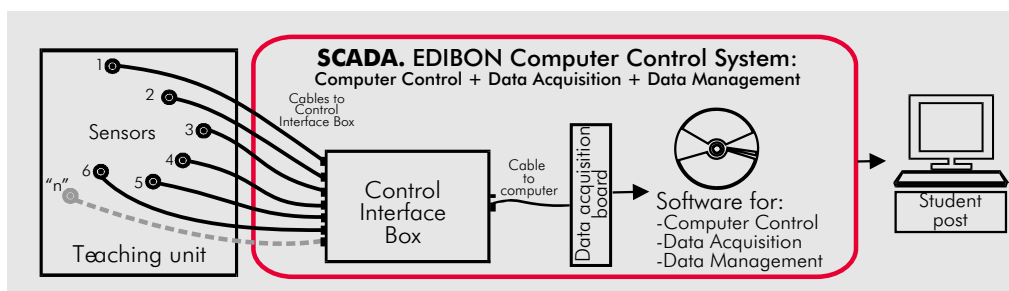


① Unit: TBMC12. Test Bench for Single-Cylinder and Two-Cylinders Engines, 11 kW



www.edibon.com

Products
Products range
Units
9. Thermodynamics & Thermotechnics

DESCRIPTION

The Engines Test Bench TBMC12 developed by EDIBON is a teaching equipment to test internal combustion engines of up to 11 kW.

The main element of the TBMC12 unit is the dynamometric brake. The unit developed by EDIBON has an eddy current brake, as element carrying out the torque resistant to the engine, also called of Foucault. With the help of the brake, which is coupled to the engine by the shaft, the torque is measured. The torque is measured by the reaction produced in the arm end on a load cell (force sensor).

The combustion engine speed is directly measured from the engine shaft with an optical slotted sensor.

This unit also includes:

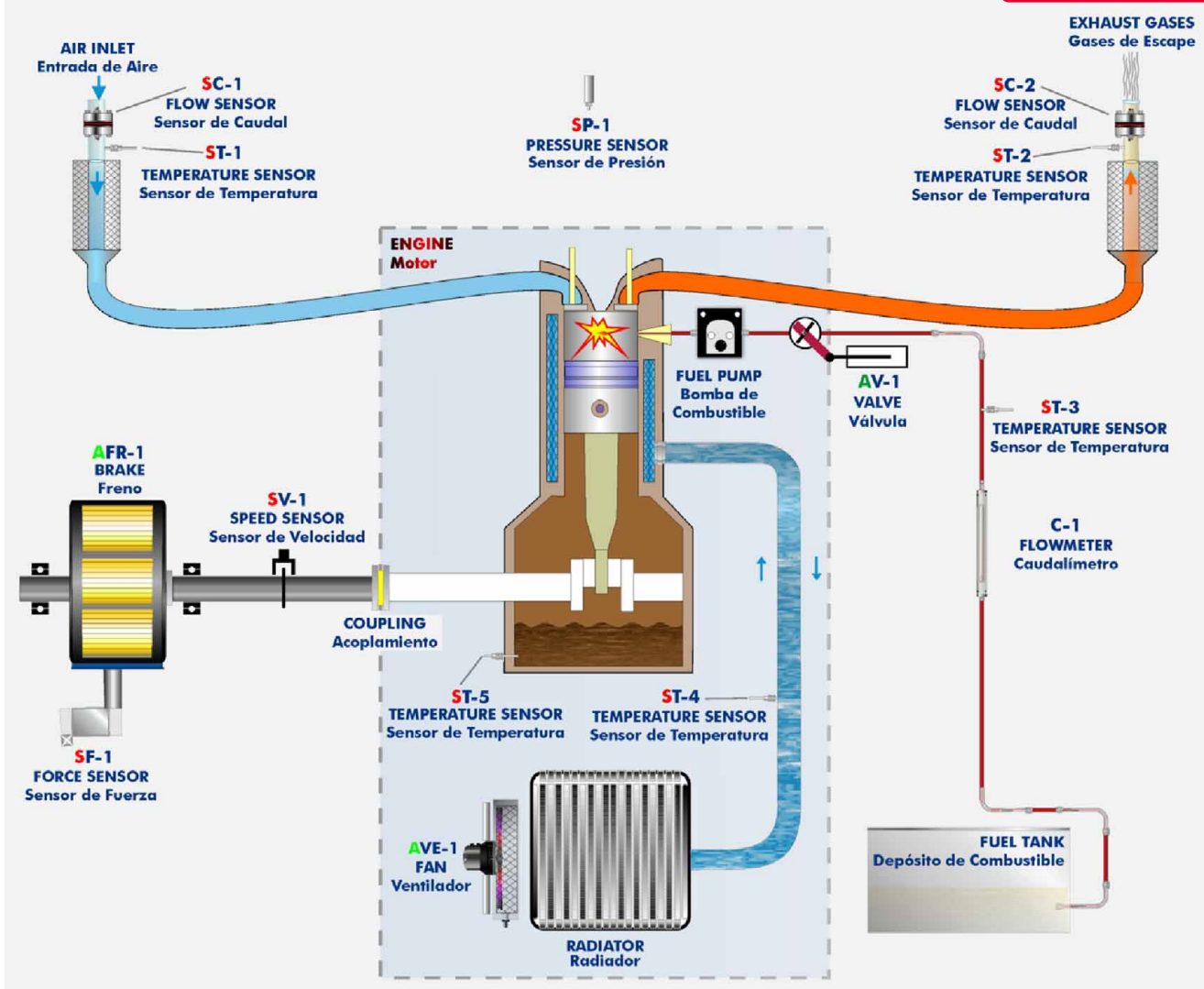
- A series of temperature, pressure, flow, speed and force sensors in different points of the unit.
- Starting installation: The start process is provided by the acceleration produced by an electric DC engine. The starter engine supply is carried out with a battery of 12V. It has a maneuvering box from which the combustion engine is started by the key.
- Fuel installation: The fuel line consists of a tank and a flowmeter. The fuel filter and pump generally belong to the combustion engine.
- Refrigeration installation: The objective of this installation is refrigerating the engine block. According to the engine which is being tested:
 - Water cooled engine: There is a radiator cooling the water which refrigerates the engine.
 - Air cooled engine: There is a fan which refrigerates directly all the engine block.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), including: Control interface Box + Data Acquisition Board + Computer Control and Data Acquisition Software, for controlling the process and the parameters involved.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

2 actuators and 10 sensors
controlled from any computer,
and working simultaneously

**OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL**



Items supplied as standard

① TBMC12. Unit:

Combustion Engine Test Bench with wheels for its mobility.
Control and load unit for four-stroke engines. Maximum power output of: **11 kW**.
Anodized aluminium structure and panels in painted steel (epoxy paint).
Main metallic elements in stainless steel.
Transparent screens for protection and easy visualization of the tests.
Diagram in the front panel with similar distribution to the elements in the real unit.
Eddy Current brake for generating the engine load, computer controlled:

Braking torque: 350 Nm.
Maximum speed: 3000 rpm.
Arm: 500 mm.

Engine started by a DC motor.
Motor and engine control.
Force transmission from the engine to the brake unit by means of the use of an elastic claw coupling.
Coupling cover.

Adjustment of the braking torque and the speed by means of an inverter, computer controlled.
Quieting vessel for intake air, with air filter and air hose.
Vibration insulated base plate for the test engine installation.
Engine acceleration by means of the fuel valve, computer controlled (acceleration/deacceleration)
Quick and easy exhaust gas connection.
Fuel tank with pump. Pump control.
Consumption control.
Speed sensor to measure the speed (rpm) of the motor, range: 0-6000 rpm.
Temperature sensors, "J type", for the measurement of cooling water temperature, air temperature, fuel temperature, oil temperature and exhaust gas temperature, etc.
Force sensor (torque), range: 0-50 Nm.
Flow meter to measure the fuel consumption, range: 0-42 ml/min.
Flow sensor to measure the air intake quantity, range: 0-100 m³/h.
Flow sensor to measure the exhaust gas, range: 0-100 m³/h.
Barometric pressure sensor necessary for obtain the corrected power of an engine, range: 900-1100 mbar.

By the previous sensors we can make measurement of the most representative parameters, as:

Speed. Power. Torque. Air intake quantity. Oil pressure. Fuel consumption.
Air temperature. Fuel temperature. Exhaust gas temperature.
Cooling water temperature. Etc.

The complete test bench requires for working a choice (optional) of at least one of the combustion test engines :

Test Combustion Engines available: (not included in the standard supply)

- TM12-1. Water-cooled single-cylinder engine, with variable compression.
- TM12-2. Two-cylinders petrol engine.
- TM12-3. Two-cylinders diesel engine.

Other accessories available: (not included in the standard supply)

- TBMC-CG. Computer Controlled Exhaust Gas Calorimeter.
- TBMC-AGE. Exhaust Gas Analyzer.

② TBMC12/CIB. Control Interface Box :

Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.

All sensors, with their respective signals, are properly manipulated from -10V. to +10V computer output.
Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.
Single cable between the control interface box and computer.

The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.

Simultaneously visualization in the computer of all parameters involved in the process.

Calibration of all sensors involved in the process.

Real time curves representation about system responses.

Storage of all the process data and results in a file.

Graphic representation, in real time, of all the process/system responses.

All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.

All the actuators and sensors values and their responses are placed in only one computer screen.

Shield and filtered signals to avoid external interferences.

Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.

Real time computer control for pumps, compressors, resistances, control valves, etc.

Open control allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.

Three safety levels, one mechanical in the unit, other electronic in control interface and the third one in the control software.



TBMC12. Unit



TBMC12/CIB

Items supplied as standard (continuation)

③ DAB. Data Acquisition Board:

PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.

Analog input: Number of **channels= 16** single-ended or 8 differential.

Resolution= 16 bits, 1 in 65536.

Sampling rate up to: 250 KS/s (Kilo samples per second).

Input range (V)= ± 10 V.

Data transfers=DMA, interrupts, programmed I/O.

Number of DMA channels=6.

Analog output: Number of **channels=2**.

Resolution= 16 bits, 1 in 65536.

Maximum output rate up to: 833 KS/s.

Output range(V)= ± 10 V.

Data transfers=DMA, interrupts, programmed I/O.

Digital Input/Output:

Number of **channels=24 inputs/outputs**.

D0 or DI Sample Clock frequency: 0 to 1 Mhz.

Timing: **Counter/timers=2**.

Resolution: Counter/timers: 32 bits.



DAB

④ TBMC12/CCSOF. Computer Control+ Data Acquisition+ Data Management Software:

Compatible with actual Windows operating systems.

Graphic and intuitive simulation of the process in screen.

Compatible with the industry standards.

Registration and visualization of all process variables in an automatic and simultaneously way.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.

Management, processing, comparison and storage of data.

Sampling velocity up to 250,000 data per second guaranteed.

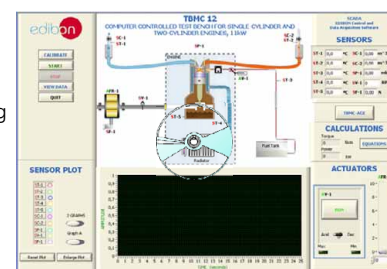
Calibration system for the sensors involved in the process.

It allows the registration of the alarms state and the graphic representation in real time.

Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access at different work levels.

This unit allows that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.



TBMC12/CCSOF

⑤ Cables and Accessories, for normal operation.

⑥ Manuals:

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

*** References 1 to 6: TBMC12 + TBMC12/CIB + DAB + TBMC12/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PLC-PI. PLC Module:

Circuit diagram in the front panel.

Front panel:

Digital inputs(X) and Digital outputs (Y) block:

16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).

14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

Analog inputs block:

16 Analog inputs (-10V. to + 10V.) (through SCSI connector).

Analog outputs block:

4 Analog outputs (-10V. to + 10V.) (through SCSI connector).

Touch screen:

High visibility and multiple functions.

Display of a highly visible status.

Recipe function.

Bar graph function.

Flow display function.

Alarm list.

Multi language function.

True type fonts.

Back panel:

Power supply connector.

Fuse 2A.

RS-232 connector to PC.

USB 2.0 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

Panasonic PLC:

High-speed scan of 0.32 µsec. for a basic instruction.

Program capacity of 32 Ksteps, with a sufficient comment area.

Free input AC voltage(100 to 240 V AC).

DC input: 16 (24 VDC).

Relay output: 14 (250 VA AC/2 A).

High-speed counter.

Multi-point PID control.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

Communication RS232 wire, to computer (PC).

⑧ TBMC12/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.



PLC-PI

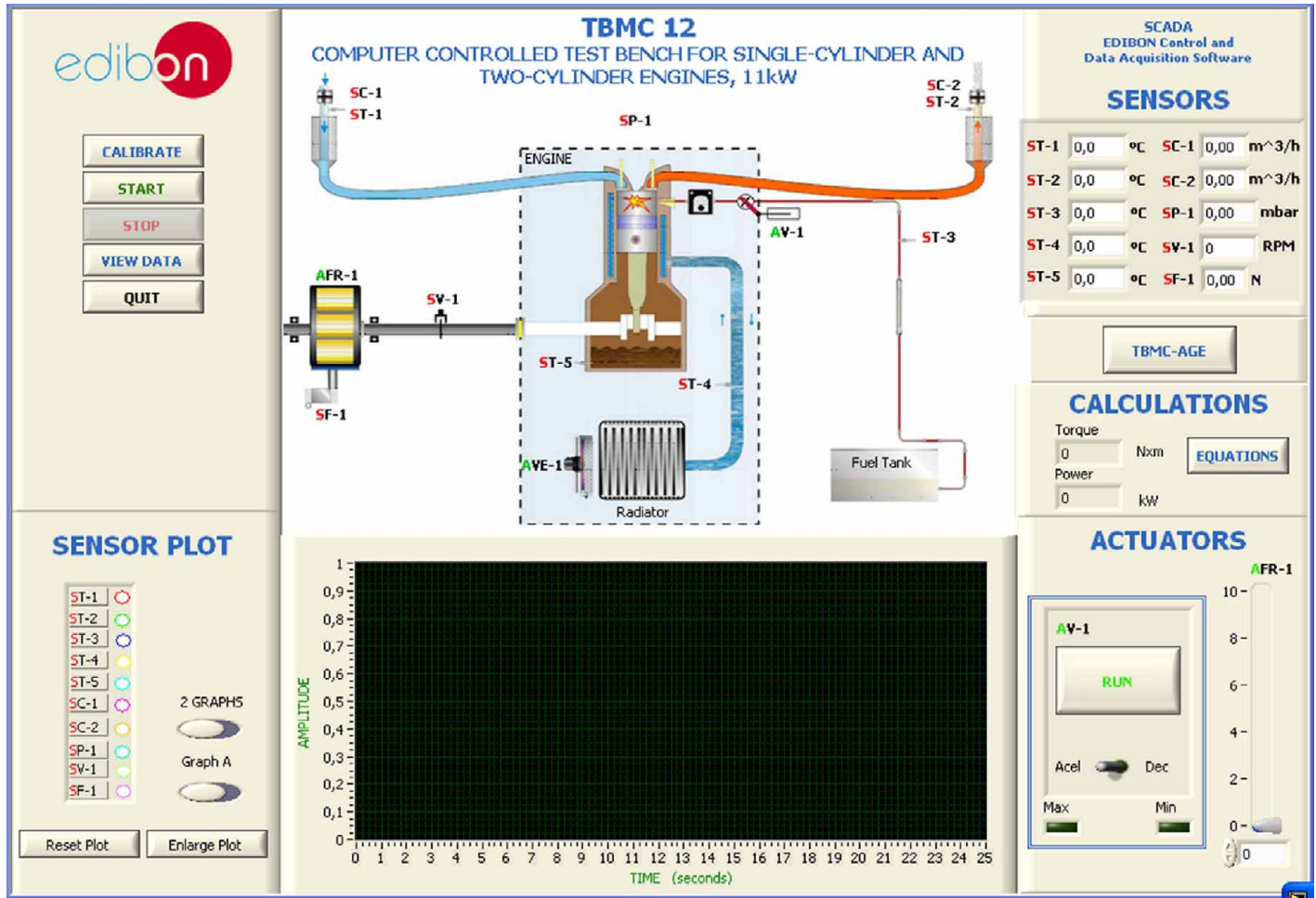
Items available on request

⑨ TBMC12/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

⑩ TBMC12/FSS. Faults Simulation System.

Software Main Screens

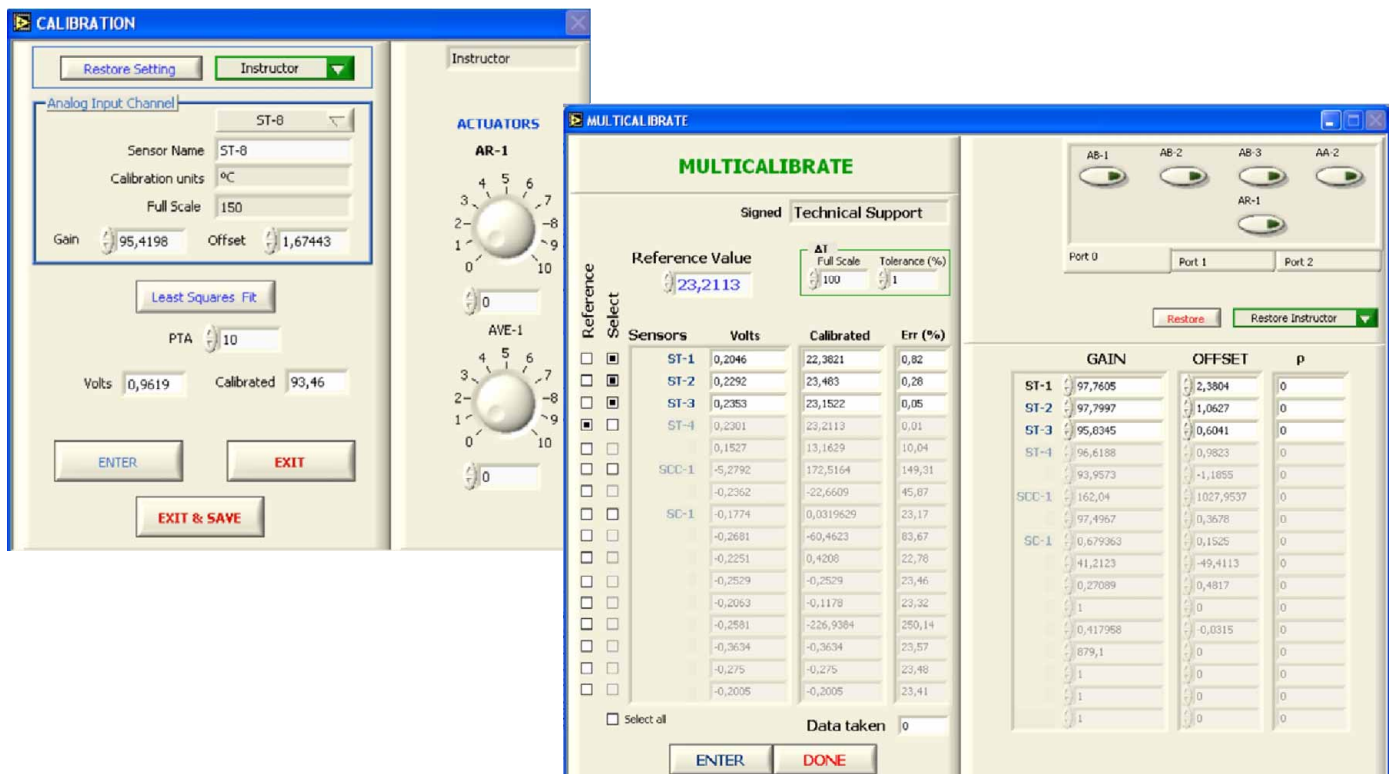
Main screen



Note: ST=Temperature sensor. SC=Flow sensor. SP=Pressure sensor. SV=Speed sensor. SF=Force sensor. AV=Fuel valve. AFR=Dynamometer brake.

* It also includes direct access to the TBMC-AGE Exhaust Gas Analyzer unit software.

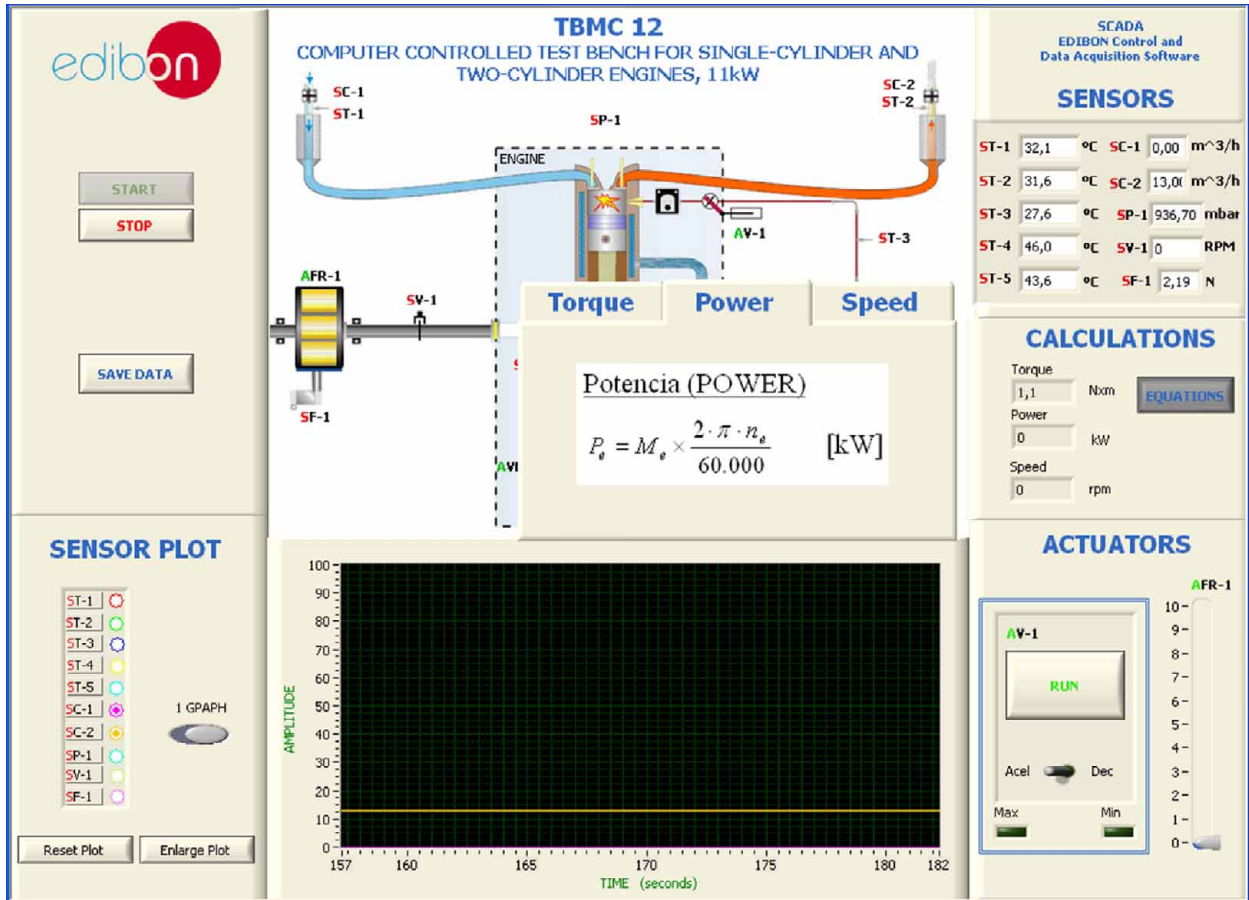
Examples of Sensors Calibration screens



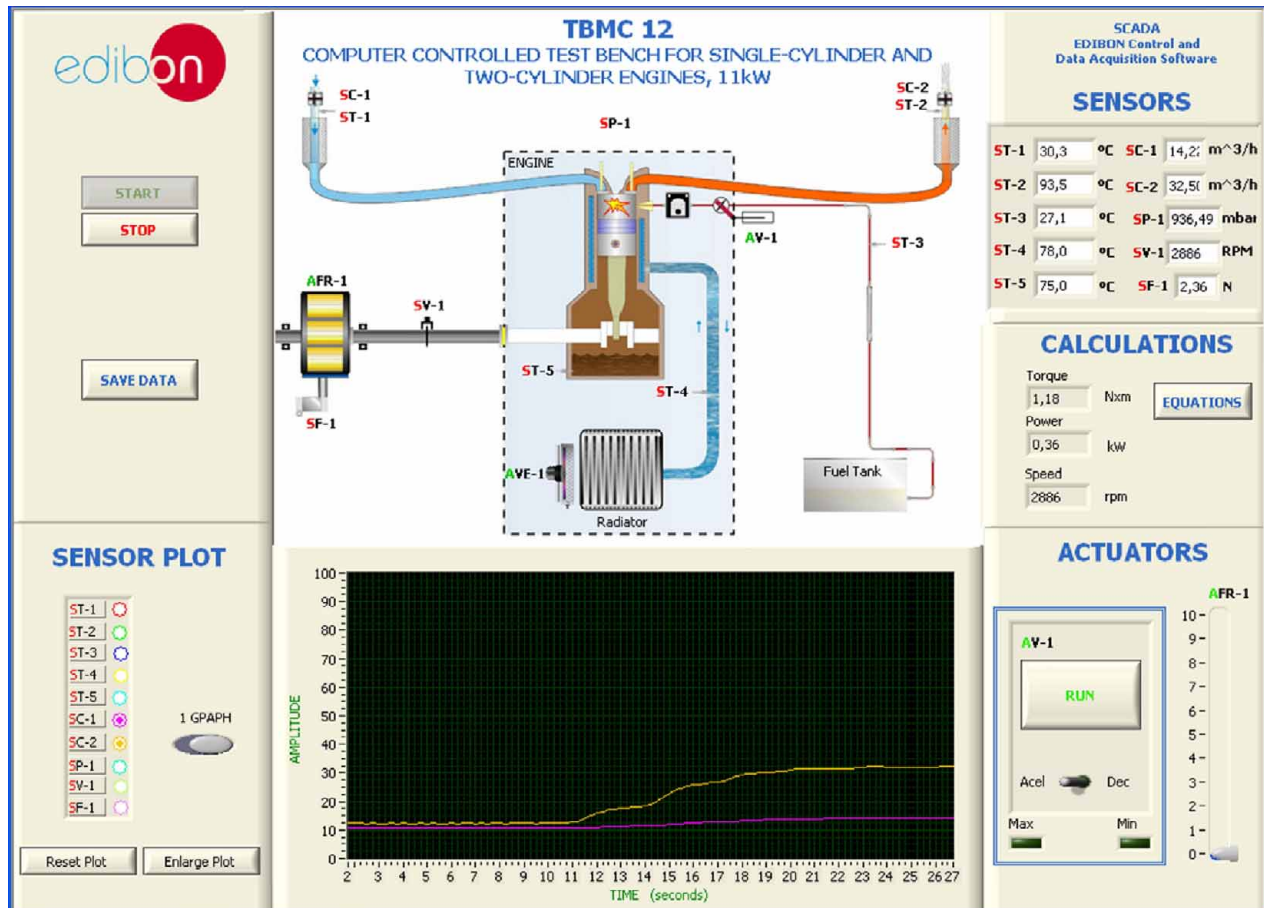
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Some typical exercises results

Window with the most representative formulas in the test of an internal combustion engine.



Real time graphs showing the selected sensors values variation facing changes in the engine. (Example: engine acceleration).

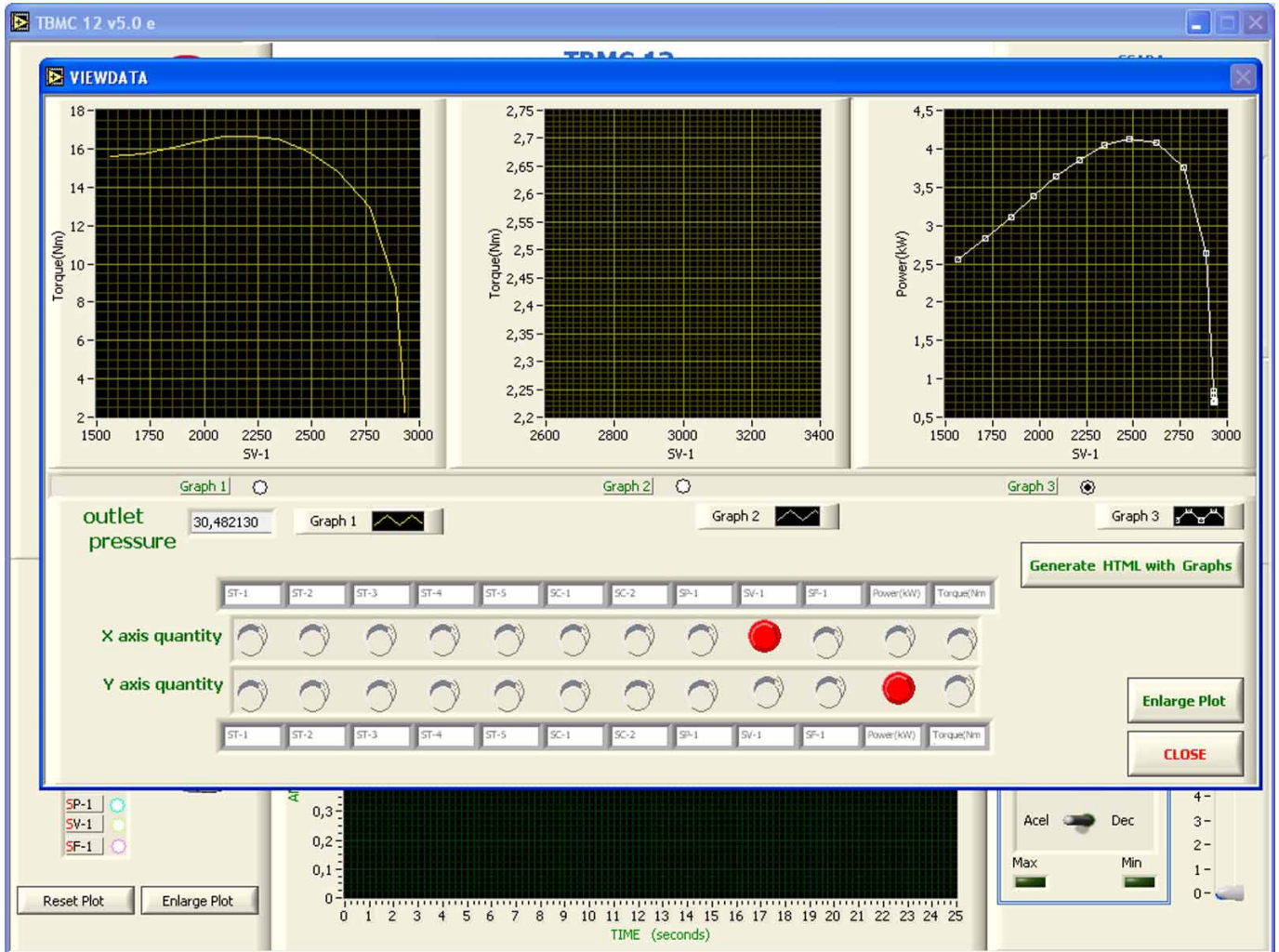


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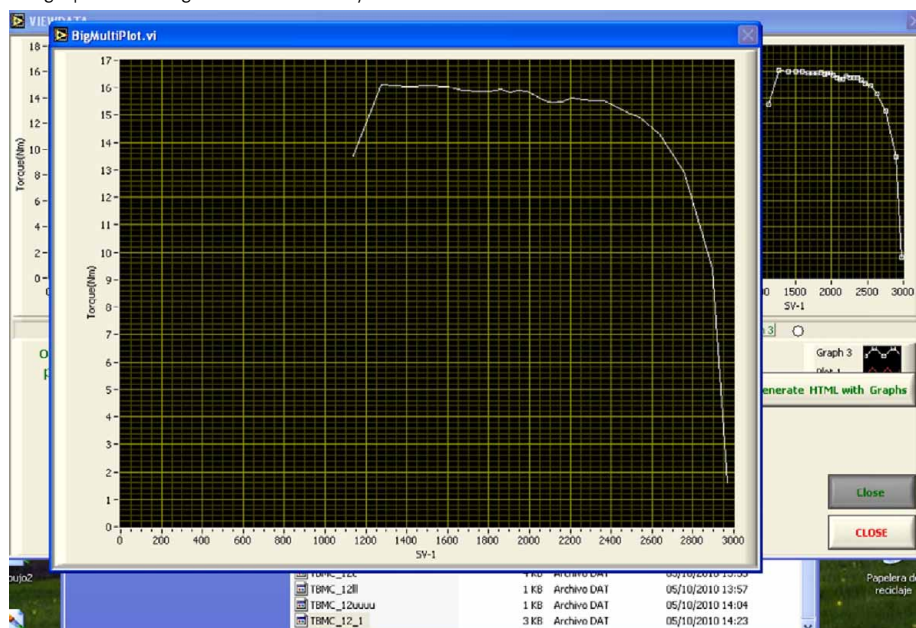
Some typical exercises results

Representation of an engine performance curves:

- On the left graph, the torque is represented facing the speed.
- On the right graph, the power is represented facing the speed.



The graphic is enlarged in order to study it in detail.



Some Practical Possibilities of the Unit:

- Other possible practices:

12.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

- 13.- Control of the TBMC12 unit process through the control interface box without the computer.
- 14.- Visualization of all the sensors values used in the TBMC12 unit process.
- 15.- Calibration of all sensors included in the TBMC12 unit process.
- 16.- Hand on of all the actuators involved in the TBMC12 unit process.
- 17.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

- 18.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 19.- PLC hardware general use and manipulation.
- 20.- PLC process application for TBMC12 unit.
- 21.- PLC structure.
- 22.- PLC inputs and outputs configuration.
- 23.- PLC configuration possibilities.
- 24.- PLC program languages.
- 25.- PLC different programming standard languages.
- 26.- New configuration and development of new process.
- 27.- Hand on an established process.
- 28.- To visualize and see the results and to make comparisons with the TBMC12 unit process.
- 29.- Possibility of creating new process in relation with the TBMC12 unit.
- 30.- PLC Programming Exercises.
- 31.- Own PLC applications in accordance with teacher and student requirements.

EXPANSION POTENTIAL

11 Mini ESN. Multipost EDIBON Mini Scada-Net System

Teaching Technique used

1 UNIT = 30 STUDENTS can work simultaneously

Test Bench for Single-Cylinder and Two-Cylinders Engines, 11 kW (TMC12)

Control Interface Box

Computer Control Software: Computer Control + Data Acquisition + Data Management

Teacher's Central Computer

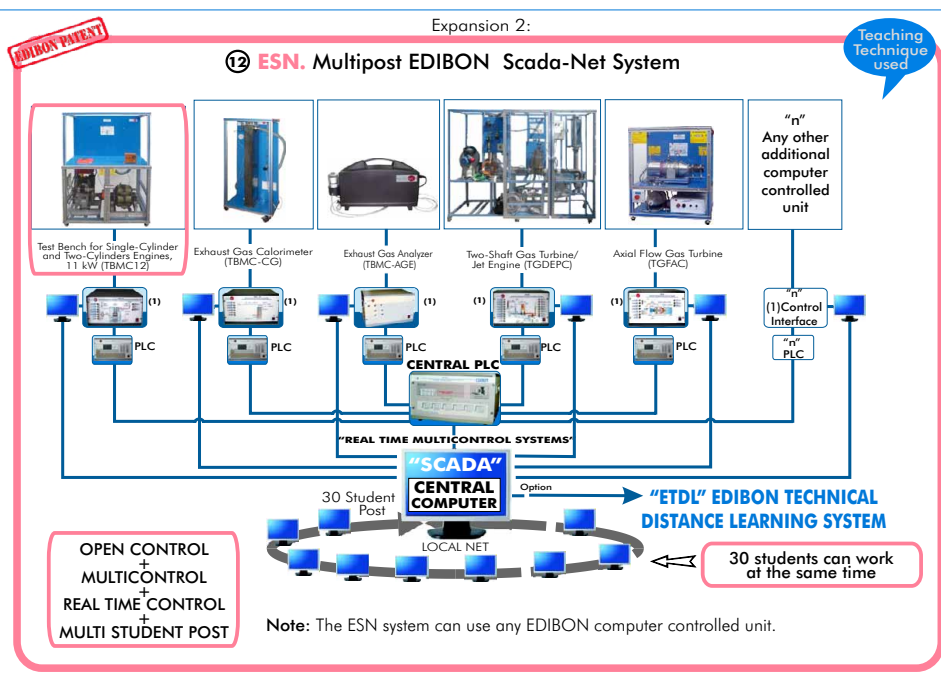
Mini Scada-Net Software

30 Student Post

LOCAL NET

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL + MULTI STUDENT POST

Note: The Mini ESN system can be used with any EDIBON computer controlled unit.



Items supplied as standard

Minimum configuration for normal operation includes:

- ① Unit: TBMC12. Test Bench for Single-Cylinder and Two-Cylinders Engines, 11 kW.
- ② TBMC12/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ TBMC12/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

* **IMPORTANT:** Under **TBMC12** we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

- ⑦ PCL-PI. PLC Module.
- ⑧ TBMC12/PLC-SOF. PLC Control Software.
- ⑨ TBMC12/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ TBMC12/FSS. Faults Simulation System. (Available on request).

Expansions

- ⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System.
⑫ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

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

DIMENSIONS & WEIGHTS

- | | |
|------------------------|--|
| TBMC12. Unit: | -Dimensions: 1100 x 900 x 1700 mm. approx. |
| | -Weight: 260 Kg. approx. |
| Control Interface Box: | -Dimensions: 490 x 330 x 310 mm. approx. |
| | -Weight: 10 Kg. approx. |
| PLC Module (PLC-PI): | -Dimensions: 490 x 330 x 310 mm. approx. |
| | -Weight: 30 Kg. approx. |

AVAILABLE TEST ENGINES AND ACCESSORIES

Test Combustion Engines:

- TM12-1. Water-cooled single-cylinder engine, with variable compression.
- TM12-2. Two-cylinders petrol engine.
- TM12-3. Two-cylinders diesel engine.

Other accessories:

- TBMC-CG. Computer Controlled Exhaust Gas Calorimeter.
- TBMC-AGE. Exhaust Gas Analyzer.

AVAILABLE VERSIONS

Offered in this catalogue:

- TBMC12. **Computer Controlled Test Bench for Single-Cylinder and Two-Cylinders Engines, 11 kW.**

Offered in other catalogues:

- TBMC3. **Computer Controlled Test Bench for Single-Cylinder Engines, 2.2 kW.**
- TBMC8. **Computer Controlled Test Bench for Single-Cylinder Engines, 7.5 kW.**
- TBMC75. **Computer Controlled Test Bench for Four-Cylinders Engines, 75 kW.**

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



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REPRESENTATIVE:

