Technical Teaching Equipment

Computer Controlled **Teaching Unit for the Study of Digital Signal Processing**

TDS

EDIBON PATENT

① Unit: TDS. Teaching Unit for the Study of Digital Signal Processing, including Control Interface

Teaching Technique used

RTC. EDIBON Real Time Control System

② Data Acquisition Board

③ Software for:
- Computer Control
- Data Acquisition
- Data Management

④ Cables and Accessories

⑤ Manuals

Computer (not included in the supply)

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

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

Key features:

- **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.**

www.edibon.com
Products
Products range
Units
2.-Electronics

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

The Digital Signal Processing is a mathematical manipulation of the data signal to adapt and improve the input signal in some way. Some examples of the digital signal processing are: digital noise reduction, signal filtering etc.

The digital signal processing helps to reach a reliable communication links with high data transfer rates and good noise rejection.

The Teaching Unit for the Study of Digital Signal Processing "TDS" allows to understand the principles of digital signal processing and signal analysis.

GENERAL DESCRIPTION

The Teaching Unit for the Study of Digital Signal Processing "TDS" allows to study the principles and more important concepts about digital signal processing, including study and practical exercises, among others, of:

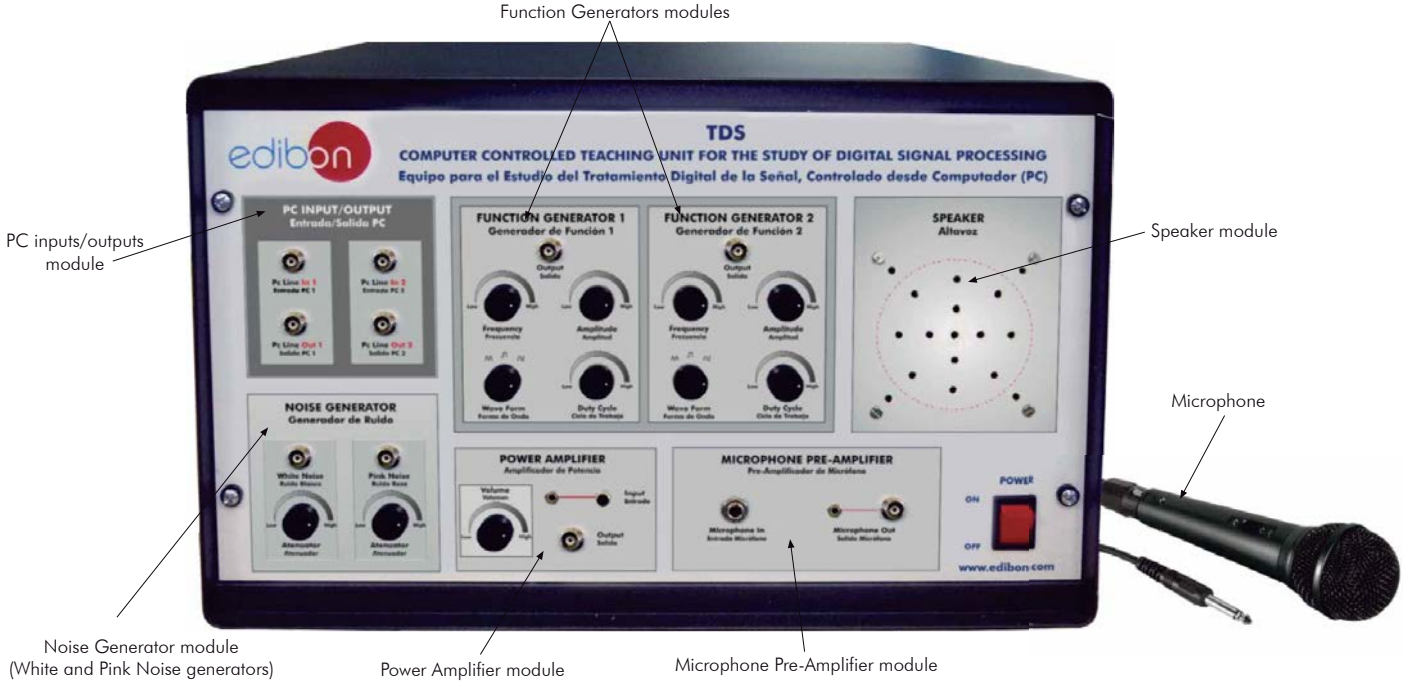
- Continuous waveforms generation.
- Analyze the nature of the signals.
- Working simultaneously with two external signals.
- Signals digitalization.
- Fast Fourier Transform visualization.
- Study of the effects of the digital signal processing.
- Study of the effects of the analog and digital filters.
- To analyze the time and frequency responses, before and after the digital signal processing
- Behaviour of the generated signal or the user's voice when noise is added to the signal.
- Etc.
- Moreover, it is possible to generate different waveforms by the software and send them to the outputs of the unit. These signals can be visualized by an external oscilloscope or be listened by the speaker.

The "TDS" unit is based on a modular design structure to allows the user a better understanding of the unit. This unit includes the following modules:

- Two Function Generators modules: Each function generator contains a waveform selector to choose one of the three different waveform shapes (sine, triangle and square) and three potentiometers to regulate the frequency, the amplitude and the duty cycle of the signal.
- Noise Generator module: It includes two different noise generators: white noise and pink noise. Each noise generator includes a potentiometer to regulate the amplitude of the noise signal.
- Microphone and Microphone Pre-Amplifier module: It allows to record and adapt the user´s voice to be analyzed with the software of the unit.
- PC Inputs/Outputs module: It allows to connect the unit with the data acquisition board (to be placed in the computer) and shows the acquired signals in the unit software. This module contains two BNC connectors for signal inputs and two BNC connectors for signal outputs.
- Power Amplifier module: It contains a potentiometer to regulate the power amplification of the signal.
- Speaker module: It allows to hear the generated signals of the unit and to study the effects of the noise and digital signal processing in the studied signal.

All connections between modules are performed through RF coaxial cable assembly.

UNIT ELEMENTS ALLOCATION



With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4 and 5.
- Optional items: 6.

Let us describe first the main items (1 to 5):

① TDS. Unit:

Unit mounted in a metallic box.

2 Function Generators modules, each one includes:

Waveform selector: sine, square and triangular.

Frequency potentiometer, range: 20 Hz to 20 KHz.

Amplitude potentiometer, range: ± 10 V.

Duty cycle potentiometer, range: 0% to 100%.

BNC output connector.

Noise Generator module:

White noise generator:

Amplitude potentiometer, range: ± 10 V.

BNC output connector.

Pink noise generator (also called frequency inverter or noise $1/f$):

Amplitude potentiometer, range: ± 10 V.

BNC output connector.

TDS. Unit

Microphone Pre-Amplifier module:

It adapts the microphone signal to be analyzed by the data acquisition system or by the speaker.

1/4'' jack input connector for the microphone.

BNC output connector.

Microphone:

Impedance: 500 Ω.

Frequency response: 70 Hz to 14 KHz.

1/4'' jack connector.

Power Amplifier module, including:

BNC input connector.

BNC output connector.

Potentiometer to regulate the power amplifier gain.

Speaker module:

Impedance: 8 Ω.

Nominal maximum power: 30 W.

Frequency response: 100 Hz to 13 KHz.

PC input/output module, including:

2 BNC input connectors.

2 BNC output connectors.

SCSI connector to the data acquisition board (to be placed in the computer).

Possibility of working simultaneously with two external signals, facilitating operations that require more than one signal.

Moreover, it is possible to generate different waveforms by the software and send them to the outputs of the unit. These signals can be visualized by an external oscilloscope or be listened by the speaker.

The complete unit includes as well:

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.

Continue...

② 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: 900 KS/s.

Output range(V)=±10 V.

Data transfers=DMA, interrupts, programmed I/0.

DAB

Digital Input/Output:

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

D0 or DI Sample Clock frequency: 0 to 100 MHz.

Timing:

Counter/timers=4.

Resolution: Counter/timers: 32 bits.

③ TDS/CCSOF. Computer Control +Data Acquisition+Data Management Software:

Compatible with actual Windows operating systems.

Graphic and intuitive operation.

Compatible with the industry standards.

Registration and visualization of signals in an automatic and simultaneous way.

2 signals can be visualized simultaneously.

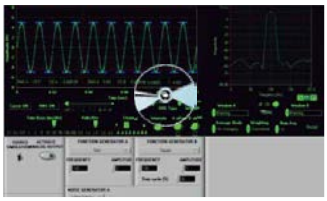
2 signals can be generated simultaneously.

Totally configurable digital filters: Infinite Impulse Response (IIR) filter and Finite Impulse Response (FIR) filter.

Totally configurable analog filters: Butterworth filter, Chebyshev filter, etc.

Visualization of frequency and time response of the signal before and after filter.

Visualization of each input signal and the signal result of the combination of the two input signals. This signal combination allows the study of the generated signal (sine, square and triangle) or the user voice (with the microphone and microphone pre-amplifier) when a white noise or pink noise is added to the signal.



TDS/CCSOF

Management, processing, comparison and storage of data.

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

④ Cables and Accessories, for normal operation.

⑤ Manuals: This unit is **supplied with the following manuals**: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

* References 1 to 5 are the main items: TDS Unit + DAB + TDS/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 MAIN ITEMS

1.- Continuous wave form generation, with the possibility of varying the frequency and amplitude of signals, besides of duty cycle.

2.- Characterization of signals. To analyze the nature of the signals: sine, square, triangular, etc.

3.- Working simultaneously with two external signals.

4.- Generating signals directly by the software and send them to the unit outputs and then visualizing or listening by the speaker or an external oscilloscope.

5.- Signal digitalization, permitting the most suitable sampling time, avoiding "aliasing".

6.- Digitalization of signals with the possibility of adjusting the sampling frequency.

7.- Fast Fourier Transforms (Power Spectrum).

8.- Addition, subtraction and multiplication of signals.

9.- Study of "aliasing".

10.- Study of different noise types:

-White noise.

-1/*f* noise.

11.- Study and use of filters:

-Possibility of filtration of any signal.

-Reconstruction of signals through the application of filters.

-Digital filters:

Finite Impulse Response (FIR) Filters and Infinite Impulse Response (IIR) Filters.

-Analogue filters:

Butterworth, Chebyshev, etc.

-Possibility to use Bartlett, Hanning, Hamming, Kaiser, Parzen, etc. windows for applying on the signal.

Other possibilities to be done with this Unit:

12.- Many students view results simultaneously.

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

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

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

15.- 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

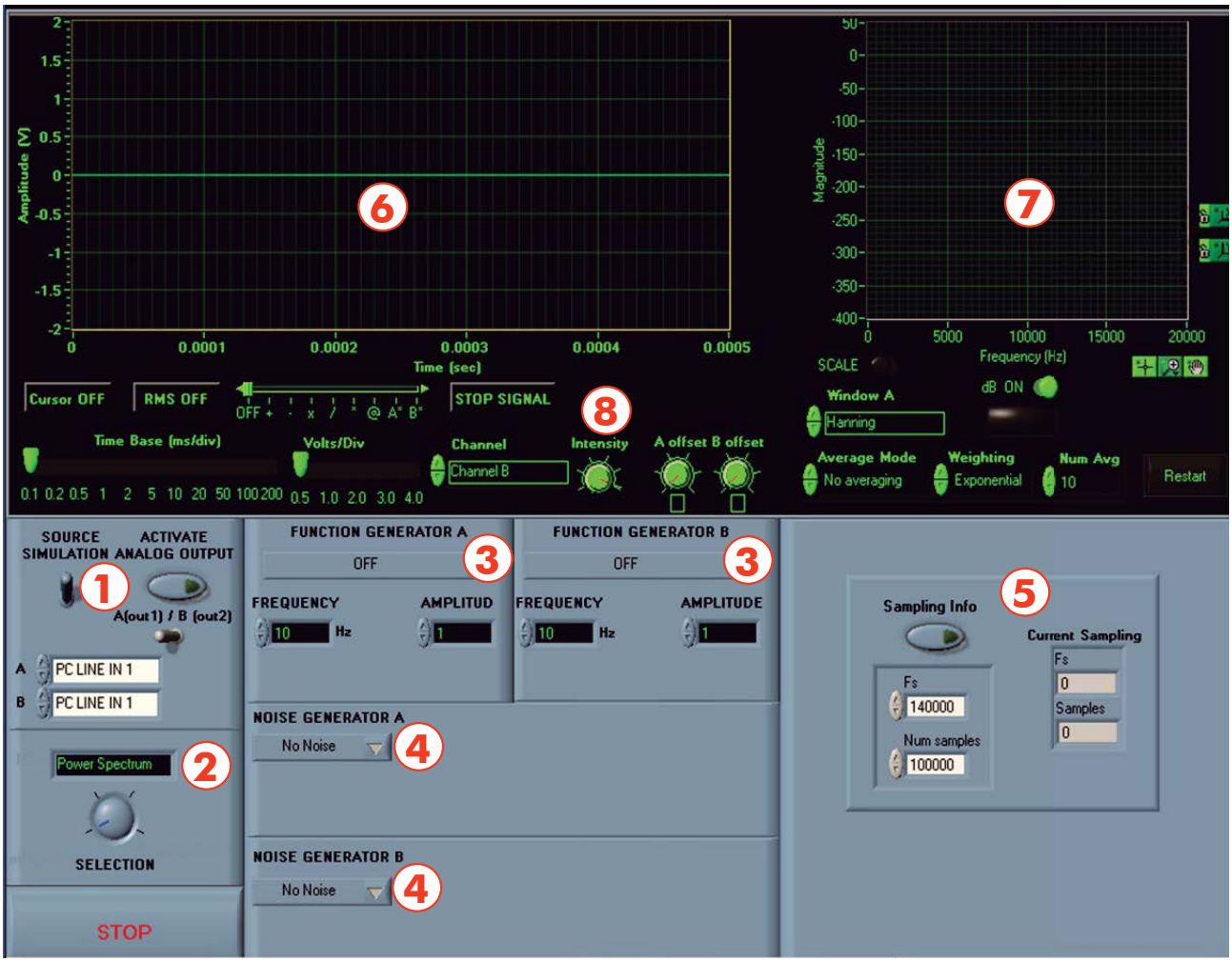
- Electrical supply: single-phase, 220V. 50Hz or 110V. 60Hz.
- Computer (PC).

DIMENSIONS & WEIGHT

-Dimensions: 490 x 330 x 310 mm. approx.
(19.29 x 12.99 x 12.20 inches approx.).

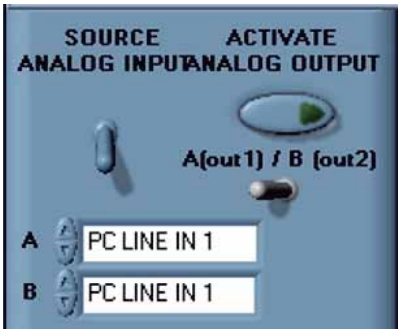
-Weight: 30 Kg. approx.
(66 pounds approx.).

Main screen

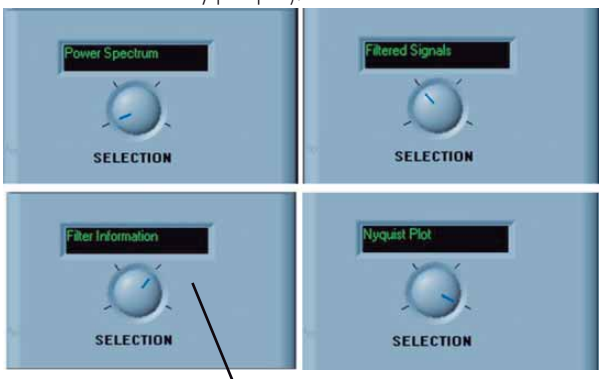


This main screen is divided in different sections:

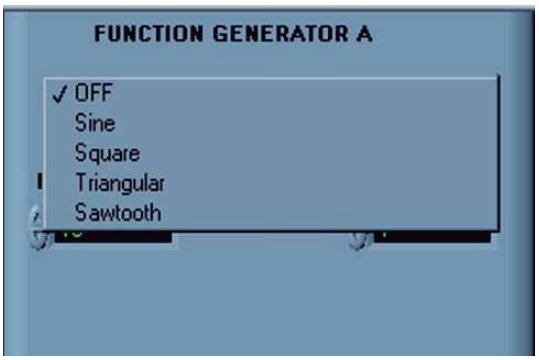
1.- Control of inputs and outputs, and source type (acquisition from the interface or simulation):



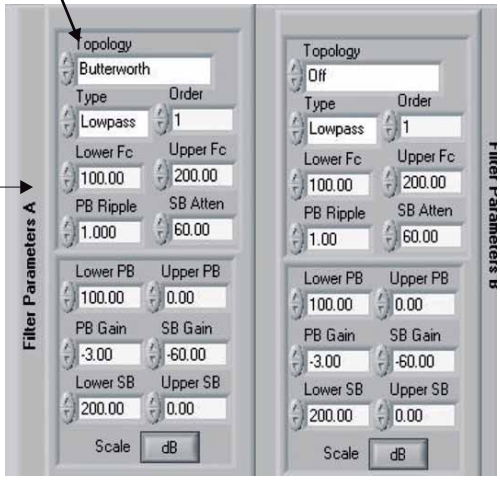
2.- Mode selection. There are 4 modes (power spectrum, filtered signals, filter information and Nyquist plot):



3.- Two Function Generators. Possibility of generating 4 different signals:

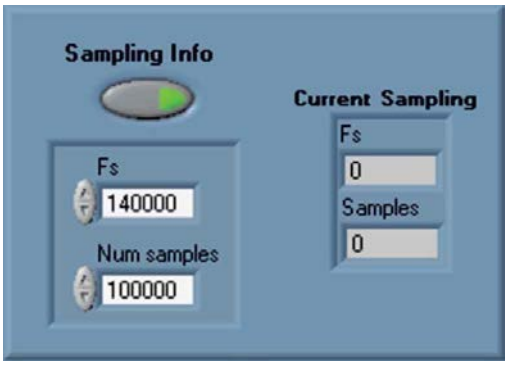


Example of Filter parameters screen

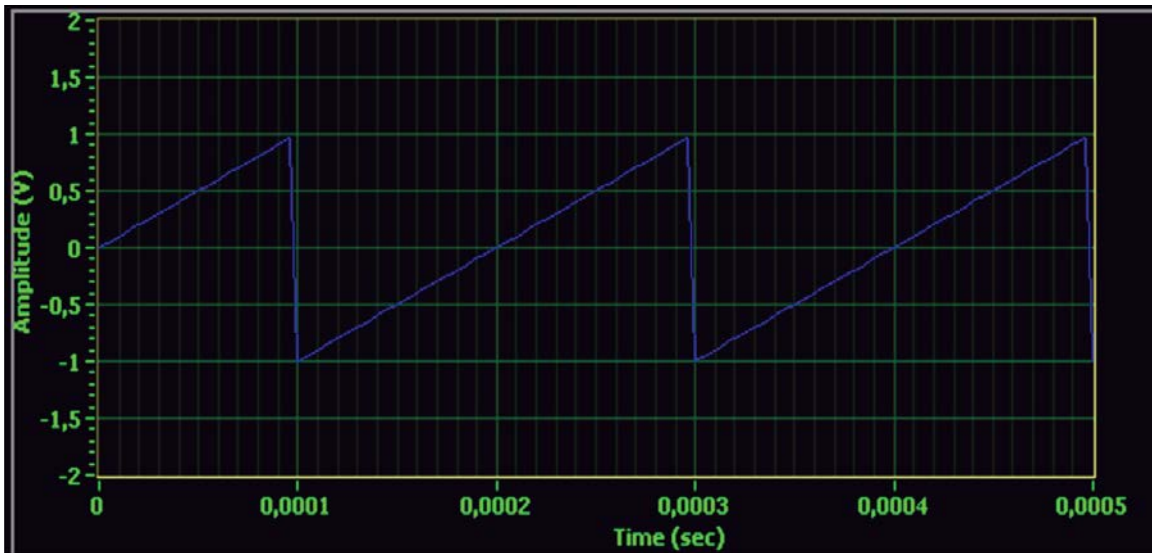


This main screen is divided in different sections:(continuation)

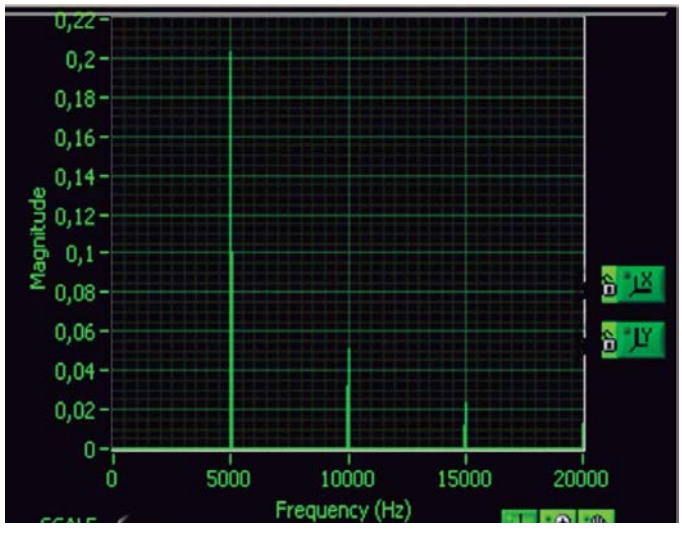
4.- Set sampling frequency:



5.- Signal/s graph visualization (in time):



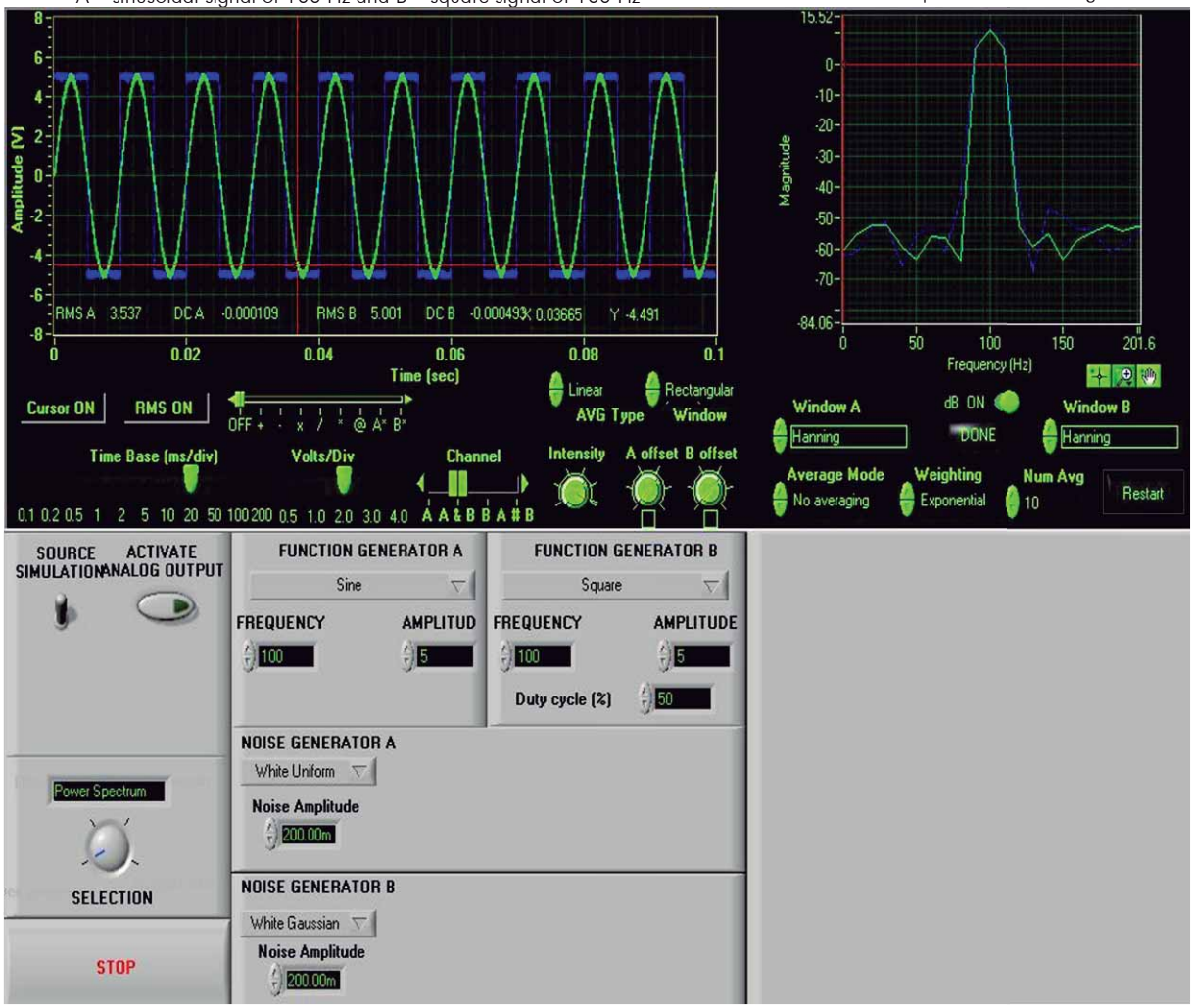
6.- Signal/s graph visualization (in frequency or time):



7.- Oscilloscope and spectroscope tools:

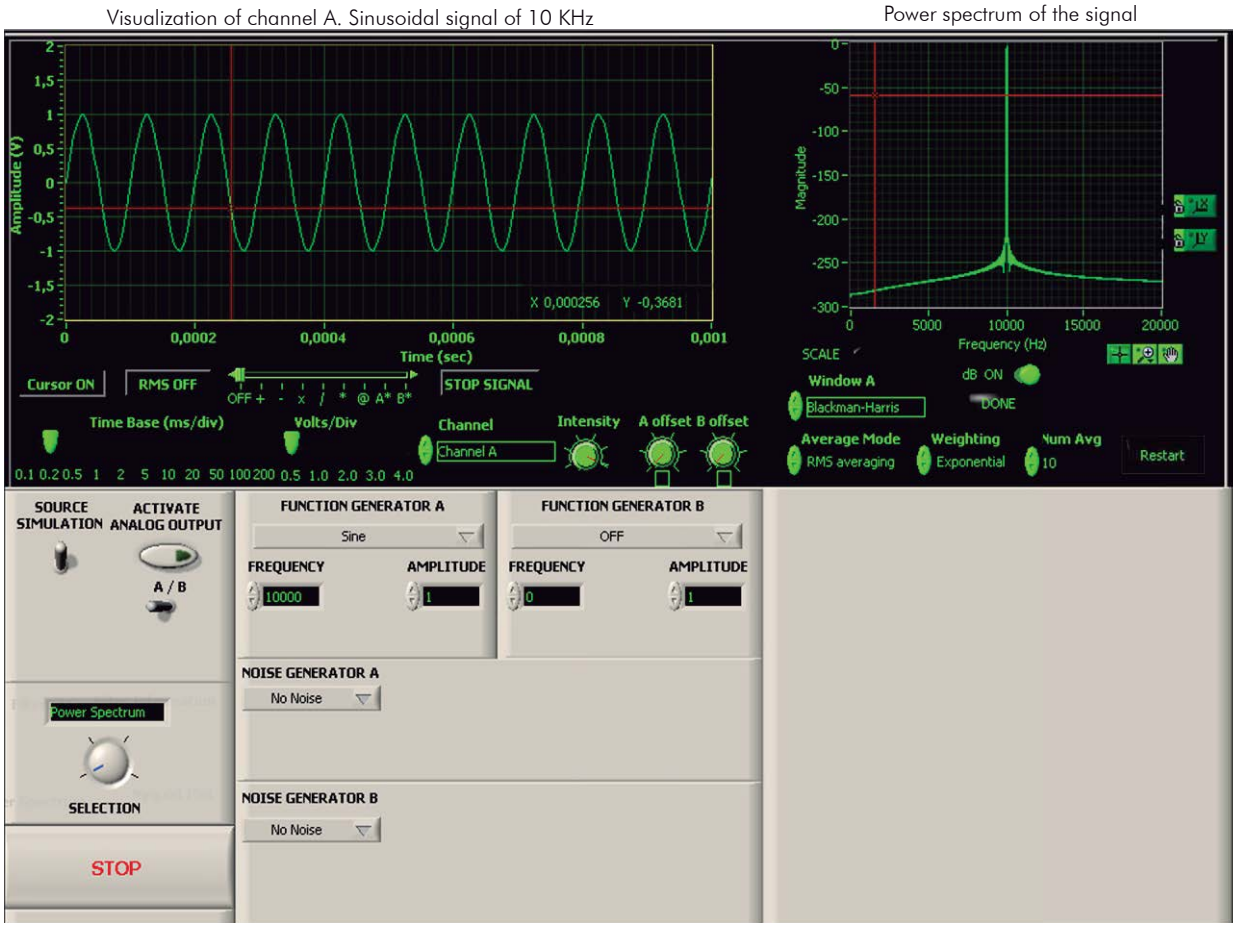
Visualization of 2 channels, A and B, simultaneously.
A= sinusoidal signal of 100 Hz and B= square signal of 100 Hz

Power spectrum of the 2 signals



Visualization of channel A. Sinusoidal signal of 10 KHz

Power spectrum of the signal

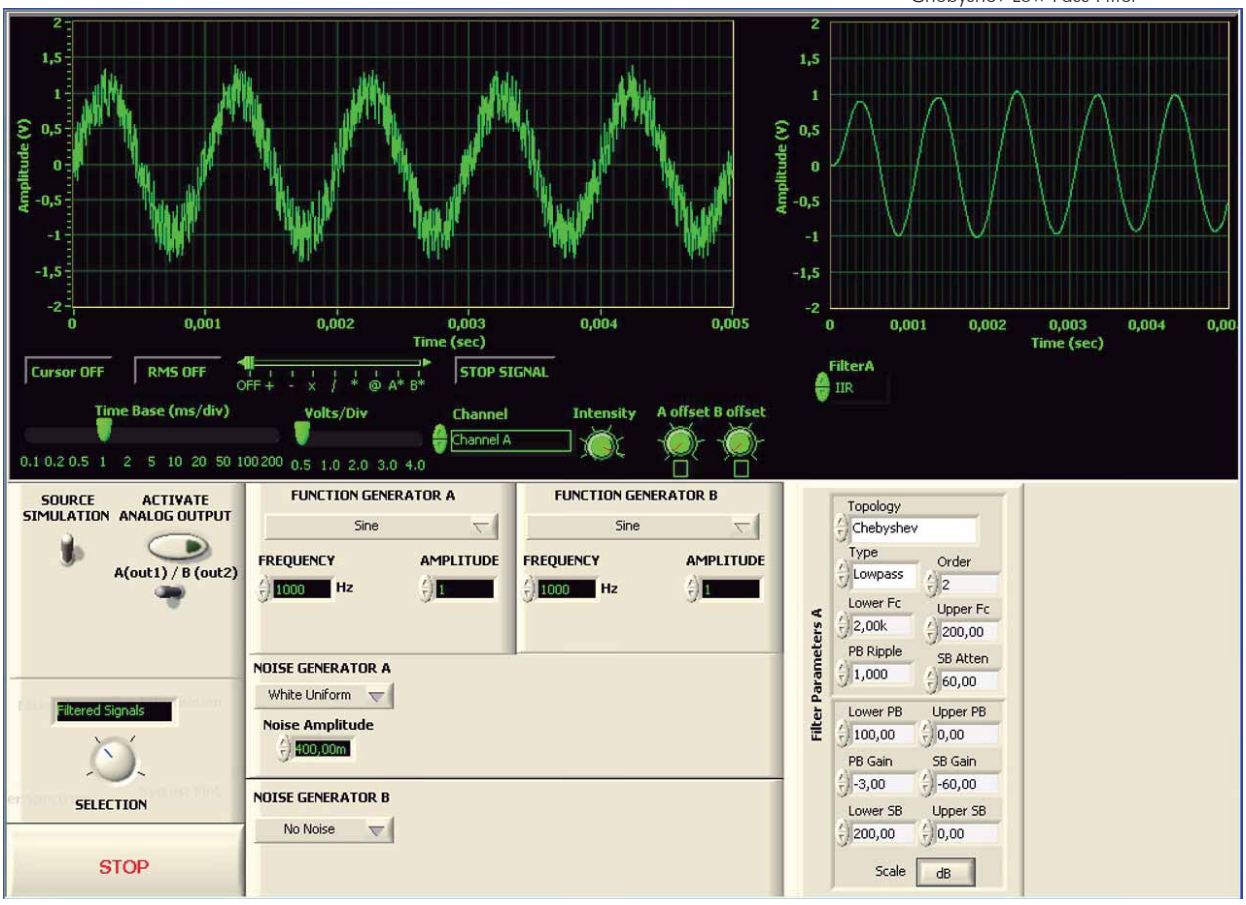


Visualization of channel B, sawtooth signal of 5 KHz.

Power spectrum of the signal

Visualization of channel A, sinusoidal signal with White Uniform Noise added

Filtered signal (signal reconstruction) through Chebyshev Low Pass Filter



Visualization of 2 channels, A and B, simultaneously.
A= square signal of 1KHz, 1V and duty cycle=50%, and B= sinusoidal signal of 1KHz and 1V.

Power spectrum of the 2 signals

COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

Additionally to the main items (1 to 5) described, we can offer, as optional, other items: 6.

These items try to give more possibilities for:

a) Technical and Vocational Education configuration. (CAI)

a) Technical and Vocational Education configuration

⑥ TDS/CAI. Computer Aided Instruction Software System.

This complete software package includes two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the TDS/SOF. Computer Aided Instruction Software (Student Software).

This software is optional and can be used additionally to items (1 to 5).

This complete software package consists of an Instructor Software (INS/SOF) totally integrated with the Student Software (TDS/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

Instructor Software

- INS/SOF. Classroom Management Software (Instructor Software):

The Instructor can:

- Organize Students by Classes and Groups.
- Create easily new entries or delete them.
- Create data bases with student information.
- Analyze results and make statistical comparisons.
- Generate and print reports.
- Detect student's progress and difficulties.
- ...and many other facilities.

Student Software

- TDS/SOF. Computer Aided Instruction Software (Student Software):

It explains how to use the unit, run the experiments and what to do at any moment.

This Software contains:

- Theory.
- Exercises.
- Guided Practices.
- Exams.

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

www.edibon.com/products/catalogues/en/CAI.pdf

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: TDS. Teaching Unit for the Study of Digital Signal Processing**

② **DAB. Data Acquisition Board.**

③ **TDS/CCSOF. Computer Control + Data Acquisition + Data Management Software.**

④ **Cables and Accessories**, for normal operation.

⑤ **Manuals.**

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

Optional items (supplied under specific order)

a) Technical and Vocational configuration

⑥ TDS/CAI. Computer Aided Instruction Software System.

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Unit mounted in a metallic box.

2 Function Generators modules, each one includes:

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- Duty cycle potentiometer, range: 0% to 100%.
- BNC output connector.

Noise Generator module:

- White noise generator:
  - Amplitude potentiometer, range: ± 10 V.
  - BNC output connector.
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- Frequency response: 70 Hz to 14 Khz.
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Analog input: Channels=16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (kilo samples per second).

Analog output: Channels=2. Resolution=16 bits, 1 in 65536.

Digital Input/Output: Channels=24 inputs/outputs.

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-TDS/SOF. Computer Aided Instruction Software (Student Software):

It explains how to use the unit, run the experiments and what to do at any moment.

This Software contains:

Theory.

Exercises.

Guided Practices.

Exams.

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

edibon INTERNATIONAL

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REPRESENTATIVE: