledge with MODE key.

Switch ON/OFF the regulation.

Push OUT/OFF key for approx. 1 sec.

The upper display shows OFF or once more the actual and the theoretical value.

During regulation the LED shows the actual state with OUT, A1, A2, AT.

When the LED is blinking the output is activated. Is the AT LED blinking the regulator is in optimization process and should not be disturbed. ( searching in PID Modus for the optimal PID Parameters ).

When the regulator found the Parameters, the blinking of the AT LED stops.

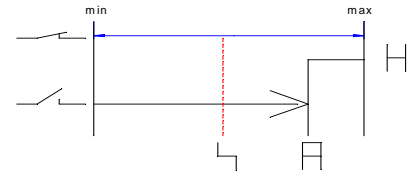
Description:

OUT	Regulator output
A1	Alarm 1
A2	Alarm 2
AT	Auto tuning ( Self optimization )
PV	Process value ( Actual value )
SV	Set value ( theoretical value )
SM	Model
Shinko	Manufacturer

## 16. ALARM TYPE

In this second face you can put in the appropriate parameters.  
Allow only qualified personnel to operate in this face.

Access to the Parameter-face:



You can switch over the parameter face with the UP- and MODE-key.

The Self optimization is reached at the first set point. You can activate the self optimization with the UP- and DOWN key.

The next parameter is reached by switching over the MODE-key. At the end of the parameter face the basic mode is reached with the MODE-key.

Regulation parameter

Proportional band 0 to 999°C, by Pt.100 with decimal dot 0 to 99,9°C.

- Integral time 0 to 999 sec.
- Differential time 0 to 300 sec.
- Proportional cycle 1 to 120 sec.

Factory set:

- Proportional band (P) 10°C.
- Integral time (I) 200 sec.
- Differential time (D) 50 sec.
- Proportional cycle 30s at relais output, 3s by output with semiconductor relais.

Important:

To receive a meaningful regulation, the I : D ratio must be at least 4 : 1! Adjust the proportional cycle in dependance to the output type and the gradient of the controlled system.

Relais output = 15 - 40 sec.  
semiconductor relais = 1 - 5 sec.  
mA Output = without Proportional cycle!

Attention:

The cycle time at the relais output should not be adjusted under 15 seconds, because a shorter time increases the wear at the contacts. The gradient is getting calculated of the temperature rise per time. The inverse time shows the optimal proportional cycle time.

Alarm date:

Alarm 1, Alarm 2 ( Option )

The value can be adjusted in the range of the choosen alarm type and probe.

## 17. STARTING

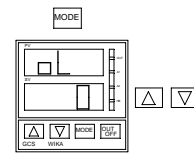
After mounting the SM3S professionally with all safety and mounting directions and after understanding the operation instructions the starting should execute like this:

1. Check on the PV-display the correctness of the sensor after switching OFF and ON the mains. If the display is not fitting with the connected sensor, the sensor must be adjusted with the right parameters of the probe ( page 15 ).

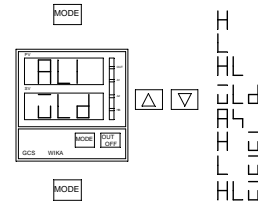
2. The maximum and minimum theoretical value set up for the user can be adjusted in the second face(Parameter face limit dates). The user can only adjust the theoretical value in this given range.



Minimum output:  
Normally 0 % output is wanted.  
Attention: Adjust this value to larger than zero only when necessary. Heater and cooler are regulating with this minimum power. (FA = 0 %)



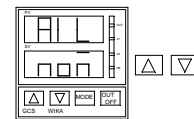
Alarm type selection:  
Please see the former page



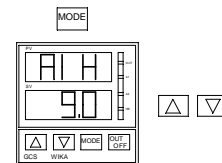
Temperature alarm 1 (A1) Select energized / Not energized

Energized:

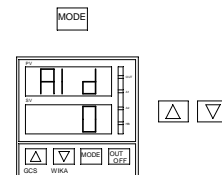
Not energized:



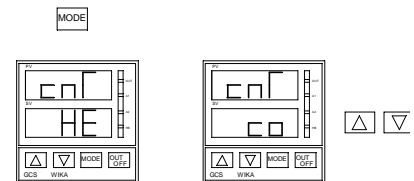
Alarm hysteresis:  
Cares for a Hysteresis between pick up and release of the Alarm relays. (FA = 1,0°C)



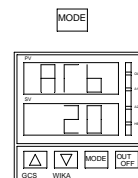
Temperature alarm 1 (A1) set up delay time: (0S)



Heating / Cooling:  
With this parameter you can switch over the regulator between heating and cooling.



Set up Offset value Auto tuning (°C)  
At this adjusted temperature, which is getting subtracted from the theoretical value, the regulator starts with an auto tuning



End of input



### 3. Cycle and parameter

In the second face the parameters are factory set like this:

P Proportional band	= 10 °C
I Integral time	= 200 s
D Differential time	= 50 s

The proportional cycle ( c ) must be controlled. This adjusting should depends to the regulation output.

By Solid State Exit	c = 1-3 sec
By Relais Exit	c = 15 - 30 sec
by mA	- Exit the parameter is not adjustable.

### 4. Optimal regulator results:

The standard parameters for the starting regulation are factory set.

When the system is getting switched ON, the regulator starts with the adjusted basic regulation values. If a direct regulation result is wanted, the self optimization in parameter face 2 are getting activated. The regulator is analyzing the regulation system and calculating the optimum parameter. This optimization is also carried out during the process, when Lock 1 and Lock 2 are not adjusted.

## 20. ERROR ALARM ON THE PV-READING

Broken probe:

- When a damage is detected at the thermostat or PT 100, or the adjusted maximum sensor value exceed 5%, the PV-display shows four blinking lines on the upper side ( " " " " )  
The regulator switches off the regulation output during this error.
- When the input remain under the minimum sensor value for 1%, the PV-display shows four blinking lines on the lower side ( " " " " ).

Self diagnosis:

During the start phase the regulator controls itself. In this Phase the adjusted Sensor and the maximum value are shown!

## 21. CLEANING

Clean the regulator front only with a wet rag.

Do not use any kind of solvents in no way!!!