Recording of characteristic curves and simulation of load models

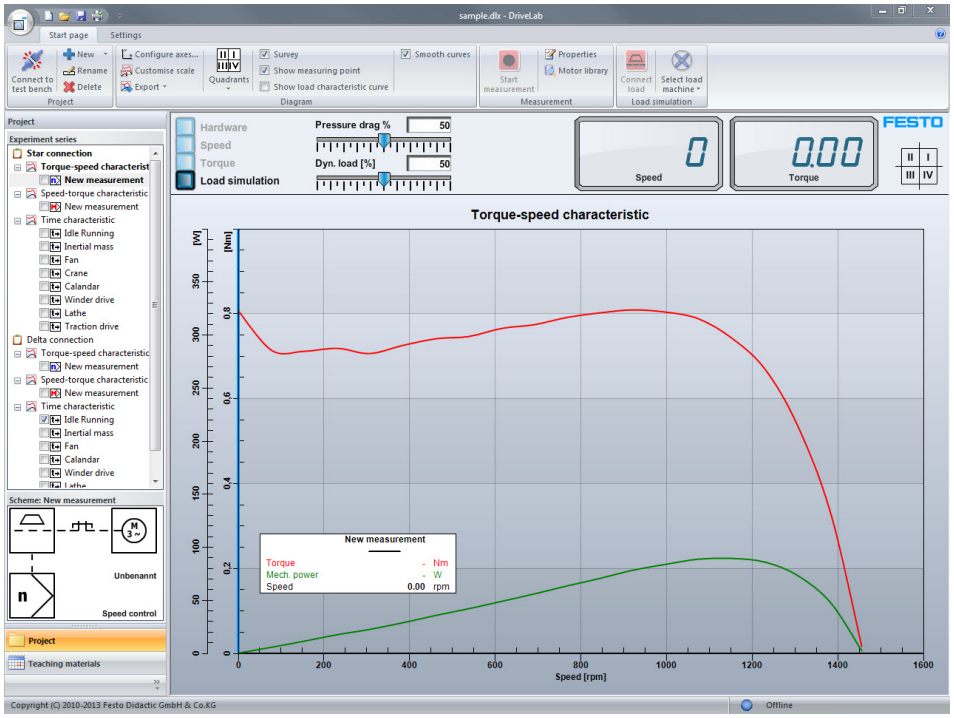
FESTO

Servo brake and drive system

DriveLab
V1.2.2

Manual

With CD-ROM



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1 General Information on DriveLab

1.1 What DriveLab can do

The DriveLab control software matches Festo Didactic's servo brake and drive system. It can be used to simulate the types of electric machines used in commercial and household applications. These include:

- Single and three-phase drives
- DC drives
- Modern servo-drives

The drives can be examined under realistic conditions with DriveLab. The user is thus able to record characteristic curves, configure static loads and simulate various load models automatically.

This enables a comparison with and optimisation of different drive concepts. This can be completed as part of a training program, for example in the form of exercises.

A structured, graphic user interface and sample configurations make getting started quick and easy.

1.2 For your safety

Please observe the instructions included in this section. They increase safety levels for you and those around you while experimenting with the new technology.

1.2.1 Use for intended purpose

The software may only be used:

- For its intended purpose in teaching and training applications
- For controlling drives that conform to the performance characteristics of the test bench (see specifications in the handbook for the motor test bench)
- With devices that are in flawless safety condition

The system is designed in accordance with the current state of technology and recognised safety rules. Nevertheless, life and limb of the user and third parties may be endangered and the system may be impaired, if it is used improperly.

The respective training companies and/or trainers must ensure that all trainees observe the safety precautions that are described in this handbook.

Festo Didactic hereby excludes any and all liability for damages suffered by trainees, the training company and/or any third parties that occur during use of the equipment set in situations that serve any purpose other than training and/or vocational education, unless such damages have been caused by Festo Didactic due to malicious intent or gross negligence.

Faults that may impair safety must not be generated in the training environment and must be eliminated immediately.

1.2.2 Safety precautions

Caution
Possible damage to materials
When motors are overloaded, mechanical or electrical damage may occur:

- In the event of sudden speed or torque changes
- If an incorrect motor type is selected from the motor library (torque overload)

Warning

Possible personal injury

Incorrect use of the motor test bench in combination with the software may result in personal injury. For this reason, please adhere to the following safety precautions when working with the test bench:

- Do not operate the motor test bench if the protective cover has been removed.
- Deactivate the connection between the software and the motor test bench before any manual intervention.

1.3 Text attributes

- Unless otherwise specified, the term “mouse click” or “click” always refers to the left-hand mouse button.
- Bold text indicates:
  An action such as clicking or selecting
  A filename or a menu designation

1.4 Hardware and software requirements

System configuration	
Processor	1 GHz Pentium IV
RAM	512 MB
Available hard disk space	100 MB
Operating system	Windows XP, Windows Vista, Windows 7 or Windows 8
Monitor	17" monitor with a resolution of 1024 x 768
Interfaces	USB port
Miscellaneous	Adobe Flash Player, Adobe Reader, Microsoft Internet Explorer

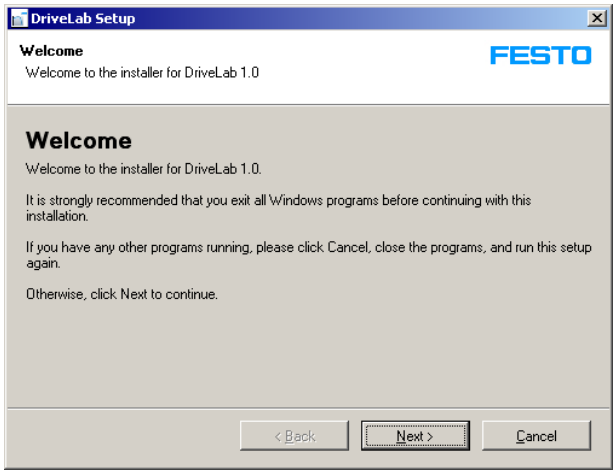
2 Installing/uninstalling the software

Below is a step-by-step description of how to install the software. You'll need the installation CD ROM included to this end.

2.1 Installing DriveLab

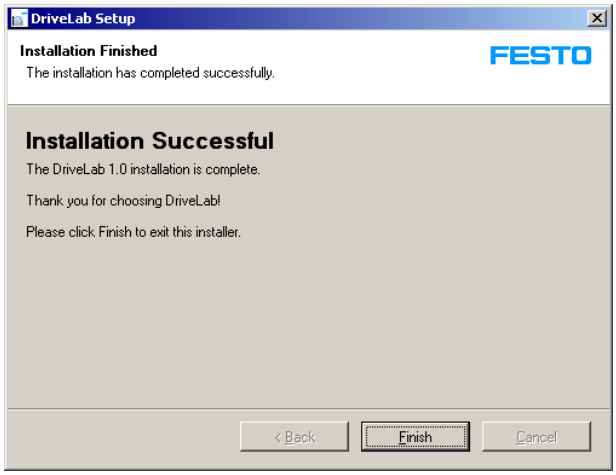
The PC must be switched on and the operating system must be running.

1. Insert the included CD ROM.



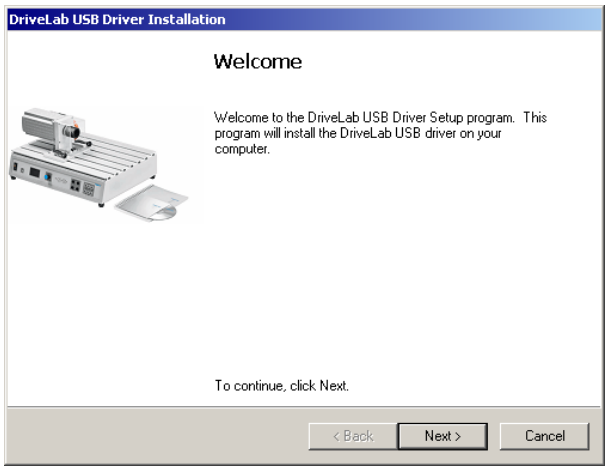
If the first window does not appear automatically, run the SETUP.EXE file in the CD directory. The following window appears.

2. The various installation steps can be controlled using the **Cancel**, **Back** and **Next** buttons.
3. Please follow the instructions that appear on the screen.
4. When the following window appears, software installation has been completed. USB driver installation is then prompted automatically.

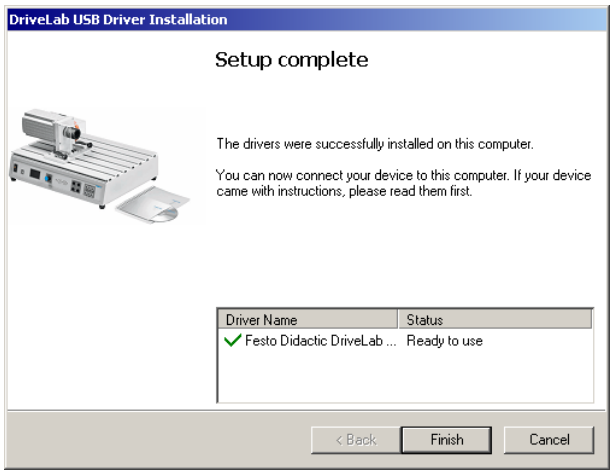


2.2 Installing the USB driver

The USB driver is installed during a second step. The driver enables communication between the software and the hardware (motor test bench). The following window appears automatically after DriveLab has been installed.



5. Driver installation is started by clicking the **Next** button.
6. The following window appears.



The green check mark means that the driver has been installed.

7. Installation is concluded by clicking the **Finish** button. A window with a corresponding message then appears.

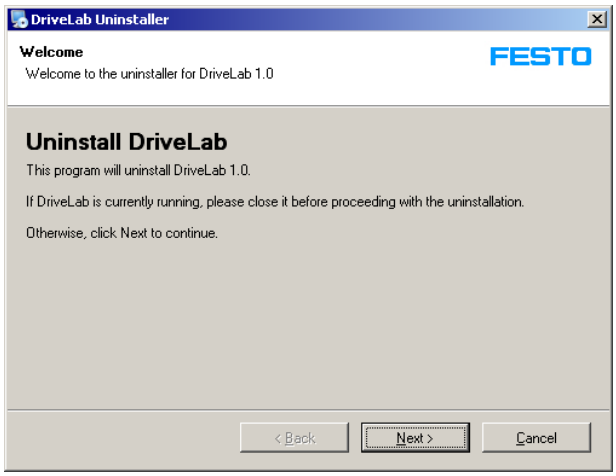
Installation is finished. You can now start the DriveLab program.

2.3 Uninstalling DriveLab

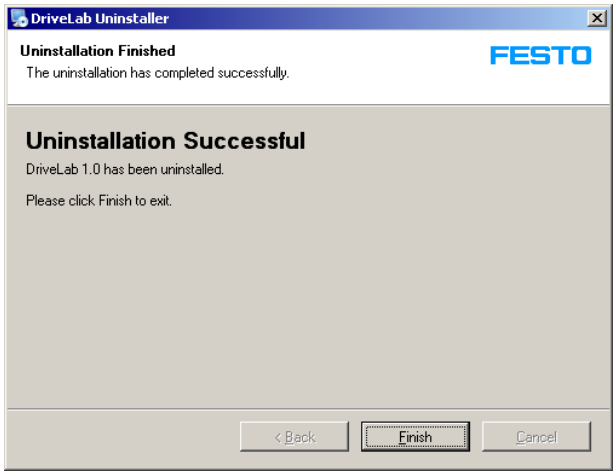
The software is uninstalled via the Windows start menu.

Select **Start › Programs › Festo Didactic › DriveLab › Uninstall DriveLab**.

The following window appears:



1. The various uninstall steps can be controlled using the **Cancel**, **Back** and **Next** buttons.
2. Please follow the instructions on the screen.
3. When the following window appears, the software has been uninstalled. The USB driver is automatically uninstalled as well.



3 Starting the program

The program is started via the Windows task bar by clicking **Start › Programs › Festo Didactic › DriveLab › DriveLab,** or by clicking the DriveLab icon at the desktop.

The DriveLab program window appears with a new, empty project.

4 A finished sample project for getting acquainted

A sample project is included with the software. Using this sample project helps you to familiarise yourself with the software without first having to connect any hardware (test bench).

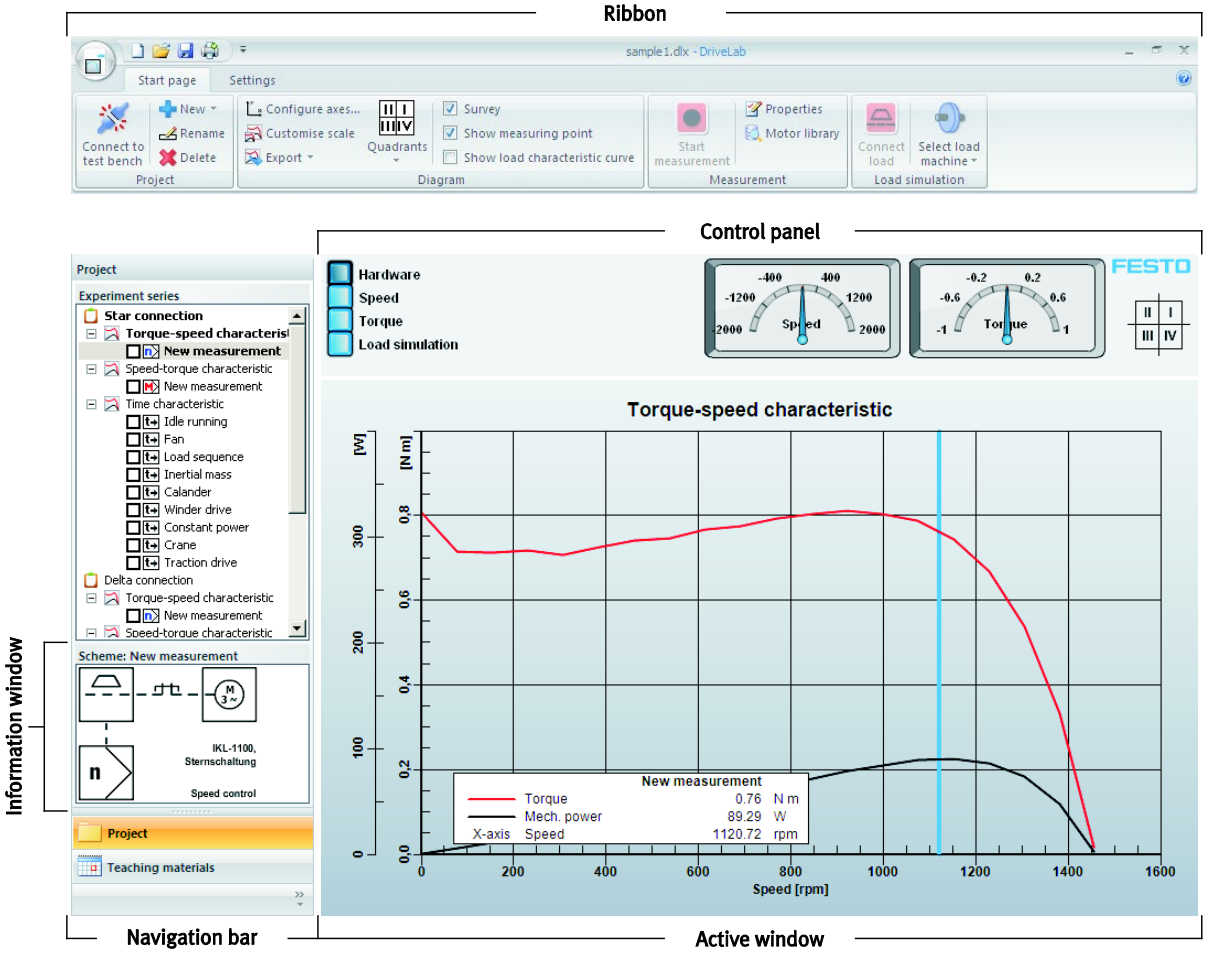
Open the sample project by clicking:

1. File › Open › My Files › DriveLab › Samples
2. Double click the “sample1.xml” file.
3. When prompted to indicate whether or not the project should be saved, respond by clicking the **No** button.

The content of the program window is changed.

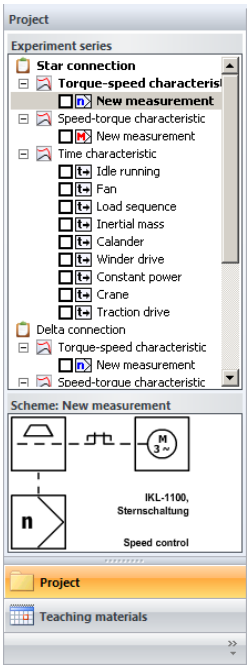
- A characteristic curve appears in the active window.
- The project list in the navigation bar is filled in.

4.1 User interface layout



4.2 The navigation bar

- There are two buttons at the bottom of the navigation bar. The appearance of the navigation bar changes depending on whether **Projects** or **Teaching materials** is selected.
- **Projects:** If “Projects” is selected, an overview of stored projects is displayed at the navigation bar. A number of experiment series have already been created in the sample file. The tree structure and usage are similar to Windows Explorer. The smallest unit (a file in Windows Explorer) is a measurement in DriveLab. Several measurements are grouped together in the “Diagram” folder. In turn, several diagrams are included in the “Experiment” folder. Just like in Windows Explorer, you can assign any name to the directories.
- **Teaching materials:** If available, teaching materials can be accessed here and viewed in a web browser. Festo Didactic would be happy to provide you with further information, for example on how you can supplement this function with training content. Refer also to the “Teaching materials” section.
- **Information window:** Displays information regarding the currently selected measurement, for example which motor, measurement type or load machine has been selected.



4.3 The active window

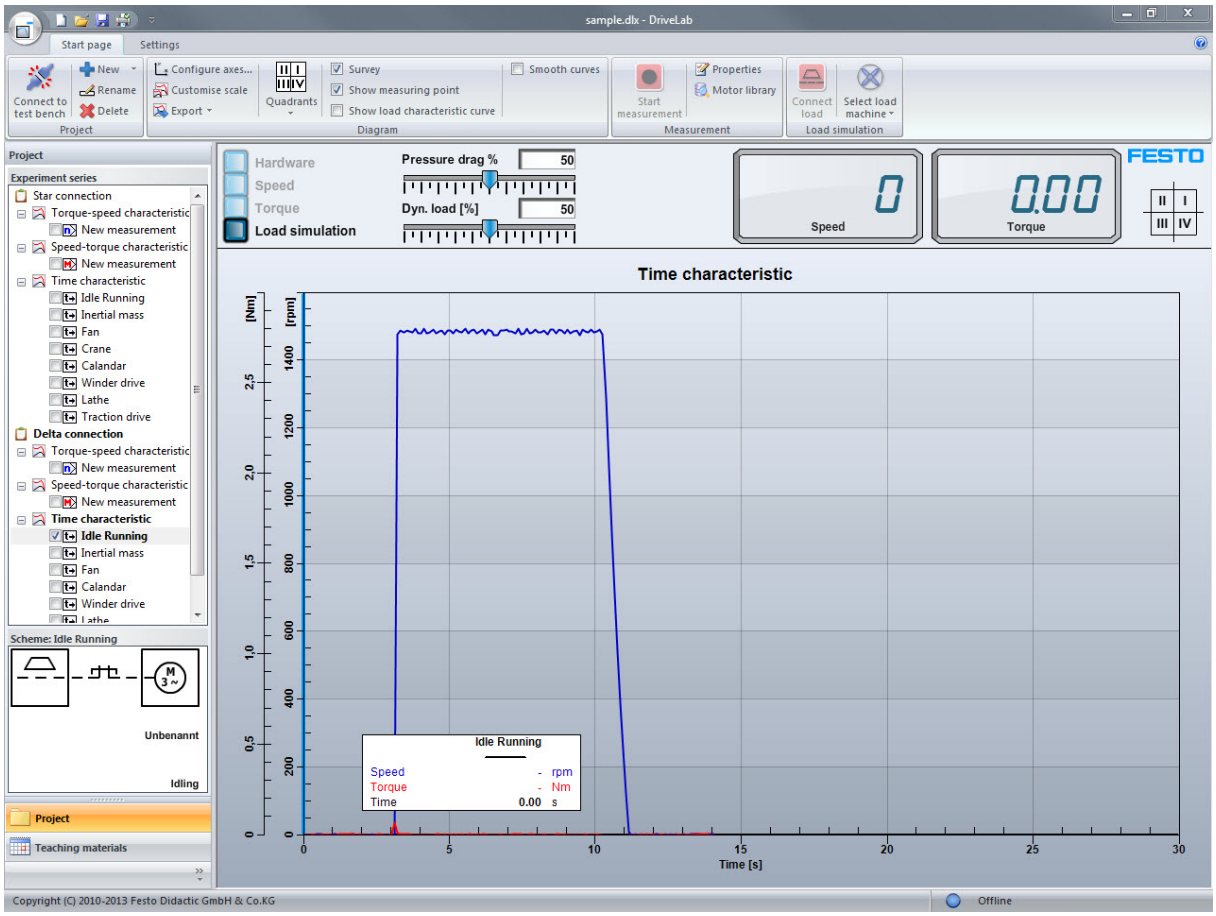
The active window displays current measurements in a coordinate system as characteristic measurement curves. The curves are generated in real-time when measurements are started. Previously saved measurements can be opened from the experiment series. A legend is automatically displayed along with the measurement, and can be moved to any desired position within the active window.

4.3.1 Displaying measurements in the active window

You can select a measurement for display in the active window.

Proceed as follows:

1. Click **Idle running** under Time characteristic (don't click the checkbox).
2. The corresponding graphic appears in the active window.

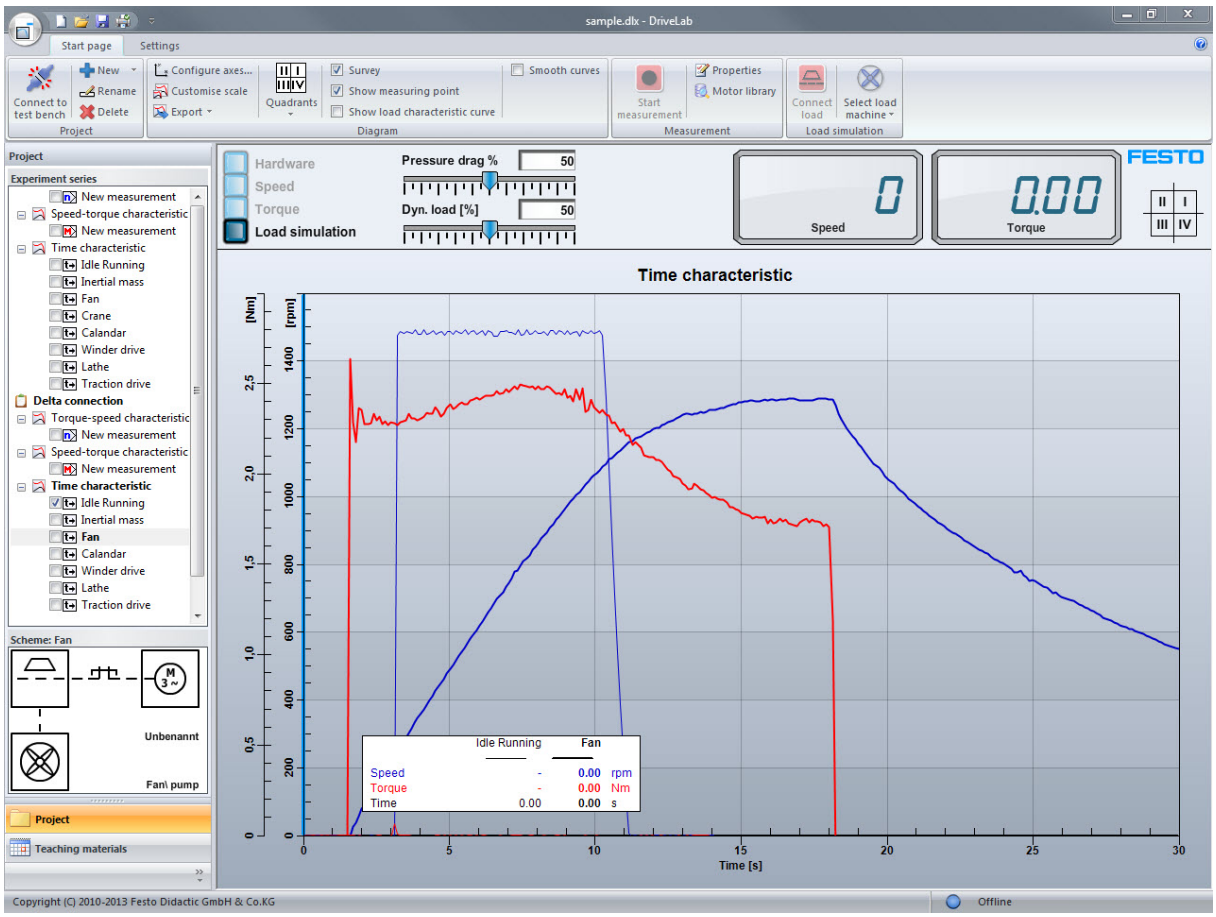


4.3.2 Comparing diagrams

You can superimpose diagrams over each other in order to compare them.

Proceed as follows:

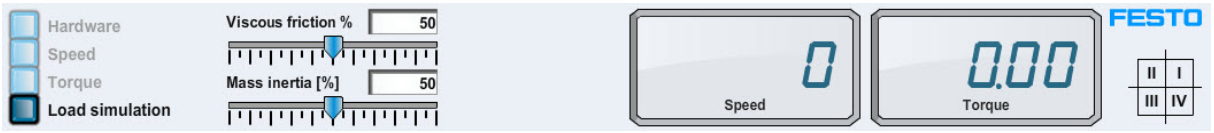
1. **Activate** the **checkbox** next to “Idle running” (click into the checkbox).
2. **Click** the word **Fan**.
3. You can now see the characteristic curves for both measurements, superimposed over each other. In order to differentiate amongst the various measurements, a different line type is used for each. The selected measurement is always highlighted by a heavier line.



A legend is displayed in the graphic as a white box with data for both measurements.

Any number of measurements can be superimposed in this way.

4.4 The control panel



The control panel contains elements for controlling the test bench, as well as displays for indicating actual values.

4.4.1 Control elements

A connected test bench can be controlled with the help of the control panel.
You can specify values for speed, torque and load simulation by clicking the respective buttons. After clicking one of the buttons, an appropriate slider appears which can be adjusted with the mouse.

- Hardware
  Select the “Hardware” function if you want to disconnect the test bench controller from DriveLab. Speed and torque of the connected test object will still be displayed, but it can only be controlled with the control elements at the test bench.
- Speed
- Torque
- Load simulation

Further information regarding the control panel is included in section “Controlling the test bench”.

4.4.2 Load setting

The characteristics of a simulated load can be configured with the two sliders.

Further information on load simulation can be found in chapter “Simulating loads”.

4.4.3 Display components

The display components indicate actual speed and torque of the connected test object.
You can switch the format of the display components back and forth between analogue and digital. Further details can be found in chapter “Selecting a display component”.

4.4.4 The quadrant symbol

The quadrant symbol indicates the current operating state of the test object. When the test object is running, the corresponding quadrant is highlighted in blue.
Section “Selecting a quadrant view”, explains how you can change the representation of the symbol in order to display one or more quadrants.

4.5 The ribbon

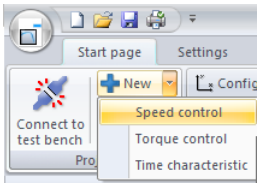
The ribbon corresponds to the menu bar as used in Microsoft Office. Its use is described in detail in the following sections.

5 Program functions in detail

5.1 Creating a new experiment

Via the ribbon – proceed as follows:

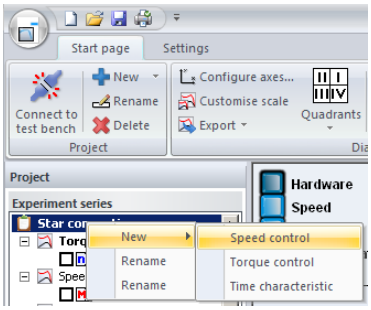
1. Select an experiment from the navigation bar.
2. **Click** the **New** button under the Projects heading in the ribbon to open the pull-down menu, and then **click** the desired experiment type.
3. A dialogue box appears. Enter the desired name and click **OK** to confirm.



At this point there's not just a new experiment in the navigation bar, conveniently enough a new diagram and a new measurement have also been created.

Directly from the navigation bar – proceed as follows:

1. **Click** an existing experiment with the right-hand mouse button. A selection window appears.
2. Select **New**, and then **click** the desired experiment type.
3. A dialogue box appears. Enter the desired name and click **OK** to confirm.

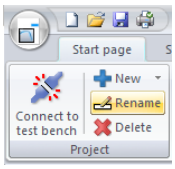


At this point there's not just a new experiment in the navigation bar, conveniently enough a new diagram and a new measurement have also been created.

5.2 Renaming an experiment

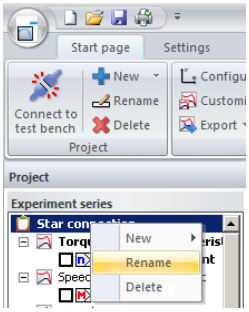
Via the ribbon – proceed as follows:

1. **Click** the desired **experiment** in the navigation bar.
2. **Click Rename** in the ribbon. The name in the text field is activated.
3. Enter the desired name in the activated text field and click **OK** to confirm.



Directly from the navigation bar – proceed as follows:

1. **Click** the existing experiment with the right-hand mouse button. A selection window appears.
2. **Click Rename**. The text field for the selected experiment is activated.
3. Change the name directly in the activated text field.



The quick alternative directly in the text field – proceed as follows:

1 **Click** the existing experiment twice, slowly. The text field for the selected experiment is activated.

2 Change the name directly in the text field.

5.3 Relocating an experiment

1 Move the mouse pointer to the experiment and **press and hold** the left-hand mouse button.

2 Without releasing the mouse button, **drag** the experiment to the required position.

3 **Release the mouse button**.

5.4 Copying an experiment

1. Move the mouse pointer to the experiment, **press and hold the Ctrl key**, and then **press and hold** the left-hand mouse button.
2. **Without releasing the Ctrl key or the mouse button**, drag the experiment to the desired position.
3. **Release the key**.

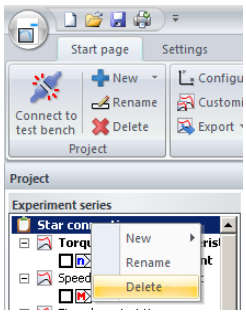
5.5 Deleting an experiment

Via the ribbon – proceed as follows:

1. **Click** the desired **experiment** in the navigation bar.
2. **Click Delete** in the ribbon. The experiment is deleted, along with the respective diagram and measurement.

Directly from the navigation bar – proceed as follows:

1. **Click** the existing experiment with the right-hand mouse button. A selection window appears.
2. **Click Delete**. The experiment is deleted, along with the associated diagrams and measurements.



5.6 Creating, renaming, relocating and deleting diagrams

Diagrams can be created, renamed and deleted using the same procedure as described for experiments (see sections „Creating a new experiment“, „Renaming an experiment“, „Relocating an experiment“ and „Deleting an experiment“).

5.7 Creating, renaming, relocating and deleting measurements

Measurements can be created, renamed and deleted using the same procedure as described for experiments (see sections „Creating a new experiment“, „Renaming an experiment“, „Relocating an experiment“ and „Deleting an experiment“).

When creating a new measurement, you have the option of selecting either a speed measurement, a torque measurement or a time measurement. Depending on your selection, different symbols appear to the left of “New measurement” in the navigation bar.

 stands for measurement with speed control.
 stands for measurement with torque control.
 stands for a time controlled measurement.

Based on the selected type of measurement, you’re presented with different setting options in the measurement’s **Properties** dialogue. Details are explained in the respective “Adjusting measurement properties ...” sections.

5.8 Changing diagram displays

You can adapt the appearance and the content of the diagram display to some extent to meet your requirements.

The following options are available:

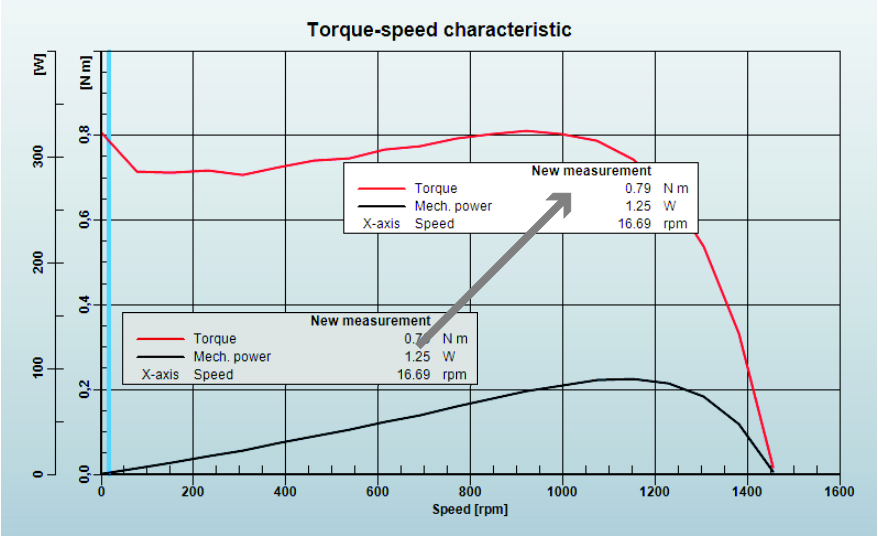
- The position of the legend can be changed.
- The selection of displayed measured variables can be changed/supplemented.
- The measured variables can be taken from the characteristic measurement curve and displayed as numeric values in the legend.
- The characteristic measurement curve colour and style can be changed.
- The characteristic load curve can be displayed and changed.

5.8.1 Relocating the legend

The white box containing the legend can be moved to any position within the graphic.

Proceed as follows:

1. **Position** the **mouse pointer** within the box that contains the legend. The pointer is changed into a hand.
2. **Press** the **mouse button**.
3. Without releasing the mouse button, **drag** the box containing the legend to the desired position.



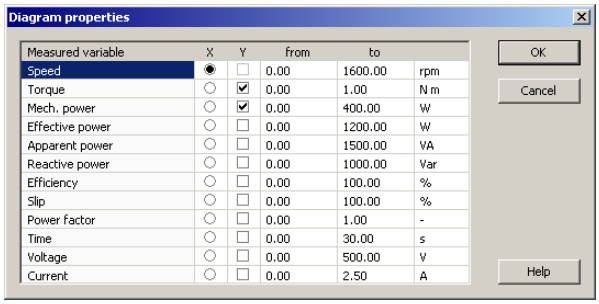
The selected position is retained in memory for each individual characteristic curve.

5.8.2 Selecting/changing measured variable displays

12 measured variables are recorded for each measurement. For purposes of clarity, not all of these are displayed when the default settings are used. You can decide which measured variables will appear in the graphic.

Via the ribbon – proceed as follows:

1. **Click Configure axes** under the Diagram heading. The following dialogue box appears.



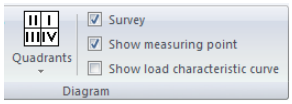
2. Select options by **clicking** the **Options** button, or by activating the **checkbox**.

Note
Only one measured variable can be selected for the X-axis.
Changes to measured value selections are automatically transferred to the legend.

Directly by clicking the right-hand mouse button – proceed as follows:
The dialogue box can also be accessed by **right clicking** and selecting **Configure axes**. The mouse pointer must be within the diagram display to this end.

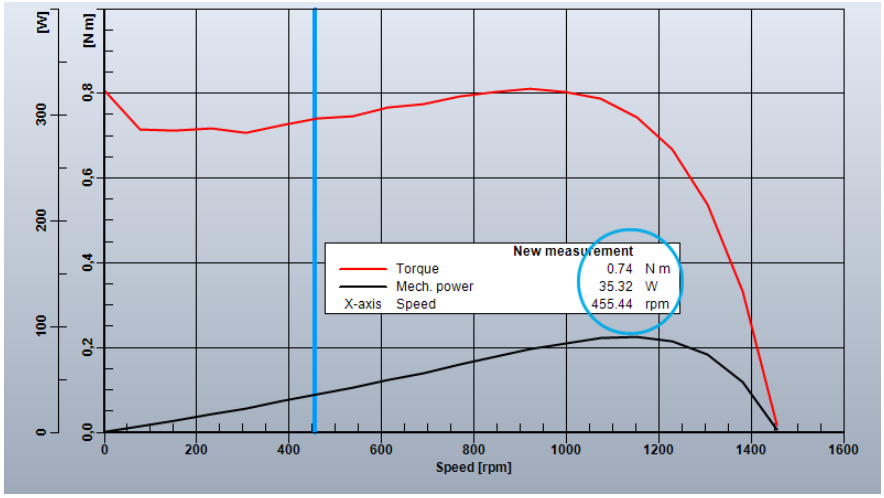
5.8.3 Displaying measured values

This function is only available when the **Survey** checkbox is activated under **Diagram** in the ribbon.



Proceed as follows:

1. Position the mouse pointer on the vertical blue line in the Y-axis diagram.
2. **Press** the **left-hand mouse button**.
3. Without releasing the mouse button, **drag** the vertical blue line.



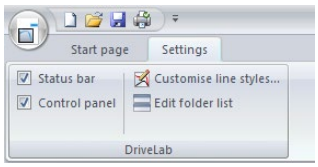
The value from the characteristic curve which corresponds to the new position of the vertical blue line appears in the legend.

5.8.4 Customising characteristic measurement curve colour and style

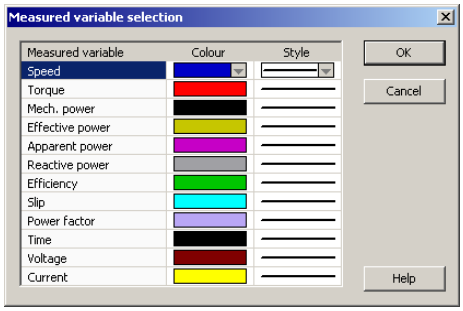
Different colours and types of lines can be assigned to each respective characteristic curve.

Via the ribbon – proceed as follows:

1. Select the **Settings** tab in the ribbon. The content of the ribbon is changed.



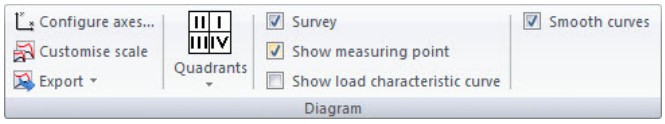
2. **Click Customise line styles** under the DriveLab heading, after which the following dialogue box appears.
3. Select the desired **measured variable** by clicking it.
4. **Select** the desired **colour** and **style** from the pull-down menu.
5. Click **OK** to confirm your selections.



Directly by using the right-hand mouse button – proceed as follows:
The dialogue box can also be accessed by **right clicking** and selecting **Customise line styles**. The mouse pointer must be within the diagram display.

5.8.5 Smoothing curves

If “Smooth curves” under the heading “Diagram” in the ribbon is activated with a checkmark, the measuring points are joined with smoothed curves. A more agreeable representation is generated in this way.



5.8.6 Customising diagram scaling

This function is helpful if the characteristic curve is smaller or larger than expected. It automatically adjusts scaling of the X and Y-axes to the range of measured values included in the characteristic curve.

Proceed as follows:

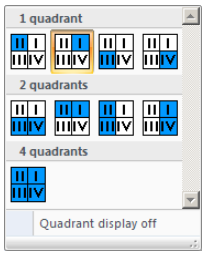
Click Customise scaling under the Diagram heading in the ribbon.

5.8.7 Selecting a quadrant view

You can adjust the display range of the diagram so that certain quadrants are displayed.

Proceed as follows:

1. **Click Quadrants** under the Diagram heading in the ribbon, after which the following selection window appears.
2. **Click** the desired quadrant view in the selected window.



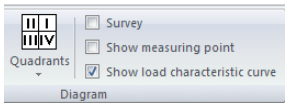
After clicking **Quadrant display off**, the diagram is once again displayed using the value range selected with the **Configure axes** command.

5.8.8 Displaying characteristic load curves

Load machines (such as fans, cranes, winches etc.) can be simulated with DriveLab, and the corresponding characteristic curves can be displayed in the diagram. This display is deactivated when the default settings are used.

Proceed as follows:

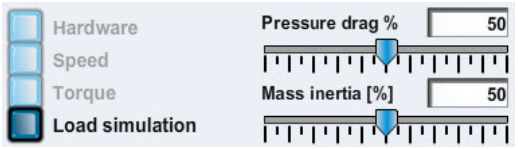
1. Activate the checkbox to the left of **Show characteristic load curve** by **clicking** it with the mouse button. A new dashed characteristic curve appears in the diagram.



Note

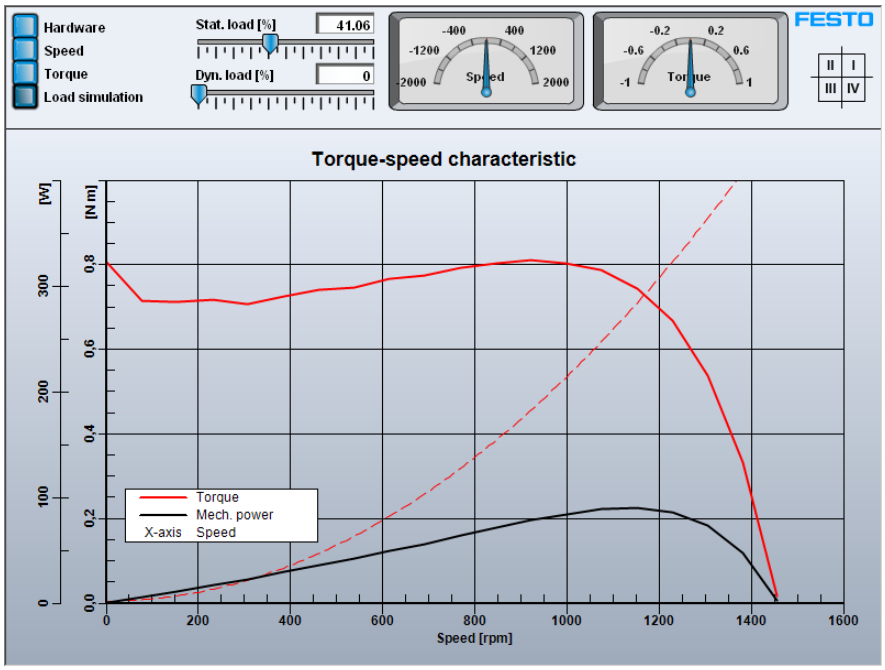
Characteristic load curves can only be displayed if torque or speed is selected as the measured variable for the X-axis.

2. **Click** the **Load simulation** button in the control panel. Two sliders then appear to the right.



You can adjust the upper slider for the static load with the mouse and observe how the characteristic load curve changes.

Dynamic load is adjusted with the bottom slider. The dynamic component changes the load's time characteristics, and thus has no influence on the displayed load curve.



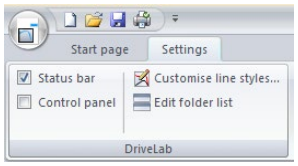
Dynamic load changes have no influence on the load machine's characteristic torque curve. The dynamic load component determines the load machine's dynamic response.

5.9 Hiding the control panel/status bar

You can hide the control panel/status bar in order to create more space at the monitor screen. This display is active when the default settings are used.

Proceed as follows:

1. Select the **Settings** tab in the ribbon. The content of the ribbon is changed.
2. Deactivate the checkbox to the left of control panel/status bar under the DriveLab heading by **clicking** it.
3. The control panel/status bar is removed from the program window.

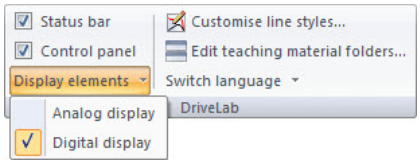


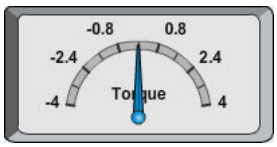
5.10 Selecting a display component

Current measured values for the test object are displayed in the control strip by either an analogue pointer instrument or a digital display. The desired display can be selected in DriveLab.

Proceed as follows:

1. Select the “Settings” tab in the ribbon. The content of the ribbon is changed.
2. Open the selection menu by clicking on “Display components” under the DriveLab heading.
3. Click on either analogue or digital display in this menu.





Analogue display

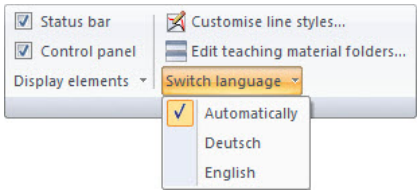
Digital display

5.11 Changing the language

DriveLab automatically uses the same language for menus and dialogues as has been selected in your Windows settings. If you would like to use a different display language, this can be selected in DriveLab.

Proceed as follows:

1. Select the **“Settings”** tab in the ribbon. The content of the ribbon is changed.
2. Open the selection menu by clicking on **“Switch language”** under the DriveLab heading.
3. Select the desired option from the menu.

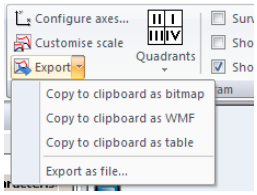


5.12 Exporting diagrams

Diagrams can be exported as graphics, or as lists of measured values, for example to use them in word processing programs. They can also be saved as JPG, BMP or WMF files.

Proceed as follows:

1. Open the pull-down menu using the **Export** function under the **Diagram** heading.



2. Select the desired format:
   - If you select “Copy to clipboard as bitmap or WMF ...”, a graphic is copied to the clipboard.
   - If you select “Copy to clipboard as table”, only the measured values are copied to the clipboard.
   - If you select “Export as file”, you can save a graphic to the data storage medium of your choice as a JPG, BMP or WMF file.

6 Controlling the test bench

The test bench must be connected to the PC and the software via the USB port for the following functions.

6.1 Connecting the test bench

Connect the PC to the test bench. A suitable USB cable is included (USB 2.0, type B).

6.2 Control panel functions

Test bench hardware can be controlled and visualised with the help of the control panel elements.

6.2.1 Connecting the controller to the test bench

Prerequisites:

- The USB cable between the test bench and the PC is plugged in.
- The test bench is switched on.

Proceed as follows:

Click the **Connect to test bench button** with the mouse button.

Once the connection has been established:

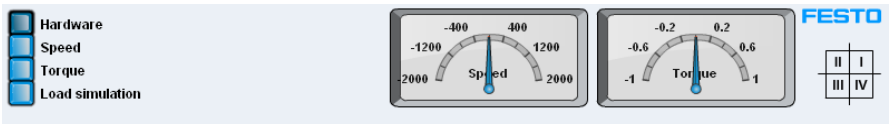
- The appearance of the button changes and
- The display in the footer of the active window changes from “Offline” to “Connected to test bench”.

Note

A connection has now been established to the test bench, but it cannot yet be controlled. See section “Activating the test bench for the controller via software”.

6.2.2 Displaying speed in RPM and torque

The actual motor speed in RPM and torque are displayed at two measuring instruments included in the control panel after connection has been established with the test bench. On the basis of these values, the indication of the current operating state is also updated in the quadrant view.



6.3 Activating the test bench for the controller via software

For safety reasons, additional activation is required at the test bench in order to enable its control with the software.

Proceed as follows:
As soon as you activate one of the three buttons (speed, torque or load simulation) or click “Start measurement”, a window appears which prompts you to activate the controller at the test bench.

1. The following display appears at the test bench: “PC mode – controller inactive”.
2. **Press** the **Rotary knob**.
3. The following display appears at the test bench: “PC mode – controller active”.
4. Attempt to establish a connection again in the open message window by clicking **Repeat**. Connection has now been established.

The actual speed and torque remain unchanged after control has been taken over by DriveLab.

Note
Manual control directly at the test bench is not possible in this operating state. If you want to control the test bench with its own rotary knob again, click the **Hardware** button.

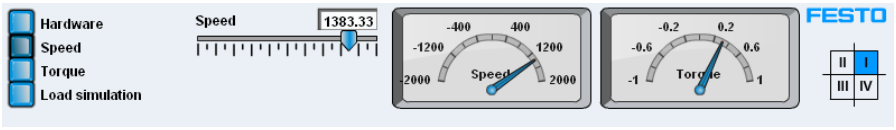
6.3.1 Setting speed in RPM

You can adjust speed as desired with a slider, or enter an exact speed value in the numeric field.

Prerequisite: Connection to the test bench is activated (see section “Activating the test bench for the controller via software”).

Adjustment with the speed slider – proceed as follows:

1. **Click** the **Speed** button with the mouse. A slider appears.
2. **Click** the **slider** with the mouse, **hold the button down** and **adjust** the slider. The speed selected in this way is displayed in the numeric field above the slider.



Entry with the keyboard – proceed as follows:

1. **Double click** into the **numeric field** above the slider. The numbers are highlighted.
2. **Enter** the desired numeric value using the **keyboard**.
3. Confirm your entry using the **return key**.

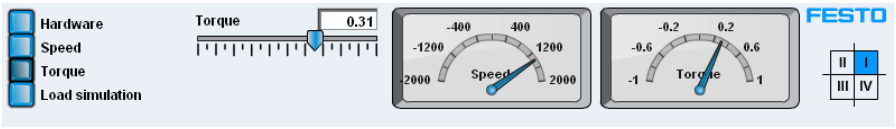
6.3.2 Setting torque

You can adjust torque as desired with a slider, or enter an exact torque value in the numeric field.

Prerequisite: Connection to the test bench is activated (see section “Activating the test bench for the controller via software”).

Adjustment with the speed slider – proceed as follows:

1. **Click** the **Torque** button with the mouse. A slider appears.
2. **Click** the **slider** with the mouse, **hold the button down** and **adjust the slider**. The torque selected in this way is displayed in the numeric field above the slider.



Entry with the keyboard – proceed as follows:

1. **Double click** in the **numeric field** above the slider. The numbers are highlighted.
2. **Enter** the desired numeric value using the **keyboard**.
3. Confirm your entry using the **return key**.

7 Preparing and starting measurements

In order to perform measurements, the test bench must be switched on and connected to the PC and the software via the USB port, and must be activated as well (see "Connecting the test bench" and "Activating the test bench for the controller via software").

Before clicking the **Start** button, several additional settings must be entered which ensure that measurement is performed exactly as you wish, and that the desired results are obtained.

7.1 Selecting a motor from the motor library

If you always use the same motor at the test bench, this setting only has to be entered once.

Proceed as follows:

1. **Click Motor library** under the Measurement heading in the ribbon.
2. Select the appropriate motor from the selection window under motors. Refer to section "Working with the motor library", for further details regarding settings.
3. **Click Save** in the Library field.
4. Click **OK** to confirm your selection.

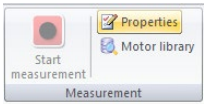
The selected motor is valid for all subsequent measurements until you select another.

7.2 Measurement with speed control

In order to start a measuring cycle, you can repeat a measurement which has already been performed, or create a new measurement with speed control in the experiment series (see section "Creating, renaming, relocating and deleting measurements").

Proceed as follows to start a measurement:

1. Select an existing **measurement** from an experiment series by **clicking** it, or create a new one.
2. **Click Properties** under the Measurement heading in the ribbon.



3. Select the desired **settings** from the selection window and click **OK** to confirm (see section „Adjusting measurement properties (speed control)" for details).
4. Switch the test object on.
5. Activate the test bench (**press** the **rotary knob** at the test bench).

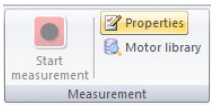
6. **Click Start measurement** under the Measurement heading in the ribbon.
   - The test sequence is started.
   - The display in the footer of the active window changes. The text changes from “Connected to test bench” to “Measurement active”, and the dot to the left of this text changes from green to flashing red.
   - The measurement’s characteristic curve appears in the diagram.
   - After measurement has been completed, the text in the footer changes back to “Connected to test bench”, and the flashing red dot changes back to green.
7. Switch the test object off, or perform further measurements.

7.2.1 Adjusting measurement properties (speed control)

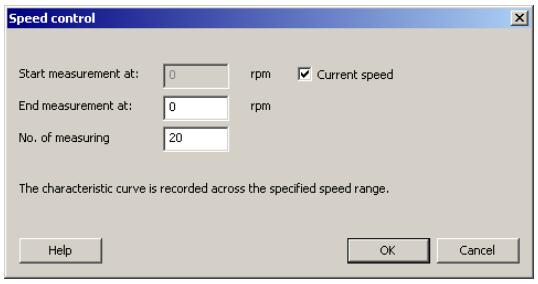
Default parameters can be changed before each measurement in order to adapt measurement characteristics to your actual needs.

Proceed as follows:

1. Select a **measurement** with speed control from the experiment series by **clicking** it.
2. **Click Properties** under the Measurement heading in the ribbon.



3. Enter the following settings in the selection window which then appears.
   - **Start measurement at:** If the checkbox next to “Current speed” is activated, measurement is started at the speed at which the motor on the test bench was running when you clicked “Start measurement”. If the checkbox is deactivated, you can specify the desired speed.
   - **End measurement at:** Measurement is stopped automatically when the motor reaches the speed entered here.
   - **Number of measuring points:** Enter the number of measuring points here. The default setting of 20 measuring points provides you with an easily assessable characteristic measurement curve.

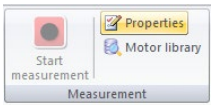


7.3 Measurement with torque control

In order to start a measuring cycle, you can repeat a measurement which has already been performed, or create a new measurement with torque control in the experiment series (see section "Creating, renaming, relocating and deleting measurements").

Proceed as follows to start a measurement:

1. Select an existing **measurement** from an experiment series by **clicking** it, or create a new one.
2. **Click Properties** under the Measurement heading in the ribbon.



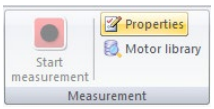
3. Select the desired settings from the selection window and click **OK** to confirm (see section „Adjusting measurement properties (torque control)" for details).
4. Switch the test object on.
5. Activate the test bench (**press** the **rotary knob** at the test bench).
6. **Click Start measurement** under the Measurement heading in the ribbon.
   - The test sequence is started.
   - The display in the footer of the active window changes. The text changes from "Connected to test bench" to "Measurement active", and the dot to the left of this text changes from green to flashing red.
   - The measurement's characteristic curve appears in the diagram.
   - After measurement has been completed, the text in the footer changes back to "Connected to test bench", and the flashing red dot changes back to green.
7. Switch the test object off, or perform further measurements.

7.3.1 Adjusting measurement properties (torque control)

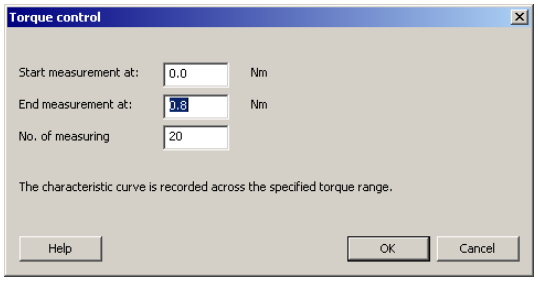
Default parameters can be changed before each measurement in order to adapt measurement characteristics to your needs.

Proceed as follows:

1. Select a **measurement** with torque control from the experiment series by **clicking** it.
2. **Click Properties** under the Measurement heading in the ribbon.



3. Enter the following settings in the selection window which then appears.
   - **Start measurement at:** You can select the torque at which measurement begins here.
   - **End measurement at:** Measurement is stopped automatically when the motor reaches the torque entered here.
   - **Number of measuring points:** The default setting of 20 measuring points provides you with an adequately accurate characteristic measurement curve. More measuring points refine the characteristic measurement curve, and fewer measuring points make it coarser.

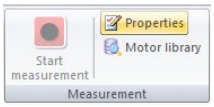


7.4 Measurement with time control

In order to start a measuring cycle, you can repeat a measurement which has already been performed, or create a new measurement with time control in the experiment series (see section "Creating, renaming, relocating and deleting measurements").

Proceed as follows to start a measurement:

1. Select an existing **measurement** from an experiment series by **clicking** it, or create a new one.
2. **Click Properties** under the Measurement heading in the ribbon.



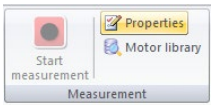
3. Select the desired settings from the selection window and click **OK** to confirm (see section „Adjusting measurement properties (time control)" for details).
4. Activate the test bench (**press** the **rotary knob** at the test bench).
5. **Click Start** measurement under the Measurement heading in the ribbon.
   - The test sequence is started.
   - The display in the footer of the active window changes. The text changes from "Connected to test bench" to "Measurement active", and the dot to the left of this text changes from green to flashing red.
   - The measurement's characteristic curve appears in the diagram.
   - After measurement has been completed, the test in the footer changes back to "Connected to test bench", and the flashing red dot changes back to green.

7.4.1 Adjusting measurement properties (time control)

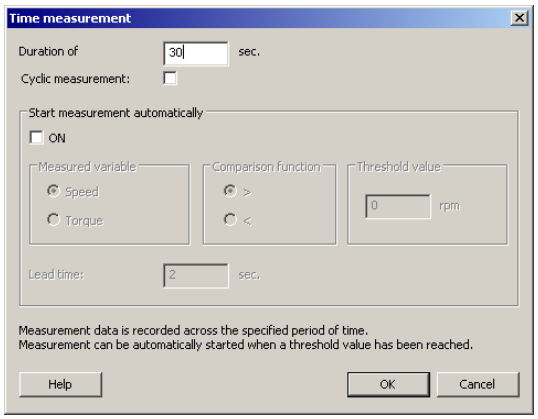
Default parameters can be changed before each measurement, in order to adapt measurement characteristics to your actual needs.

Proceed as follows:

1. Select a **time measurement** from the experiment series by **clicking** it.
2. **Click Properties** under the Measurement heading in the ribbon.



3. Enter the following settings in the selection window which then appears.
   - **Measurement duration:** Any value between 1 and 3600 seconds can be selected.
   - **Cyclic measurement:** If this checkbox is activated, the measuring cycle is continuously repeated until the “Stop measurement” button is clicked.
   - **Start measurement automatically:** If the “ON” checkbox is activated, you can enter a threshold value for speed or torque, as of which measurement will begin. For example, if you enter a threshold value of 1000 RPM and start measurement with a switched off motor, measurement doesn’t begin until the motor has been switched on and reaches a speed of 1000 RPM. If you want measurement to begin 2 seconds earlier, enter a value of 2 in the “Lead-time” field.



7.5 Simulating loads

The DriveLab controller is capable of simulating the load characteristics of various machines, for example a lathe, a grinder or a fan. A detailed explanation of individual load machine performance is included in section “Descriptions of individual load machines included with DriveLab”.

7.5.1 Selecting a load type

Proceed as follows:

1. **Click Select load machine** under the Load simulation heading in the ribbon.
2. **Click** the desired, predefined load machine in the selection window.
3. The characteristics of each respective machine are explained in section “Descriptions of individual load machines included with DriveLab”.

7.5.2 Copying load settings from a previous measurement

You can use the load simulation settings from a previous measurement.

Proceed as follows:

1. **Click Select load machine** under the Load simulation heading in the ribbon.
2. **Click Copy from selected measurement** at the bottom of the selection window.
   The load machine used for the measurement, as well as the static and dynamic load settings, are then used by DriveLab.

7.5.3 Connecting a load

Proceed as follows:

1. **Click Connect load** under the Load simulation heading in the ribbon.
2. The button’s appearance changes. The released brake icon is replaced with an applied brake icon, and the text changes to “Disconnect load”.

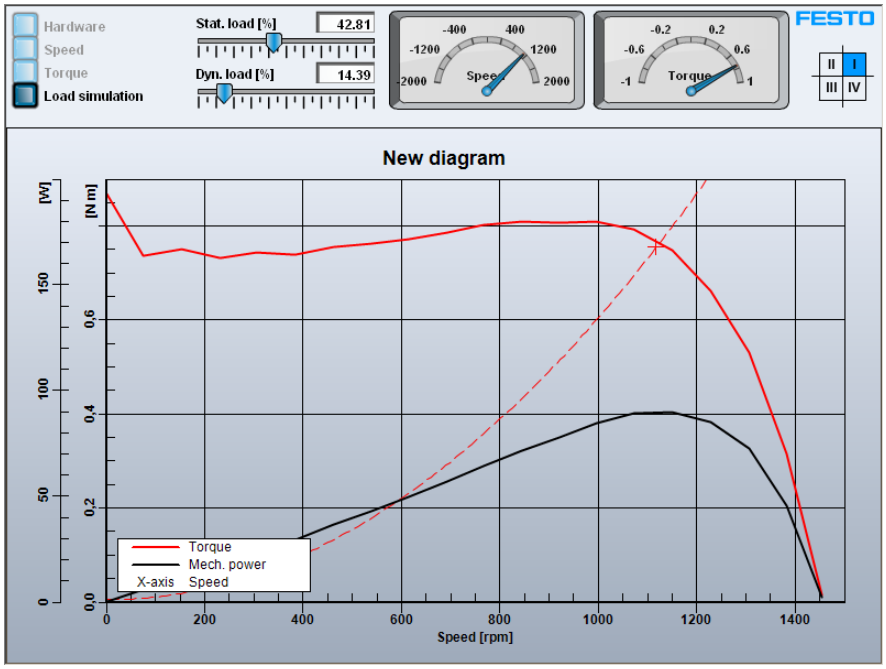
7.5.4 Adjusting and simulating load characteristics

This function makes it possible to change the test object’s static and dynamic loading during operation, and to observe the effects directly in the diagram. This function can be best explained with the help of an example.

Prerequisites:

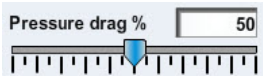
- Connection to the test bench has been established (see section “Activating the test bench for the controller via software”).
- A measurement with speed control has been performed (using default settings), and the characteristic torque curve is available (see section “Measurement with speed control”).
- The test object is switched off.
- A load type has been selected and the load, for example a fan, has been connected.

The active window might now look like this:



Proceed as follows to simulate a static load change:

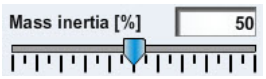
1. **Click Display characteristic load curve** under the View heading in the ribbon.
2. A new dashed line appears in the diagram, i.e. the characteristic load curve. The intersection of the characteristic load and torque curves identify the motor's working point.



3. If you adjust the upper slider for the static load in the control panel, you'll be able to see how the characteristic load curve, and thus the motor's working point, are changed.

Proceed as follows to simulate a dynamic load change:

1. **Switch the test object on**.
2. A red cross is displayed in the diagram, exactly at the motor's working point. When the motor is switched on, the cross moves along the characteristic curve from 0 RPM (standstill) to the intersection of the characteristic load and motor curves.
3. If you now adjust the static load slider, you'll see how the motor's working point follows the characteristic load curve, always along the characteristic torque curve. The speed (sluggishness) of this following movement depends on the magnitude of the dynamic load.

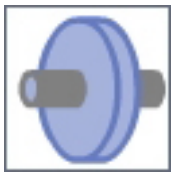
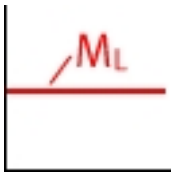
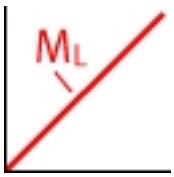
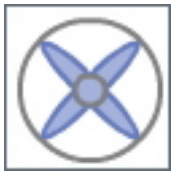
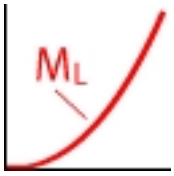
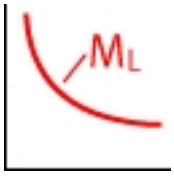
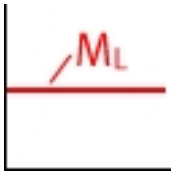


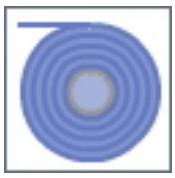
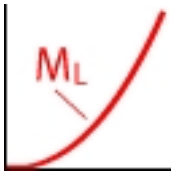
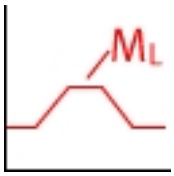
4. The dynamic load can be adjusted with the lower slider for dynamic load. Try out a variety of settings in order to become better acquainted with this function.

7.5.5 Descriptions of individual load machines included with DriveLab

The **Select load machine** button is located under the Load simulation heading in the ribbon.

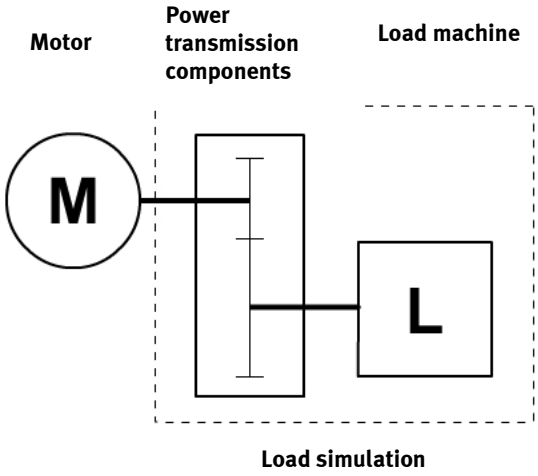
The following load machines are available:

Symbol	Characteristic load curve	Explanation
		**Inertial mass** Load characteristics are determined exclusively by inertia and friction. Torque is constant over the entire speed range.
		**Calender** In the case of the calender, torque also occurs which is proportional to speed.
		**Pump/fan** In the case of pumps and fans, torque is proportional to speed squared.
		**Lathe** In order to achieve constant cutting force and cutting speed, constant power is required over the entire speed range of the lathe. As a result, torque is inversely proportional to speed. It's advisable to connect the load after the motor has been started up, because the necessary power is not available during start-up.
		**Hoist** Load characteristics are determined by the weight to be lifted. As is also the case with inertial mass, this results in constant torque. A hoist without brake is simulated, which means that the load goes back down when the motor is switched off.

Symbol	Characteristic load curve	Explanation
		**Winch** Winding of material onto a roller is simulated. Torque increases along with the diameter of the material wound onto the roller. Initial diameter is set with the “Stat. load” entry, and diameter increase with the “Dyn. load” entry
		**Traversing drive** A traversing drive is simulated which runs through 5 path segments for 5 seconds each. 1. A flat segment 2. An upwardly inclined segment 3. A flat segment 4. A downwardly inclined segment 5. A flat segment

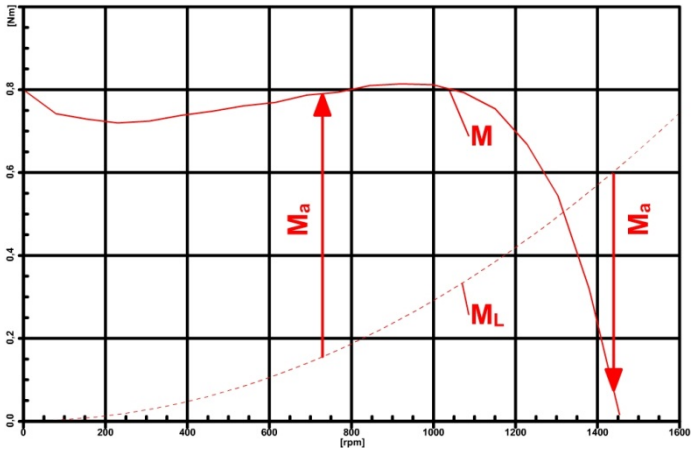
7.5.6 Basic principles of load simulation

Load simulation is based on the following drive system model:



The drive system consists of an electric motor, power transmission components (shafts, couplings, gear unit) and the load machine. The electric motor provides drive torque which is resisted by load machine torque and torque losses resulting from the power transmission components. Load torque and torque losses are simulated by the braking system at the motor test bench.

During operation, opposing torques attain equilibrium, which is illustrated in the following diagram:



Torque equilibrium:

$M_a = M - M_L$

Where
M = electric motor torque
M_L = load torque of the load machine
M_a = resulting accelerating torque

We differentiate between stationary and dynamic operation:

Speed is constant during stationary operation. This is the case where motor torque and load torque are equal. In the diagram, this corresponds to the intersection of the characteristic motor and load curves. Accelerating torque is 0 in this case.

Dynamic operation occurs during start-up and deceleration, as well as when the load is changed. In these operating states, the difference between motor torque and load torque results in accelerating torque, which in turn causes speed to change.

7.5.7 Influences taken into consideration by DriveLab during load simulation

The following influences are taken into consideration by DriveLab during load simulation:

- Inertia:
  Inertia determines the drive's dynamic performance. The greater inertia is, the more slowly the drive reacts during acceleration and deceleration.
  Inertia can be set within a range of 0 to 100% with the "Dyn. load" slider.
- Friction:
  Friction in the bearings is simulated as constant braking torque which is independent of speed. Consequently, it plays a role with regard to deceleration when the drive motor is switched off.
  Frictional torque can be adjusted with the "Stat. load" slider.

Depending on which load machine has been selected, additional torques which are typical for the respective machine are also taken into consideration. The magnitude of these torques can be adjusted with the "Stat. load" slider. If the "Display characteristic load curves" option is selected, the characteristic load curve is adjusted accordingly in the diagram.

8 Working with the motor library

Characteristic data for various motors can be saved to the motor library. These characteristic data correspond to information provided on the rating plate. Additional data are also required in order to avoid overloading the test object with the test bench.

8.1 Adding new motors to the motor library

If you use one of Festo Didactic's standard motors, the necessary motor data are already entered in the software. If you want to use other motors, they must be entered by the user along with the required performance data such as current, voltage, speed etc.

Proceed as follows:

1. **Click Motor library** under the Measurement heading in the ribbon.
2. **Click New motor** in the selection window.
3. Assign a new name in the designation field, and select the motor type.
4. Enter the corresponding values for the new motor in the Rating plate and Load limit fields.
   The values in the Rating plate field are for information only, and do not affect the test sequence. Load limit values are of greater significance (see following safety precaution).
5. **Click Save** in the "Library" field.

Caution

Property damage may occur in the event of non-compliance.

Load limits are of special significance. The limit values entered here are adhered to by the software when the brake motor is activated. Entering correct values thus prevents overloading of the test motor. Refer to the motor's data sheet or contact the manufacturer in order to obtain correct values.

8.2 Exporting/importing the motor library

You can also export/import an existing library, for example if you have entered numerous motors in a library and want to use them at other test benches.

Proceed as follows to export a library:

1. **Click Motor library** under the Measurement heading in the ribbon.
2. **Click Export** in the Library field in the selection window.
   Select a target directory in the “Save to ...” window which then appears, for example a memory stick.
3. Assign a file name in the same window, and then **click** the **Save** button.

Files saved in this way can be subsequently imported on another PC.

Proceed as follows to import a library:

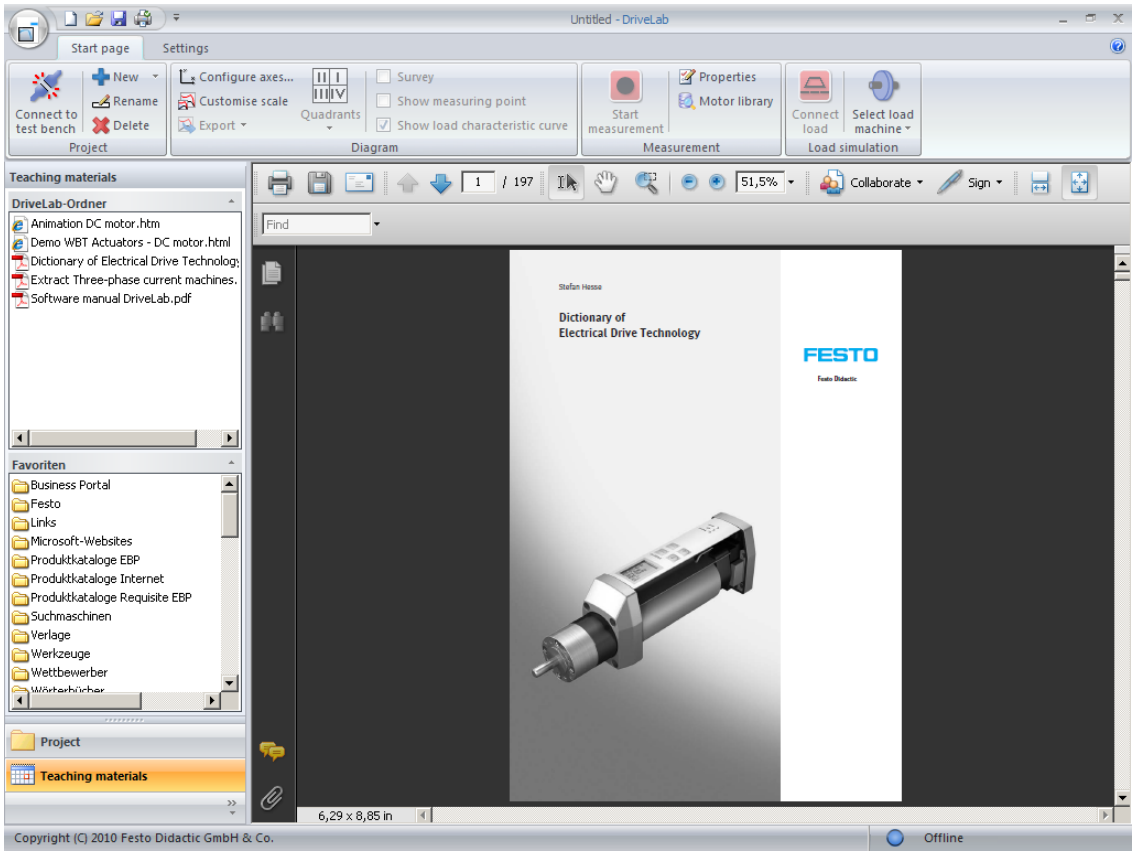
1. **Click Motor library** under the Measurement heading in the ribbon.
2. **Click Import** in the Library field in the selection window.
3. Select your source directory in the “Browse” window which then appears, for example a memory stick.
4. **Click** the desired file.

9 Teaching materials

DriveLab software includes a function which provides you with additional knowledge. This encompasses:

- The complete handbook for DriveLab software
- A dictionary of electric drive technology
- A demo WBT, animations and sample readings

You can supplement these materials with additional information in the form of data files. Refer to section "Adding (managing) teaching materials", to find out how this is done, and which file formats are suitable.



9.1 Displaying teaching materials

Proceed as follows:

1. **Click** the **Teaching materials** button in the navigation bar.
   The navigation bar is split into two windows (DriveLab folder and favourites).
2. **Select** the desired **file** from the DriveLab folder window.
   The content of the selected file is displayed in the active window.

9.2 Accessing the Internet via DriveLab

Proceed as follows:

1. **Click** the **Teaching materials** button in the navigation bar.
   The navigation bar is split into two windows (DriveLab folder and favourites). The Favourites window displays the content of the Favourites folder from Internet Explorer.
2. **Select** the desired **folder** or a **file** from the Favourites window.
   If a folder is selected, its content is displayed in the active window. If a file is selected, the corresponding website is accessed automatically with Internet Explorer.

9.3 Adding (managing) teaching materials

You can add new teaching materials to DriveLab. Documentation obtained from Festo Didactic or that you have created yourself, can be used to this end, for example in PDF format.

9.3.1 Adding a file

Proceed as follows:

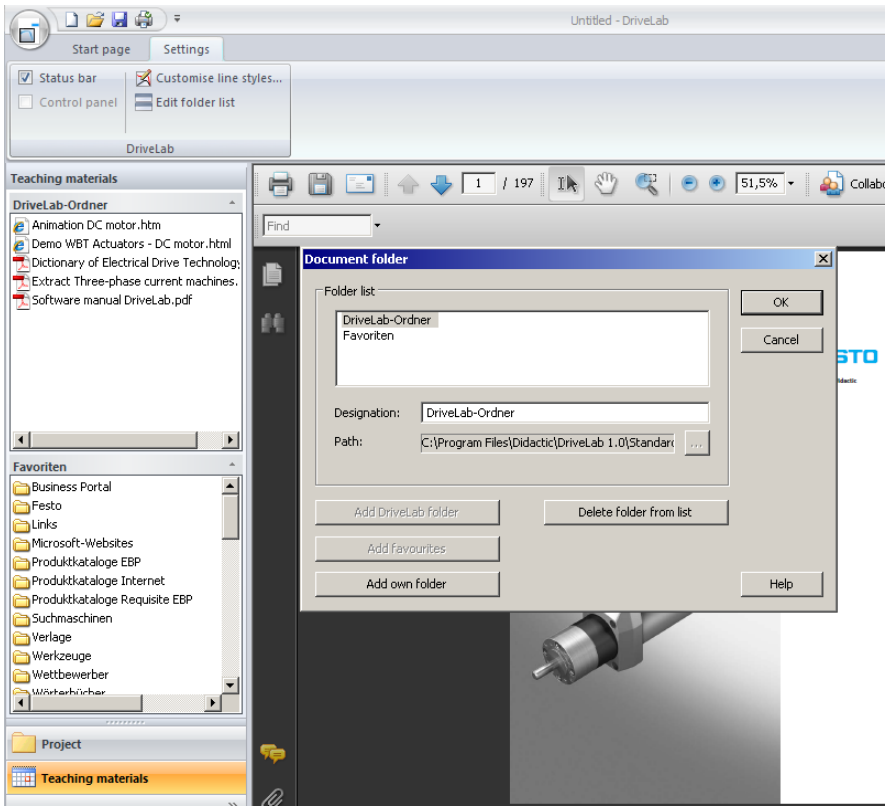
1. Navigate to the **Standard** folder with the help of the Windows Explorer (e.g. C:\Programs\didactic\DriveLab\StandardENU).
2. Copy the new file (e.g. a PDF document) to the standard folder.
3. Exit and restart DriveLab.

Your new file now appears under Teaching materials in the DriveLab folder.

9.3.2 Adding a folder

Proceed as follows:

1. **Click** the **Teaching materials** button in the navigation bar.
2. **Click** the **Settings tab** at the very top of the ribbon.
3. **Click Administrate teaching materials ...** under the DriveLab heading. A dialogue box appears.
4. **Click Add own folder**. An Explorer window appears.
5. Navigate to the desired folder, select it and click OK to confirm.
   Your new folder now appears in the folder list which is displayed in the dialogue box.
   The following functions are also available in this dialogue box:
   - Change the name of the folder. Enter the desired name in the designation field.
   - Add an additional folder (as described above).
   - Delete a folder from the list with the help of the **Delete folder from list** button.
   - Add the DriveLab folder or the Favourites folder with the **Add DriveLab folder** button or the **Add favourites** button, if you have previously deleted them from the folder list.
6. Click **OK** to confirm your change(s).



9.4 Suitable formats for teaching materials

Due to the fact that Microsoft Internet Explorer is used to display the documents, all file formats which can be displayed with it are usable. Typical formats include:

- HTM and HTML documents
- Adobe Acrobat PDF documents
- TXT documents
- JPG and PNG bitmaps
- SWF videos