Computer Controlled **Axial Flow Gas Turbine/ Jet Engine,** with SCADA

TGFAC

EDIBON PATENT

Teaching Technique used

EDIBON **SCADA** System

② Control Interface Box

③ Data Acquisition Board

④ Software for:
- Computer Control
- Data Acquisition
- Data Management

Computer
(not included in the supply)

⑤ Cables and Accessories

⑥ Manuals

* Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6
(Computer not included in the supply)

① Unit: TGFAC. Computer Controlled Axial Flow Gas Turbine/ Jet Engine

Key features:

➤ **Advanced Real-Time SCADA.**

➤ **Open Control + Multicontrol + Real-Time Control.**

➤ **Specialized EDIBON Control Software based on LabVIEW.**

➤ **National Instruments Data Acquisition board (250 KS/s, kilo samples per second).**

➤ **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**

➤ **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**

➤ **Capable of doing applied research, real industrial simulation, training courses, etc.**

➤ **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**

➤ **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**

➤ **Designed and manufactured under several quality standards.**

➤ **Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**

➤ **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL

POWERED BY **NATIONAL INSTRUMENTS** **LabVIEW™**

www.edibon.com
↳PRODUCTS
↳90.- THERMODYNAMICS & THERMOTECHNICS

For more information about Key Features, click here

INTRODUCTION

A jet engine is a type of engine that discharges a jet of fluid at high speed to generate a thrust in accordance with Newton's law, although the term generally refers to a gas turbine used to generate a jet of gas for propulsion purposes.

Reaction engines are used in planes for propulsion due to their reduced weight and high performance.

The Computer Controlled Axial Flow Gas Turbine/ Jet Engine, "TGFAC", designed by EDIBON is a teaching unit that demonstrates the operation of a gas turbine as reaction engine.

GENERAL DESCRIPTION

The main element of the "TGFAC" unit is the gas turbine, which consists of:

- <u>Axial compressor</u>, supplied by atmospheric air that will be compressed afterwards.
- <u>Annular combustion chamber</u>, where fuel is added to the compressed air and that mixture is burnt. The combustion gases increase their temperature and velocity.
- <u>Expansion axial turbine</u>. The obtained combustion gases flow to the axial turbine, where they transfer part of their energy to the vanes. Since the compressor and the turbine are coupled on the same shaft, when the system is self-sustained, part of the energy of the combustion gases is used to move the compressor. Both the turbine and the compressor are made up of discs with vanes that rotate (rotor) and stationary ones (stator). The difference is that the compressor transforms kinetic energy into pressure while the turbine performs the opposite work. The gas expands when being expelled, its temperature drops and is accelerated. It is expanded till environmental pressure at the outlet of the nozzle and reaches great speed, generating the thrust.
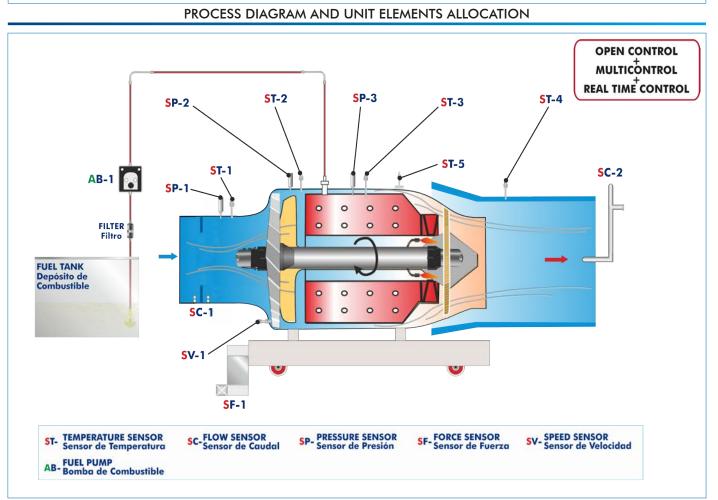
The gas turbine works as open cycle process, air is taken from the environment and expelled to the environment.

Besides, the unit includes a series of additional installations:

- <u>Starting system</u>: it is completely automatic; it is done with the aid of an electric starter motor that, coupled to the shaft of the compressor, generates the rotation of the shaft. There is a spark plug for the ignition.
- <u>Fuel supply system</u>: the fuel (kerosene/paraffin) passes through a filter and is supplied by a pump to the combustion chamber.
- <u>Lubrication of the turbine</u>: it is carried out with the oil mixed with the fuel (with a proportion of 5 % of special turbine oil).

The "TGFAC" unit includes the sensors required to measure all the important parameters of the process: pressure, temperature, air flow and fuel flow, speed and force (movable table with force sensor to measure thrust).

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

With this unit there are several options and possibilities:
 - Main items: 1, 2, 3, 4, 5 and 6.
 - Optional items: 7, 8, 9 and 10.
Let us describe first the main items (1 to 6):

① **TGFAC. Unit:**
Bench-top unit.
Anodized aluminum frame and panels made of painted steel.
Main metallic elements made of stainless steel.
Diagram in the front panel with distribution of the elements similar to the real one.
Axial flow gas turbine (reaction turbine) with a thrust of 180 N at 110000 rpm. It consists of:
  Axial compressor.
  Combustion chamber.
  Expansion axial turbine.
Computer controlled jet engine of the turbine with speed regulation. Quick response of the unit to speed changes.
Computer controlled starting system. It consists of:
  Electric motor.
  Spark plug for the ignition.
Computer controlled fuel supply system (kerosene with 5% approx. of jet oil, not included). It consists of:
  Fuel pump.
  Fuel tank of 5 l.
Intake gases manifold and exhaust gases pipe, 150 mm long, with sensors to measure flows, temperatures and pressures of the gases.

<u>Instrumentation</u>:
  Five K type temperature sensors located in different stages of the process to measure:
    Inlet air temperature.
    Inlet air temperature in the compressor.
    Fuselage temperature.
    Combustion chamber temperature.
    Exhaust gases temperature.
  Speed sensor to measure the speed (rpm) of the shaft of the turbine, range: 0 – 120000 rpm.
  Force sensor to measure the thrust of the turbine, range: 0 – 300 N.
  Three pressure sensors to measure:
    Pressure in the intake gases.
    Pressure in the compressor.
    Pressure in the combustion chamber.
  Three flow sensors to measure:
    Inlet air flow.
    Exhaust gases flow (Pitot with two pressure sensors).
    Fuel flow.
  <u>Local control of the turbine</u> through an electronic box installed in the unit, which includes:
    Switch to start and stop the turbine.
    Potentiometer to accelerate or decelerate the turbine.
    Display to show the speed of the turbine.
  The unit includes all the **required safety measures** for a safe operation:
    Transparent safety screens for a safe operation and observation of the practical exercises.
    Two emergency stop buttons:
      One located in the unit, which stops it immediately.
      A remote one, located close to the computer.
    An individual hearing protector.
The complete unit includes as well:
  Advanced Real-Time SCADA.
  Open Control + Multicontrol + Real-Time Control.
  Specialized EDIBON Control Software based on LabVIEW.
  National Instruments Data Acquisition board (250 KS/s, kilo samples per second).
  Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.
  Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.
  Capable of doing applied research, real industrial simulation, training courses, etc.
  Remote operation and control by the user and remote control for EDIBON technical support, are always included.
  Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).
  Designed and manufactured under several quality standards.
  Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.
  This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

Unit: TGFAC

Complete Technical Specifications (for main items)

② **TGFAC/CIB. Control Interface Box:**

The Control Interface Box is part of the SCADA system.

<u>Control interface box with process diagram in the front panel</u> 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.

Simultaneous 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 displayed on only one screen in the computer.

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, heating elements, control valves, etc.

Real time computer control for parameters involved in the process simultaneously.

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

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

TGFAC/CIB

③ **DAB. Data Acquisition Board:**

The Data Acquisition board is part of the SCADA system.

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

Analog input:

Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.

Sampling rate up to: <u>250 KS/s (kilo samples per second)</u>.

Input range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.

Analog output:

Number of **channels=2**. **Resolution=16 bits**, 1 in 65536.

Maximum output rate up to: 900 KS/s.

Output range(V)=±10 V. Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

Number of **channels=24 inputs/outputs**. D0 or DI Sample Clock frequency: 0 to 100 MHz.

Timing: Number of **Counter/timers=4**. Resolution: Counter/timers: 32 bits.

DAB

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

The three softwares are part of the SCADA system.

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 simultaneous 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 <u>250 KS/s (kilo samples per second)</u>.

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 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 to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

TGFAC/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.
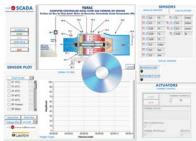
∗References 1 to 6 are the main items: TGFAC + TGFAC/CIB + DAB + TGFAC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

1.- Study of a gas turbine.

2.- Function and operation of a gas turbine as jet engine.

3.- Determination of fuel consumption.

4.- Determination of air and fuel ratio.

5.- Recording the relevant parameters of the turbine.

6.- Determination of the efficiency of the compressor.

7.- Determination of the turbine thrust.

8.- Determination of the efficiency of the gas turbine.

9.- Determination of the gas turbine characteristic curves.

10.-Determination of the compression ratio of the compressor at different thrust regimes.

11.-Determination of the gas turbine specific consumption.

12.-Study of the safety systems in the operation of a gas turbine.

Additional practical possibilities:

13.-Sensors calibration.

Other possibilities to be done with this Unit:

14.-Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

15.-Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

16.-The Computer Control System with SCADA allows a real industrial simulation.

17.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.

18.-This unit can be used for doing applied research.

19.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

20.-Control of the TGFAC unit process through the control interface box without the computer.

21.-Visualization of all the sensors values used in the TGFAC unit process.

- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

- Electrical supply: single-phase, 220 V/50 Hz or 110 V/60 Hz.
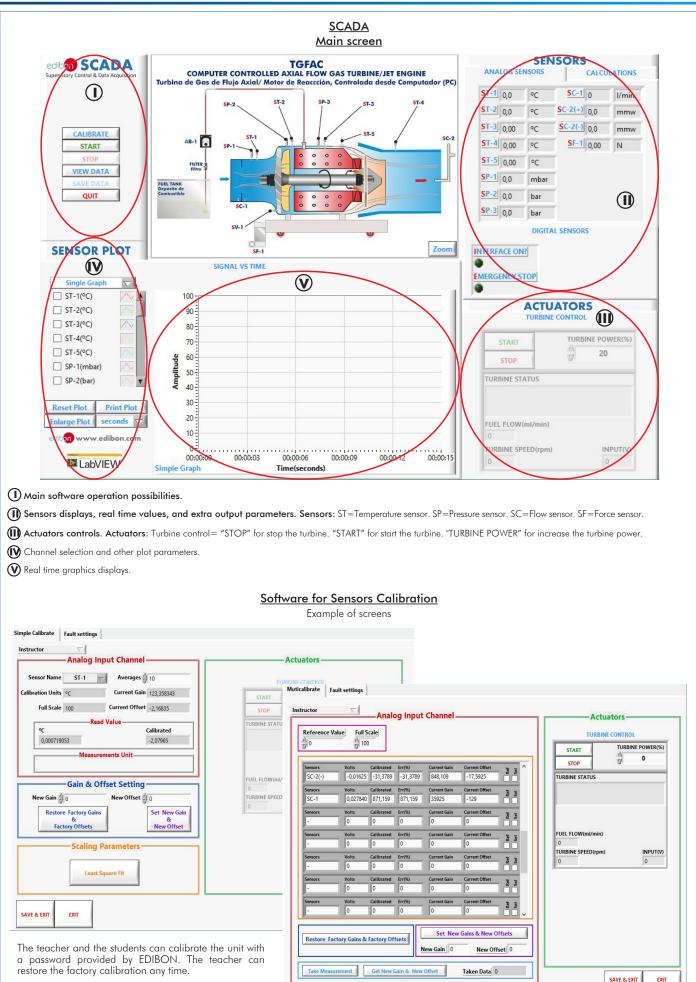- Exhaust gases extractor.
- Computer.

DIMENSIONS AND WEIGHTS

TGFAC:
Unit:
-Dimensions: 700 x 500 x 800 mm approx.
(27.55 x 19.68 x 31.49 inches approx.)
-Weight: 70 Kg approx.
(154.32 pounds approx.)
Control-Interface Box:
-Dimensions: 490 x 330 x 310 mm approx.
(19.29 x 12.99 x 12.2 inches approx.)
-Weight: 10 Kg approx.
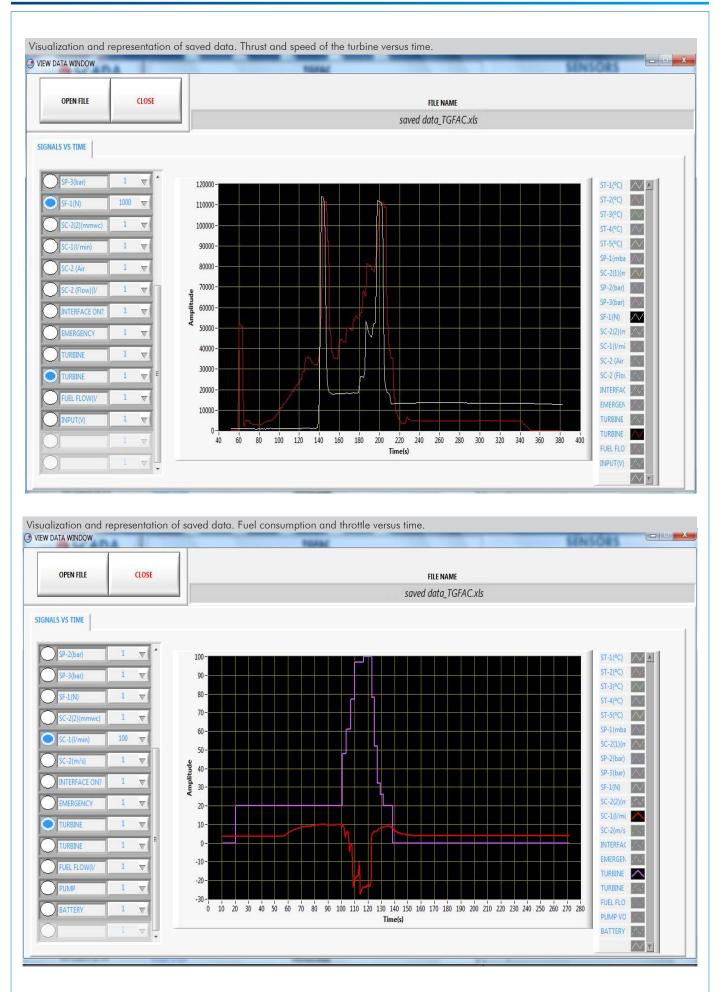(22 pounds approx.)

REQUIRED CONSUMABLES (Not included)

- Fuel: kerosene or paraffin.
- Jet type oil to mix at 5% with the fuel.

SCADA
Main screen

Ⓘ Main software operation possibilities.

Ⓘⓘ Sensors displays, real time values, and extra output parameters. **Sensors:** ST=Temperature sensor. SP=Pressure sensor. SC=Flow sensor. SF=Force sensor.

Ⓘⓘⓘ Actuators controls. **Actuators:** Turbine control= "STOP" for stop the turbine. "START" for start the turbine. "TURBINE POWER" for increase the turbine power.

Ⓘⓥ Channel selection and other plot parameters.

Ⓥ Real time graphics displays.

Software for Sensors Calibration
Example of screens

The teacher and the students can calibrate the unit with a password provided by EDIBON. The teacher can restore the factory calibration any time.

Visualization and representation of saved data. Thrust and speed of the turbine versus time.

Visualization and representation of saved data. Fuel consumption and throttle versus time.

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 10.

All these items try to give more possibilities for:

a) Technical and Vocational Education configuration. (ICAI and FSS)

b) Multipost Expansions options. (Mini ESN and ESN)

a) Technical and Vocational Education configuration

⑦ **TGFAC/ICAI. Interactive Computer Aided Instruction Software System.**

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

This software is optional and can be used additionally to items (1 to 6).

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

• User Data Base Management.

• Administration and assignment of Workgroup, Task and Training sessions.

• Creation and Integration of Practical Exercises and Multimedia Resources.

• Custom Design of Evaluation Methods.

• Creation and assignment of Formulas & Equations.

• Equation System Solver Engine.

• Updatable Contents.

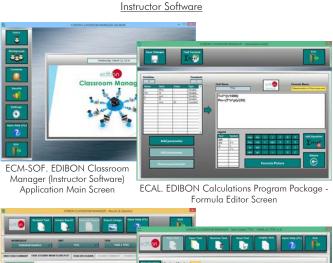• Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.
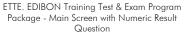
Innovative features:

• Student Log-In & Self-Registration.

• Existing Tasks checking & Monitoring.

• Default contents & scheduled tasks available to be used from the first session.

• Practical Exercises accomplishment by following the Manual provided by EDIBON.

• Evaluation Methods to prove your knowledge and progression.

• Test self-correction.

• Calculations computing and plotting.

• Equation System Solver Engine.

• User Monitoring Learning & Printable Reports.
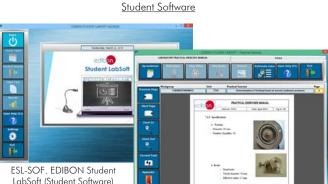
• Multimedia-Supported auxiliary resources.

For more information see **ICAI** catalogue. Click on the following link:

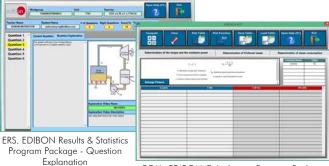www.edibon.com/en/files/expansion/ICAI/catalog

Instructor Software

ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen

ECAL. EDIBON Calculations Program Package - Formula Editor Screen

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Student Software

ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

⑨ TGFAC/**FSS. Faults Simulation System.**

Faults Simulation System (FSS) is a Software package that simulates **several faults** in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them. There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.

- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.

- Response reduction of an actuator.

Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.

- Reduction or increase of the calculated total response.

- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

Example of some screens

For more information see **FSS** catalogue. Click on the following link:

www.edibon.com/en/files/expansion/FSS/catalog

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b) Multipost Expansions options

⑩ **Mini ESN. EDIBON Mini Scada-Net System.**

Mini ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The Mini ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).
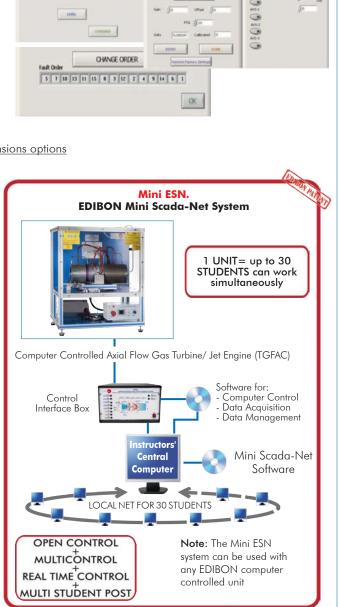
Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

Mini ESN.
EDIBON Mini Scada-Net System

1 UNIT= up to 30 STUDENTS can work simultaneously

Computer Controlled Axial Flow Gas Turbine/ Jet Engine (TGFAC)

Control Interface Box

Software for:
- Computer Control
- Data Acquisition
- Data Management

Instructors' Central Computer

Mini Scada-Net Software

LOCAL NET FOR 30 STUDENTS

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

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

For more information see **Mini ESN** catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/Mini-ESN.pdf

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⑪ **ESN. EDIBON Scada-Net System.**

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.

For more information see **ESN** catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/esn-thermodynamics/ESN-THERMODYNAMICS.pdf

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① Unit: TGFAC. Computer Controlled Axial Flow Gas Turbine/ Jet Engine.

② TGFAC/CIB. Control Interface Box.

③ DAB. Data Acquisition Board.

④ TGFAC/CCSOF. Computer Control + Data Acquisition + Data Management Software.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals.

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

Optional items (supplied under specific order)

a) Technical and Vocational Education configuration

⑦ TGFAC/ICAI. Interactive Computer Aided Instruction Software System.

⑧ TGFAC/FSS. Faults Simulation System.

b) Multipost Expansions options

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Analog input: Channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (kilo samples per second).
Analog output: Channels=2. Resolution=16 bits, 1 in 65536.
Digital Input/Output: Channels=24 inputs/outputs.

④ TGFAC/CCSOF. Computer Control +Data Acquisition+Data Management Software:
The three softwares are part of the SCADA system.
Compatible with the industry standards.
Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
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It allows the registration of the alarms state and the graphic representation in real time.
Open software, allowing 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 to different work levels.
This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

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.

Exercises and Practical Possibilities to be done with the Main Items

1.- Study of a gas turbine.

2.- Function and operation of a gas turbine as jet engine.

3.- Determination of fuel consumption.

4.- Determination of air and fuel ratio.

5.- Recording the relevant parameters of the turbine.

6.- Determination of the efficiency of the compressor.

7.- Determination of the turbine thrust.

8.- Determination of the efficiency of the gas turbine.

9.- Determination of the gas turbine characteristic curves.

10.-Determination of the compression ratio of the compressor at different thrust regimes.

11.-Determination of the gas turbine specific consumption.

12.-Study of the safety systems in the operation of a gas turbine.

Additional practical possibilities:

13.-Sensors calibration.

Other possibilities to be done with this Unit:

14.-Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

15.-Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

16.-The Computer Control System with SCADA allows a real industrial simulation.

17.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.

18.-This unit can be used for doing applied research.

19.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

20.-Control of the TGFAC unit process through the control interface box without the computer.

21.-Visualization of all the sensors values used in the TGFAC unit process.

- Several other exercises can be done and designed by the user.

⑦ TGFAC/ICAI. Interactive Computer Aided Instruction Software System.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

• User Data Base Management.

• Administration and assignment of Workgroup, Task and Training sessions.

• Creation and Integration of Practical Exercises and Multimedia Resources.

• Custom Design of Evaluation Methods.

• Creation and assignment of Formulas & Equations.

• Equation System Solver Engine.

• Updatable Contents.

• Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

• Student Log-In & Self-Registration.

• Existing Tasks checking & Monitoring.

• Default contents & scheduled tasks available to be used from the first session.

• Practical Exercises accomplishment by following the Manual provided by EDIBON.

• Evaluation Methods to prove your knowledge and progression.

• Test self-correction.

• Calculations computing and plotting.

• Equation System Solver Engine.

• User Monitoring Learning & Printable Reports.

• Multimedia-Supported auxiliary resources.

⑧ TGFAC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:
- An incorrect calibration is applied to them.
- Non-linearity.

Faults affecting the actuators:
- Actuators channels interchange at any time during the program execution.
- Response reduction of an actuator.

Faults in the controls execution:
- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

On/off faults:
- Several on/off faults can be included.

⑨ Mini ESN. EDIBON Mini Scada-Net System.

EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

The Mini ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

The system basically will consist of:

This system is used with a Computer Controlled Unit.

- Instructor's computer.

- Students' computers.

- Local Network.

- Unit-Control Interface adaptation.

- Unit Software adaptation.

- Webcam.

- Mini ESN Software to control the whole system.

- Cables and accessories required for a normal operation.

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

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