PRESSURE MEASUREMENT TRANSMITTER
(Using Strain Gauge Transducer)

1. OBJECT

To study the performance characteristics of a Pressure Transducer.

2. EQUIPMENT DESCRIPTION

Strain Gauge based Pressure measurement Trainer Kit is designed for the students of Instrumentation Course. It allows the students to under stand the concept of Pressure Transducer, its application and its associated electronic circuits.

This trainer kit consists of:

(i) Strain Gauge based Pressure Transducer
(i) Electronic circuitry along with a 3½ digit DVM
(ii) Suitable mechanism to apply the pressure with calibration arrangement, through a Pressure Gauge.

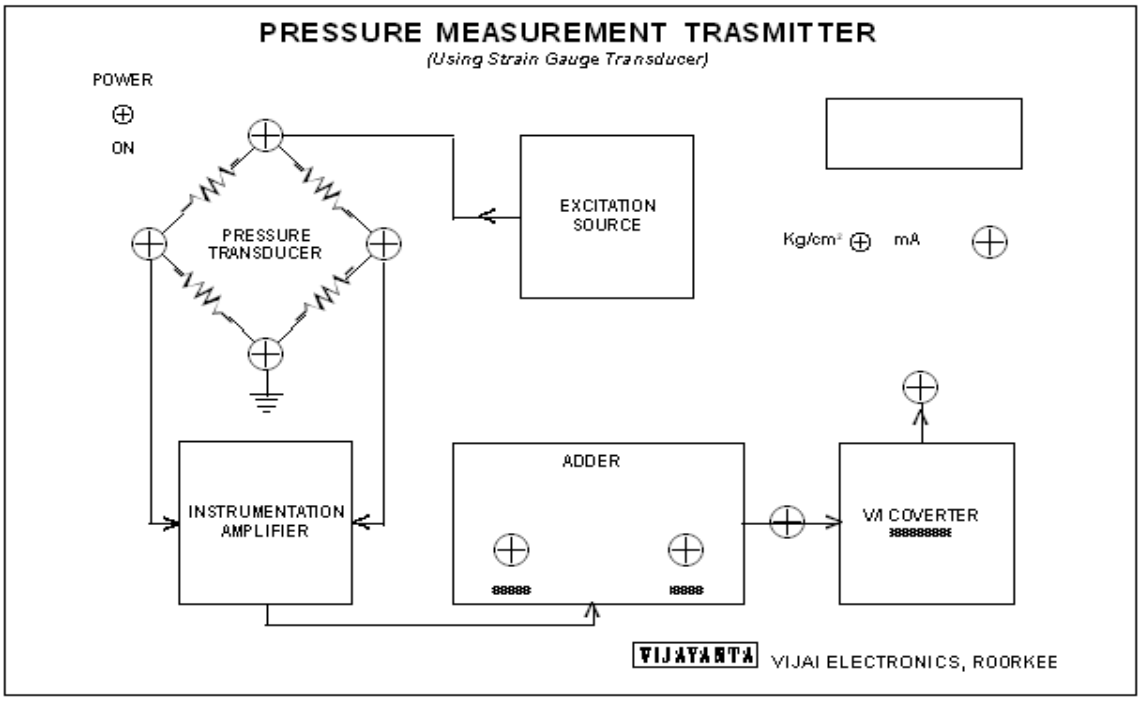
Specification :

(i)	Pressure Transducer	:	Strain Gauge based
	Measuring Range	:	0 –10 Kg/cm^2.
	Non-linearity errors	:	$\pm$ 1 %
	Resolution	:	0.1 Kg/cm^2.
(ii)	**Electronic Circuit**		
	Excitation Source	:	DC Excitation (5 Volt)
	Amplifiers	:	Instrumentation and Inverting Summing Amplifier with Zero & Gain adjustment V/I Converter
	Termination	:	For 4 arm strain gauge bridge.
(iii)	DVM		
	Display	:	3½ Digit LED
	Range	:	0 - 2000 mV F.S.

(iv) **Power Supply**

The kit has number of IC regulated power supplies which are permanently connected to all the circuits.
No external D.C. supply should be connected to the unit.
Only 230V $\pm$10%, 50Hz mains supply is required to operate the kit.

A toggle switch is provided to select the Kg/cm^2 & mA measurement range



3. THEORY

Pressure is basically a mechanical concept that can be expressed in terms of the primary dimensions of mass and length, and is a physical parameter encountered in many fields. It is defined as the force acting per unit area, measured at a given point or over a surface. This can be in absolute, gauge or differential, depending upon the reference taken.

The measurement involved can be of a static or dynamic nature.

Pressure Transducer can be classified into gravitational and elastic types. In the gravitational type, the familiar Manometer is the simplest device. In elastic type transducers the pressure exerts a force over the area of an elastic device. The force responsive elastic member is in form of a diaphragm, capsule, bellow, or burden type. The most common type pressure sensing element used in a transducer is the diaphragm.

An elegant arrangement of a bonded strain gauge device is to fix the strain gauge directly on to the diaphragm. The range of application of this method is limited by the non-linearity of the strain-pressure relationship above a certain strain value.

For a clamped circular diaphragm of radius **R**, thickness **t**, pressure difference **P**, the strain is obtained from the relation (within the linear range)

$$\varepsilon = \frac{3 P R^2}{4 E t^2} \qquad \text{-- (1)}$$

where, **E** is the Young's modulus of the material.

The advantage of this type of transducer are its simplicity, high natural frequency and good dynamic response. Since, both tensile and compressive stress exist on the surface of the diaphragm, the two strain gauges are bonded near periphery responds to radial strain, while two gauges are bonded near the center respond to tensile strain. This arrangement yields high sensitivity and fairly good temperature stability. All four strain gauges are connected to form a four arm active Wheatstone bridge.

A Mechanical arrangement fitted with a hydraulic pressure generating mechanism and Pressure Gauge, is supplied along with the kit to generate pressure on the Pressure Transducer.

4. OPERATION

1. Open the top cover of the Trainers kit box.
2. Connect the Pressure Transducer leads with the trainer kit terminals
   Red lead with red terminal.
   Black lead with black terminal.
   Green lead with green terminal.
   Yellow lead with yellow terminal.
3. Connect the 3 pin mains plug of the kit to the mains socket.
   (230V± 10%,50Hz power supply).
4. Keep toggle switch at Kg/cm^2 position.
5. Switch on the trainer kit, the display will light up, and will show some reading.
6. Adjust zero pot to set 000 reading on display, when applied pressure is 0.
7. Apply 10 Kg/cm^2 pressure with the help of pressure pump, and adjust span pot to show 10.0 Kg/cm^2 reading on display.
8. Repeat steps 5 to 6.
9. Now apply pressure in steps of 1/ 2 Kg/cm^2. and note down the reading in the following Table in increasing and decreasing mode.
10. Now plot the graph between applied pressure and DVM reading in Kg/cm^2. with a resolution of 0.1 Kg/cm^2 and measure non-linearity, hysteresis error etc.
11. Keep toggle switch at mA position.
12. Repeat step 9 to note down the reading in mA range and measure non-linearity, hysteresis error etc.

Table-1

S. No.	Reading in Increasing mode		Reading in Decreasing mode	
	Applied Pressure in Kg/cm^2	**DVM in Kg/cm^2**	**Applied Pressure in Kg/cm^2**	**DVM in Kg/cm^2**
1. 2. 3. 4. 5. 6. 7. 8. 9. 10.				

Table-2

S. No.	Reading in Increasing mode		Reading in Decreasing mode	
	Applied Pressure in Kg/cm^2	**DVM in mA**	**Applied Pressure in Kg/cm^2**	**DVM in mA**
1. 2. 3. 4. 5. 6. 7. 8. 9. 10.				