



* Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6
(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.**
- **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**



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↳ 70.- MECHANICS

For more information about Key Features, click here



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)



European Union Certificate (total safety)



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



Certificate and Worlddidac Member

INTRODUCTION

To extend the operation time of a machine, prevent serious damage and correctly perform the maintenance tasks, it is essential to know the machine state.

In general, the state of a machine or its parts can be measured by analyzing the type and magnitude of the vibrations generated.

It is possible to simulate certain faults and study the effects caused in the vibration spectrum thanks to the machinery diagnostic kits.

GENERAL DESCRIPTION

The Computer Controlled Machine Diagnosis Unit, "MDUC", of EDIBON, allows carrying out vibration measurement practices, by measuring the movement, speed and acceleration of vibrations within a time margin – frequency.

The basic components of the "MDUC" unit are mechanical elements such as: couplings, bearings and a rotor shaft, a drive motor with speed through a frequency converter and a tachometer generator.

It is possible to align the motor since its base plate is mounted on a motor cart. In addition, a quick, flexible and precise assembly of the different components of the test can be carried out thanks to the guide grooves. The unit includes a transparent protective cover which provides safety during the operation and allows to observe the whole process.

The function of the computer-aided vibration analyzer is to assess the machine diagnostic testing with different kits related to the vibration technology.

The system consists of two acceleration sensors, a speed sensor, a measuring amplifier with adjustable amplification degree, a USB box and the analysis software.

The analysis software has the following features: two-channel oscilloscope (studies in the time domain), two-channel spectrum analyzer (studies in the frequency domain), vibration intensity gauge, analysis of shock effects and damage in roller bearings, filter for acceleration curve recording, orbit representation and module for single or dual plane balancing of rigid rotors in operation.

Thanks to the software, it is possible to compare the effectiveness of vibration signals by applying various analysis methods and by determining the advantages and disadvantages of different techniques.

Specific cases of machine faults may be studied with the kits, such as: shaft bending vibrations, shaft fissures, roller bearing faults, coupling vibrations, belt drive vibrations, gear faults, pump cavitation, blower vibration, and electromechanical vibrations. Furthermore, with the baking and loading kit, ranges of two loading moments may be generated as well as two speed ranges.

The unit consists of the following kits:

- **BLU. Break and Load Unit:**

The Break and Load Unit, "BLU", of EDIBON is a magnetic particle brake, a display unit and an electrical control. It is possible to precisely adjust the braking moment. The excitation current is used as a measurement of the braking moment and it can be displayed through a computer.

The braking unit consists of an integrated drive belt and a second projecting shaft, thus it has two speed ranges and two moment ranges.

The power generated is converted into heat by the brake and evacuated to the outside through a fan.

- **SES. Set of Elastic Shaft:**

The Set of Elastic Shaft, "SES", of EDIBON allows to study the behavior of an elastic rotor subjected to imbalance. It is possible to study the resonance and the phenomena occurred in subcritical and supercritical regimes. The balancing of elastic rotors in operation will be studied with the unit. The Set of Elastic Shaft, "SES", includes some oscillating ball bearings that guarantee the total shaft movement, and the protective bearings limit the amplitude in areas close to the resonance to non-hazardous values.

- **SRS. Set of Rotating Shaft with Crank:**

The Set of Rotating Shaft with Crank, "SRS", consists of two shafts with different lengths, the short shaft simulates a projecting shaft end and the load is transmitted with the belt drive, whereas the long shaft is used with a protective bearing and a flywheel in order to study a shaft fissure in the case of an elastic rotor.

It is important that fissures resulting from material fatigue in rotating machines are detected in time before the break occurs, which usually leads to fatal consequences. With the "SRS" unit, a fissure with very close to real behaviors is simulated. This enables to carry out a timely machine check.

To determine the remaining life cycle of a roller bearing and decide on its replacement, the slow variation of the vibration spectrum is analyzed. The spectral distribution will enable to draw accurate conclusions about the type of defect and its location.

- **SRBF. Set of Roller Bearings with Faults:**

The Set of Roller Bearings with Faults, "SRBF", has six roller bearings with which to check and explain several faults in roller bearings, such as: damaged outer ring, damaged inner fault, damaged rolling element, combined damage, very used and new and non-faulty.

The radial bearing load may be adjusted within certain limits through the Set of Belt Drive, "SBD".

- **SCO. Set of Couplings:**

The Set of Couplings, "SCO", allows to compare the properties of different couplings such as curved tooth, bolt, flange and claw couplings. The vibrational behavior of the different types of couplings is important to draw conclusions about faults or defects in the manufacturing or assembly of rotating machines. The usual faults are eccentricity, oscillation and pitch errors.

- **SBD. Set of Belt Drive:**

The Set of Belt Drive, "SBD", allows to study the conditions that cause vibrations or slip in belts. The belt drives are noiseless drive devices, have a long life and require little maintenance, provided that its design, assembly and adjustment are correct. To study the conditions that cause vibrations or slip, adjustable tensor rollers are used to show the influence of an unequal elongation.

- SSDG. Set to Study Damage in Gears:

The Set to Study Damage in Gears, "SSDG", allows to study the vibrational behavior of gears with typical defects. For that purpose, gears with tooth defects and gears without defects are included, so a comparative study can be carried out. The gears included in the kit are helical and straight-toothed gears. Due to the importance of lubrication in the vibrational signal of the unit, this may be lubricated with grease and gear oil.

The compressors and pumps frequently use crank and connecting rod mechanisms. The force and mass oscillations cause vibrations in the units.

- SCM. Set of Crank Mechanism:

The Set of Crank Mechanism, "SCM", allows to adjust the stroke, mass compensation and bearing clearance, as well as the speed, to simulate vibrations in compressors or internal combustion motors through springs.

When you want to simulate the force obtained by a gas compression, a higher torque is required, for which it is recommended to use the Set of Belt Drive, "SBD", or the Set to Study Damage in Gears, "SSDG".

Pump cavitation is produced when steam cavities are created within a fluid in which forces act responding to the pressure differences. Cavitation causes noise, damage to components and loss of performance.

- SSCP. Set to Study Cavitation in Pumps:

The Set to Study Cavitation in Pumps, "SSCP", allows to produce the cavitation phenomenon and study its vibrational response.

The Set of Cavitation in Pumps consists of a single-stage centrifugal pump connected to flexible tubes with a tank.

It is possible to adjust different operating conditions with valves and manometers. Furthermore, it is possible to observe the inside of a pump in operation through the plastic casing. It is recommended to use a stroboscope to visualize the pump as if it was calm or rotating slowly.

In addition to measuring the vibrations generated by bearings and imbalances, it is possible to measure the vibrations caused by the movable vanes.

- SSVF. Set to Study Vibrations in Fans:

In the Set to Study Vibrations in Fans, "SSVF", the vibrations are magnetically induced. It is possible to study three impellers with a different number of movable vanes. It is also possible to study the gyroscopic effect by mounting the flywheel plate at an oblique angle.

Among the drive systems are the asynchronous motors, which generate vibrations in machines.

This is the case with an asymmetric air gap (space between rotor and stator), in which the magnetic vibrational forces induce torsional and bending vibrations.

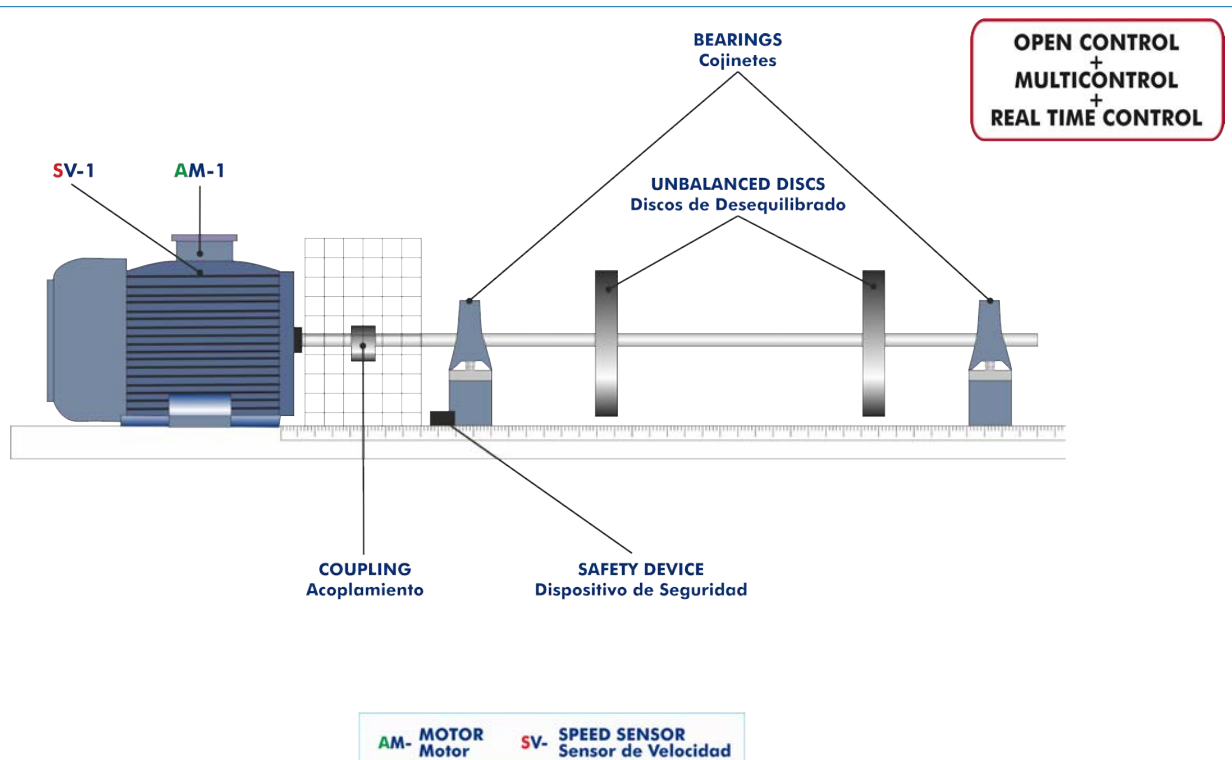
In the event of a partial failure of the electrical windings, mechanical vibrations are produced in the asymmetrical magnetic field.

- SEV. Set of Electromechanical Vibrations:

The Set of Electromechanical Vibrations, "SEV", is an adjustable unit that allows to adjust an asymmetric air gap or to disconnect a winding, generating an electromechanical asymmetry and thus it is possible to study its vibrational behavior.

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, 10 and 11.

Let us describe first the main items (1 to 6):

① **MDUC. Unit:**

Bench-top unit with adjustable legs.
 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.
 Required toolkit included.
 All sets include a packaging and carrying case.

Base plate:

Grooves: 50 mm spacing.

Clamping plate.

Two clamping kits.

Toolkit.

Asynchronous motor with a frequency converter and a movable cart:

Drive power: 0.37 kW.

Nominal speed: 2800 min⁻¹.

Speed range through converter: 100 – 6000 min⁻¹.

Elastic claw coupling and Controlflex coupling:

Controlflex coupling: nominal torque: 15 nm.

Two bearing sawhorses:

6004, it is possible to change them.

Two shafts:

Short: Ø = 20 mm, length = 300 mm.

Long: Ø = 20 mm, length = 500 mm.

Two unbalanced flywheels with removable counterweights (screws):

Ø = 150 mm, 1675 g each.

230V, 50 Hz, single phase.

230V, 60 Hz, single phase; 120V, 60 Hz, single phase.

230V, 60 Hz, 3 phases.

Protective cover.

Instrumentation:

Two acceleration sensors for recording of oscillation travel, oscillation speed and acceleration:

Frequency range: 1 – 1000 Hz, sensitivity: 100 mV/g.

Resonance frequency: 32 kHz.

Optical speed sensor for recording the number of revolutions:

Scanning range: 3 – 150 mm.

Class II laser, 675 nm.

Two-channel measuring amplifier with adjustable amplification:

Adjustable amplifier: x1, x10, x100.

Electrical supply with 12V DC supply power.

Unit dimensions: 230 x 220 x 80 mm.

16 analogs in, 2x analogs out.

4x digital in/out each.

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: MDUC

Optional Models and Accessories: (Not included)

- BLU. Break and Load Unit:

This set consists primarily of:

Magnetic particle brake:

Composed of: stator, excitation coil, crack with magnetic particles, rotor and shaft.

Continuous brake power: approx. 4500 W/3000 min⁻¹.

Speed margin: 200 – 2000 min⁻¹.

Braking moment: 1 – 10 Nm.

Axial fan.

Display and control unit with excitation current display.

Shaft for direct connection of the brake:

Gear ratio between braking shafts: $i = 3$.

Integrated belt drive for the second speed range and the moment range:

Speed margin: 600 – 6000 min⁻¹.

Braking moment: 0.3 - 3.3 Nm.

Shaft for connecting the brake through a belt drive.

230V, 50 Hz, single phase.

230V, 60 Hz, single phase; 120V, 60 Hz, single phase.

- SES. Set of Elastic Shaft:

This set consists primarily of:

Elastic shaft made of high-grade steel:

$\varnothing = 10$ mm.

Length: 530 mm.

Nominal length between bearings: 450 mm.

Roller bearing brackets with oscillating ball bearings and a protective bearing with holes for sensor housing.

Protective bearing:

$\varnothing = 20$ mm.

- SRS. Set of Rotating Shaft with Crank:

This set consists primarily of:

Taker-in plate.

Flange with short shaft (load with belt drive):

$\varnothing = 90$ mm.

Six screws:

Hexagon head screw for flange M8 x 20.

Clamping kit.

Two shafts:

$\varnothing = 200$ mm.

Short shaft for 'projecting shaft end' simulation: length = 85 mm.

Long shaft for 'elastic rotor' simulation: length = 200 mm.

Maximum allowable bearing moments:

Short shaft for belt: 15.9 Nm.

Long shaft for flywheel: 3.9 Nm.

Centering mandrel for shaft alignment during the test assembly.

- SRBF. Set of Roller Bearings with Faults:

This set consists primarily of:

Six oscillating ball bearings NU204-E-TVP2 type:

Inner diameter: $\varnothing = 20$ mm.

Outer diameter: $\varnothing = 47$ mm.

Width: 14 mm.

Number of rollers: 12.

Roller bearing bracket.

Two retaining rings.

- SCO. Set of Couplings:

This set consists primarily of:

Curved tooth coupling.

Non-faulty flange coupling.

Flange coupling with eccentricity fault:

Eccentricity fault (non-centering): 0.2 mm.

Flange coupling with oscillation fault:

Oscillation fault: 0.4 ± 0.1 mm.

Bolt coupling with variable pitch fault:

Non-eccentric bolt.

Eccentric bolt:

Bolt eccentricity: 1 mm.

Maximum pitch error: $180^\circ \pm 1.909^\circ$.

Three stars for claw coupling:

98 Shore A (red).

92 Shore A (yellow).

64 Shore D (green).

80 Shore A (blue, included in MDUC).

Roller bearing bracket with elastic support.

- SBD. Set of Belt Drive:

This set consists primarily of:

Rubber V-belt:

SPX profile, approx. 10 mm wide.

Belt length: 912 mm.

Damaged rubber V-belt:

SPX profile, approx. 10 mm wide.

Belt length: 912 mm.

Damaged rubber V-belt:

SPX profile, approx. 10 mm wide.

Belt length: 912 mm.

Small drive pulley:

$\varnothing = 63$ mm.

Small pulley with eccentricity fault for the V-belt:

$\varnothing = 63$ mm.

Large pulley for V-belt:

$\varnothing = 125$ mm.

Distance between shafts: 300 mm.

Clamping kit.

Belt pre-tension meter: 0 – 150 N.

Belt tensioning device.

Individually adjustable tensor rollers.

V-belt tension adjustment.

Roller bearing bracket.

- SSDG. Set to Study Damage in Gears:

This set consists primarily of:

Gear drive ratio: $i = 1:3$.

Variable distance between shafts.

Reference profile according to DIN 867.

Transparent box cover to observe the gear in operation.

Box cover with holes for sensors.

Sets of straight-toothed gears, with fault.

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Sets of straight-toothed gears, without fault:

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Sets of helical-toothed gears, with fault:

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Propeller pitch angle: 10° .

Sets of helical-toothed gears, without fault:

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Propeller pitch angle: 10° .

Engine oil SAE 10W 40, 1.5 l.

- SCM. Set of Crank Mechanism:

This set consists primarily of:

Crank and connecting rod mechanism.

Stroke: 50 – 75 – 100 mm.

Two balance weight masses: Total 490 g, designed to operate with a 50 mm stroke.

Bearing set adjustment:

Bearing clearance: 0 – 1 mm.

Two pressure springs:

Length without tension: 170 mm.

Spring ratio: $R = 0.55$ N/m.

- SSCP. Set to Study Cavitation in Pumps:

This set consists primarily of:

Centrifugal pump:

Maximum flow: 17 l/min (3300 min^{-1}).

Maximum lift height: 12 m (3300 min^{-1}).

Three-vane impeller.

Minimum speed for cavitation: 2240 min^{-1} approx. (choked suction side)

Two manometers:

Pressure side: 0 – 4 bars.

Suction side: -1 – 1.5 bars.

Casing cap.

Knurled screw to open the casing cap.

Suction side tube.

Two ball valves.

Set of flexible tubes.

Tank:

Material: HDPE.

Capacity: 20 l.

- SSVF. Set to Study Vibrations in Fans:

This set consists primarily of:

Steel plate impeller with three movable vanes:

Diameter: 204 mm.

Maximum speed: 3000 min^{-1} .

Steel plate impeller with five movable vanes:

Diameter: 204 mm.

Maximum speed: 3000 min^{-1} .

Steel plate impeller with seven movable vanes:

Diameter: 204 mm.

Maximum speed: 3000 min^{-1} .

Flywheel plate to simulate axial forces.

Protective cover.

Roller bearing bracket.

Aluminum protective plate:

$\varnothing = 220$ mm.

Permanent magnet.

- SEV. Set of Electromechanical Vibrations:

This set consists primarily of:

Asynchronous motor with variable speed:

Speed margin: 100 – 6000 min^{-1} .

Nominal power: 370 W.

Armature eccentricity: 0 – 0.2 mm.

② MDUC/CIB. Control Interface Box:

The Control Interface Box is part of the SCADA system.

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.

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.



MDUC/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: 250 KS/s (kilo samples per second).

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

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 MDUC/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 250 KS/s (kilo samples per second).

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.



MDUC/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: MDUC + MDUC/CIB + DAB + MDUC/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

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|--|--|
| <ol style="list-style-type: none"> 1.- Assessment of the vibration state of a machine. 2.- Analysis of damage to gears and roller bearings through the spectrum envelope. 3.- Detecting cracks and fissures in shafts through acceleration curves and order analysis. 4.- Measuring the vibrations caused by single or dual plane balancing of rigid rotors in operation. 5.- Study of the basic essentials of the vibration measurement in shafts and bearings. 6.- Study of the basic magnitudes and parameters. 7.- Use of measuring sensors and instruments. 8.- Understanding the influence of speed and shaft and recorder arrangements. 9.- Learning to balance rigid shafts in operation and alignment between motor and bearing. 10.-Understanding and interpreting the frequency spectrums. 11.-Learning about the different vibration signals. 12.-Applying the FFT analysis correctly. 13.-Measuring the speed, oscillation travel, oscillation speed and acceleration. 14.-Learning about the influence of the balanced and unbalanced elastic rotor. 15.-Understanding the influence of misalignment. 16.-Study the variation of a typical vibrational behavior (vibration speed, frequency, amplitude, and phase) due to a fissure. 17.-Identifying a fissure through the variation of a vibration spectrum. 18.-Estimating the life cycle of a roller bearing. 19.-Detecting faulty roller bearings. 20.-Checking the influence of roller bearing faults on outer and inner ring, or the roller bearing body on the vibration spectrum. 21.-Learning about the effects of misalignment in different types of couplings. 22.-Detecting the effects produced by the manufacturing faults, such as: eccentricity, oscillation and pitch errors. 23.-Detecting the coupling faults on the vibration signal. 24.-Understanding the influence of ring gear hardness on claw couplings. 25.-Comparing the curved tooth, bolt, flange or claw couplings 26.-Understanding the importance of the belt tension in vibrational behavior. 27.-Checking the influence of eccentricity on pulleys and the speed on vibrational behavior. 28.-Understanding and interpreting the frequency spectrums to differentiate between faulty or non-faulty belts. 29.-Identification of gear faults based on their vibrational behavior. 30.-Learning about the influence of the gear tooth type, lubrication used and distance between shafts and clearance between teeth. 31.-Locating a gear defect. 32.-Learning about the influence of the bearing clearance and impacts. 33.-Understanding and interpreting the frequency spectrums. 34.-Detecting the rod and piston wear. | <ol style="list-style-type: none"> 35.-Study of the vibrations of a centrifugal pump in operation. 36.-Understanding the cavitation phenomenon in a centrifugal pump. 37.-Identifying the vibrations caused by movable vanes in the vibration spectrum. 38.-Measuring the movable vane pass frequency. 39.-Measuring the blower vibrations. 40.-Learning about the influence of an asymmetric air gap on the vibrational behavior and the electromagnetic and performance losses. 41.-Learning about the influence of speed on vibrational behavior. 42.-Learning about the influence of electrical windings on vibrational behavior. <p>Other possibilities to be done with this Unit:</p> <ol style="list-style-type: none"> 43.-Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard. 44.-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. 45.-The Computer Control System with SCADA allows a real industrial simulation. 46.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices. 47.-This unit can be used for doing applied research. 48.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions. 49.-Control of the MDUC unit process through the control interface box without the computer. 50.-Visualization of all the sensors values used in the MDUC unit process. <p>- By using PLC-PI additional 19 more exercises can be done.
- Several other exercises can be done and designed by the user.</p> |
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REQUIRED SERVICES

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

DIMENSIONS AND WEIGHTS

MDUC:

Unit:

-Dimensions:

Base plate: 1100 x 800 mm approx.

(43.30 x 31.49 inches approx.)

Base plate + cover: 1100 x 800 x 500 mm approx.

(43.30 x 31.49 x 19.68 inches approx.)

Control unit: 475 x 420 x 200 mm approx.

(18.70 x 16.53 x 7.87 inches approx.)

Storage system: 600 x 390 x 325 mm approx.

(23.62 x 15.35 x 12.79 inches approx.)

-Weight: 95 Kg approx. (209 pounds approx.)

BLU:

-Dimensions: 600 x 400 x 320 mm approx.

(23.62 x 15.74 x 12.59 inches approx.)

-Weight: 30 Kg approx. (66.13 pounds approx.)

SES:

-Dimensions: 600 x 400 x 120 mm approx.

(23.62 x 15.74 x 4.72 inches approx.)

-Weight: 6 Kg approx. (13.22 pounds approx.)

SRS:

-Dimensions: 400 x 300 x 120 mm approx.

(15.74 x 11.81 x 4.72 inches approx.)

-Weight: 3 Kg approx. (6.61 pounds approx.)

SRBF:

-Dimensions: 400 x 300 x 120 mm approx.

(15.74 x 11.81 x 4.72 inches approx.)

-Weight: 4 Kg approx. (8.81 pounds approx.)

SCO:

-Dimensions: 400 x 300 x 170 mm approx.

(15.74 x 11.81 x 6.69 inches approx.)

-Weight: 6 Kg approx. (13.22 pounds approx.)

SBD:

-Dimensions: 600 x 400 x 170 mm approx.

(23.62 x 15.74 x 6.69 inches approx.)

-Weight: 6 Kg approx. (13.22 pounds approx.)

SSDG:

-Dimensions: 600 x 400 x 320 mm approx.

(23.62 x 15.74 x 12.59 inches approx.)

-Weight: 25 Kg approx. (55.11 pounds approx.)

SCM:

-Dimensions: 600 x 400 x 170 mm approx.

(23.62 x 15.74 x 6.69 inches approx.)

-Weight: 8 Kg approx. (17.63 pounds approx.)

SSCP:

-Dimensions: 600 x 400 x 320 mm approx.

(23.62 x 15.74 x 12.59 inches approx.)

-Weight: 16 Kg approx. (35.27 pounds approx.)

SSVF:

-Dimensions: 400 x 300 x 320 mm approx.

(15.74 x 11.81 x 12.59 inches approx.)

-Weight: 6 Kg approx. (13.22 pounds approx.)

SEV:

-Dimensions: 400 x 300 x 320 mm approx.

(15.74 x 11.81 x 12.59 inches approx.)

-Weight: 11 Kg approx. (24.25 pounds approx.)

OPTIONAL MODELS AND ACCESSORIES (Not included)

- BLU. Break and Load Unit.
- SES. Set of Elastic Shaft.
- SRS. Set of Rotating Shaft with Crank.
- SRBF. Set of Roller Bearings with Faults.
- SCO. Set of Couplings.
- SBD. Set of Belt Drive.
- SSDG. Set to Study Damage in Gears.
- SCM. Set of Crank Mechanism.
- SSCP. Set to Study Cavitation in Pumps.
- SSVF. Set to Study Vibrations in Fans.
- SEV. Set of Electromechanical Vibrations.

COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 11.

All these items try to give more possibilities for:

- a) Industrial configuration. (PLC)
- b) Technical and Vocational Education configuration. (ICAI and FSS)
- c) Multipost Expansions options. (Mini ESN and ESN)

a) Industrial configuration

⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):

-PLC-PI. PLC Module:

Metallic box.

Circuit diagram in the module 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 (-10 V. to + 10 V.) (through SCSI connector).

Analog outputs block:

4 Analog outputs (-10 V. to + 10 V.) (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 μ sec. for a basic instruction.

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

Power supply input (100 to 240 V AC).

DC input: 16 (24 V DC).

Relay output: 14.

High-speed counter.

Multi-point PID control.

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

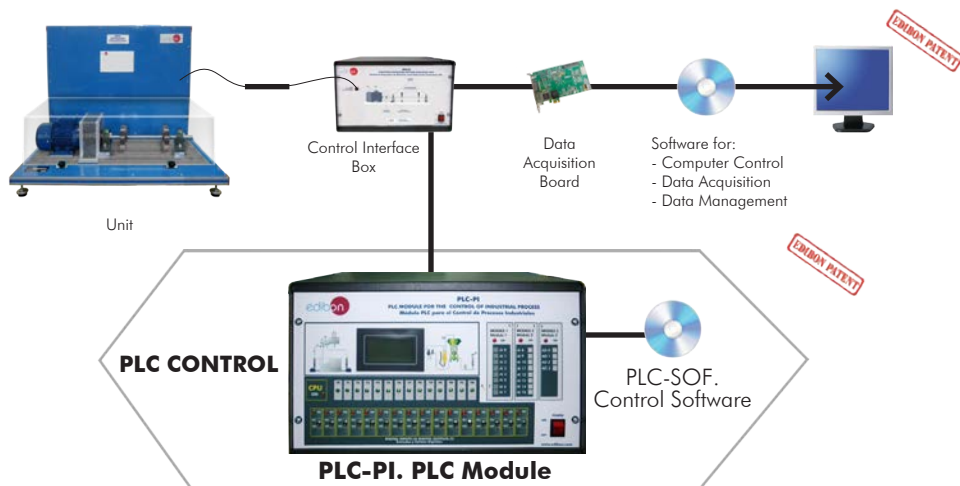
Communication RS232 wire to computer (PC).

Dimensions: 490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.). Weight: 30 Kg. approx. (66 pounds approx.).

-MDUC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

The software has been designed using Labview and it follows the unit operation procedure and linked with the Control Interface Box used in the Computer Controlled Machine Diagnosis Unit (MDUC).



Practices to be done with PLC-PI:

- 1.- Control of the particular unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the particular unit process.
- 3.- Calibration of all sensors included in the particular unit process.
- 4.- Hand on of all the actuators involved in the particular unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the particular unit. (These experiments can be decided previously).
- 6.- 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).
- 7.- PLC hardware general use.
- 8.- PLC process application for the particular unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC program languages.
- 13.- PLC different programming standard languages (ladder diagram (LD), structured text (ST), instructions list (IL), sequential function chart (SFC), function block diagram (FBD)).
- 14.- New configuration and development of new process.
- 15.- Hand on an established process.
- 16.- To visualize and see the results and to make comparisons with the particular unit process.
- 17.- Possibility of creating new process in relation with the particular unit.
- 18.- PLC Programming Exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ **MDUC/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

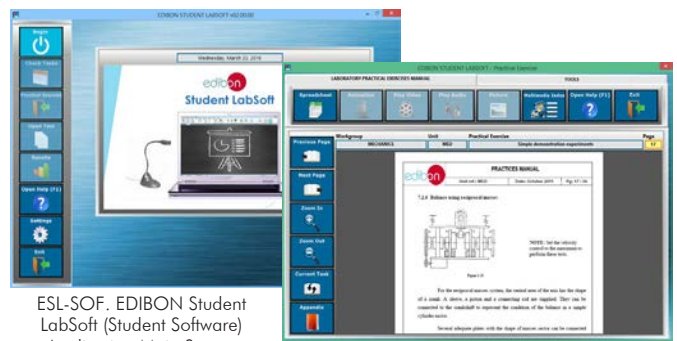
ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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

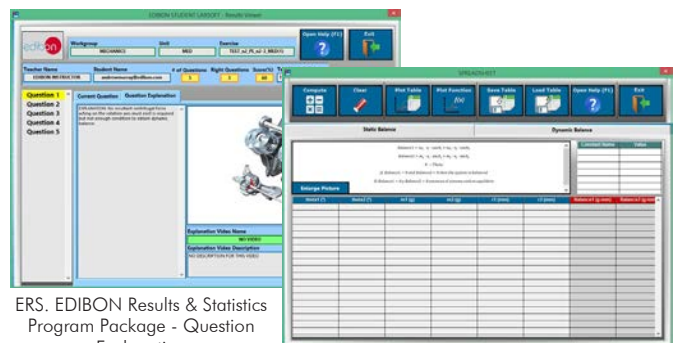
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

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

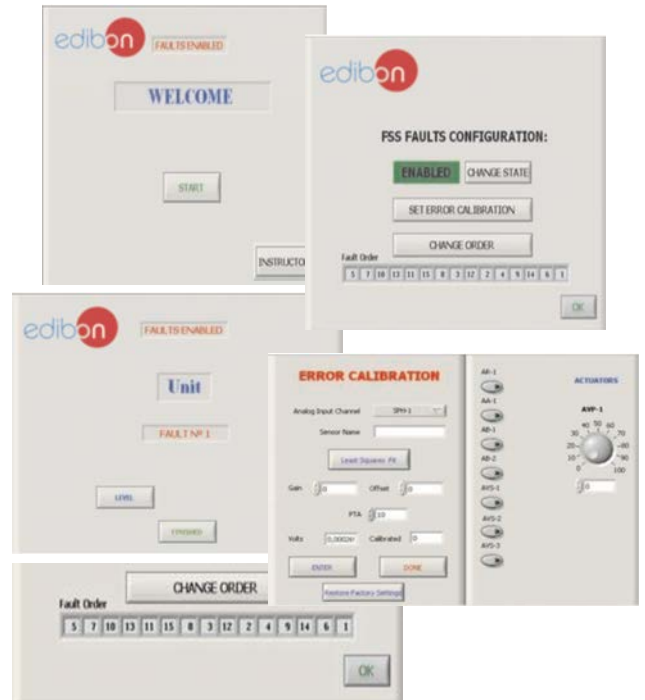
⑨ **MDUC/FSS. Faults Simulation System.**

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

c) 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:

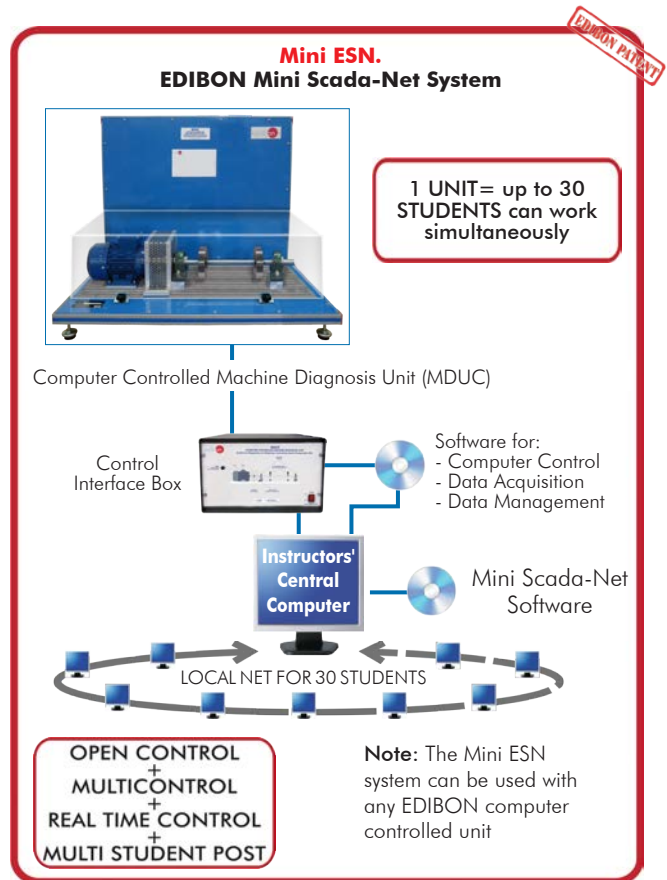
- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

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

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

⑪ **ESN. EDIBON Scada-Net System.**

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



ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

- ① **Unit: MDUC. Computer Controlled Machine Diagnosis Unit.**
- ② **MDUC/CIB. Control Interface Box.**
- ③ **DAB. Data Acquisition Board.**
- ④ **MDUC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ⑤ **Cables and Accessories**, for normal operation.
- ⑥ **Manuals.**

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

Optional items (supplied under specific order)

a) Industrial configuration

- ⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):
 - PCL-PI. PLC Module.
 - MDUC/PLC-SOF. PLC Control Software.

b) Technical and Vocational Education configuration

- ⑧ MDUC/ICAI. Interactive Computer Aided Instruction Software System.
- ⑨ MDUC/FSS. Faults Simulation System.

c) Multipost Expansions options

- ⑩ Mini ESN. EDIBON Mini Scada-Net System.
- ⑪ ESN. EDIBON Scada-Net System.

① **MDUC. Unit:**

Bench-top unit with adjustable legs.
 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.
 Required toolkit included.
 All sets include a packaging and carrying case.
 Base plate:
 Grooves: 50 mm spacing.
 Clamping plate.
 Two clamping kits.
 Toolkit.
 Asynchronous motor with a frequency converter and a movable cart:
 Drive power: 0.37 kW.
 Nominal speed: 2800 min⁻¹.
 Speed range through converter: 100 – 6000 min⁻¹.
 Elastic claw coupling and Controlflex coupling:
 Controlflex coupling: nominal torque: 15 Nm.
 Two bearing sawhorses:
 6004, it is possible to change them.
 Two shafts:
 Short: Ø = 20 mm, length = 300 mm.
 Long: Ø = 20 mm, length = 500 mm.
 Two unbalanced flywheels with removable counterweights (screws):
 Ø = 150 mm, 1675 g each.
 230V, 50 Hz, single phase.
 230V, 60 Hz, single phase; 120V, 60 Hz, single phase.
 230V, 60 Hz, 3 phases.
 Protective cover.
 Instrumentation:
 Two acceleration sensors for recording of oscillation travel, oscillation speed and acceleration:
 Frequency range: 1 – 1000 Hz, sensitivity: 100 mV/g.
 Resonance frequency: 32 kHz.
 Optical speed sensor for recording the number of revolutions:
 Scanning range: 3 – 150 mm.
 Class II laser, 675 nm.
 Two-channel measuring amplifier with adjustable amplification:
 Adjustable amplifier: x1, x10, x100.
 Electrical supply with 12V DC supply power.
 Unit dimensions: 230 x 220 x 80 mm.
 16 analogs in, 2x analogs out.
 4x digital in/out each.
 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.

Optional Models and Accessories: (Not included)

- **BLU. Break and Load Unit:**

This set consists primarily of:
 Magnetic particle brake:
 Composed of: stator, excitation coil, crack with magnetic particles, rotor and shaft.
 Continuous brake power: approx. 4500 W/3000 min⁻¹.
 Speed margin: 200 – 2000 min⁻¹.
 Braking moment: 1 – 10 Nm.
 Axial fan.
 Display and control unit with excitation current display.
 Shaft for direct connection of the brake:
 Gear ratio between braking shafts: i = 3.
 Integrated belt drive for the second speed range and the moment range:
 Speed margin: 600 – 6000 min⁻¹.
 Braking moment: 0.3 - 3.3 Nm.
 Shaft for connecting the brake through a belt drive.
 230V, 50 Hz, single phase.
 230V, 60 Hz, single phase; 120V, 60 Hz, single phase.

- **SES. Set of Elastic Shaft:**

This set consists primarily of:
 Elastic shaft made of high-grade steel:
 Ø = 10 mm.
 Length: 530 mm.
 Nominal length between bearings: 450 mm.
 Roller bearing brackets with oscillating ball bearings and a protective bearing with holes for sensor housing.
 Protective bearing:
 Ø = 20 mm.

- **SRS. Set of Rotating Shaft with Crank:**

This set consists primarily of:
 Taker-in plate.
 Flange with short shaft (load with belt drive):
 Ø = 90 mm.
 Six screws:
 Hexagon head screw for flange M8 x 20.
 Clamping kit.

Two shafts:

$\varnothing = 200$ mm.

Short shaft for 'projecting shaft end' simulation: length = 85 mm.

Long shaft for 'elastic rotor' simulation: length = 200 mm.

Maximum allowable bearing moments:

Short shaft for belt: 15.9 Nm.

Long shaft for flywheel: 3.9 Nm.

Centering mandrel for shaft alignment during the test assembly.

- SRBF. Set of Roller Bearings with Faults:

This set consists primarily of:

Six oscillating ball bearings NU204-E-TVP2 type:

Inner diameter: $\varnothing = 20$ mm.

Outer diameter: $\varnothing = 47$ mm.

Width: 14 mm.

Number of rollers: 12.

Roller bearing bracket.

Two retaining rings.

- SCO. Set of Couplings:

This set consists primarily of:

Curved tooth coupling.

Non-faulty flange coupling.

Flange coupling with eccentricity fault:

Eccentricity fault (non-centering): 0.2 mm.

Flange coupling with oscillation fault:

Oscillation fault: 0.4 ± 0.1 mm.

Bolt coupling with variable pitch fault:

Non-eccentric bolt.

Eccentric bolt:

Bolt eccentricity: 1 mm.

Maximum pitch error: $180^\circ \pm 1.909^\circ$.

Three stars for claw coupling:

98 Shore A (red).

92 Shore A (yellow).

64 Shore D (green).

80 Shore A (blue, included in MDUC).

Roller bearing bracket with elastic support.

- SBD. Set of Belt Drive:

This set consists primarily of:

Rubber V-belt:

SPX profile, approx. 10 mm wide.

Belt length: 912 mm.

Damaged rubber V-belt:

SPX profile, approx. 10 mm wide.

Belt length: 912 mm.

Damaged rubber V-belt:

SPX profile, approx. 10 mm wide.

Belt length: 912 mm.

Small drive pulley:

$\varnothing = 63$ mm.

Small pulley with eccentricity fault for the V-belt:

$\varnothing = 63$ mm.

Large pulley for V-belt:

$\varnothing = 125$ mm.

Distance between shafts: 300 mm.

Clamping kit.

Belt pre-tension meter: 0 – 150 N.

Belt tensioning device.

Individually adjustable tensor rollers.

V-belt tension adjustment.

Roller bearing bracket.

- SSDG. Set to Study Damage in Gears:

This set consists primarily of:

Gear drive ratio: $i = 1:3$.

Variable distance between shafts.

Reference profile according to DIN 867.

Transparent box cover to observe the gear in operation.

Box cover with holes for sensors.

Sets of straight-toothed gears, with fault.

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Sets of straight-toothed gears, without fault:

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Sets of helical-toothed gears, with fault:

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Propeller pitch angle: 10° .

Sets of helical-toothed gears, without fault:

Sprocket wheel:

75 teeth each, $m = 2$ mm.

Pinion:

25 teeth each, $m = 2$ mm.

Propeller pitch angle: 10°.
Engine oil SAE 10W 40, 1.5 l.

- SCM. Set of Crank Mechanism:

This set consists primarily of:
Crank and connecting rod mechanism.
Stroke: 50 – 75 – 100 mm.
Two balance weight masses: Total 490 g, designed to operate with a 50 mm stroke.
Bearing set adjustment:
Bearing clearance: 0 – 1 mm.
Two pressure springs:
Length without tension: 170 mm.
Spring ratio: R = 0.55 N/m.

- SSCP. Set to Study Cavitation in Pumps:

This set consists primarily of:
Centrifugal pump:
Maximum flow: 17 l/min (3300 min⁻¹).
Maximum lift height: 12 m (3300 min⁻¹).
Three-vane impeller.
Minimum speed for cavitation: 2240 min⁻¹ approx. (choked suction side)
Two manometers:
Pressure side: 0 – 4 bars.
Suction side: -1 – 1.5 bars.
Casing cap.
Knurled screw to open the casing cap.
Suction side tube.
Two ball valves.
Set of flexible tubes.
Tank:
Material: HDPE.
Capacity: 20 l.

- SSVF. Set to Study Vibrations in Fans:

This set consists primarily of:
Steel plate impeller with three movable vanes:
Diameter: 204 mm.
Maximum speed: 3000 min⁻¹.
Steel plate impeller with five movable vanes:
Diameter: 204 mm.
Maximum speed: 3000 min⁻¹.
Steel plate impeller with seven movable vanes:
Diameter: 204 mm.
Maximum speed: 3000 min⁻¹.
Flywheel plate to simulate axial forces.
Protective cover.
Roller bearing bracket.
Aluminum protective plate:
Ø = 220 mm.
Permanent magnet.

- SEV. Set of Electromechanical Vibrations:

This set consists primarily of:
Asynchronous motor with variable speed:
Speed margin: 100 – 6000 min⁻¹.
Nominal power: 370 W.
Armature eccentricity: 0 – 0.2 mm.

② MDUC/CIB. Control Interface Box:

The Control Interface Box is part of the SCADA system.
Control interface box with process diagram in the front panel.
The unit control elements are permanently computer controlled.
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.
All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
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 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.

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.
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 MDUC/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.
Sampling velocity up to 250 KS/s (kilo samples per second).
Calibration system for the sensors involved in the process.
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.- Assessment of the vibration state of a machine.
 - 2.- Analysis of damage to gears and roller bearings through the spectrum envelope.
 - 3.- Detecting cracks and fissures in shafts through acceleration curves and order analysis.
 - 4.- Measuring the vibrations caused by single or dual plane balancing of rigid rotors in operation.
 - 5.- Study of the basic essentials of the vibration measurement in shafts and bearings.
 - 6.- Study of the basic magnitudes and parameters.
 - 7.- Use of measuring sensors and instruments.
 - 8.- Understanding the influence of speed and shaft and recorder arrangements.
 - 9.- Learning to balance rigid shafts in operation and alignment between motor and bearing.
 - 10.-Understanding and interpreting the frequency spectrums.
 - 11.-Learning about the different vibration signals.
 - 12.-Applying the FFT analysis correctly.
 - 13.-Measuring the speed, oscillation travel, oscillation speed and acceleration.
 - 14.-Learning about the influence of the balanced and unbalanced elastic rotor.
 - 15.-Understanding the influence of misalignment.
 - 16.-Study the variation of a typical vibrational behavior (vibration speed, frequency, amplitude, and phase) due to a fissure.
 - 17.-Identifying a fissure through the variation of a vibration spectrum.
 - 18.-Estimating the life cycle of a roller bearing.
 - 19.-Detecting faulty roller bearings.
 - 20.-Checking the influence of roller bearing faults on outer and inner ring, or the roller bearing body on the vibration spectrum.
 - 21.-Learning about the effects of misalignment in different types of couplings.
 - 22.-Detecting the effects produced by the manufacturing faults, such as: eccentricity, oscillation and pitch errors.
 - 23.-Detecting the coupling faults on the vibration signal.
 - 24.-Understanding the influence of ring gear hardness on claw couplings.
 - 25.-Comparing the curved tooth, bolt, flange or claw couplings
 - 26.-Understanding the importance of the belt tension in vibrational behavior.
 - 27.-Checking the influence of eccentricity on pulleys and the speed on vibrational behavior.
 - 28.-Understanding and interpreting the frequency spectrums to differentiate between faulty or non-faulty belts.
 - 29.-Identification of gear faults based on their vibrational behavior.
 - 30.-Learning about the influence of the gear tooth type, lubrication used and distance between shafts and clearance between teeth.
 - 31.-Locating a gear defect.
 - 32.-Learning about the influence of the bearing clearance and impacts.
 - 33.-Understanding and interpreting the frequency spectrums.
 - 34.-Detecting the rod and piston wear.
 - 35.-Study of the vibrations of a centrifugal pump in operation.
 - 36.-Understanding the cavitation phenomenon in a centrifugal pump.
 - 37.-Identifying the vibrations caused by movable vanes in the vibration spectrum.
 - 38.-Measuring the movable vane pass frequency.
 - 39.-Measuring the blower vibrations.
 - 40.-Learning about the influence of an asymmetric air gap on the vibrational behavior and the electromagnetic and performance losses.
 - 41.-Learning about the influence of speed on vibrational behavior.
 - 42.-Learning about the influence of electrical windings on vibrational behavior.
- Other possibilities to be done with this Unit:
- 43.-Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 44.-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.
 - 45.-The Computer Control System with SCADA allows a real industrial simulation.
 - 46.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 47.-This unit can be used for doing applied research.
 - 48.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
 - 49.-Control of the MDUC unit process through the control interface box without the computer.
 - 50.-Visualization of all the sensors values used in the MDUC unit process.
- By using PLC-PI additional 19 more exercises can be done.
- Several other exercises can be done and designed by the user.

TENDER SPECIFICATIONS (for optional items)

a) Industrial configuration

⑦ **PLC. Industrial Control using PLC** (it includes PLC-PI Module plus PLC-SOF Control Software):

-PLC-PI. PLC Module:

Metallic box.

Circuit diagram in the module front panel.

Digital inputs (X) and Digital outputs (Y) block: 16 Digital inputs. 14 Digital outputs.

Analog inputs block: 16 Analog inputs.

Analog outputs block: 4 Analog outputs.

Touch screen.

Panasonic PLC:

High-speed scan of 0.32 μ sec. Program capacity of 32 Ksteps. High-speed counter. Multi-point PID control.

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

-MDUC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

Practices to be done with PLC-PI:

- 1.- Control of the particular unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the particular unit process.
- 3.- Calibration of all sensors included in the particular unit process.
- 4.- Hand on of all the actuators involved in the particular unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the particular unit. (These experiments can be decided previously).
- 6.- 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).
- 7.- PLC hardware general use.
- 8.- PLC process application for the particular unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC program languages.
- 13.- PLC different programming standard languages (ladder diagram (LD), structured text (ST), instructions list (IL), sequential function chart (SFC), function block diagram (FBD)).
- 14.- New configuration and development of new process.
- 15.- Hand on an established process.
- 16.- To visualize and see the results and to make comparisons with the particular unit process.
- 17.- Possibility of creating new process in relation with the particular unit.
- 18.- PLC Programming Exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

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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.

⑨ **MDUC/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.

c) Multipost Expansions options

⑩ **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.



C/ Del Agua, 14. Polígono Industrial San José de Valderas.
28918 LEGANÉS. (Madrid). ESPAÑA - SPAIN.
Tel.: 34-91-6199363 Fax: 34-91-6198647
E-mail: edibon@edibon.com Web: www.edibon.com

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