MATRIX | MATERIALS

DATA ACQUISITION MANUAL

CP4276

Inspiring The Next Generation Of Engineers

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Contents

Data Acquisition Box

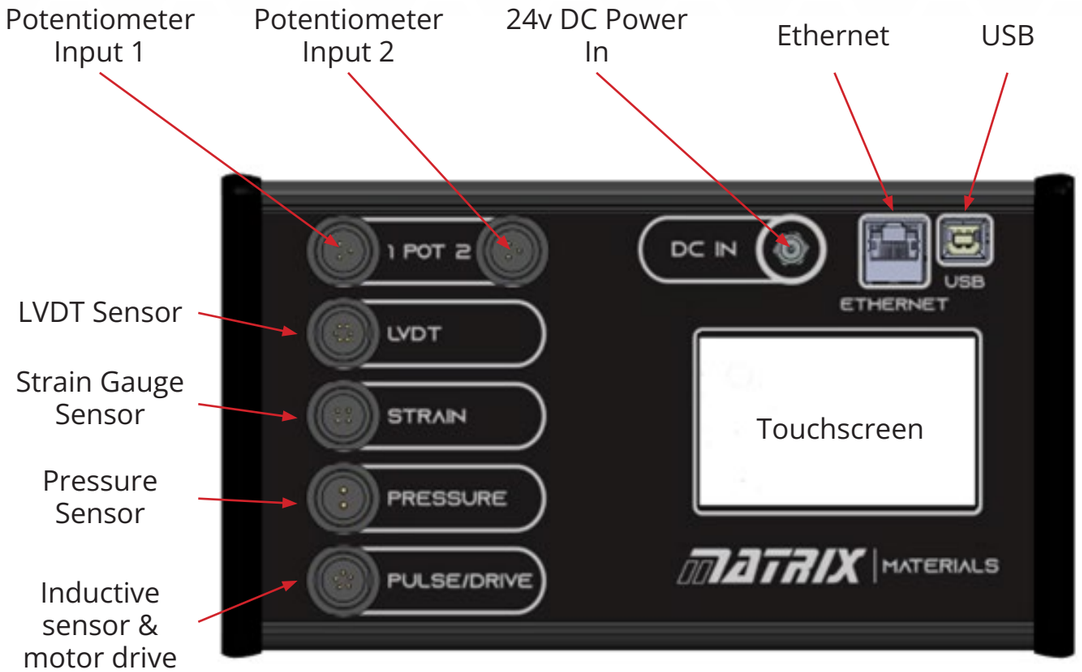
The following document explain how to use the matrix material data acquisition box.

The data acquisition box can be used with the following products:

- MH9198 Universal Testing Machine
- MH6225 Torsion Testing Machine
- MH6324 Universal Vibration Apparatus
- MH2825 Torsional Vibration Apparatus
- MH8220 Rotating Fatigue Machine (Electronic Loading Mechanism)

Data Acquisition Box

Data Acquisition Overview



Data Acquisition Box

Power Supply

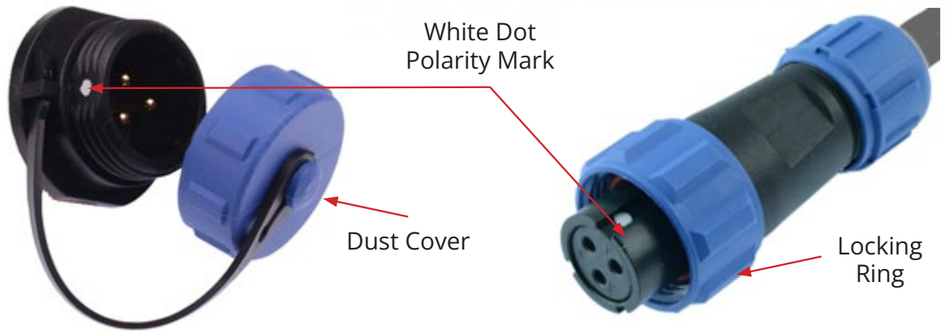
The power supply for the device is 24 VDC with a power rating of 60W. The power supply connector is a 2.1mm barrel-type connector. It is recommended that only the power supply included with the device is used. If any replacement is needed, please contact matrix.

The unit is supplied with a number of mains outlet adapters. The appropriate one for the region where the device is used should be selected. The selected adapter slides onto the power supply and locks in place.

The mains supply should be between 80 and 264VAC at a frequency between 47 and 63 Hz.

Data Acquisition Box

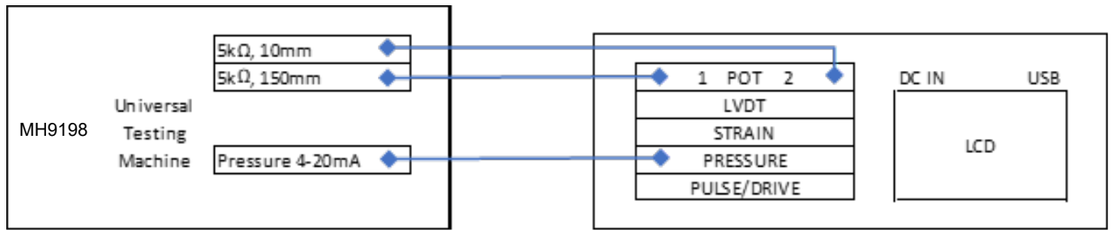
How to connect sensors



The sensor connectors are arranged on the left hand side of the device and labelled by function. It is important to ensure that sensors are plugged into the correct sockets. Each connector has a different number of pins to help identify its sensor.
To connect a sensor, first unscrew the dust cover from the connector. A white dot is printed on the connector and this will align with a corresponding white dot on the sensor plug. Push the plug straight down into the connector and screw the locking ring to secure it.
Each of the machines has a different set of sensors which need to be connected to the corresponding inputs on the data acquisition box.

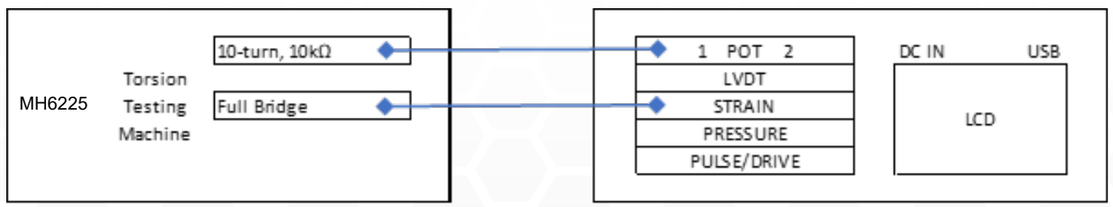
MH9198 Universal Tester Machine

The Universal Tester Machine has an elongation sensor with a travel of 150 mm. This is connected to the Pot 1 socket. It has an extensometer with a travel of 10 mm connected to Pot 2. The force applied to the sample is measured using a pressure transducer in the hydraulic system which is connected to the Pressure input.



MH6225 Torsion Testing Machine

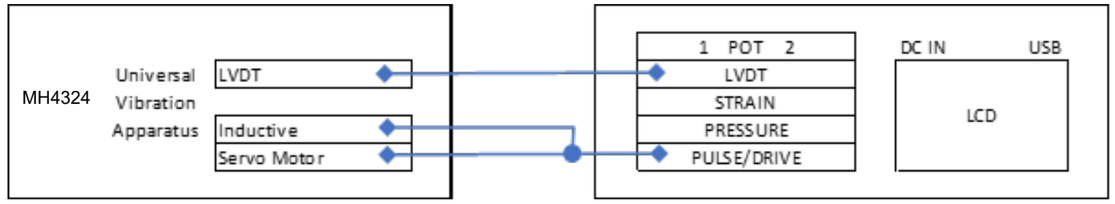
The torsion testing machine has an angle sensor connected to the Pot 1 socket. The torque is sensed by a strain gauge which is connected to the Strain socket.



Data Acquisition Box

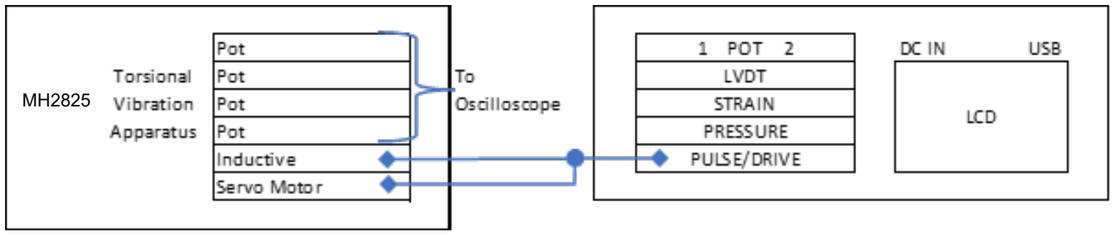
MH4324 Universal Vibration apparatus

The Universal Vibration apparatus includes a motor and an inductive pulse detector. These are connected to the Pulse/Drive socket. The amplitude of vibration is detected by an LVDT sensor that is connected to the LVDT socket.



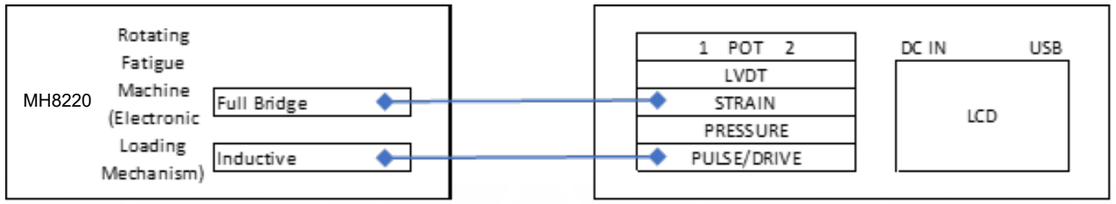
MH2825 Torsional Vibration Apparatus

The Torsional Vibration apparatus includes a motor and an inductive pulse detector. These are connected to the Pulse/Drive socket. The apparatus has four separate angle detectors that are connected to an oscilloscope so that both amplitude and phase can be studied.



MH8220 Rotating Fatigue Machine

The Rotating Fatigue machine has a strain gauge for measuring the applied load. This is connected to the Strain socket. It uses a pulse detector to count the number of rotations; this is connected to the Pulse/Drive socket. The rotation of the sample is driven by a mains-powered motor that is not under the control of the data acquisition box. A microswitch stops the motor at the point where the sample fails.

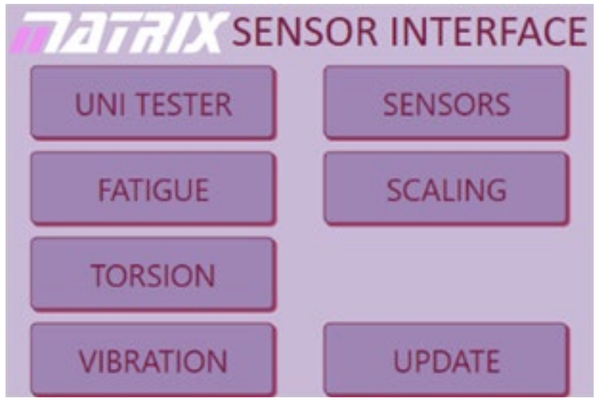


Data Acquisition Box

How to use the Touch Screen

The Data Acquisition Box can be controlled using the touch screen interface. When the device powers up it will show a home screen containing the main menu.

Main Menu



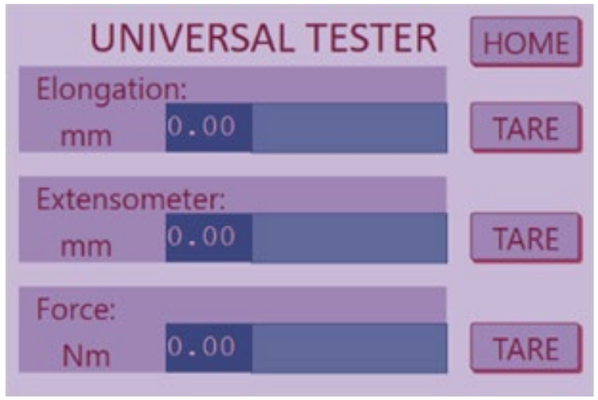
Touch buttons for instrument screens

Touch buttons for: -
- Sensors screen
- Scaling screen
- Activate bootloader

Home Screen

The main menu shown on the home screen contains touch buttons that load the function screens. Each screen has a 'HOME' button that navigates back to the main menu.

Universal Tester



Elongation reading

Extensometer reading

Force reading

Home button

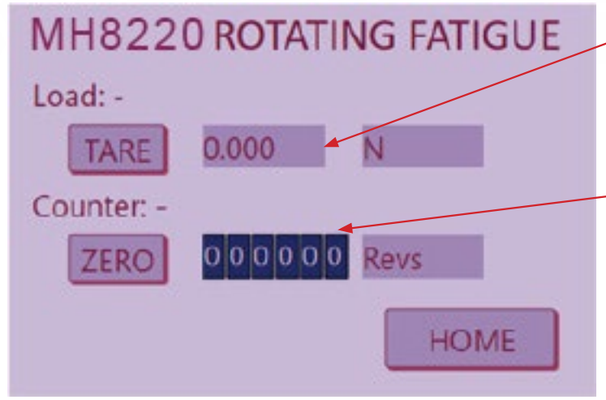
Tare Buttons

Universal Tester Screen

The Universal Tester screen displays the inputs from the three sensors that are used in the Universal Tester Machine. The elongation input is a 0 ~ 150 mm linear potentiometer that is connected to the 'Pot 1' input. The extensometer input is a 0 ~ 10 mm linear potentiometer that is connected to the 'Pot 2' input. The force input is a pressure sensor that is connected to the 'Pressure' input. This sensor senses the pressure of the hydraulic fluid in the cylinder that is applying force to the sample. The three quantities are displayed as both digital displays and also as analogue bars that provide a quick visual indication. On the right hand side of the screen are four touch buttons. The Home button returns to the main menu. The Tare buttons zero each of the sensors at their current position.

Data Acquisition Box

Rotating Fatigue



Load Tare Button

Counter Zero Button

Load Display

Counter Display

Home Button

Rotating Fatigue Screen

The rotating fatigue screen shows the load applied to the sample and a count of the number of rotations that the sample has endured. The load is measured using a strain gauge connected to the 'Strain' input. This input is tared by touching the Tare button with no load applied to the sample. The counter display counts pulses from an inductive proximity detector connected to the 'Pulse' input. This count is zeroed by touching the Zero button before beginning the test.

Torsion Tester

Tare Buttons

Rotation Display

Torque Display

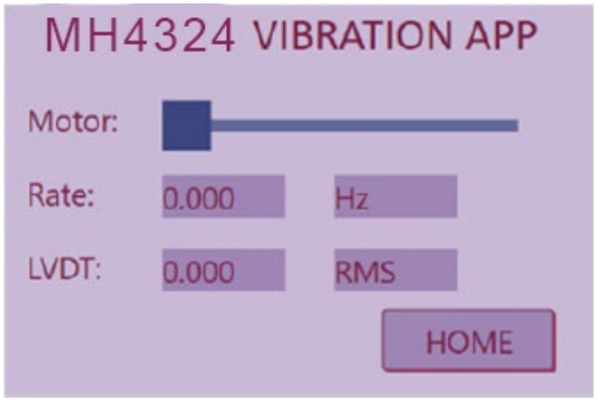
Home Button

Torsion Tester Screen

The Torsion Tester screen shows the rotation applied to a sample and the torque produced. The rotation is measured using a multi-turn potentiometer connected to the 'Pot 1' input. The torque is measured by a strain gauge connected to the 'Strain' input. At the beginning of a test, both inputs can be tared by touching the 'Tare' buttons. The rotation is shown as both a digital display and also a simple visualisation.

Data Acquisition Box

Vibration Apparatus



Motor Control Slider

Frequency Display

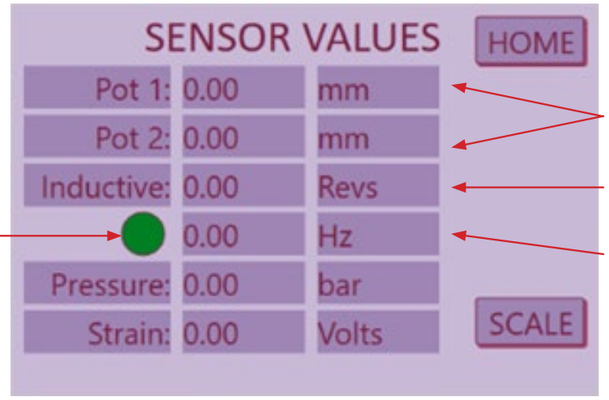
Displacement Display

Home Button

Universal Vibration Apparatus Screen

The Universal Vibration Apparatus screen enables control of a motor connected to the 'Pulse/Drive' socket. A slider on the screen is used to set the output level of the motor drive. An inductive proximity detector connected to the same socket and positioned adjacent to a hole cut out of an excentric flywheel is used to measure the frequency of vibration. The frequency is displayed on the screen. A linear variable displacement transformer (LVDT) is used to measure the amplitude of vibration. The LVDT is connected to the 'LVDT' socket and the root-mean-square displacement is displayed on the screen.

Sensor Values



Home Button

Potentiometer Values

Pulse Counter

Pulse Frequency

Scale Button

Pulse Status

Pressure Value

Strain/Lvdt Value

Sensor Values Screen

The Sensor Values screen shows the current value of all connected sensors along with their units of measurement. The pulse sensor is shown as both a running count of the number of pulses detected and also as the pulse frequency. There is also a status indicator which shows bright green when the pulse input is active (indicating an inductive material close to the sensor) and dull green when the input is inactive (indicating that the sensor is not detecting metal). This can be useful when setting the position of the sensor.

Data Acquisition Box

The Strain display shows either the value of the sensor connected to the Strain input or that of the LVDT input. By default, it will show the Strain input. Navigating to the vibration apparatus screen will switch the input channel so that it shows the LVDT input. Navigating to either the Torsion Tester or Rotating Fatigue screens will switch back to the Strain input.
The Home button navigates back to the main menu. The Scale button will show the saved scaling factors for each of the sensors.

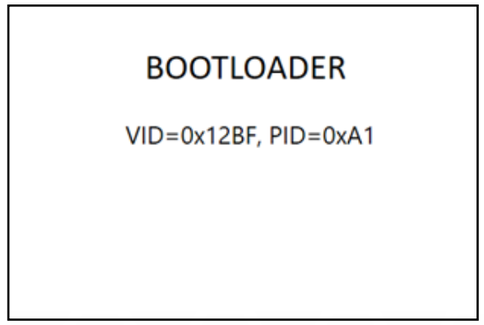
Scaling Factors

Home Button

Live button

Scaling Factors Screen

The Scaling screen shows the scale and offset applied to the sensors. For each sensor, the displayed value is given by the formula: -
Display Value = Raw Reading X Scale + Offset
The Home button returns to the main menu while the Live button navigates to the Sensor Values screen.



Bootloader Screen

The Bootloader Screen is activated by touching the Update button on the main menu. When this screen is displayed the device stops measuring and is in software update mode. The software can be updated by an application that runs on a PC connected by USB. If the application is not connected within a minute of entering this mode then the device will restart and then continue to operate normally without updating.

Data Acquisition Box

Interface Software Installation to Host Computer

Below is a guide to how to use the data acquisition software that comes alongside the data acquisition box interface.
The software is designed to be as flexible and possible, with many parameters that are editable to increase the amount of experimental options as much as possible.

Installation

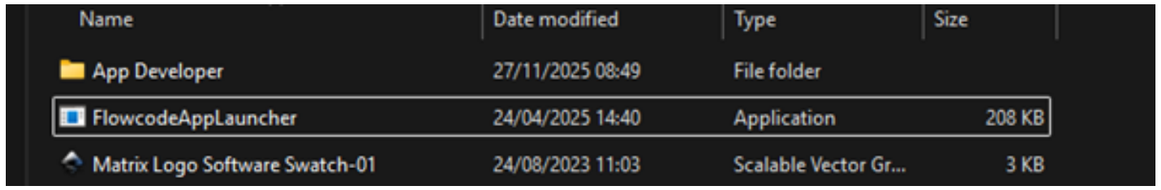
The software can be downloaded from the Matrix website. Choose Materials from the Products menu. On the Materials page, select the Resources tab. The Data Acquisition software is available to download in a zip file.

www.matrixtsl.com/materials

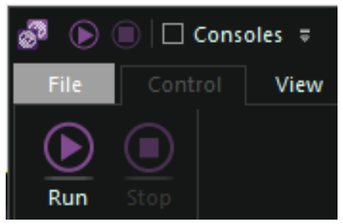
Save the zip file on a Windows PC and extract the whole folder in a convenient location.

Running the Software

To start the software, open the folder and run the file FlowcodeAppLauncher.exe.



Connect a USB cable between the Data Acquisition Box and the PC. Plug the 24VDC power supply into the socket labelled 'DC IN'. Wait for the device to power up and show the main menu, then click the Run button in the top left corner of the software screen. Alternatively, a larger Run button can be found by clicking on the Control menu.

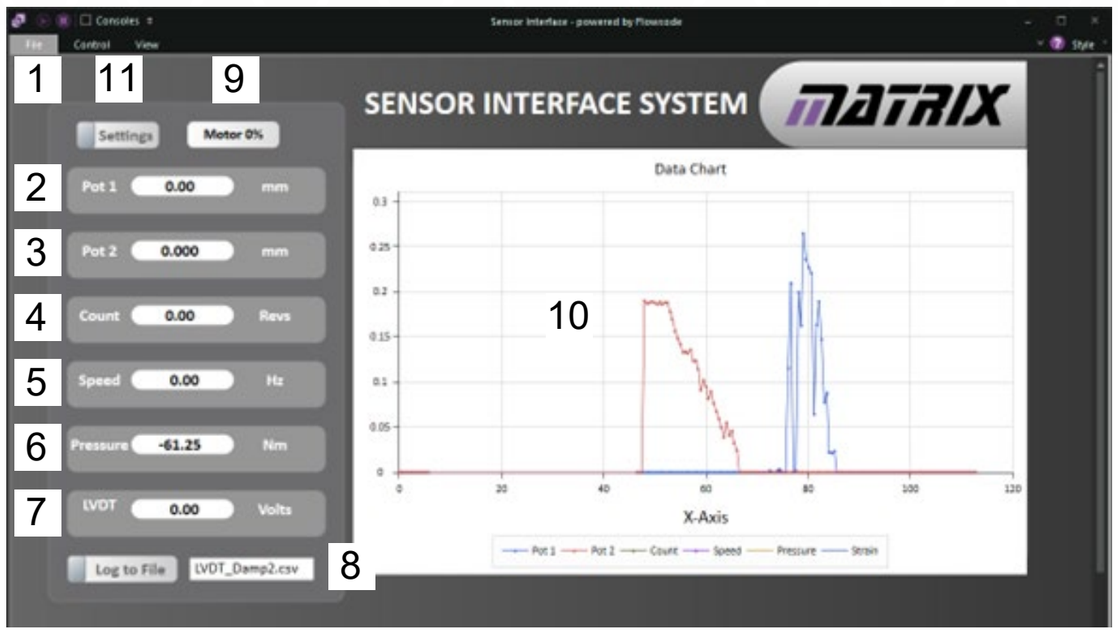


When the run button is clicked, the software should immediately begin displaying and plotting sensor values.

Run/Stop Buttons

When the run button is clicked, the software should immediately begin displaying and plotting sensor values.

Data Acquisition Box



Software Main Window

1. Run/Stop buttons
2. Potentiometer 1 value
3. Potentiometer 2 value
4. Pulse count
5. Pulse frequency
6. Pressure value
7. Strain or LVDT value
8. File logging control
9. Motor Drive Level Control
10. Chart Plotting Area
11. Run/Settings mode switch

Function of the Main Window

The readings of each sensor are shown in digital displays on the left hand side of the window. (2~7) The pulse input is presented as both a running count of pulses and the frequency of the pulses. The last display (7) will show either the strain gauge input or the LVDT input depending upon which is selected. The data acquisition system can not read both at once.
At the bottom of the window is the file logging control. (8) A file name can be entered in the text box and then clicking the switch will result in the sensor values being written to the specified file. While the file logging is active, the switch will change to show the legend "Stop Log". Files are written into the same directory as the application.

Logging Controls

Data Acquisition Box

Files are written as comma-separated-value files. If no file name extension is given then the software will automatically add the extension '.csv'. When logging starts, the software first writes a header row with the names of the logged values. It then writes the values read from the data acquisition box. If logging is stopped and then restarted, then another header row will be added before the new data. The files can be opened in either a spreadsheet or a text editor.

	A	B	C	D	E	F	G	H
1	Time	Pot 1	Pot 2	Counter	Speed	Pressure	Strain	LVDT
2	0	75.419	5.807	0	0	-61.25	0.001118	0
3	0.566	75.093	5.389	0	0	-61.25	0.001118	0
4	1.087	75.269	5.300	0	0	-61.25	0.001118	0
5	1.577	75.360	5.608	0	0	-61.25	0.001118	0
6	2.029	75.883	5.247	0	0	-61.25	0.001118	0
7	2.591	75.292	5.276	0	0	-61.25	0.001116	0
8	3.074	75.864	5.364	0	0	-61.25	0.001116	0
9	3.605	75.933	5.590	0	0	-61.25	0.001116	0

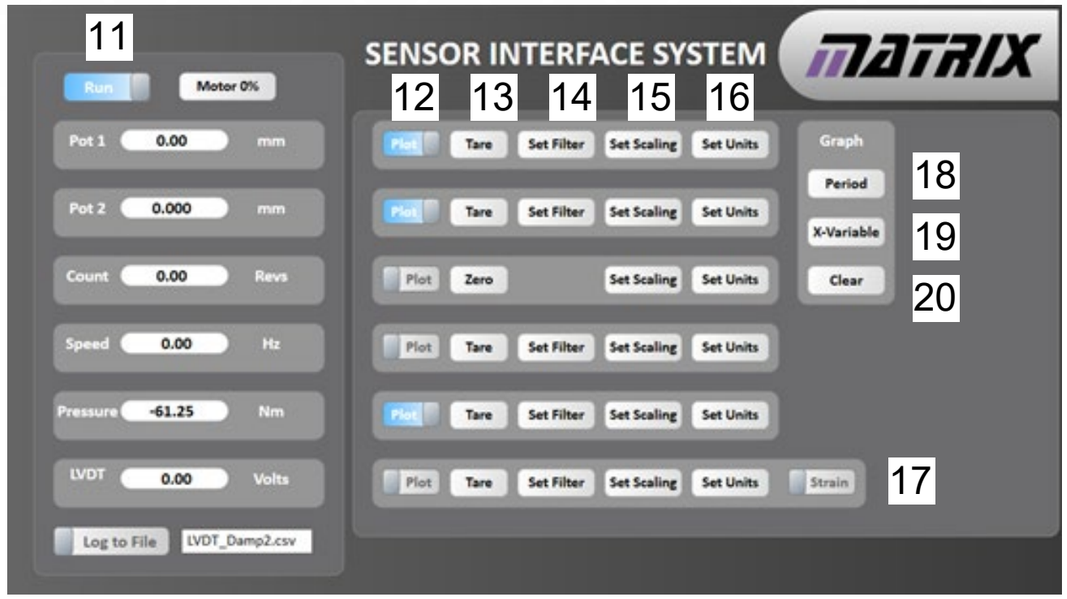
Sample Data Log File

Above the sensor value displays is the motor drive level control. (9) When this is clicked, a dialog box will appear prompting for a new drive output level. The drive output is a pulse width modulated signal and its level is set as a percentage. When a new level is entered, it will take effect immediately and the control will be updated to show the new value.

Drive Level Input Box

When the Run/Settings mode switch (11) is clicked, the chart plotting area is hidden and a number of settings are available. When in settings mode, data collection is suspended. This mode is illustrated below.

Data Acquisition Box

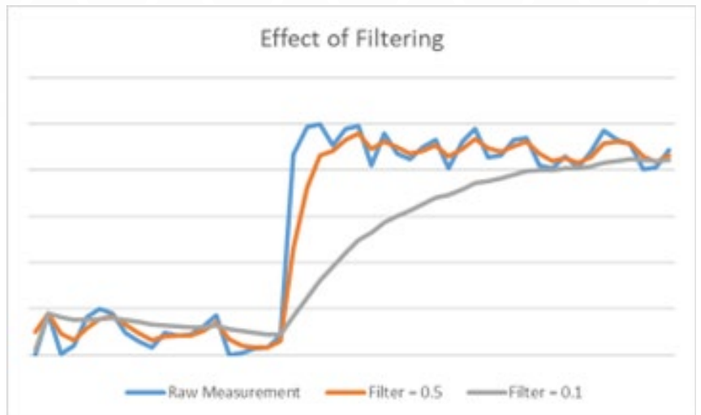


Main Window in Settings Mode

11. Run/Settings mode switch
12. Plot selection switches
13. Tare buttons
14. Set filter buttons
15. Set scaling buttons
16. Set unit buttons
17. Strain/LVDT mode selector
18. Set plotting period
19. Set X-axis variable
20. Clear chart plot.

Each of the sensor inputs has a row of controls that are visible in settings mode. With a few exceptions, these controls are duplicated for each of the sensor inputs.
The first control for each sensor is the Plot selector (12). When this is switched to the on position, this sensor is included in the chart plot (10). This control does not affect the log to file function. All available sensor values are always written to the file.
The Tare button (13) commands the data acquisition system to define the current state of the sensor as zero. All subsequent measurements are then relative to the current state. The pulse counter is slightly different in that it has a Zero button which resets the pulse count to zero.
The Filter button (14) shows a dialog prompting the user to enter a filter factor for the sensor channel. No filter is available for the pulse counter since this is simply a count. The filtering is a simple low-pass filter that reduces noise from a reading by combining each new measurement with the previous value. A filter factor of one gives no filtering at all. For values less than one, the smaller the value, the greater the filtering. The figure below gives an illustration of the effect of filtering on a noisy signal. A factor closer to one takes out some of the noise and slightly delays the response of the signal. A smaller factor takes out nearly all of the noise but significantly reduces the responsiveness of the signal. Some experimentation is required to find the ideal factor for each application.

Data Acquisition Box

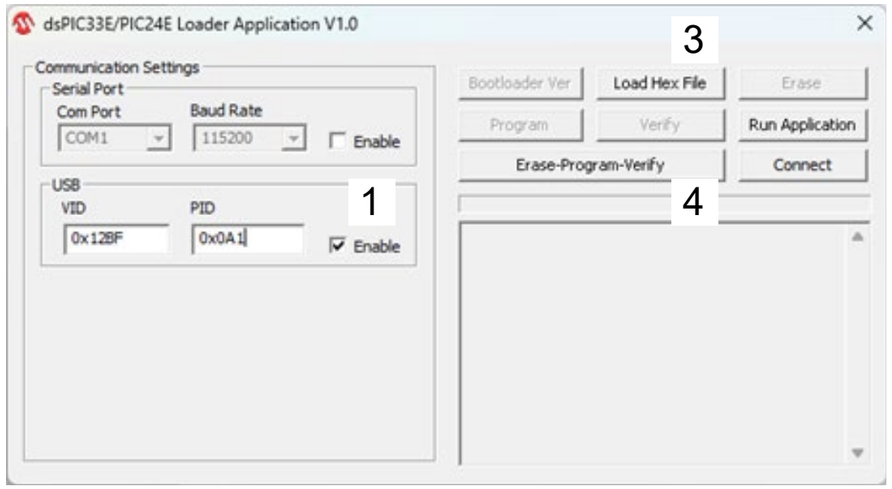


Each sensor channel has a Set Scaling button (15). This will show a dialog box that prompts the user for an appropriate scaling factor for each channel. After the scaling factor is entered, a subsequent dialog box will prompt for an offset value.
For each sensor, the displayed value is given by the formula: -
Display Value = Raw Reading X Scale + Offset
The facility to enter scale and offset for each channel enables calibration of individual machines.
The Set Units button (16) shows a dialog box that prompts for the display unit of each sensor channel. The units for each channel are shown on the software and also on the touch screen. Each unit can be a string of up to eight characters. Units will match the quantity being measured and the scaling. For example, the strain gauge in the torsion apparatus is used to measure torque so an appropriate unit might be “Nm”.
The last channel displayed will be either the Strain Input or the LVDT. The Data Acquisition box can not measure both of these inputs simultaneously. The device will automatically select between the two whenever the touch screen is used to select a machine that requires one input or the other.
Selection between the two can also be made by clicking the Strain/LVDT mode selector (17). The label of the digital display will change to show which one has been selected.
On the right hand side of the window are controls for the graph display. The Period button (18) shows a dialog that prompts for an update period for the graph. The period is given in seconds. By default, the graph plots the selected quantities against time. Click the X-Variable button (19) to plot against one of the measurement channels. When the Clear button (20) is clicked, the graph display is erased , time is reset to zero and a new graph plot is begun.

Data Acquisition Box

Appendix: Update Procedure

The Data Acquisition box comes with the latest firmware. There should normally be no need to update it. If it becomes necessary to update the device, only firmware issued by Matrix TSL should be used.
The application “PC_Loader.exe” will be issued along with the new firmware. Start the application and then put the device into update mode by touching the Update button on the main menu. This is described in the section on using the touch screen.
Click the Enable check box in the USB section (1) and enter the VID and PID codes shown on the touch screen. Click the Connect button (2) to initiate communication to the device.
Click on the Load Hex File button (3) and navigate to the supplied hex file. Click Erase-Program-Verify (4) to load the new firmware into the device. Once the load procedure has completed, the Run-Application button (5) will cause the device to disconnect from the loader application and re-boot with the new firmware installed.
The update procedure will erase stored scaling, filter factors and custom units. These will be reset to default values and have to be re-programmed. Any appropriate calibration procedures should be repeated.



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