MotorSizer™ 4 – How to use

MotorSizer™ IV is an internet-based program to help you to find the best solutions for your application among JVL Stepper (MIS) and Servo (MAC) motors together with the JVL gear boxes.

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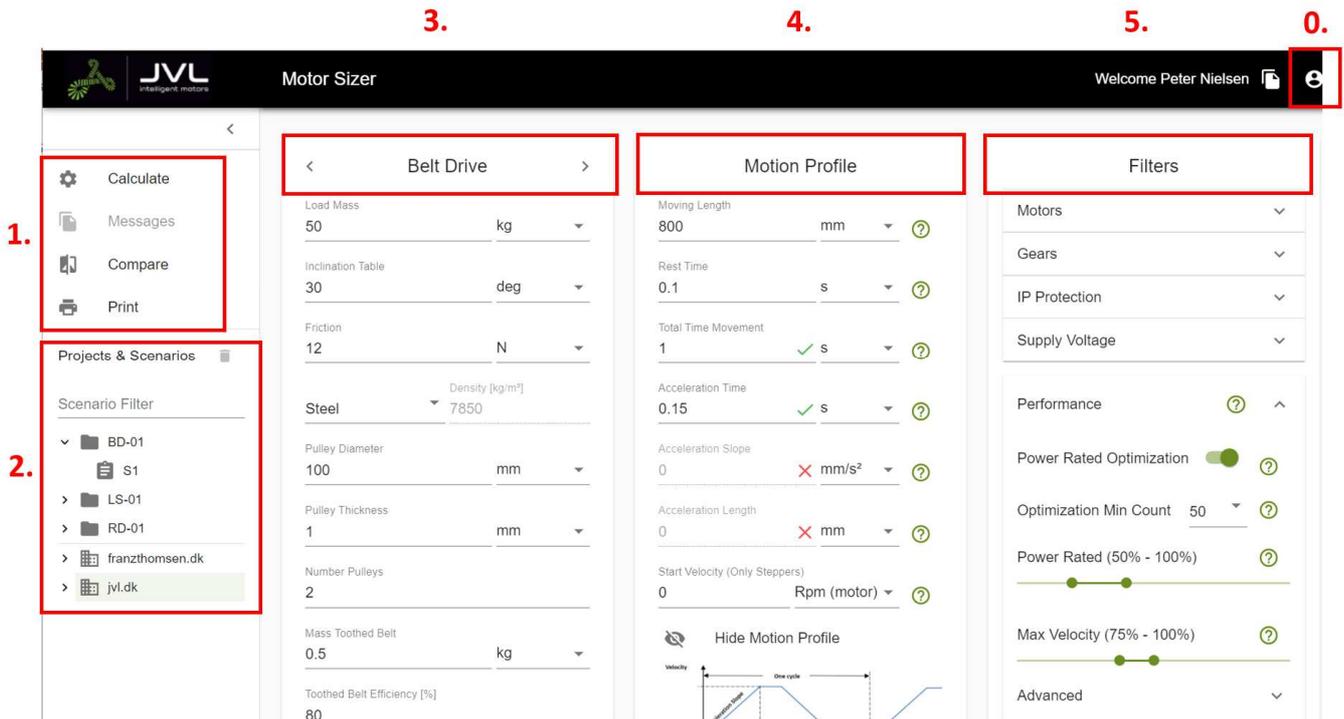
1. Login and menu (0. and 1.)

Before you can use this program you need to have a login from JVL.
When you have got that you can use this tool to make calculations for different applications like Belt Drives, Lead Screw or Disc.

In the menu there are 4 possibilities except this Help document.
- Calculate
- Messages
- Compare
- Print
- User guide

1.1 Calculate

When you press "Calculate you get a box where you have to tell for which mail address, Project and Scenario. Then the project is saved and a calculation is made from the parameters entered for the mechanics and the motion profile and the selected filters. (See more in "Calculation Results".)

1.2 Messages

When the project is calculated you get the possibility to look into this box to see what has happened to the data. Which motors and gears have been removed and which calculations have been made to find the result.

1.3 Compare

When the calculations have been made you can select some of these calculations and compare the different values to see which solution is best for your application.

1.4 Print

When the calculations have been made you can select some of these calculations and print the different values to see which solution is best for your application. You can print to printer or maybe a pdf-file to send to a customer as documentation.

2. Project Management (2.)

Here you have the list of all your projects and you can make new and erase old ones. You make the new ones when you press "Calculate" and when you mark a project or a customer you can erase those.

3. Application (3.)

There are 3 types of applications for which it can be used directly:

- Belt Drive
- Lead Screw
- Rotary Disc.

For other applications you may need to adapt them to one of these 3 options.

3.1 Mechanical data for Belt Drive

These data are the first to be put into the calculation sheet.

The "*Load mass*" is what you move with the belt. It could be a wagon + some attached load mounted on the wagon.

The highest load you normally get when you move the load upwards why the "*Inclination table*" is the angle you are transporting the load.

"*Friction*" is often a value you don't know from the application so you can either measure this and put in the value or just give some qualified guess after the first calculation have been made.

The "*Density*" is used for the pulleys to calculate the inertia of those together with "*Pulley Diameter*" and "*Pulley Thickness*" and "*Number of Pulleys*".

The "*Mass of Tooth Belt*" are added to the "Load Mass" for total calculation.

When using the Tooth Belt there might be some "*Tooth Belt efficiency*" that need to be added for the calculation of torque and power.

And last there might also be some "*Other Rotating Inertia*" that need to be added.

And last some data for mechanical backlash might be added to calculate a total loss of position.

3.2 Mechanical data for Lead Screw

These data are the first to be put into the calculation sheet.

The "*Load mass*" is what you move with the leadscrew. It could be a wagon + some attached load mounted on the wagon.

The highest load you normally get when you move the load upwards why the "*Inclination table*" is the angle you are transporting the load.

"*Friction*" is often a value you don't know from the application so you can either measure this and put in the value or just give some qualified guess after the first calculation have been made.

The "*Density*" is used for the lead screw to calculate the inertia of that together with "*Length*" and "*Diameter*".

The "*Pitch*" is used to find the relation between rotation and moving length.

When using the Lead Screw there might be some Lead Screw "*Efficiency*" that need to be added for the calculation of torque and power.

And last there might also be some "*Other Rotating Inertia*" that need to be added.

And last some data for mechanical backlash might be added to calculate a total loss of position.

3.3   Mechanical data for Rotary Disc

These data are the first to be put into the calculation sheet.

The "*Mass*" is the weight of the rotary disc if known.

If the weight of the disc is not known you key-in 0 and it will be calculated using the "Outer Diameter", the "Inner Diameter", "Density" and "Width" of the disc.

"*Friction*" is often a value you don't know from the application so you can either measure this and put in the value or just give some qualified guess after the first calculation have been made.

And last there might also be some "*Other Rotating Inertia*" that need to be added.

And last some data for mechanical backlash might be added to calculate a total loss of position.

4. Motion Profile (4.)

When all the mechanical data are entered you need to consider how the motor should be moving.

The Motion Profile is looking like this and is the one we use for the calculation:
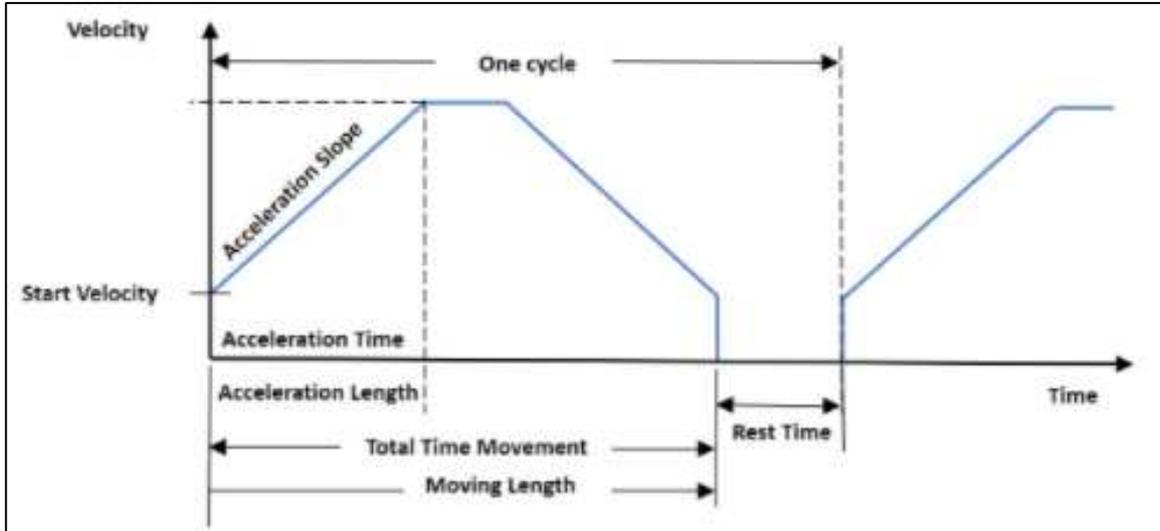
The "Acceleration Slope" is the same used for the deceleration.

The rated values for power and torque are looking at one cycle.

The units for each parameter are rather flexible and you can select what is best for you or the application.

"*Moving Length*" for Belt Drive and Lead Screw are often a length in m or mm.
For a rotary disc it could be either mm or degrees. In case you want to use mm the length is at the outer diameter.

The "*Rest Time*" is the pause time between each move. This time is included in the calculation of rated power and torque values.

Then we have "*Total Time of Movement*", "*Acceleration Time*", "*Acceleration Slope*" and "*Acceleration Length*".
You have to key-in a value for 2 of those and the others should be 0.

In case you want to change from using "*Total Time of Movement*" and "*Acceleration Time*" and want to use "*Acceleration Slope*" instead of "*Acceleration Time*" you change "*Acceleration Time*" to 0 and then key-in the value for "*Acceleration Slope*".

And last we have the "Start Velocity" value.
This value is only used for steppers in open loop to avoid resonances which might make the motor stall (Lose position).
A standard 200 step/rev stepper motor in open loop often have resonances around 40-60rpm (133 to 200Hz) why we normally make a calculation for at start velocity higher than this speed.

5. Filters (5.)

Now all the data for the application are key-in and you need to set up some data from which you can get the result you want when MotorSizer™ IV make the calculation.

5.1 Motor

You need to specify what kind of motor you want to use:

- AC-Servo (MAC), Stepper motor (MIS)
- with incremental or absolute encoder,
- option for STO (Safe Torque Off)
- option for brake
- control the motor using Ethernet, Fieldbus or Wireless.

For the Stepper motors you can also select if you want the motor with a shaft out in the rear end for external encoder.

Showing default settings.

5.2 Gear

You also may need to specify what type of gear you want for the application or if need to be angled.

5.3 IP Protection

Here you select the required IP degree
for motor housing, motor output shaft
and the gear if needed.

IP Protection

Motor House	IP42 ✓
	IP55 ✓
	IP65 ☐
	IP66 ☐
	IP67 ☐

Motor Shaft	IP42 ✓
	IP55 ✓
	IP65 ☐
	IP66 ☐
	IP67 ☐

Gear House	IP42 ✓
	IP55 ✓
	IP65 ✓
	IP66 ✓
	IP67 ✓

5.4 Supply Voltage

Here you can specify what kind of voltage
you want to use for the driver in the motor
– AC (1- or 3-phases) or DC.
For the control part you normally
use 24VDC.

Supply Voltage

AC	1x115V ✓
	1x230V ✓
	3x400V ✓

DC	12V ✓
	24V ✓
	48V ✓
	72V ✓

5.5   Performance

The filter parameters above just remove some motor and gear options from what we need to calculate to find the right solutions.

Next step is to calculate the possible options to see if they are within our specifications for motors and gears and the specifications you have set up. Here is a guideline that hopefully can help you to set them in the best way.

5.6   Performance - Basic Selection

When looking at the "*Performance*" window there are 3 basic things available to select or adjust:

- "*Optimization*"
- "*Power Rated*"
- and "*Max Velocity*".
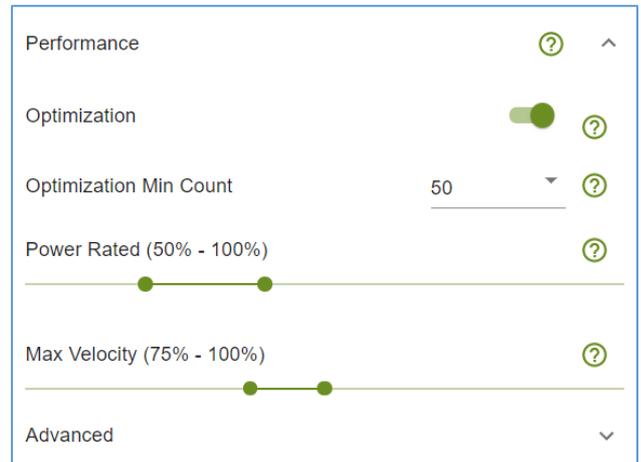
When "*Optimization*" is **marked** you get an extra input ("*Optimization Min Count*") where you select the minimum number of results you want. If you tell only 1 result you only get the "default" calculation which is without gear and motor. If you select "all" you get all possible results and can select in the result list afterwards.

"Max Velocity" is set to 75% to 100% and the "Power Rated" is set to 50% to 100% by default and it will automatically start searching in this range for results when pressing "Calculate". It will start in the Power Rated range from 95% to 100% and if not finding any or enough results it will lower the minimum limit in steps of 5% and search and try again until the requested number of results have been found.

In case the "Power Rated" range is x% to 92% it will start searching for results from 90% to 92% and then from 85% to 92% and so on until it has found the requested number of combinations of motors and gears or has reached 0%.

If it has reached 0% and hasn't found enough combinations it will automatically try lowering the lower Velocity range in steps of 5% and make a new test with Power Rated to see if any combinations would then be better. It'll continue lowering the minimum Velocity value until enough combinations are found.

When the calculation is made for the motor and gear combination they will be checked again if they are in the range for these parameters and the "Advanced" range and if they are, they are put in the result list.

The Performance filter for Power Rated and Velocity will afterwards show in which range the results were found.

If no results are found you'll see a box showing that no results were found and also some parameters and the calculated values for the application. You can also look at the "Default Calculation" and the values you have keyed in and check if they are correct. It might be that the maximum velocity is above the max velocity for the motors we supply or the load inertia is much too big.

MotorSizer could not find any results with the filter settings selected or with the data you have keyed in for the load and movement.

These are some of the critical parameters in the default calculation to check:

Motor Power Rated: 8528.38 W
Motor Power Peak: 40608.38 W
Torque Rated: 1601.38 Nm
Torque Peak: 2707.23 Nm
Motor Velocity Max: 143.24 Rpm
Inertia Load: 62515.04 kg·cm²

If you open the default calculation you can find more parameters to check.

In case you can't see why you don't get any results then contact JVL on support@jvl.dk and we can help you.

OK

When "*Optimization*" is **unmarked** you have to set up the parameters yourself.

The combination of motor and gear will be put into the calculation selected within this range of "*Power Rated*" and "*Max Velocity*".

When the calculation is made for the motor and gear combination they will be checked again if they are in the range for these parameters and the "Advanced" range and if they are, they are put in the result list.

If you set "Max Velocity" to the range from 0% to 100% and "Power Rated" to 0% to 100% you'll get all possible combinations. You can then sort the result list manually and find the best solution for you.

5.7   Performance - Advanced Selection

In this section there are some more possibilities to adjust some ranges to get the results you want.

"Power Peak" is default 0% to 100% which means the motor is not at the peak or is at the edge of the motor capability.

The lower limit may be increased to you know the motor has to work a little and the upper limit may be decreased a bit to avoid too much heating of the motor.

"Torque Peak" is default 0% to 100%.
Same adjustment as for Power Peak.

"Torque Rated" is default 0% to 100%.
Same adjustment as for Power Peak.

"Filter Precision on" can be either Repeatable or Absolute and for Belt drive and Lead Screw it's in mm and for Rotary Disc it's Degrees.

Advanced

Power Peak (0% - 100%)

Torque Peak (0% - 100%)

Torque Rated (0% - 100%)

Filter Precision on   Requested Precision Repe... ▾

Precision (0mm - 10mm)

Inertia Ratio JL/JM (0.2% - 500.0%)

Net Weight Max (150.0kg)

"Inertia Ratio – JL/JM" is the ratio between the load inertia and the motor inertia.
This value we use for the MAC motors as "Load" factor which is then this calculated Inertia Ratio +1.
-   For stiff systems with no backlash and very dynamic running the "Inertia Ratio" value could be from 0% to 2500% (25:1).
    If you have a higher value then you have to be careful. We have had applications with a ratio of 20000% (200:1) working fine but we don't want this to be a standard limit. Values from 2500% to 20000% are shown in read.
-   For Medium systems the range should be 0% to 1000% (10:1).
-   For systems with backlash and not very dynamic it should be in the range of 0% to 300% (3:1) or less.

And last you can put in a limit of the maximum weight of the motor and gear combination if needed.

If you make any changes in the filters you need to make a new calculation.

6.   Calculation Results

When the calculation has been made and you get some results for possible solutions the list looks like this:

Be aware that the calculations are made for motors running once and for a short time so it's been warmed up to high temperatures before starting. In case you keep repeating the motion profile the motor heats up and at some temperature the motor reaches the maximum temperature where it's too warm and go into error.
For MAC (AC-servo motors) it's the "Motor Load (mean)" and for the MIS motors (ServoStep) it's the "Temperature" that stops the motor.
In the result list you find "Duty Cycle" that indicates if you can keep running continuous torque (S1) or has to run the motor with some cooling period (S3) The "Duty Cycle %" shows if your continuous torque need to be lowered and how much.
(The S1 and S3 calculations will be a part of coming version of Motorsizer IV.)

1.

The Calculation Result show how many motor and gear combinations you have chosen/marked (3) between the possible solutions (51). This first number we use to show how many results will be put into the "Compare" or "Print".
If you select too many there'll be very little space for each.

2.

The " (0/1)" indicates the default calculation with the default motor with no inertia or friction and with motor with an encoder of 200 counts/revolution. The default gear has a ratio 1:1, no inertia or friction and 100% efficiency.

If you click the ">" the data are folded out and you can see all the data selected for the calculation.

Using the cursor "Left" or "Right" in the bottom of the screen you can see all the data.

If you don't want to see the default data anymore you can close this group clicking at the "v".

3.

Here you have the group of motor and gear combinations that will do in your application.
Here you can also use the ">" and the "v" to open and closing the group of results.

4.

Each of these columns can be filtered (sorted) in different ways.
If you click at the column text you can sort between low to high or high to low.

If you click at "abc" you get these options for text comparison:

- abc Contains
- abc Does not contain
- abc Starts with
- abc Ends with
- = Equals
- ≠ Does not equal
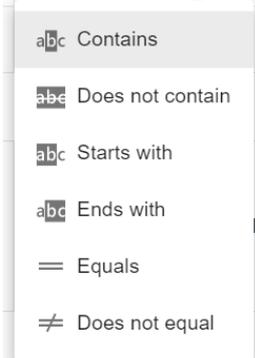
… and these can be used in combination with the "Filter …." next to these values.
The first 4 are text comparisons and the last 2 are value comparisons.

For comparison values you have these options:

- = Equals
- ≠ Does not equal
- > Greater than
- ≥ Greater than or equal to
- < Less than
- ≤ Less than or equal to
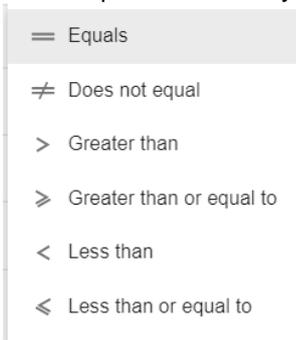
5.

By default the motors are grouped so you have an overview of the types that might be used.
If you want to sort the motors by velocity or power rated (Using 4.) the values are sorted within the group and the groups are also sorted looking at the highest or lowest value within the group.

In case you rather want to ungroup all groups you can do this using this button (Grouped/Tabular).
Then all motors are sorted one by one and not just within the groups.
Now you can see which solution runs the fastest or with lowest power rated value or have the lowest inertia ratio or any other.

6.

When pushing this buttom you can select or deselect the columns to show in the result list.
In the result list you can also drag each column to a new position to make it easier for you to use.
These settings are saved locally when you close down MotorSizer™.

7.

This button resets the setup from 6.
The default settings are set.

8.

The first 4 columns stay until you move right to see the last columns and then only "Motor Number" and "Gear Number" are shown until you move to the left and then the last 2 comes back.

9.

These columns can be selected in 6. and moved to the best position (Right and Left) on the screen.

You have the following possible parameters to select and watch in the list:

☑ Group

☑ Motor Number

☑ Motor Description

☑ Gear Number

☑ Gear Description

☑ Supply Voltage

☑ Motor Power Rated [W]

☑ Motor Power Rated Ref [W]

☑ Motor Power Rated [%]

☑ Motor Power Peak [W]

☑ Motor Power Peak Ref [W]

☑ Motor Power Peak [%]

☑ Motor Torque Rated [Nm]

☑ Motor Torque Rated Ref [Nm]

☑ Motor Torque Rated [%]

☑ Motor Torque Peak [Nm]

☑ Motor Torque Peak Ref [Nm]

☑ Motor Torque Peak [%]

☑ Total Time Movement [s]

☑ Rest Time [s]

☑ Motor Velocity Max [Rpm]

☑ Motor Velocity Rated [Rpm]

☑ Motor Velocity [%]

☑ Motor Velocity Max [mm/s]

☑ Frequency [Hz]

☑ Acceleration Time [s]

☑ Acceleration Slope [m/s²]

☑ Acceleration Length [m]

☑ Motor Acceleration [Hz/s]

☑ Motor Acceleration Counts [Counts]

☑ Load Acceleration length [mm]

☑ Inertia, Load [kg·cm²]

☑ Inertia, Motor [kg·cm²]

☑ Inertia Ratio

☑ Total Gearing [Cnt/mm]

☑ Encoder

☑ Brake

☑ STO (Safe Toque Off)

☑ Ethernet

☑ Fieldbus

☑ Wireless

☑ Other Comms

☑ Motor Counts [Counts/rev]

☐ Flange and Shaft

☐ Net Weight [kg]

☐ Motor Net Weight [kg]

☐ Gear Net Weight [kg]

☑ Pulley / Screw / Disc weight [kg]

☑ Gear Ratio

☐ Gear Efficiency [%]

☐ Gear Inertia [kg·cm²]

☐ Double Shaft

☐ Torque, Mechanics [Nm]

☐ Torque, Belt and Other Inertia [Nm]

☐ Torque, Motor and Gear [Nm]

☐ Torque, Const. Velocity) [Nm]

☐ Torque, Dec [Nm]

☐ Power, Const. Velocity [W]

☐ Calculated Motor Precision Repeatable [mm/mm/mm]

☐ Calculated Gear Precision Repeatable [mm/mm/mm]

☐ Calculated Mechanics Precision Repeatable [mm/mm/mm]

☐ Calculated Total Precision Repeatable [mm/mm/mm]

☐ Calculated Motor Precision Absolute [mm/mm/mm]

☐ Calculated Gear Precision Absolute [mm/mm/mm]

☐ Calculated Mechanics Precision Absolute [mm/mm/mm]

☐ Calculated Total Precision Absolute [mm/mm/mm]

☐ IP Protection Motor House

☐ IP Protection Motor Shaft

☐ IP Protection Gear House

"Inertia Ratio" (IR) can be used for the MAC motors as "Load" factor by using the value IR+1.

In case you need more information and have any questions regarding this program then write an E-mail to Support@jvl.dk and tell us your email and project name and we'll come back as soon as possible with an answer.