



ALTAIR

Altair[®] FluxMotor[®] 2022.3

Motor Factory – Design & Test

Introduction

General user information

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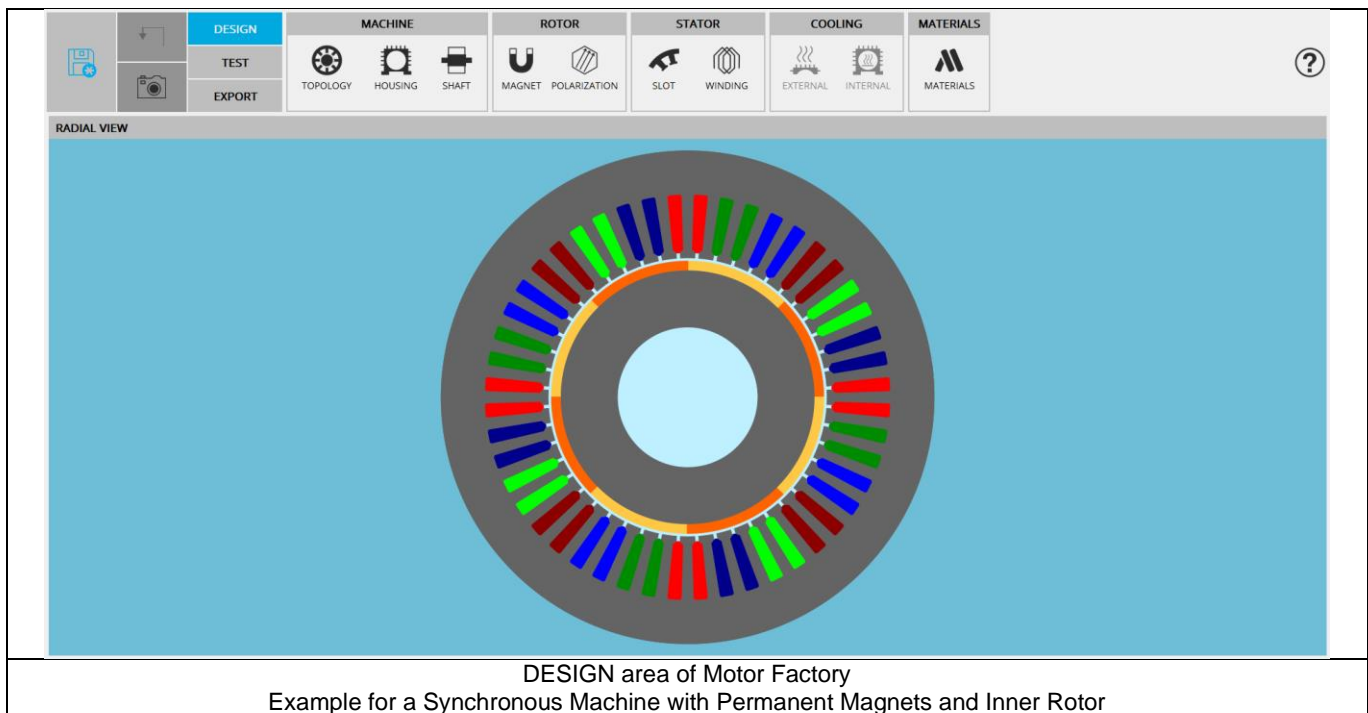
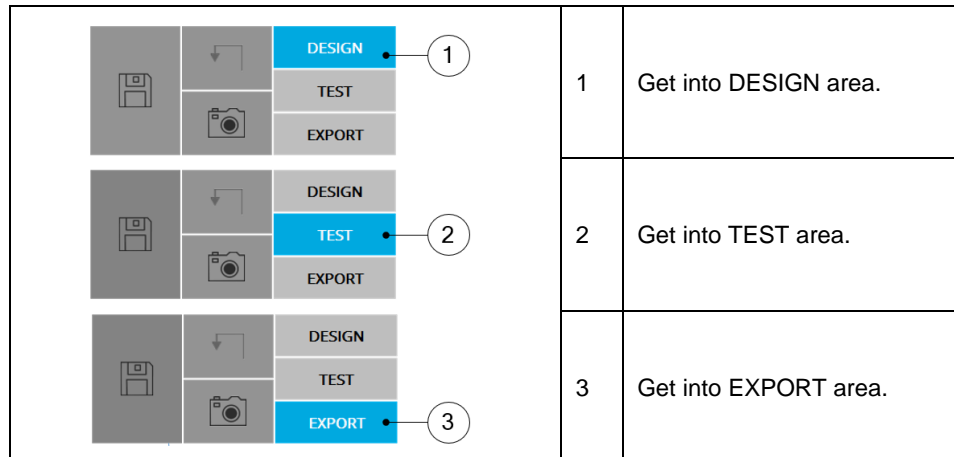
1 MOTOR FACTORY OVERVIEW

1.1 Main areas of Motor Factory

Motor Factory is a dedicated application to design and test motors.
Motor Factory consists of three main areas:

- The DESIGN area to design the motor (topology, winding, materials etc....)
- The TEST area to perform tests and performance analysis of motors
- The EXPORT area to export documents or models to perform advanced studies

To reach one of these areas just click on the corresponding button.



Note: By default, accesses to External cooling and Internal cooling environments are locked. See how to consider thermal cooling properties in the section below.

TEST OVERVIEW		
CHARACTERIZATION		
Open circuit - Motor ...	-	-
Cogging	-	-
Back emf	-	-
Model - Motor	-	-
Maps	-	-
Datasheet - Motor	-	-
I-U	-	-
Thermal - Motor & Ge...	-	-
Steady st.	-	-
Transient	-	-
WORKING POINT		
Sine wave - Motor	-	-
I-W-N	-	-
T-N	-	-
I-U	-	-
Sine wave - Generator	-	-
I-W-N	-	-
R-L-N	-	-
Square wave - Motor	-	-
Forced I	-	-
PERFORMANCE MAPPING		
Sine wave - Motor	-	-
Eff. map	-	-
Sine wave - Generator	-	-
Eff. map	-	-
MECHANICS		
NVH - Working Point	-	-
I-W-N	-	-
NVH - Spectrogram	-	-
I-W-N	-	-
T-N	-	-

TEST area of Motor Factory
Example for a Synchronous Machine with Permanent Magnets and Inner Rotor

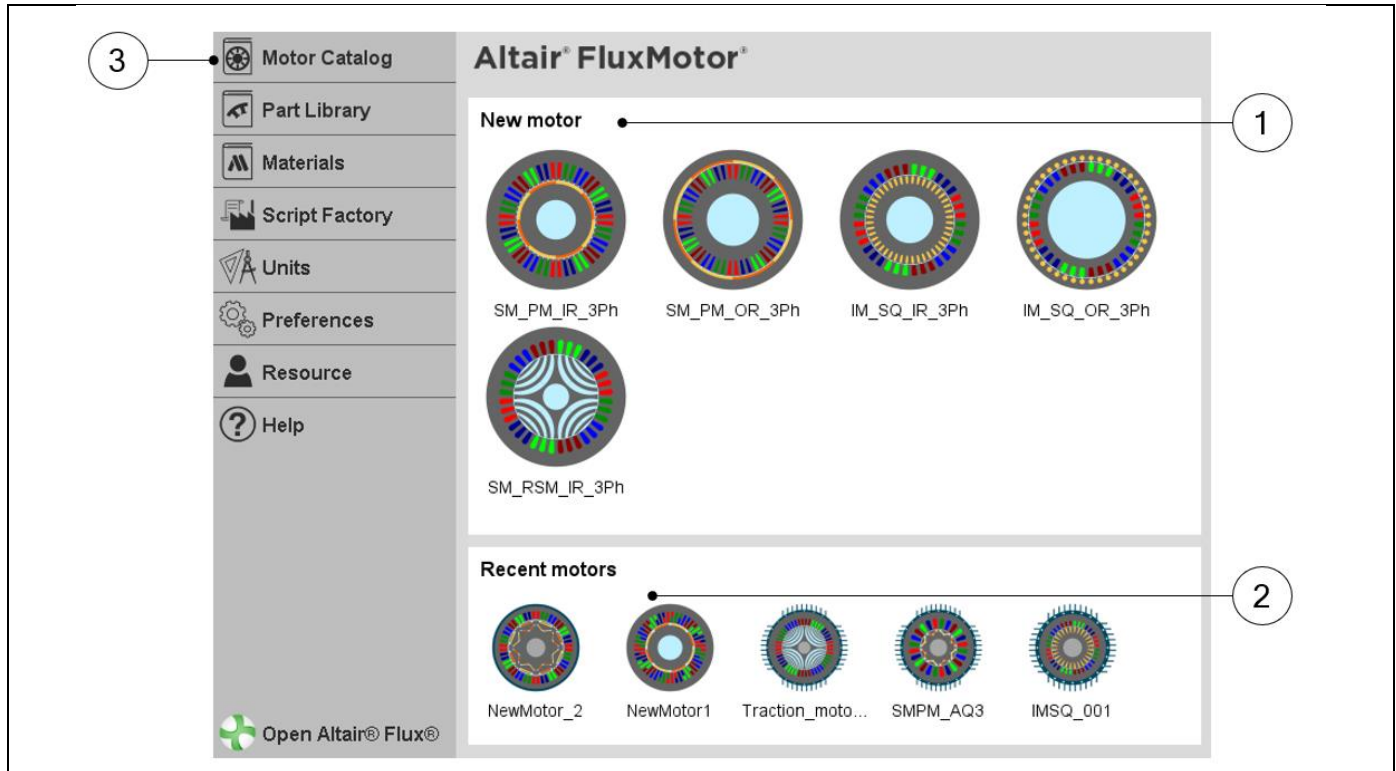
EXPORT area of Motor Factory
Example for a Synchronous Machine with Permanent Magnets and Inner Rotor

1.2 How to get into Motor Factory

1.2.1 Introduction

Two ways are possible to get into Motor Factory:

- 1) From the supervisor, select the type of motor you want to design
- 2) From the “Motor Catalog”, by editing a selected motor in a catalog



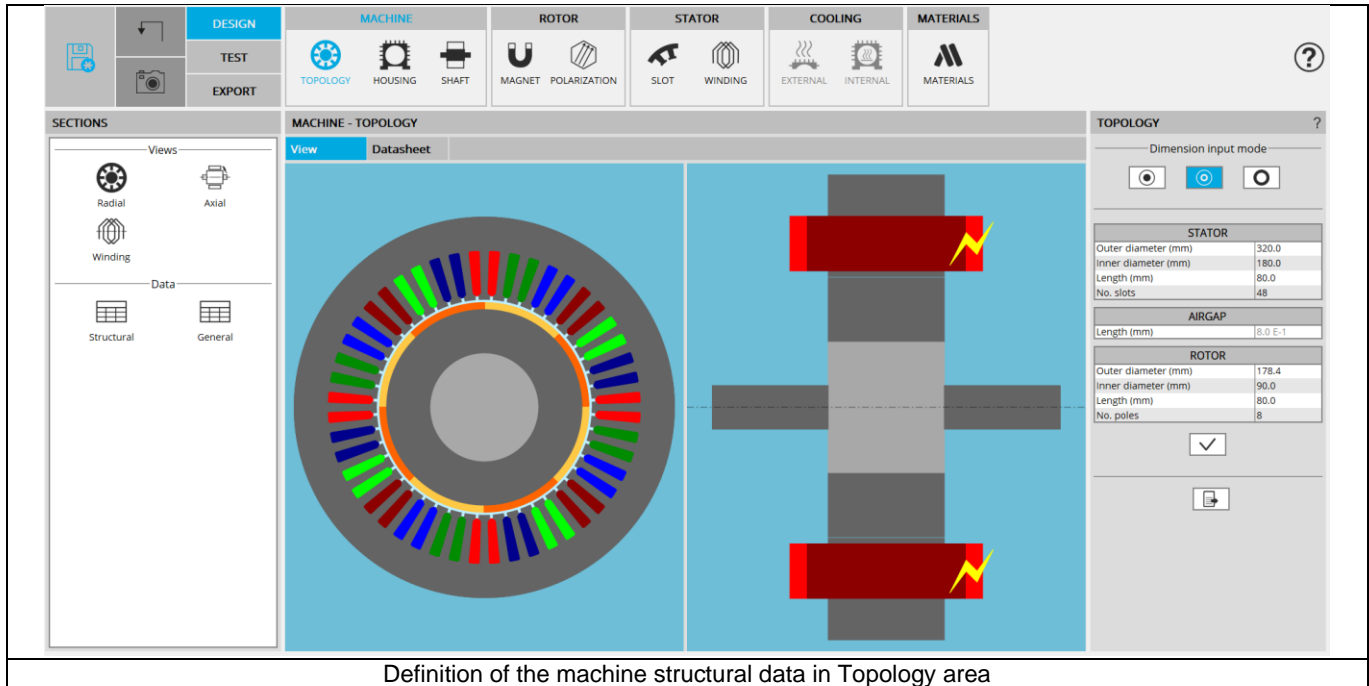
Create a new motor or open one of the most recently used motors

1	<p>Get into Motor Factory for designing and testing a new motor. Create a new motor in Motor Factory by selecting a type of motor you need to design 5 types of motor are currently available:</p> <ul style="list-style-type: none"> • SM_PM_IR_3PH: 3-Phase - Synchronous Machine with Permanent Magnets - Inner Rotor • SM_PM_OR_3PH: 3-Phase - Synchronous Machine with Permanent Magnets - Outer Rotor • IM_SQ_IR_3PH: 3-Phase - Induction Machine with Squirrel cage - Inner Rotor • IM_SQ_OR_3PH: 3-Phase - Induction Machine with Squirrel cage - Outer Rotor • SM_RSM_IR_3PH: 3-Phase – Reluctance Synchronous Machine - Inner Rotor
2	<p>Choose a motor among a list of most recently used motors and get into Motor Factory. The number of most recently used motors available are defined with the user preferences. See section “User preferences” in the supervisor user guide.</p>
3	<p>Refer to catalogs, compare and choose a motor already designed.</p>

1.2.2 Get into Motor Factory for designing and testing a new motor

From supervisor, clicking on a motor from the “New motor” section or from the “Recent motors” section opens directly Motor Factory environment.

Structural data (outer and inner diameters, number of poles, number of slots, etc. must be defined from the sub area “Topology” when designing a new machine.



The screenshot displays the Altair FluxMotor software interface for defining machine structural data in the Topology area. The interface is divided into several sections:

- Top Navigation Bar:** Includes tabs for DESIGN, TEST, and EXPORT. Below these are icons for MACHINE (TOPOLOGY, HOUSING, SHAFT), ROTOR (MAGNET, POLARIZATION), STATOR (SLOT, WINDING), COOLING (EXTERNAL, INTERNAL), and MATERIALS.
- SECTIONS Panel:** Contains 'Views' (Radial, Axial, Winding) and 'Data' (Structural, General) options.
- MACHINE - TOPOLOGY View:** Shows a 3D model of the motor's cross-section, including the stator and rotor.
- TOPOLOGY Panel:** Contains a 'Dimension input mode' section with three radio buttons. Below are tables for STATOR, AIRGAP, and ROTOR parameters.

STATOR	
Outer diameter (mm)	320.0
Inner diameter (mm)	180.0
Length (mm)	80.0
No. slots	48

AIRGAP	
Length (mm)	8.0 E-1

ROTOR	
Outer diameter (mm)	178.4
Inner diameter (mm)	90.0
Length (mm)	80.0
No. poles	8

Definition of the machine structural data in Topology area

1.2.3 Edit a motor from Motor Catalog

For additional information, please see “Motor Catalog” application.

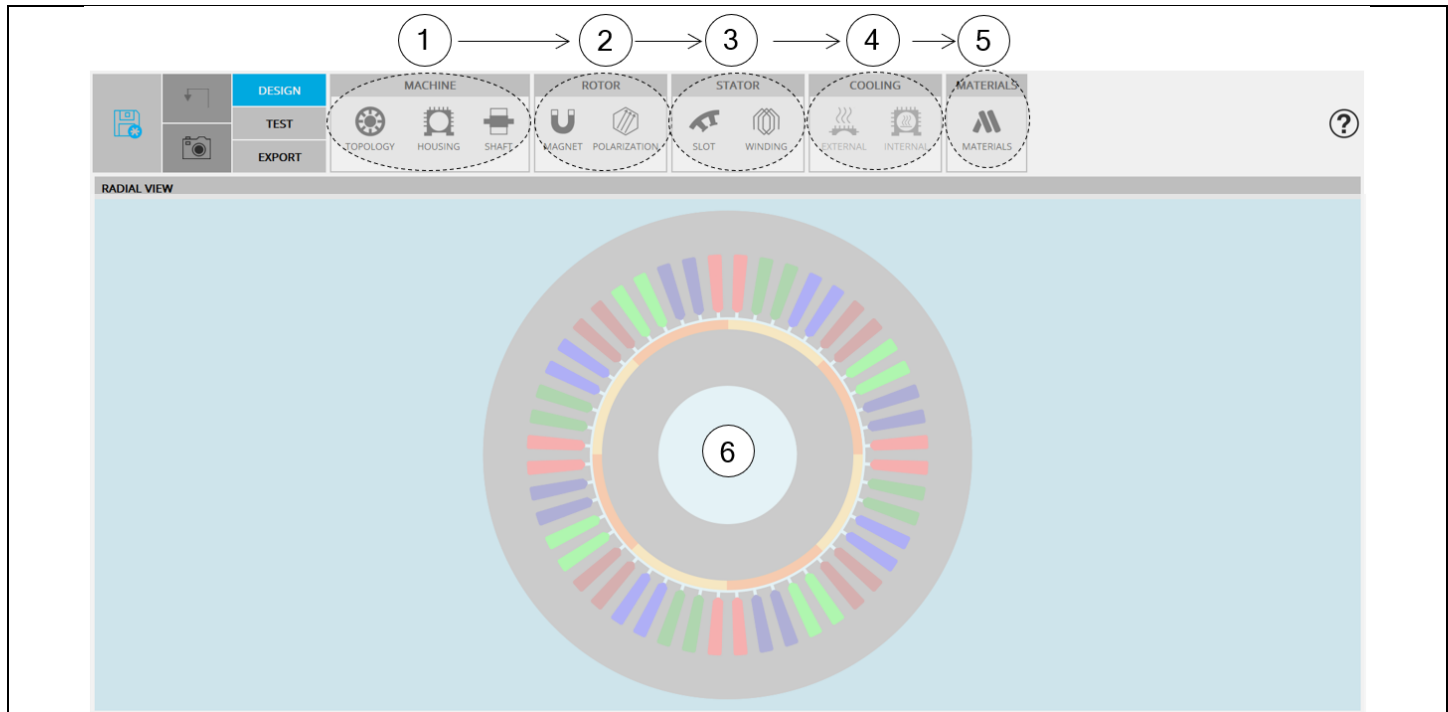
	<p>1 Select a motor from the main area of Motor Catalog.</p>
	<p>2 “Edit” the selected motor in Motor Factory.</p>

	<p>1 From the comparator area Add the motors to be compared and select the motor.</p>																																																																					
<table border="1"> <thead> <tr> <th>Parameter</th> <th>Automotive_Transport_1_Accord_2005</th> <th>Automotive_Transport_1_Camry_2007</th> </tr> </thead> <tbody> <tr> <td>Altgap</td> <td></td> <td></td> </tr> <tr> <td>Length (mm)</td> <td>1.0</td> <td>7.0 E-1</td> </tr> <tr> <td>Rotor</td> <td></td> <td></td> </tr> <tr> <td>Outer diameter (mm)</td> <td>230.0</td> <td>160.5</td> </tr> <tr> <td>Inner diameter (mm)</td> <td>188.0</td> <td>105.0</td> </tr> <tr> <td>Length (mm)</td> <td>40.1</td> <td>60.7</td> </tr> <tr> <td>Stator</td> <td></td> <td></td> </tr> <tr> <td>Outer diameter (mm)</td> <td>315.5</td> <td>264.0</td> </tr> <tr> <td>Inner diameter (mm)</td> <td>232.0</td> <td>161.9</td> </tr> <tr> <td>Length (mm)</td> <td>40.1</td> <td>60.7</td> </tr> <tr> <td>Operating conditions</td> <td></td> <td></td> </tr> <tr> <td>Winding temperature (°C)</td> <td>170.0</td> <td>170.0</td> </tr> <tr> <td>Magnet temperature Tmag (°C)</td> <td>80.0</td> <td>80.0</td> </tr> <tr> <td>Operating mode</td> <td>Motor</td> <td>Motor</td> </tr> <tr> <td>Speed (rpm)</td> <td>1 512.69</td> <td>3 765.574</td> </tr> <tr> <td>Max. Line-Line voltage, rms (V)</td> <td>103.7</td> <td>468.16</td> </tr> <tr> <td>Phase current, rms (A)</td> <td>159.1</td> <td>219.2</td> </tr> <tr> <td>Electrical frequency (Hz)</td> <td>201.692</td> <td>251.038</td> </tr> <tr> <td>Performance</td> <td></td> <td></td> </tr> <tr> <td>Machine electrical power (W)</td> <td>22 217.355</td> <td>1,276 E5</td> </tr> <tr> <td>Reactive power (VAr)</td> <td>17 974.847</td> <td>1,237 E5</td> </tr> <tr> <td>Apparent power (VA)</td> <td>28 576.535</td> <td>1,777 E5</td> </tr> </tbody> </table>	Parameter	Automotive_Transport_1_Accord_2005	Automotive_Transport_1_Camry_2007	Altgap			Length (mm)	1.0	7.0 E-1	Rotor			Outer diameter (mm)	230.0	160.5	Inner diameter (mm)	188.0	105.0	Length (mm)	40.1	60.7	Stator			Outer diameter (mm)	315.5	264.0	Inner diameter (mm)	232.0	161.9	Length (mm)	40.1	60.7	Operating conditions			Winding temperature (°C)	170.0	170.0	Magnet temperature Tmag (°C)	80.0	80.0	Operating mode	Motor	Motor	Speed (rpm)	1 512.69	3 765.574	Max. Line-Line voltage, rms (V)	103.7	468.16	Phase current, rms (A)	159.1	219.2	Electrical frequency (Hz)	201.692	251.038	Performance			Machine electrical power (W)	22 217.355	1,276 E5	Reactive power (VAr)	17 974.847	1,237 E5	Apparent power (VA)	28 576.535	1,777 E5	<p>2 “Edit” the selected motor in Motor Factory.</p>
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2 OVERVIEW MOTOR FACTORY – DESIGN AREA

2.1 Home page view

The Motor Factory – DESIGN area is the first environment of Motor Factory. It is composed of five main zones. This is the guided line to design your machine.



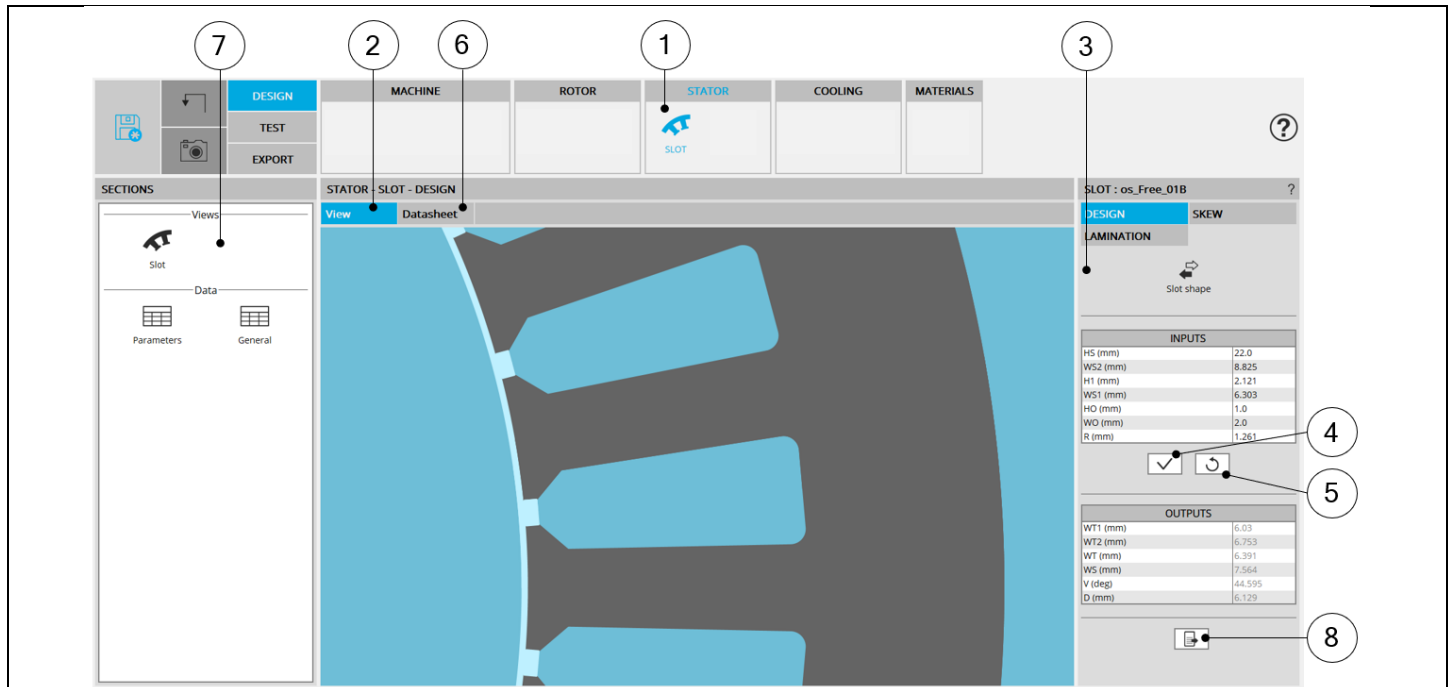
Motor Factory – DESIGN area view – Example for synchronous machine – Permanent magnets

Zone 1 MACHINE	Definition of general data of the machine depending on the considered type of machine <ul style="list-style-type: none"> • Topology with overall dimensions, No. slots, No. poles, • Housing, Frame, Fins and cooling circuit topologies and dimensions • Shaft, type, Bearings and dimensions
Zone 2 ROTOR	Access to the main functions to design the ROTOR and its corresponding subsets: <ul style="list-style-type: none"> • Magnet, Polarization
Zone 3 STATOR	Access to the main functions to design the STATOR and its corresponding subsets: <ul style="list-style-type: none"> • Slot, Winding
Zone 4 COOLING	Define external and internal cooling parameters Convection, radiation, conductivity parameters and X-factors Note: By default, accesses to External cooling and Internal cooling environments are locked. External cooling is unlocked when a frame is defined (Housing / Frame environment) Internal cooling is unlocked when a frame is defined (Machine / Housing / Frame environment) and a shaft with bearings are defined (Machine / Shaft / Bearing environment).
Zone 5 MATERIALS	Area to select all the materials needed to build the machine, rotor, stator and the cooling
Zone 6 VIEW	Visualization of the motor radial view. The winding (automatically defined) is shown. Note: Graphic functions like export picture and zoom are available on this view by right clicking on mouse (right part of the panel). See system functions, graphic management to get more information.

2.2 Description of Sub areas

In each of three main areas (Machine, Rotor and Stator), there are sub areas, which allows defining a sub section of the machine such as shaft, housing, slots, winding, magnets, polarization, materials.

2.2.1 Sub area design view



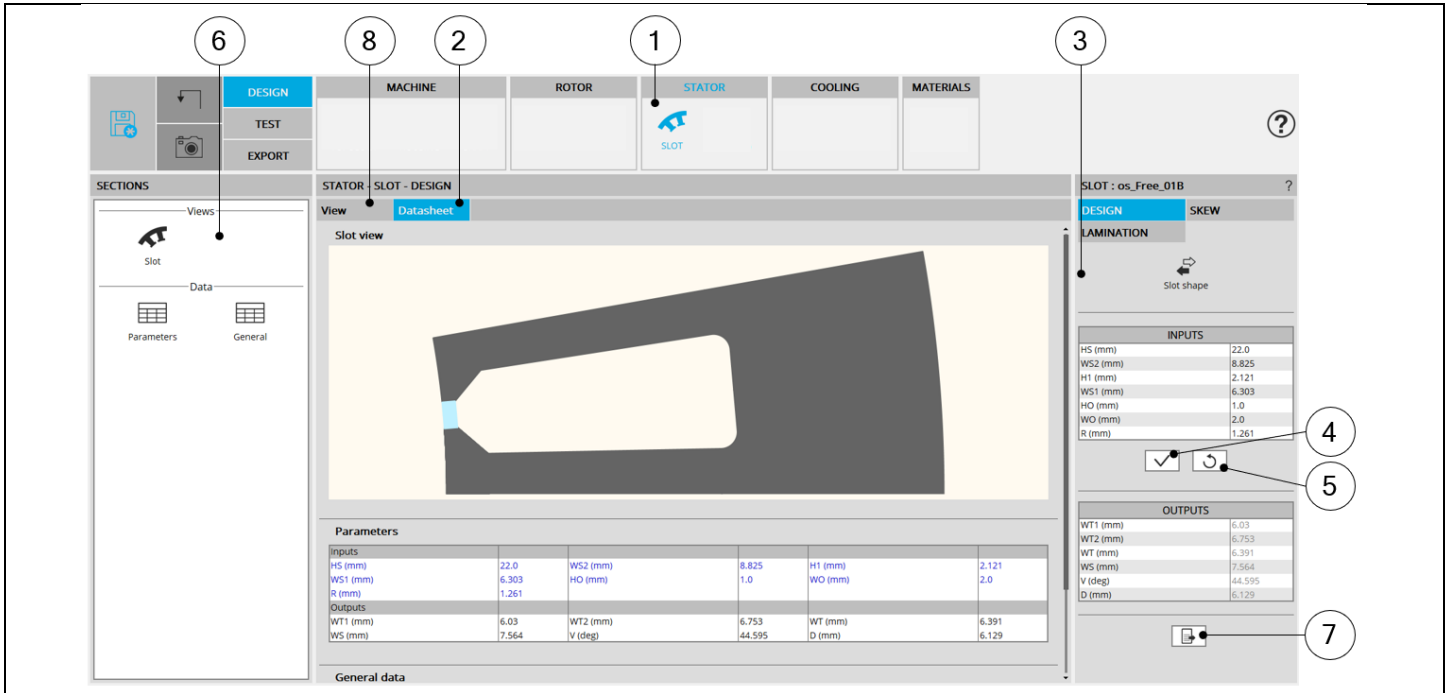
Motor Factory – Design sub area

Example - Sub area of Stator dedicated to the design of slot topology – Main view

1	Icon to access the sub area (Slot area in this example)
2	The default screen allows displaying the main view which illustrates the purpose of the study
3	Inputs are always displayed on the right part of the screen
4	Button to apply inputs
5	Button to restore default values
6	Each sub area has its own design report. It is visible under the tab “Datasheet”
7	Shortcuts allow reaching main section of the current design report
8	Icon to export data into *.txt or *.xlsx files.

The next table described the tab “Datasheet”

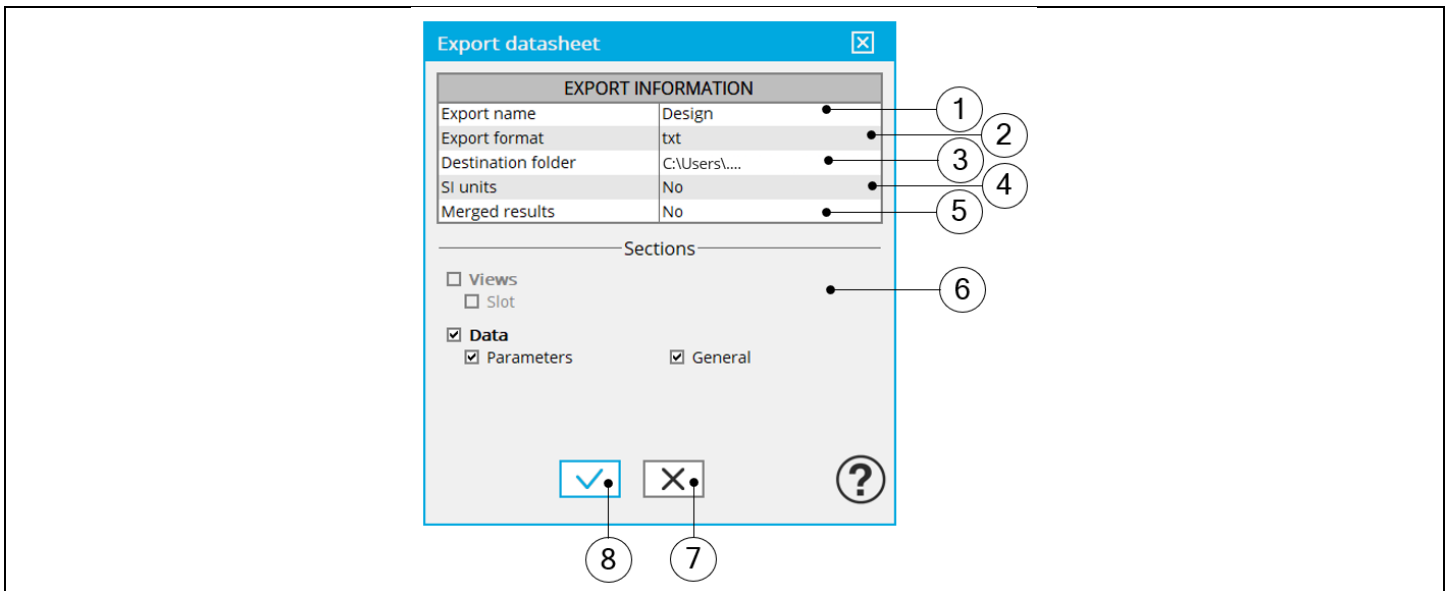
2.2.2 Sub area Datasheet



Motor Factory – Design sub area
 Example - Sub area dedicated to the design of slot topology – Datasheet view

1	Icon to access the sub area (Slot area in this example)
2	Each sub area has its own design report. It is visible under the tab “Datashet” Note: Input data are written in blue, Output data are written in black
3	Inputs are always displayed on the right part of the screen
4	Button to apply inputs
5	Button to restore default values
6	Shortcuts allow reaching main section of the current design report
7	Icon to export data in text files - Please see below illustration
8	The default screen which illustrates the purpose of the study

2.2.3 Export of data



Motor Factory – Design sub area
Example of dialog box to export data into *.txt or *.xlsx files

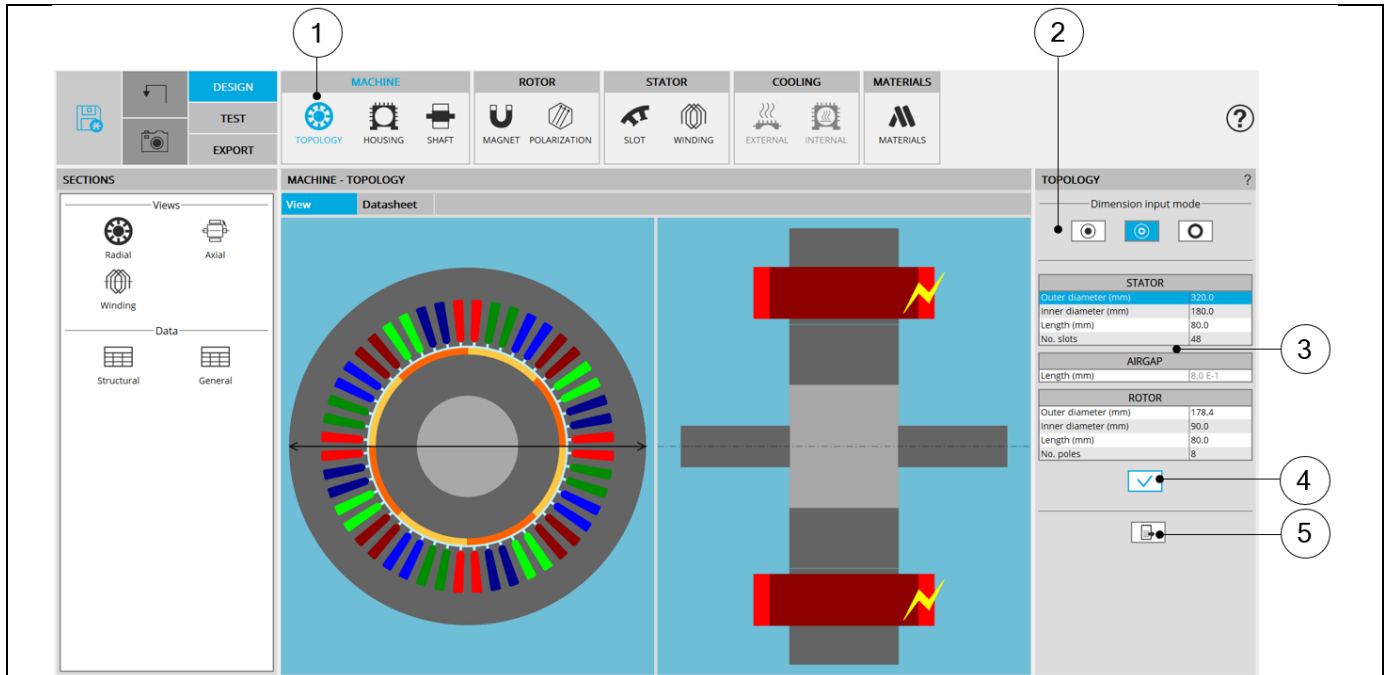
1	Name of the exported text file
2	Choice for exporting data into *.txt or *.xlsx files
3	Folder in which the provided file will be stored
4	System of units for numerical data can be given using SI Units (Units based on International System of Units) When the answer is "No", the default units used in FluxMotor® will be considered
5	Merged results mean the results are written in one text file. When the answer is no, a text file is provided for each category of result (Parameters and General in our example).
6	Visualization of all categories of results. Categories must be checked for adding them to the text files
7	Button to cancel action and close the panel
8	Button to apply inputs, close the panel and open the folder in which the generated text files are stored

2.3 Structural data

The first step of the design consists of defining structural data of the machine.

However, at any time, it is possible to reach and modify the structural data from the Motor Factory design environment.

Here is the process to modify the structural data from the general data panel.



Process to modify the structural data

1	Open the TOPOLOGY panel (Click on the icon TOPOLOGY)
2	Choose a way to define the diameters of the machine and the airgap See below illustration
3	Modify the values of structural data – When relevant the corresponding arrow is displayed on the view
4	Button to apply inputs
5	Icon to export data into text files - Please see above illustration

2.4 Method to define the airgap

In the topology sub area, three ways are possible to define the structural data of the machine based upon the diameters and the airgap. They are illustrated below.

	①	②	③
	Method to define the diameters of machine and the airgap Example for a Synchronous Machine with Permanent Magnets and Inner Rotor		
1	User defines the inner diameter of the stator and the airgap. The outer diameter of the rotor is automatically deduced (automatically computed value is displayed in grey color).		
2	User defines the inner diameter of the stator and the outer diameter of the rotor. The airgap is automatically deduced (automatically computed value is displayed in grey color).		
3	User defines the outer diameter of the rotor and the airgap. The inner diameter of the stator is automatically deduced (automatically computed value is displayed in grey color).		

2.5 Consideration of thermal properties

By default, accesses to External cooling and Internal cooling environments are locked.

External cooling is unlocked when a frame is defined (Housing / Frame environment)

Internal cooling is unlocked when on the one hand a frame is defined (Machine / Housing / Frame environment) and on the other hand a shaft with bearings are defined (Machine / Shaft / Bearing environment). See below illustrations.

	How to unlock cooling environments
1	External and internal cooling environments are locked
2	External and internal cooling environments are unlocked

2.6 Advice for use

The choice of diameters is possible over the range [1, 20000] mm.
The number of slots is possible over the range [3, 2400].
The number of poles is possible over the range [2, 400].
The number of bars (induction machines) is possible over the range [5, 500].

For more information, see the list of allowed combinations between the number of slots and the number of poles, synthesized in the section dedicated to winding.

Note: Our process for building and computations have been qualified over the following data ranges:

For Synchronous Machines with Permanent Magnets – Inner or Outer Rotor
Or for Reluctance Synchronous Machines – Inner Rotor
Range for diameters [1, 1000] mm.
Range for number of slots [3, 90].
Range for number of poles [2, 80].

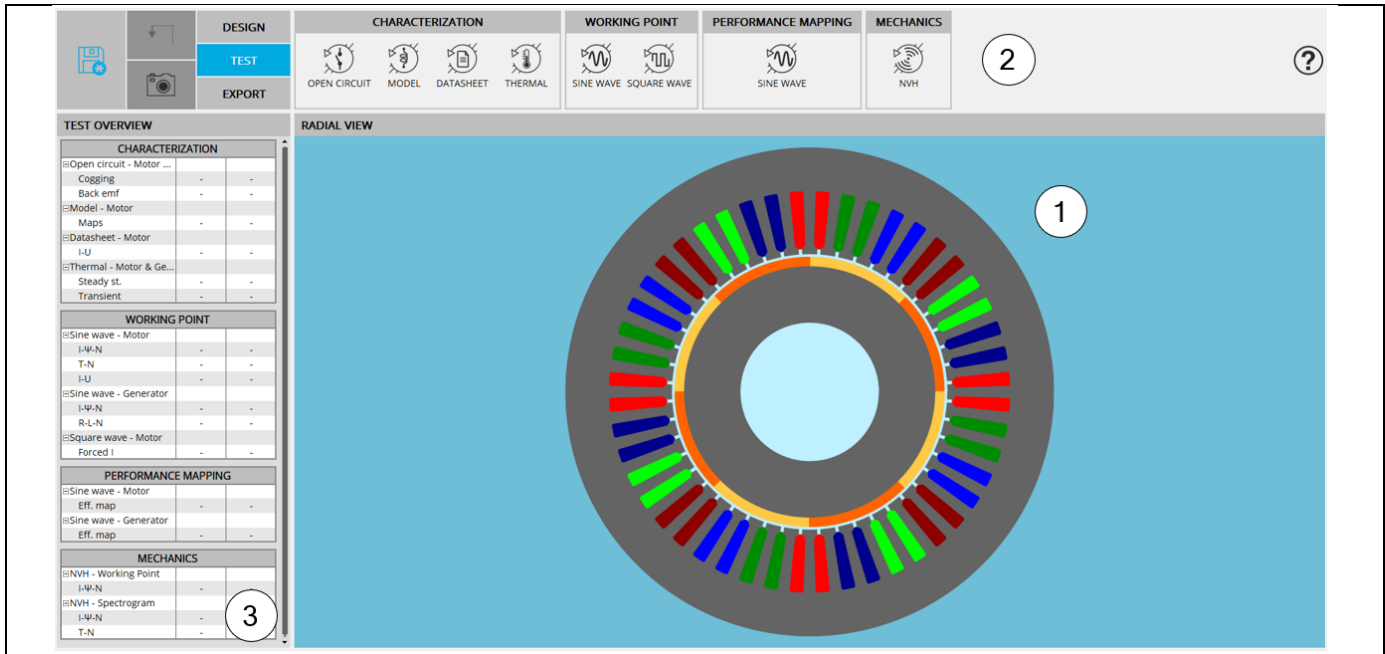
For Induction Machines with Squirrel Cage – Inner or Outer Rotor
Range for diameters [1, 1000] mm.
Range for number of slots [3, 144].
Range for number of poles [2, 20].
Range for number of bars (induction machines) [5, 180].

Working beyond these limits is possible but accurate results are the responsibility of the user.

3 OVERVIEW MOTOR FACTORY – TEST AREA

3.1 Home page view

The test area home page includes three main zones



Home page view of the test area
Example for a Synchronous Machine with Permanent Magnets and Inner Rotor

Zone 1	Visualization of topology of the machine being studied.
Zone 2	Visualization and access to the different test packages classified into families. One clicks on a package's icon opens it and gives access to the tests stored in it.
Zone 3	All the test names are displayed in this zone and classified under test families and test packages.

When no test package is selected, an overview ("TEST OVERVIEW") appears, giving more details about the status of each test. Here is an illustration for Synchronous Machine with Permanent Magnets

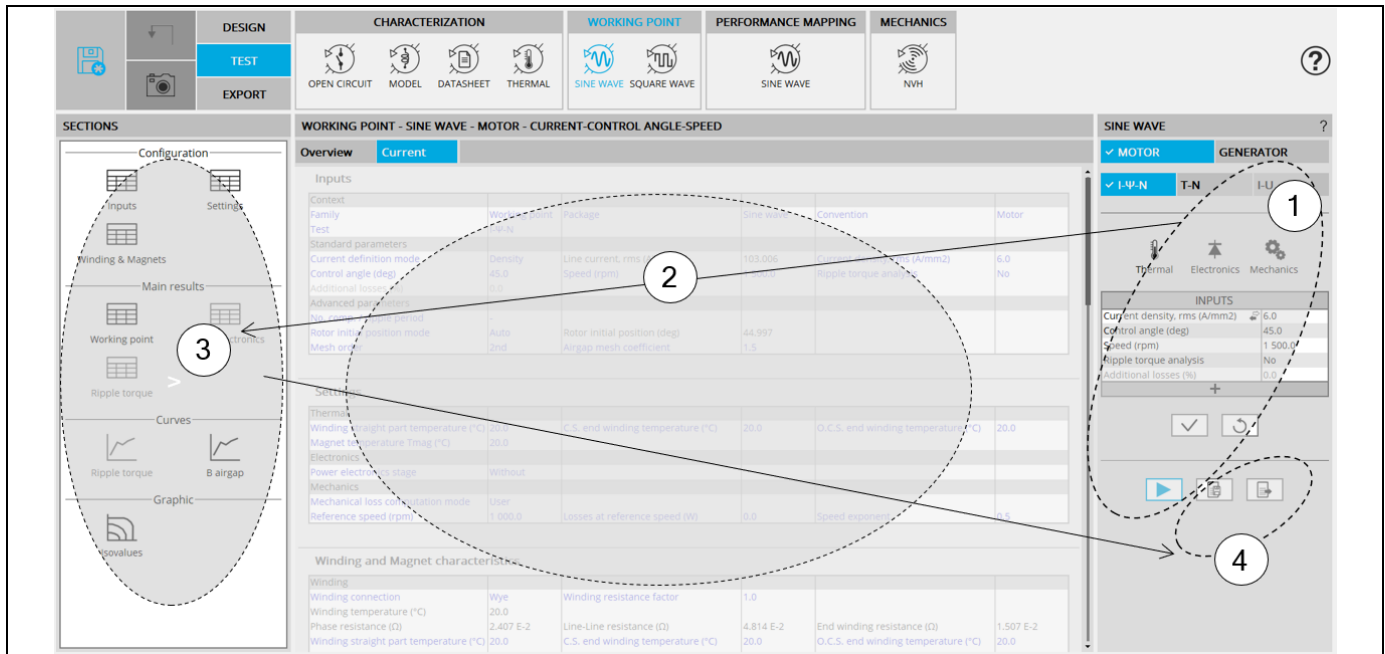
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Back emf	✓	-																																																																																										
Model - Motor	-	-																																																																																										
Maps	-	-																																																																																										
Datasheet - Motor	-	-																																																																																										
I-U	-	-																																																																																										
Thermal - Motor & Gen...	-	-																																																																																										
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I-U	-	-																																																																																										
Thermal - Motor & Gen...	-	-																																																																																										
Steady st.	-	-																																																																																										
« R »: Test is running	« v »: Test is already performed	« (1) » One test is saved																																																																																										

Clicking on a test row shows the operational area dedicated to the corresponding test.

3.2 Test page view

3.2.1 Overview

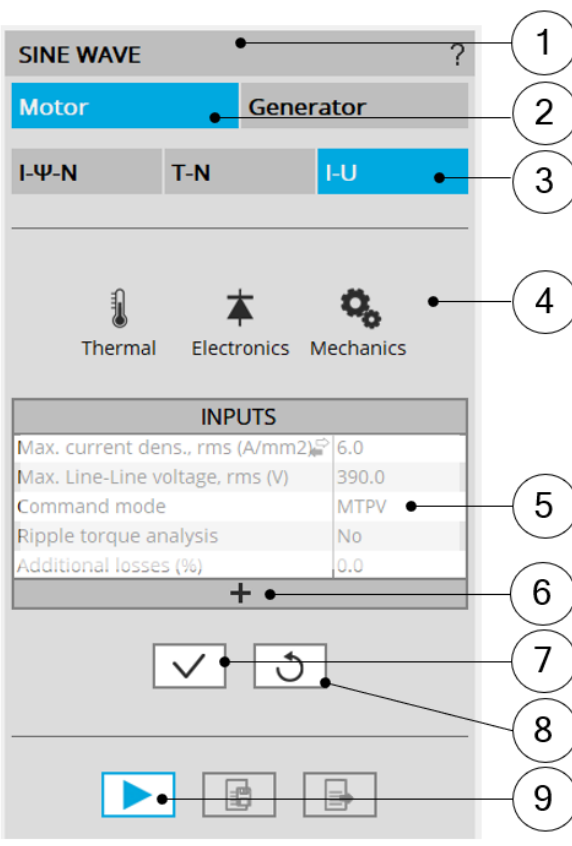
The test page view is composed of four main zones.



Zones of the test page view
Example for a Synchronous Machine with Permanent Magnets

Zone 1	Management of inputs and test execution <ul style="list-style-type: none"> Defining test settings Defining test parameters Buttons apply parameter values, restore default parameter values and to start running the test
Zone 2	Once a test is finished, corresponding results are automatically displayed in this zone. Visualization of the test reports (inputs, data, curves etc. ...) are possible. Scrollbars allow browsing the whole document rapidly and having an overview of all the results. Using scrollbars, complete data can be accessed and visualized.
Zone 3	Shortcuts for displaying quickly the corresponding chapter of the test report.
Zone 4	Buttons to save and export test results.

3.2.2 Management of inputs – Overview

	<p>1 Name of the test package</p> <p>2 Selection of the operating mode: Motor or Generator.</p> <p>3 Button to select the test to perform, when several tests are available in the test package. The check mark v indicates that the results are available.</p> <p>4 Defining test settings: General conditions relative to the machine:</p> <ul style="list-style-type: none"> • Active component temperatures (winding, magnet) • Electronics • User Mechanical loss model parameters <p>For more information, please see “Test settings” section</p>
5	User input parameters to be defined.
6	Click on (+) to displayed advanced parameters when needed
7	Button to apply input parameter values.
8	Button to restore default parameter values.
9	Button to start running the test (Input parameters are validated after clicking this button). For more details see the section dedicated to test functions.

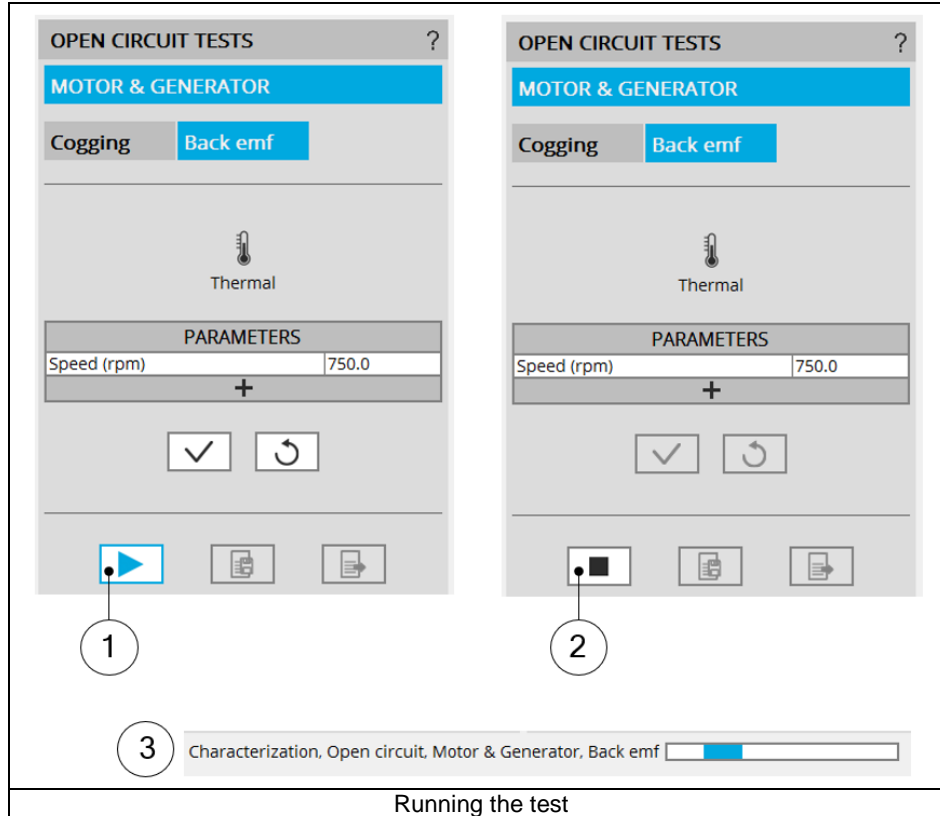
3.2.3 Start and stop

To start the test, click on the **Start test** button (1).

Note that before running the test, even if the dedicated button to validate input parameters has not been used, FluxMotor® automatically validates and records all the input parameters.

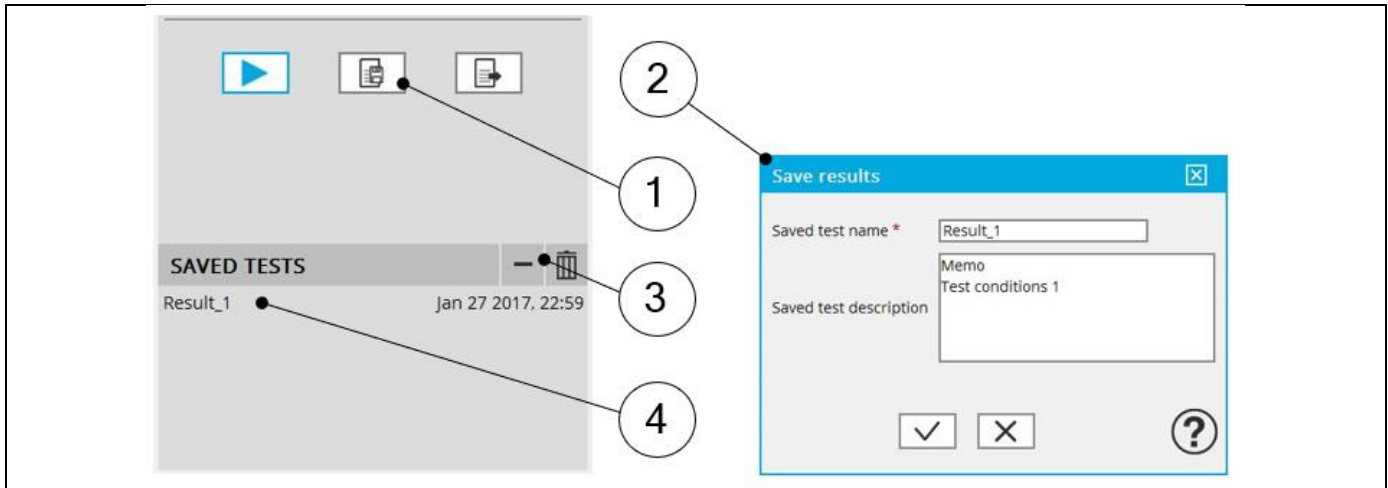
When the solving begins, the **Start test** button (1) turns into **Stop** button (2).

During the computation a progress bar appears (3). At any moment, the computation can be stopped by clicking on the **Stop** button (2).



3.2.4 Save the results

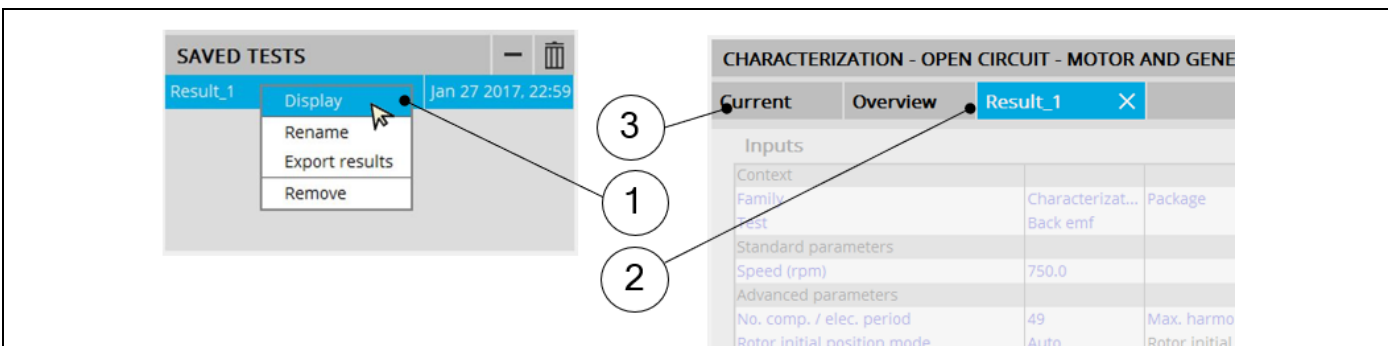
Once a test is completed, the corresponding results can be saved by using the **Save test results** button (1).



Save test results

1	Button to save the test result
2	Dialog box to save test results. Give a name and write a description.
3	By clicking on the Remove selected test (-) button, the selected saved test result is removed By clicking on the Remove all tests (bin) button all the saved test results are removed.
4	List of the saved tests. The list of saved test results is limited to five elements.

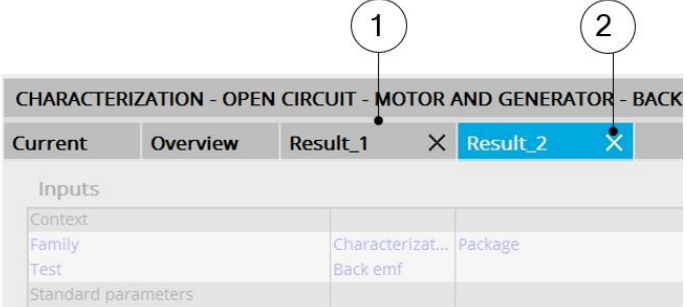
Saved results can be displayed in the test area for analysis. See below to know how to do that.



Saved test


1	Click on a saved test to select it. Once the test is selected, right-click on it to open a list box which allows displaying results with the command " Display ". A double-click on the saved test result name (for example Result_1) gives the same result.
2	The test result is displayed in a new tab inside the test results zone (Zone 2)
3	Displaying of edited results (saved and current results) is possible by clicking on the corresponding tabs. Several saved tests can be displayed. See below.
*	Note: Other functions available in this list box are: The selected test result can be renamed, exported (see next section) and removed.

Additional information about the saved test results

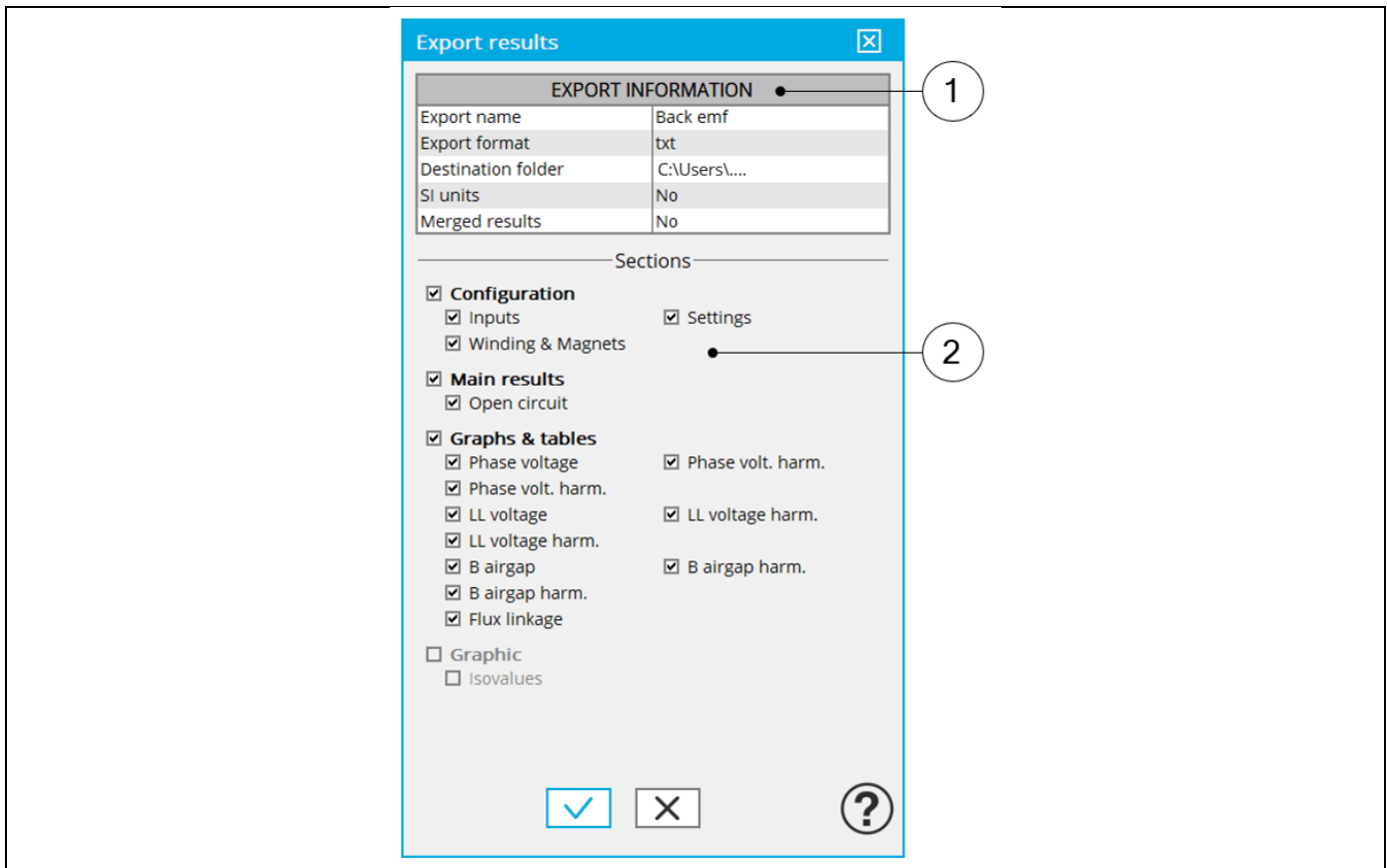
	<p>1 Several saved test results (maximum five) can be displayed inside the test area for comparison with each other.</p>
	<p>2 X allows removing the selected test result from the test area A test result removed from test area can be re-displayed at any moment.</p>

3.2.5 Export test results

When a test is completed, the corresponding results can be exported in a text file format by using the **Export test results** button (1)

	<div data-bbox="824 686 1328 1539"> <p>Export results [X]</p> <table border="1"> <thead> <tr> <th colspan="2">EXPORT INFORMATION</th> </tr> </thead> <tbody> <tr> <td>Export name</td> <td>Back emf</td> </tr> <tr> <td>Export format</td> <td>txt</td> </tr> <tr> <td>Destination folder</td> <td>C:\Users\....</td> </tr> <tr> <td>SI units</td> <td>No</td> </tr> <tr> <td>Merged results</td> <td>No</td> </tr> </tbody> </table> <p>Sections</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Configuration <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Inputs <input checked="" type="checkbox"/> Winding & Magnets <input checked="" type="checkbox"/> Settings <input checked="" type="checkbox"/> Main results <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Open circuit <input checked="" type="checkbox"/> Graphs & tables <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Phase voltage <input checked="" type="checkbox"/> Phase volt. harm. <input checked="" type="checkbox"/> LL voltage <input checked="" type="checkbox"/> LL voltage harm. <input checked="" type="checkbox"/> B airgap <input checked="" type="checkbox"/> B airgap harm. <input checked="" type="checkbox"/> Flux linkage <input checked="" type="checkbox"/> Phase volt. harm. <input checked="" type="checkbox"/> LL voltage harm. <input checked="" type="checkbox"/> B airgap harm. <input type="checkbox"/> Graphic <ul style="list-style-type: none"> <input type="checkbox"/> Isovalues <p>[✓] [X] [?]</p> </div>	EXPORT INFORMATION		Export name	Back emf	Export format	txt	Destination folder	C:\Users\....	SI units	No	Merged results	No
EXPORT INFORMATION													
Export name	Back emf												
Export format	txt												
Destination folder	C:\Users\....												
SI units	No												
Merged results	No												
1	Icon to export test results into *.txt or *.xlsx files.												
2	Dialog box to export test results. See the next chapter for details about the fields in this dialog box.												

The process of exporting results into a text file is managed inside the following dedicated dialog box.



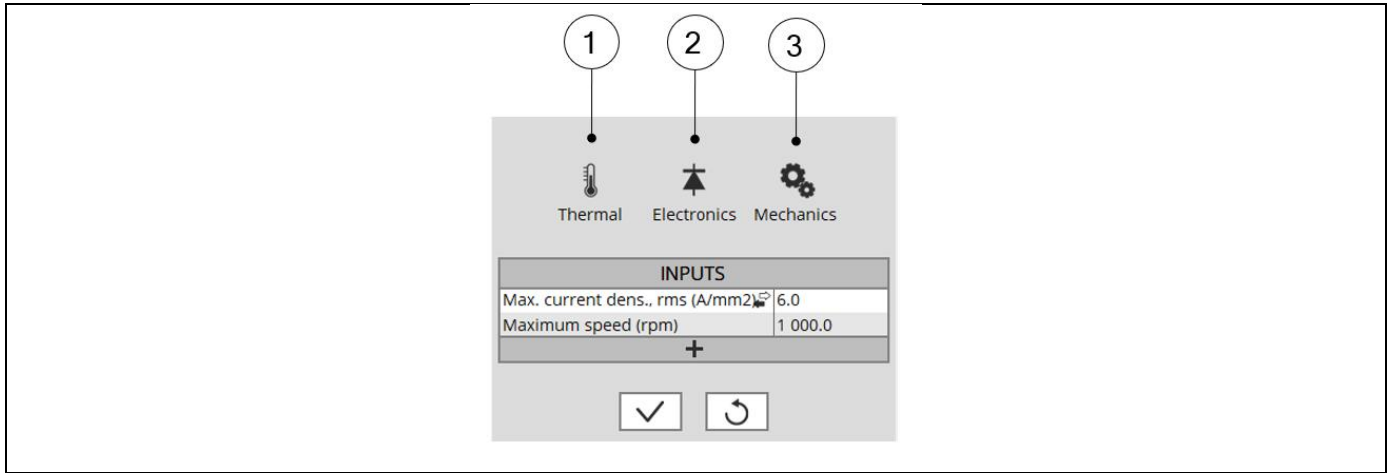
1	<p>Field to give information about the exported file:</p> <ul style="list-style-type: none"> • Name of the file (*.txt or *.xlsx file) • Folder where the file must be stored • Check if you want to export data in SI unit system. If not, data are exported in the current unit system that was used to solve the test (defined in “Units” application). • Merged results are to be chosen if you want to export all results in one file or one file per result
2	<p>Select the results you want to export. All the results available for exporting are grouped in section as it is in the result panel of the considered test.</p>
*	<p>Resulting file can be imported in other software packages like MS Excel, Compose, Octave etc.</p>

3.3 Test settings

The settings allow defining the context in which the tests are going to be performed. Their definition is specific to each test.

Settings are defined into three main domains:

- Thermal: To define active components temperature (magnets and winding)
- Electronics: To define the power electronics stage feeding the machine
- Mechanics: To define the mechanical loss model parameters



1	Button to define winding and magnet temperatures to be considered in the test.
2	Button to define the user inputs of the power electronics stage
3	Button to define the parameters of the mechanical loss model

For more details refer to the dedicated section “Test settings” in the user help document to each type of machine and test.

4 MOTOR FACTORY – EXPORT AREA – HOME PAGE VIEW

The area “EXPORT” of Motor Factory groups two main families of functions:

1) “DOCUMENT”

In “DOCUMENT” area the function “REPORT” allows building reports automatically to describe all the work achieved in the design as well as for the tests.

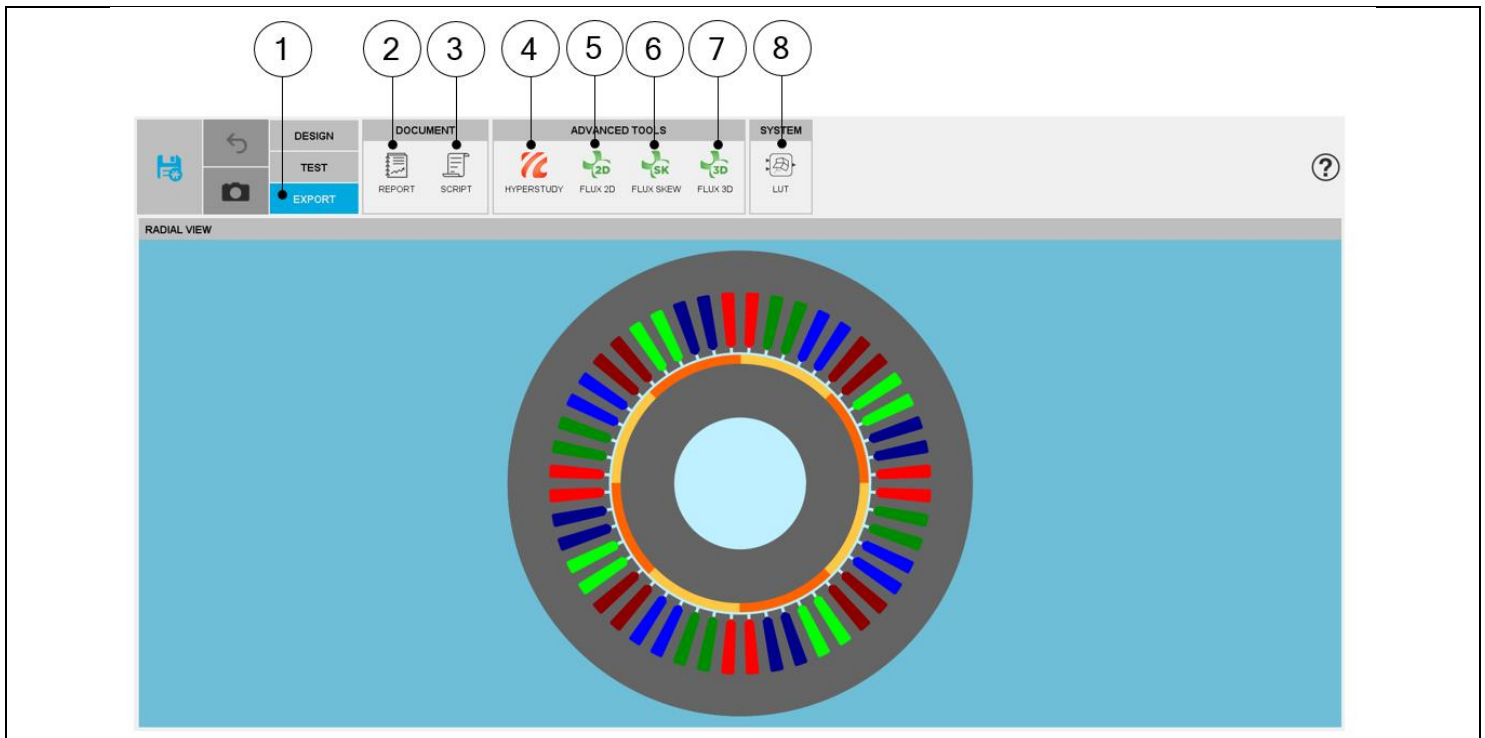
Then, the function “SCRIPT” allows to build and export a python script of a current motor in the application Script Factory or in a targeted folder. “ADVANCED TOOLS “

2) In “ADVANCED TOOLS” area the function “HYPERSTUDY” allows to build and to export a connector in Altair® HyperStudy® for performing studies like optimization or Design Of Experiment (DOE).

Then, the functions “FLUX2D”, Flux Skew, Flux 3D allow to build and export a model in Altair® Flux® environment (2D, Skew or 3D) for performing advanced studies either with magneto static or transient applications.

3) “SYSTEM”

Last, the function “SYSTEM” allows exporting files in FMU (Functional Mock-up Unit) format file or in MAT format file from FluxMotor® for PSIM or Activate.



Motor Factory - EXPORT area

1	Selection of EXPORT area of Motor Factory opens Export window
2	Access the area “REPORT” through which a report can be made
3	Access the area “SCRIPT” through which a python file in which all the needed command lines are written to rebuild the motor
4	Access the area “HYPERSTUDY “in which a connector can be made and be sent to Altair® HyperStudy®
5	Access the area “FLUX 2D” through which a model can be made and be sent to Flux® 2D
6	Access the area “FLUX SKEW” through which a model can be made and be sent to Flux® Skew
7	Access the area “FLUX 3D” through which a model can be made and be sent to Flux® 3D
8	Access the area “SYSTEM” in which a Lookup tables can be exported in FMU or MAT format files for PSIM or Activate

For more information, please, refer to the user guide dedicated to Motor Factory – Export environment.

5 SYSTEM FUNCTIONS

5.1 Overview

The main system functions are accessible from the top menu of Motor Factory.

Expanding the menu in the left top part of Motor Factory – for any area: DESIGN, TEST or EXPORT allows to visualize and select these functions.

Note: Some of these functions are directly available from the Motor Factory area.

The main ways to access to the functions like SAVE, SAVE AS or STORE are illustrated below.

The screenshot shows the Motor Factory software interface. The top menu bar includes categories: MACHINE, ROTOR, STATOR, COOLING, and MATERIALS. Below these are sub-categories: TOPOLOGY, HOUSING, SHAFT, MAGNET, POLARIZATION, SLOT, WINDING, EXTERNAL, INTERNAL, and MATERIALS. The main area is labeled 'RADIAL VIEW' and shows a motor model. A context menu is open over the model, listing: Save (Ctrl+S), Save as (Ctrl+E), Store (Ctrl+T), About, Debug (Ctrl+D), Help, and Exit (Ctrl+Q). The context menu also shows 'DESIGN', 'TEST', and 'EXPORT' options. Callout 1 points to the main menu area, and callout 2 points to the context menu.

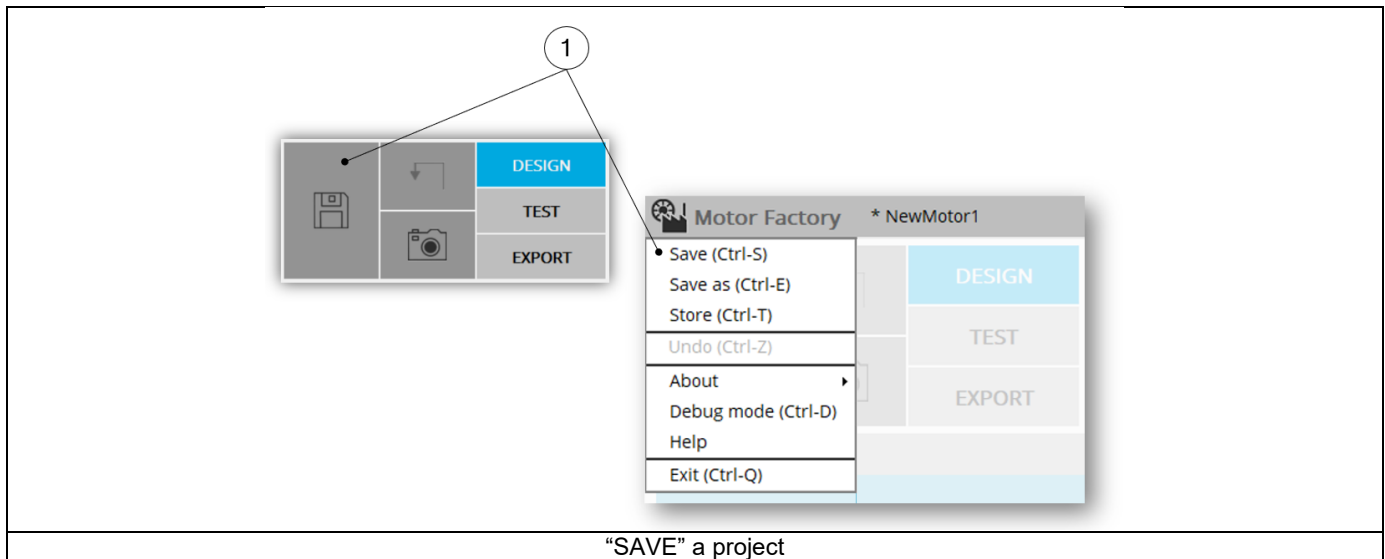
1	SAVE function (disk), STORE function (Camera) or UNDO (Back arrow) are accessible directly from the main area of Motor Factory.
2	When expanding the menu in the left top part of Motor Factory – for any area: DESIGN, TEST or EXPORT gives access to the main system functions. All these functions are explained and illustrated below.

5.2 File management

5.2.1 Save, Save as

5.2.1.1 SAVE a project

“SAVE” a project is possible, directly from the top part of the Motor Factory or via the top expanded menu. Saving a project keeps the same name of the project and the same catalog.

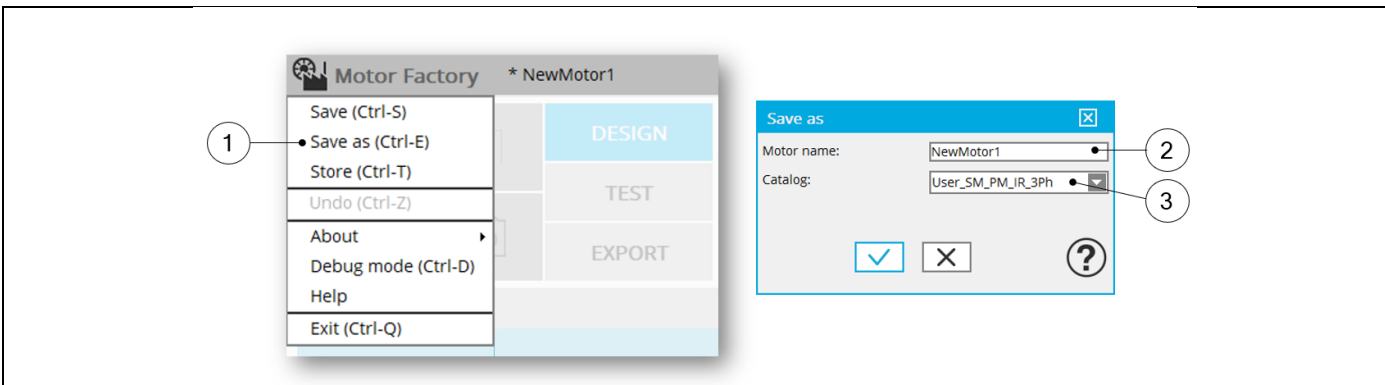


5.2.1.2 SAVE AS a project

“SAVE AS” a project is possible only via the top expanded menu.

“SAVE AS” a project allows to choose a new name for the project and save it in another catalog.

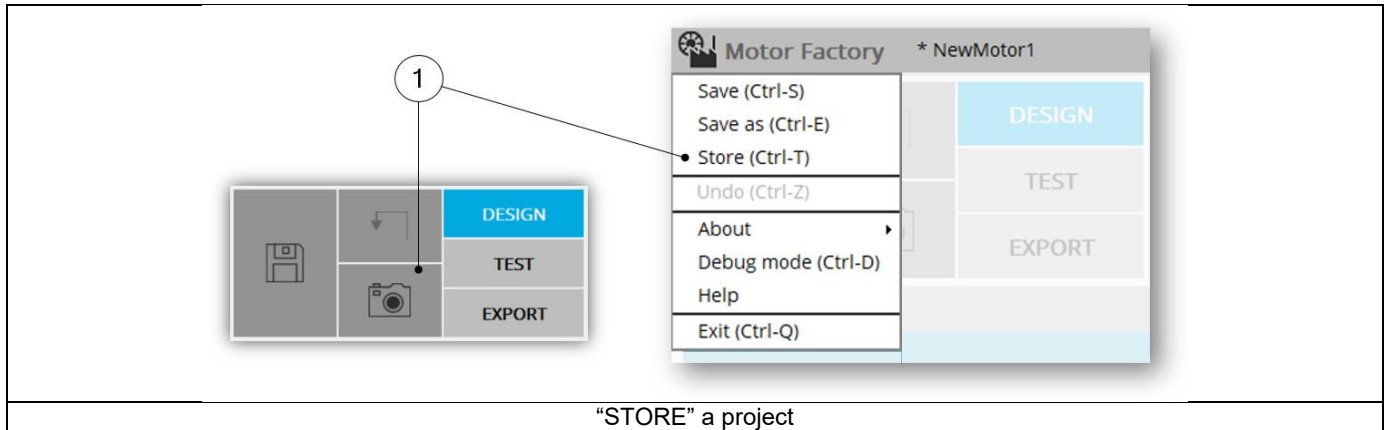
User must give a new name to the motor and select an existing catalog in which the motor will be stored.



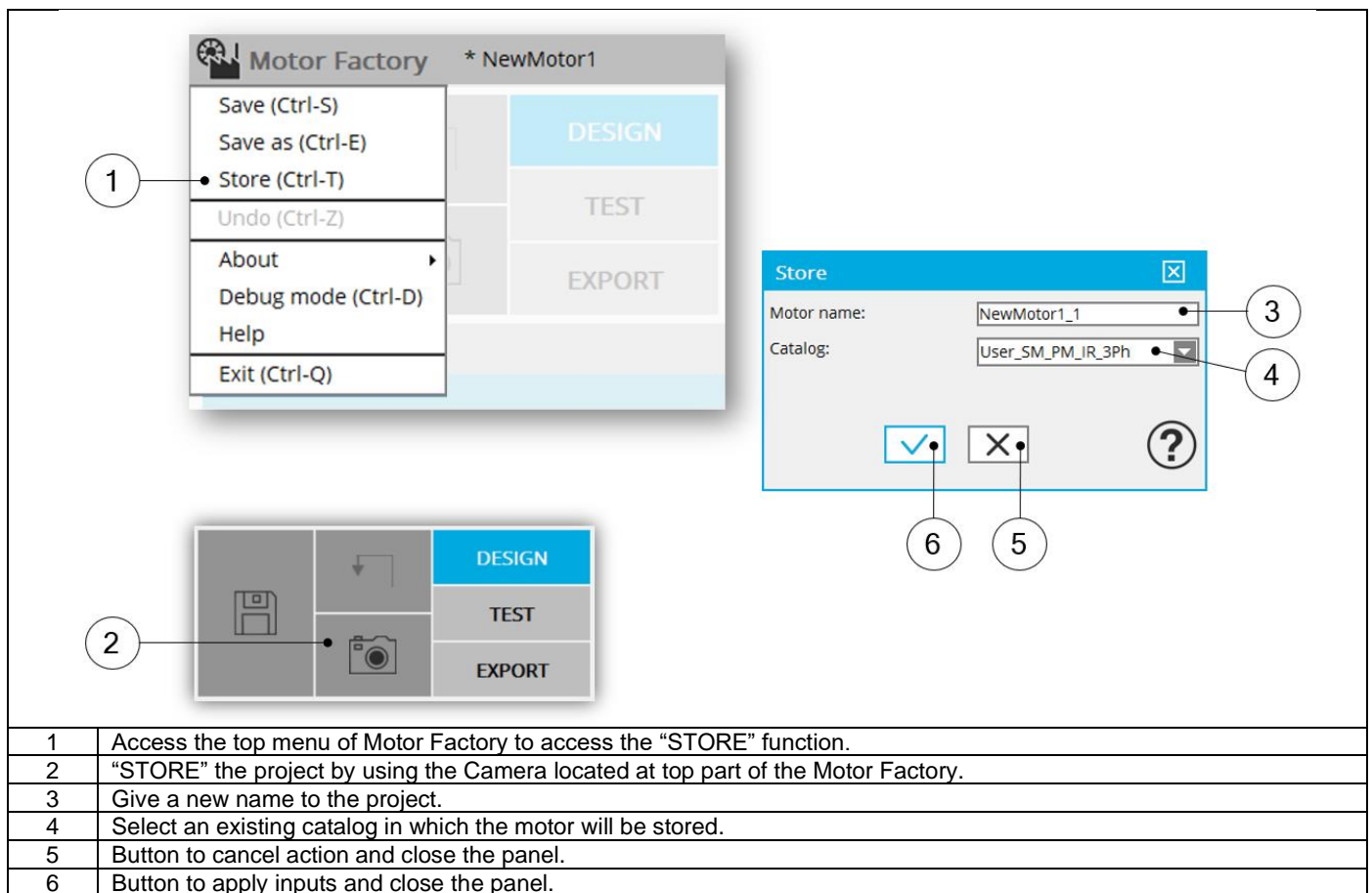
1	Access to the top menu of Motor Factory to access the “SAVE AS” function.
2	Give a new name to the project.
3	Select an existing catalog in which the motor will be stored.

5.2.2 Store

“STORE” a project is possible directly from the top part of the Motor Factory (by using the camera) or via the top expanded menu.

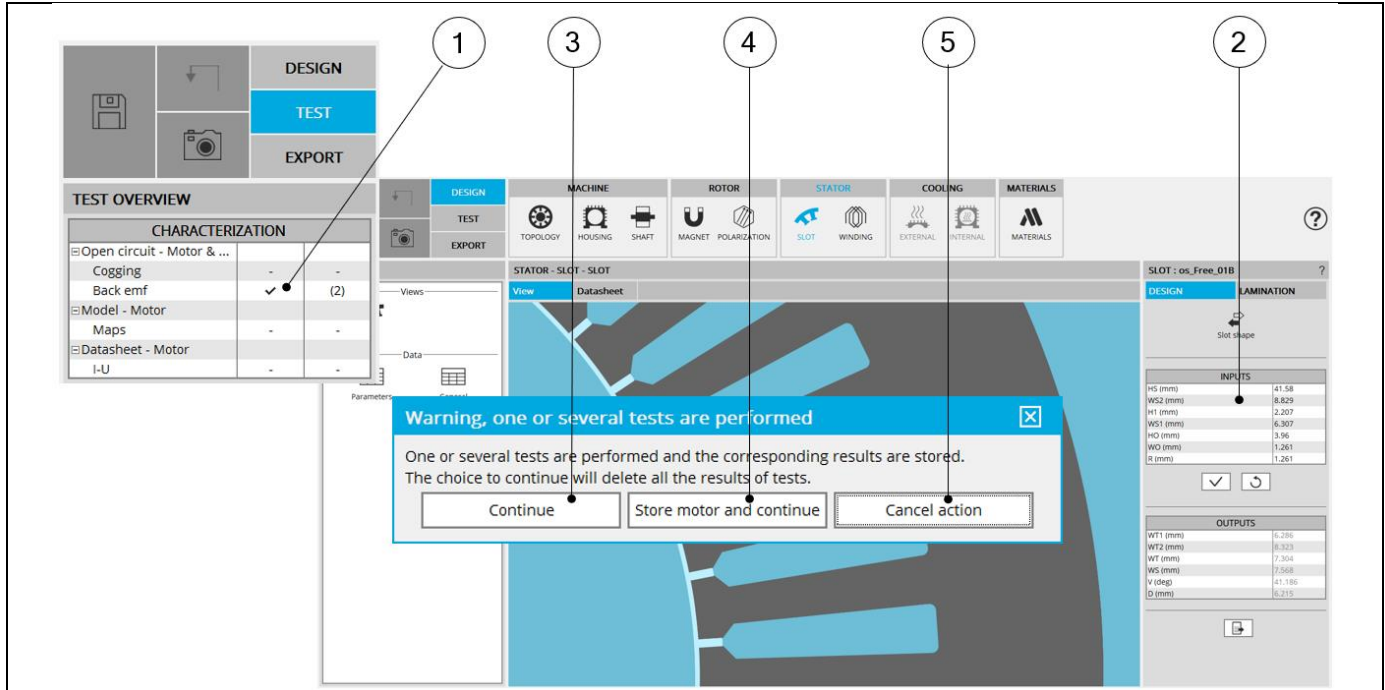


In any case, user must give a new name of the motor and select an existing catalog in which the motor will be stored.

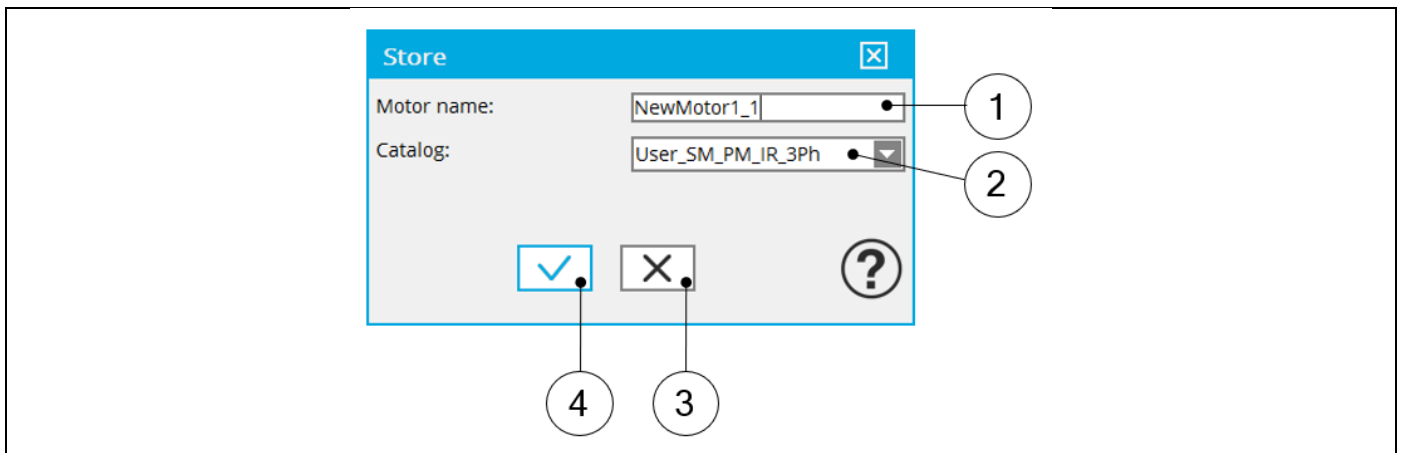


5.2.3 Store and continue

The conditions to use this function are described below.



1	One or several tests are performed.
2	Modification in DESIGN dealing with dimensions topology etc
3	“Continue” removes test results and considers the new modification and keeps the current name of the project.
4	<p>“Store motor and continue” allows the user to first store the current motor and then continue the design on the current motor.</p> <ul style="list-style-type: none"> • The stored motor keeps the test results • The current motor loses the test results thus allowing the modification of the design parameters <p>See the dialog box which allows the storage of the motor below.</p>
5	“Cancel action” closes the dialog box. Previous modifications are cancelled.



Dialog box allowing to store a motor	
1	Give a new name to the project.
2	Select an existing catalog in which the motor will be stored.
3	Button to cancel action and close the panel.
4	Button to apply inputs and close the panel.

5.3 User actions

5.3.1 Undo

Undo function cancels the last action.

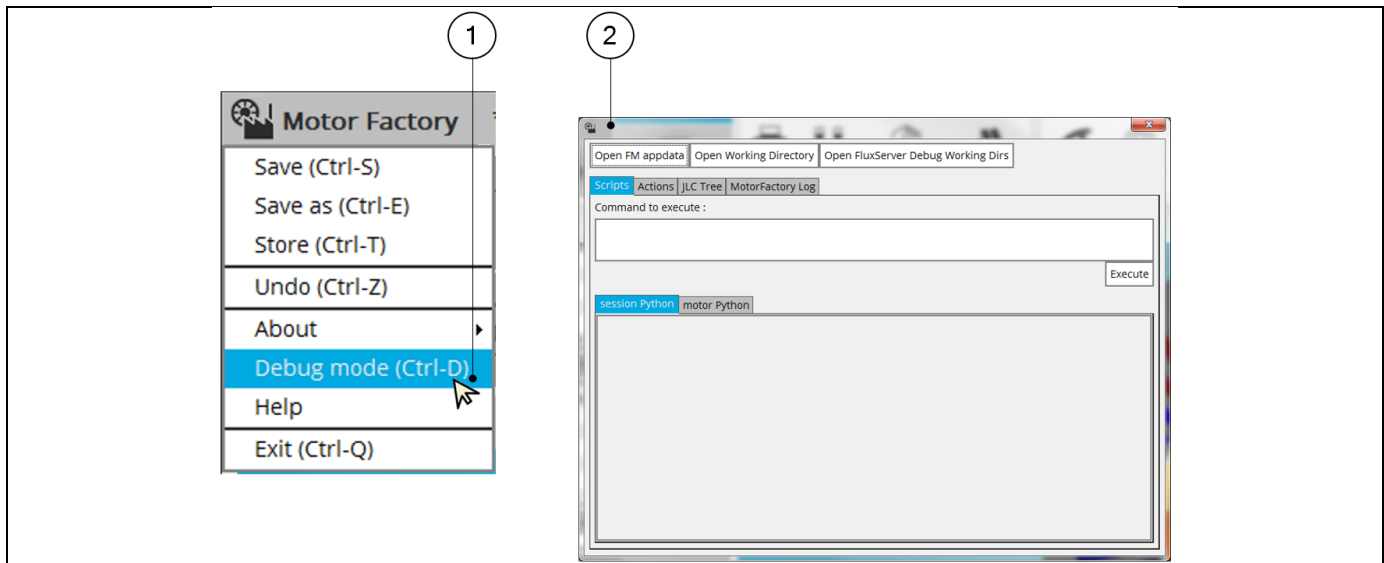
The three ways allowing to access the undo function are illustrated below.

The diagram shows two screenshots of the Motor Factory software interface. The first screenshot, labeled '1', shows the 'Motor Factory' menu with 'Undo (Ctrl-Z)' highlighted. The second screenshot, labeled '2', shows the top-left toolbar with three buttons: a back arrow, a camera icon, and a save icon with a star. A mouse cursor is pointing at the back arrow button.

Undo function	
1	Access from the top menu of Motor Factory.
2	Access by clicking on one of the three main buttons on the top left part of Motor Factory <ul style="list-style-type: none"> • Back arrow = Undo the last action
*	Access by using the shortcut CTRL-Z defined in the user preferences. For more information, refer to the chapter "user's preferences".

5.3.2 Debug mode function

The Debug mode function is dedicated to solving of problem in the use of Motor Factory.
In case of trouble, instructions will be given by our support team to use this function.

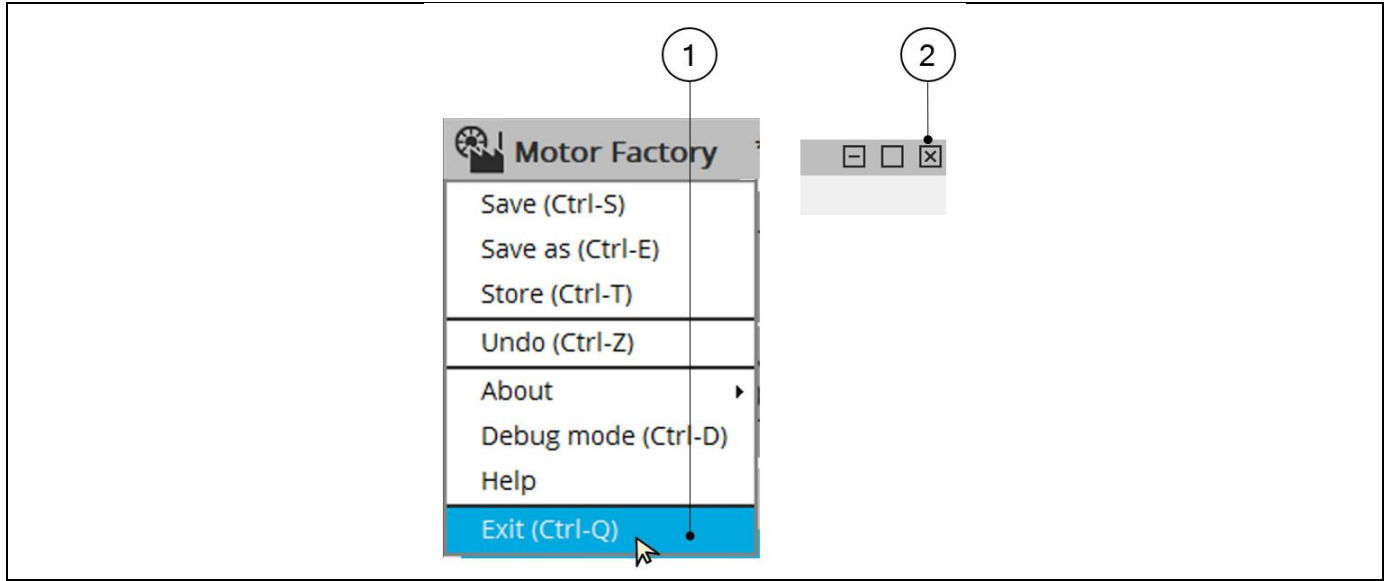


The image shows two parts of the Motor Factory interface. On the left, a menu is open with 'Debug mode (Ctrl-D)' highlighted by a mouse cursor. A circled '1' points to this menu item. On the right, a dialog box titled 'Motor Factory Log' is shown, with a circled '2' pointing to its title bar. The dialog box contains a 'Command to execute:' field and an 'Execute' button.


Debug mode function	
1	Access to the "Debug mode" from the top menu of Motor Factory.
2	Dialog box corresponding to the "Debug mode" function.

5.3.3 Exit

Closing Motor Factory is possible



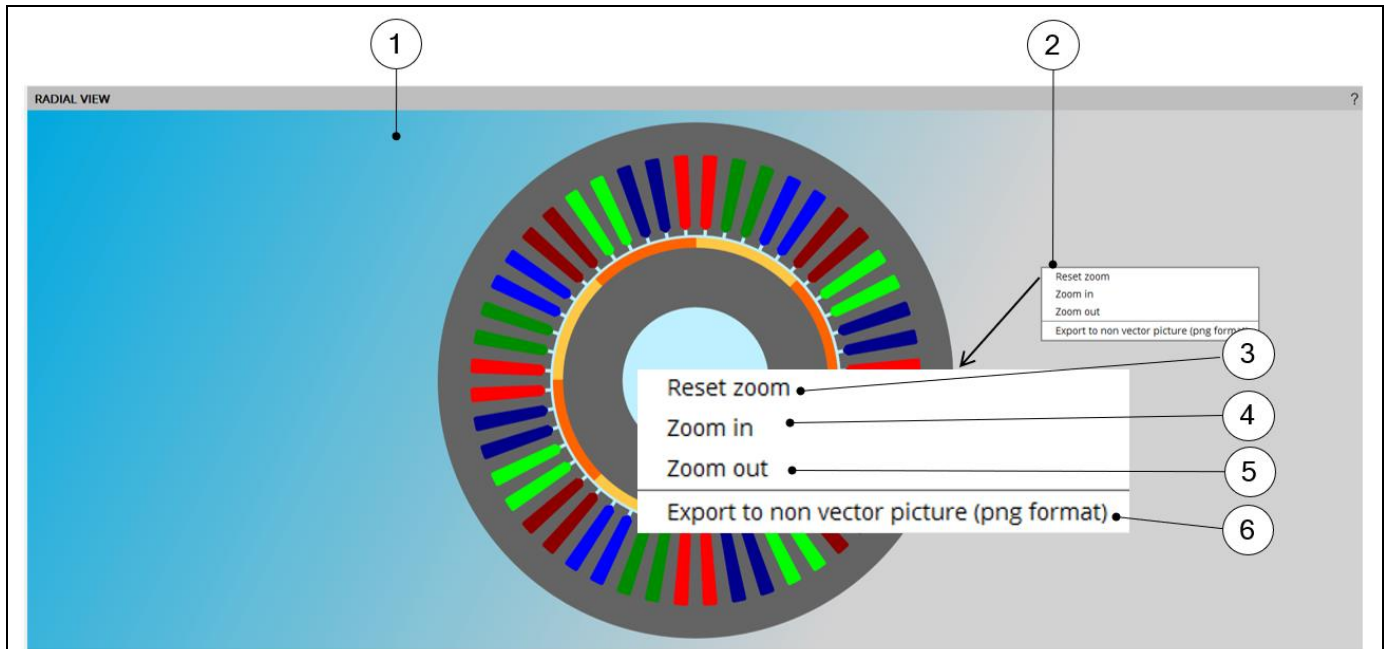
The image shows two parts of the Motor Factory interface. On the left, a menu is open with 'Exit (Ctrl-Q)' highlighted by a mouse cursor. A circled '1' points to this menu item. On the right, a close button icon (a square with an 'X') is shown, with a circled '2' pointing to it.

Exit – Close Motor Factory	
1	Close Motor Factory from the top menu of Motor Factory.
	Close Motor Factory by using the following icon on the right top part of the Motor Factory panel.
*	Close Motor Factory by using the shortcut CTRL-Q defined in the user preferences. For more information, refer to the chapter "user's preferences".

5.4 Graphic management

5.4.1 Overview

The graphic functions are available on every graphic area of the Motor Factory application.



1	From the any graphic window it is possible to access the graphic functions by using the right mouse button.
2	A dialog box allows to choose among four functions: <ul style="list-style-type: none"> • Reset zoom • Zoom in • Zoom out • Export to non-vector picture
3	Reset zoom allows getting back the original size of the picture (i.e. without zooming). Reset zoom allows making the picture recover its original size.
4-5	Zoom in and zoom out are used for adjusting the size of the picture, step by step. Zoom in and zoom out can also be applied by using the scroll wheel on the mouse.
6	Export function to get a picture with .png format. The picture is captured by considering its original size (i.e. without zooming).

5.4.2 Management of panels in Motor Factory

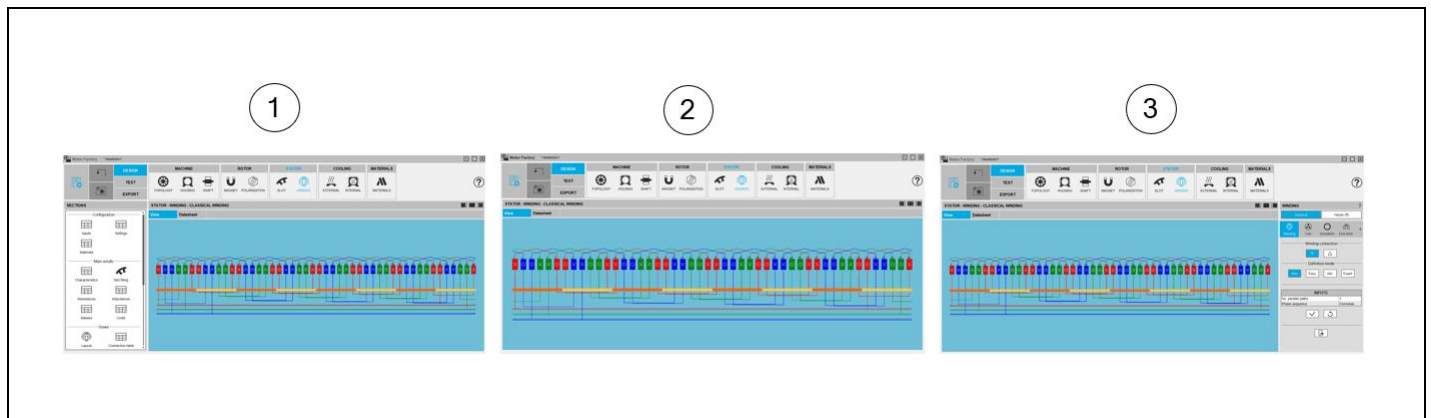
When the computer screen is too small or when the resolution of the screen is too low, three buttons appear on the top part of Motor Factory panels.

They allow to remove or to display the right and/or left panels of the screen. See illustrations below.



Dedicated buttons allow the management of panels in Motor Factory

1	Three buttons are available to manage the displaying of panels in Motor Factory.
2	Button to hide right side and/or left side or both sides.
3	Button to display right side and/or left side or both sides.



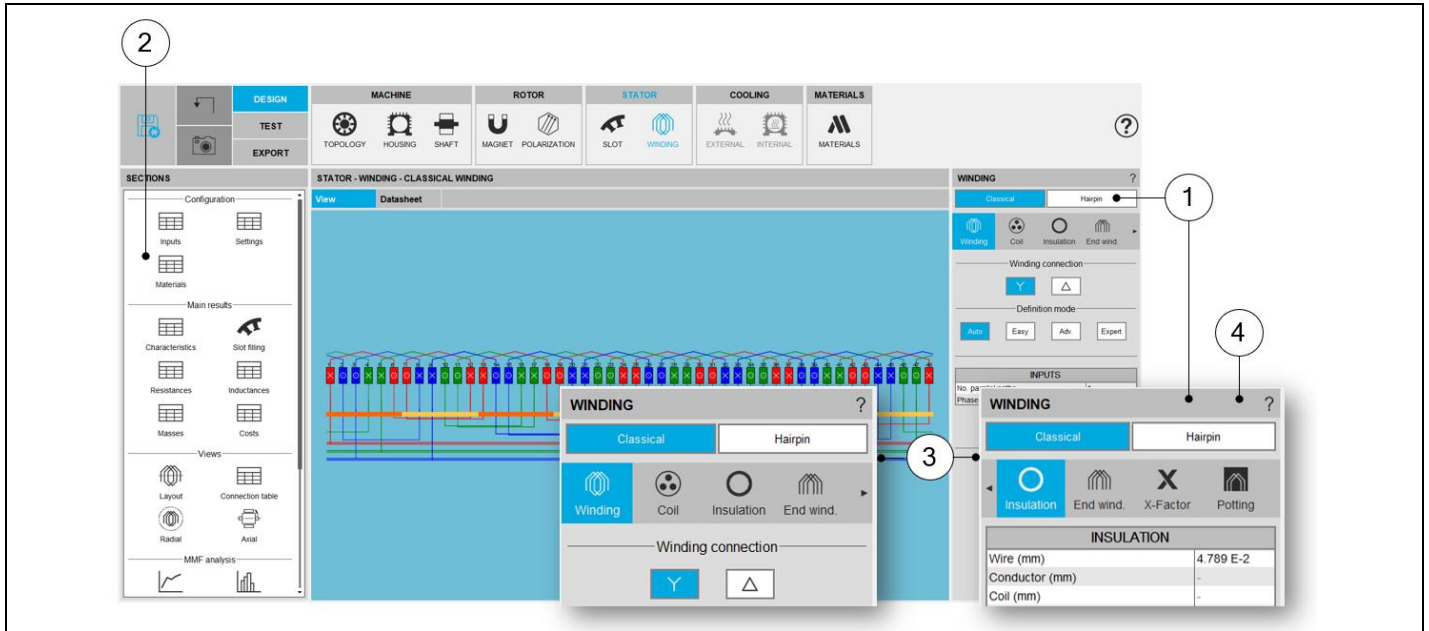
Different ways to display (or remove) the panels in Motor Factory

1	Right side removed and left side displayed.
2	Both sides (right and left) removed.
3	Right side displayed and left side removed.

5.5 Selection modes in GUI

5.5.1 Section selection mode

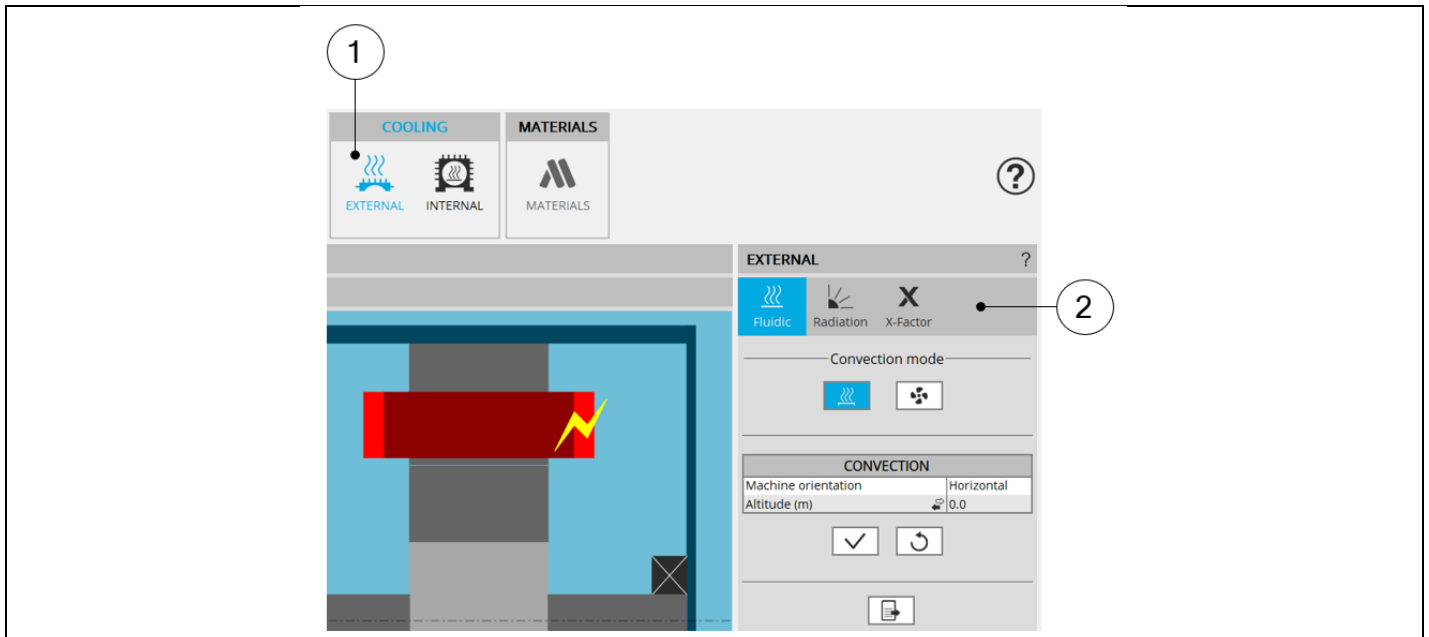
The process for choosing the section in which user inputs are defined is implemented in the winding area as illustrated below



Scrolling selection bar – Winding environment

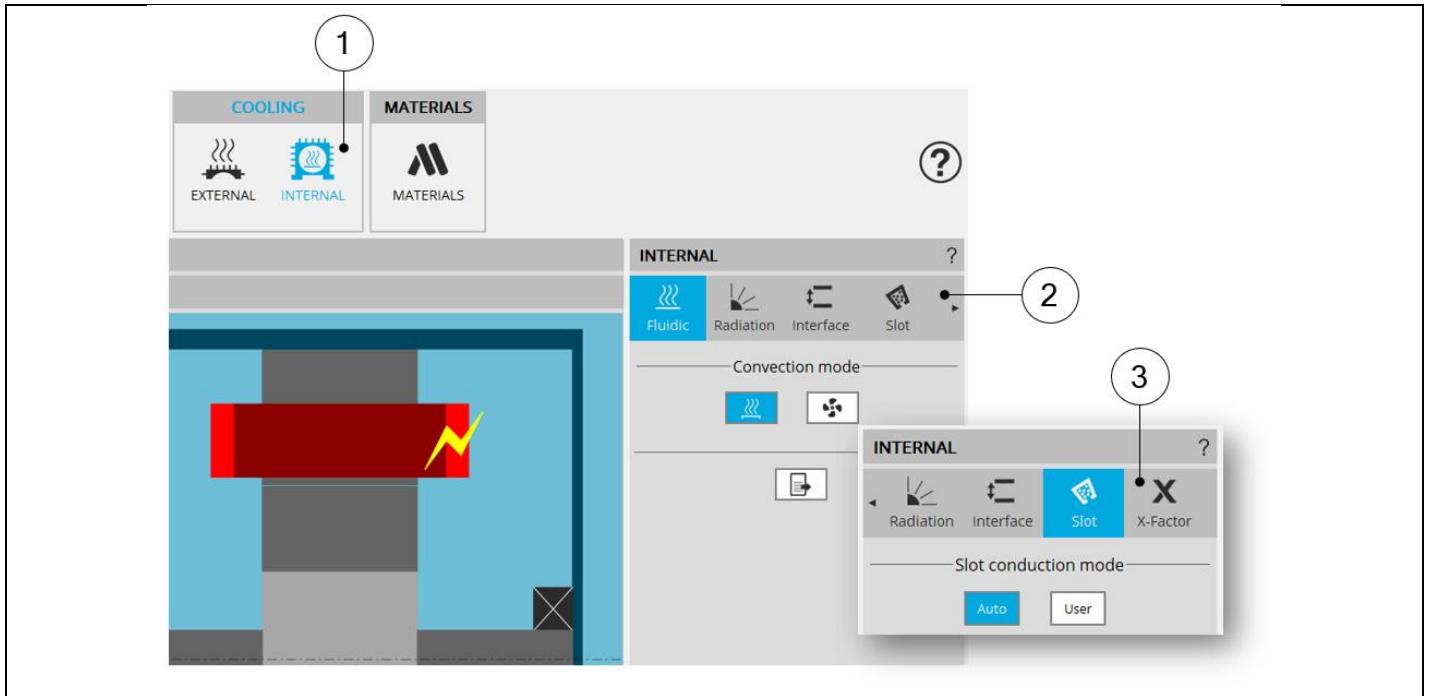
1	Scrolling selection bar where Winding, Coil, End-winding, X-Factor and Potting sections can be selected.
2	Section data can be reached thanks to shortcuts.
3	Arrow allows to scroll the bar to reach other sections (on the right or the left) when needed.
4	The bar slides on the right to allow reaching Potting section.

Note: This new way of selection has been implemented in the design environment of Motor Factory for external and internal cooling as illustrated below.



Scrolling selection bar – External cooling area

1	External cooling area of Motor Factory design environment.
2	Scrolling selection bar where Fluidic, Radiation, X-Factor sections can be selected. In that case, all the sections can be reached without sliding the bar.

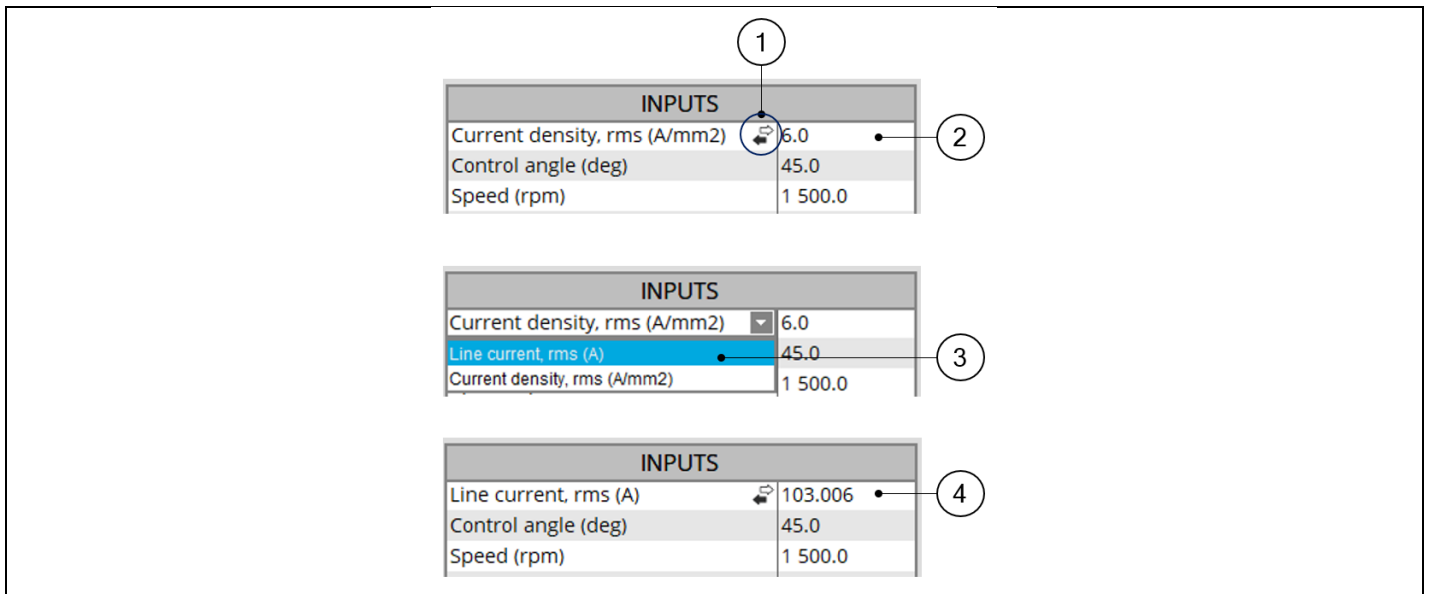


Scrolling selection bar – Internal cooling area

1	Internal cooling area of Motor Factory design environment.
2	Scrolling selection bar where Fluidic, Radiation, Interface, Slot sections can be selected.
3	The bar slides on the right to allow reaching X-Factor section.

5.5.2 Multiple choices for inputs

A process allowing Multiple choices for selecting the type of user’s inputs has been implemented. This allows giving users several choices within only one input line. Please see the below example showing the different ways to define the electrical current in conductors.



Scrolling selection bar – External cooling area

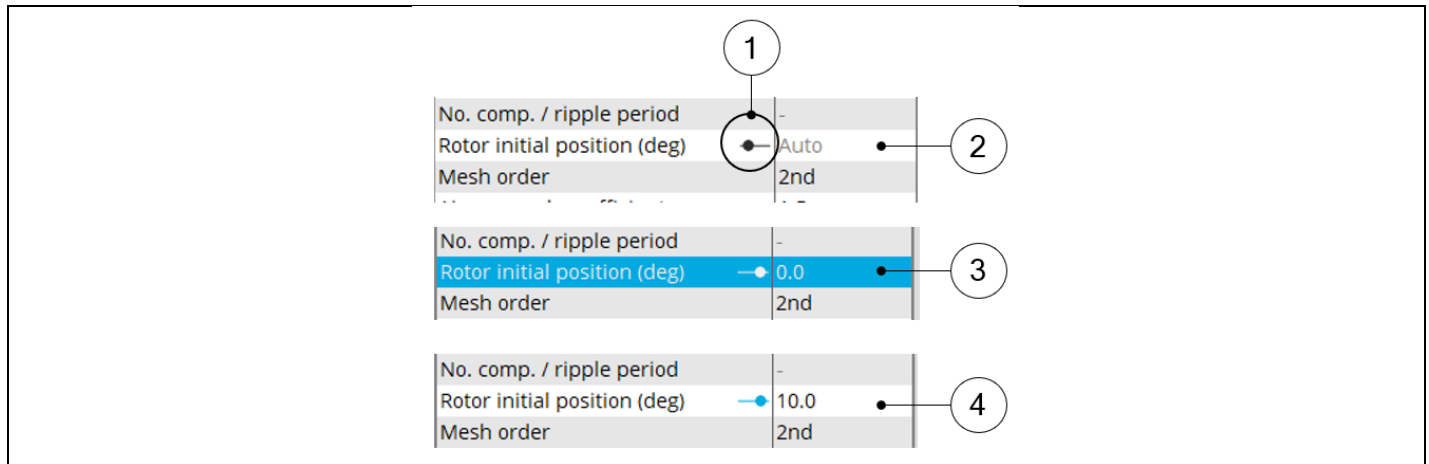
1	Icon allowing to give multiple choices to the users.
2	First choice = Current density (A/mm ²).
3	In that case two choices are possible: either the current density or the line current. Whatever is the choice the units and the corresponding data are updated.
4	Second choice = Line current, rms (A).

5.5.3 Auto/User mode switch

A process allowing to switch between two types of answer (Auto or user for example) has been implemented.

For example, when the “Rotor initial position mode” is set to “Auto”, the initial position of the rotor is automatically defined by an internal process of FluxMotor®.

When the “Rotor initial position” is set to “User input” (i.e. toggle button on the right), the initial position of the rotor to be considered for computation must be set by the user in the field « Rotor initial position ».



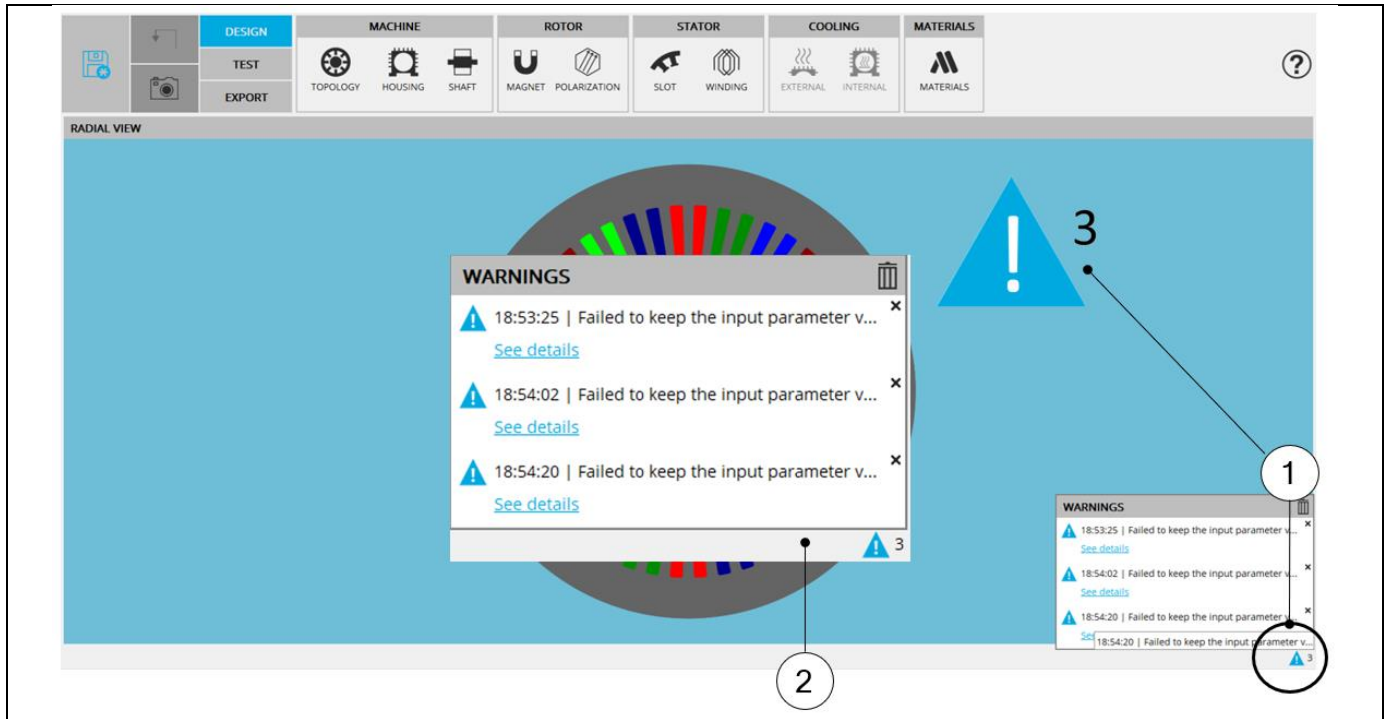
Auto/User mode switch – Example of application

1	Icon allowing to switch between two types of answer.
2	First position: automatic mode
3	Second position - toggle button on the right – One can write a data in the field
4	The toggle button is blue, the data is taken into account.

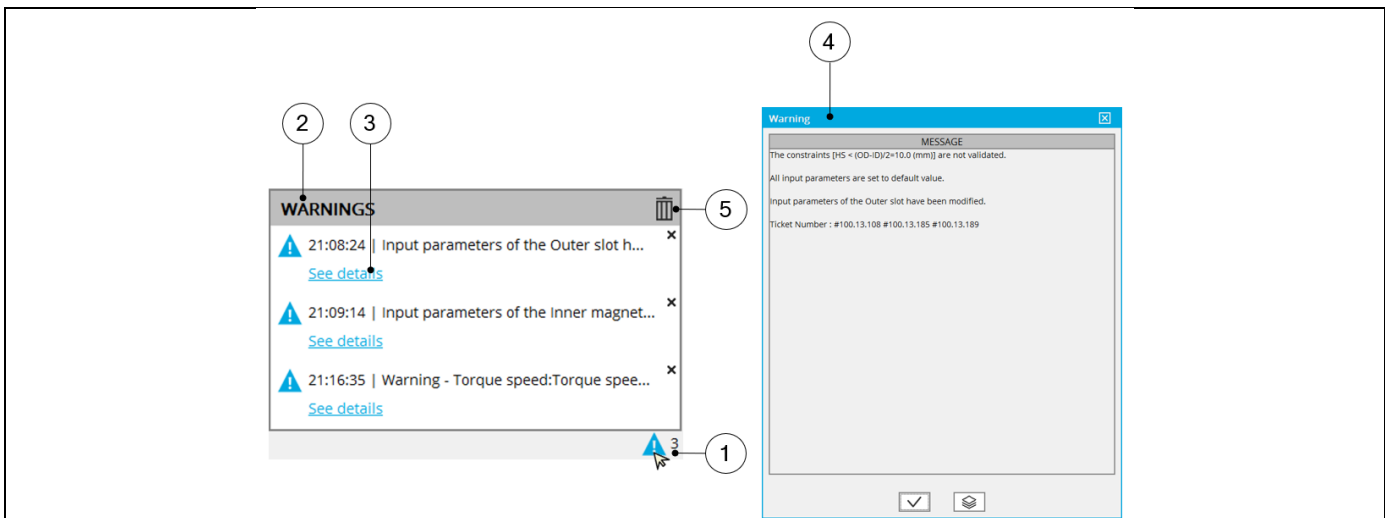
5.6 Warning messages

5.6.1 Standard warnings

In the DESIGN, TEST or EXPORT area of Motor Factory, warning messages can be issued. They are stored on the right bottom part of the screen.



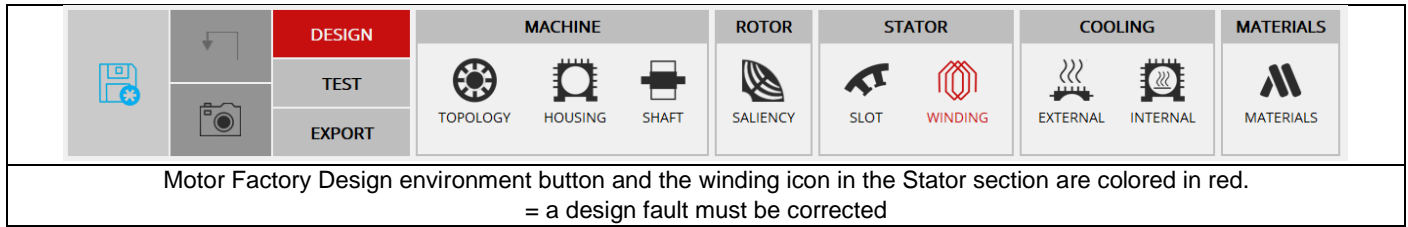
1	Location of the warning messages. The number (3 in the example) indicates the number of warning messages to read.
2	When the test is running or when designing a machine, messages can appear on the screen to notify user about some warnings to check.



1	Click on the warning message icon to open the corresponding dialog box.
2	Dialog box dedicated to display warning messages.
3	Each warning message can be visualized by clicking on: "see details".
4	Clicking on "See details" allows to read the warning message.
5	All the warning messages can be removed from the list by clicking on the bin icon.

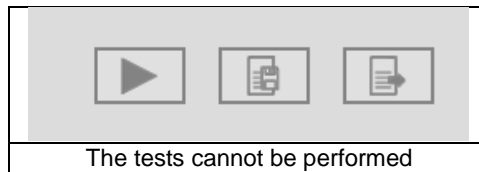
5.6.2 Case of a design fault

Motor Factory Design environment button and winding icon in the Stator section can be colored in red. This meaning that a design fault must be corrected in the winding section of the design environment.



Therefore, the tests cannot be performed; the tooltip message indicates that the slot filling is not valid, and the user must modify the slot filling parameters to unlock the test.

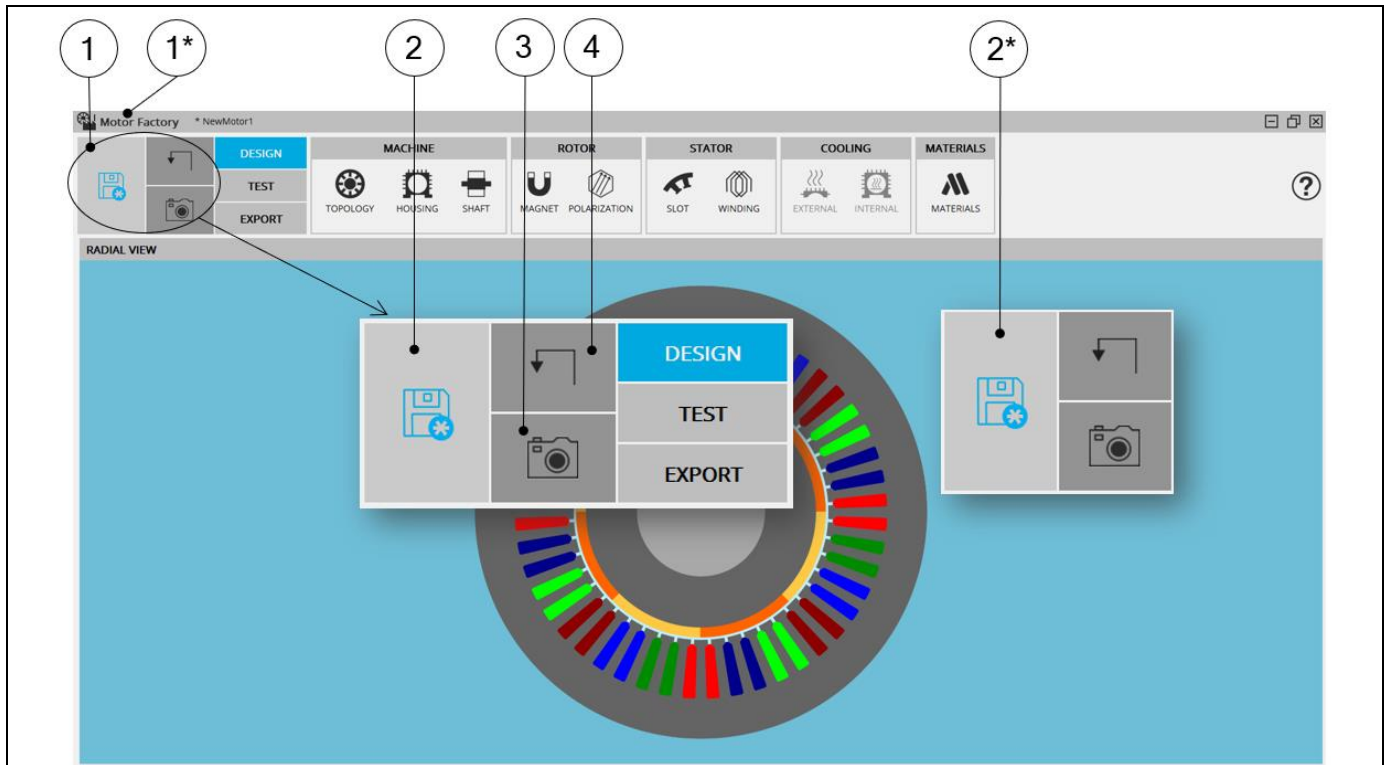
At the same time, a warning message indicates that there is not enough space for the specified number of wires. The allowed number of wires is mentioned in comparison with the targeted ones.



5.7 System functions

5.7.1 Direct access to some system functions

All the functions listed below are described in the section dedicated to system functions.

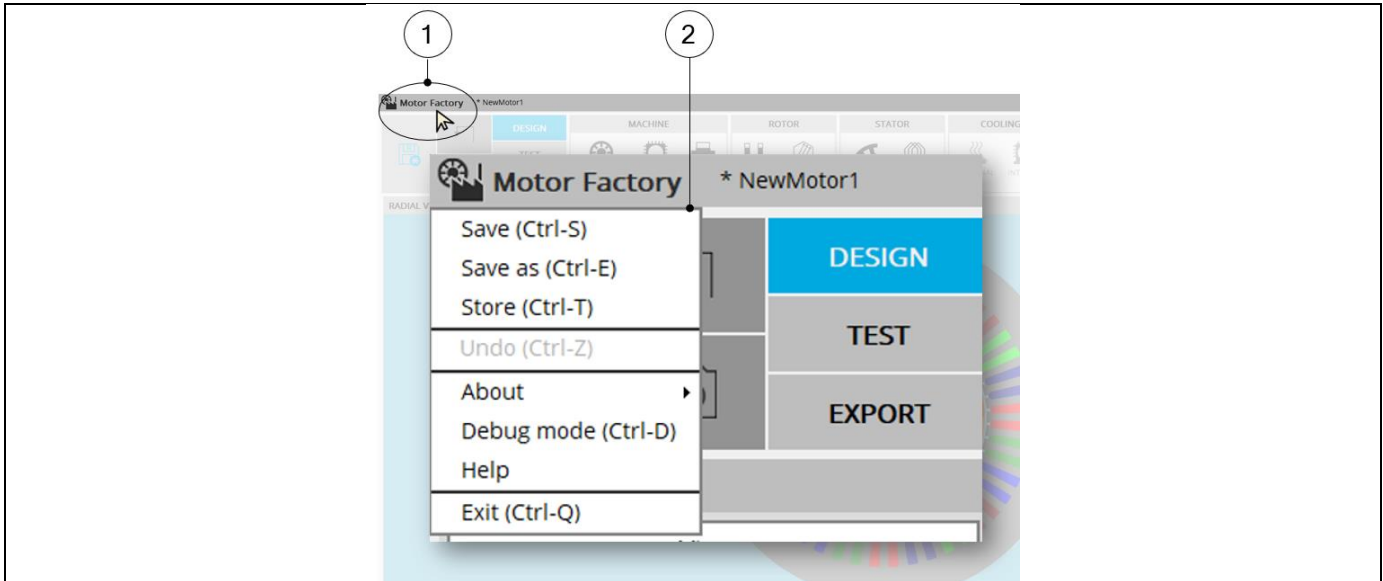


1	<p>Click on one of the three main buttons to use some main system functions.</p> <ul style="list-style-type: none"> • Disk = Save motor changes • Camera = Store motor • Back arrow = Undo action <p>Note: These three functions are available in the DESIGN and TEST area. In the EXPORT area, Undo action is not available (See “expanding the menu in Motor Factory”).</p>
1*	Clicking on this zone allows access to the main menu.
2	Save motor changes: to save the current project, by keeping the same name of the motor which remains in the catalog.
2*	A new button to save motor changes appears when any modifications are done in the description of the motor inside Motor Factory.
3	<p>Store motor by using the camera button.</p> <p>Store a motor means that a copy of the current motor is stored in a catalog using a new name.</p> <p>User must give a new name of the motor and select an existing catalog in which the motor will be stored.</p> <p>Note: This command allows user to continue working on the current motor. “Store” can also be selected from the main menu (ref. 1* - See “expanding the menu in Motor Factory”).</p>
4	Undo action, to cancel the previous actions.

5.7.2 Expanding the menu in Motor Factory

This menu gives access to some system functions.

All the functions listed below are described in the section dedicated to system functions.



1	Expand the menu in the left top part of Motor Factory – can be used from all the DESIGN, TEST and EXPORT area.
2	<p>List of actions available:</p> <ul style="list-style-type: none"> • Save • Save as • Store • Undo • About • Debug mode • Help • Exit <p>All these functions are described in the dedicated section: System functions</p>