Temperature Controller
Operating Manual

Read & understand this manual before using the instrument

⚠ CAUTION!	The proper and safe operation of device assumes that the operating instructions are read and the safety warnings given in the various section mounting ,electrical connection, commissioning are observed.

📖	All operations concerning installation, electrical connection, commissioning must be carried out by qualified, skilled person and national regulations for prevention of accidents must be observed.

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DMAN-00IM-0776_Rev A

1.Introduction

The instrument is used for temperature control in plastics, food & dehydration industries where the temperature stabilization is necessary. It has universal inputs like RTD sensors , Thermocouple sensors.

The controller has 7 segment display for indication of process value (PV) and the setpoint (SP) with proper annunciation of output/alarm signal as well as the mode of the controller.

RE series provides PID & ON/OFF control algorithm as well as different types of alarm .It has two outputs which can be configured for control as well as for alarm or both can be configured as alarm.

The meter can be configured onsite through use of front keys. The front panel has three keys for user interface.

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(1) – 7 Segment display (Process value & Setpoint value) Three digit ,Red, Decimal point configurable also used for operator prompting(display of setup menu).Also used for display of other features and setup parameter values in setup.
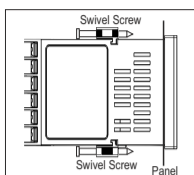
(2) – Indications
    1 – output 1 status   2 – Output 2 status
    🖑 – Manual mode   ST – Self tuning
(3) – Keys
    Configuration of setup parameter & scrolling through additional features

2. Scope of delivery

- Controller
- Swivel Clips (02 nos)
- Operating Manual

3.Installation

Caution:
In the interest of safety and functionality this product must be installed by a qualified engineer, abiding by any local regulations. Voltages dangerous to human life are present at some of the terminal connections of this unit. Ensure that all supplies are de-en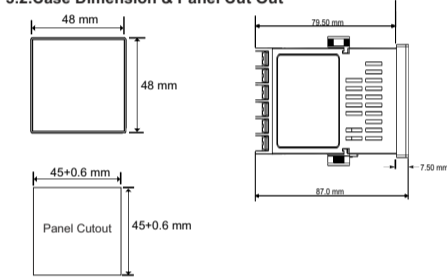ergised before attempting any connection or disconnection. These products do not have internal fuses therefore external fuses must be used to ensure safety under fault conditions. Push the meter in panel slot (size 45 x 45 mm). Mount the meter with the help of provided swivel screws as shown in figure. The front of the enclosure conforms to IP54. The terminals at the rear of the product should be protected from liquids. The Controller should be mounted in a reasonably stable ambient temperature and where the operating temperature is within the range -10° to 55° C. Vibration should be kept to a minimum and the product should not be mounted where it will be subjected to excess of sunlight.

3.1. EMC Installation Requirements

This product has been designed to meet the certification of the EU directives when installed to a good code of practice for EMC in industrial environments, e.g.
1. Screened output and low signal input leads or have provision for fitting RF suppression components, such as ferrite absorbers, line filters etc., in the event that RF fields cause problems.
Note: It is good practice to install sensitive electronic instruments that are performing critical functions, in EMC enclosures that protect against electrical interference which could cause a disturbance in function.
2.Avoid routing leads alongside cables and products that are, or could be, a source of interference.
3.To protect the product against permanent damage, surge transients must be limited to 2kV pk. It is good EMC practice to suppress differential surges to 2kV at the source. The unit has been designed to automatically recover in the event of a high level of transients. In extreme circumstances it may be necessary to temporarily disconnect the auxiliary supply for a period of greater than 5 seconds to restore correct operation.
4.ESD precautions must be taken at all times when handling this product.

3.2.Case Dimension & Panel Cut Out

48 mm
48 mm
79.50 mm
87.0 mm
7.50 mm
45+0.6 mm
45+0.6 mm
Panel Cutout

3.3. Wiring

Input connections are made directly to screw-type terminals with indirect wire pressure. Choice of cable should meet local regulations.
Note: It is recommended to use wire with lug for connection with meter.

3.4. Auxiliary Supply

Meter should ideally be powered from a dedicated supply, however powered from the signal source,provided the source remains within it may be the limits of the chosen auxiliary voltage range. A switch or circuit may be used in closed proximity to the equipment and within easy reach of operator. Disconnecting device used must meet the IEC-60947-1 and IEC-60947-3 requirement.
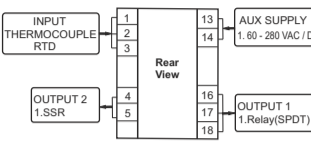
3.5. Fusing

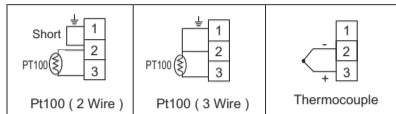It is recommended that all voltage lines are fitted with 1A HRC fuses.

3.6 Earth / Ground Connection

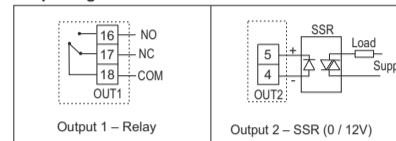For safety reason, ensure proper grounding of panel.

4. Connection Diagrams

Input Signals

Short — Pt100 (2 Wire)
Pt100 (3 Wire)
Thermocouple

Output Signals

| 16 — NO |
| 17 — NC |
| 18 — COM |
OUT1
Output 1 – Relay

SSR — Load — Supply
OUT2
Output 2 – SSR (0 / 12V)

5.Programming :

5. 1. Setpoint Programming :

In main display screen, press Up key or Down Key to enter into setpoint edit mode. Default setpoint is 200°C (392°F).

When setpoint edit mode is enable, last digit decimal point start blinking. Use Up key and Down key to scroll the value.

Press Enter key to confirm setpoint value.

Note: Setpoint Inhibit function needs to be disable while programming of setpoint through display.

5. 2. Setup Parameter Programming :

In main display screen, press & hold Enter key for approx. 5 sec to enter into setup edit mode.

hold 5 sec — If setup is password protected, user has to enter the correct password to enter into the setup edit mode. With entry of incorrect password, user can only read the setup parameter values(editing is prohibited) then setup menu is appears on the display.

Use Up Key & Down Key to scroll through different setup menu parameter.

To enter into the sub-menu of display menu , press Enter key.
Use Up Key & Down Key to scroll through different sub-menu parameter.

Press Enter key to edit the value of submenu parameter value. value will start blinking in edit mode.
Use Up Key & Down Key to scroll value .
Press Enter key to confirm the parameter value.

5. 3. Cancel Change of value

To cancel the changes before confirming, press Up key and Down Key simultaneously.
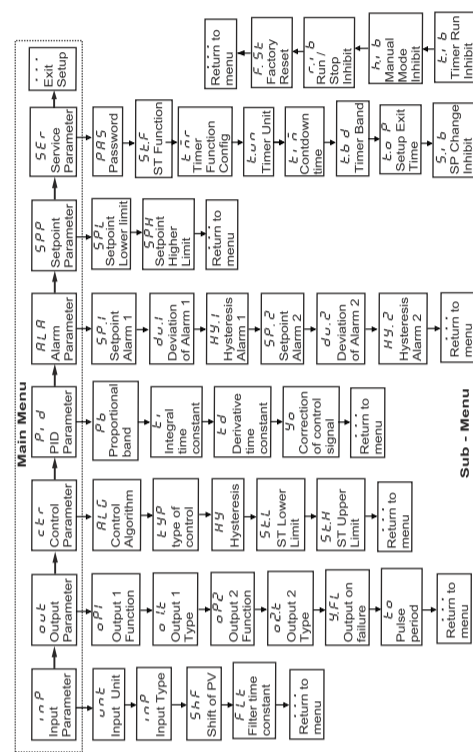
cancel the change

5. 4. Menu Exit

To exit from the setup menu or to return to the main menu from the sub menu, select the display screen with dot and press Enter Key.
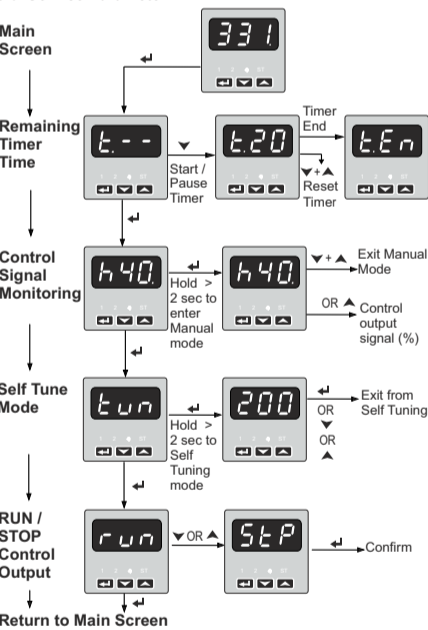
return to previous menu

Main Menu / **Sub - Menu**

5.5 Setup Screens

5.6 Service Parameter

Main Screen

Remaining Timer Time — Start / Pause Timer — Timer End — Reset Timer

Control Signal Monitoring — Hold > 2 sec to enter Manual mode — Exit Manual Mode — Control output signal (%)

Self Tune Mode — Hold > 2 sec to Self Tuning mode — Exit from Self Tuning

RUN / STOP Control Output — Confirm

Return to Main Screen

Remaining Timer Time

Press Down Key to start timer or Pause timer.
When timer is pause, timer value start blinking.
Press Up key and Down key simultaneously to reset timer.
When timer countdown is finish, display shows t.En
Note: Set Timer inhibit function to disable, for accessing timer function.

Control Signal Monitoring / Manual Mode Entry
This screen shows the output control signal in %.Press & hold Enter key for approx 2 sec to enter into Manual control mode . In manual mode, hand symbol 🖑 starts blinking.Use Up key or Down Key to set the output control signal(%). When output control signal is 100% it shows "h.On" on display screen.
In Manual Mode, if power supply interruption occurs, after power on instrument will take the value of Y.FL(output on failure) as the output control signal(%).Press Up Key & Down key simultaneously to exit from manual mode control.
Note: Set Manual mode inhibit function to disable to start timer.

Self tune (Auto tune) Mode
Press & hold Enter key for approx 2 sec to enter into self tuning mode. In self tuning mode ST symbol will start blinking.Pressing any key during self tuning will exit tune mode with showing error message on display.
Note: Set ST inhibit function to disable, for accessing timer function.

RUN/STOP Control Output
Press Up key or Down Key to change control output state. Press Enter key for confirmation.
Note: Set Run/Stop inhibit function to disable, for accessing RUN/STOP function.

5.7 Setup Parameters

Table 1.Setup Parameters

Symbol	Parameter description	Factory Default Setting (°C)	(°F)	Range
inp – Input Parameter				
unt	Unit	°C	°F	°C: Degree Celsius °F: Degree Fahrenheit
inP	Type of main input	pt1	pt1	pt1: Pt100 t-j: thermocouple of J type t-t thermocouple of T type t-k: thermocouple of K type t-s: thermocouple of S type t-r: thermocouple of R type
SHF	measured value shift of the main input	0°C	0°F	-100...100 °C (-180...180 °F)
FLT	Time constant of the filter	0.0	0.0	0...99.9 (0 = OFF)
outp – Output parameters				
oP1	Function of output 1	y	y	off: without function y: control signal A.Hi : absolute upper alarm A.Io: absolute lower alarm du.H: relative upper alarm du.l relative : lower alarm du.i: inner relative alarm du.o: outer relative alarm aLt: timer alarm
o1.t	Output type 1*	rely	rely	rely: relay output
oP2	Function of output 2	AHi	AHi	off: without function y: control signal A.Hi : absolute upper alarm A.Io: absolute lower alarm du.H: relative upper alarm du.l relative : lower alarm du.i: inner relative alarm du.o: outer relative alarm aLt: timer alarm
o2.t	Output type 2*	ssr	ssr	ssr: voltage output 0/12 V
y.FL	Output on Failure	0	0	0...100 %
to	Pulse period of of output	20.0 s	20.0 s	0.5...99.9 s
ctrl – Control parameters				
ALG	Control algorithm	pid	pid	on.of : control algorithm on-off pid: control algorithm PID
tyP	Kind of control	inu	inu	dir: direct control (cooling) inu: reverse control(heating)
Hy	Hysteresis	2.0 °C	3.6 °F	0.2...99.9 °C/°F
St.L	Lower threshold for autotuning	0.0 °C	32.0 ºF	Parameters depended on the measuring range
St.H	Upper threshold for autotuning	800 °C	999 ºF	Parameters depended on the measuring range
pid – PID parameters				
Pb	Proportional band	32 °C	54 °F	1...550 °C (1...990 °F)
ti	Integration time constant	13.6 min	13.6 min	0...99.9 min
td	Differentiation time constant	205 s	205 s	0...999 s
Yo	Correction of the control signal, for P or PD control	0	0	0...99.9 %

Symbol	Parameter description	Factory Default Setting (°C)	(°F)	Range
alar – Alarm parameters				
SP.1	Set point for absolute alarm 1	100 °C	212 °F	Parameters depended on the measuring range
du.1	Deviation from the set point for relative alarm 1	0.0 °C	0.0 °F	-199...200°C (-199...360°F)
Hy.1	Hysteresis for alarm 1	10.0 °C	50.0°F	0.2...99.9 C/°F
SP.2	Set point for absolute alarm 2	0.0 °C	32.0 °F	Parameters depended on the measuring range
du.2	Deviation from the set point for relative alarm 2	0.0 °C	0.0 °F	-199...200°C (-199...360°F)
Hy.2	Hysteresis for alarm 2	2.0 °C	3.6 °F	0.2...99.9 C/°F
spp – Set point parameters				
SPL	Lower limit of the set point change	-199 °C	-199 °F	Parameters depended on the measuring range
SPH	Upper limit of the set point change	800 °C	999 °F	Parameters depended on the measuring range
seru – Service parameters				
PAS	Access code to the menu	0	0	0...999 (0 = unlock i.e setup is not secure)
St.F	Auto-tuning function	on	on	off: locked on: available
tmr	timer function Configartion	off	off	off: Timer function disable non: None stp: control stop tun: Start self tuning St.C: Stop self tuning Hnd: Switching into manual working
t.un	Timer value setting unit	min	min	min: Minute hour: Hour
tim	timer Counting off time	30	30	0.1…99
t.bd	Timer band	10	10	0...99.9(0 = function is off)
t.oP	Automatic setup exit time	60 s	60 s	30...250 s
S.ib	Setpoint Inhibit	off	off	off : disable on : enable
t.ib	Timer Inhibit	off	off	off : disable on : enable
h.ib	Manual Control Inhibit	off	off	off : disable on : enable
r.ib	Control Output Run/Stop' Inhibit	off	off	off : disable on : enable
F.rST	Factory reset	no	no	no: no change in existing setting °C: Factory reset values in °C °F: Factory reset values in °F

Table 2. Parameter depending on Measuring range

Symbol	Input / Sensor	Min	Max
pt1	Resistance thermometer Pt100	-199 °C/°F	850 °C (999°F)
t-J	Thermocouple of J type	-100 °C (-148 °F)	999 °C/°F
t-t	Thermocouple of T type	-100 °C (-148 °F)	400 °C (752 °F)
t-k	Thermocouple of K type	-100 °C (-148 °F)	999 °C/°F
t-S	Thermocouple of S type	0 °C (32 °F)	999 °C/°F
t-r	Thermocouple of R type	0 °C (32 °F)	999 °C/°F

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6. Controller Input and Output

6.1 Measuring Input
Controller has programmable universal input, so different types of sensors input can be connected .Set input type (in.t) parameter to select type of input connected.Control output and Alarm output is dependent on input.
The display range for input is dependent on the selected input type and decimal point set.

6.2 Outputs
The controller has two outputs. Both outputs can be configured as an alarm output. Any one output can be configure as control output. For the proportional control the pulse period is additionally set. The pulse period is the time which goes by between successive switches of the output during the proportional control. The length of the pulse period must be chosen depending on dynamic object properties and suitably for the output device. For fast processes, it is recommended to use SSR relays. The relay output is used to steer contactors in slow-changing processes.
The application of a high pulse period to steer slow changing processes can give unwanted effects in the shape of oscillations. In theory, lower the pulse period, better the control, but for a relay output it can be as large as possible in order to prolong the relay life.

Recommended setting for the pulse period:

Output Type	Pulse Period (t0)	Load
Relay	> 20 sec	2A / 230 VAC
	min 5 sec	1A / 230 VAC
Transistor Output	1 ... 3 sec	SSR Relay

7. Control Algorithm

Controller has two types of algorithm ON-OFF algorithm and PID algorithm.
7.1 ON-OFF Algorithm
When a high accuracy of temperature control is not required, especially for objects with a great time constant and small delay, one can apply the on-off control with hysteresis. Advantages of this way of control are simplicity and liability, but disadvantage are the occurring oscillations, even at small hysteresis values.

Fig 1. Heating Output Type Operation

7.2 PID Algorithm
When a high accuracy of the temperature control is required, use the PID algorithm.PID parameters can be tuned manually as per requirement or automatically with use of auto tuning function.

7.2.1 Self Tuning (Auto Tuning)
This function is used to tune the PID parameter automatically as per object. In most of the case it provides optimum control.To begin the Self Tuning , go to " tun " message screen and hold Enter key at least 2 seconds. If the control algorithm is set on on-off or the Self-tuning function is locked then, the tune message will be hidden.For correct realization of the Self-tuning function, it is required to set St.L and St.H parameters. The St.L parameter must be set on the value corresponding to the measured value at disabled control. For temperature control objects, one can set 0ºC. One must set the St.H parameter on the value corresponding to the maximum measured value at switched on control on full power.In Self tuning mode, St symbol will start blinking . The duration of auto-tuning depends on dynamic object properties and can last maximally 10 hours. In the middle of the Self-tuning or directly after it, over-regulations can occur, and for this reason one must set a smaller set point, if it possible.The Self-tuning process will be stopped without counting PID settings, if a supply decay occurs or the Enter key is pressed. In this case, the control with current PID settings begins.If the Self-tuning is not achieved with success, the error code will be displayed refer the table 3 .

Table 3. Self Tuning (Auto Tuning) Error Codes

Error code	Reason	Corrective Action
ES.1	P and PD control was selected	For auto tuning, PI or PID control is required . Ti parameter must be greater than zero.
ES.2	Setpoint value is incorrect	Change Setpoint value or St.I & St.H settings
ES.3	auto tuning interrupted due to 1.Enter key was pressed. 2.Control Run/Stop function 3.Timer setting	Control Run/Stop function should be set to run.Check the timer function settings.
ES.4	The maximal duration time of auto-	Check if the temperature sensor is correctly placed and if the set point value is not set too higher for the given object.
ES.5	The waiting time for switching was exceeded	
ES.6	The measuring input range was exceeded.	Check sensor connections. Do not allow that an over-regulation could cause the exceeding of the input measuring range.
ES.0	Very non-linear object, making impossible to obtain correct PID parameter values, or noises have occurred.	Carry out the auto-tuning again. If that does not help, select manually PID parameters.

7.2.2 Tuning of PID parameter in case of a dissatisfying control

The best way to select PID parameters is to change the value a twice higher or a twice lower. During changes, one must respect following principles:

Table 4. Tuning PID Parameter

↑ - Increase ↓ - Decrease

Controlled Quantity	P	PD	PI	PID
Oscillations	Pb ↑	Pb ↑ td ↓	Pb ↑ ti ↑	Pb ↑ ti ↑ td ↓
Over-regulations	Pb ↑	Pb ↑ td ↑	Pb ↑ ti ↑	Pb ↑ ti ↑ td ↑
Instability		Pb ↓ td ↓		Pb ↓ td ↓
Slow jump response	Pb ↓	Pb ↓	ti ↓	Pb ↓ ti ↓

8. Alarms

Controller provides seven alarm types one of which can be assigned to any output . The alarm configuration requires the selection of the alarm type through setting out 1, out 2 parameters on the suitable type of alarm. Available types of alarms are given on following figure.
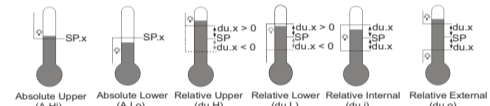

Fig 2. Types of alarms

Note:- x signifies 1, 2 i.e output 1 or output 2 Alarm.

The set point value for absolute alarms is the value defined by the SP.1 / SP.2 parameter.
For relative alarms, it is the deviation from the set point value in the main channel – du.1 / du.2 parameter.The alarm hysteresis , i.e. the zone around the set point value, in which the output state is not changed, is defined by the Hy.1 / Hy.2 parameter. Hysteresis is applied to both the side of the set point value as hysteresis/ 2.

9. Timer Function

When reaching the set point temperature (SP) the timer begins the countdown of the time defined by the time parameter. After counting down to zero, the timer alarm is set, which remains active till the moment of the timer erasing.
To activate the timer function, one must set the parameter tmr.
To indicate the alarm state on an output, one of the outputs out1, out2 should be set to AL.tr.
The timer status/ residual time is displayed with the mark "t" on the first position. To display it, one must press the Enter key till the moment of it appearance on the display (acc. to the fig. 3)
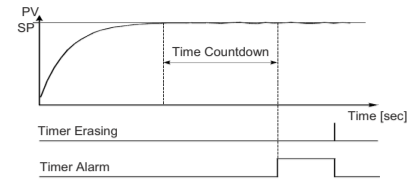The return to the set point value display is set by the manufacturer on 60 sec, but can be changed.

Fig 3. Principle of timer operation

Status	Description	Signaling
Timer stopped		t - - -
Starting of the timer	- Temperature over SP - Press the Down key	Residual time in minutes e.g. (t 2 9. 9)
Pause of the timer	Press the Down key	Flickering residual time in minutes
End of the countdown	Reaching zero by the timer	t E n
Timer Reset	During the countdown : Press Down key and Up key	
	After the countdown end : - Press the Up key	

9.1 Tolerance band (t.bd)

This is the band around the set-point in which timer starts running automatically when the process value has reached a tolerance band . When Tolerance band is enable the timer starts only if process value is in tolerance band. When process value jumps outside the tolerance band, timer will pause & it automatically starts running when the process value comes within the tolerance band. If the Tolerance band is set to zero, this function is disabled.
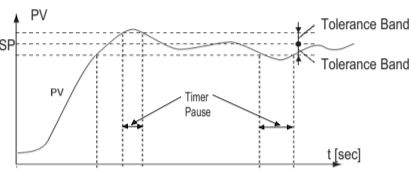

Fig 4. Timer operation with Tolerance Band

9.2 Timer Functions(tmr)

Timer Output can be assigned to following soft function to take action when the timer countdown is completed.
1. OFF: Timer Function is disable.
2. non: Timer Function is enable but the output of timer is not assigned to any of the soft features.
3.StP: Control output is stopped when the timer countdown is completed.(only when one of the output is control)
4. tun: Start the auto tuning when the timer countdown is completed.(only when one of the output is PID control & auto tuning function is enable & control output is set to RUN)
5.St.C: Cancel auto tuning when the timer countdown is completed.(only when one of the output is PID control & the meter is in the auto tuning mode & control output is set to RUN)
6.Hnd: Jump to Manual mode when the timer countdown is completed.(only when one of the output is control)

10. ADDITIONAL FUNCTIONS

10.1 Control Signal Monitoring

The control signal is displayed with the mark "h" on the first position. The accessibility of the control signal depends on the suitable controller configuration. To display the control signal, one must press the Enter key till the moment of its appearance on the display. The return to the set point value display is set by the manufacturer on 60 sec. but it can be changed.

10.2 Manual Control

The input to the manual control mode follows after holding down the Enter key during the control signal monitor screen display. The manual control is signaled by blinking of symbol. The controller interrupts the automatic control and begins the manual control of the output. The control signal value is on the display, preceded by the symbol "h – " for the main channel.
Down key and Up key serve to change the control signal. The exit to the normal working mode follows after the simultaneous pressure of Down key and Up key.
At set on-off control on the output 1 (parameter Pb=0), one can set the control signal on 0% or 100% of the power, however when the Pb parameter is higher than zero, one can set the control signal on any value from the range 0…100%. For 100% value ,"h.on".is shown on display screen.

10.3 Digital Filter

In case when the measured value is unstable, one can switch a programmed low-pass filter on. One must set the lowest possible time constant at which the measured value is stable. A high time constant can cause control instability. The time constant of the filter (FLt)can be set from 0.0 sec. up to 99.9 seconds.
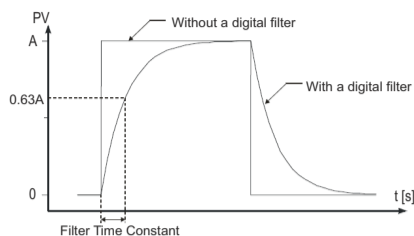

Fig 5.Time characteristic of the filter

Table 6 . Error Signaling

Error Code	Reason	Procedure
- - -	Down overflow of the range limit or lack of RTD	Check, if input signal values are situated in the appropriate range – if yes, check if there is no short circuit in the thermoresistor or the thermocouple is connected inversely.
⌐ - -	Upper overflow of the range limit or break in the sensor circuit	Check, if input signal values are situated in the appropriate range – if yes, check if there is no break in the sensor circuit.

Table 7 . Controller Error

Error Code	Reason	Procedure
Er.A	Input discalibrated	Connect the controller supply again and if that is not effective, contact the nearest service shop.
Er.E	Configuration parameters checksum error	

11. Technical Data

Input signals :

Symbol	Input / Sensor	Min	Max
pt1	Resistance thermometer Pt100	-199 °C/°F	850 °C (999°F)
t-J	Thermocouple of J type	-100 °C (-148 °F)	999 °C/°F
t-t	Thermocouple of T type	-100 °C (-148 °F)	400 °C (752 °F)
t-k	Thermocouple of K type	-100 °C (-148 °F)	999 °C/°F
t-S	Thermocouple of S type	0 °C (32 °F)	999 °C/°F
t-r	Thermocouple of R type	0 °C (32 °F)	999 °C/°F

Measurement time 0.2 sec

Resolution 1°C

Auxiliary Supply

- Higher Aux 60 V – 280 V AC/DC
- Higher Aux supply frequency 45 to 65 Hz range
- Higher Aux Nominal Value 230 V AC/DC 50/60 Hz for AC

VA Burden
- Auxiliary Supply Burden : < 6 VA approx

Types of Outputs :
- Relay Contact SPDT-NO/NC, rated load: 10A @ 250 VAC / 30 VDC
- SSR Drive Output(optional) 12 VDC, maximum load capacity: 40mA

Accuracy :
- Reference Conditions 23 °C
- RTD 0.1 % of range ± 1°C
- Thermocouple 0.25 % of range + 1°C (0.5 % of range for R, S) ± 1°C

Influence of Variations :
- Temperature Coefficient 0.025 % / Deg

Applicable Standards :
- EMC IEC 61326 - 1 : 2012
- Safety IEC 61010- 1- 2010,Permanently Connected Use
- IP for water and dust IEC 60529
- Pollution degree 2
- Installation Category II

Isolation :
- Protective Class 2
- High Voltage Test
  Input+Output +Aux Vs Surface 2.2 kV RMS, 50Hz, 1min
- Input+SSR Vs Relay Output 1.5 kV RMS, 50Hz, 1min
- Aux Vs Remaining circuit 2.2 kV RMS,50Hz, 1min

Dimensions and Weight
Bezel size 48 mm X 48 mm (DIN 43718)
Panel Cutout 45+0.6mm X 45+0.6mm
Weight Approx. 0.3 Kg

Additional Error
- (Cold junction compensation < 3 °C
  for thermocouple)

Environmental :
- Operating Temperature -10 °C to +55 °C
- Storage Temperature -30 °C to +80 °C
- Relative Humidity 0 ... 90 %RH (non condensing)
- Warm up time 20 min
- Shock Half sine wave, Peak acceleration
  (As per IEC60068-2-27) 30g, (300 m/s^2),duration 18ms
- Vibration 10 ...150 ...10 Hz, 0.15 mm amplitude
- No. of sweep cycles 10 per axis
- Enclosure IP 54 (front face)
- Altitude 2000 m max
- Location Indoor Use

Note : Variation due to influence quantity is 100% of Class index.

Meaning of Symbols

⚠ Warning concerning a point of danger (Attention: Observed Documentation)

∼ AC / DC voltage

Note:-

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