edibon

Engineering and Technical Teaching Equipment

EDIBON PATENT

Teaching Technique used

EDIBON **SCADA** System

②

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

③ Cables and Accessories
④ Manuals

Computer
(not included in the supply)

① Unit: AEL-SVC. Voltage Control with SVCs in Transmission Systems Application, with SCADA

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

Key features:

➤ **Advanced Real-Time SCADA.**

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

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

➤ **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
➜ 4.- ELECTRICITY

For more information about Key Features, click here

PDF Adobe   You Tube

INTRODUCTION

Nowadays Static Var Compensators SVCs play an important role in transmission systems. The purpose of this power electronic devices is to solve voltage regulation and system dynamic performance deficiencies. The "SVC" is a type of "Flexible AC Transmission System" (FACTs) and it consists of a thyristor based controller which allows rapid voltage control to support electric power transmission voltages during immediately after major disturbances.

GENERAL DESCRIPTION

The Voltage Control with SVCs in Transmission Systems Application, with SCADA, "AEL-SVC", has been designed to study the most important applications based on thyristor controlled reactor (TCR) and thyristor switched capacitor (TSC). The goal of this application is to demonstrate the actual SVC topologies used in power systems and the advantages of the utilization of this cutting-edge technology. SVCs are part of Smart Grids and it is unthinkable an actual grid without the SVCs to control the reactive power flows and voltage levels in transmission systems.

The "AEL-SVC" application provides different modules in order to the students and teachers configure their own Flexible AC Transmission System. This application allows various levels of training and research for beginners and advanced researchers who want to start from scratch or improve their knowledge in this field.

Additionally, it is recommended a series of modules for a better understanding of the importance of SVCs in transmission systems. The "AEL-SVC" application offers the possibility of the integration of a real synchronous generator to study the influence of sudden reactive energy changes (droop voltage) and how the SVCs solve this problem compensating the power factor and avoiding significant droops voltage in the synchronous machine.

On the other hand, it is recommended too to acquire the Control and Data Acquisition System Software for Electrical Machines, ''EM-SCADA'', for the fulfillment of SVCs advanced tests. This advanced software allows monitoring the waveforms for currents and voltages to study in depth these signals.

The "SVC-UB" is the base unit of the "AEL-SVC" application.

The "SVC-UB" includes the following elements:

- N-ALI01. Industrial Main Power Supply.
- N-AE1. Transmission Lines Simulation Module.
- N-EALD. Network Analyzer Unit with Data Acquisition (2 units).
- N-REL09. Time Electronic Relay against Overcurrents (1.2 - 7 A).
- N-PSM. Power Switch Module.
- N-REFT/3C. 3 x 300 W Three-Phase Configurable Resistors Module.
- N-INDT/3C. 3 x 300 VAr Three-Phase Configurable Inductances Module.
- N-CAR19T/3C. 3 x 300 VAr Three-Phase Configurable Capacitors Module.
- N-TRANS09. Three- phase Isolating Transformer, 400/400 VAC, 1 kVA, Module.

Required element/s to operate with "SVC-UB" unit:

- AEL-PC. Touch Screen and Computer.

At least one of these kits is required to operate with "SVC-UB" unit:

- SVC-K1. TCR Thyristor Reactor Controller Kit.
  - N-TCR01. TCR Thyristor Reactor Controller Module.
  - N-INDT. Three-phase Commutable Inductive Load.
- SVC-K2. TSC Thyristor Switch Capacitor Kit.
  - N-TSC01. TSC Thyristor Switch Capacitor Module.
  - N-CONT. Three-phase Commutable Capacitive Load.

Recommended kit:

- SVC-K3. Dynamic Load Kit 1.
  - EMT7/1K. 1kW/1P Asynchronous Three-Phase Motor of Squirrel Cage.
  - FRENP. Magnetic Powder Brake.
  - N-DLC01. Dynamic Load Controller 1.

Recommended elements to increase the functionality of the "SVC-UB" unit:

- EM-SCADA. Control and Data Acquisition System Software for Electrical Machines with SCADA.

  (http://www.edibon.com/en/files/equipment/EM-SCADA/catalog)

- AEL-TI-07. Power Transmission Application with Synchronous Generator.

  (http://www.edibon.com/es/files/equipment/AEL-TI-07/catalog)

- N-PPIM1. Instrumentation Module 1.

  (http://www.edibon.com/es/files/equipment/AEL-TI-07/catalog)

The application AEL-SVC can be mounted on rack (option A) or on rail (option B):

Option A:

This application needs the following racks:

- N-RACK-A.

Optionally the AEL-WBR. Electrical Workbench (Rack) can be supplied to place the rack/s.
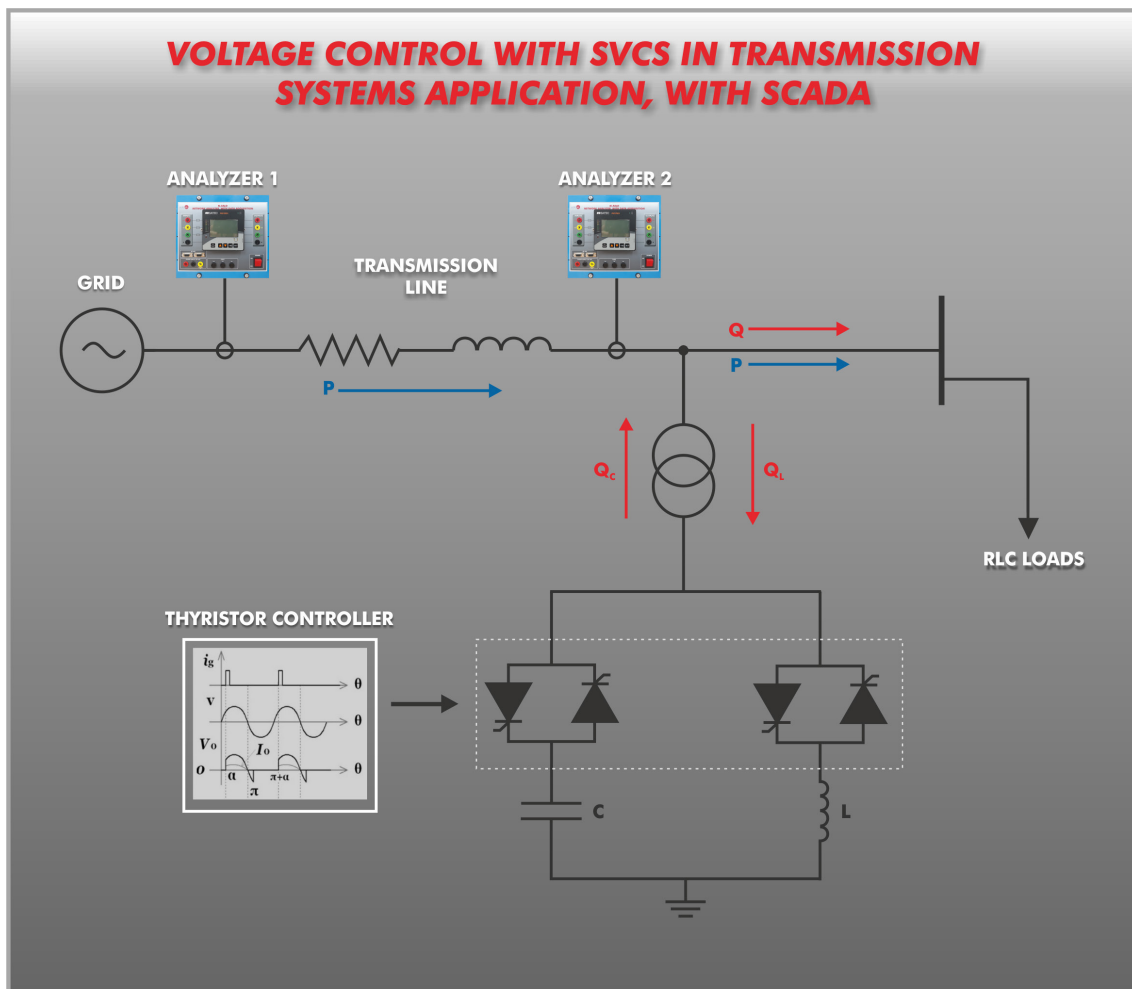
Option B:

This application can be mounted on rail.

Optionally the AEL-WBC. Electrical Workbench (Rail) can be supplied to mount the modules.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + 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

VOLTAGE CONTROL WITH SVCS IN TRANSMISSION SYSTEMS APPLICATION, WITH SCADA

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

① **AEL-SVC Application.**

  • **N-ALI01. Industrial Main Power Supply.**
      Supply voltage: 400 VAC, 3PH+N+G.
      ON-OFF removable key.
      Output voltage connections:
          Three-Phase + Neutral: 400 VAC.
          Single-Phase: 230 VAC.
      Three-Phase supply hose with IP44 3PN+E 32A 400 V connecting plug.
      Differential magnetothermal, 4 poles, 25 A, 30 mA AC 6 KA.
      Emergency stop push button.
      GND terminal.

N-ALI01

  • **N-AE1. Transmission Lines Simulation Module.**
      Supply voltage: 400 VAC, 3PH+N.
      Three-phase line with variable parameters.
      Concentrated parameters line.
      Four capacitances benches between lines with three capacitances of 1 μF each one.
      Two capacitances benches between line and ground composed by two capacitances of 1 and 2 μF.
      Resistance of the line that can be wiring independently:
          Three resistors of 15 Ω.
          Three resistors of 30 Ω.
          Inductance of the line with several set values: 33 mH, 78 mH, 140 mH, 193 mH and 236 mH.
          Neutral resistor of 10 Ω.

N-AE1

  • **N-EALD. Network Analyzer Unit with Data Acquisition (2 units).**
      The network analyzer module allows fulfilling measurements, displaying and analyzing all the parameters of the AC electrical networks. It has an LCD screen and push-buttons for the navigation through the different menus. It includes specific software for monitoring current and voltage curves, harmonics display, tariffs programming, alarms programming and electrical parameters storage.
      Features:
          Multifunctional three-phase power meter:
              Single and three-phase voltage. Up to 690 VAC L-L.
              Phase and line current. Current range up to 200%. Measurement from 0-10 A.
              Active, reactive and apparent power.
              Suitable frequencies: 25 Hz, 50 Hz, 60 Hz y 400 Hz.
              Display of the V-I vector diagram.
              Supply voltage: 85-265 VAC.
          Energy quality control:
              Current and voltage individual harmonics measurement. Up to the 40th harmonic.
              THD voltage and current, TDD and K-factor.
              Maximums and minimums display.
              Waveforms display, 128 samples/sec.
          Events and data storage.
          Harmonics analyzer:
              THD voltage and current, TDD current and K-factor, up to the 40th harmonic.
              Current and voltage harmonic spectrum and angles.
          Tariff programming:
              Class 0.5S IEC 62053-22, active and reactive power in four quadrants.
              Measurement of the total and per phase three-phase active, reactive and apparent powers.
              Usage time, 4 energy/demand records of total tariffs.
              8 tariffs, 4 seasons, 4 types of days.
              Automatic daily report of energy consumption maximums and minimums.
          Communications:
              Modbus TCP communication protocol with Ethernet interface.

N-EALD

- **N-REL09. Time Electronic Relay against Overcurrents (1.2 - 7 A).**
    Electronic thermal relay.
    Overload protection.
    Range 1.2 - 7 A.
    Reset and test function.
    One NONC contact.
    Temporization.

N-REL09

- **N-PSM. Power Switch Module.**
    Supply voltage: single-phase 230 VAC.
    Power terminals:
        Four power input terminals (3PH+N).
        Four power output terminals (3PH+N).
    Auxiliary contacts:
        One "NO" contact.
        One "NC" contact.
    Two push-buttons to open / close the power terminals and auxiliary contacts.
    Two control contacts of 24 VDC.
    Two voltage supply outputs of 24 VDC.

N-PSM

- **N-REFT/3C. 3 x 300 W Three-Phase Configurable Resistors Module.**
    Configurable Star and Delta connections.
    Three banks with three three-phase resistors of 1600 Ω.
    Nominal voltage: 400 VAC.
    Nominal power: 3x (3 x 300) W.

N-REFT/3C

- **N-INDT/3C. 3 x 300 VAr Three-Phase Configurable Capacitors Module.**
    Configurable Star and Delta connection.
    Three benches with three-phase inductances of 5 H each one.
    Nominal voltage: 400 VAC.
    Nominal power: 3 x (3x300) VAr.

N-INDT/3C

- **N-CAR19T/3C. 3 x 300 VAr Three-Phase Configurable Inductances Module.**
    Configurable Star and Delta connection.
    Three benches with three-phase capacitors of 2 μF each one.
    Nominal voltage: 400 VAC.
    Nominal power: 3 x (3 x 300) Var.

N-CAR19T/3C

- **N-TRANS09. Three- phase Isolating Transformer, 400/400 VAC, 1 kVA, Module.**
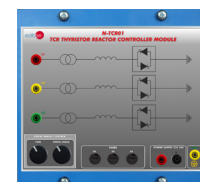   Nominal power: 1kVA.
    Primary Winding Voltage: 3x 400 VAC Δ.
    Secondary Winding Voltage: 3x 400 VAC Y.
    Adjustable overcurrent protection: 1.6-2.5 A.
    GND terminal.

N-TRANS09

- **N-TCR01. TCR Thyristor Reactor Controller Module.**
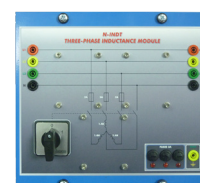   Supply voltage: 230 VAC.
    Nominal power: 1 kVA.
    Rated current: 1.44 A.
    Thyristor bridge firing angle control.

N-TCR01

- **N-INDT. Three-phase Commutable Inductive Load.**
    Nominal voltage: 400 VAC.
    Inductance: 1.4 H.
    Nominal Current: 1.6 A.
    Manual switch to turn on / off inductances.
    Fuses: 3x 2 A.
    Terminals:
        Four Input Terminals (3PH+N).
        Four Output Terminals (3PH+N).
    GND terminal.

N-INDT

- AEL-PC. **Touch Screen and Computer.**

    Touch Screen:

        Energy efficiency class: A.

        Screen diagonal: 68.6 cm (27 inch (s)).

        Power consumption (operating): 26 watts.

        Annual energy consumption: 38 kWh.

        Power consumption (standby / off) 0.49 watts.

   Screen resolution: 1920 x 1080 pixels.

    Computer:

        Processor Number: Intel Core i7-6600U Processor (4M Cache, up to 3,40 GHz).

        Cache: 4 MB Intel Smart Cache.

        Clock speed: 2.6 GHz.

        # Of Cores/# of Threads: 2/4.

        Max. TDP/Power: 15 W.

        Memory Types: DDR4-2133, LPDDDR3-1866, DDR3L-1600.

        Graphics: Intel HD Graphics 530.

        Slot for PCI Express.

AEL-PC

- N-TSC01. **TSC Thyristor Switch Capacitor Module.**

    Supply voltage: 230 VAC.

    Nominal power: 1 kVA.

    Rated current: 1,44 A.

    Thyristor bridge firing angle control.
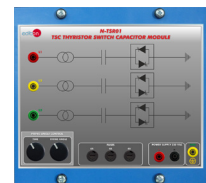
N-TSC01

- N-CONT. **Three-phase Commutable Capacitive Load.**

    Nominal voltage: 400 VAC.

    Capacitance: 3x 7 μF.

    Manual switch to turn on / off capacitors.

    Fuses: 3x 4 A.

    Terminals:

        Four Input Terminals (3PH+N).

        Four Output Terminals (3PH+N).

    GND terminal.

N-CONT

- EMT7/1K. **1 kW/1P Asynchronous Three-Phase Motor of Squirrel Cage.**

    Nominal power: 1100 W.

    Nominal voltage: 3 x 230/400 VAC Δ/Y.

    Frequency: 50/60 Hz

    Number of poles: 2.

    Speed: 2730 rpm.

    Nominal current: 2.52 / 1.45 A.
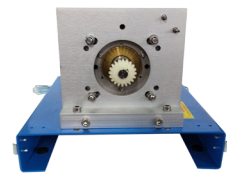

EMT7/1K

• FRENP. **Magnetic Powder Brake.**

    Nominal Torque: 5 Nm.

    Maximum Power Dissipation: 100 W.

    Maximum output current adjustment.

    Operating modes "freewheel " and "blocking".

    Nominal voltage: 24 VAC/VDC.

    Maximum Output Current: 2 A.

    Output Load (Resistor): 4 to 20 Ohms.

    Maximum power consumed: 70 W.

    Remote voltage control: 0 to 10 VDC.

    Weight: 4 Kg.

FRENP

• N-DLC01. **Dynamic Load Controller 1.**

    Supply voltage: 230 VAC.

    LCD Display.

    Setting of maximum, minimum and valley braking signal times to simulate real daily energy consumption.

    Manual and automatic braking torque.

    GND terminal.

N-DLC01

• **All necessary cables to realize the practical exercises are included.**

The complete unit includes as well:

    Advanced Real-Time SCADA.

    Open Control + Multicontrol + Real-Time Control.

    Specialized EDIBON Control Software based on LabVIEW.

    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.

② **AEL-SVC/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.
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.

AEL-SVC/CCSOF

③ **Cables and Accessories**, for normal operation.

④ **Manuals:**

This unit **is supplied with 7 manuals**: Required Services, Assembly and Installation, Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

∗References 1 to 4 are the main items: AEL-SVC + AEL-SVC/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

Some practical exercises possibilities with the base unit SVC-UB and SVC-K1:

1.- Manual reactive power control with manual commutable inductances and capacitors loads.

2.- Automatic reactive power compensation with the thyristor reactor controller module (TCR).

3.- Manual reactive power compensation with the thyristor reactor controller module, varying the firing "alfa".

4.- Comparison of the behavioral dynamics of the transmission system with the manual reactive power control and the automatic reactive power control with thyristors (TCR).

5.- Visualization of the grid parameters with the influence of the manual reactive power control.

6.- Visualization of the grid parameters with the influence of the automatic reactive control with the thyristors reactor module (TCR).

7.- Manual control of the thyristor firing angle in the TCR and visualization of the grid reactive power response.

8.- Visualization of the voltages nodes in the transmission line and droop voltages compensation against sudden load changes.

Some practical exercises possibilities with the base unit SVC-UB and SVC-K2:

9.- Automatic reactive and active power compensation with the thyristor reactor controller module (TCR) and thyristor capacitor switch controller module (TCS).

10.- Manual reactive power compensation with the thyristor reactor controller module and the thyristor capacitor switch controller module, varying the firing "alfa".

11.- Comparison of the behavioral dynamics of the transmission system with the manual reactive power control and the automatic reactive power control with both thyristors reactor and capacitor controllers (TCR and TSC).

12.- Visualization of the grid parameters with the influence of the manual reactive and active power control.

13.- Visualization of the grid parameters with the influence of the automatic power factor control with the thyristors reactor and capacitor modules (TCR and TSC).

14.- Manual control of the thyristor firing angle in the TCR and TSC, and visualization of the grid power factor response.

15.- Visualization of the voltages nodes in the transmission line and droop voltages compensation against sudden load changes.

Some practical exercises with Control and Data Acquisition System Software for Electrical Machines EM-SCADA:

16.- Optimum firing angle determination for each load condition.

17.- Visualization and comparison of the reactive power compensation waves working with both TCR and TSC

18.- Visualization of the voltage and current gaps according to the thyristors firing angle.

19.- Thyristors firing angle identification with the high speed data acquisition system.

Other possibilities to be done with this unit:

20.- Many students view results simultaneously.
    To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

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

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

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

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

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

REQUIRED SERVICES

- Electrical supply: three phase, 380 VAC- 400 VAC/50 Hz o 190 VAC-240/60 Hz, 3 kW.
- Computer (PC).

DIMENSIONS AND WEIGHTS

AEL-SVC:
- Dimensions: 2000 x 400 x 2000 mm approx.
    (78.74 x 15.75 x 78.74 inches approx.)
- Weight: 85 Kg approx.
    (187 pounds approx.)

ADDITIONAL APPLICATION (Not Included)

- AEL-TI-07. Power Transmission Application with Synchronous Generator.

AVAILABLE VERSIONS

Offered in this catalogue:
- AEL-SVC. Voltage Control with SVCs in Transmission Systems Application, with SCADA.

Offered in other catalogue:
- AEL-MPSS-01. Complete Smart Grid Power Systems, with Automatic Control Generation, Transmission Line, Loads and Protection Relays, with SCADA.
- AEL-CPSS-01S. Smart Grid Power Systems Application, with Automatic Control generation, Transmission Line and Loads, with SCADA.
- APS12. Advanced Mechanical, Electrical and Smart Grid Power Systems (Utilities).
- AEL-MEPD-01. Modular Marine Electrical Power Distribution Application, with SCADA.

SOME **REAL** RESULTS OBTAINED FROM THIS UNIT

Waveform plot of the real time currents and voltages measured by the analyzer, showing the angular, maximum, minimum and RMS values, and the phasors corresponding to such electrical parameters.
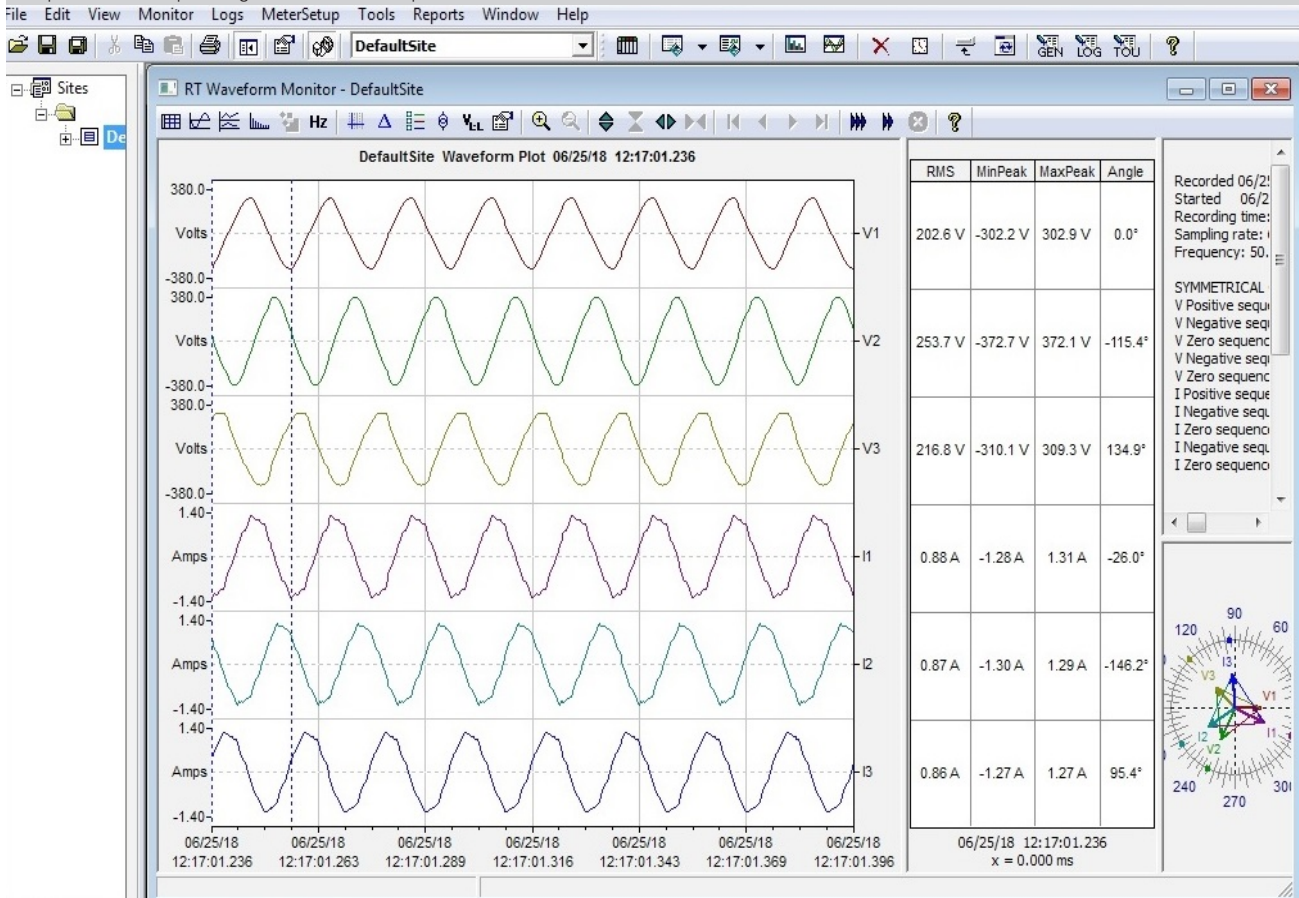
Representation of the torque-speed curve for the Three-Phase Asynchronous Squirrel Cage Motor. Notice that the motor nominal speed and the maximum torque can be appreciated.
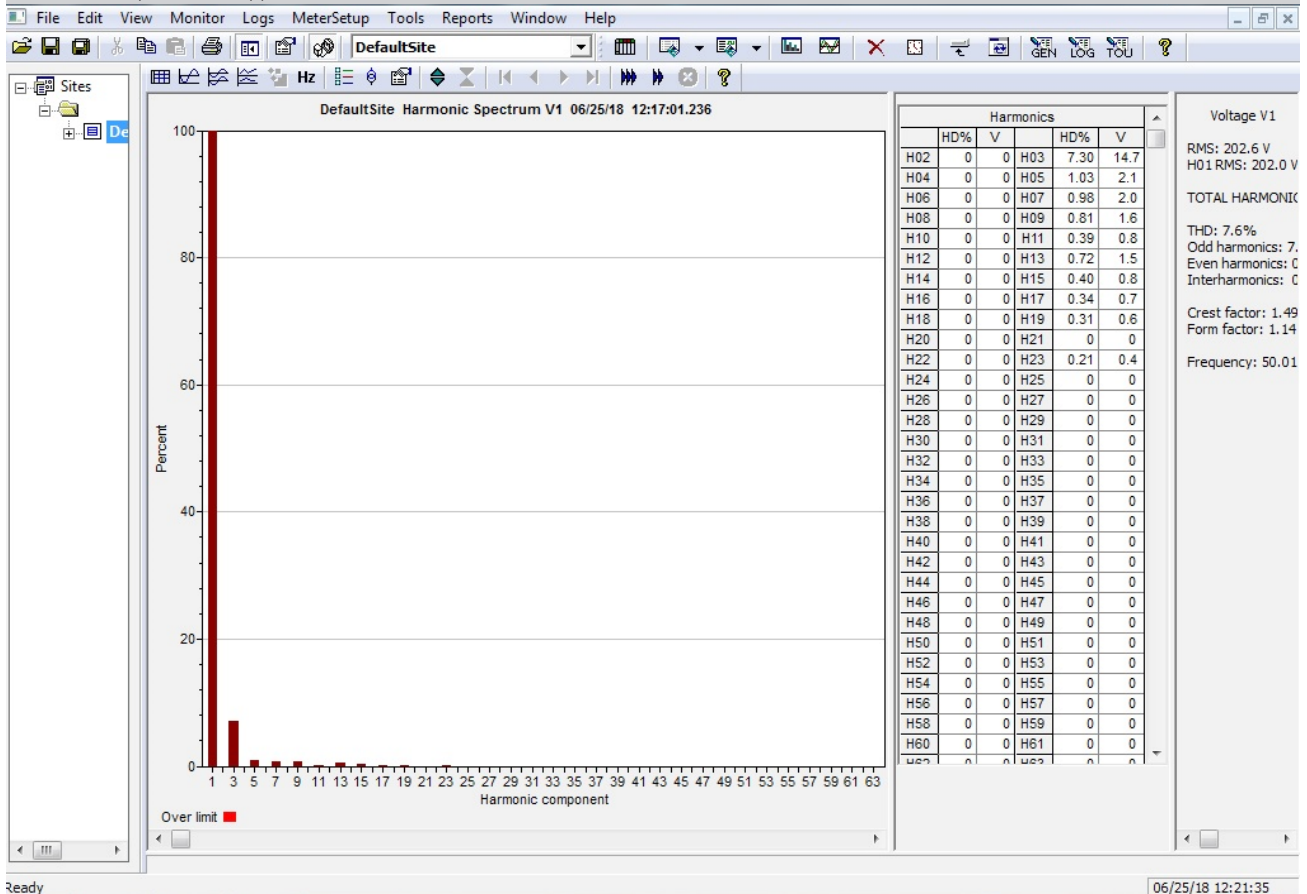
Additionally to the main items (1 to 4) described, we can offer, as optional, other items from 5 to 7.

All these items try to give more possibilities for:

    a) Technical and Vocational Education configuration. (ICAI)

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

<u>a) Technical and Vocational Education configuration</u>

⑤ **AEL-SVC/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 4).

Instructor Software

- 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.

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

ECAL. EDIBON Calculations Program Package - Formula Editor Screen

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.**

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

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

- 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.
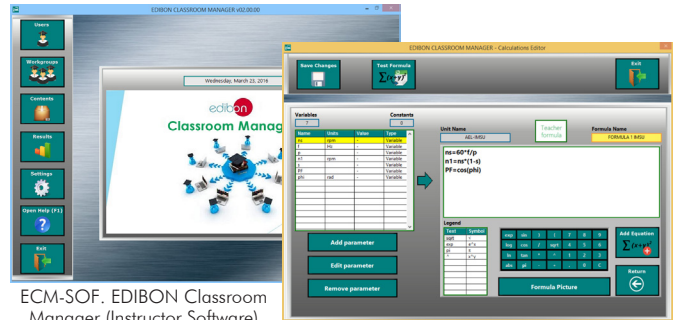
Student Software

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

EPE. EDIBON Practical Exercise Program Package Main Screen

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.**

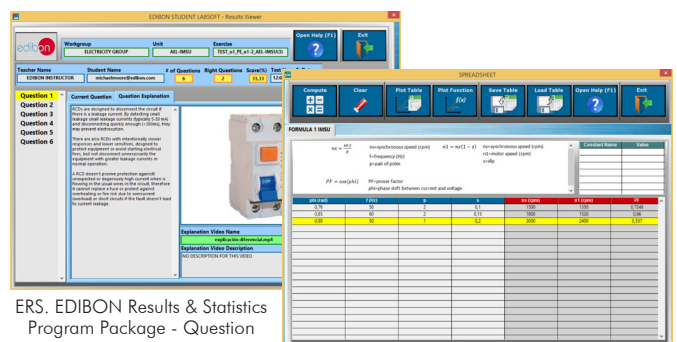• **Multimedia-Supported auxiliary resources.**

ERS. EDIBON Results & Statistics Program Package - Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

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

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

<u>b) Multipost Expansions options</u>

⑥ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**

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).

<u>Main characteristics:</u>

- 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.

<u>Main advantages:</u>

- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

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

www.edibon.com/en/files/expansion/MINI-ESN/catalog

MINI ESN.
EDIBON Mini Scada-Net System

1 UNIT= up to 30 STUDENTS can work simultaneously

Voltage Control with SVCs in Transmission Systems Application, with SCADA (AEL-SVC)

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

⑦ **ESN. EDIBON Scada-Net Systems.**

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/en/files/expansion/ESN/catalog
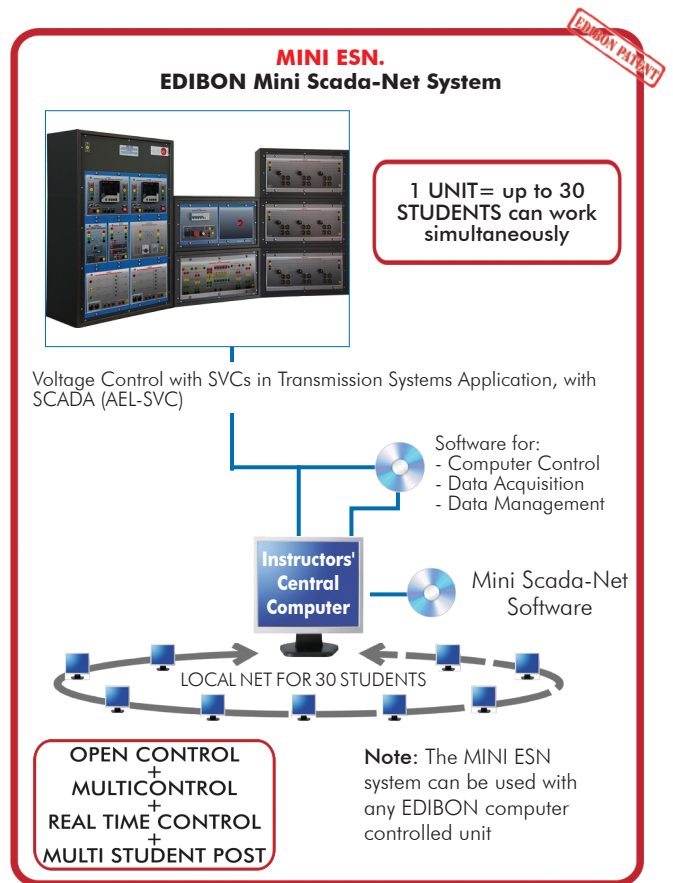
ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① Unit: AEL-SVC. Voltage Control with SVCs in Transmission Systems Application, with SCADA.

② AEL-SVC/CCSOF. Computer Control + Data Acquisition + Data Management Software.

③ Cables and Accessories, for normal operation.

④ Manuals.

*IMPORTANT: Under AEL-SVC we always supply all the elements for immediate running as 1, 2, 3 and 4.

Optional items (supplied under specific order)

a) Technical and Vocational Education configuration

⑤ AEL-SVC/ICAI. Interactive Computer Aided Instruction Software System.

b) Multipost Expansions options

⑥ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

⑦ ESN. EDIBON Scada-Net Systems.

①AEL-SVC Application.

- **N-ALI01. Industrial Main Power Supply.**

    Supply voltage: 400 VAC, 3PH+N+G.

    ON-OFF removable key.

    Output voltage connections:

    Three-Phase + Neutral: 400 VAC.

    Single-Phase: 230 VAC.

    Three-Phase supply hose with IP44 3PN+E 32A 400 V connecting plug.

    Differential magnetothermal, 4 poles, 25 A, 30 mA AC 6 KA.

    Emergency stop push button.

    GND terminal.

- **N-AE1. Transmission Lines Simulation Module.**

    Supply voltage: 400 VAC, 3PH+N.

    Three-phase line with variable parameters.

    Concentrated parameters line.

    Four capacitances benches between lines with three capacitances of 1 μF each one.

    Two capacitances benches between line and ground composed by two capacitances of 1 and 2 μF.

    Resistance of the line that can be wiring independently:

    Three resistors of 15 Ω.

    Three resistors of 30 Ω.

    Inductance of the line with several set values: 33 mH, 78 mH, 140 mH, 193 mH and 236 mH.

    Neutral resistor of 10 Ω.

- **N-EALD. Network Analyzer Unit with Data Acquisition. (2 units).**

    The network analyzer module allows fulfilling measurements, displaying and analyzing all the parameters of the AC electrical networks. It has an LCD screen and push-buttons for the navigation through the different menus. It includes specific software for monitoring current and voltage curves, harmonics display, tariffs programming, alarms programming and electrical parameters storage.

    Features:

    Multifunctional three-phase power meter:

    Single and three-phase voltage. Up to 690 VAC L-L.

    Phase and line current. Current range up to 200%. Measurement from 0-10 A.

    Active, reactive and apparent power.

    Suitable frequencies: 25 Hz, 50 Hz, 60 Hz y 400 Hz.

    Display of the V-I vector diagram.

    Supply voltage: 85-265 VAC.

    Energy quality control:

    Current and voltage individual harmonics measurement. Up to the 40th harmonic.

    THD voltage and current, TDD and K-factor.

    Maximums and minimums display.

    Waveforms display, 128 samples/sec.

    Events and data storage.

    Harmonics analyzer:

    THD voltage and current, TDD current and K-factor, up to the 40th harmonic.

    Current and voltage harmonic spectrum and angles.

    Tariff programming:

    Class 0.5S IEC 62053-22, active and reactive power in four quadrants.

    Measurement of the total and per phase three-phase active, reactive and apparent powers.

    Usage time, 4 energy/demand records of total tariffs.

    8 tariffs, 4 seasons, 4 types of days.

    Automatic daily report of energy consumption maximums and minimums.

    Communications:

    Modbus TCP communication protocol with Ethernet interface.

- **N-REL09. Time Electronic Relay against Overcurrents (1.2 - 7 A).**

    Electronic thermal relay.

    Overload protection.

    Range 1.2 - 7 A.

    Reset and test function.

    1 NONC contact.

    Temporization.

- **N-PSM. Power Switch Module.**

    Supply voltage: single-phase 230 VAC.

    Power terminals:

    Four power input terminals (3PH+N).

    Four power output terminals (3PH+N).

    Auxiliary contacts:

    One "NO" contact.

    One "NC" contact.

    Two push-buttons to open / close the power terminals and auxiliary contacts.

    Two control contacts of 24 VDC.

    Two voltage supply outputs of 24 VDC.

- N-REFT/3C. 3 x 300 W Three-Phase Configurable Resistors Module.

    Configurable Star and Delta connections.

    Three banks with three three-phase resistors of 1600 Ω.

    Nominal voltage: 400 VAC.

    Nominal power: 3x (3 x 300) W.

- N-INDT/3C. 3 x 300 VAr Three-Phase Configurable Capacitors Module.

    Configurable Star and Delta connection.

    Three benches with three-phase inductances of 5 H each one.

    Nominal voltage: 400 VAC.

    Nominal power: 3 x (3x300) VAr.

- N-CAR19T/3C. 3 x 300 VAr Three-Phase Configurable Inductances Module.

    Configurable Star and Delta connection.

    Three benches with three-phase capacitors of 2 μF each one.

    Nominal voltage: 400 VAC.

    Nominal power: 3 x (3 x 300) Var.

- N-TRANS09. Three- phase Isolating Transformer, 400/400 VAC, 1 kVA, Module.

    Nominal power: 1kVA.

    Primary Winding Voltage: 3x 400 VAC Δ.

    Secondary Winding Voltage: 3x 400 VAC Y.

    Adjustable overcurrent protection: 1.6-2.5 A.

    GND terminal.

- N-TCR01. TCR Thyristor Reactor Controller Module.

    Supply voltage: 230 VAC.

    Nominal power: 1 kVA.

    Rated current: 1.44 A.

    Thyristor bridge firing angle control.

- N-INDT. Three-phase Commutable Inductive Load.

    Nominal voltage: 400 VAC.

    Inductance: 1.4 H.

    Nominal Current: 1.6 A.

    Manual switch to turn on / off inductances.

    Fuses: 3x 2 A.

    Terminals:

        Four Input Terminals (3PH+N).

        Four Output Terminals (3PH+N).

    GND terminal.

- AEL-PC. Touch Screen and Computer.

    Touch Screen:

        Energy efficiency class: A.

        Screen diagonal: 68.6 cm (27 inch (s)).

        Power consumption (operating): 26 watts.

        Annual energy consumption: 38 kWh.

        Power consumption (standby / off) 0.49 watts.

        Screen resolution: 1920 x 1080 pixels.

    Computer:

        Processor Number: Intel Core i7-6600U Processor (4M Cache, up to 3,40 GHz).

        Cache: 4 MB Intel Smart Cache.

        Clock speed: 2.6 GHz.

        # Of Cores/# of Threads: 2/4.

        Max. TDP/Power: 15 W.

        Memory Types: DDR4-2133, LPDDDR3-1866, DDR3L-1600.

        Graphics: Intel HD Graphics 530.

        Slot for PCI Express.

- N-TSR01. TSC Thyristor Switch Capacitor Module.

    Supply voltage: 230 VAC.

    Nominal power: 1 kVA.

    Rated current: 1,44 A.

    Thyristor bridge firing angle control.

- N-CONT. Three- phase Commutable Capacitive Load.

    Nominal voltage: 400 VAC.

    Capacitance: 3x 7 μF.

    Manual switch to turn on / off capacitors.

    Fuses: 3x 4 A.

    Terminals:

        Four Input Terminals (3PH+N).

        Four Output Terminals (3PH+N).

    GND terminal.

- EMT7/1K. 1 kW/1P Asynchronous Three-Phase Motor of Squirrel Cage.

    Nominal power: 1100 W.

    Nominal voltage: 3 x 230/400 VAC Δ/Y.

    Frequency: 50/60 Hz

    Number of poles: 2.

    Speed: 2730 rpm.

    Nominal current: 2.52 / 1.45 A.

- FRENP. Magnetic Powder Brake.

    Nominal Torque: 5 Nm.

    Maximum Power Dissipation: 100 W.

    Maximum output current adjustment.

    Operating modes "freewheel " and "blocking".

    Nominal voltage: 24 VAC/VDC.

    Maximum Output Current: 2 A.

    Output Load (Resistor): 4 to 20 Ohms.

    Maximum power consumed: 70 W.

    Remote voltage control: 0 to 10 VDC.

    Weight: 4 Kg.

- N-DLC01. Dynamic Load Controller 1.

    Supply voltage: 230 VAC.

    LCD Display.

    Setting of maximum, minimum and valley braking signal times to simulate real daily energy consumption.

    Manual and automatic braking torque.

    GND terminal.

- All necessary cables to realize the practical exercises are included.

The complete unit includes as well:

  Advanced Real-Time SCADA.

  Open Control + Multicontrol + Real-Time Control.

  Specialized EDIBON Control Software based on LabVIEW.

  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.

②**AEL-SVC/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.
Management, processing, comparison and storage of data.
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.

③**Cables and Accessories**, for normal operation.

④**Manuals:**
This unit is supplied with 7 manuals: Required Services, Assembly and Installation, Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

Exercises and Practical Possibilities to be done with the Main Items

Some practical exercises possibilities with the base unit SVC-UB and SVC-K1:

1.- Manual reactive power control with manual commutable inductances and capacitors loads.

2.- Automatic reactive power compensation with the thyristor reactor controller module (TCR).

3.- Manual reactive power compensation with the thyristor reactor controller module, varying the firing "alfa".

4.- Comparison of the behavioral dynamics of the transmission system with the manual reactive power control and the automatic reactive power control with thyristors (TCR).

5.- Visualization of the grid parameters with the influence of the manual reactive power control.

6.- Visualization of the grid parameters with the influence of the automatic reactive control with the thyristors reactor module (TCR).

7.- Manual control of the thyristor firing angle in the TCR and visualization of the grid reactive power response.

8.- Visualization of the voltages nodes in the transmission line and droop voltages compensation against sudden load changes.

Some practical exercises possibilities with the base unit SVC-UB and SVC-K2:

9.- Automatic reactive and active power compensation with the thyristor reactor controller module (TCR) and thyristor capacitor switch controller module (TCS).

10.- Manual reactive power compensation with the thyristor reactor controller module and the thyristor capacitor switch controller module, varying the firing "alfa".

11.- Comparison of the behavioral dynamics of the transmission system with the manual reactive power control and the automatic reactive power control with both thyristors reactor and capacitor controllers (TCR and TSC).

12.- Visualization of the grid parameters with the influence of the manual reactive and active power control.

13.- Visualization of the grid parameters with the influence of the automatic power factor control with the thyristors reactor and capacitor modules (TCR and TSC).

14.- Manual control of the thyristor firing angle in the TCR and TSC, and visualization of the grid power factor response.

15.- Visualization of the voltages nodes in the transmission line and droop voltages compensation against sudden load changes.

Some practical exercises with Control and Data Acquisition System Software for Electrical Machines EM-SCADA:

16.- Optimum firing angle determination for each load condition.

17.- Visualization and comparison of the reactive power compensation waves working with both TCR and TSC

18.- Visualization of the voltage and current gaps according to the thyristors firing angle.

19.- Thyristors firing angle identification with the high speed data acquisition system.

Other possibilities to be done with this unit:

20.- Many students view results simultaneously.

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

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

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

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

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

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

a) Technical and Vocational Education configuration

⑤ AEL-SVC/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.

b) Multipost Expansions options

⑥ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

MINI ESN. 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.

REPRESENTATIVE: