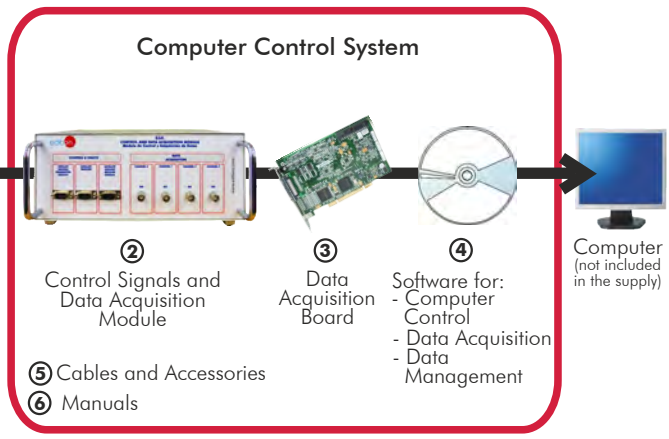
edibon
Technical Teaching Equipment

Satellite Trainer

ESA

① Unit: ESA. Satellite Trainer



Key features:

- **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, 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.**
- **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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Products
Products range
Units
3.-Communications

ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate and
Worlddidac Member

INTRODUCTION

Nowadays satellite communications are the only way to obtain a global coverage (for marine and land communications). This important characteristic of this technology provides a reliable communication in places without conventional coverage provided by ground antennas.

Satellite communication (SATCOM) is an extended technology with application in a wide range of fields such as military, marine communication, TV broadcasting, positioning system, etc.

The Satellite Trainer "ESA" provides a practical example of the technology used in a satellite communication link and all the information about the main components involved. The "ESA" trainer is provided with a set of practical exercises, through which the student will familiarize with the operation of a Satellite Communication System.

GENERAL DESCRIPTION

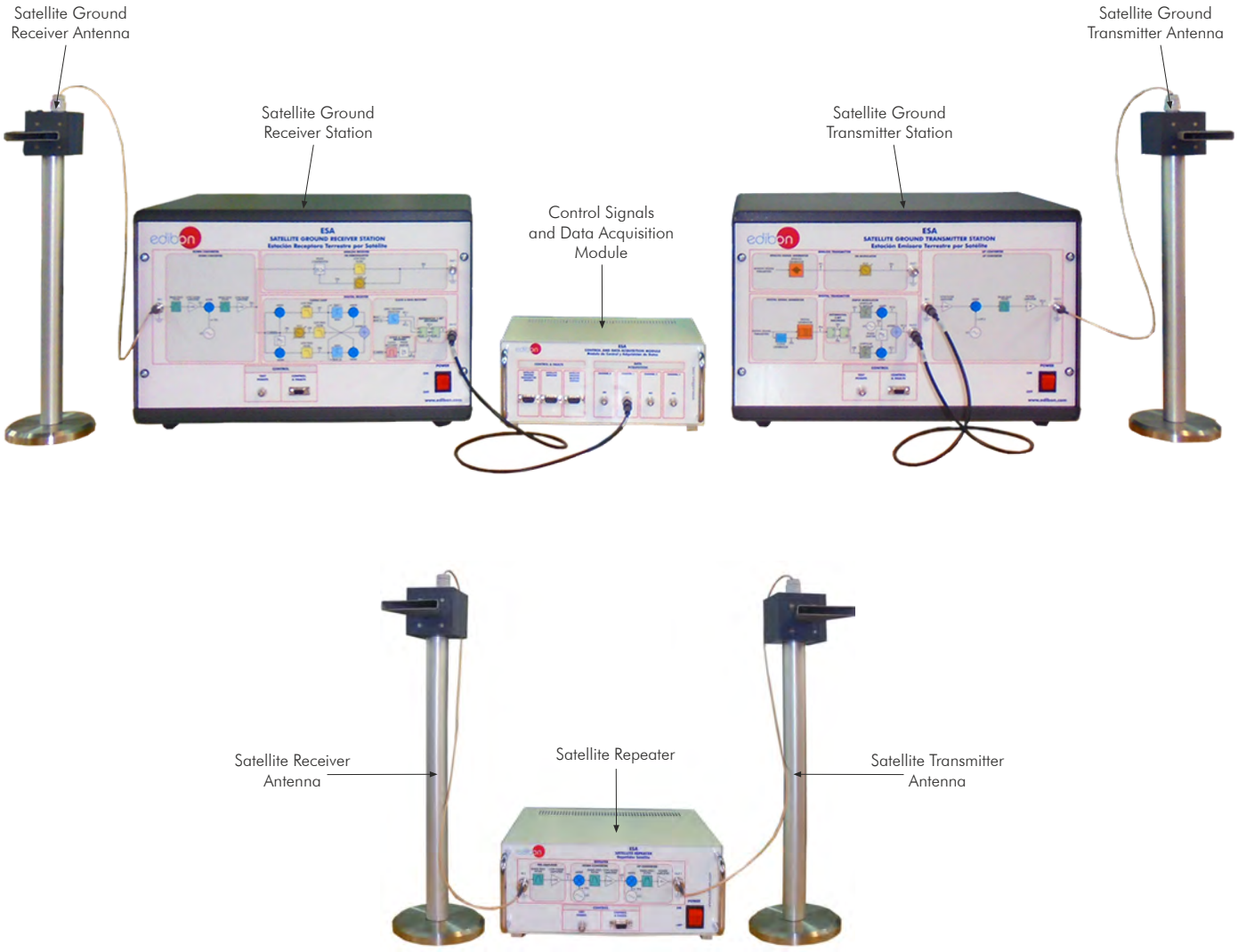
The "ESA" trainer is an advanced system that operates in conjunction with a computer (PC), which allows students an easy way to manage and visualize the data. The "ESA" software allows to perform multiple actions: configuring the sending data, selecting the desired test point to visualize, selecting different faults in the equipment, etc.

The "ESA" trainer is divided into different modules to allow the student a better understanding of the unit. These modules are: Satellite Ground Transmitter Station, Satellite Ground Receiver Station, Satellite Repeater and the Control Signal and Data Acquisition Module.

The Satellite Ground Transmitter Station works as a real ground based equipment, transmitting the signal (Uplink) to the Satellite Repeater through the Satellite Ground Transmitter Antenna. The Satellite Ground Receiver Station works as a real ground based equipment, receiving the signal (Downlink) from the Satellite Repeater through the Satellite Ground Receiver Antenna. Both, Transmitter and Receiver, are connected to the computer for signal analysis, configuring the data transmission, data visualization, etc.

The Satellite Repeater Module works as real active satellite repeater. It includes a processing system that amplifies the incoming signal from the Satellite Ground Transmitter Station (Uplink) through the Satellite Receiver Antenna, and emits the processed signal in a different band of frequencies (Downlink) through the Satellite Transmitter Antenna.

UNIT ELEMENTS ALLOCATION



① ESA. Unit:

Satellite Ground Transmitter Station (in metallic box):

Block diagram on the front panel with the components of the Satellite Ground Transmitter Station.

Different test points to connect to the Control Signal and Data Acquisition Module, to visualize in the computer the internal signals and the intermediate steps in the modulation of a signal and generation of the uplink.

Possibility of insert different faults to test the response of the system to components failure.

Generators:

Analog Generator:

Analog signal parameters configured with the software.

Audio Frequency Range: 0 Hz to 100 Hz.

Digital Generator:

Digital signal parameters configured with the software.

One byte sent per cycle.

Satellite Ground Transmitter Station
+ Satellite Ground Receiver Station
+ Control Signals and Data Acquisition Module

Modulators:

Analog Modulator:

FM modulator based on Voltage Controlled Oscillator.

Digital Modulator:

DQPSK modulator based on PSK modulator.

Up Converter (Two steps up-converter): Receive the original modulated signal and generates the Uplink to be transmit to the Satellite Repeater.

First Local Oscillator: 10 kHz.

Second Local Oscillator: 916 MHZ.

BNC connector to Satellite Ground Transmitter Antenna.

Satellite Repeater (in metallic box):

Block diagram on the front panel with the components of the Satellite Repeater.

Different test points to connect to the Control Signal and Data Acquisition Module, to visualize in the computer the internal signals and the intermediate steps in the Satellite Repeater.

Possibility of insert different faults to test the response of the system to components failure.

Down Converter (Two steps down-converter): Receive the Uplink and recover the original modulated signal:

First Local Oscillator: 916 MHZ.

Second Local Oscillator: 10 kHz.

BNC connector to Satellite Receiver Antenna.

Up Converter (Two steps up-converter): Receive the original modulated signal and generates the Downlink to be transmit to the Satellite Ground Receiver Station:

First Local Oscillator: 8 kHz.

Second Local Oscillator: 869 MHZ.

BNC connector to Satellite Transmitter Antenna.

Satellite Repeater

Satellite Ground Receiver Station (in metallic box):

Block diagram on the front panel with the components of the Satellite Ground Receiver Station.

Different test pointsto connect to the Control Signal and Data Acquisition Module, to visualize in the computer the internal signals and the intermediate steps in the reception of the downlink and demodulation of a signal.

Possibility of insert different faults to test the response of the system to components failure.

Down Converter (Two steps down-converter): Receive the Downlink and recover the original modulated signal:

First Local Oscillator: 869 MHZ.

Second Local Oscillator: 8 kHz.

BNC connector to Satellite Ground Receiver Antenna.

Demodulators:

Analog Demodulator:

FM demodulator based on PLL circuit.

Digital Demodulator:

DQPSK demodulator based on Costas Loop circuit.

Four Antennas for the Satellite Ground Transmitter and Receiver stations and the Satellite Repeater:

Horn antenna:

Operates in the Microwaves band of frequencies.

Sectorial horn antenna.

Flared in the direction of the magnetic plane (H-plane).

Antenna holder and structure:

Fixed antenna holder.

Continue...

The complete unit includes as well:

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, 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.

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 Control Signal and Data Acquisition Module:

Metallic box.

Control & Faults: To connect to the different Control & Faults connectors of the unit.

Three DB-9 connectors to Satellite Ground Transmitter/Receiver Stations and Satellite Repeater.

Data Acquisition: To connect to the different test points of the unit.

Four BNC connectors to analog inputs.

250.000 samples per second in each channel.

Voltage range: ±10V.

Control Signal and Data Acquisition Module

③ DAB. Data Acquisition Board:

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/0. DMA channels=6.

Analog output:

Number of **channels=2**. **Resolution=16 bits**, 1 in 65536. Maximum output rate up to: 900KS/s.

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

Digital Input/Output:

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

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

DAB

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

It works in conjunction with the "Control Signal and Data Acquisition Module" and it used to perform several tasks:

Generation configuration of the analog and digital signals that the user wants to transmit through the Satellite link.

Select the desired test points in the Satellite Ground Transmitter Station, Satellite Ground Receiver Station and the Satellite Repeater to be visualized.

Select the desired fault in the Satellite Ground Transmitter Station, Satellite Ground Receiver Station and the Satellite Repeater to analyze the response of the system.

Compatible with actual Windows operating systems.

Compatible with the industry standards.

Registration and visualization of all values and data information in an automatic and simultaneous way

Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all data from the system.

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

Graphic representation in real time

Comparative analysis of the obtained data, after the process with different parameters configuration

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.

ESA/CCSOF

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is **supplied with the following manuals**: Required Services, Assembly and Installation, Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

* References 1 to 6 are the main items: ESA + Control Signal and Data Acquisition Module + DAB + ESA/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Study of the operation principles of a satellite communication system.

2.- Basic principles of analog modulation, frequency modulation (FM).

3.- Basic principles of analog demodulation, frequency modulation (FM).

4.- Basic principles of digital modulation, differential quadrature phase shift keying (DQPSK).

5.- Basic principles of digital demodulation, differential quadrature phase shift keying (DQPSK).

6.- Study of the characteristics of the Satellite Ground Transmitter Station, Satellite Repeater and Satellite Ground Receiver Station.

7.- Study of the communication system through a Satellite Repeater performing the uplink and downlink.

8.- Performing data transfers through a satellite communication system (Satellite Ground Transmitter Station–Satellite Repeater-Satellite Ground Receiver Station).

9.- Study of the quality of the data transmission link.

10.- Analysis of the system response with different fault insertions in the Satellite Ground Transmitter Station.

11.- Analysis of the system response with different fault insertions in the Satellite Repeater.

12.- Analysis of the system response with different fault insertions in the Satellite Ground Receiver Station.

REQUIRED SERVICES

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

- Computer.

DIMENSIONS & WEIGHTS

ESA:

Satellite Ground Transmitter Station:

-Dimensions: 490 x 330 x 310 mm. approx.
(19.29 x 12.99 x 12.2 inches approx.).

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

Satellite Repeater:

-Dimensions: 310 x 220 x 180 mm. approx.
(12.2 x 8.66 x 7.08 inches approx.).

-Weight: 5 Kg. approx.
(11 pounds approx.).

Satellite Ground Receiver Station:

-Dimensions: 490 x 330 x 310 mm. approx.
(19.29 x 12.99 x 12.2 inches approx.).

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

Control and Data Acquisition Module:

-Dimensions: 310 x 220 x 180 mm. approx.
(12.2 x 8.66 x 7.08 inches approx.).

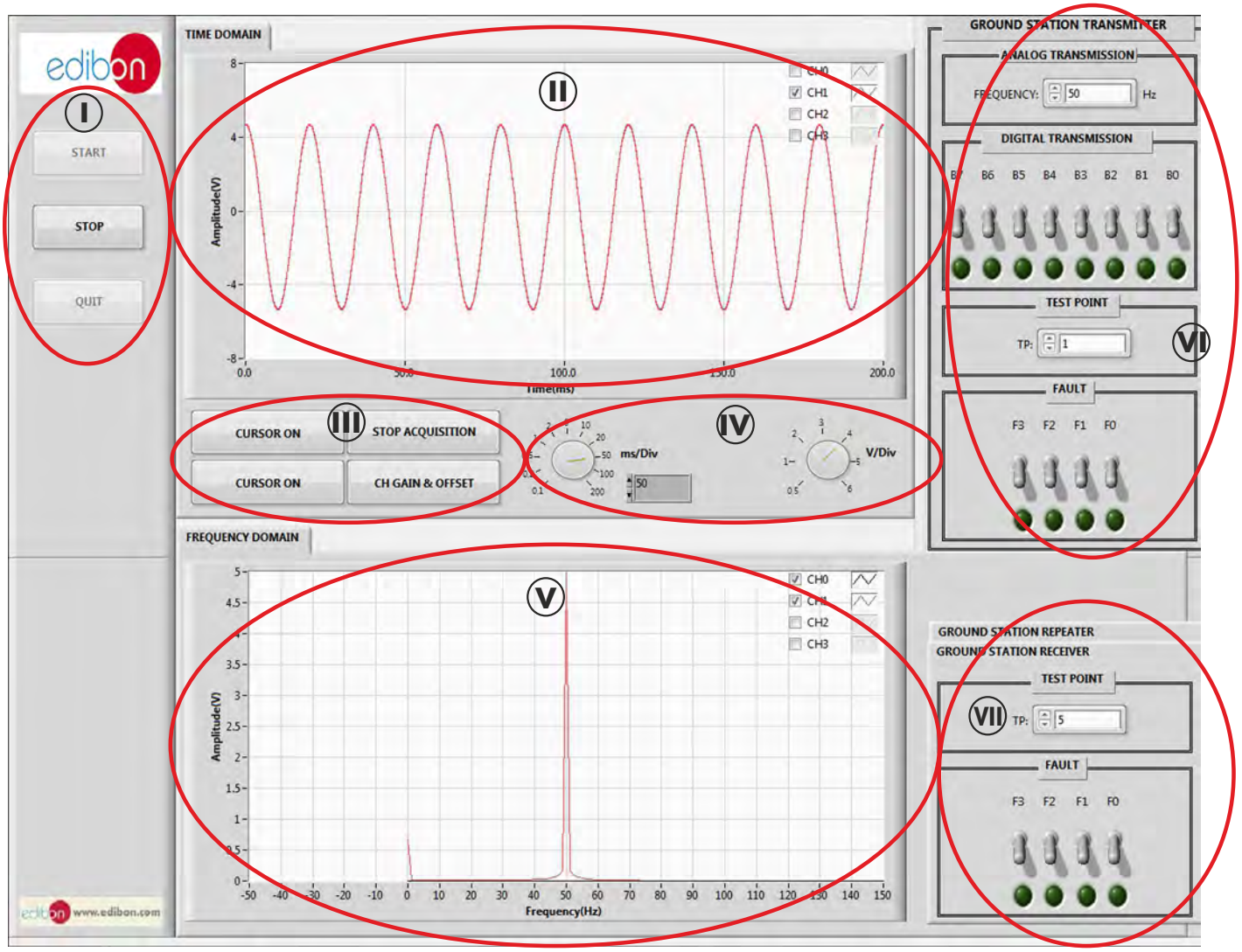
-Weight: 4 Kg. approx.
(8.81 pounds approx.).

Antennas (each one):

-Dimensions: 310 x 310 x 500 mm. approx.
(12.2 x 12.2 x 19.68 inches approx.).

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

Main screen



I **Main software operation buttons.**

II **Time domain graph** of the selected signals, with the scale parameters for the complete configuration of the graph.

III **Graph control panel:** allows to stop the signal acquisition, activate the cursors of the time domain chart and frequency domain chart and adjust the offset and gain of every channel separately.

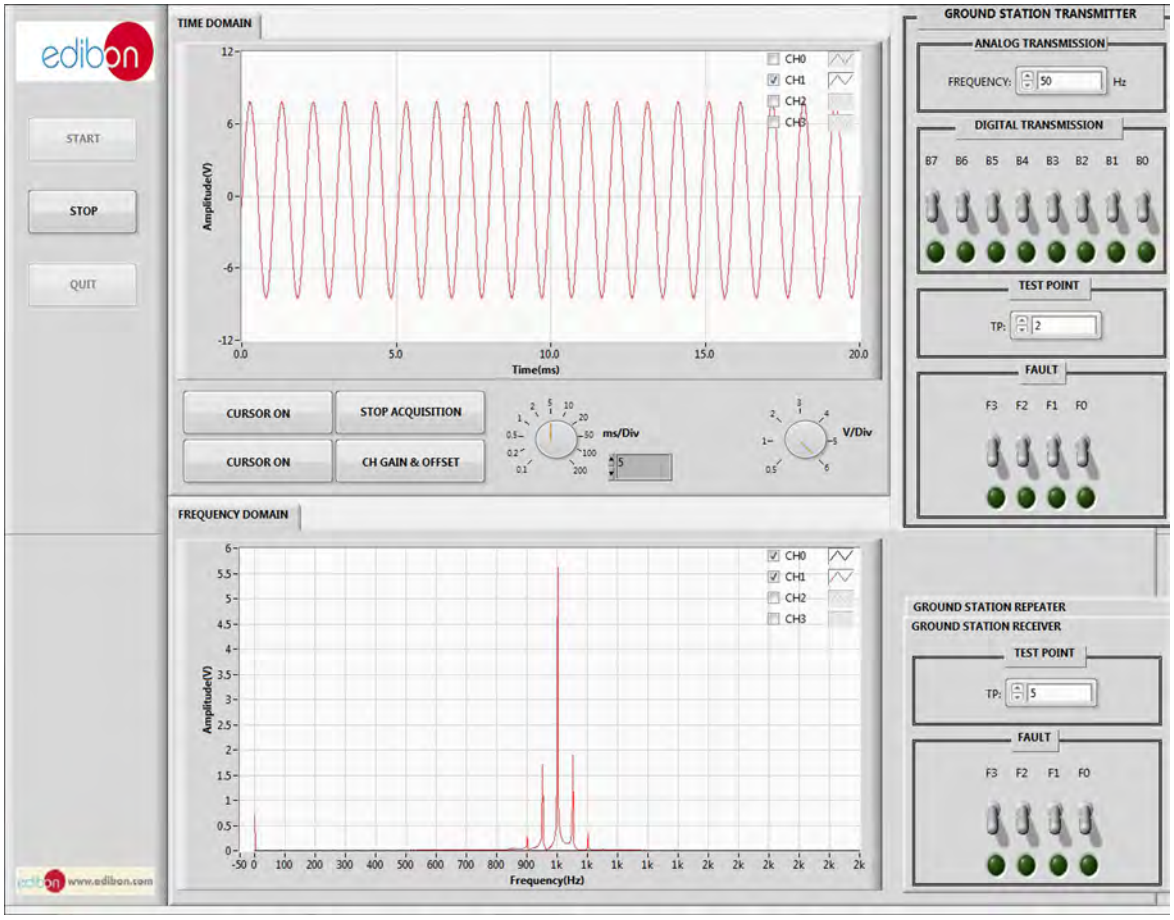
IV The time domain graph include two knobs to adjust the time per division and the voltage per division.

V **Frequency domain graph** of the selected signals, with the scale parameters for the complete configuration of the graph.

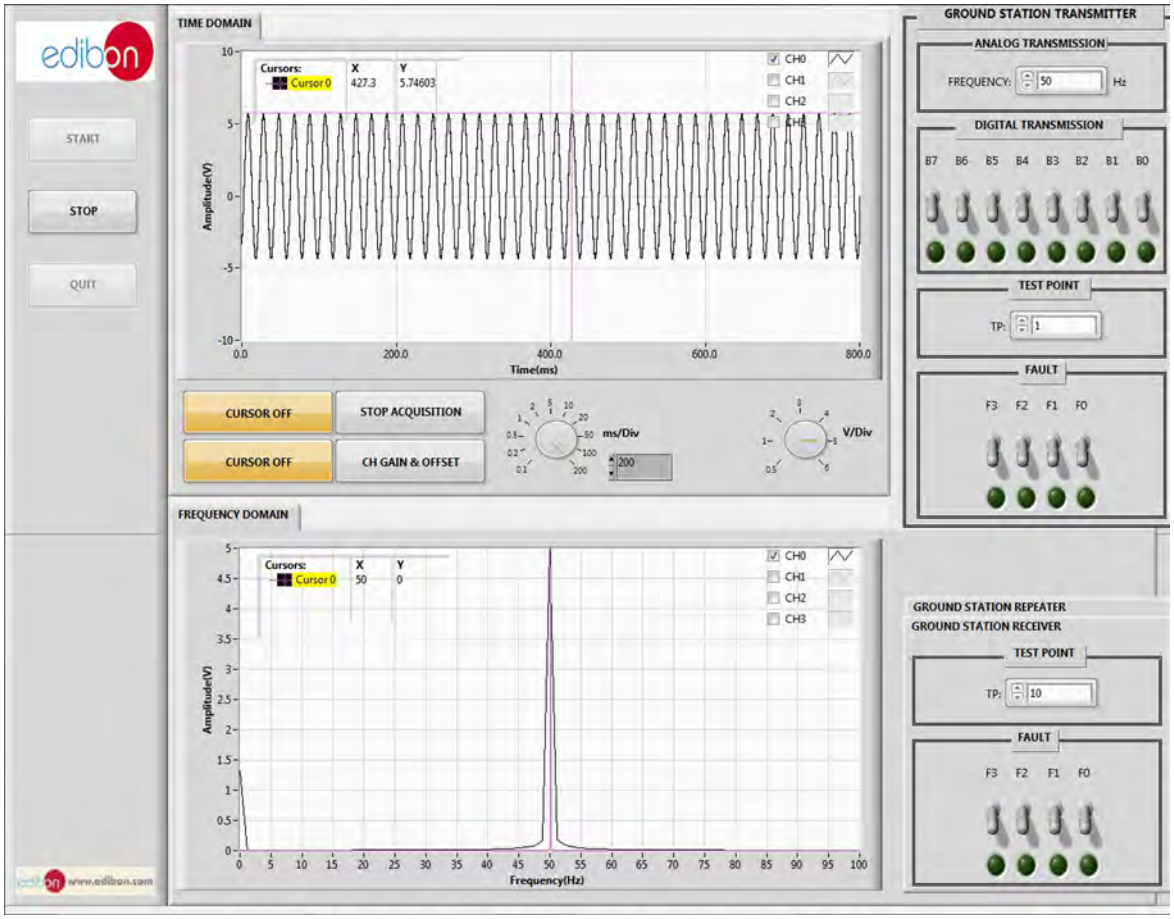
VI **Satellite Ground Transmitter Station setting:** allows to configure the parameters of the analog and digital generation. This settings also allows to select the test point and fault of the Satellite Ground Transmitter Station.

VII **Satellite Ground Receiver Station and Satellite Repeater setting:** allows to select the test point and the fault of the Satellite Ground Receiver Station and Satellite Repeater.

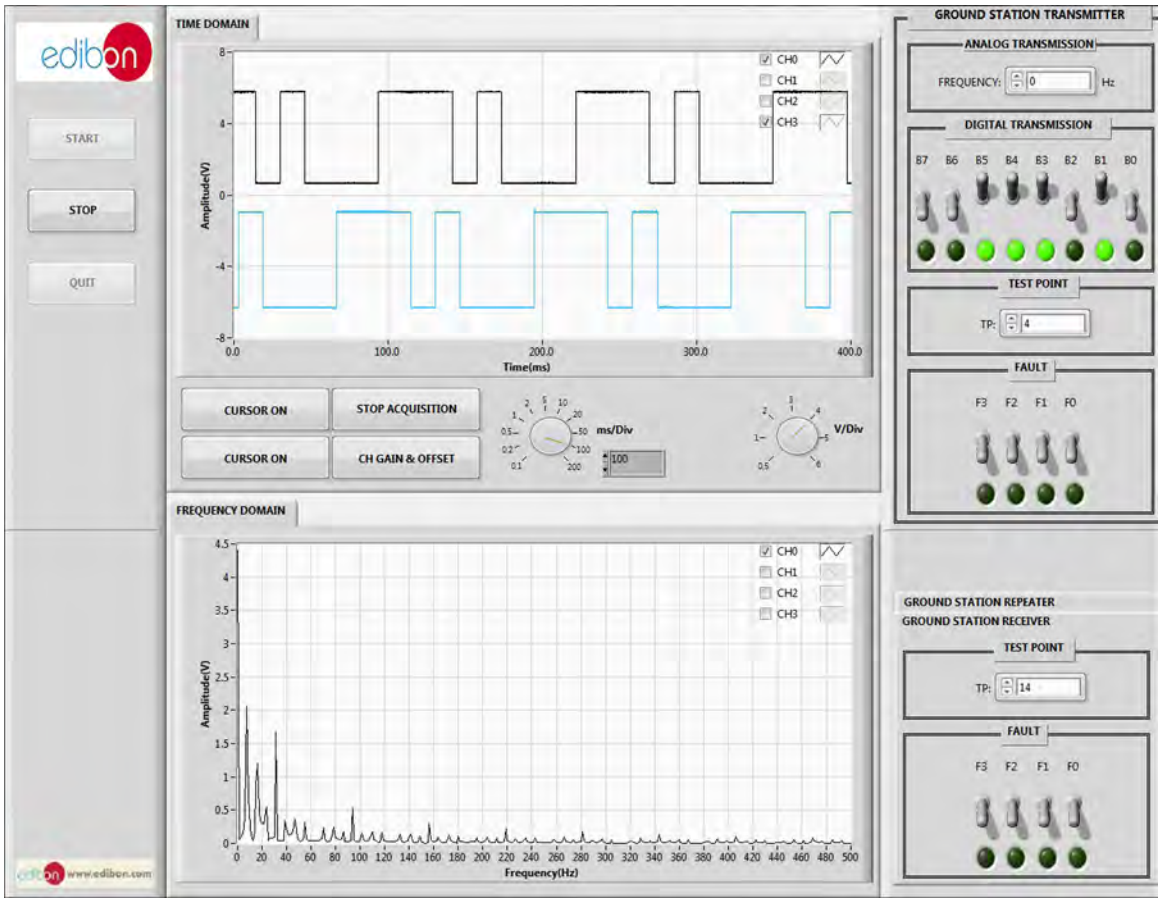
The screen below shows the analysis of a FM signal in time domain and in frequency domain.



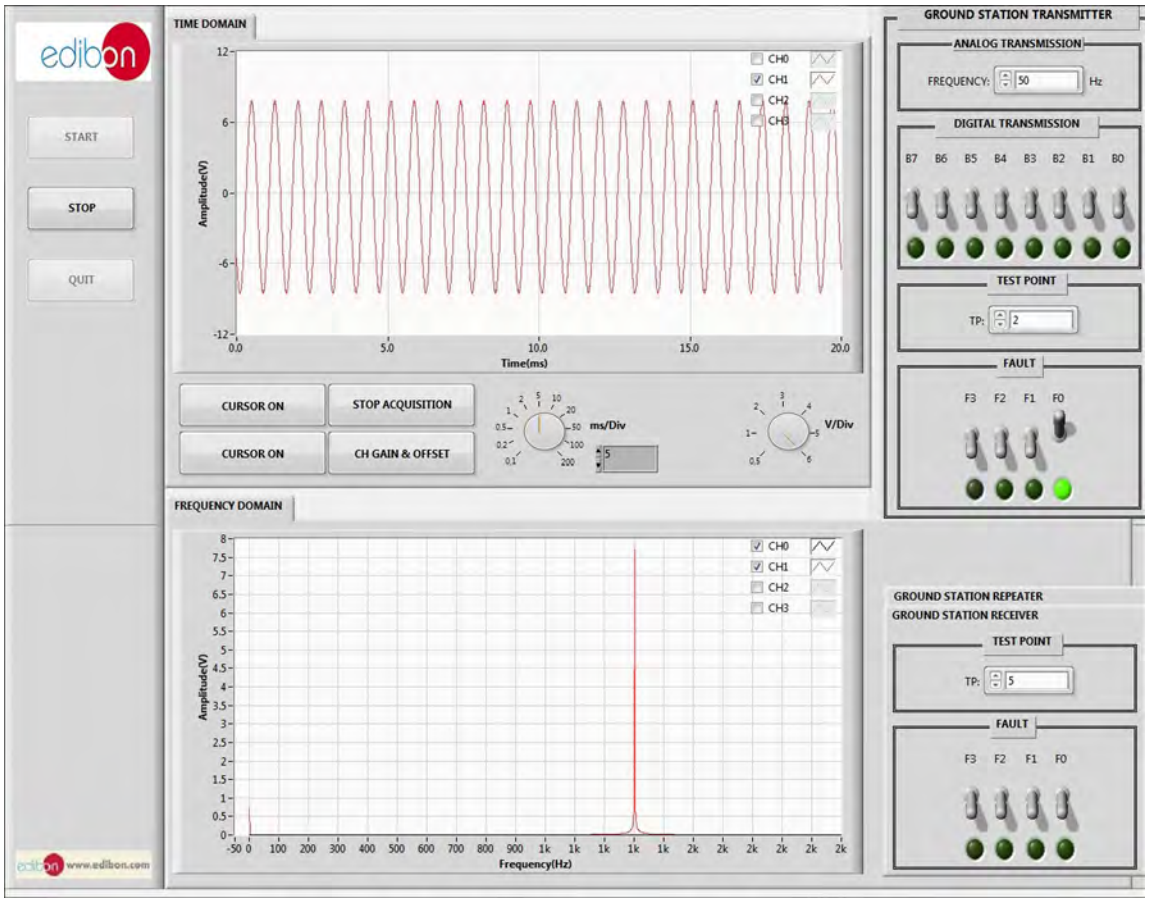
The screen below shows the use of the cursors to facilitate the analysis of the input signals. The screen shows the analysis of a 50 Hz signal.



The screen below shows the analysis of a digital signal transmitted and received in time domain and in frequency domain. The generation of the digital signal is configured with switches at the right of the screen.
The signals can be compared in the same time domain chart by adjusting the offset of the signals, as shown in the image.



The screen below shows the analysis of a signal with an inserted fault in the Satellite Ground Transmitter Station. The faults can be configured at the right of the screen. In the image, the inserted fault is "F0".



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

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REPRESENTATIVE: