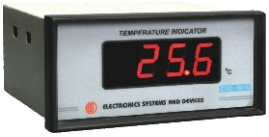
Digital Temperature Indicator
ESD 90 series



The Inside Stuff

Version - 11 Date - 1st June 07

1. As you unpack

Congratulations on buying
ESD - 90 series
Digital Temperature Indicator

As you unpack kindly ensure that
1. The material received is in good condition
2. You have received following material
   i) ESD - 90 series Digital Temperature Indicator as per your purchase order.
   ii) Mounting bracket pair.
   iii) This manual along with Warranty Certificate.
   iv) Test Certificate.

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.

2. Introduction

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

The ESD 90 series is a Digital Temperature Indicator designed for fast and accurate measurement. It is designed using highly reliable electronic components. Process temperature is displayed directly in digits, giving better resolution compared to analog indicators.

The ESD 90 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 measurement are available depending on the sensor used.

The ESD 90 series has various models with different display heights to suit various applications where long distance visibility is a must. This series has models with display heights varying from standard 12.5 mm to 25,50,100,150,200,250,300 mm.

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

3. Principle of Operation

The ESD 90 series is based on the principle of a high input impedance amplifier feeding 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 and 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.

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.

4. Features

- ✓ Proven field performance
- ✓ Highly compact
- ✓ Dust and vermin proof enclosure with epoxy powder coating
- ✓ LED display gives better long distance readability
- ✓ Fast response
- ✓ Available in different DIN standard cutouts
- ✓ Designed for Thermocouples, RTD, mA, mV input
- ✓ Maximum MTBF and minimum MTTR
- ✓ Choice of different display heights to suit various applications

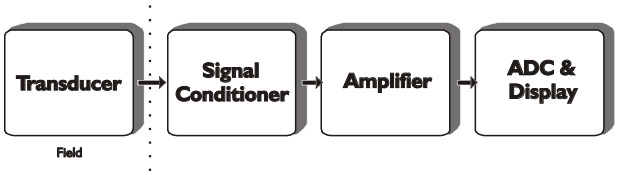
5. Specifications

Model : ESD 9010 / ESD 9012 / ESD 9013 / ESD 9014
Ranges :Refer chart in Ordering Information
Input : Thermocouples / Pt - 100 (3 wire sys) / 4 - 20 mA
No. of Inputs : One
Indication accuracy : +/- 0.5 % of FS +/- 1 digit
Least count : 0.1 °C upto 200 °C, 1°C above 200 °C
Accuracy deviation
a) Temp. change : +/- 0.01 % / °C, reference at 25 °C
b) Supply Variation : +/- 0.005 % /V
Display : 3 & 1/2 digit 7 segment 12.5 mm Red LED
Power supply : 230 V AC, +/- 10 %, 50 Hz
Ambient Temp. range: 5 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)
Relative Humidity : 90 % Non-condensing
Power consumption : 6 VA
Input impedance : > 10 Mohms , (only for thermocouple input)
Weight : 600 grams approximately
Mounting : Flush Panel
Termination : PUT 2.5 mm^2
Dimensions (mm) :

Model	Facia	Cutout	Depth ■
ESD **9010**	96 x 48	92 x 45	80
ESD **9012**	72 x 72	67 x 67	100
ESD **9013**	96 x 96	92 x 92	50
ESD **9014**	144 x 72	138 x 67	100

■ Add 25 for terminals

6. Block Diagram and Operation



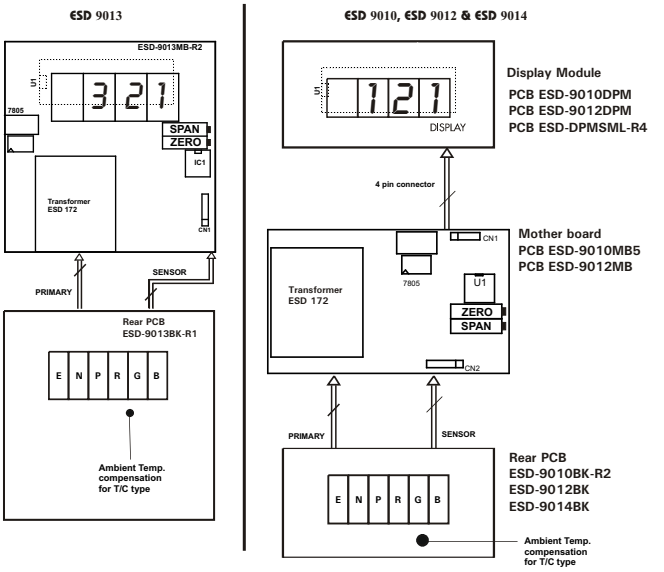
1. Temperature sensor: This block consists of either a Thermocouple, Pt- 100 (RTD) or a 4 - 20 mA current signal. It senses the temperature and sends a signal to the sensor compensation circuit.

2. Sensor compensation: 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. Signal conditioning circuit: 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 to display the temperature. The amplifier output is fed to the display circuit and the comparator.

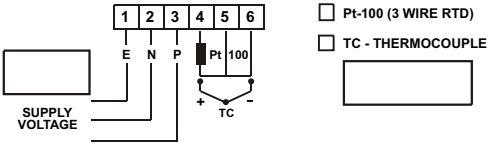
4. ADC & Display : consists of an analog to digital convertor (ADC), a digital voltmeter and 4 seven segment LED displays. The ADC converts the analog output of the amplifier to a digital signal which is read by the digital voltmeter and displayed on the seven segment displays, directly in terms of process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

7 Schematic and Connection Diagram for ESD 9010, ESD 9012, ESD 9013 & ESD 9014



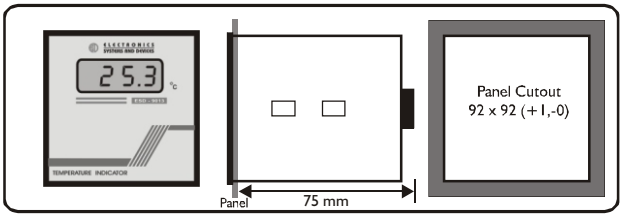
SPAN :- 'Span' adjust Potentiometer ZERO :- 'Zero' adjust Potentiometer
DISPLAY :- 12.5 mm 7 segment Red LED IC1 :- Amplifier

Connection Diagram



8. 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 a suitable cutout and fix it using the bracket pair provided on the sides.

2. Depending on the type of instrument make connections as shown in Connection diagram (Chapter 7).

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 terminal no. 5 has no connection.

5. Use correct compensating cables for thermocouple type instruments.

6. Ensure proper earthing to the instrument.

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

9. 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 :

9.1) 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.

9.2) 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.

10. 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**

11. 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.
Irrelevant Indication	Loose Sensor Connections Noise pickup on sensor / sensor cable Excessive Abmbient temperature Improper sensor type
Fluctuations in Indication	Supply voltage not within specified limit. Excessive Abmbient temperature
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.

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 Indicator ESD - 90 series

Customer :_____

_____

Model No. : ☐ ESD 9010 ☐ ESD 9012

☐ ESD 9013 ☐ ESD 9014

Serial No. : _____ Date: _____

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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 90 X1 X2 X3 X4 X5 X6

Input
1 - One
2 - Two
3 - Three
4 - Six
5 - Nine
6 - Twelve
7- Other

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

Ordering eg. ESD 9013 - 1011

Digital Temp. Indicator	ESD 90	
No of inputs	- One	(1)
Panel cutout	- 92 x 92 mm	(3)
Input	- Pt - 100	(1)
Range	- -50 °C to 50 °C	(0)
Power Supply	- 230 V AC	(1)
Display Height	- 12.5 mm	(1)

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

Display Height (mm)
1 - 12.5
2 - 25
3 - 50
4 - 100
5 - 150
6 - 200
7 - Other

Cutout (mm) V /s No. of inputs suffix

No. of Inputs	Cutout					
	1	2	3	4	5	6
1	●	●	●	●	●	
2		●				
3			●	●	●	
4			●	●	●	●
5						●
6						●

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.
✓ 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 several 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 the lead wires (cold junction).

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