Digital Temperature Controller
ESD 92 series

1. Introduction

The Inside Stuff

Version - 12
Date - 25 April 08

Temperature Indicators and Controllers play an important part in any process industry. Quick and accurate measurement and control of process temperature will improve the final product quality, reliability and reduce rejection. Temperature indication and control is therefore one of the prime considerations in any process industry.

The ESD 92 series is a On / Off type Digital Temperature Controller designed for fast and accurate measurement and control. The instrument is designed using highly reliable electronic components. Process temperature is displayed directly in digits, giving better resolution compared to analog indicators.

The ESD 92 series accepts all types of Thermocouples, Pt - 100, 0 to 20 mA, 4 - 20 mA as well as 0-2/5/10 V DC as input . Wide ranges of measurements are available.

The instrument is immune to mechanical vibrations. Even the mounting position will not affect the measurement accuracy. The large bright red LED seven segment display allows long distance readability. Use of highly reliable electronic components with low temperature coefficient ensure long and trouble free service. The instrument is tested for its performance under various climatic conditions.

2. Principle of Operation

The ESD 92 series is based on the principle of a high input impedance amplifier feeding a comparator followed by a relay and an analog to digital convertor. The input signal generated by the transducer is fed to a sensor compensation circuit, where automatic ambient compensation in case of thermocouple & lead resistance compensation in case of Pt-100 is achieved.

Duly compensated signal is fed to a signal conditioning amplifier, output of which is given to digital display as well as to a comparator. This comparator compares the process value with the desired value (Set point). Output of the comparator is given to the relay which switches ON or OFF depending upon the process value as compared to the setpoint.

Linearisation of the input signal from the transducer is done by hardware in the input circuit. This gives a standardized signal to the analog to digital convertor which drives the LED display, indicating the temperature directly.

3. Features

- ✓ Proven field performance
- ✓ Highly compact
- ✓ Dust and vermin proof enclosure with epoxy powder coating
- ✓ LED display gives better long distance readability
- ✓ Feather touch Push buttons
- ✓ Fast response
- ✓ Available in different DIN standard cutouts
- ✓ Designed for Thermocouples, RTD, mA, mV input
- ✓ Fail safe relay logic
- ✓ Maximum MTBF and minimum MTTR

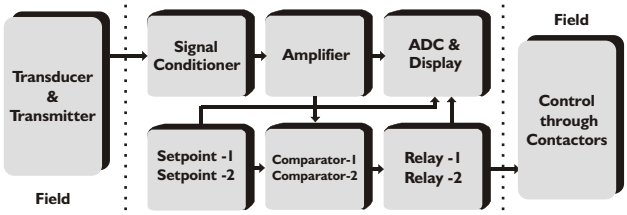
4. Specifications

Model	: **€SD - 9213 / €SD - 9223**
Control action	: On / Off
Ranges	: Refer Ordering Information chart
Input	: Thermocouples / Pt - 100 (3 wire sys) / 4 - 20 mA
Indication accuracy	: +/- 0.5 % of FS +/- 1 digit
Least count	: 0.1 °C upto 200 °C, 1 °C above 200 °C
Accuracy deviation	
a) Temperature change	: +/- 0.01 % / °C , reference at 25 °C
b) Supply Variation	: +/- 0.005 % /V from rated supply
Set point	: One / Two (through ten turns potentiometer)
Set point Read	: By pressing respective self release switch on front panel
Set point Read & Adjust	: By pressing self release switch and simultaneously (on front panel) turning corresponding set potentiometer
Outputs	: One set of Relay change over contact 5 Amp resistive at 230 V AC per setpoint
Relay logic	: 1. Actual temp. < set point - Relay ON for Heating application (Factory set) 2. Actual temp. > set point - Relay ON for Cooling application (On demand)
Relay ON indication	: By Red LED per setpoint
Control Sensitivity	: 0.25% of FS
Display	: 3 & 1/2 digit 7 segment 12.5 mm Red LED
Power supply	: 230 V AC, +/- 10 % , 50 Hz
Ambient Temp. range	: 0 to 55 °C
Amb. Temp. Compensation	: Built in upto 55 °C only for thermocouple input.
Sensor break indication	: Up scale [I _ _ _] (Down scale on demand)
Sensor break protection	: Relay 'Off' (Relay 'On' by demand)
Relative Humidity	: 90 % Non-condensing
Power consumption	: 6 VA
Input impedance	: > 10 Mohms, (only for thermocouple input)
Weight	: 800 grams approximately
Mounting	: Flush Panel
Termination	: PUT 2.5 mm^2 / PBT

Dimensions (mm)

Panel Cutout	Front Facia	Depth
92 x 92 (+1,-0)	96 x 96	80

5. Block Diagram



1. Transducer : This block consists of either a Thermocouple, Pt- 100 (RTD) or a 4 - 20 mA current signal. It senses the temperature and sends a signal to the sensor compensation circuit.

2. Signal conditioner : consists of a bridge generating mV signal corresponding to the ambient temperature. In case of thermocouple input this is added to input mV signal for automatic ambient temperature compensation. In case of Pt-100 input, it gives constant current for Pt-100 excitation and provides 3 wire system for lead wire compensation.

3. Amplifier : reads the signal from the sensor and calculates the temperature. It consists of a bridge and an amplifier. The signal from the sensor causes an unbalance in the bridge. This unbalance is proportional to the temperature being measured. The output of the bridge is amplified and calibrated suitably. The amplifier o/p is fed to the display circuit and the comparator.

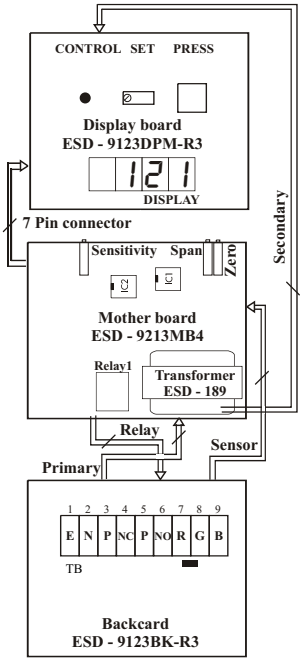
4. ADC & Display : consists of an analog to digital convertor (ADC), a digital voltmeter and 4 seven segment LED displays. The ADC converts the analog output of the amplifier to a digital signal which is read by the digital voltmeter and displayed on the seven segment displays, directly in terms of process parameter.

5. Setpoints : consists of ten turn highly stable potentiometer excited by precision regulated power supply for setting desired set values.

6. Comparator : compares the output of the amplifier (process value), with the set point set by the user. Depending on whether the process value is greater than or less than the set point the comparator output is either -ve or +ve. For 'n' set points we have 'n' comparators.

7. Relay : The relay switches ON or OFF depending on comparator output. For 'n' set points we have 'n' relays.

6.1 Schematic & Connection Diagram for ESD 9213



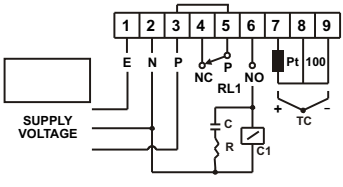
CONTROL - Red LED's for Relay Status
SET - Potentiomenters for setpoint adjust
PRESS - Press Switches to read set values
DISPLAY - 12.5 mm 7 segment RED LED

VSEN - 'Sensitivity' adjust Potentiometers
SPAN - 'Span' adjust Potentiometer
ZERO - 'Zero' adjust Potentiometer

IC1 - Amplifier
IC2 - Comparator
RL - 12 V DC Relays

TB - PBT Terminal board

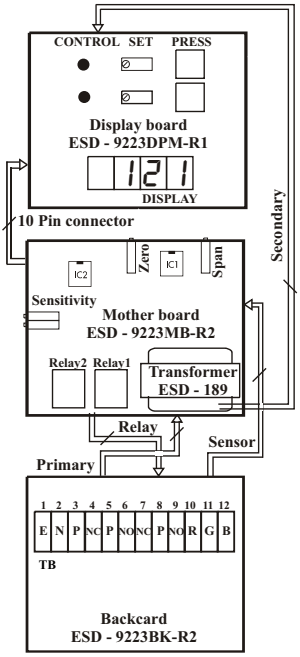
User Terminals



R - 220 Ω, 1/2 Watt Resistor
C - 0.1 uF / 600 V Capacitor
C1 - Contactor to be connected externally as per load

☐ Pt-100 (3 WIRE RTD)
☐ TC - THERMOCOUPLE

6.2 Schematic & Connection Diagram for ESD 9223



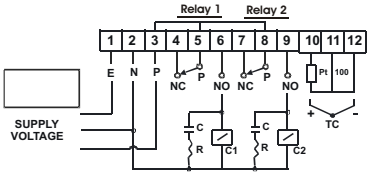
CONTROL - Red LED's for Relay Status
SET - Potentiomenters for setpoint adjust
PRESS - Press Switches to read set values
DISPLAY - 12.5 mm 7 segment RED LED

VSEN1/ VSEN2 - 'Sensitivity' adjust Potentiometers
SPAN - 'Span' adjust Potentiometer
ZERO - 'Zero' adjust Potentiometer

IC1 - Amplifier
IC2 - Comparator
RL1, RL 2 - 12 V DC Relays

TB - PBT Terminal board

User Terminals

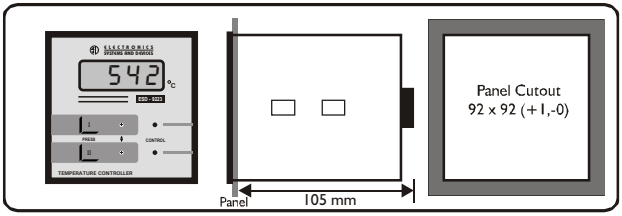


R - 220Ω, 1/2 Watt Resistor
C - 0.1 uF / 600 V Capacitor
C1 & C2 - Contactor
(To be connected externally by user)

☐ Pt-100 (3 WIRE RTD)
☐ TC - THERMOCOUPLE

7. Installation Procedure

Also observe **Instrumentation Health Tips** chapter 14



The instrument should be mounted in a place where it is clearly visible and accessible.

1. Insert the instrument in the cutout and fix it using the bracket pair.

2. Depending on the type of instrument make connections as shown in Connection diagram (Chapter 6).

3. In case of Pt-100 sensor Red wire is to connected to the terminal indicated with a Box.

4. In case of thermocouple input : (a) for ESD-9213 terminal no.8 has no connection. (b) for ESD-9223 terminal no. 11 has no connection.

5. Use correct compensating cables for thermocouple type instruments.

6. Ensure proper earthing to the instrument.

7. Output loads connected through the relay change over contact should be less than the maximum specified value.

8. Connect a series combination of 0.1 F /600 V non polar capacitor & 220 1/2 W resistor across phase & neutral.

9. For setting set values as per your requirement, press the push button and rotate respective potentiometer with proper size screw driver.

10. If factory set control sensitivity (0.25% of FS) is not suitable for your application, then adjust it by the potentiometer marked SENSITIVITY (inside the instrument).

i) If relay chattering is observed, reduce the sensitivity by turning the potentiometer Counter Clock Wise (CCW) .

ii) If over-shoots and under-shoots are observed increase the sensitivity by turning the potentiometer Clock Wise (CW) .

8. Calibration Procedure

Warning: Procedure to be carried out strictly by technical persons.
Follow instructions given in this manual.

The instrument is calibrated at the factory using accurate calibrating equipment traceable to international standards. No recalibration should be required in normal course, however if the instrument requires recalibration, follow the procedure given below:

i. Remove the cover of the instrument, by removing the fixing screws on the back side of the instrument.

ii. Switch on the supply and allow 5 min. to achieve thermal stability.

iii. For uniform error distribution calibration points should be at 20% of Full Scale (FS) for ZERO calibration and at 80% of FS for SPAN calibration. i.e. If the range is 0 to 1000 °C, the ZERO calibration should be done at 200 °C (20% of FS) and SPAN calibration should be done at 800 °C (80% of FS).Depending on the type of input proceed as follows :

8.1) Thermocouple input

1. Remove the thermocouple from its terminals and connect a stable mV source in its place with proper polarity.
2. Feed ambient compensated mV corresponding to 20 % of FS. The display should show corresponding temperature. If the displayed temperature is incorrect turn the potentiometer marked 'ZERO' to display correct reading (CW to increase & CCW to decrease).

   eg.: Cr-Al thermocouple - Ambient compensated mV for 200 °C at ambient temp 30 °C will be mV corresponding to 200 °C (8.137mV) minus mV corresp to 30 °C (1.203 mV) = 6.934 mV

3. Feed ambient compensated mV corresponding to 80 % of FS. The display should show corresponding temperature. If the displayed temperature is incorrect turn the potentiometer marked 'SPAN' to display correct reading (CW to increase & CCW to decrease).
   eg.: Cr - Al thermocouple - Ambient compensated mV for 800 °C at ambient temp 30 °C will be mV corresp. to 800 °C (33.277 mV) minus mV corresponding to 30 °C (1.203 mV) = 32.074 mV

   Repeat steps 2 and 3 to get zero error at both calibration points.

8.2) Pt - 100 input (3 wire system)

1. Remove the Pt - 100 from its terminals and connect a resistance decade box with 3 wire system in its place.
2. Feed resistance corresponding to 20 % value of FS (eg.resistance corresponding to 20 °C for 0 to 100 °C range) The display should show corresponding temperature. If the displayed temperature is incorrect turn the potentiometer marked 'ZERO' to display correct reading. (CW to increase and CCW to decrease)
3. Feed resistance corresponding to 80 % value of FS (eg. resistance corresponding to 80 °C for 0 - 100 °C range). The display should show corresponding temperature. If the displayed temperature is incorrect adjust the potentiometer marked 'SPAN' to display correct reading. (CW to increase and CCW to decrease).

   Repeat steps 2 and 3 to get zero error at both calibration points.

Check the calibration of the instruments every six months.
In case of error recalibrate using certified calibrators only.

9. Look-up Table

Temperature vs Sensor output

Temp. in Deg. C	Pt-100 resis. in ohms	**Output in mV** (Reference junction at 0 Degree Celcius)			
		Fe - Ko (J)	Cr - Al (K)	Pt-Pt, 13% Rh (R)	Pt-Pt, 10% Rh (S)
-100	60.25	-4.63	-3.55	-	-
-50	80.31	-2.43	-1.89	-	-
-25	90.13	-1.24	-0.37	-	-
0	100.00	0.00	0.00	0.00	0.00
10	103.90	0.51	0.40	0.11	0.05
20	107.79	1.02	0.80	0.17	0.11
22	108.57	1.12	0.88	0.12	0.13
24	109.35	1.23	0.96	0.14	0.14
26	110.12	1.39	1.04	0.15	0.15
28	110.90	1.43	1.12	0.16	0.16
30	111.67	1.54	1.20	0.23	0.17
32	112.45	1.64	1.29	0.18	0.19
34	113.22	1.75	1.37	0.20	0.20
36	113.99	1.85	1.47	0.21	0.21
38	114.77	2.00	1.53	0.22	0.22
40	115.54	2.06	1.61	0.30	0.24
50	119.40	2.59	2.02	0.36	0.30
60	123.24	3.12	2.44	0.43	0.37
80	130.89	4.19	3.27	0.57	0.50
100	138.50	5.27	4.10	0.72	0.65
120	146.06	6.36	4.92	0.88	0.80
140	153.58	7.46	5.73	1.04	0.95
160	161.04	8.56	6.54	1.21	1.11
180	168.46	9.67	7.34	1.38	1.27
200	175.84	10.78	8.14	1.56	1.44
250	194.07	13.55	10.15	2.02	1.87
300	212.02	16.33	12.21	2.50	2.32
350	229.67	19.09	14.29	3.00	2.79
400	247.04	21.85	16.40	3.51	3.26
500	280.90	27.39	20.64	4.58	4.23
600	313.59	33.10	24.90	5.70	5.24
700	345.13	39.13	29.13	6.86	6.27
800	-	-	33.28	8.07	7.35
900	-	-	37.33	9.20	8.45
1000	-	-	41.27	10.50	9.59
1200	-	-	48.83	13.22	11.95
1400	-	-	-	16.04	14.37
1600	-	-	-	18.84	16.77

Charts for higher resolution on demand **°K = 273.15 + °C** **°F = (1.8 x °C) + 32**

10. Fault Diagnosis

Commonly observed problems and their likely causes. Please read Installation Procedure and Instrumentation health prior to this.

Problem	Likely cause
No Indication	Supply connections not as per connection diagram or no Supply voltage .
Over range	Sensor not connected Sensor not connected properly. Sensor Open
Irrelevant Indication	Loose Sensor Connections Noise pickup on sensor / sensor cable Excessive Abmbient temperature Improper sensor type
Fluctuations in Indication Or Setpoint not steady	Supply voltage not within specified limit. Excessive Abmbient temperature
No relay Output	Improper Setpoint Changeover tracks on PCB burnt due to overload Relay faulty
Temp. Overshoot/ Undershoot Relay chattering	Improper Sensitivity Adjustment
Error in Indication	Improper Sensor Location Improper Sensor type Calibration error. Excessive Abmbient temperature

In case the problem persists, please refer the service manual of the product or get in touch with our Customer Support division.

11. As you unpack

Congratulations on buying
ESD - 92 series
Digital Temperature Controller

As you unpack kindly ensure that
1. The material received is in good condition
2. You have received following material
   i) ESD - 92 series Digital Temperature Controller as per your purchase order.
   ii) Mounting bracket pair.
   iii) This manual along with Warranty Certificate.
   iv) Test Certificate.
   v) Small size screw driver for setpoint adjustment.

In case of any discrepancies contact our customer support department immediately.

We are sure you will get long and troublefree service from our instrument.

We need your feedback :

Every attempt is made to make this Manual clear and easy to understand. We believe that you will feel confident to install, use and maintain our product. ESD welcomes your suggestions, which will help us improve this product as well as the document and make them more user friendly.

Warranty Certificate

This instrument is warranted against any manufacturing defects for a period of twelve months from the date of installation or eighteen months from the date of purchase, which ever is early.

Digital Temperature Controller ESD-92 series

Customer: _____

_____

_____

Model No. : ☐ ESD 9213 ☐ ESD 9223

Serial No.:_____ Date: _____

Authorised signatory

1. The warranty is limited to repairing the instrument and no responsibility is taken for any other damage resulted.
2. The warranty will be void if the instrument is tampered with in any way.
3. The faulty instrument has to be returned to our factory, carriage prepaid.

13. Ordering Information

ESD 92 X1 X2 X3 X4 X5 X6

No of Setpoints
1
2
3
4

Panel Cut-out (mm)
0 - 92 x 45
1 - 45 x 92
2 - 67 x 67
3 - 92 x 92
4 - 138 x 67
5 - 67 x 138
6 - 186 x 92

Input
1 - Pt - 100
2 - J type T/C
3 - K type T/C
4 - R type T/C
5 - S type T/C
6 - 0 to 20 mA
7 - 4 to 20 mA
8 - 0 to 2V DC
9 - Other

Range (°C)
0 - -50 to 50
1 - 0 to 100
2 - 0 to 200
3 - 0 to 100 %
4 - 0 to 400
5 - 0 to 600
6 - 0 to 800
7 - 0 to1000
8 - 0 to1200
9 - Other

Ordering eg. ESD 9213 - 1011

Digital Temp. Controller	ESD 92	
No of setpoints-	One	(1)
Panel cutout	- 92 x 92 mm	(3)
Input	- Pt - 100	(1)
Range	- -50 °C to 50 °C	(0)
Relay Output	- 1 C/O 5 Amp	(1)
Power Supply	- 230 V AC	(1)

Relay Output
1 - 1 C/O 5 A
2 - 1 C/O 10 A
3 - 2 C/O 5 A
4 - Other

Power Supply
1 - 230 V AC
2 - 110 V AC
3 - 48 V AC
4 - 24 V AC
5 - 24 V DC
6 - Other

Cutout (mm) V /s Setpoints suffix

No. of Setpoints	Cutout						
	0	1	2	3	4	5	6
1	●	●	●	●	●	●	●
2	●			●	●	●	●
3				●			●
4				●			●

Input	Standard Ranges in °C		
Pt-100	-50 - 50	0 - 100	0 - 200
J	0 - 200	0 - 400	0 - 600
K	0 - 200	0 - 400	0 - 600
	0 - 800	0 -1000	0 - 1200
R, S	800 -1600		
mA / mV	0 to 100 % or process value		

14. Instrumentation Health Tips

Taking care of your equipment is just as important as buying the best equipment. So simply take the following precautions and ensure a long, trouble-free service from your measurement and control system.

Use

- Three wire system for connecting Pt-100 sensor to the instrument.
- Same area of cross section for all the three wires for Pt-100.
- Appropriate compensating cables for connecting T/c to an instrument
- Appropriate thermally conductive media between Thermowell & sensor sheath.
- Proper sheathing material as per application and environment.
- Proper size screw driver for making connections to the terminations and also while adjusting calibration and set points.
- Fuses of correct ratings for mains.

Do's

✓ Sensor cables must be isolated from power cables.
✓ Insert minimum required sensitive length in the measurement object.
✓ Operating temperature should be 80 % of the maximum specified temperature.
✓ Check that all the wiring is firm and as per wiring diagram.
✓ Loads connected should be within specified limits.
✓ Provide proper Earthing to Instrument / Instrumentation Panel.

Avoid

× Terminal joints or junction boxes for sensor cables.
× Exposure of T/c head to temperatures greater than 90°C.
× Sharp objects for operating front panel membrane keys.
× Magnetic field / inductive pick up / noise.
× Excessive ambient temperature at installation place.
× Corrosive gases in the surroundings.
× Chemical or pressure wash for cleaning instruments.

15. Important Definitions

Accuracy : Closeness of reading or indication of a measurement device to the actual value of the quantity being measured.

Ambient Compensation : The design of an instrument such that the changes in the ambient temperature do not affect the readings of the instrument.

Calibration : The process of adjusting an instrument or compiling a deviation chart so that it's reading can be correlated to the actual value being measured.

Differential : For an on / off controller, it refers to the temperature difference between the temperature at which the controller turns the heat off and the temperature at which the heat is turned back on. It is expressed in degrees.

DIN : Deutsche International Norms. A German agency which sets engineering and dimensional standards. These now have worldwide recognition.

Deviation : The difference between the value of the controlled variable and the value at which it is being controlled

Drift : A change in the reading or a set point value over long periods due to factors like ambient temperature, time, line voltage etc.

Error : The difference between the correct or desired value and the actual value or the value being measured.

Explosion-proof enclosure : An enclosure that can withstand an explosion of gases within it and prevent the explosion of gases surrounding it due to sparks, flashes or the explosion of the container itself and maintain an external temperature which will not ignite the surrounding gases.

Linearity : A deviation of an instruments response from a straight line.

Precision : The measure of the degree with which successive measurements of the same variable differ from one another.

Sensitivity : The minimum change in input signal to which an instrument can respond.

Stability : The quality of an instrument or sensor to maintain a consistent output when a constant input is applied.

Thermocouple : A junction of two dissimilar metals / alloys which has a voltage output proportional to the difference in temperature between the hot junction and cold junction.

Transducer : A device which converts a parameter being measured into another form. e.g. a thermocouple transforms heat into millivolt output.