Motor Selection Tool

User's Guide

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About Motor Selection Tool

Motor Selection Tool is a utility software for selecting the most suitable Cool Muscle motor according to the applications involved.

Main features

According to the selected speed reducer and application, Motor Selection Tool can calculate the inertia and torque on the motor shaft and motor motion data; draw motion simulation graphs; and select the most suitable Cool Muscle motor.

The latest Motor Selection Tool can be downloaded for free from the following website.
URL: https://musclecorp.com/motion-en/dl-top/

Compatible OS:	Windows 7, Windows 8.1, Windows 10
File Name:	MotorSelectionTool_v1.3.zip

*Motor Selection Tool will be updated without notice.

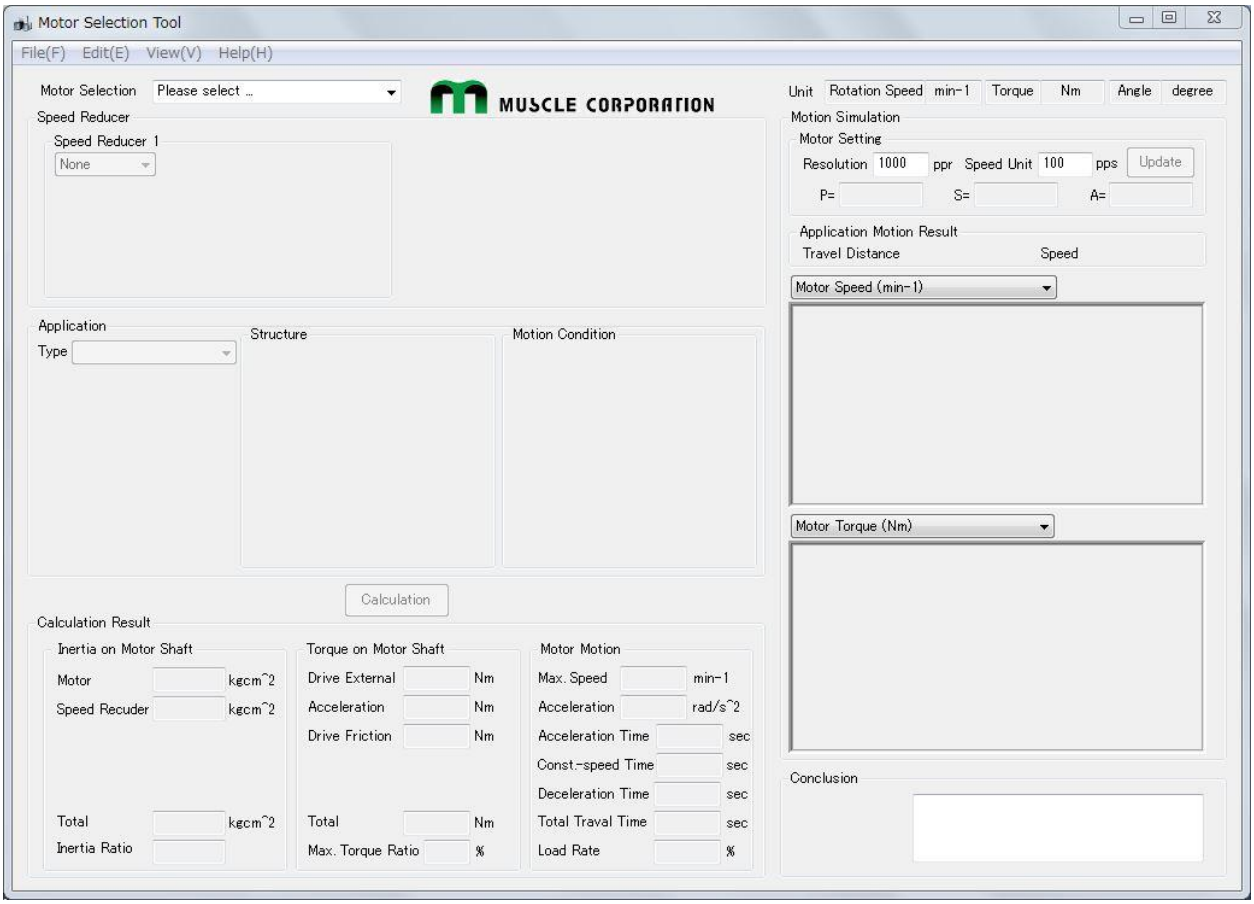
1.1 Start up and Initial Settings

1. Extract the downloaded zip file.
   MotorSelectionTool_v1.3.zip

2. Before starting, please set your PC screen resolution at least 1024 * 768 or more in order to see all content on the form.

3. To start, double click the MotorSelectionTool.exe in the folder where the files are extracted.

   The Motor Selection Tool window will be displayed as follows:



Chapter 2 Window Composition and Operation

Motor Selection Tool window is composed of the following six parts:

① Data Input (Refer to 2.1 Data Input)
② Calculation Result Display (Refer to 2.2 Calculation Result Display)
③ Data Unit Display (Refer to 2.3 Data Unit Display)
④ Motion Simulation (Refer to 2.4 Motion Simulation)
⑤ Motor Usable Conclusion Display (Refer to 2.5 Motor Usable Conclusion Display)
⑥ Menu Bar (Refer to Chapter3 Menu Bar)

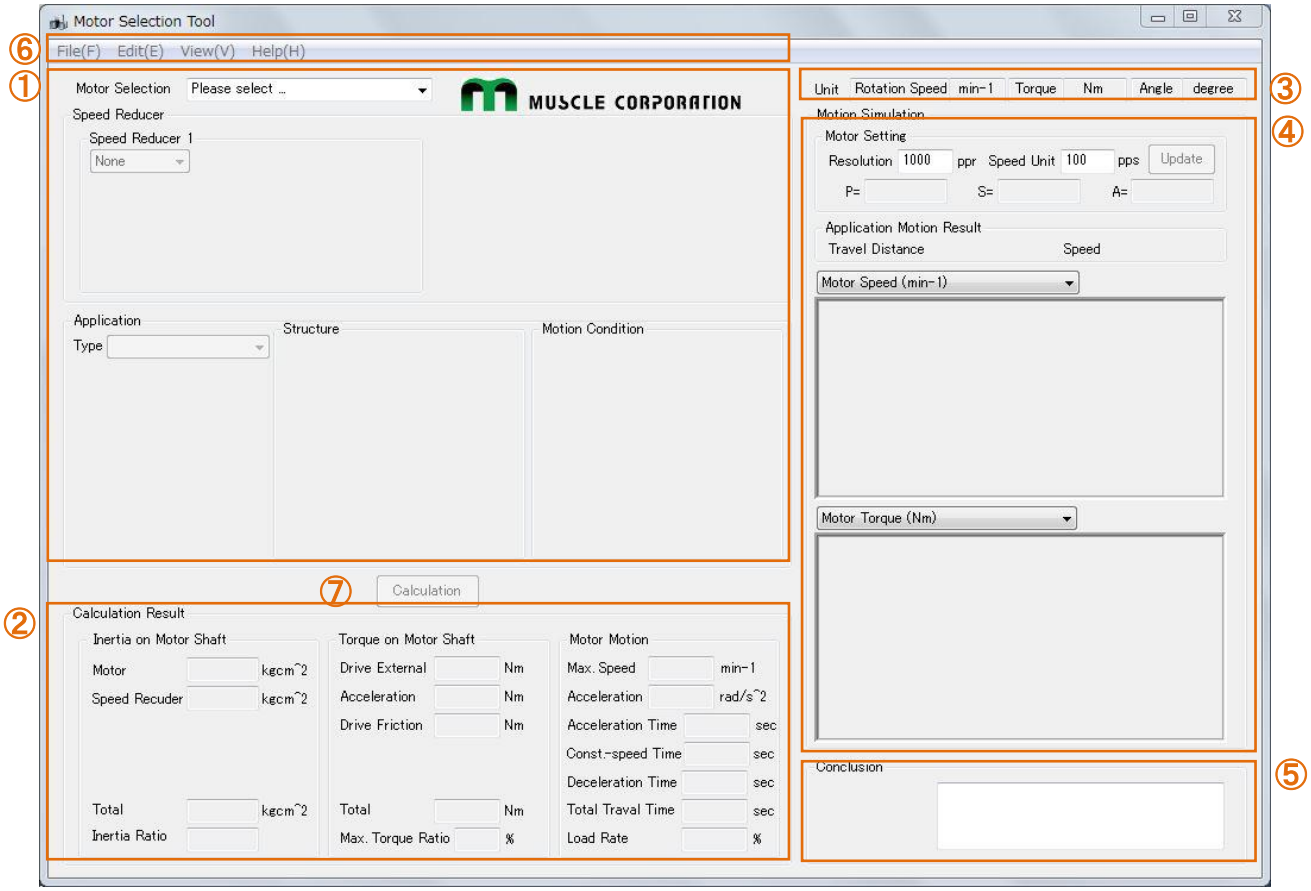
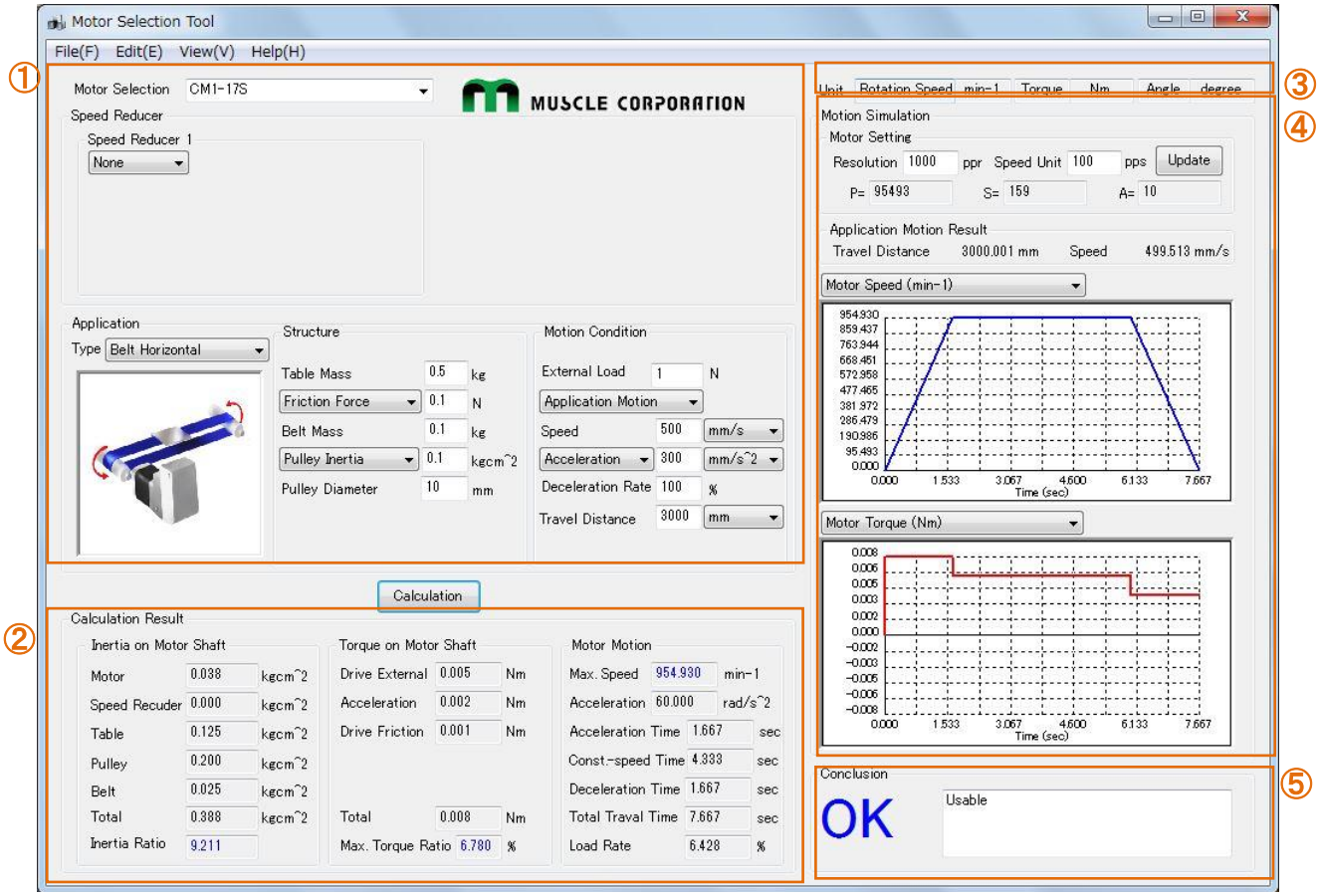


Fig 2.1

Operation Steps:

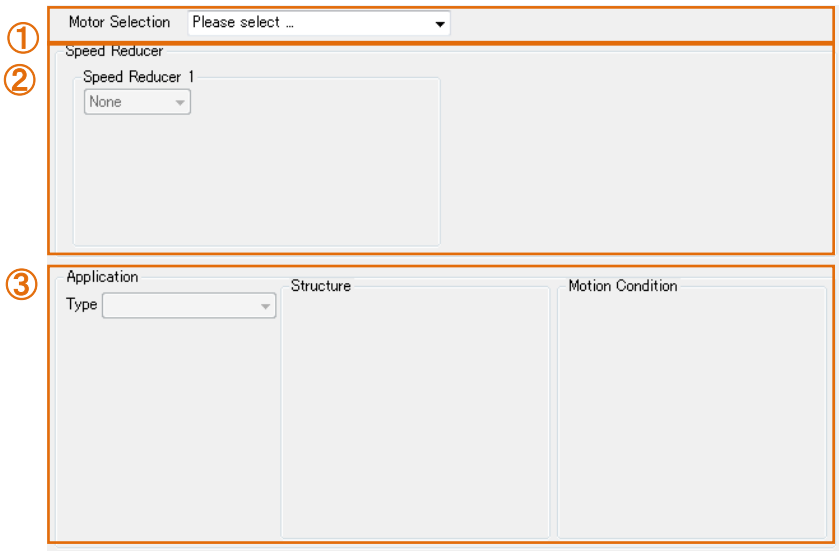
① Enter the calculation data.
After all necessary data have been entered, the Calculation button will be available.
⑦ Click the Calculation button.
② The calculation result will be displayed.
The units of the result are displayed in the ③Data Unit Display.
④ The motor setting data and motion simulation result will be displayed and graphed.
⑤ The motor usable conclusion will be displayed.

Example:



① Data Input
② Calculation Result
③ Data Unit Display
④ Motion Simulation
⑤ Conclusion

2.1 Data Input



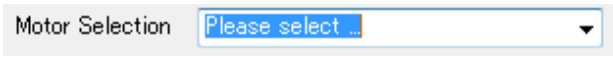
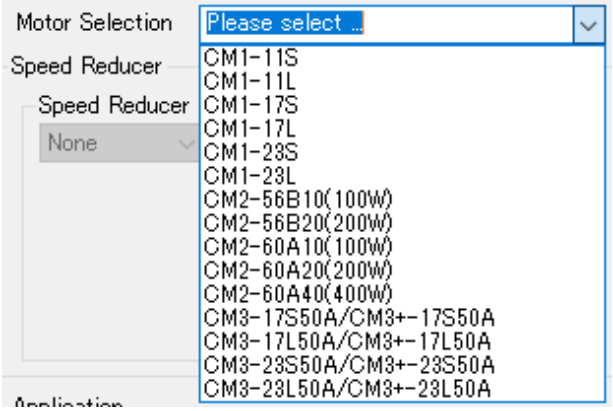
The composition of the Data Input :

① Motor Selection
Select the Cool Muscle motor
(Refer to 2.1.1 Motor Selection)

② Speed Reducer
Select from [None/Gear/Pulley] in Speed Reducer 1 & 2, and input the related data
(Refer to 2.1.2 Speed Reducer Selection)

③ Application
Select the type of application and input related data
(Refer to 2.1.3 Application Selection)

2.1.1 Motor Selection

Display	Operation
	Initial display when starting the software.
	Click the ▾ to display all Cool Muscle motors. Select one of the Cool Muscle motors by clicking on it. After selection, ②Speed Reducer and ③Application will be available.

2.1.2 Speed Reducer Selection

There are three cases in choosing speed reducers:

- No speed reducer
- One speed reducer
- Two speed reducers

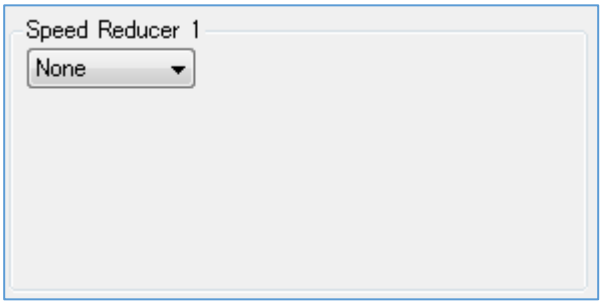
When select to use one or two speed reducers, there are two types of selectable speed reducers:

- Gear
- Pulley

The following steps describe the window operation and necessary data entry:

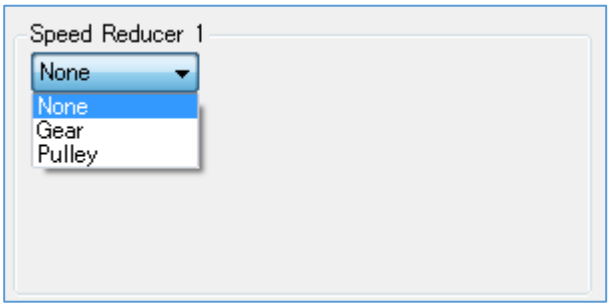
*1. Please use numeric characters in all inputs. If only alphabetic characters are entered,it will be recognized as 0. If both alphabetic and numeric characters are entered, the alphabetic characters will be ignored.
*2. When one or two speed reducers are selected, the necessary inputs are Input Reducing Ratio, Output Reducing Ration, and Efficiency.
*3. The Calculation button will not be available until all necessary data have been input.
*4. If other unnecessary inputs remain blank, they will be recognized as 0s when calculated.

1) No speed reducer:



Motor Selection Tool starts with the Speed Reducer 1 as [None] and no other inputs available.

2) Single speed reducer:



Please select a sort of the first speed reducer, “Gear” or “Pulley”, from the pulldown menu.

After selecting the first speed reducer, “Speed Reducer 2” will be selectable.

Gear

When “Gear” is selected, the following data have to be entered. (Fig 2.1)

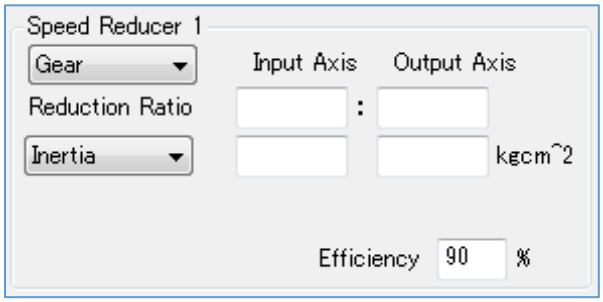


Fig 2.1: “Gear” and “Inertia” selected.

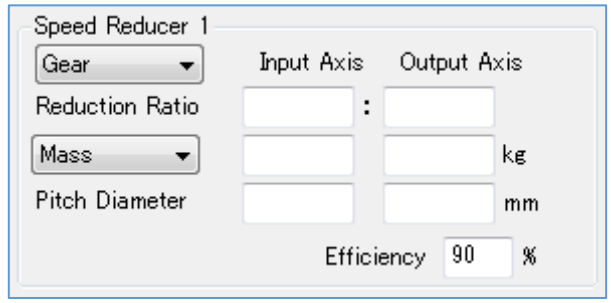


Fig 2.2: “Gear” and “Mass” selected.

Gear Ratio

Please enter Gear Reduction Ratio on both Input Axis and Output Axis. When the Reduction Rate is 3, for instance, put “1” on the input axis side, and “3” on the output axis side. In this case, output torque would be 3 times larger, and Gear Ratio and rotation speed of the output shaft would be the following.

$$Gear\ Ratio = \frac{1}{Gear\ Reduction\ Ratio} = \frac{1}{3}$$

Inertia

One of Input Axis Inertia or Output Axis Inertia should be filled up. Input Axis Inertia is Gear’s inertia which is usually shown in input moment of inertia in gear specification. The number entered tends to be low as 0, so that when using small gear, you can leave this blank with no number.

Note: If moment of inertia is not available, please enter the mass and pulley diameter of a gear train.

Mass/Pitch Diameter

Either one of Input Axis Inertia or Output Axis mass should be filled up. Input Axis mass is Gear’s mass of input axis. Output Axis mass is Gear’s mass in output axis. The inertias of Input and Output Axes are calculated by the mass and diameter defined here.

Efficiency

The efficiency when using gear. You can set a suitable number along with your safety margin in relation with mechanical configuration

Pulley

When the [Pulley] is selected, please enter the following data.

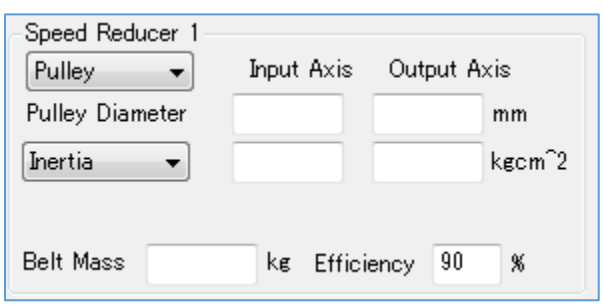


Fig 2.3: “Pulley” and “Inertia” selected.

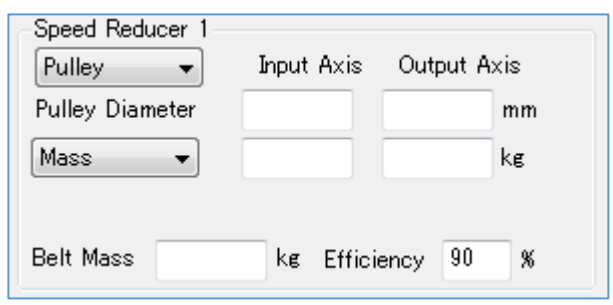


Fig 2.4: “Pulley” and “Mass” selected.

Pulley Diameter

If diameters of input and output are the same, leave this window as blank and go to " Belt Horizontal" or "Belt Vertical".

Inertia

The inertia of pulley mounted on motor shaft and mechanical side.

Note: If moment of inertia is not available, please enter the mass and pulley diameter of a gear train.

Mass

The weight of pulley mounted on motor shaft and mechanical side.

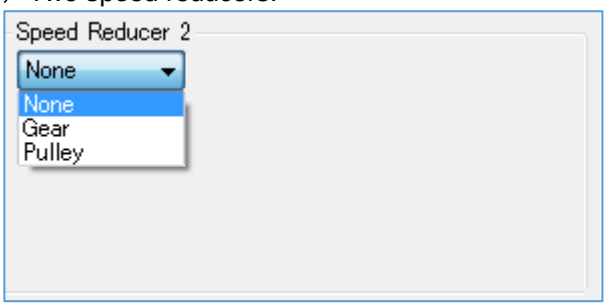
Belt Mass

Weight of belt put on pulleys on motor shaft & the shaft at the other end. Data should be referred to Belt specification from belt manufacturer.

Efficiency

The efficiency when using pulleys. You can set a suitable number along with your safety margin in relation with mechanical configuration.

3）Two speed reducers:



Please select a sort of the first speed reducer, "Gear" or "Pulley", from the pulldown menu.

After selecting the first speed reducer, "Speed Reducer 2" will be selectable.

Note: If moment of inertia is not available, please enter mass and pitch diameter. (Fig. 2.6)

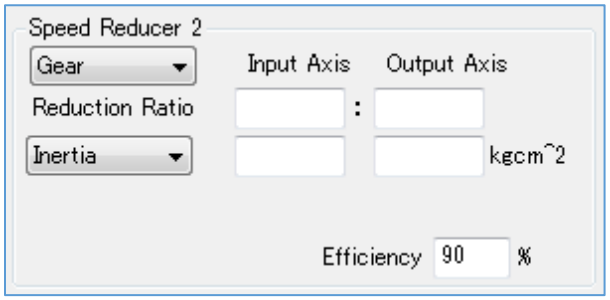


Fig 2.5: "Gear" and "Inertia" selected.

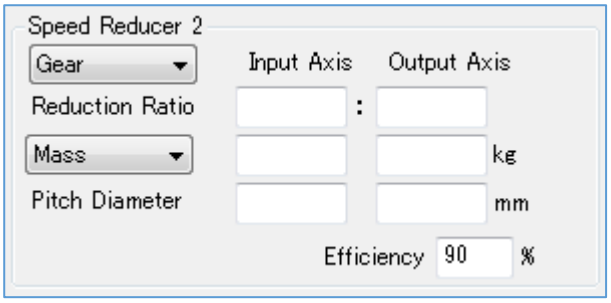


Fig 2.6: "Gear" and "Mass" selected.

Note: If moment of inertia of pulley is not available, mass of pulley should be filled out.

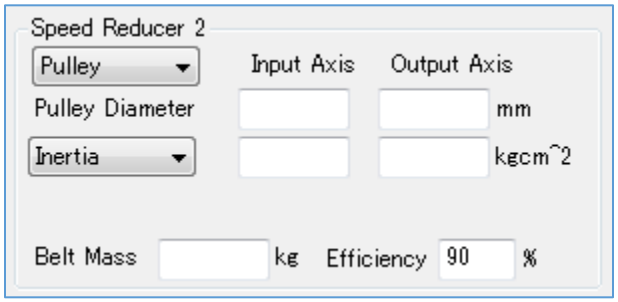


Fig 2.7: "Pulley" and "Inertia" selected.

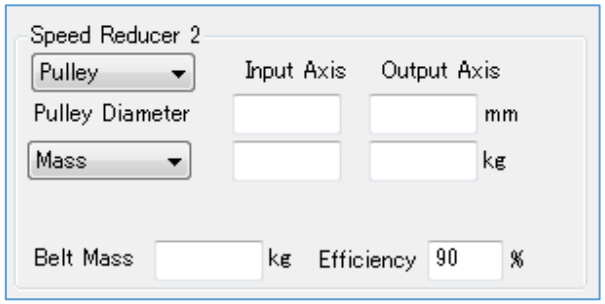


Fig 2.8: "Pulley" and "Mass" selected.

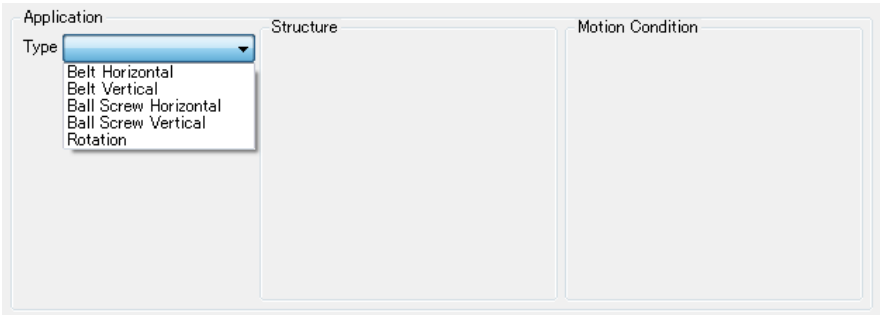
2.1.3 Application Selection

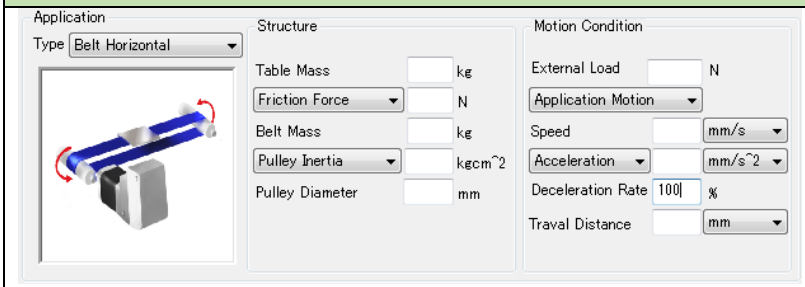
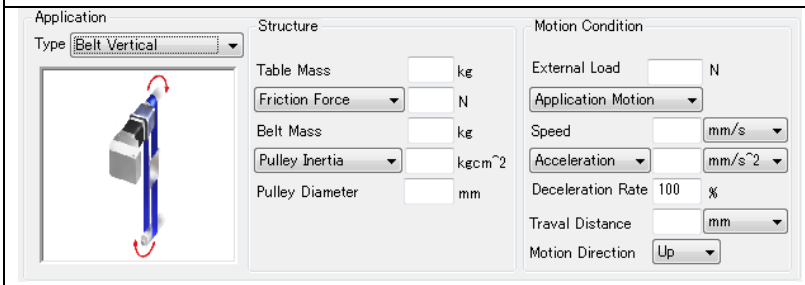
There are 5 selectable applications:

- Belt Horizontal
- Belt Vertical
- Ball Screw Horizontal
- Ball Screw Vertical
- Rotation

*1. Please use numeric characters in all inputs.If only alphabetic characters are entered, it will be recognized as 0.If both alphabetic and numeric characters are entered, the alphabetic characters will be ignored.
*2. The Calculation button will not be available until all necessary data have been input.
*3. If other unnecessary inputs remain blank, they will be recognized as 0s when calculated.

Table 2.1: the necessary inputs when select one of the applications

Display	Operation
	Motor Selection Tool starts with no application displayed. Click ▾ in Type and select one from the displayed application list.

Belt	
	When Belt Horizontal is selected, the related inputs are displayed.
	When Belt Vertical is selected, the related inputs are displayed.

Additional details for application type "Belt Horizontal" and "Belt Vertical".

Structure

Table Mass

Total mass (unit: kg) of table and work load.

Friction / Friction Coefficient

The constant Friction Force (unit: N) exerted in the table. You can select Friction coefficient (no unit) between the table and driver system instead of the friction force. The friction force is calculated by the weight of the Table * Friction coefficient.

Pulley Specific Gravity (Sp. Gr.) / Pulley Diameter / Pulley Length

If pulley inertia (unit: kgcm^2) is not available, please fill in the Pulley Specific Gravity (no unit), such as Aluminum = 2.7 and Steel = 7.87, Pulley Diameter (unit: mm), and Pulley Length (unit: mm).

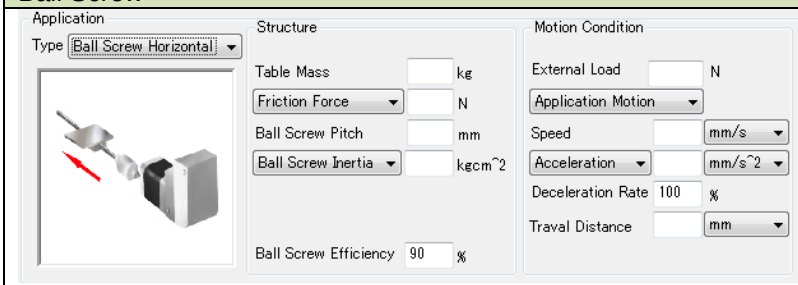
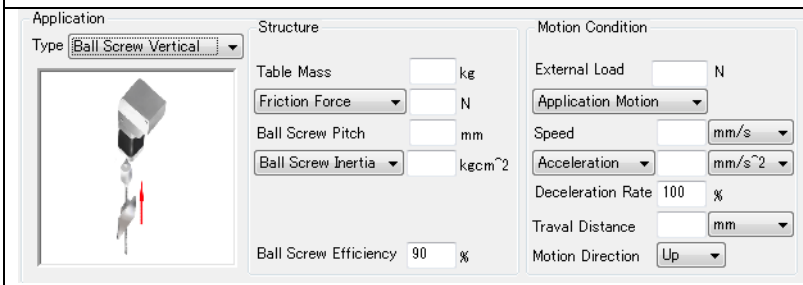
Motion Condition

External Load

The force applied to work and table (unit: N).

Application Motion / Motor Motion

Choose Application Motion or Motor Motion to set units to the following data.

Ball Screw	
	When Ball Screw Horizontal is selected, the related inputs are displayed.
	When Ball Screw Vertical is selected, the related inputs are displayed.

Additional details for application type "Belt Horizontal" and "Belt Vertical".

Structure

Table Mass

Total mass of table and work load (unit: kg).

Friction / Friction Coefficient

The constant Friction Force exerted in the table (unit: N). You can select Friction coefficient (no unit) between the table and driver system instead of the friction force. The friction force is calculated by the weight of the Table * Friction coefficient.

Ball Screw Mass / Ball Screw Specific Gravity (Sp. Gr.)

If Ball Screw Inertia is not available, please fill in the Ball Screw Mass (unit: kg) and Diameter (unit: mm), or the Ball Screw Specific Gravity (no unit), Diameter (unit: mm), and Length (unit: mm).

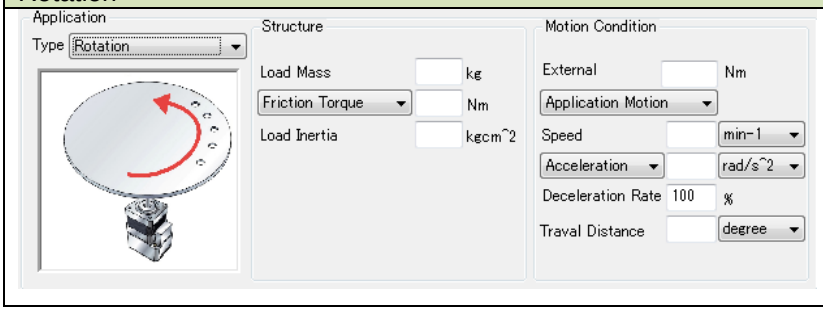
Motion Condition

External Load

The force applied to work or table (unit: N).

Application Motion / Motor Motion

Choose Application Motion or Motor Motion to set units to the following data.

Rotation	
	When Rotation is selected, the related inputs are displayed.

Additional details for application type "Belt Horizontal" and "Belt Vertical".

Structure

Load Mass

Total mass (unit: kg) of table and work load.

Friction Torque

The constant Friction Torque (unit: Nm) to slow down the table

Motion Condition

External Load

The force applied to work and table (unit: N).

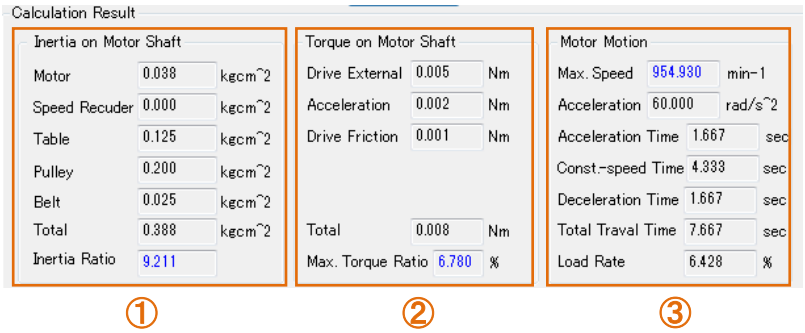
Application Motion / Motor Motion

Choose Application Motion or Motor Motion to set units to the following data.

2.2 Calculation Result Display

The calculation result will be displayed after all data in the necessary inputs of Speed Reducers and Application have been entered then click the Calculation button.

Example:



The composition of Calculation Result:

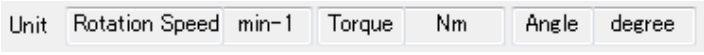
① Inertia on Motor Shaft
Display inertia on Motor Shaft

② Torque on Motor Shaft
Display torque on Motor Shaft

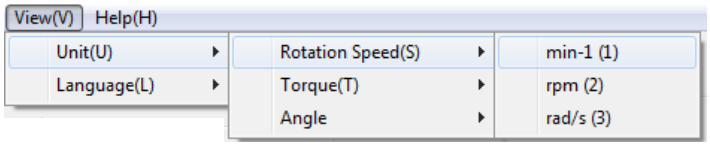
③ Motor Motion
Display motion data

2.3 Data Unit Display

Data Unit Display shows the units of rotation speed, torque, and angle and reflects them in the units for inputs and calculation results.



Ex. Rotation speed unit: min-1,
Torque unit: Nm,
Angle unit: degree.



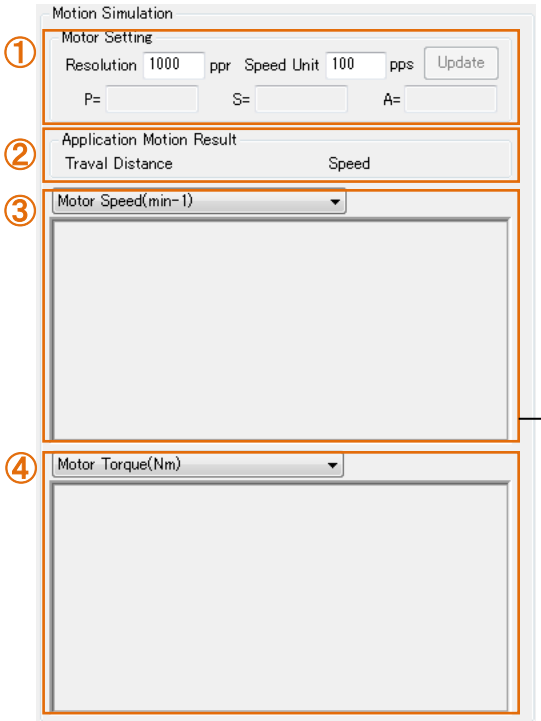
The display unit can be changed in menu bar
(Refer to Chapter3 Menuu Bar)

2.4 Motion Simulation

After clicking the Calculation button, the motion simulation result will be displayed and graphed.
The composition of the Simulation Result:

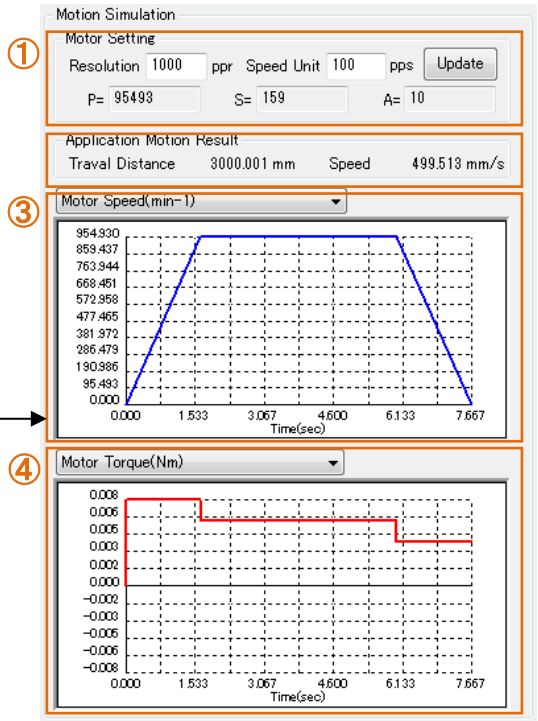
① Motor setting data display
② Application motion result display
③ Motor speed graph
④ Motor torque graph

Before Calculation

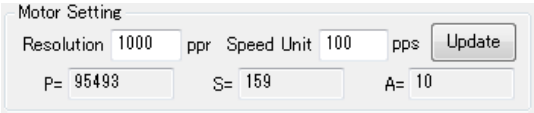


Click the Calculation button

After Calculation



2.4.1 Motor Setting Data Display



After clicking the Calculation button, Motor Setting data such as P (Position), S (Speed), A (Acceleration) are calculated according to the Resolution and Speed Unit. The result are displayed in P, S, A respectively.

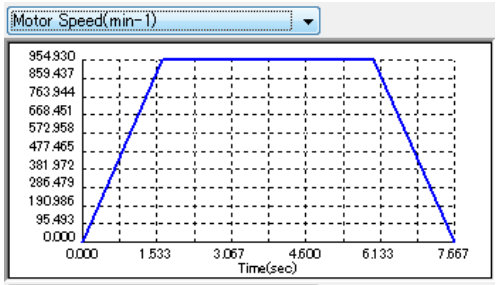
At this time, the Update button becomes available. If the Resolution or Speed Unit is changed, then the P, S, A data can be recalculated according to the new Resolution and Speed Unit by clicking the Update button.

2.4.2 Application Motion Result Display

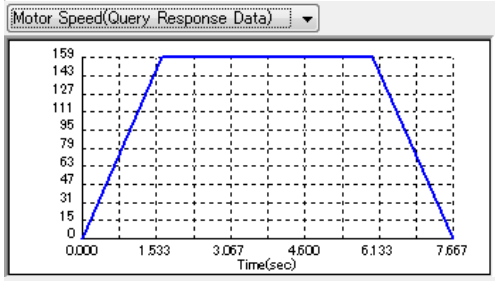
After clicking the Calculation button, the real travel distance and speed are calculated and displayed.

2.4.3 Motor Speed Graph

Motor Speed Graph plots the result of the motor motion's speed simulation after the Calculation button is clicked. The data displayed on the Y axis has 3 selections:

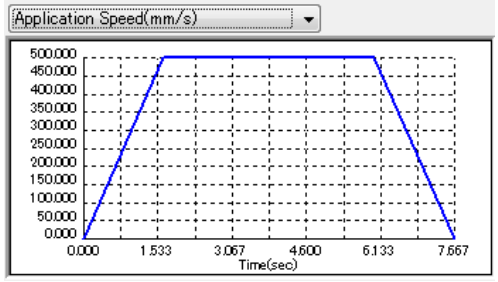


This graph is the result when Y axis is selected to display motor speed (min-1)



This graph is the result when Y axis is selected to display motor speed (Query Response Data).

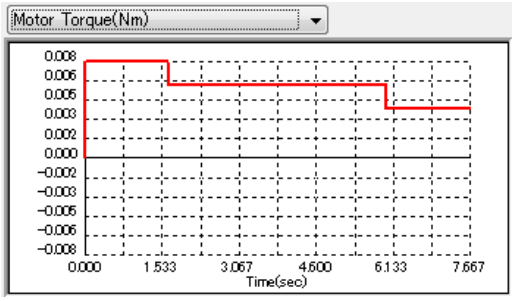
* Motor speed (Query Response Data) is the responded Sx value when use ?97 to query current speed.



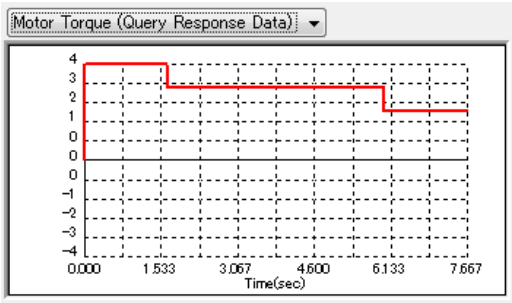
This graph is the result when Y axis is selected to display application speed (mm/s).

2.4.4 Motor Torque Graph

Motor Torque Graph plots the result of the motor motion's torque simulation after the Calculation button is clicked. The data display for the Y axis has 2 selections:



This graph is the result when Y axis is selected to display motor torque (Nm).

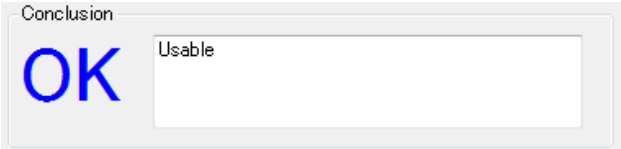


This graph is the result when Y axis is selected to display motor torque (Query Response Data).

* Motor torque (Query Response Data) is the responded Ix value when use ?98 to query current torque.

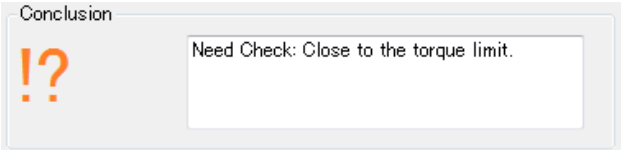
2.5 Motor Usable Conclusion Display

After clicking the Calculation button, the conclusion on the usability of the selected motor is displayed in the Conclusion panel. The conclusion comes from the calculation result of inertia on motor shaft, torque on motor shaft, and motor motion.



When the selected motor is determined to be usable, **[OK]** will be displayed in the Motor Usable Conclusion.

When the selected motor is determined to be unusable, **[NG]** and suggestions will be displayed.



When the selected motor is determined to be [Need Check], **[!?]** will be displayed and the reasons will be described in the Conclusion panel.
[!?] means the selected motor is usable according to the calculation results but is close to the motor limitation. Then, it should be confirmed if the selected motor works properly under disturbances and variations.

Checking Rules:

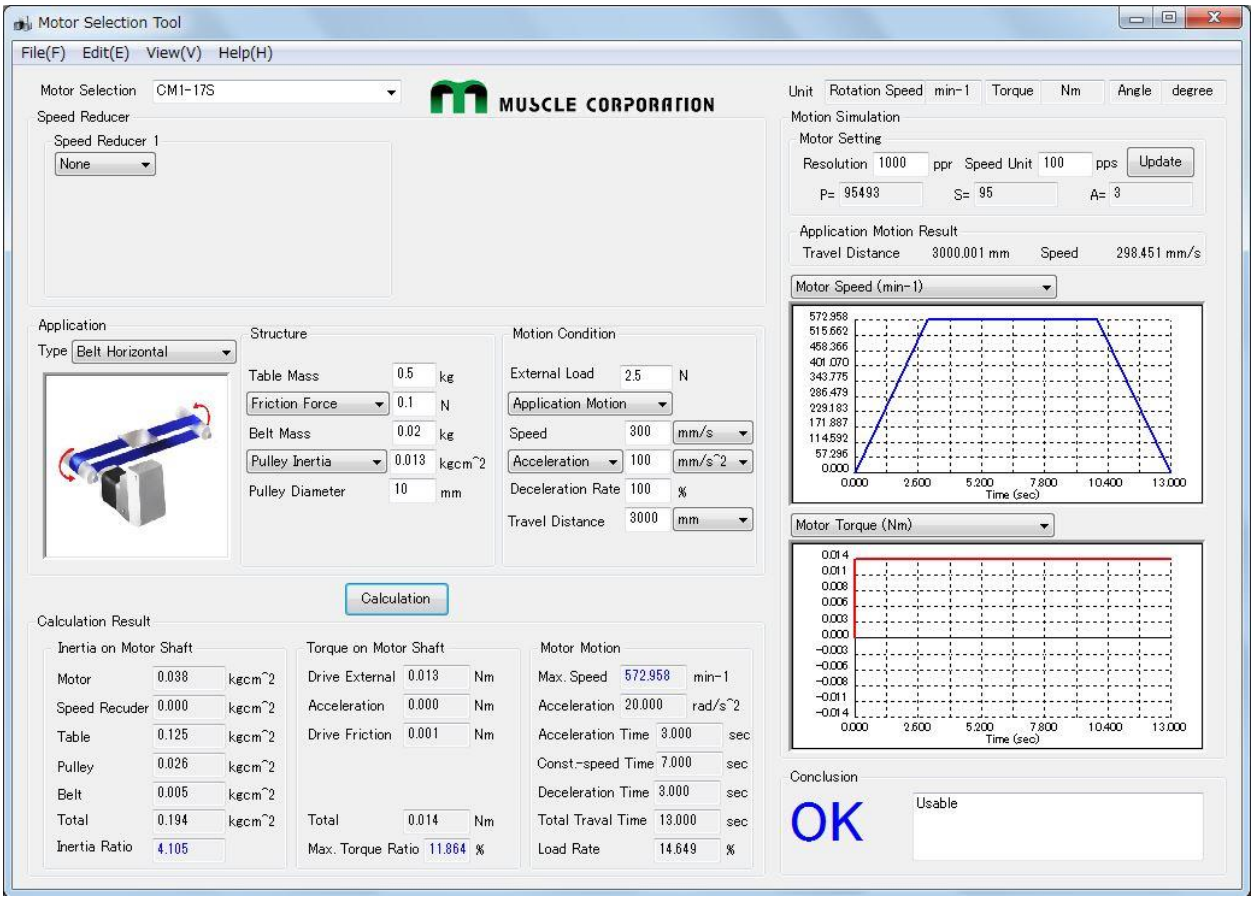
Calculation Result	Conclusion
Inertia Ratio ≤ 10 and Max. Speed ≤ Selected motor's allowable Max. speed and Max. Torque Ratio ≤ 75%	**OK**
Inertia Ratio ≤ 10 and Max. Speed ≤ Selected motor's allowable Max. speed and Max. Torque Ratio > 75% and Max. Torque Ratio ≤ 100%	**!?** Need Check: Close to the torque limit
Inertia Ratio > 10	**NG** Unusable: Please reduce the load inertia.
Max. Speed > Selected motor's allowable Max. speed	**NG** Unusable: Please reduce the maximum speed.
Max. Torque Ratio > 100%	**NG** Unusable: Please reduce the load torque.

2.6 Application Examples

2.6.1 Belt Horizontal

The calculation example of the below condition.

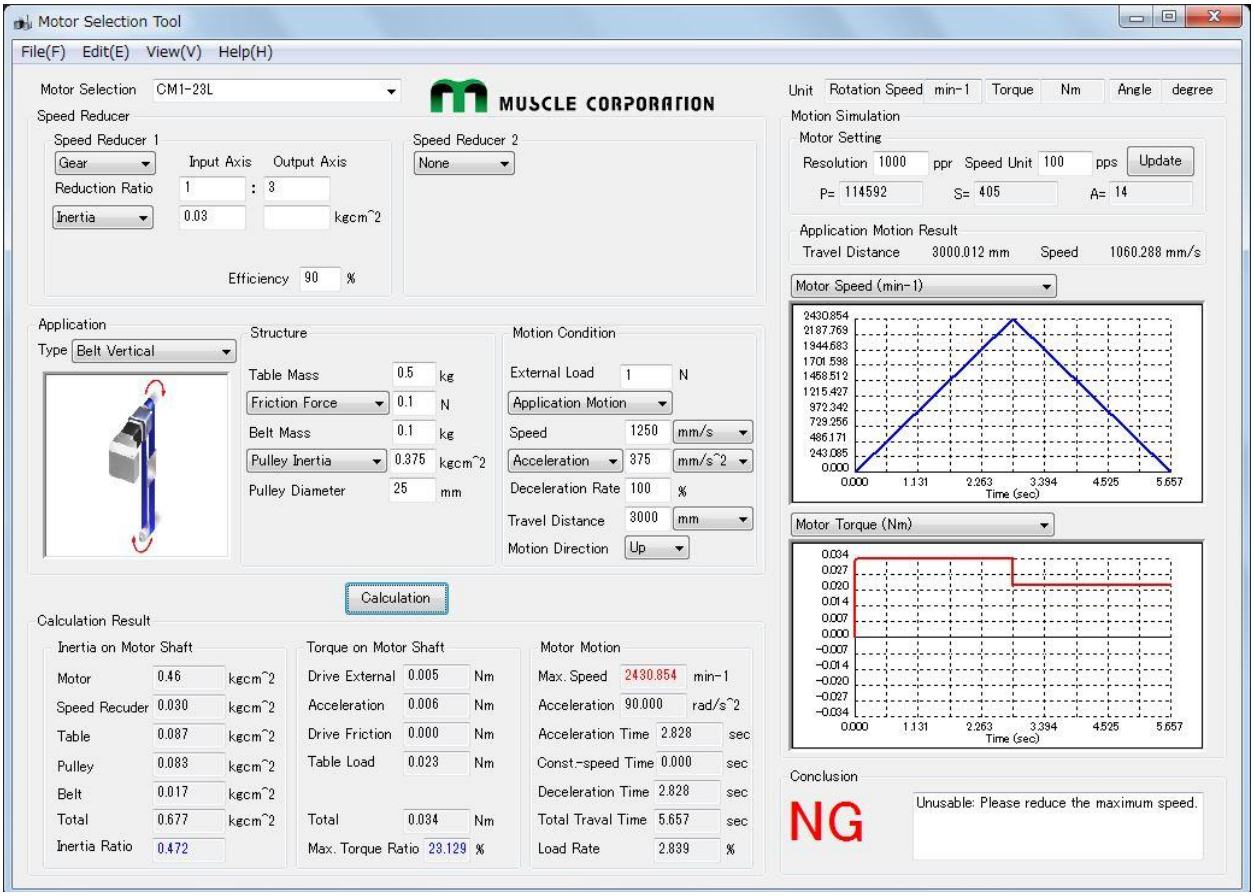
Motor: CM1-17S
Speed Reducer: None
Application: Belt Horizontal



2.6.2 Belt Vertical

The calculation example of the below condition.

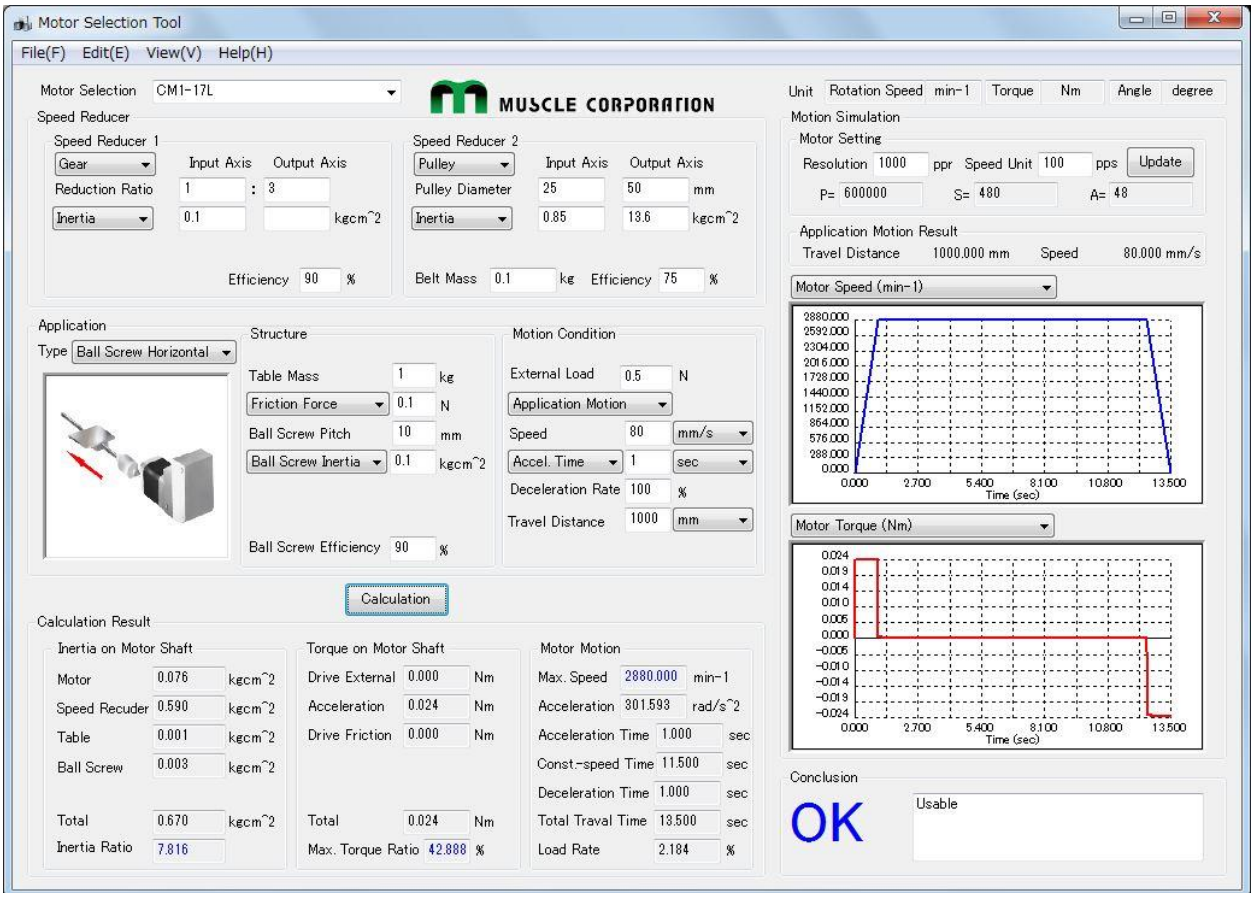
Motor Selection: CM1-23L
Speed Reducer 1: Gear
Application: Belt Vertical



2.6.3 Ball Screw Horizontal

The calculation example of the below condition.

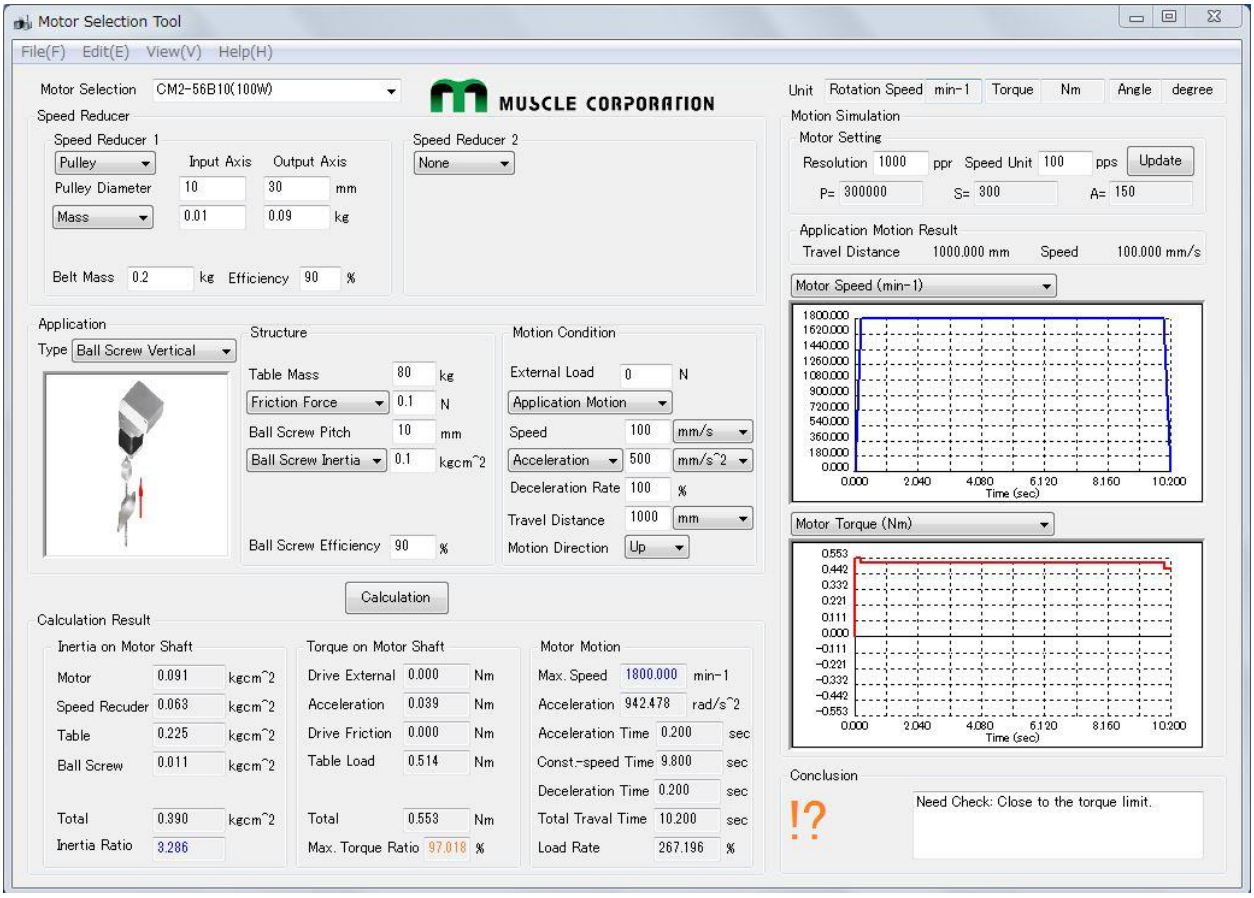
Motor Selection: CM1-17L
Speed Reducer 1: Gear
Speed Reducer 2: Pulley
Application: Ball Screw Horizontal



2.6.4 Ball Screw Vertical

The calculation example of the below condition.

Motor Selection: CM2-56B10 (100W)
Speed Reducer 1: Pulley,
Application: Ball Screw Vertical



2.6.5 Rotation

The calculation example of the below condition.

Motor Selection: CM2-60A40 (400W)
Speed Reducer 1: Pulley,
Speed Reducer 2: Gear
Application: Rotation

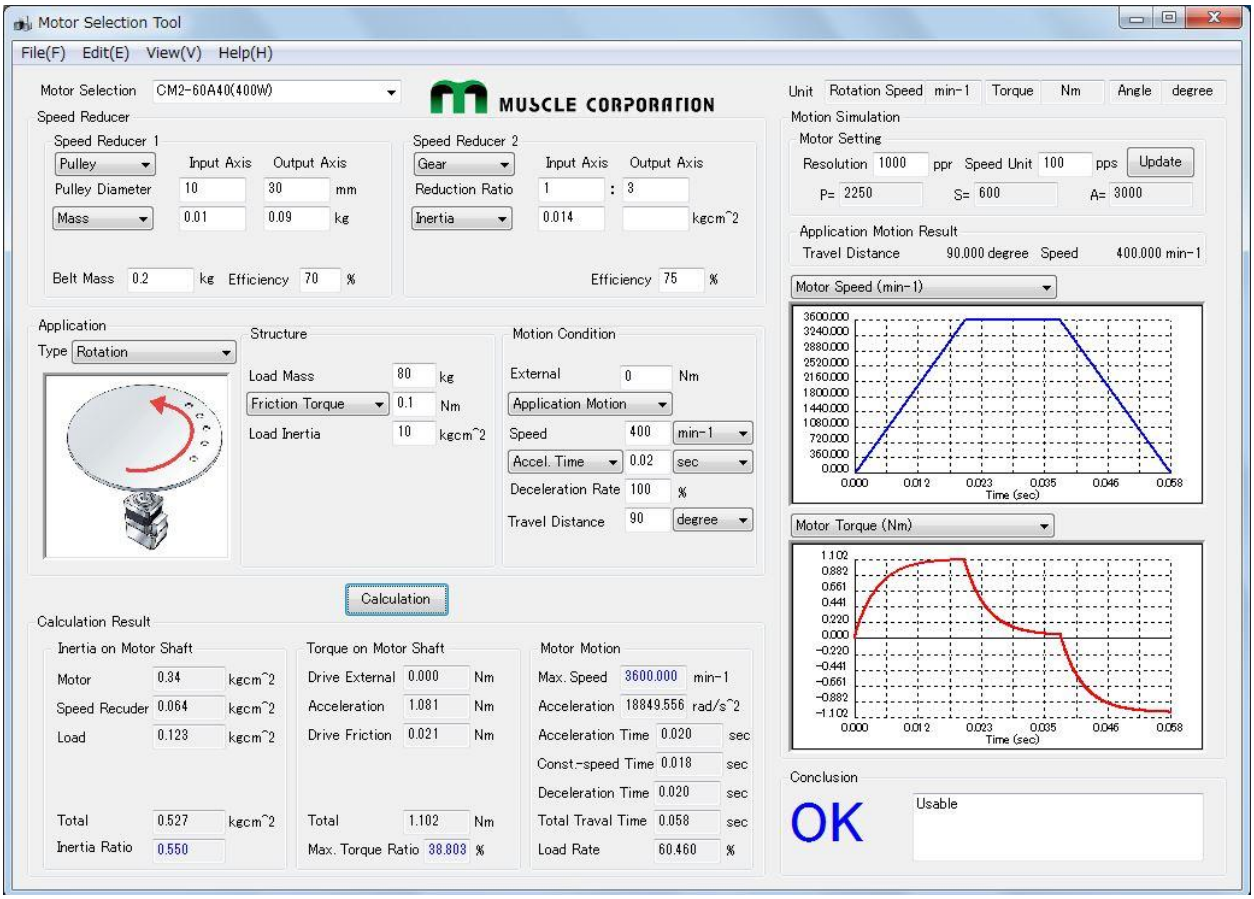
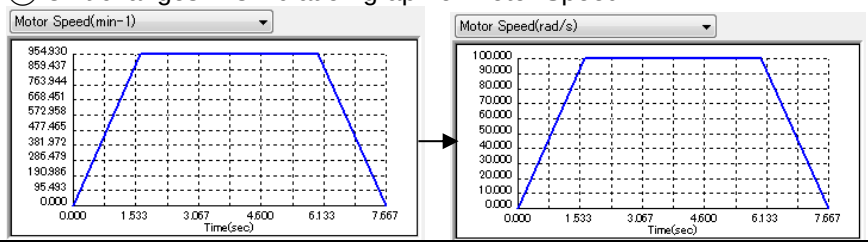


Table3.1

Menu	Item Name	Description
File	Open	Open a selected file
	Save	Save all data on the current form into the current opened file
	Save As	Save all data on the current form into a new file
	Print	Print the current form
	Exit	Close Motor Selection Tool
Edit	Cut	Cut the selected data
	Copy	Copy the selected data
	Paste	Paste the contents on the clipboard
	Delete	Delete the selected data
View	Unit	Define the unit of the display data Unit ─ Rotation Speed ─ min-1, rpm, rad/s } Define the unit of Rotation Speed Unit ─ Torque ─ Nm, kgfcm } Define the unit of Torque Unit ─ Angle ─ degree, rad } Define the unit of Angle When one of the units is changed: ① If the unit is used in the Calculation Result, change the unit and recalculate the related data according to the new unit. ② Change the unit in the Data Unit Display ③ If the unit is used in the simulation graph (Motor Speed or Motor Torque), change the unit in the graph. Example: When change the unit of Rotation Speed from min-1 to rad/s, the changes on the form are as follows: ① Unit changes in the Calculation Result Panel Motor Motion: Max. Speed 954.930 min-1 → Motor Motion: Max. Speed 100.000 rad/s ② Unit changes in the Data Unit Display Panel Unit | Rotation Speed | min-1 | Torque | Nm | Angle | degree ↓ Unit | Rotation Speed | rad/s | Torque | Nm | Angle | degree

Table3.1 Continued

Menu	Item Name	Description
View	Unit	③ Unit changes in simulation graph of Motor Speed 
	Language	Select language from Japanese and English
Help	Help	Open this User's Guide
	About Motor Selection Tool	Display the version information of Motor Selection Tool

Chapter 4 Revision History

Document No.	Date	Revised Page	Revised Content
MDUG-MST/11601E-01 Rev.1	2011,6,1		New Documentation.
MDUG-MST/14501E-01 Rev.1	2014,5,1	Page.5	Add new type in Motor Selection list: CM2-60A20 (200W).
MDUG-MST/15501E-01 Rev.1	2015,5,1	Page.1	Compatible OS changed to Windows 7 and 8.
		Page.7 – 12	Description for input data added.
		Page.18 – 22	Input data values changed.
MDUG-MST/17301E-01 Rev.1	2017,1,5	Page.2 – 5 Page.18 – 22	Muscle official logo changed
MDUG-MST/20831E-01 Rev.1	2020,8,31	Page.1	Compatible OS: Windows 10
		Page.5	Add new type in Motor Selection list: CM3 and CM3+