

TDG SHAKE TABLE – ATOM

USER MANUAL

DSPM Industria®
sensori & trasduttori

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Original Instructions

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General Safety Precautions



Seismic testing systems are potentially hazardous.



Seismic testing involves inherent hazards from high forces, rapid motions, and stored energy. You must be aware of all moving and operating components in the testing system that are potentially hazardous, particularly force actuators and upper table.

Carefully read all relevant manuals and observe all Warnings and Cautions. The term Warning is used where a hazard may lead to injury or death. The term Caution is used where a hazard may lead to damage to equipment or to loss of data.

Because of the wide range of applications with which our instruments are used, and over which we have no control, additional protection devices and operating procedures may be necessary due to specific accident prevention regulations, safety regulations, further EEA directives or locally valid regulations. The extent of our delivery regarding protective devices is defined in your initial sales quotation. We are thus free of liability in this respect.

At your request; we will gladly provide advice and quotations for additional safety devices such as protective shielding, warning signs or methods of restricting access to the equipment.

The following pages detail various general warnings that you must always heed while using materials testing equipment. You will find more specific Warnings and Cautions in the text whenever a potential hazard exists.

Your best safety precautions are to gain a thorough understanding of the equipment by reading your instruction manuals and to always use good judgement.

It is our strong recommendation that you should carry out your own safety risk assessment on the use of the test system, test methods employed, specimen loading and specimen behavior at failure.

WARNINGS



Crush Hazard - Allow only one person to always handle or operate the system.
Operator injury may result if more than one person operates the system. Before working inside the hazard area between the grips or fixtures, ensure that no other personnel can operate the computer or any of the system controls. When test is start, no one inside working space.



Crush Hazard - Take care when installing or removing a specimen, assembly, structure, or load string component.

Installation or removal of a specimen, assembly, structure, or load string component involves working inside the hazard area between bearing rails and upper table and stoppers. Keep clear of the hazard area during actuator movement. Ensure that all actuator movements necessary for installation or removal are slow and, where possible, at a low force setting.



Hazard - Press the Emergency Stop button whenever you consider that an unsafe condition exists.

The Emergency Stop button removes hydraulic power or electrical drive from the testing system and brings the hazardous elements of the system to a stop as quickly as possible. It does not isolate the system from electrical power, other means are provided to disconnect the electrical supply. Whenever you consider that safety may be compromised, stop the test using the Emergency Stop button. Investigate and resolve the situation that caused the use of the Emergency Stop button before you reset it.



Flying Debris Hazard - Make sure that test specimens are installed correctly in grips or fixtures to eliminate stresses that can cause breakage of grip jaws or fixture components.

Incorrect installation of test specimens creates stresses in grip jaws or fixture components that can result in breakage of these components. The high energies involved can cause the broken parts to be projected forcefully some distance from the test area. Install specimens in the center of the grip jaws in line with the load path. Insert specimens into the jaws by at least the amount recommended in your grip documentation. This amount can vary between 66% to 100% insertion depth; refer to supplied instructions for your specific grips. Use any centering and alignment devices provided.



Hazard - Protect electrical cables from damage and inadvertent disconnection.

The loss of controlling and feedback signals that can result from a disconnected or damaged cable causes an open loop condition that may drive the actuator or crosshead rapidly to its extremes of motion. Protect all electrical cables, particularly transducer cables, from damage. Never route cables across the floor without protection, nor suspend cables overhead under excessive strain. Use padding to avoid chafing where cables are routed around corners or through wall openings.



High/Low Temperature Hazard - Wear protective clothing when handling equipment at extremes of temperature.

Materials testing is often carried out at non-ambient temperatures using ovens, furnaces or cryogenic chambers. Extreme temperature means an operating temperature exceeding 60 °C (140 °F). You must use protective clothing, such as gloves, when handling equipment at these temperatures. Display a warning notice concerning low or high temperature operation whenever temperature control equipment is in use.

You should note that the hazard from extreme temperature can extend beyond the immediate area of the test.



Hazard - Do not place a testing system off-line from computer control without first ensuring that no actuator or crosshead movement will occur upon transfer to manual control.

The actuator or crosshead will immediately respond to manual control settings when the system is placed off-line from computer control. Before transferring to manual control, make sure that the control settings are such that unexpected actuator or crosshead movement cannot occur.



Robotic Motion Hazard - Keep clear of the operating envelope of a robotic device unless the device is de-activated.

The robot in an automated testing system presents a hazard because its movements are hard to predict. The robot can go instantly from a waiting state to high-speed operation in several axes of motion. During system operation, keep away from the operating envelope of the robot. De-activate the robot before entering the envelope for any purpose, such as reloading the specimen magazine.



Hazard - Set the appropriate limits before performing loop tuning or running waveforms or tests.

Operational limits are included within your testing system to suspend motion or shut off the system when upper and/or lower bounds of actuator or crosshead travel, or force or strain, are reached during testing. Correct setting of operational limits by the operator, prior to testing, will reduce the risk of damage to test article and system and associated hazard to the operator.



Electrical Hazard - Disconnect the electrical power supply before removing the covers to electrical equipment.

Disconnect equipment from the electrical power supply before removing any electrical safety covers or replacing fuses. Do not reconnect the power source while the covers are removed. Refit covers as soon as possible.



Rotating Machinery Hazard - Disconnect power supplies before removing the covers to rotating machinery.

Disconnect equipment from all power supplies before removing any cover which gives access to rotating machinery. Do not reconnect any power supply while the covers are removed unless you are specifically instructed to do so in the manual. If the equipment needs to be operated to perform maintenance tasks with the covers removed, ensure that all loose clothing, long hair, etc. is tied back. Refit covers as soon as possible.



Explosion Hazard - Wear eye protection and use protective shields or screens whenever any possibility exists of a hazard from the failure of a specimen, assembly or structure under test.

Wear eye protection and use protective shields or screens whenever a risk of injury to operators and observers exists from the failure of a test specimen, assembly or structure, particularly where explosive disintegration may occur. Due to the wide range of specimen materials, assemblies or structures that may be tested, any hazard resulting from the failure of a test specimen, assembly or structure is entirely the responsibility of the owner and the user of the equipment.

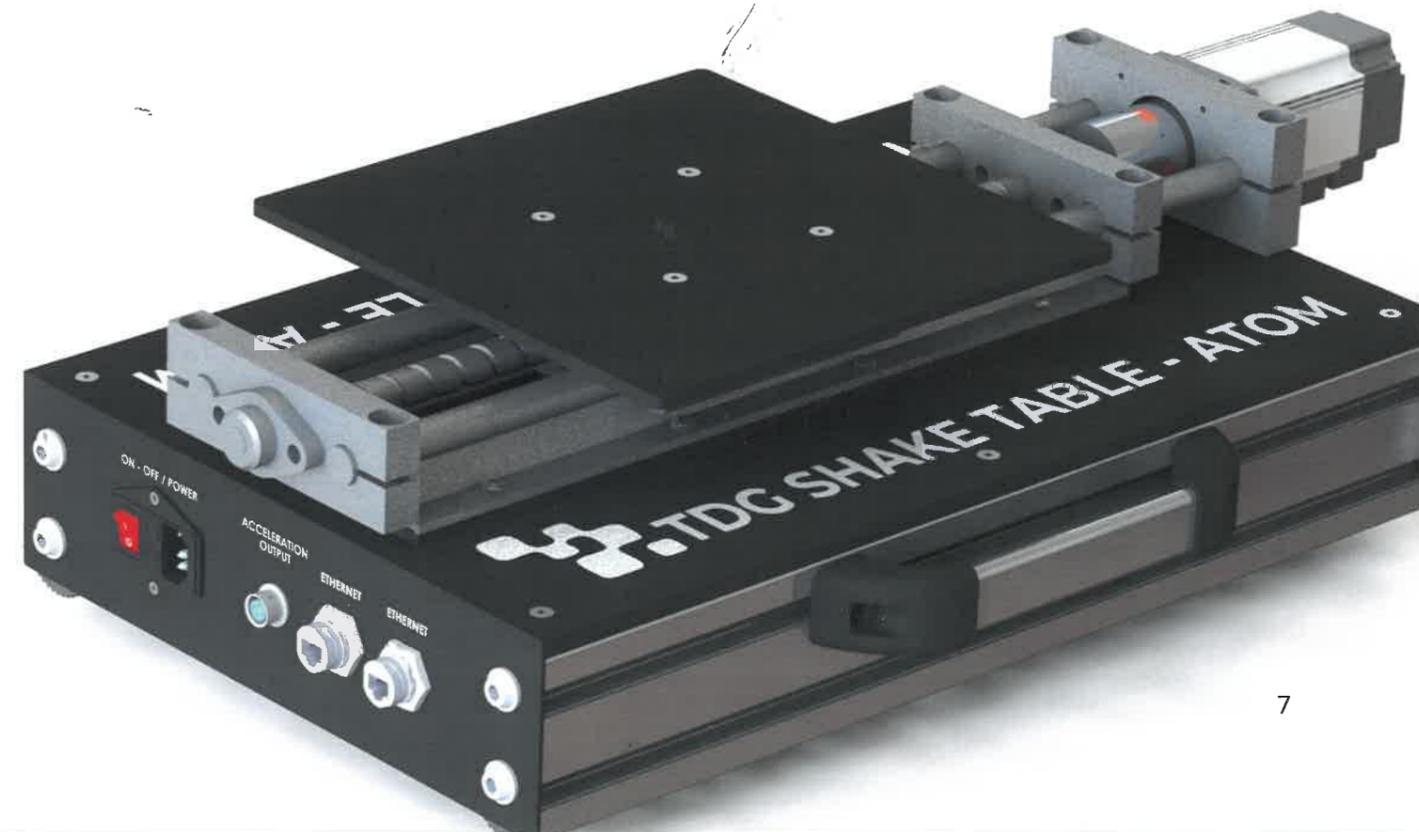


Hazard - Ensure components of the load string are correctly pre-loaded to minimize the risk of fatigue failure.

Dynamic systems, especially where load reversals through zero are occurring, are at risk of fatigue cracks developing if components of the load string are not correctly pre-loaded to one another. Apply the specified torque to all load string fasteners and the correct setting to wedge washers or spiral washers. Visually inspect highly stressed components such as grips and threaded adapters prior to every fatigue test for signs of wear or fatigue damage.

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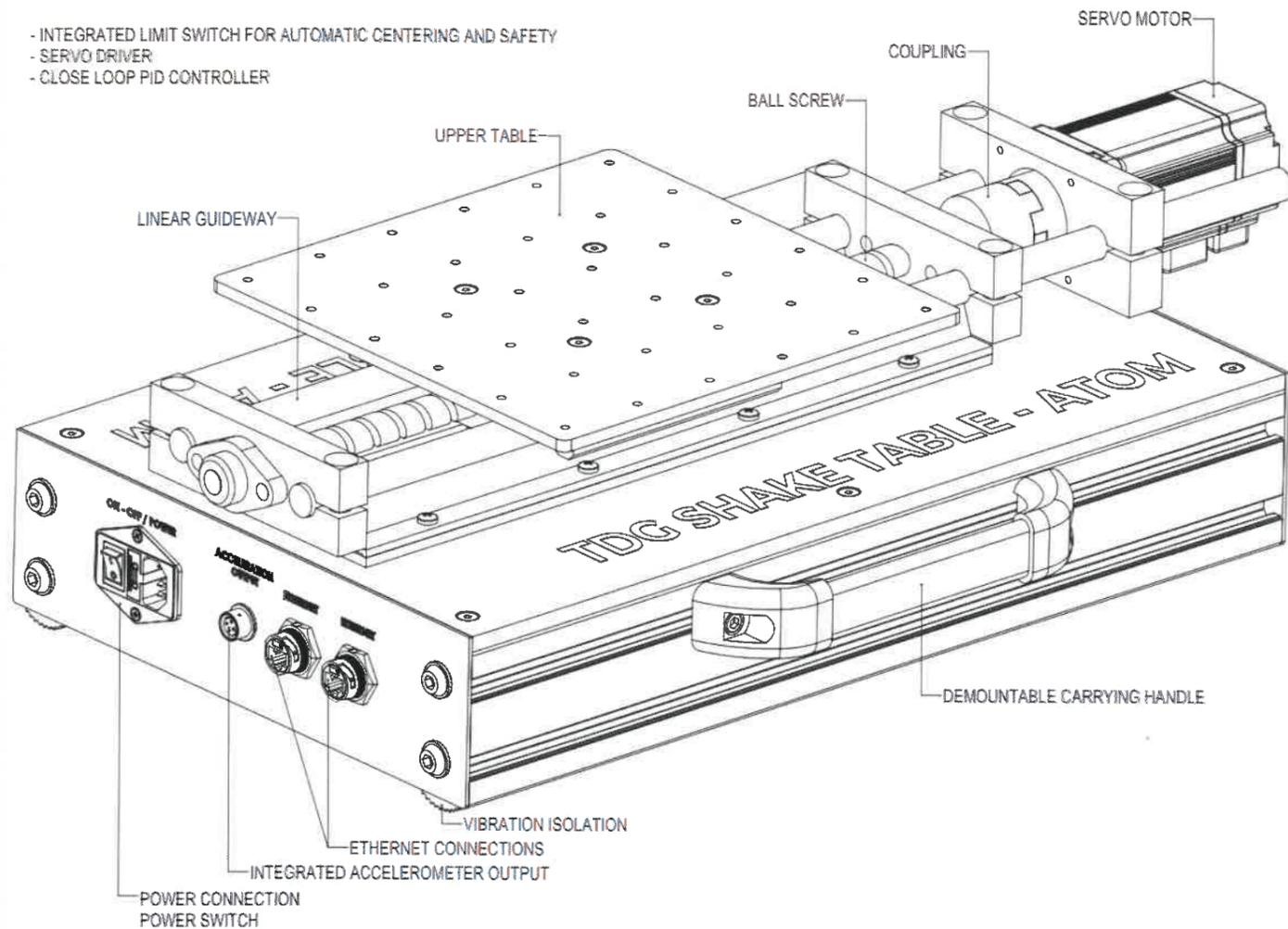
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1. HARDWARE

1.1. General Overview

- INTEGRATED LIMIT SWITCH FOR AUTOMATIC CENTERING AND SAFETY
- SERVO DRIVER
- CLOSE LOOP PID CONTROLLER



COMPONENTS	DESCRIPTION
Linear Module	Main motion component of shake table is linear module. It includes linear guideway, ball screw, upper table and coupling. Customer can fasten up specimen to upper table with M5 bolts.
Servo Motor and Driver	Servo driver transmits the motion signal to the servo motor with the command it receives from the controller.
Controller	Controller directly connect to PC with ethernet. It gives signal that takes from PC software to the servo driver.
Integrated Accelerometer and Limit Switches	There is integrated accelerometer inside shake table. Customer can observe the acceleration output data during test.
® EasyTest ShakeTable Control Software	EasyTest ShakeTable testing software that controls the testing system, running tests and analyzing test data to produce test results.

1.2. Specifications and Startup

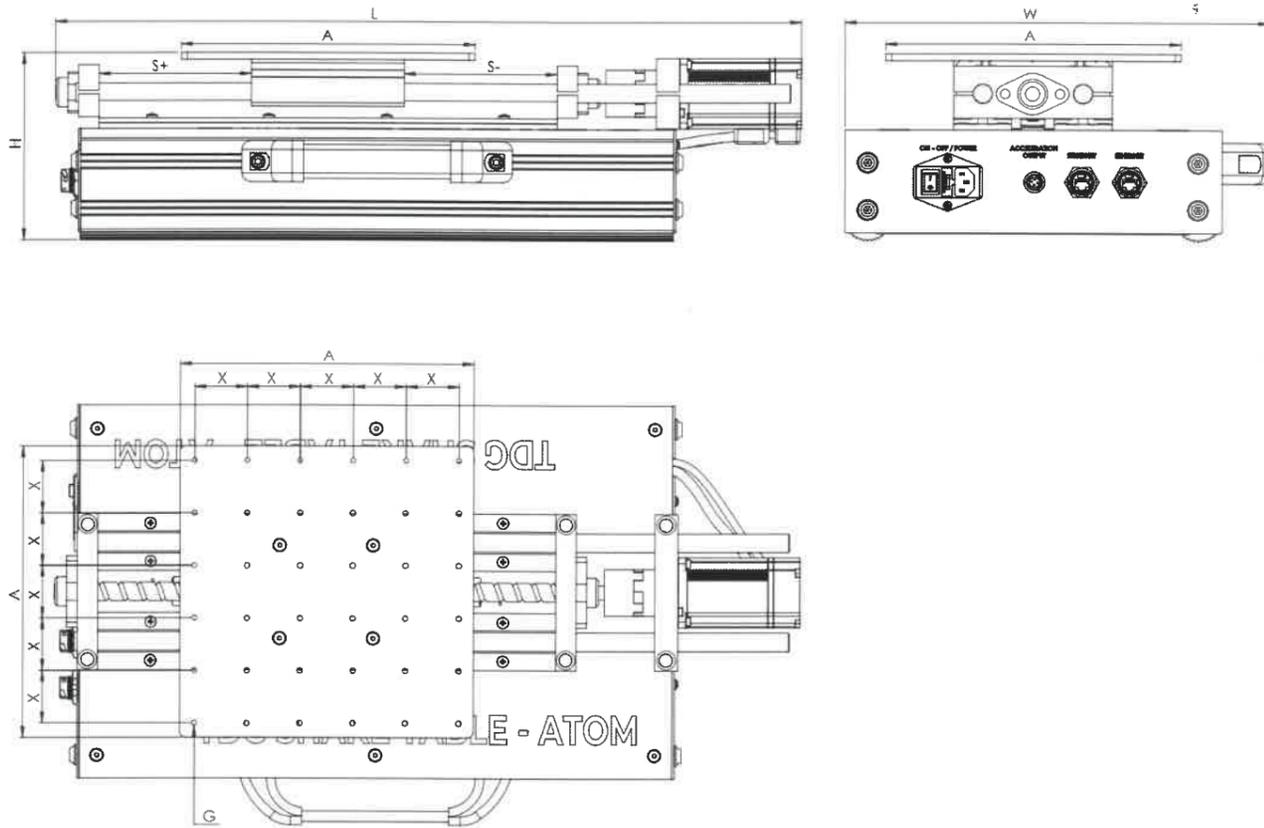
TECHNICAL SPECIFICATIONS		
Input Voltage	230 V AC, 50-60 Hz	
Upper Table Dimensions	250 x 250 mm	
Overall Dimensions	635 x 360 x 160 mm (L x W x H)	
Total Weight	18 kg	
Capacity and Payload	50 kg @ ±1g ± 4g @ < 5 kg	
Effective Stroke	± 125 mm (250 mm)	
Maximum Velocity	800 mm/s	
Frequency Range (< 5 kg Payload @ ±4 g)	Amplitude (mm)	Frequency (Hz)
	± 125	0,9
	± 59,7	2
	± 23,9	5
	± 17,1	7
	± 10	10
	± 7	12
± 4,5	15	
± 2	20	
Resolution	16 Bit	
Controller	Closed Loop PID Controller	
Position Feedback	Quadrature Encoder	
Acceleration Feedback	Integrated Accelerometer	
Encoder Resolution	626 counts/mm	



NOTE: Shake table is delivered with all the connections except the ones mentioned below are intact. When installing the first time, take a look at the bottom side of the table to check if there are any loose cables or connectors.

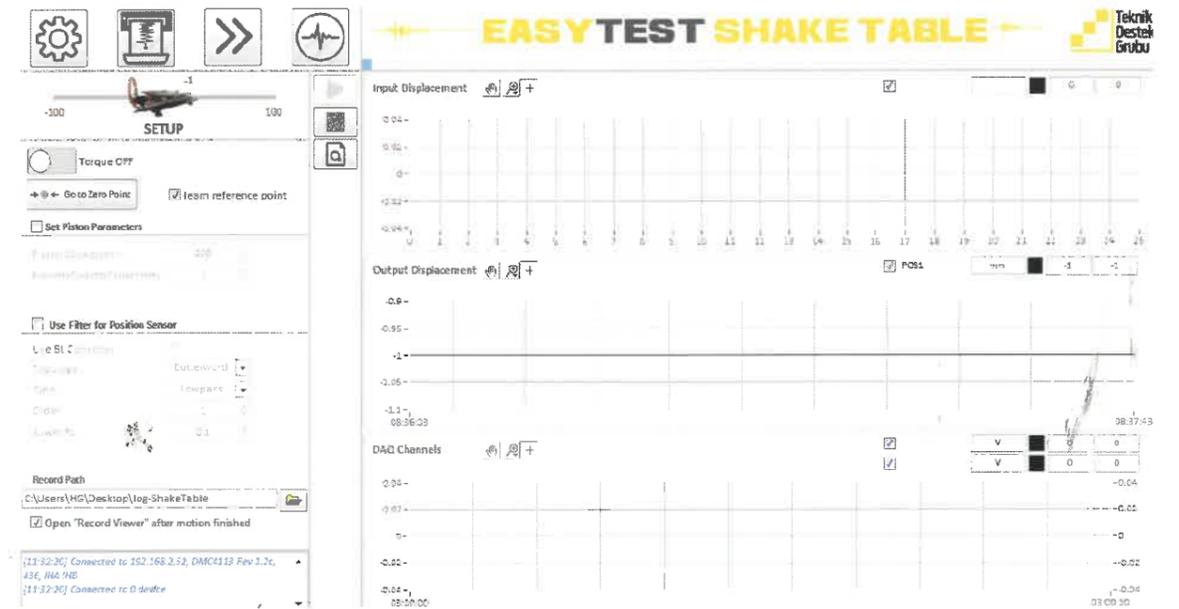
1. Connect the power cord of the table to 220 V power socket.
2. Connect the connectors between servo motor and driver, if not already connected.
3. Connect the ethernet to a desktop or PC by a standard network cable. Customer can use either of two ethernet connectors located on behind of table. Also, customer can use the other ethernet connector to connect a second network device to the computer.
4. When all the connections are complete, press the power switch which is located next to the power cord to power up the system.
5. The mini screen on the servo driver should show "rdy" that means ready.
6. Now the system is ready for enabling the torque, which will be done by PC software.

1.3. General Dimensions



SYMBOL	VALUE	UNIT
L	635 / 25	mm / in
W	360 / 14,2	mm / in
H	160 / 6,3	mm / in
S+	130 / 5,1	mm / in
S-	130 / 5,1	mm / in
A	250 / 9,8	mm / in
X	45 / 1,8	mm / in
G	M5 x 0,8	mm
Mass	18 / 39,7	kg / lb

2. SOFTWARE



2.1: Installation

In order to run EASYTEST Shake Table software properly, "Galil Tools" software should be installed which includes the necessary drivers. This software is used for detailed configuration of the controller and should not be used by anyone other than experts.

2.2. IP Settings

The controller is connected to the PC via a standard ethernet cable and the PC's IP address should be configured as static IP. In order to do this;

- Go to the network connections page
- Right click your local area connection and navigate,
- Properties -> Internet Protocol Version 4 -> Properties -> Use this IP address: section and enter an appropriate IP address.

The controller is delivered with the default IP address 192.168.2.10-255 (which can be changed using Galil Tools).

The address you will set to your PC should have the same numbers in the first three sections (192.168.2) and have a different number in the last section.

For example (192.168.2.5)

2.3. Project Settings

Some settings specific to the project can be changed using the "project.ini" file located at the data folder of the software.

```

project.ini - Notepad
File Edit Format View Help
[Project Parameters]
axisSize = "1"
ADC_Resolution = "12 bit"
absoluteEncoder = "Yes"
dioType = "Sinking"
Axes.<size(s)> = "1"
Axes 0.name = "A"
Axes 0.UIName = "Axis-A"
Axes 0.enablePin = "1"
Axes 0.positionSource = "_TPA"
Axes 0.flimitSource = "_LFA"
Axes 0.rlimitSource = "_LRA"
Axes 0.accSource = "@AN[1]"
    
```

The main settings that might be modified are:

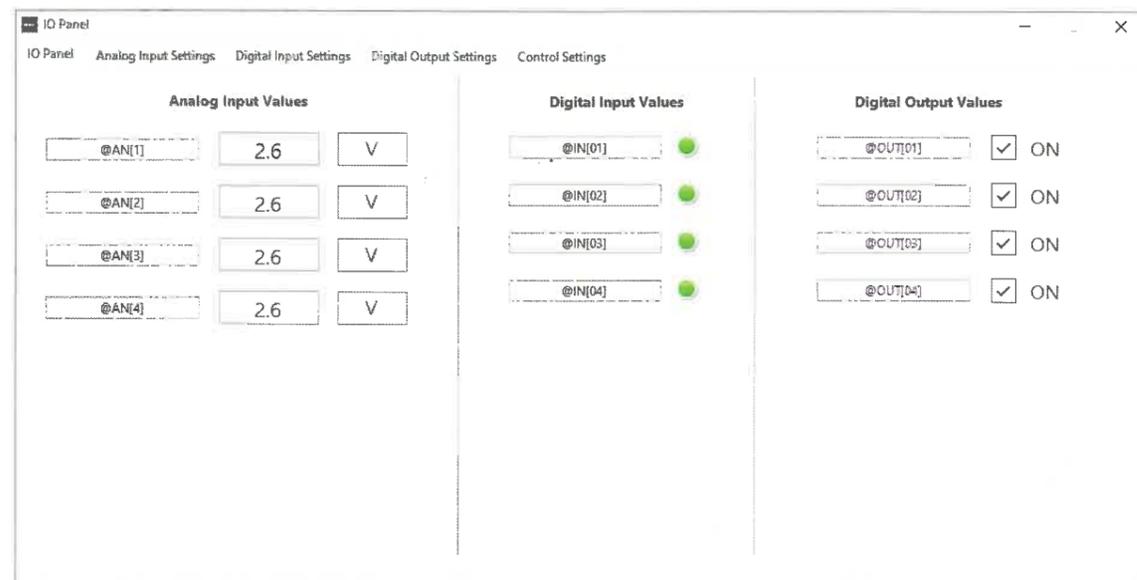
- absoluteEncoder: If there's a relative encoder, write "No" instead of "Yes"
- dioType: If the outputs are Rising Edge type, write "Sourcing" instead of "Sinking"
- enablePin: Write the number of the output that enables the servo system



NOTE: Editing this file in an incorrectly may cause some features of the software not to function properly.

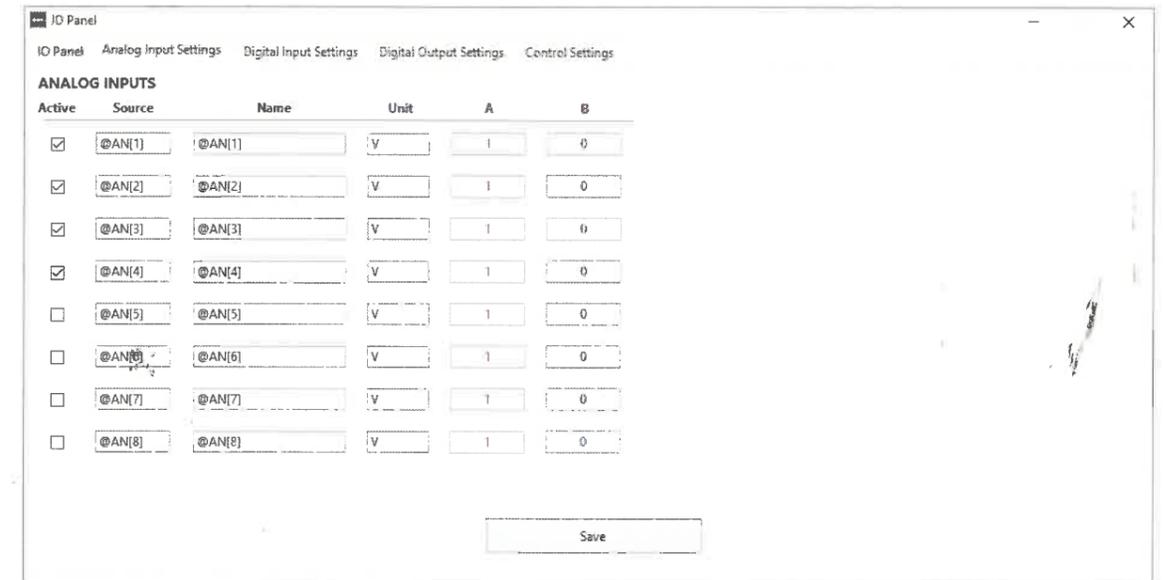
2.4. IO Panel

This panel is used to control and monitor digital and analog inputs/outputs of the controller.



2.4.1. Analog Input Settings

You can assign names to the analog inputs along with units and enter the calibration factor and activate the ones you would like to display in the first IO Panel tab.



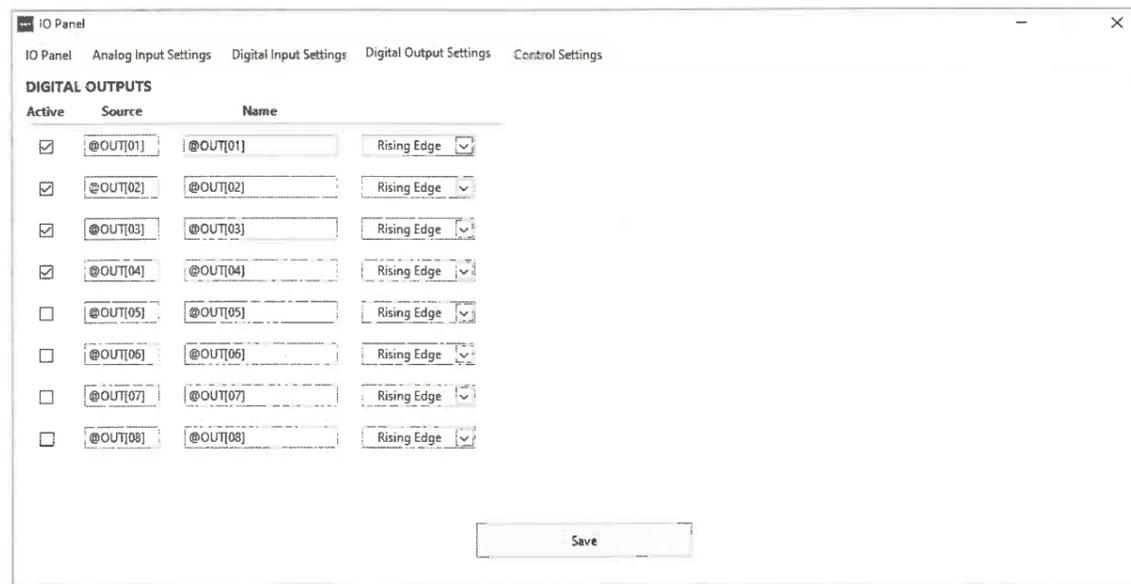
2.4.2. Digital Input Settings

You can assign names to the digital inputs of the controller and activate the ones you would like to display in the IO Panel tab.



2.4.3. Digital Output Settings

You can assign names to the digital outputs, select the Edge Type and activate the ones you would like to display in the IO Panel tab.



2.4.4. Control Settings

In the Control Settings, tuning and control parameters can be displayed and modified.



“Send to Controller” button sends the values to the controller without saving them permanently, whereas “Save to Controller” saves the PID values to the controller permanently.

After tuning the system, Position Error can be observed during the stationary conditions and entered into the Steady State Error box. This way, the system will use this value as an offset, which can result in better stability when the servo system is enabled.

Stationary Output Limit can be set to a small enough value (by observing the output value of the system during stationary condition) which will help prevent jerks and oscillations while the system is not moving. (Note that the maximum output of the system is 9.99 V and typically, the Output Limit can be set between 0.2 to 0.5 V)

“Automatic Output Limiting” is another safety function, which calculates the required output of any given motion (Point, sine or profile) based on its maximum speed and sets an automatic output limit for the system. This feature should be enabled to prevent undesired oscillations and resonances during the motion.

For information on how to tune a system, please refer to the tuning manual for the controller or the documents provided by the manufacturer.

Undesired and excessive movements can occur during the tuning. Make sure you take the necessary precautions at the test site and follow a well determined procedure for modifying the parameters.

2.5. Menu Bar

Easytest Shake Table



This The menu bar has 4 following sections respectively:

- Settings
- DAQ
- Easy Mode
- Profile Mode

2.6. Setup Tab

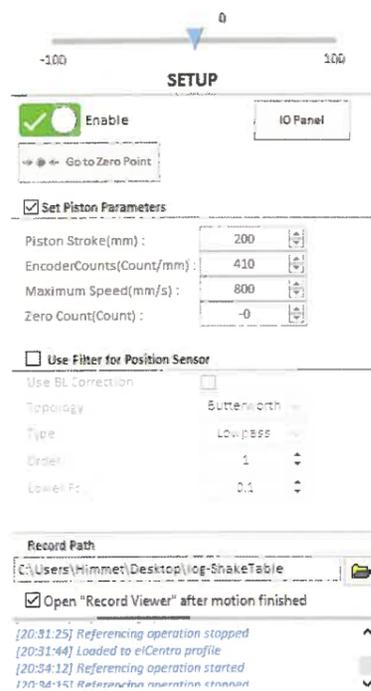


Table Position: Displays the absolute position of the table after the “learn reference point” function is applied.

Enable: Enables/Disables the torque to the motor. Enabling the torque is mandatory for the system to move. Click the switch button to enable it when you are ready to start the operation.

Go to Zero Point: This button takes the system to the middle position (absolute zero)

Set Piston Parameters: Allows changing the actuator parameters.

Piston Stroke: The total displacement capacity of the table. It is recommended not to use to full mechanical stroke to leave tolerances at both sides. The software will assign the stroke evenly to positive and negative sides, where the midpoint will be determined by “Zero Count” parameter.

Encoder Counts This value is used to convert the rotation amount of the motor to linear displacement. The unit is counts/mm. Value for Standard Shake Table Atom is “626”.

Maximum Speed will be used by the software to warn the user if the given input has a greater speed value than the maximum speed. It is also used for “automatic output limiting” function, which is explained later in the manual.

Zero Count is the count value from the position sensor corresponding the midpoint of the mechanical stroke. The position value is calculated as $\text{Position (mm)} = (\text{rawValue} - \text{Zero Count}) / \text{EncoderCounts}$, where rawValue is the uncalibrated count value read from the position transducer.

Use filter for position sensor Turns on/off digital filter applied to table position data. Filter parameters can be set up to eliminate high frequencies which are out of the interested range for the specified motion.

Use BL Correction Turns on/off baseline correction for table displacement.

Record Path The path on the computer where the record files will be saved.

Open “Record Viewer” after motion finished When selected, the View Panel will be opened automatically once the last motion is finished.

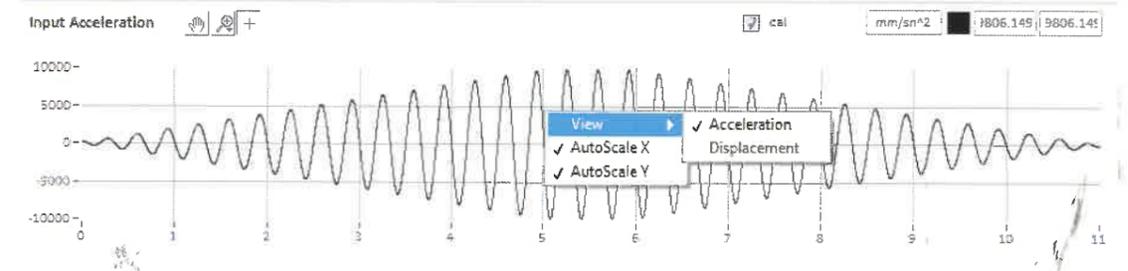
NOTE: Make sure the Piston Parameters are entered correctly before activating the torque.

2.7. Main Panel

There are 3 graphs on the main panel, These means;

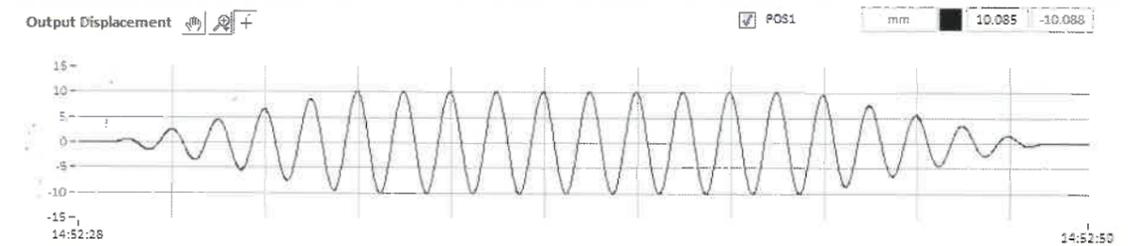
1- Input Acceleration or Displacement Graph (Changeable)

Displays the “Acceleration – Time” or “Displacement – Time” history of the input motion. Customer can right click on this graph to select the data type to view.



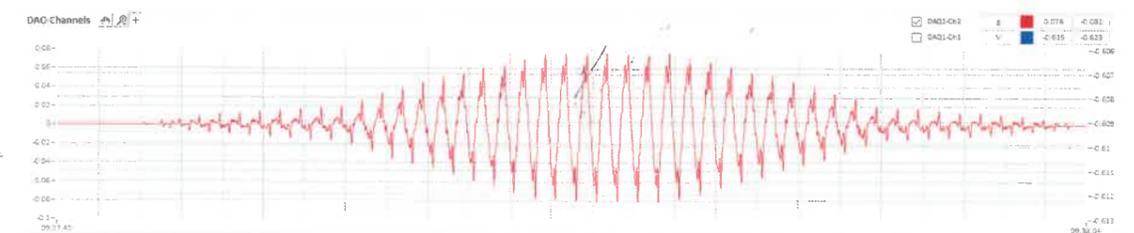
2- Output Displacement Graph

Displays the “Real displacement of the table – Time” graph. The display starts automatically once a motion is started.



3- DAQ Channels Graph

Displays the data from sensors connected to Data Acquisition System (TESTBOX 2010)



Customer can right click this graph or the following settings:

- **Select Channels:** Customer can select 2 channels to view on graph during the motion.
- **Clear Chart:** Clears the current data on the graph.
- **View on Graph:** Starts or stops the data display manually.
- **Full View:** Opens a separate window for this graph with its current content.
- **View All Data:** Opens a separate window where you can display data from all the channels of Data Acquisition System.

NOTE: The data display on “Output Displacement” and “DAQ Channels” graph starts automatically when a motion is initiated and stops when it is finished. You can right click and click “View on Graph” to start and stop the display manually.

2.8. DAQ Tab

DAQ

Calib.
Filter

Table Accelerometers: None...

<input type="checkbox"/>	Channel Name	Calibration (C)	Filter (F)
<input type="checkbox"/>	DAQ1-Ch1	Select	Select
<input checked="" type="checkbox"/>	DAQ1-Ch2	acc	filter1
<input type="checkbox"/>	DAQ1-Ch3	Select	Select
<input type="checkbox"/>	DAQ1-Ch4	Select	Select
<input type="checkbox"/>	DAQ1-Ch5	Select	Select
<input type="checkbox"/>	DAQ1-Ch6	Select	Select
<input type="checkbox"/>	DAQ1-Ch7	Select	Select
<input type="checkbox"/>	DAQ1-Ch8	Select	Select

CALIBRATION

Id	Name
0	linear
1	acc

Name:
 Unit:
 Type:

PARAMETERS

Sensitivity:
 DC Offset: Ch Value
 Acc - Tilt Conv.

FILTER

Id	Name
0	filter1
1	filter2

Name:
 Topology:
 Type:

PARAMETERS

Order:
 Lower Fc:
 Upper Fc:

Save
Cancel

EASYTEST Shake Table can read data from TESTBOX 2010 Data Acquisition System.

You should select the channels which are going to be used during the test by checking the boxes on the left side. The data record will be made only from selected channels.

Calibrations and filters can be defined and applied to one or more channels, using the drop-down menus.

Calib Button: Opens the Calibration Menu

Filter Button: Opens the Filter Menu

Table Accelerometer: Select the channel to which the accelerometer on the Shake Table is connected.

- In calibration menu; Right click and select "New" for creating a new calibration. You can choose from the list by left clicking and edit the parameters. After entering the parameters, click "Save".
- In Filter menu; Right click and select "New" for creating new filter. Select a filter from the table to change its settings. Click "Save" to apply new settings or to save the new filter.

2.9. Easy Mode Tab

EASY MODE

Type	Point
Move (mm)	1
Speed (mm/s)	1

This menu allows applying some simple moves to the shake table.

Point to point or Sinusoidal moves are possible. Click "Start" button after entering the desired parameters.

2.10. Profile Tab

More complicated motion types which are previously configured can be applied using this menu.

PROFILE MODE

Loma Prieta

Sample Rate (Hz):
Start Point

Scale Factor (%):
Start Point

M button: Opens the "Profile" panel where you can create new profiles or select a previously configured one.

Sample Rate: Is the Samples per Second (sample rate, record rate, record frequency) value of the recorded profile.

Scale Factor: Allows quick scaling of the data, before starting the motion. The unit is in percents.

"Start Point" button allows you to move the table to the best position for the selected motion. Then click the "Start" button to apply the selected profile.

2.10.1. Profile Menu

The screenshot shows the Profile Menu interface with several panels:

- Left Panel:** A list of profiles including 'Loma Prieta', 'cal', 'kobe', and 'elCentro'. Below it are configuration fields for 'Name', 'Data Type', 'Unit', 'Sample Rate(Hz)', 'Coefficient', and 'Data Start Index'.
- Top-Right Panel:** 'Time-Acceleration' plot showing a red waveform over time.
- Bottom-Right Panel:** 'Time-Velocity' plot showing a blue waveform over time.
- Bottom-Left Panel:** 'Time-Displacement' plot showing a blue waveform over time.
- Bottom-Middle Panel:** 'FILTER OPERATION' settings for 'Butterworth' topology, 'Lowpass' type, 'Order: 1', 'Low Fc: 100.00', and 'High Fc: 200.00'.
- Right Panel:** 'FFT' plot showing a red frequency spectrum.

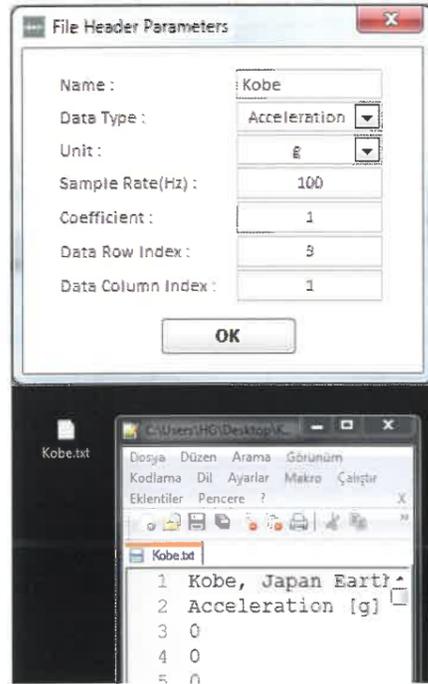
NOTE: To apply a previously configured profile without changing any parameters, just click on it in the top-left list and then close the Profile Menu.

The diagram shows the Profile Menu interface with two callouts:

- Signal Generation Menu:** Points to the top-left icon of the menu.
- File Import Menu:** Points to the top-right icon of the menu.

The main interface shows a list of profiles: 'pattern', 'Loma Prieta', 'cal', 'kobe', and 'elCentro'.

Using the *File upload menu*, you can load a tab-delimited file as a profile.



Name: Enter a name for the profile to be loaded

Data Type: Choose acceleration or displacement, with respect to the content of the file.

Unit: Select the unit for the data in the file.

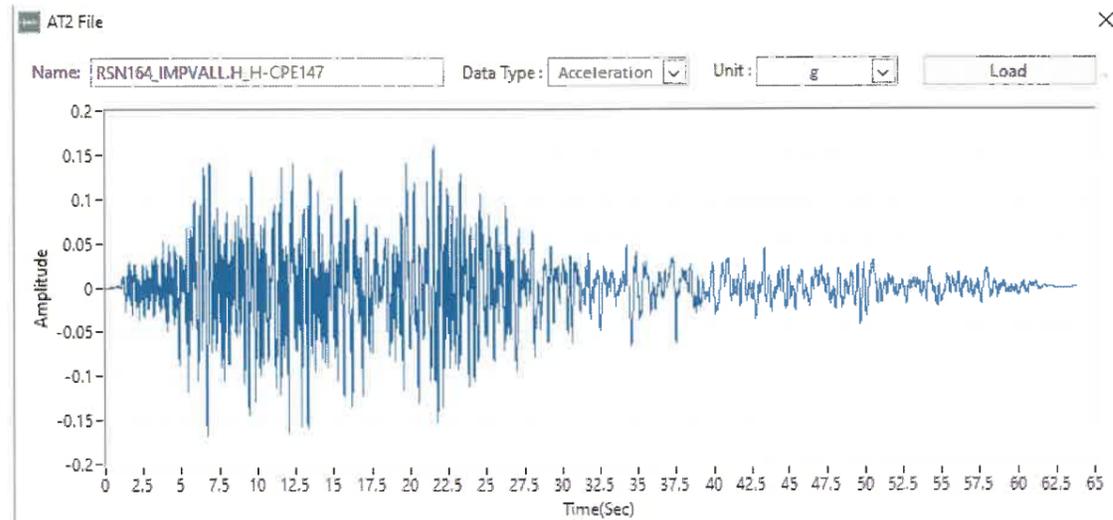
Sample Rate: Enter the sample rate ie the samples per second rate in which the file was recorded.

Coefficient: You can use this field to convert the data into another unit or to scale the data.

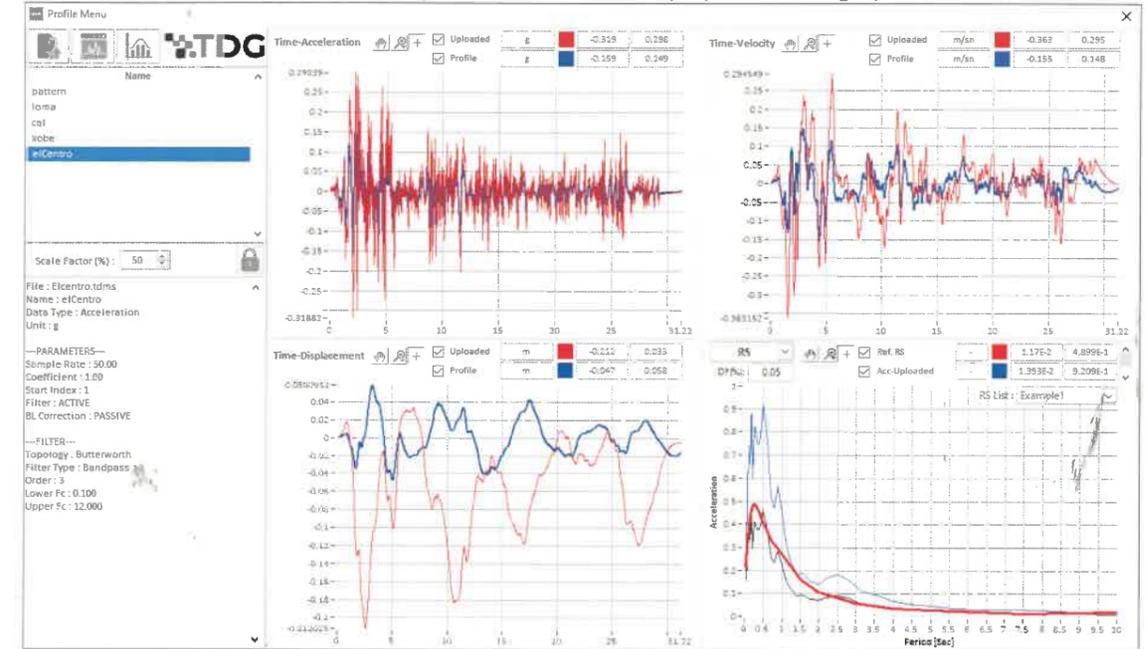
Data Row Index: Enter the number of the row where the first value of the relevant data column lies. (This parameter is used to skip the header parts in the file)

Data Column Index: Enter the column number of the relevant data. (This parameter is used to choose within the multiple columns of a file such as an additional time-stamp column or X-Y-Z axis recordings of an accelerometer.)

The software can automatically detect files downloaded from Berkeley university's Peer database. For that, file extension should be ".AT2". Below menu will be displayed after uploading this type of files:



After the file is uploaded successfully, Profile Menu will display the below graphs:



Time-Acceleration

Uploaded: Original acceleration-time history loaded from the file

Profile: Acceleration-time history after the selected modifications are applied (Filter, Base-line Correction, etc.)

Time-Displacement

Uploaded: Original displacement-time history loaded from the file

Profile: Displacement-time history after the selected modifications are applied (Filter, Base-line Correction, etc.)

Time-Velocity

Uploaded: Original velocity-time history loaded from the file

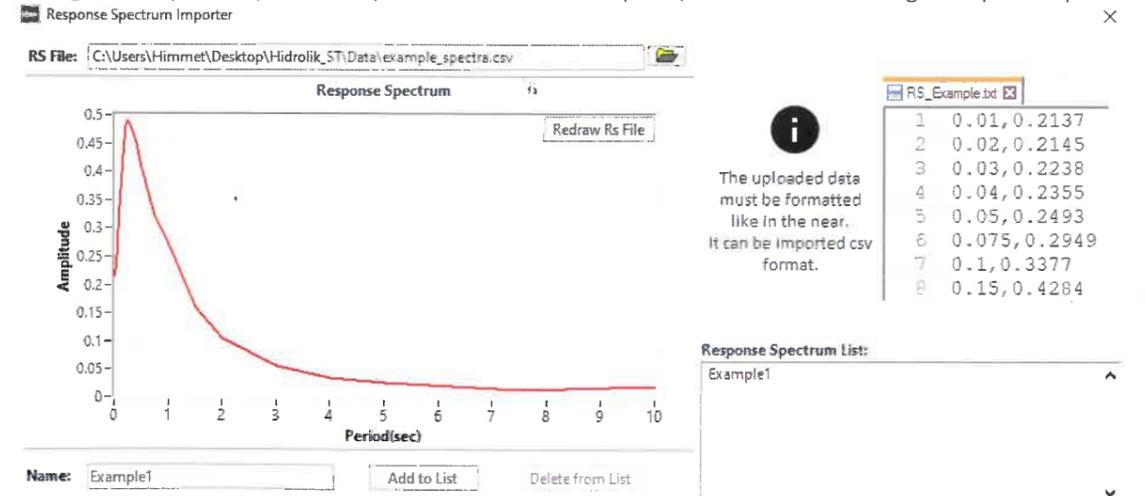
Profile: Velocity-time history after the selected modifications are applied (Filter, Base-line Correction)

FFT- RS

Uploaded: Original FFT and RS (Response Spectrum) history loaded from the file

Profile: FFT and SRS history after the selected modifications are applied (Filter, Base-line Correction)

Using the Response Spectrum Upload button on the top left, users can install target response spectra:



The spectrum file should be formatted as a csv (comma separated values) file and contain the period information at the first column and spectral acceleration (g) in the second.
It is possible to upload several files and add them to the list. The RS Graphs will allow to choose which Target Spectrum will be displayed.

After loading a file, user should provide a Name and save this profile so that same motion can be reached easily afterwards. By clicking the unlock button, user can modify the parameters below:

Scale Factor (%): 100

Kobe.tdms

Name: kobe

Data Type: Acceleration

Unit: g

Sample Rate(Hz): 100

Coefficient: 1

Data Start Index: 1

FILTER OPERATION

Use Filter Use BL Correction

Topology: Butterworth

Type: Lowpass

Order: 1

Low Fc: 100.00

High Fc: 200.00

Scale Factor (%): Scale factor of the profile motion to be applied. (Use %100 to apply original data)

Name: Name of the profile assigned by the user.

Data Type: Data type of the profile (Displacement or Acceleration)

Unit: Unit of the profile data.

Sample Rate: Sampling per second of the profile data.

Coefficient: Shows whether a coefficient for unit conversion is used.

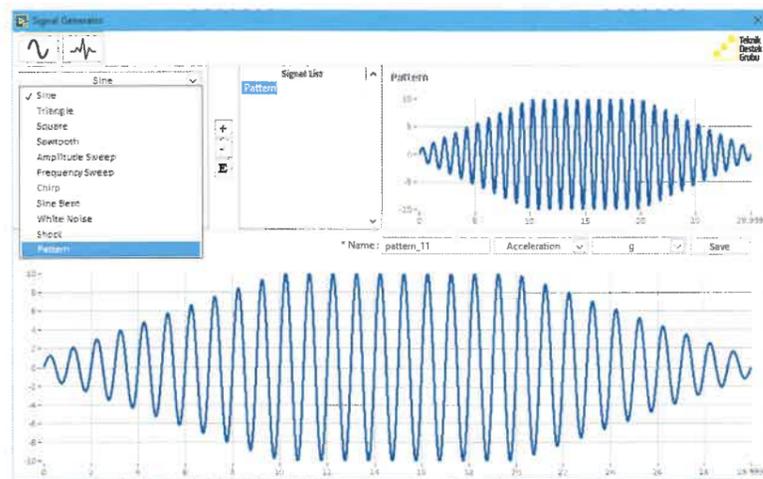
Data Start Index: This parameter can be used to discard a certain number of data points from the beginning of the data set.

Use Filter: Enabled/disables the digital filtering to the input data.

Use BL Correction: Enabled/disables the base line correction to the input data.

Using the **Signal Generation Menu** t below types of motion types can be generated.

- Sine
- Triangle
- Square
- Sawtooth
- Chirp
- Frequency Sweep
- Shock
- White Noise
- Sine Beat
- Amplitude Sweep



(+) Adds the selected signal type with the entered parameters to the Signal List.

(-) Removes the selected entry from the Signal List.

(E) Updates the selected signal using the current parameters.

Name: The Name of the profile to be saved.

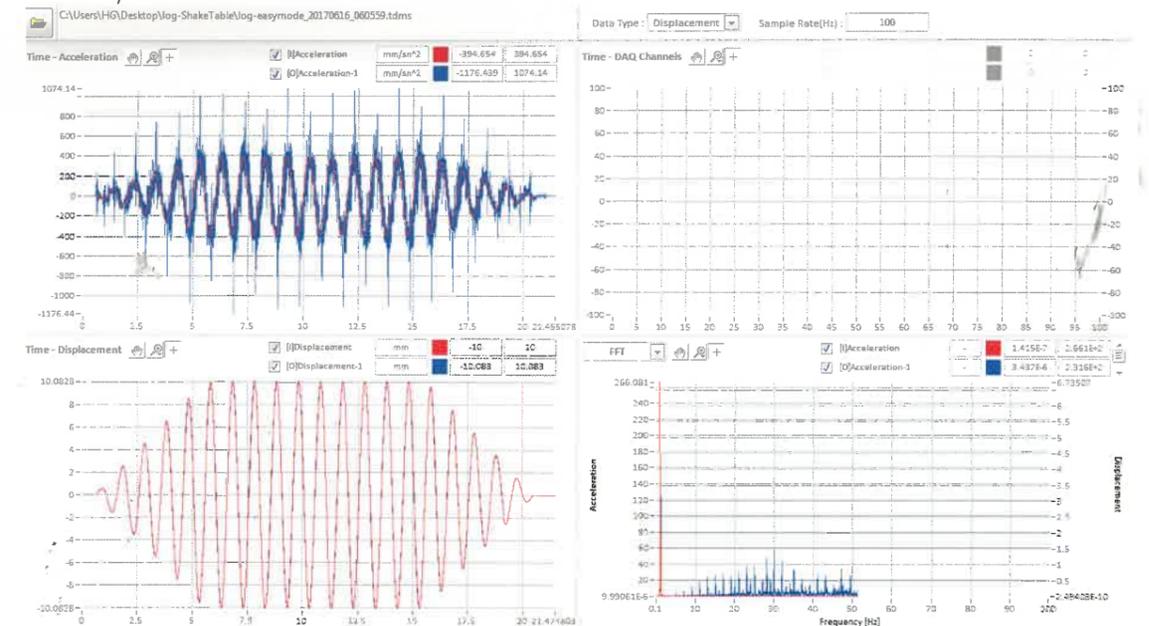
Type: Type of the motion profile to be saved.

Unit: Unit of the data in the generated profile.

The graph on the right-top shows the signal to be added to the main profile.

2.11. Record Viewer Panel

Data recording starts automatically when a motion is started. (Except the "Point to Point" motion in "Easy Mode") The record files are generated in the folder selected by the user in the "Setup" tab. The record format is "tdms" which can be converted and opened by MS Excel after "TDM Excel Add-In" is installed. If "Open record viewer after motion finished" is selected, the panel will appear automatically after the motion is complete. Also, click the "Record Viewer" to open the panel manually.



Time-Acceleration: Acceleration-time graph of the input and the measured values.

[I] Acceleration: Input Acceleration

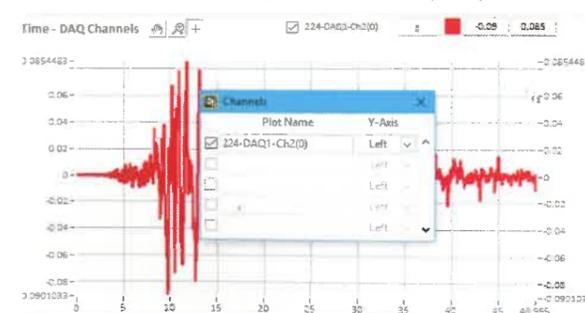
[O] Acceleration: Output (Measured) Acceleration, calculated by differentiating the measured table-displacement.

If there'd a DAQ device with an accelerometer connected and selected as the "Table Accelerometer" it will also appear on this graph.

Time-Displacement: Displacement-time graph of the input and the measured values.

[I] Displacement: Input Displacement

[O] Displacement: Output (Measured) Displacement



Time-Daq Channels: The channels which are selected as active can be displayed in this graph. Right-click the graph to add data from DAQ Channels to the Left or Right Y-axis.

FFT-SRS: Displays the FFT and SRS graph for the input vs output data of acceleration and displacement.

You can right click any graph open it in a separate window for more detailed examination.



NOTE: There may be small phase differences while displaying the input and output graphs. After clicking a graph, use the mouse scroll while holding down the Ctrl key to match the graphs in time. Pressing Ctrl + Shift together will allow more precise adjustment.

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