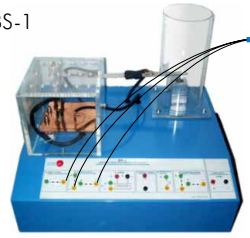
Modular System for the Study of Sensors

BS

Technical Teaching Equipment

② Test Modules
(to be used with Base Unit)

BS-1



BS-2

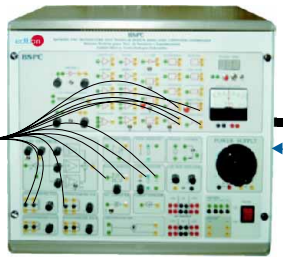
BS-3

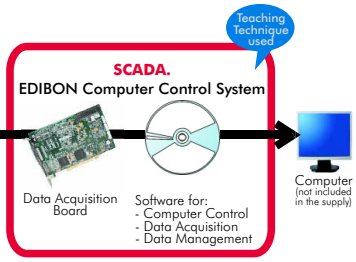
BS-4

BS-5

① Base Unit:
(common for all test modules type "BS")

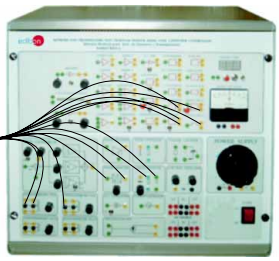
BSPC. Computer Controlled Base Unit





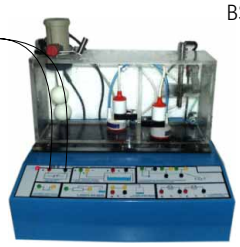
OR

BSUB. Base Unit (non computer controlled).



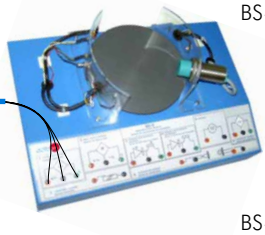
② Test Modules
(to be used with Base Unit)

BS-6

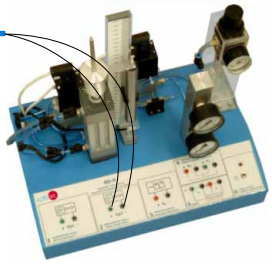


BS-7

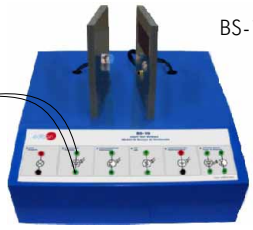
BS-8



BS-9



BS-10



Other modules

www.edibon.com
Products
Products range
Units
2.-Electronics

"BS" System includes a set of electronic components with a twofold purpose: to control the signal produced by the transducers, and to evaluate and quantify it. Sensors or transducers are common elements in the state of our technology. Therefore this SYSTEM has been developed to show the basic principles of different types of sensors and their way of processing signals.
This system consists of:

①Base Unit, to control the system:

Option 1: BSPC. Computer Controlled Base Unit, including EDIBON Computer Control System. OR
Option 2: BSUB. Base Unit (non computer controlled).

②Test Modules:

BS-1. Vibration and/or Deformation Test Module.
BS-2. Temperature Test Module.
BS-3. Pressure Test Module.
BS-4. Flow Test Module.
BS-5. Ovens Test Module.
BS-6. Liquid Level Test Module.
BS-7. Tachometers Test Module.
BS-8. Proximity Test Module.
BS-9. Pneumatic Test Module.
BS-10. Light Test Module.

ISO 9001:2000
Certificate of Approval

European Union Certificate

Certificates ISO 14001: 2004 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter
Certificate
Worlddidac Member

BSPC. **Computer Controlled Base Unit:**

DESCRIPTION

Unit to control the system.

Common for the different test modules type "BS".

Elements of the unit are included in a stainless steel box.

In the back part of the box, we can find the outlet and the general switch of the equipment for its operation.

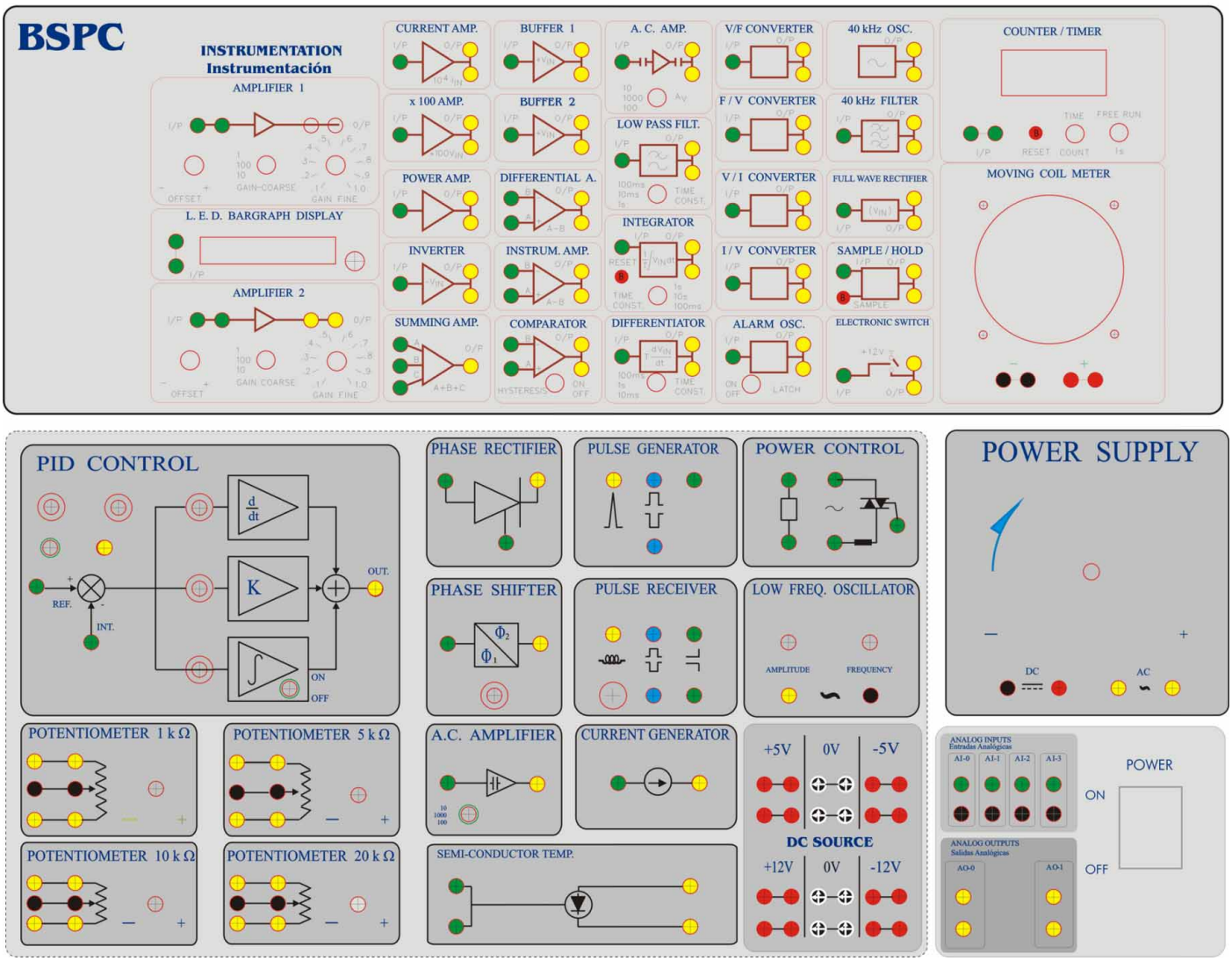
In the front part there are two masks with all type of signal conditioners, and even an analogical voltmeter.

Sensor connections with the Base Unit and with power supplies is through 2mm. terminals located in the front panel of each test module. The test modules may operate independently one of another.

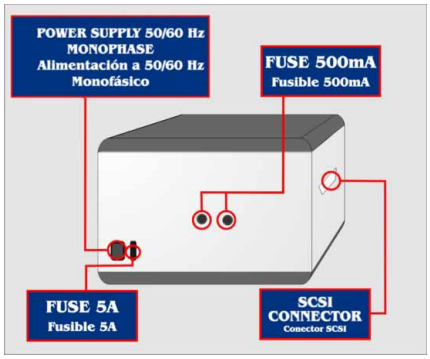
SCADA. EDIBON Computer Control System, formed by:

- Control interface is integrated into the unit box (BSPC).
- Data acquisition board to be installed in a computer slot.
- Computer Control Software.

Front Panel of the Computer Controlled Base Unit (BSPC)



Back Panel of the Computer Controlled Base Unit (BSPC)



Continue...

BSPC. **Computer Controlled Base Unit:** (continuation)

SPECIFICATIONS

Base Unit:

Unit to control the system. Common for the different test modules.

All elements are included in a stainless steel box.

In the back panel of the box, we can find outlet and the general switch of the unit for its operation. In the front panel there masks with all type of signal conditioners, and even an analogical voltmeter.

Amplifiers:

-Several amplifier circuits of DC are included in the Base Unit, but only three are used specifically for the amplifiers applications:
Amplifier 1 that holds a changeable gain from 0.1 to 100 approximately. Amplifier 2 that is identical to the amplifier 1.
Amplifier 3: x100 amplifier that holds a fix gain of 100 approximately and lacks an offset control.

- AC amplifier. It holds three fix gains: 10, 100 and 1000.
- Power amplifier. It holds gain unit and a maximum current output about 1.5A.
- Current amplifier. It is used for working with the photodiode, giving an output voltage of 10000 times bigger than the input current. That is to say, a maximum of 10V for a 1mA input current.
- Two buffer amplifiers. They holds an output current around 20mA maximum.
- Inverter amplifier. It inverts the polarity of the voltage applied at the input. Voltage gain=-1.
- Two circuits of differential amplifiers are supplied. We called the second one "Instrumentation Amplifier". This one makes the same basic operations as the differential amplifier, but holds an improved gain in common mode and shows the same impedance in each input.

Signal Converters Circuits:

- Converter from Voltage to Current. It is used to convert the input voltage into a current at the output.
- Converter from Current to Voltage. It transforms an input current into an output voltage.
- Converter from Voltage to Frequency. It converts an input voltage in an output frequency.
- Converter of Frequency to Voltage (F/V). It converts an input frequency signal to an output voltage.
- Full-Wave Rectifier. It converts an input signal, whatever it polarity may be, to a DC signal with positive polarity. The circuit allows the voltage measurement in AC using instruments for DC.
- Phase rectifier. This circuit rectifies an input signal depending on the rectification angle that has been taken when a comparison of two out-phased signals has been made.
- Phase shifter. This circuit has a taken to connect an alternating current signal and to change the phase of the output according to the input. It is used in the balance of sensible systems of the phase.
- Semiconductor detector of temperature.

Comparators, Generators, Oscillators and Filters:

- Comparator. The output voltage has two possible states from 0 V. to +12V.
- Alarm oscillator. It consists basically on two stages: an input circuit that it is a comparator and an oscillator.
- Electronic switch. Basically, it consists on a comparator that controls a power transistor that works as a static switch.
- Oscillator. It makes a sinusoidal output with a frequency approximated of 40KHz to be used with any of the AC transducers supplied.
- Filters. There are basically two types of filters, depending on the pass frequency: Bandpass filter. Low-pass filter.
- Integrator.
- The differentiator.
- Circuit "Sample and Hold". It allows picking up the input signal value in a certain moment and save it for a later treatment.
- Pulse generator. With it, we shall obtain adequate pulses to give energy to the coils of some meters. Its maximum voltage AC of synchronisation is 20V.
- Pulse Receiver. This circuit is designed to amplify microvolts signals, generated by the circulation of a flow through an electromagnetic flux meter.
- PID Control. This circuit is used to process error signals in a closed loop. It includes potentiometers to set the proportional, integral and derivative constants to the different systems to be controlled.
- Power Control. This circuit allows the control of the heating time for a resistor (for example, the one in an oven).
- Low Frequency Oscillator. This circuit makes possible to have a sinusoidal signal with a variable frequency and amplitude. The frequency can vary from 4.7 to 47 Hz.
- Current generator. This circuit generates a constant current of about some 397 mA. It has been built only for small resistances, between 1Ω and 10Ω as a maximum.

Others:

- Supply Sources of Direct Current (1A). There are +/-5V and +/-12V voltages sources of low power (1 A maximum) and some ground taken.
- Power source (4A). It has a variable output of direct current: 0 and 15V and other output of alternate current, variable: 0 and 24V.
- 4 Potentiometers of: 1KΩ, 5KΩ, 10KΩ and 20KΩ, to use them on assemblies, whenever necessary.

SCADA. EDIBON Computer Control System:

- Control Interface integrated in the unit box (BSPC).
- Data acquisition board to be installed in a computer slot.
- Computer Control Software.

Cables and Accessories, for normal operation.

Manuals: It is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer (PC)

DIMENSIONS AND WEIGHT

- Dimensions: 490 x 450 x 470 mm. approx.
- Weight: 30 Kg. approx.

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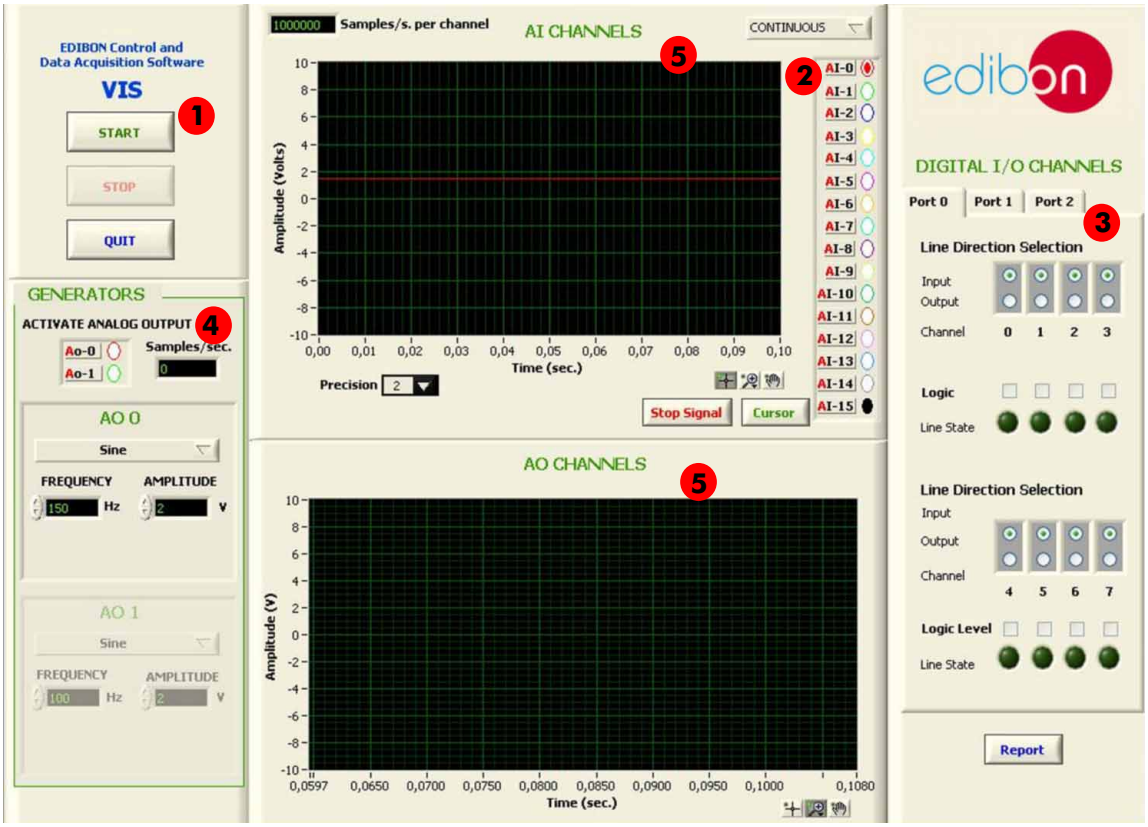
Software Main Screens

Main screen

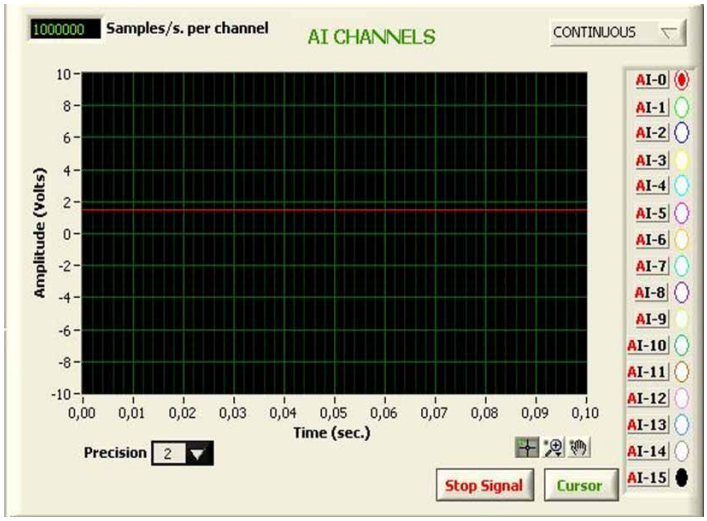


Screens of the main parts of the software:

1 Actions:

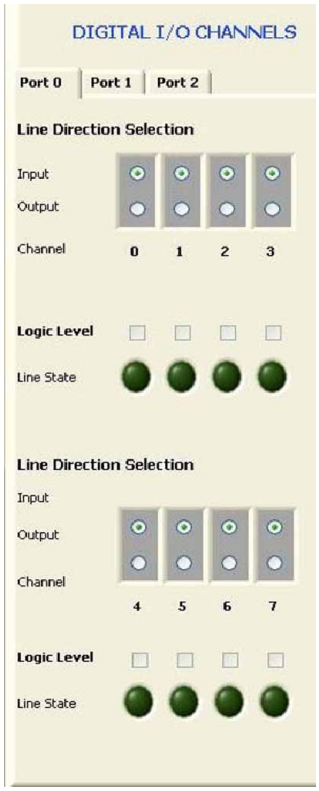
On this panel the user can see the main three buttons that control the action to be done.

2 Analog inputs:



The system consists on 16 analog inputs (AI0 to AI15) with a level of +/-10V. All 16 input channels could be scaled to compare signal with different voltage levels.

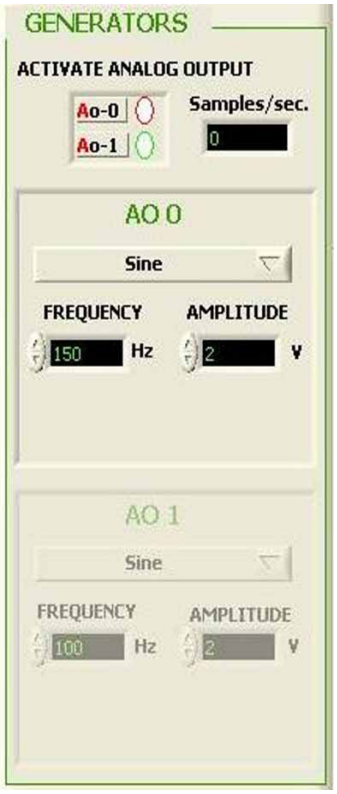
3 Digital inputs/outputs:



The system holds 24 digital inputs/outputs, configurable as inputs or outputs.

These digital inputs/outputs are grouped in 3 ports of eight channels, which can be selected.

4 Signal generators:

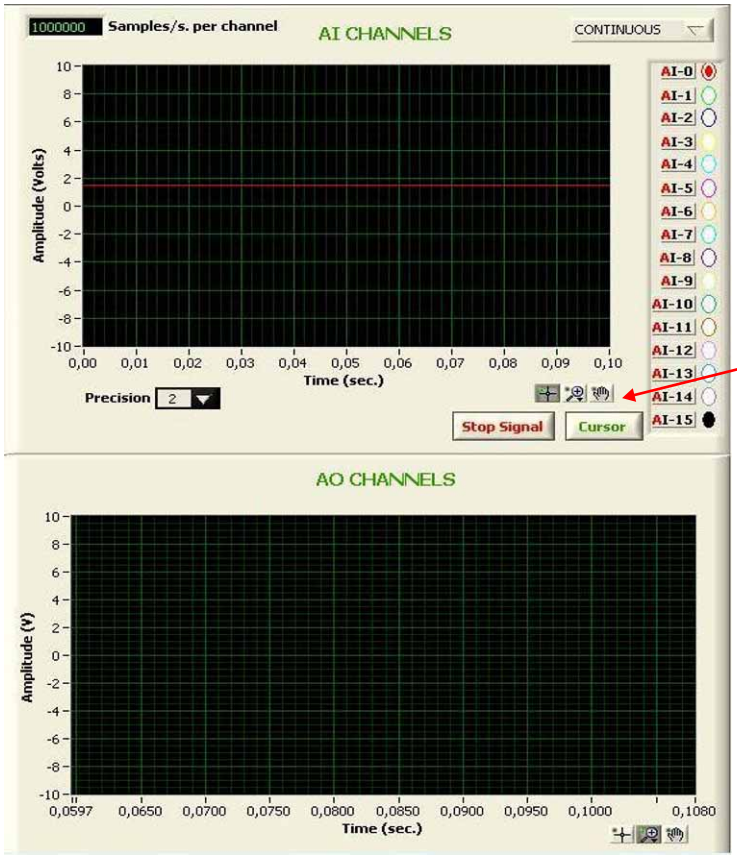


This system has 2 analog outputs (AO0 and AO1).

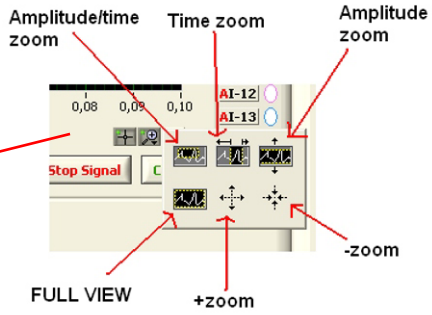
By them and through the frame GENERATOR of the software the user can generate different analog outputs, with a variable form, frequency and amplitude.

Continue...

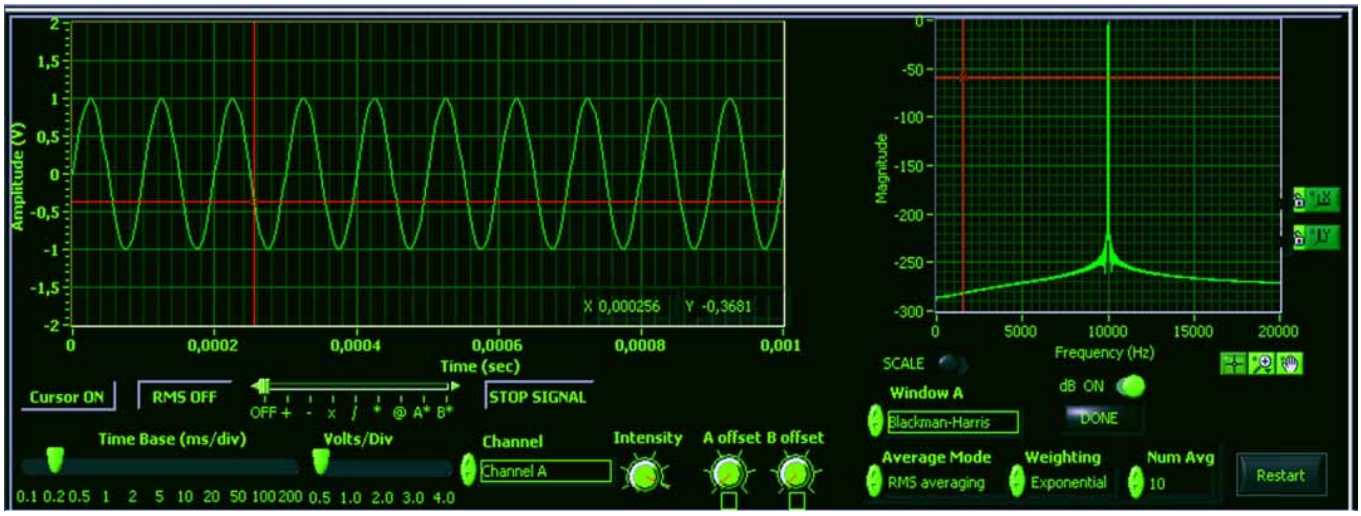
5 Graphic representation:



Graphics are in the lower and upper central frames. In the upper frame the analog input signals are represented, and in the lower one the analog ouput signal is shown.
In the graphic "AI CHANNELS" the user can find 2 modes of representation: CONSTANT and TRANSIENT.



In the transient mode the user will visualize a signal of analog input for an instant, which will be indicated with the controls that can be seen once this mode has been selected. These controls are: Capture Time, Begin Capture and Select Analog Input:



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- 4 Potentiometers of: 1KΩ, 5KΩ, 10KΩ and 20KΩ, to use them on assemblies, whenever necessary.

Cables and Accessories, for normal operation.

Manuals: It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.]
- Measurement instrumentation (oscilloscope, multimeter, etc.).

DIMENSIONS AND WEIGHT

- Dimensions: 490 x 450 x 470 mm. approx.
- Weight: 30 Kg. approx.

BS-1.**Vibration and/or Deformation Test Module:**

DESCRIPTION

This Test Module has been designed to teach mechanical vibration and displacement variable measurement techniques.

On the upper side of the test module there is a girder or elastic/vibrant sheet that is the one carrying the sensors which can have many applications depending on the use we give to them.

This girder is strongly fixed to the module chassis in one of its ends. This enables this free projection system to vibrate on a flat surface but also turns it resistant to the movement of other surfaces.

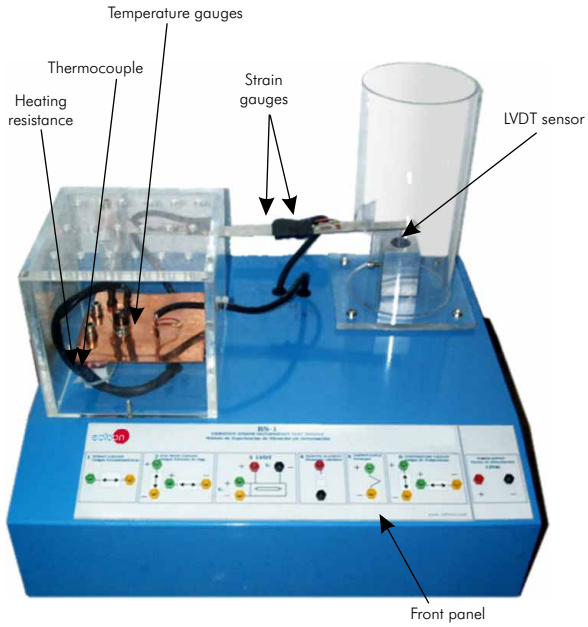
On the girder bottom there are different types of pressure meters that work in different ways.

When the girder is distorted, the surfaces are in traction or compression, as appropriate. Is at this moment when the sensor outlets are to be analyzed.

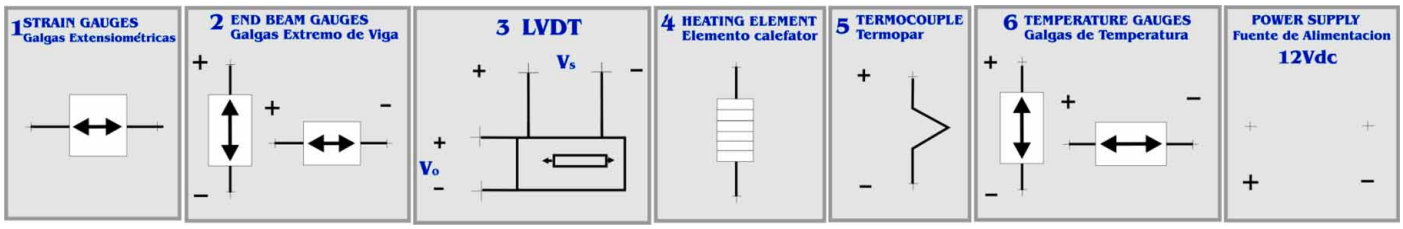
Near the girder fixed end there is also a mechanism to heat the system and a thermocouple to measure the temperature which is used to determine the dependence that studied material has on the temperature.

On the girder free end there are control instruments that can determine the movement variations, as for example lineal displacement and deformations.

The girder end vertical column has a coil that provides a signal that is proportional to the speed and a measurement system that can be used to give a signal that is proportional to the displacement.



Front panel of the Vibrations and/or Deformations Test Module (BS-1)



SPECIFICATIONS

Painted steel box.

Connection diagrams for each transducer are represented graphically.

Extensiometric gauges:

Gauges of a metallic material that vary their resistance depending on the distortion to which they are going to be subjected. They are stacked in different positions so that during the vibrant bar movement some of them suffer compressions and others extensions.

Characteristics: Resistance at 24°C: 120 Ω. Gauge factor at 24°C: 2.120.

Heating resistance and thermocouple:

Resistance used to produce temperature variations in the vibrant bar and to see how this situation affects the extensiometric gauges.

A K thermocouple place near the resistance measures the bar temperature.

Characteristics: Temperature range: -50°C to 350°C.

LVDT Sensor:

Linear displacement sensor, that detects the relative displacement of a ferromagnetic core between the primary and the secondary.

Input Voltage range: 10 to 24VDC.

Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.

Manuals:

It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

Each module may operate independently of another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- To measure the vibration of a vibrant girder using extensiometric gauges.
2.- To use a heating resistance to rise the girder temperature in order to study the effect on the sensors. (Thermocouple and heating resistance).
3.- To detect the displacement of the BS-1 system vibrant girder using a LVDT sensor.
4.- Effect of temperature variation on an extensiometric beam.
5.- Effect of deformation on the resistance of a beam.
6.- Measure of the three deformation dimensions or deformation of spherical or cylindrical systems.
7.- Linear variable differential transformer (LVDT) for measuring displacements.
8.- Analysis of how to compensate the variation of resistance of a gauge due to temperature variations, using shorted circuits with compensating gauges.
9.- Linear variable differential transformers (LVDT) as a weighing system.
10.- Effect on the vibration of a beam with different masses.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).

DIMENSIONS AND WEIGHT

- Dimensions: 405 x 300 x 350 mm. approx.
- Weight: 10 Kg. approx.

BS-2. **Temperature Test Module:**

DESCRIPTION

The Temperature Test Module has been designed to teach the use and applications of sensors of temperature as a measure, and its control.

We have a half-open space in whose interior there are two lamps that are going to heat that space. Temperatures will be around 40°C in the lower part and around 80°C in the upper part.

To measure the temperatures there are different type of sensors placed in different positions that are at different distances from the warming source, in order to get higher or lower temperatures.

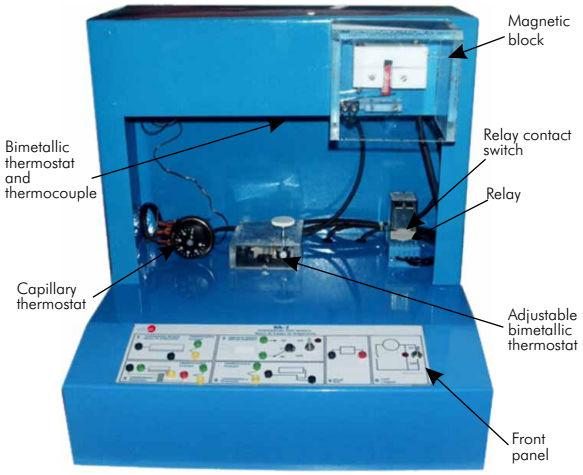
Among the sensors there are thermostat sensors. In them a contact in closed at a precise temperature which can be directly chosen with a numbered dial placed on the thermostat. There is also a switch sensor and thermocouple.

On the other hand, in the external casing there is a "magnetic block" where we have a "Curie effect" temperature control.

Sensors:

Bimetallic switch sensor. It is placed at the left side of the module, very close to one of the heater sources, in order to allow the temperature to rise quickly even over the switching temperature.

Adjustable bimetallic thermostat.



It is placed in the central part of the module at the lowest position, because the temperatures at which it works must be not too high. It is based, just as the one before, on the combination of two different metals, but with the difference that in this one we can chose the cut-off temperature.

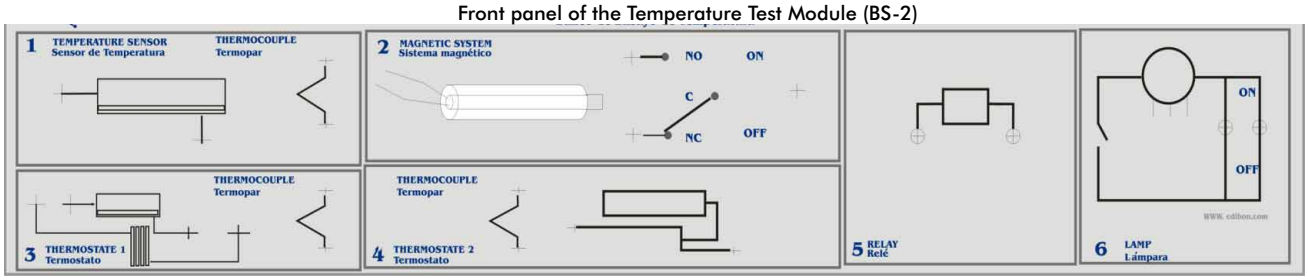
Relay that enables to turn on and off in the magnetic block both the heater light bulb and the heater resistor that rises the temperature in the magnetic block.

Magnetic block. It is in the external part of the module. It has a ferrite with an empty cylindrical form through which goes a resistor that is going to heat it at high temperatures. It also has a gravity switch that closes two sockets.

Capillary thermostat. The capillary is placed in the upper part on the left end of the module, near another light bulb, since the temperatures reached will be high. The thermostat works with a fluid placed at 90 mm. in the capillary tube. The switch temperature is adjustable .

Thermocouples.

Front panel of the Temperature Test Module (BS-2)



SPECIFICATIONS

Painted steel box. Connection diagrams for each transducer are represented graphically.

Bimetallic switch sensor:

Bimetallic contact thermal switch. Opening temperature: 50°C. Closing temperature: 30°C.

Adjustable bimetallic thermostat, with heater resistor that allows minimizing the differential cycles and preventing overpeaks. Temperature range: 0°C to 30°C.

Relay AC:

It allows to turn on and off the heater light bulbs placed over the temperature sensors. Voltage and current (nominal) :250V-10A. 3 sockets. Switching voltage: 12 V.

Capillary thermostat:

Temperature range: 0°C-90°C. Max. bulb temperature: 150°C. Socket current: 15A, 250V AC.

Thermocouples:

3 Cromel-Alumel thermocouples type K. One of them is placed near the capillary thermostat and the bimetallic sensor, another on the adjustable bimetallic thermostat and the third one inside the magnetic collection. Each one of them is used to measure the temperature that each one of the sensor are controlling. Temperature range: -50 °C to 250 °C.

Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.

Manuals:

It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

Each module may operate independently of another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- How to use the Curie effect as application of a high temperature thermostatic controller.
2.- Adjustable bimetallic thermostat. To use the bimetallic thermostat as a temperature control, calculating its hysteresis.
3.- Adjustable bimetallic thermostat. How we can reduce the hysteresis by adding a resistor to the heating circuit.
4.- To use the thermostat based on a bimetallic sensor to control the temperature.
5.- Capillary thermostatic controller.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).

DIMENSIONS AND WEIGHT

- Dimensions: 405 x 280 x 335 mm. approx.
- Weight: 10 Kg. approx.

BS-3. **Pressure Test Module:**

DESCRIPTION

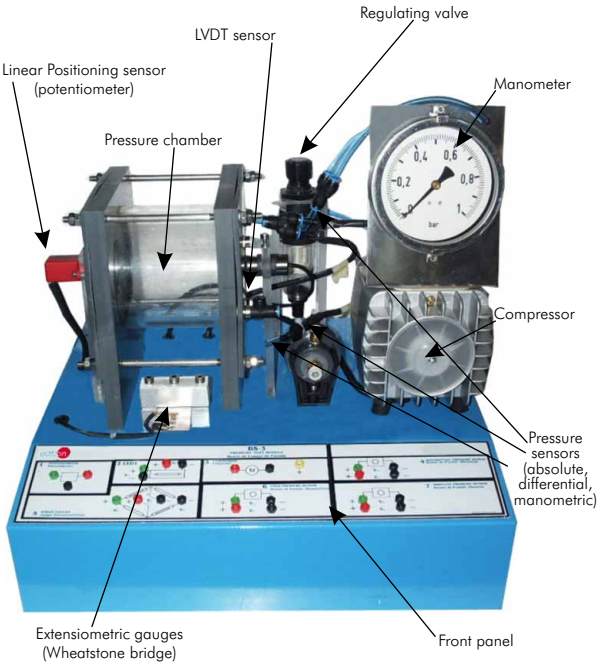
The Pressure Test Module has been designed to teach the use and applications of this kind of sensors measurement systems. It shows the different pressure measurement techniques.

On the left upper side of the module there is a pressure chamber with several sensors adjusted to measure the pressure changes inside the chamber. Next to the pressure chamber on the left side there is a relay activates a compressor that gives the system pressure. On the upper right side there are a compressor and a manometer connected next to the regulating valve with which the pressure chamber maximum pressure can be adjusted.

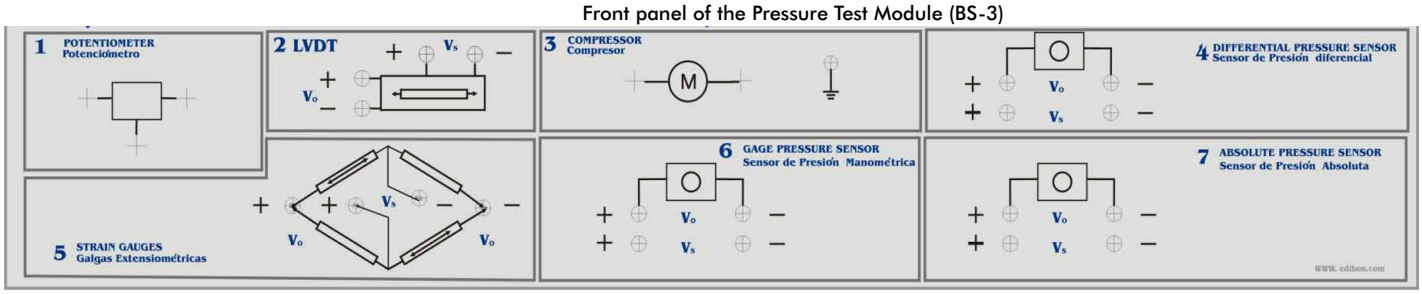
On both sides of the pressure chamber there are two diaphragms where displacement sensors are connected and some extensiometric gauges that detect the diaphragm distortion as the pressure rises.

Sensors:

- Linear positioning sensor (potentiometer).
- LVDT sensor.
- Differential pressure sensor with hole board system.
- Extensiometric gauges.
- Manometric pressure sensor.
- Absolute pressure sensor.



Front panel of the Pressure Test Module (BS-3)



SPECIFICATIONS

Painted steel box.
Connection diagrams for each transducer are represented graphically.
Linear positioning sensor (Potentiometer):
Resistor range: 500 Ω to 5KΩ. Operation force: 200-750g.
LVDT sensor:
Sensibility: 780mV/mm. Power voltage: 10 to 24Vdc. Total path: 2.5mm.
Differential pressure sensor:
Measurement range: 0 to 30 psi. Sensibility: 3.33mV/psi. Overpressure: 60 psi. Power supply range: 10 to 16 Vdc.
Extensiometric gauges:
Nominal resistor @ 25°C: 120Ω. Gauge factor: 2.00 to 2.1 typical. Nominal resistor tolerance: +-0.5%.
Manometric pressure sensor:
Measurement range: 0 a 30 psi. Sensibility: 3.33mV/psi. Overpressure: 60 psi. Power supply range: 10 to 16 Vdc.
Absolute pressure sensor:
Measurement range: 2 to 30 psi. Sensibility: -11mV/psi. Overpressure: 60 psi. Power supply range: 10 to 12 Vdc.
Air Compressor: Air flow: 10 l/min. Pressure: 1.83Kg/cm^2. Power supply: 220V, 50/60Hz.
Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.
Manuals:
It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.
Each module may operate independently of another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- Use of linear positioning sensor (potentiometer) to detect the displacement produced by a diaphragm expansion caused by the air pressure.
2.- Use of a LVDT as an element to measure the diaphragm distortion that is consequence of the pressure inside the pressure chamber.
3.- Differential pressure sensor with hole-board system. Use of a differential pressure sensor of the semiconductor type to measure the pressure fall in a hole-board system.
4.- Extensiometric Gauges. To detect objects using an infrared sensor by light beam interruption.
5.- Measure the pressure in the chamber, using two different types of sensors (manometric and absolute pressure sensor).
6.- Extensiometric gauges for measuring deformations: their resistance changes as the diaphragm expands due to the pressure coming from the pressure container.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).

DIMENSIONS AND WEIGHT

- Dimensions: 400 x 270 x 320 mm. approx.
- Weight: 10 Kg. approx.

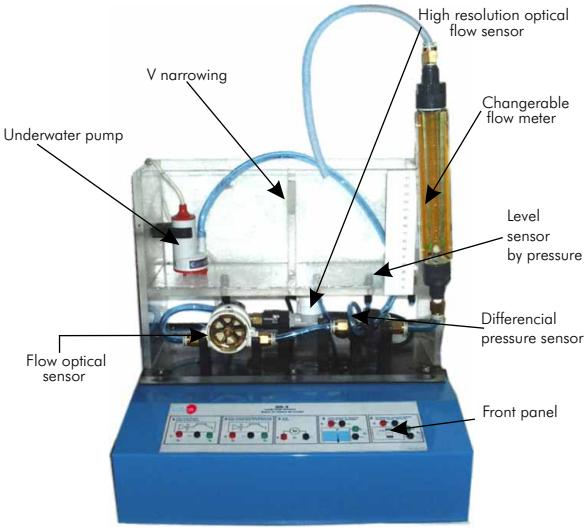
BS-4. **Flow Test Module:**

DESCRIPTION

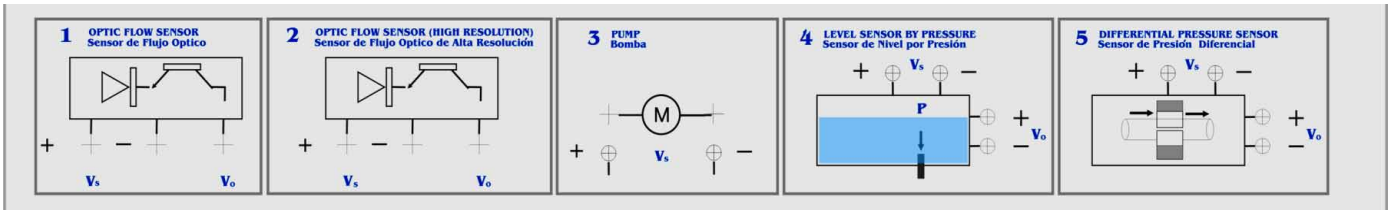
The objective this module is to show techniques to measure changeable fluids.
The module is made up of two tanks assembled on a structure. In one of them there is a pumping system that allows to pump the water from the reserve tank, using a measurement transducer system, and to return it to the main tank.
The pump enables that a big amount of water from the tank flows between the reserve tank and the main one. It is possible to change the flow volume by changing the pump power supply voltage using the terminals placed on the "BS-4" front panel.
This module has:

- Flow optical sensor.
- High-resolution flow optical sensor.
- Underwater pump.
- Level sensor by pressure.
- Differential pressure sensor.
- Changeable flow meter.
- V narrowing.

All the connections from the different transducers and from the pumping system are made using a group of 2 mm. terminals placed on the front panel of the test module with drawings describing their functions.



Front panel of the Flow Test Module (BS-4)



SPECIFICATIONS

Painted steel box. Connection diagrams for each transducer are represented graphically.
Flow optical sensor:
It gives an output in pulses proportional to the liquid flow. It is made up of a paddle wheel, placed on the fluid current that turns producing a pulse signal while passing between the emitter and the paddle detector. Power supply: 4.5 to 24Vdc. Standard flow range: 0.5 to 5 GPM.
High resolution optical flow sensor:
It works in the same way as the sensor just described with the difference that it is able to measure with a good resolution very low flow. At the output of this sensor we get a pulse signal with a frequency proportional to the flow volume that crosses the sensor.
Power supply: 5Vdc. Measurement range: 0.25 to 6.5 l/min. Temperature range: -40°C to 70°C.
Underwater pump: The variation in the pump power supply voltage enables to change the water volume in the test module.
Level sensor by pressure:
It is a differential pressure sensor that measures the pressure practice by the water in relation to the atmospheric pressure, so the liquid level in the tank can be calculated. Pressure range: 0 to 1 psi. Output at scale bottom: 16.7mV. Sensitivity: 16.7mV/psi. Overpressure: 20psi.
Differential pressure sensor (Hole board system):
This sensor is connected to a hole-board system to measure the pressure difference caused by the volume narrowing of the conduct through which the water flows. On this way, with the measurement of the pressure difference between the hole board water output and input, it is possible to calculate the water volume that crosses the board.
Measurement range: 0 to 30 psi. Sensitivity: 3.33mV/psi. Overpressure: 60 psi.
Changeable flow meter:
Using a small floating buoy that is inside the tube calibrated in liter/minute, it can be read the volume measure flowing through the pipe. Range: 0-2 l/min.
V narrowing:
The connection between the main and the secondary tank, a dam, includes a "V" narrowing. The altitude of the water level above the dam bottom is a very precise measure of the flow relation. The ruler fixed on the right end of the tank will show this height.
Main and secondary tanks.
Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.
Manuals:
It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.
Each module may operate independently of another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- To measure the water volume produced by an underwater pump in the module using an optical flow sensor.
2.- To use a high-resolution optical flow sensor to measure low volumes.
3.- Level sensor by pressure. To use a differential pressure sensor to measure the liquid level in one of the tanks.
4.- Differential pressure sensor. To measure the pressure-fall in the module hole board system, as a necessary parameter to determine volume.
5.- To measure the flow volume generated by the underwater pump using a flow meter of changeable area.
6.- To obtain the flow-volume value in the secondary tank using the V narrowing weir.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).
- Water.

DIMENSIONS AND WEIGHT

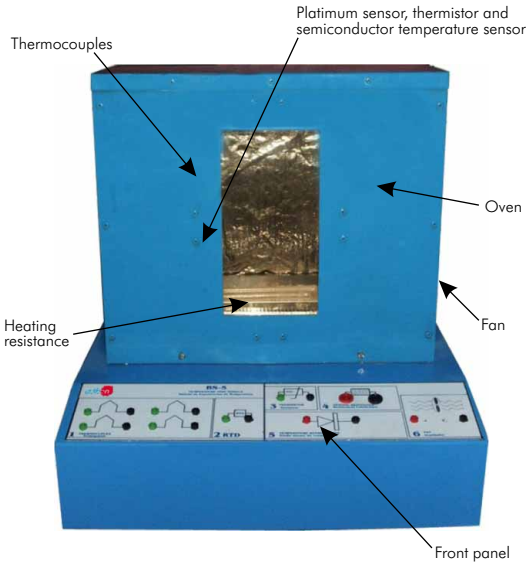
- Dimensions: 405 x 280 x 400 mm. approx.
- Weight: 10 Kg. approx.

BS-5. **Ovens Test Module:**

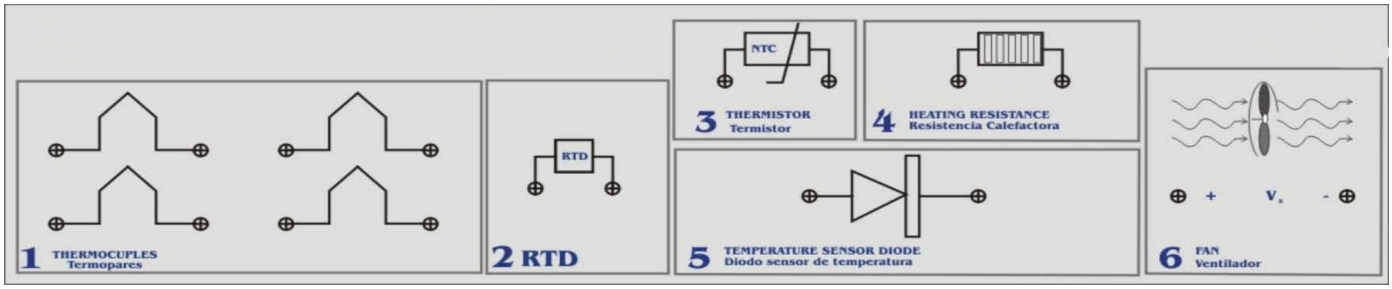
DESCRIPTION

With "BS-5" Test Module it is possible to study temperature measurement techniques using several kinds of sensors placed inside the sealed place that is used as oven.
This module is basically made up of an oven that contains a changeable speed circular fan that enables to modify the oven time constant.
The heating element that the oven has can be manually controlled or work through a triac which can be regulated with a PID.
The measurement mechanisms the oven has are 4 identical thermocouples placed at different heights. The oven also has a platinum resistance thermometer, a thermistor and a semiconducting mechanism sensitive to temperature. Using any temperature gauge or mercury thermometer it is possible to calibrate the different sensors by introducing the thermometer through the opening the oven has at its upper part.
This module has:

- Oven chamber.
- Heating resistance.
- Fan.
- Thermocouples.
- Platinum resistance thermometer.
- Thermistor.
- Semiconducting temperature sensor.



Front panel of the Ovens Test Module (BS-5)



SPECIFICATIONS

Painted steel box. Connection diagrams for each transducer are represented graphically.
Oven chamber.
Heating resistance:
Oven heating resistance made up of two parallel resistances with a maximum dissipation power of 500W. The heating element power supply is of 0-30V AC. Inside the heating element there is a temperature sensor element.
Fan:
Fan with changeable speed that can be operated varying the fan energy supply voltage.
Energy supply voltage: +12 Vdc (max). Maximum power: 0.96 W. Maximum air flow: 2.5 l/s.
Thermocouples:
4 thermocouples placed inside the oven, each one of them at a different height. Temperature range: -184°C to 400°C.
Platinum resistance thermometer:
Platinum resistance temperature detector, suitable for measuring air and gas temperatures. Temperature range: -70°C to 600°C. Resistance (0°C): 100+/-0.1Ω.
Thermistor:
NTC thermistor for temperature measurement and control, with great sensitivity and stability. Resistence at 25°C: 5.8 KΩ. Temperature range: -40°C to 125°C.
Semiconductor temperature sensor:
Reverse polarized diode. The current through the diode depends on the temperature at which balance with the surrounding environment is achieved. Therefore it needs a conditioning circuit able to transform this current variation in voltage proportional to temperature.
Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.
Manuals:
It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.
Each module may operate independently of one another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- Heating resistance. Raise the oven internal temperature over the environmental temperature using a heating resistance to make tests and practices related with temperature measurement.
2.- To use a fan as refrigerating element of the oven.
3.- To use thermocouples as temperature sensors elements inside the oven. Temperature measurement using a thermocouple.
4.- To measure temperature inside the oven using a platinum resistance thermometer.
5.- To measure temperature inside the oven using a thermistor temperature sensor.
6.- Temperature measurement using a thermistor, based on its negative temperature coefficient.
7.- To obtain the temperature value inside the oven, using a semiconductor sensor (diode).
8.- PID control.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).

DIMENSIONS AND WEIGHT

- Dimensions: 405 x 300 x 470 mm. approx.
- Weight: 10 Kg. approx.

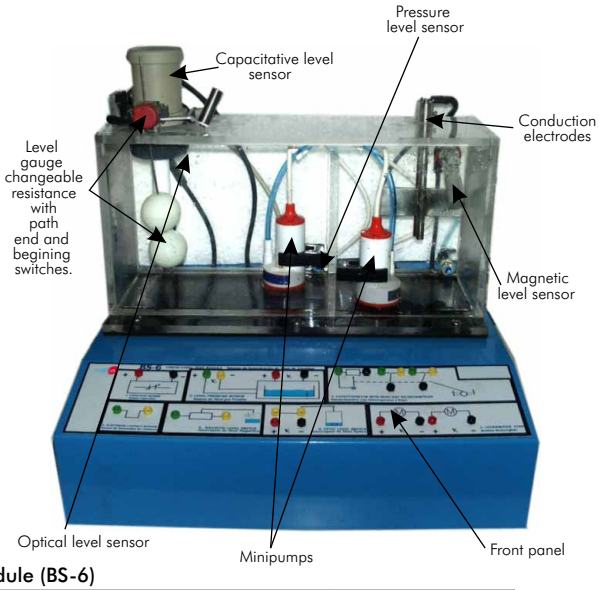
BS-6. **Liquid Level Test Module:**

DESCRIPTION

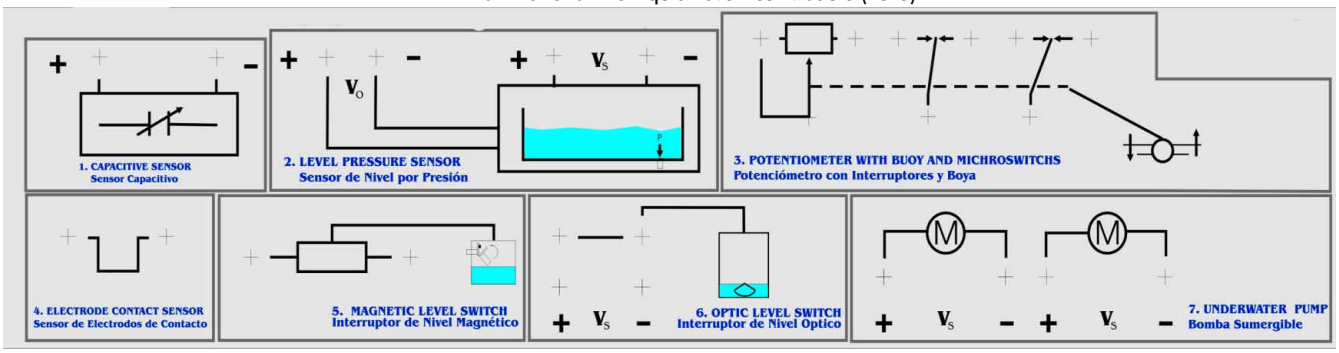
The Liquid Level Test Module "BS-6" has been designed to teach the use and applications of level sensors and their measurement systems. This module teaches techniques to measure and control the liquid level in a tank.
On this there is a two tanks system whose aim is to pump the liquid (usually water) between both tanks. Both tanks have sensors of different technology so they can be used as liquid storage tanks or to study the level measurement sensors. Each tank has an individual pump.
Sensors:

Capacitative level sensor. Pressure water level sensor. Float type level gauge changeable resistance and two float path end and beginning contacts. Conduction level sensor (Electrodes). Magnetic float level sensor. Optical level sensor.

Two minipumps fed through direct current that can be used to pump the liquid from one tank to the other.
All the connections of the different sensors and pump systems are done using the 2mm. terminals available on the test module front panel, with diagrams describing their functions.



Front Panel of the Liquid Level Test Module (BS-6)



SPECIFICATIONS

Painted steel box. Connection diagrams for each transducer are represented graphically.
Water tanks.
Capacitative level sensor:

Level sensor immersed in the tank . Power supply: 24 Vdc (max). Output: 11-20mAdc.

Pressure level sensor.

It is a differential pressure sensor that measures the pressure practiced by the water compared to the atmospheric pressure. Pressure range: 0-1psi. Sensibility: 16.7mV/psi. Excitation Voltage: 10-16 Vdc.

Level gauge changeable resistance with path end and beginning switches:

It is a resistance fixed to a float arm that will vary its position compared to the water level. This system complements itself with two end and beginning path switches respectively. Nominal value: 250V-10A. Switching current of the path end and beginning switches: 5 A/220Vac.

Conduction sensor:

This sensor works with two electrodes immersed in one of the tanks. As the water level rises and covers the electrodes its resistance will decrease until it arrives to KΩ unit values, as long as the water does not touch the electrodes, the resistance between them will be very big and will behave like an open circuit.

Magnetic float level sensor:

Sensor formed by a small float that has inside a magnetic element, the float base has a Hall effect element that detects when the float has gone up due to the effect of the water. Switching voltage: 240Vac, 110Vac. Max. switching current: 0.6Amp.

Optical level sensor:

It is a photodiode and phototransistor, which in presence of water changes its refraction properties and make the output state approximately change from 3Vdc to 0Vdc. Power supply: 5Vdc. Load current: 20mA max. at 125°C.

2 Minipumps:

The volume supplied by these pumps can be regulated varying the dc voltage value with which they are supplied. Power supply: 12Vdc (max. voltage). Nominal volume: 1 l/minute. Nominal current: 1 A DC.

Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.

Manuals:

It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

Each module may operate independently of one another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- To use a capacitative sensor to measure the liquid level in the tank.
2.- To use the differential pressure sensor as an element to determine the water level in a tank.
3.- To use a changeable resistance fixed to a float system as a liquid level measurement element.
4.- Conduction Sensor. Use of a sensor made up of to steel electrodes to measure the water level of a tank.
5.- Magnetic float level sensor. Detect a precise tank liquid level with a magnetic switch sensor.
6.- Control the BS-6 system left tank liquid level using an optical level sensor.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).
- Water supply.

DIMENSIONS AND WEIGHT

- Dimensions: 400 x 300 x 400 mm. approx.
- Weight: 10 Kg. approx.

BS-7. **Tachometers Test Module:**

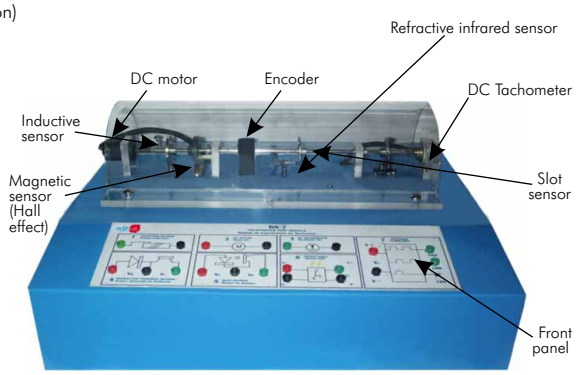
DESCRIPTION

The Tachometer Test Module "BS-7" has been designed to teach linear and angular speed measurement techniques. In this module placed on the upper part we have a miniature motor used to move the axle. The motor speed can be changed adjusting the voltage delivered to the actuator motor. The rotation speed can be measured using the different measure transducers placed on the axle.

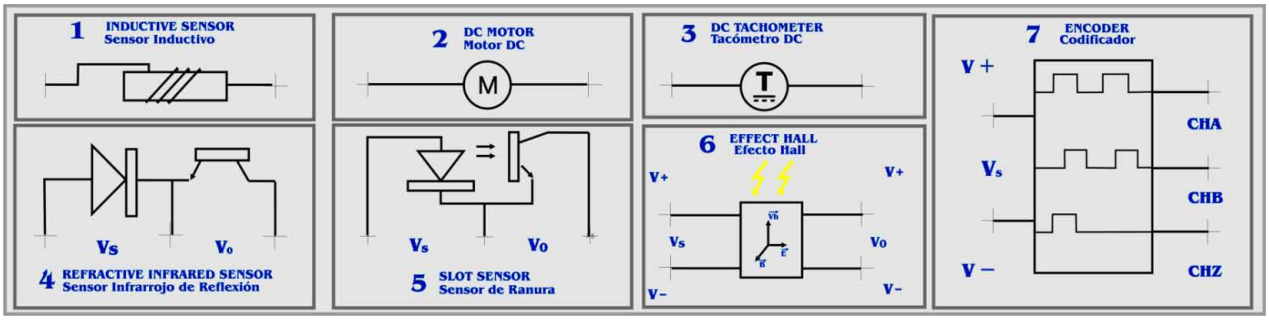
Elements included:

DC Tachometer. Encoder.

Inductive Sensor. Refractive Infrared Sensor. Slot Sensor. Effect Hall.



Front panel of the Tachometer Test Module (BS-7)



SPECIFICATIONS

Painted steel box.

Connection diagrams for each transducer are represented graphically.

Inductive Sensor:

Output voltage: up to 10 Vpp. Body-housing material: Steel. Operating temp. range: -40°C to +60°C.

DC Motor:

Nominal voltage: 12V. Resistance: 9,7 Oh. Max. vacuum speed: 8500 r.p.m. Max. load speed: approx. 3500 r.p.m. Start voltage: 210mV.

DC Tachometer: Voltage rating: 1.5V(dc). Power rating: 1.21W.

Refractive Infrared Sensor:

Sensor where an infrared emitting diode and an NPN silicon phototransistor encased side-by-side on coverging optical axes in a black thermoplastic housing. Vo in output bornes of the module: 0.0-400mV for Vs=12VDC.

Slot Sensor:

Slotted optical switch where an input LED and an output phototransistor are capsulated. Vo in output bornes of the module: 0.0-5V for Vs=5VDC.

Hall Effect

Hall-effect position sensor where exist a relationship between supply voltage and the combined effects of a change in sensitivity (gain) and null voltage output at room temperature.

Supply Voltage: 4 to 10V. Supply Current: 3.5mA. Output type: Differential. Output voltage: 0 to 0.25V at 5V, 0 gauss. Sensitivity: (-400 to +400 gauss); 0.75 to 1.06 mV/gauss. Vo in output bornes of the module: 0.0-1V for Vs=5VDC.

Encoder

This optical encoder contains a lensed LED source, an integrated circuit with detectors and output cicuitry, and a codewheel which rotates between the emitter and the detector IC. Operating temperature: -40 to 100°C. Supply voltage: -0.5 to 7 V. Output voltage: -0.5 to Vdc. Output current per channnel voltage: -1 to 5 mA. Vibration: 20 g, 5 to 1000 Hz. Velocity: 30000 r.p.m.

Sensor connections with the Base Unit and with power supplies is through 2 mm.terminals located in the front panel of the Test Module.

Manuals:

It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

Each module may operate independently of one another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- DC Motor. Provide the group of sensors of the BS-7 system fixed to the central axle of the equipment with movement power.
2.- DC Tachometer. To use a DC motor as a tachometer to measure the revolutions of the BS-7 system central axle.
3.- Inductive Sensor.
4.- Refractive Infrared Sensor. To measure the central axle revolutions of the BS-7 system using a light reflection optical sensor.
5.- To obtain the central axle speed value using a slotted optical sensor through light interruption.
6.- To obtain the central axle speed value using a Hall-effect position sensor.
7.- To measure the central axle revolutions of the BS-7 system using the encoder.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).

DIMENSIONS AND WEIGHT

- Dimensions: 300 x 200 x 200 mm. approx.
- Weight: 10 Kg. approx.

BS-8. **Proximity Test Module:**

DESCRIPTION

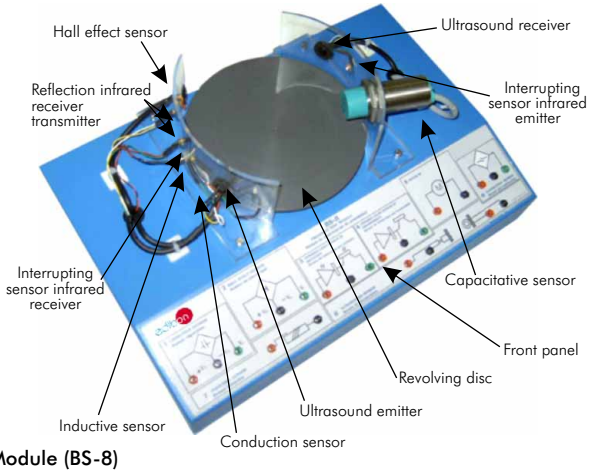
This Module has been designed to teach techniques to detect the proximity of objects, focusing on the distance at which each sensor is able to detect the object and the type of material it can detect.

In the upper part there is a revolving disc on which the objects to be detected are placed. All sensors are situated in front of the disc on walls perpendicular to the disc, so that when the disc turns with an object on it, it will pass in front of each of the module sensors.

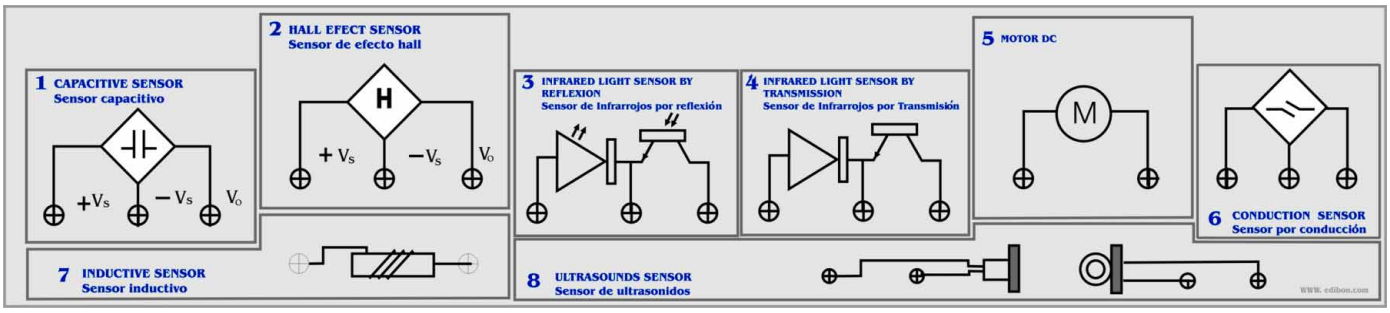
A dc motor moves the disc at different speeds, which allows studying the maximum frequency the sensor is able to detect

Elements included in the module:

Capacitative proximity sensor. Hall effect sensor. Infrared reflection sensor. Infrared transmission sensor. Motor DC. Conduction sensor. Inductive sensor. Ultrasound sensor.



Front panel of the Proximity Test Module (BS-8)



SPECIFICATIONS

Painted steel box.
Connection diagrams for each transducer are represented graphically.
DC Motor: Nominal power supply: 12Vdc.
Proximity capacitative sensor:
It can detect metallic objects.
Detection distance: 10 mm. Output: 10-60V Imax = 200mA. Power supply voltage: 10-60V.
Hall effect sensor:
Proximity switch using the Hall effect, switching when there is a magnetic field. Power supply voltage: 5Vdc. Magnetic flux density: works at 22 mT (35mT max), output voltage: low: 85mV., high: Vdc.
Infrared sensor by reflection:
Emission narrow beam GaAs IR Emitter. Detection narrow beam IR Photodetector.
Emitter: VF(max): 1.7, VR (min): 3V., radiation power: 4.8mW, peak wavelength: 935nm. Receiver: Vc (max): 12Vdc., Ic (min): 8mA., Darkness current: 100nA.
Transmission infrared sensor:
Emission narrow beam GaAs IR Emitter. Detection narrow beam IR Photodetector.
Emitter: VF (max): 1.7, VR (min): 3V., radiation power: 4.8mW., peak wavelength: 935nm. Receiver: Vc (max): 30V., Ic (min): 8mA., Darkness current: 100nA.
Conduction sensor:
Proximity sensor with plate sensible to magnetic fields. Contact material: Rhode. Output: NO-NC. Breaking voltage: 400V. DC or AC current (max) 0.6Amp.
Inductive sensor:
Sensor that gives variations in the output voltage as a variation of the magnetic field, caused by the near ferromagnetic material movement. Inductance: 12mH. Winding Resistance: 130 Oh. Detection distance: 2mm.
Ultrasound sensor:
Transmitter sensibility: 106 dB. Receiver sensibility: -65 dB. Resonance frequency: 40kHz. Operation distance: 40 cm. Output voltage: 20V rms.
Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.
Manuals:
It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.
Each module may operate independently of one another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some practical possibilities of the Module:

1.- How to use a capacitative sensor to detect metal objects as the pass in front of the sensor.
2.- To use a Hall effect sensor as an element to detect the presence of magnetic objects.
3.- Reflection infrared sensor. To use an optical sensor that works through infrared light reflection.
4.- Infrared sensor by transmission. To detect objects using an infrared sensor by light beam interruption.
5.- Conduction sensor. To detect magnetic objects using a REED switch sensor.
6.- To detect the presence of ferrous object using an inductive sensor.
7.- Ultrasound sensor. To detect metallic and non-metallic object using high frequency sounds.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).

DIMENSIONS AND WEIGHT

- Dimensions: 400 x 270 x 200 mm. approx.
- Weight: 10 Kg. approx.

BS-9. **Pneumatic Test Module:**

DESCRIPTION

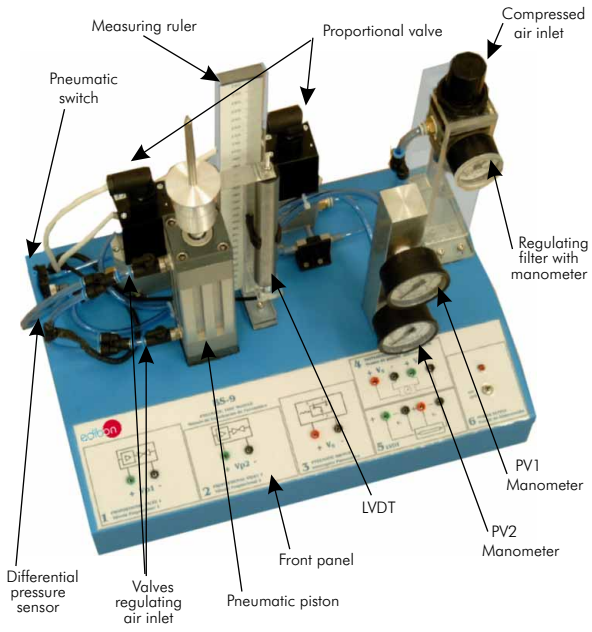
The Pneumatics Test Module "BS-9" has been designed to teach techniques of control and handling of a pneumatic piston.

All connections of the different BS-9 mechanisms will have output through a group of 2 mm. terminals. They are placed in the panel of the test module with a diagram representing their functions.

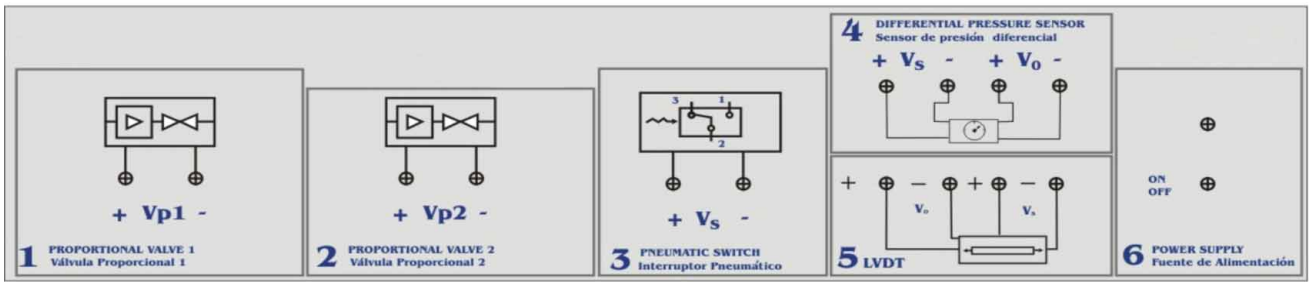
A double-action pneumatic piston is used to move a platform placed on the upper part of the piston axle. The control of the air inlet to the piston is carried out using two proportional electronic valves. There is a differential pressure sensor is connected between both pneumatic piston air inlets. This way the pressure difference between both inlets can be obtained any time. At one of the air inlets to the piston there is connected in series a pneumatic switch that works as air output in the circuit. An external compressor must provide the compressed air needed for this unit to operate. An LVDT sensor will indicate the displacement of the pneumatic piston axle.

Elements in the test module are:

- Two Proportional Valves. (PV1 and PV2).
- Differential pressure sensor.
- Pneumatic switch (2 positions).
- Linear displacement sensor (LVDT).
- Regulating filter with manometer.
- Manometer indicator of pressure in proportional valve 1.
- Manometer indicator of pressure in proportional valve 2.



Front panel of the Pneumatic Test Module (BS-9)



SPECIFICATIONS

Painted steel box. Connection diagrams for each transducer are represented graphically.

Proportional valve 1 and 2:

Nominal voltage: 24Vdc. Pressure range: 8 bar maximum, 0 to 6 bar control. Linearity: 1% full scale.

Differential pressure sensor: Measurement range: 0 to 30 psi. Sensitivity: 3.33mV/psi. Power-supply range: 10 to 16 Vdc.

Pneumatic switch: Activation: 20 to 24Vdc. Positions: 2. Maximum pressure: 6 bars.

LVDT Sensor: Power-supply voltage: 9 to 24Vdc. Sensitivity: 60mV/mm/10Vdc.

Regulation filter: Manual drainage. Maximum input pressure: 8 bars. Flux: 14.5 dm^3/s.

Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.

Manuals:

It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

Each module may operate independently of one another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- Proportional valves. To control electronically the vertical displacement of a double effect pneumatic piston using proportional valves.

2.- Differential pressure sensor. To use a pressure sensor for measuring the pressure difference between both pneumatic piston air inlets.

3.- Pneumatic switch. To deflect the air flow in the BS-9 system using a pneumatic switch.

4.- LVDT Linear Displacement Sensor. To measure pneumatic piston displacement using an excitation and DC output LVDT.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).
- Compressor.

DIMENSIONS AND WEIGHT

- Dimensions: 300 x 300 x 300 mm. approx.
- Weight: 10 Kg. approx.

BS-10. **Light Test Module:**

DESCRIPTION

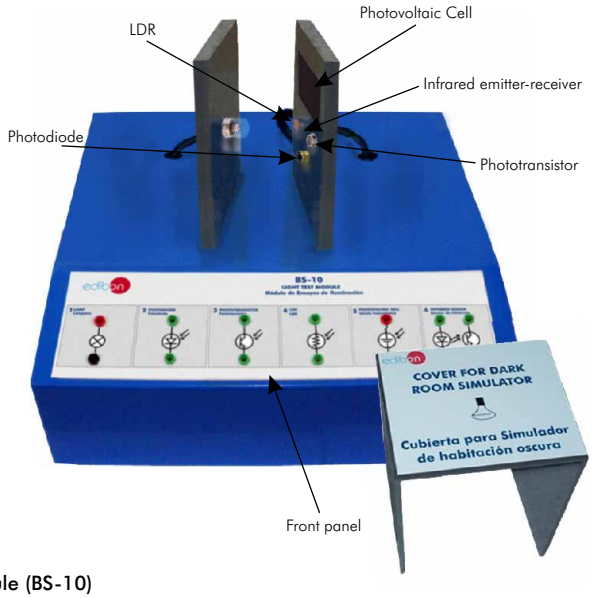
The objective of this module is to show some of the techniques used to measure light or illumination intensity.

The module is equipped with a lamp whose light intensity can be controlled by the variation of the voltage supplied.

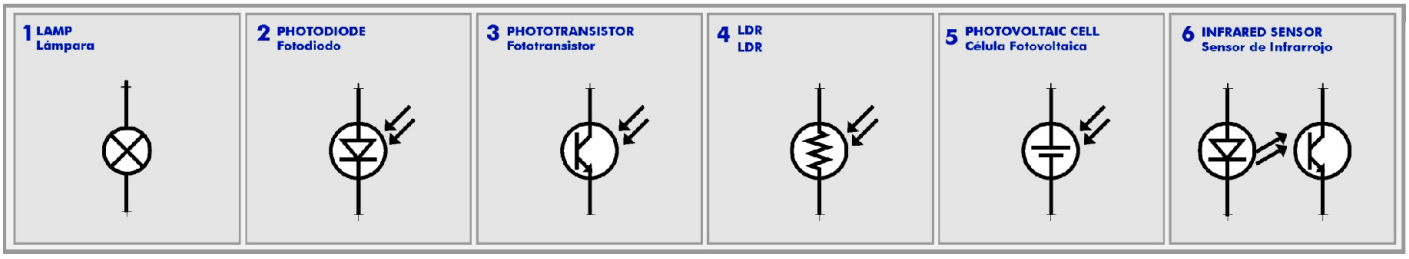
This module has:

- Photodiode.
- Phototransistor.
- Light Dependent Resistance (LDR).
- Photovoltaic Cell.
- Infrared emitter-receiver.

All the connections from the different transducers and the lamp are made using a group of 2 mm. terminals placed on the front panel of the test module with drawings describing their functions.



Front panel of the Light Test Module (BS-10)



SPECIFICATIONS

Painted steel box. Connection diagrams for each transducer are represented graphically.
Photodiode:
This sensor converts light into either current or voltage, depending upon the mode of operation.
Phototransistor:
It also consists of a photodiode with internal gain.
Light Dependent Resistor:
A LDR is a resistor whose resistance decreases with increasing incident light intensity.
Photovoltaic Cell:
A photovoltaic cell converts solar radiation into direct current electricity.
Infrared emitter-receiver:
This element consists of a IR emitter LED and IR phototransistor.
Sensor connections with the Base Unit and with power supplies is through 2 mm. terminals located in the front panel of the Test Module.
Manuals:
It is **supplied with the following manuals:** Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.
Each module may operate independently of one another.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Module:

1.- Study of the equivalent electrical circuit of a photodiode. Study the V-I characteristic of a photodiode.
2.- Study of the normal operation mode of a photodiode. Study the "ON/OFF" operation (light switch) of a phototransistor.
3.- Measurement of light intensity using a solar cell.
4.- Study of the properties of light dependent resistors (LDR).
5.- Study of the operation of IR sensors.
6.- Study of a real application for controlling the light intensity using PID control elements.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V/50Hz or 110V/60Hz.
- Computer Controlled Base unit (BSPC) or Base unit (BSUB).

DIMENSIONS AND WEIGHT

- Dimensions: 405 x 300 x 350 mm. approx.
- Weight: 10 Kg. approx.

✱Specifications subject to change without previous notice, due to the convenience of improvements of the product.

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Issue: ED01/10
Date: June/2010

REPRESENTATIVE: