MITSUBISHI

General-Purpose AC Servo

MELSERVO

Capacity Selection Software

MRZJW3-MOTSZ71E

Installation Guide

Thank you for choosing the Mitsubishi general-purpose AC servo MELSERVO capacity selection software.
To optimize the use of the capacity selection software, please read over this Installation Guide before using the software. After reading the Installation Guide, always place it in a safe place.

MITSUBISHI ELECTRIC D

● Safety Instructions ●

(Always read these instructions before using the equipment.)

Do not attempt to install, operate, maintain or inspect the servo amplifier and servo motor until you have read through this Installation Guide, and appended documents carefully and can use the equipment correctly. Do not use the servo amplifier and servo motor until you have a full knowledge of the equipment, safety information and instructions.
In this Installation Guide, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠ WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury to personnel or may cause physical damage.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.
What must not be done and what must be done are indicated by the following diagrammatic symbols:

⃠: Indicates what must not be done. For example, "No Fire" is indicated by ⃠ .
●: Indicates what must be done. For example, grounding is indicated by ⏚ .

In this Installation Guide, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".
After reading this Installation Guide, always keep it accessible to the operator.

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⚠ CAUTION	The capacity selection software is designed to perform operations according to the calculation formulas given in Chapter 4 and Mitsubishi does not guarantee its capacity selection results. Please determine whether those calculation formulas are suitable for your machine or not, and make the final capacity decision on your side, e.g. provide allowances for the calculation results.

MEMO

CONTENTS

1. INTRODUCTION

1.1 Specifications

The capacity selection software is designed to properly select the capacity of a servo motor required for machine structure. By entering the specifications data of the machine used, the servo amplifier series and the servo motor series, the software selects the optimum capacity of the servo motor.

Combination of Servo Amplifier and Servo Motor

Servo Motor Series	Servo Amplifier Series										
	FCUA -MP10	MR-C	MR-J-A	MR-J-B	MR-J2-03A5 MR-J2-03C5	MR-J2-A MR-J2-B MR-J2-C	MR-H-AN MR-H-BN MR-H-ACN MR-H-TN	MR-H-AN4 MR-H-BN4 MR-H-ACN4 MR-H-TN4	MR-J2S-A MR-J2S-B	MR-J2-C-S100	MR-H-DN4
HA-ME	○		○								
HA-FE	○		○								
HA-SE	○		○								
HA-MH				○			○				
HA-FH				○			○				
HA-SH				○			○				
HA-LH							○				
HA-UH							○				
HC-PQ		○									
HC-MF						○	○			○	
HA-FF						○	○			○	
HC-SF						○	○			○	
HC-RF						○	○			○	
HC-UF						○	○			○	
HC-KF						○	○			○	
HC-AQ					○						
HA-LF							○	○			
HC-MFS									○		
HC-KFS									○		
HC-SFS									○		
HC-RFS									○		
HC-UFS									○		
HR115											○
HR142											○

Specifications List

Item		Specifications
Model		MRZJW3-MOTSZ71E
Machine component		9 types: ballscrew (horizontal), ballscrew (vertical), rack and pinion, roll feed, rotary table, cart, elevator, conveyor, generic (direct inertia input)
Result output	Item	Selected servo amplifier type, selected servo motor type, selected regenerative brake resistor type, load inertia moment, load inertia moment ratio, peak torque ratio, effective torque, effective torque ratio, regenerative power, regenerative power ratio
	Print	Entered specifications, calculation process and selection results are printed.
	Data save	Entered specifications are saved on to a floppy disk with a file name.
Inertia moment and tension calculation function		5 types: cylinder, square block, converted load, linear movement, hanging and tension

1.2 Inspection at delivery

Confirm the following items after unpacking:

Items	Quantity
Floppy disk	2 pcs. (Disks 1, 2)
Installation Guide	1 pc.

1.3 Required system configuration

The following components are required to use the capacity selection software. Configure the system according to the Installation Guide of each equipment:

Model	Description
Personal computer (Note)	Which has 80386 or higher CPU and on which Windows 3.1・95 (English) runs (80486 or higher is recommended). Memory : 8MB or more Hard disk : 4MB or more Floppy disk drive : 1 unit
OS	Windows 3.1・95 (English)
Display	At least 640 × 400, color or 16-scale monochrome display which can be used with Windows 3.1・95 (English)
Keyboard	Which can be connected to the personal computer.
Mouse	Which can be used with Windows 3.1・95 (English).
Printer	Which can be used with Windows 3.1・95 (English).

Note: Some models cannot perform operations given in this Installation Guide.

1.4 Basic terms

1) Mouse pointer
   An on-screen arrow which moves with movements of the mouse.
2) Point
   To move the mouse pointer to a particular item or position on the screen.
3) Click
   To press and release the left button of the mouse once.
4) Double-click
   To press and release the left button of the mouse twice.
5) Drag
   To hold down the left button of the mouse and move the mouse.
6) Focus
   Highlights characters, button or the like when the menu or button is ready to accept an input from the keyboard.
7) Text box
   Box used to enter characters.
8) List box
   Box used to select one of several items.

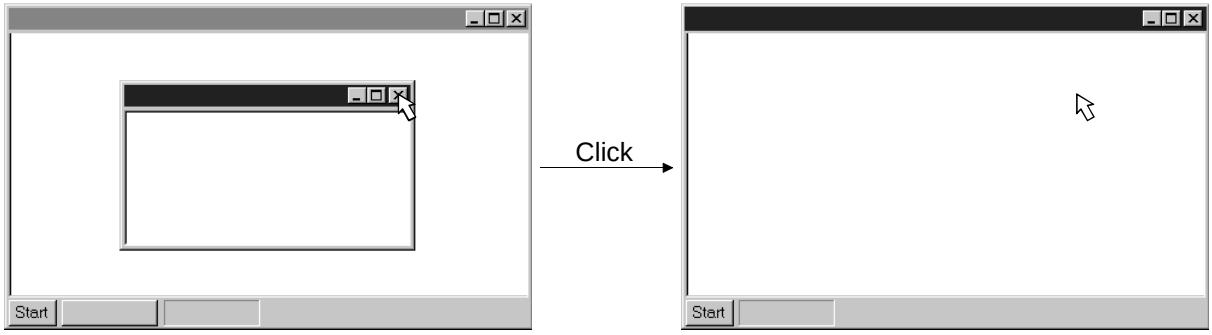
9) Combo box
   Box used to select one of several items.

10) Check box
    Box used to select one or more of several items. When a choice is made a mark appears in the box.
11) Option button
    Button used to select only one of several items. When a choice is changed ◉ moves to a new choice.

1.5 Basic operations

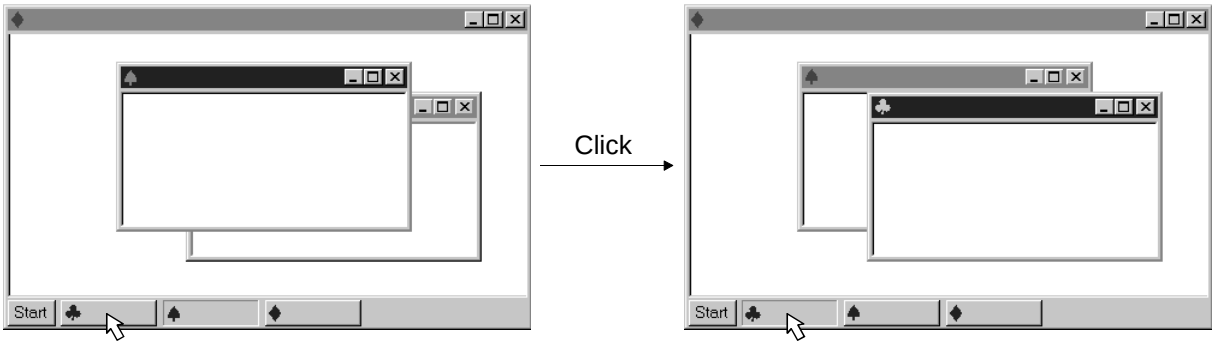
(1) Closing the window

Click the closing bottom at top right corner of the window.



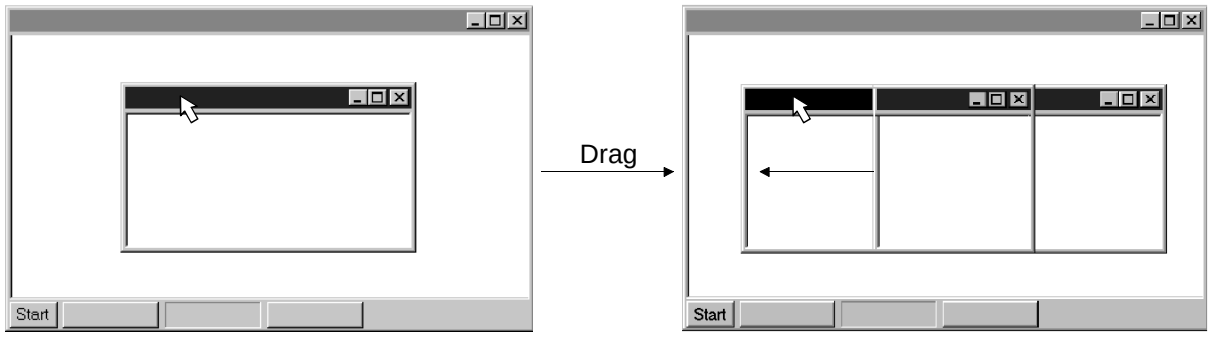
(2) Moving the focus from one window to another

Click the button of the task bar corresponding to the window to be used.



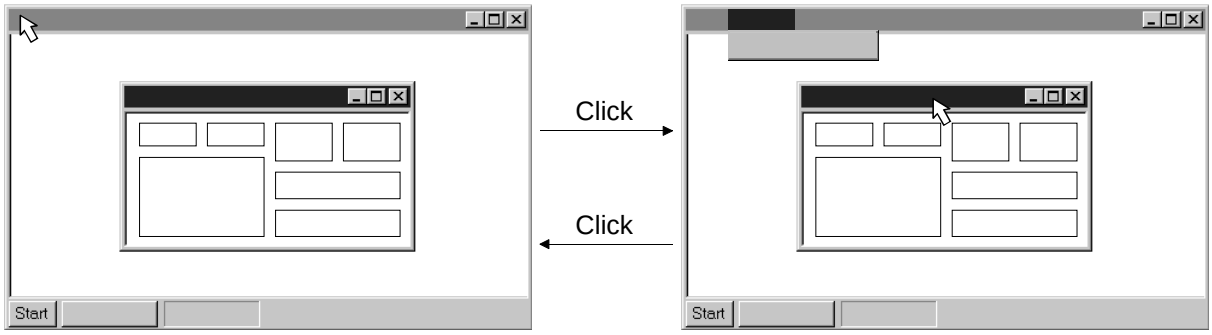
(3) Moving the window

Point to the title bar, drag the window to the required position, and release the button.



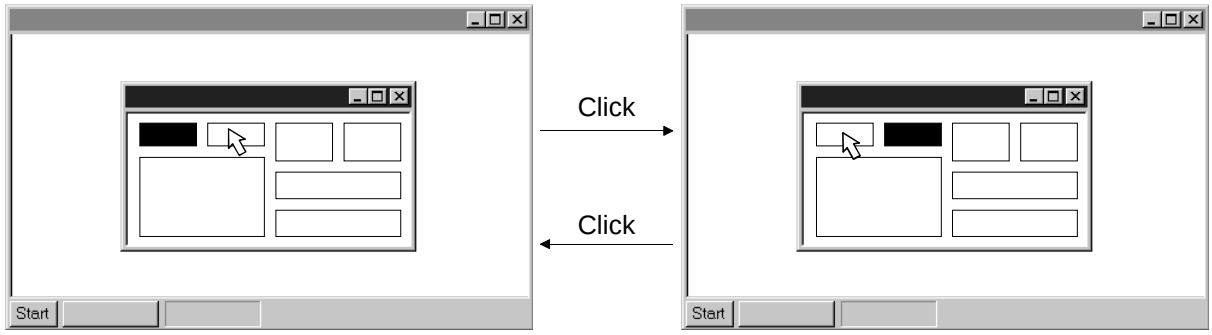
(4) Moving the focus to the menu bar

Click the menu bar. To move the focus to a window, click the window.



(5) Moving the focus inside the window

Click the object to be operated (such as a text box). When the object to be operated is a button, clicking it will start its processing.

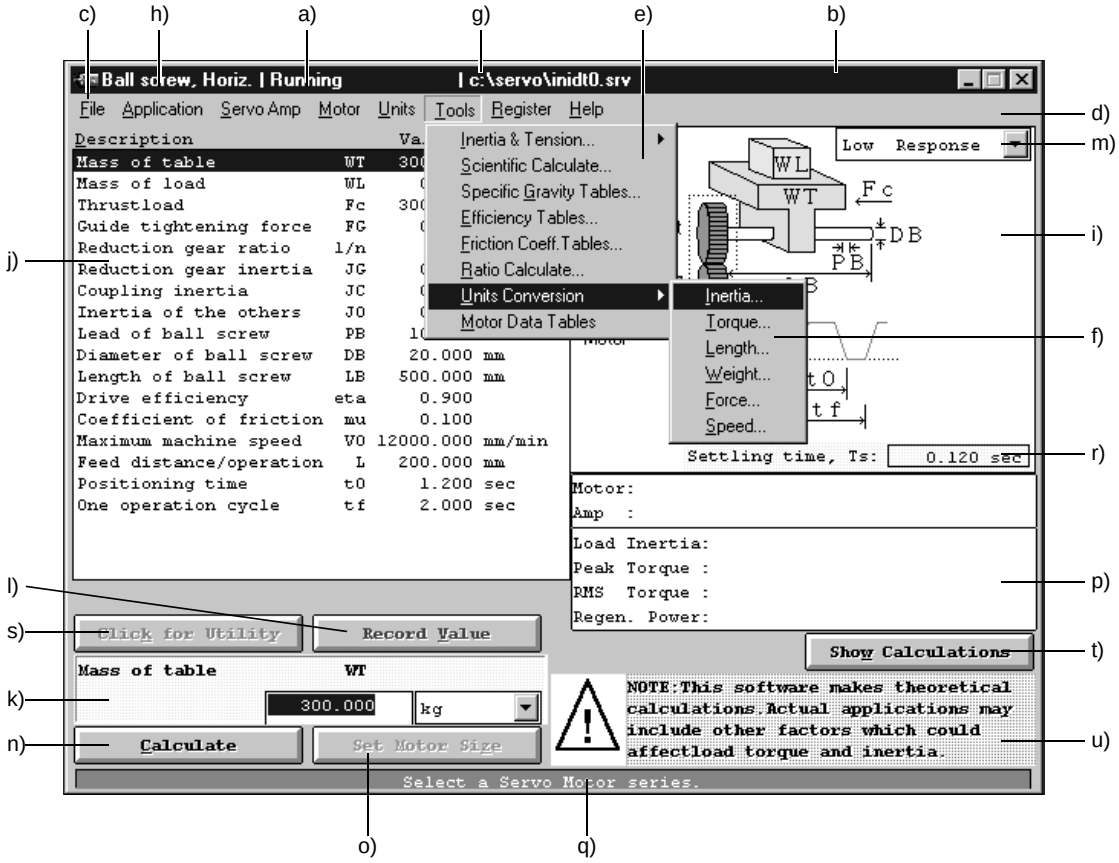


<Short-cut keys>

Any of the following short-cut keys may be used to perform operation from the keyboard:

Intended Operation	Keyboard
Show help	"F1"
End program	"Alt" + "F4"
Show start menu	"Ctrl" + "Esc"
Change window	"Alt" + "Tab"
Change object	"Tab"

1.6 Screen definitions



a) Title
Shows the title which has been set.

b) Title bar

c) Menu title

d) Menu bar
Shows the menu title.

e) Menu
Command menu in tier 1

f) Submenu
Command menu in tier 2

g) File name
Shows the file name being selected.

h) Machine component name
Shows the machine component name selected.

i) Machine structure illustration area
Shows a machine structure diagram.

j) Machine specifications display area
Shows the machine specifications, items and data.

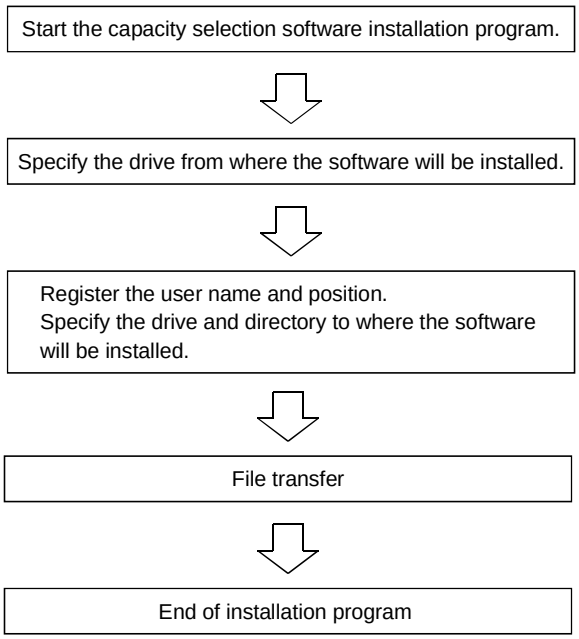
k) Machine specifications entry area
Enter data in machine specifications.

l) Record Value button
Used to set the data entered into the machine specifications display area.

m) Servo response level setting area
Set the servo response level.
n) Calculate button
Click this button to start automatic calculation.
o) Set Motor Size button
Click this button to specify the servo motor capacity before starting calculation.
p) Selection/calculation result display area
Shows the results of selecting the servo motor, servo amplifier and regenerative brake option and the results of calculating load inertia, peak torque, effective torque and regenerative power.
q) Message display area
Shows a comment or error message. This area is normally blue, but turns to red when showing an error message.
r) Settling time (t_s) display area
Shows the settling time (t_s) in the servo response level which has been set.
s) Click for Utility button
While selecting the item in the machine specifications display area, click this button to start the corresponding tool.
t) Show Calculations button
After capacity calculation is over, click this button to show the calculation process.
u) PL law display area
Shows the caution mark and statement in accordance with the PL law.
When the guidance mode is chosen, shows the operation guidance.

1.7 Installation

1.7.1 Installation sequence

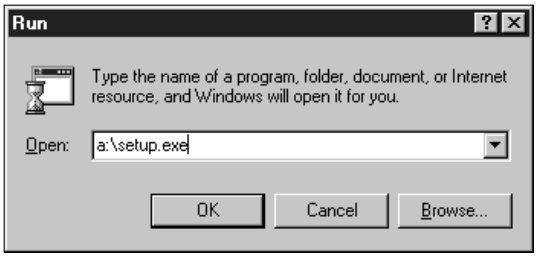


1.7.2 Installation procedure

In this procedure, it is assumed that the hard disk drive of the personal computer is C and the floppy disk drive is A.

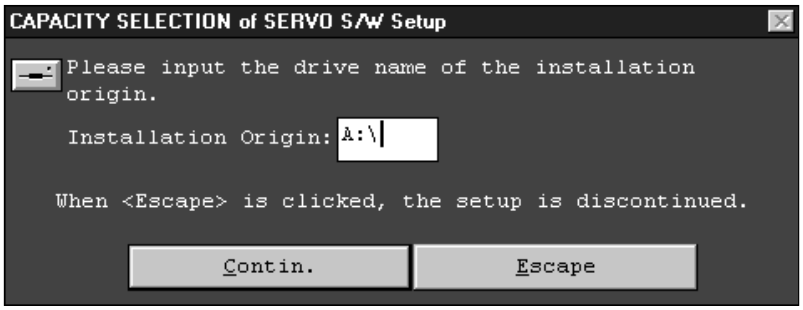
(1) Execution of installation program

1) Insert floppy disk 1 (Disk 1) in Drive A (floppy disk drive).
2) Click the "Start" button of the task bar to open the menu.
3) When "Run" is clicked, the following window has appeared.
4) Type "a:\setup.exe" and click the "OK" button or press the "Enter".



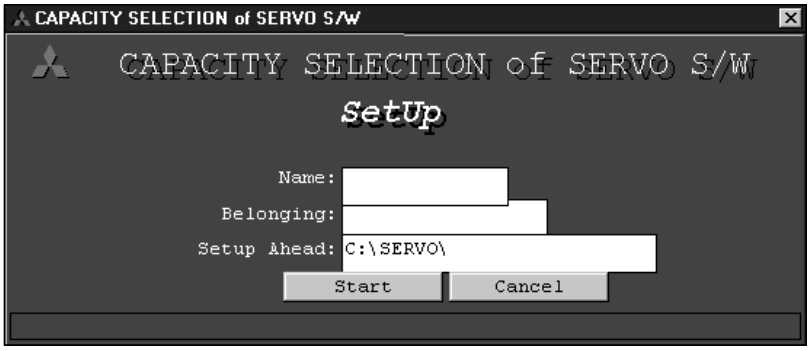
(2) Specifying the drive for installation source

Following the above window, call the next window.



1) Specify the drive from where the software will be installed.
2) Type "A:\ " and click the "Contin." button or press the "Enter" to execute.

(3) Registering the user name and position and specifying the drive and directory for installation destination



1) Set the user name in the "Name" field and his or her position in the "Belonging" field.
2) In Setup Ahead, set the drive "C:\" and "directory" to where the software will be installed.
3) After setting, click the "Start" button or press the "Enter" to start.

(4) Changing the floppy disks

1) When the following window has appeared, remove Disk 1 from Drive A and insert Disk 2 according to the prompt, then click the "OK" button or press the "Enter".

2) When the following window has appeared, remove Disk 2 from Drive A and insert Disk 1 according to the prompt, then click the "OK" button or press the "Enter".

(5) End of installation

When installation is finished, the following window is displayed:

Click the "OK" button or press the "Enter" to return to Windows.

POINT

- To the suspend installation, click the "Escape" or "Cancel" button in the corresponding window.

2. CAPACITY SELECTION PROCEDURE

2.1 Capacity selection sequence

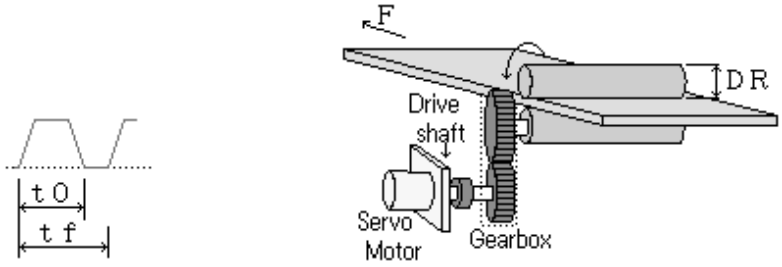
The following operation flowchart introduces a general operation procedure for capacity selection:

Procedure	Operation	Description
1	System start-up	Windows is started up, and the capacity selection software is started.
2	Initial value read	Select "New Project" or "Open Project" to initialize or read data.
3	Machine component selection	Select the machine type from 9 machine components.
4	Servo amplifier series selection	Select the series name of the servo amplifier to be selected.
5	Servo motor series selection	Select the series name of the servo motor to be selected. Select the motor model and choose the rated speed.
6	Motor option selection	When the motor is selected, the Motor Options window will appear automatically. Select whether to use the reduction gear or not, the reduction gear ratio, and whether to use the electromagnetic brake or not.
7	Unit system selection	Select the unit system, in which machine specifications will be entered.
8	Machine specifications entry	Enter the values of machine specifications displayed on the basis of the machine components selected. They may also be calculated and substituted using various tool windows.
9	Selection operation execution	After entering all machine specifications, click the "Calculate" button. Operation will be performed on the basis of the entered machine specifications to select the servo amplifier and servo motor capacities. The selected capacities of servo amplifier type, servo motor type and regenerative brake option type are displayed together with calculation results. By clicking the "Set Motor Size" button, the capacity may be specified for calculation.
10	Result confirmation	Confirm the selection results. To change the machine components or any of the machine specifications, only that item may be changed and operation performed again.
11	Printing	In printing, the machine component, machine specifications and selection results are printed.
12	Data save	In data save, machine component, machine specifications (including units) and selection results may be saved with file name.
13	End	Terminate the capacity selection software.

2.2 Capacity selection example

This section offers an example of capacity selection for a machine having particular specifications.

2.2.1 Machine specifications

Item	Setting			
Machine component	Roll feed 			
Machine specifications	Tension	F:	25.000	N
	Reduction gear ratio	1/n:	1/2	
	Reduction gear inertia	J_G:	0.100	kg-cm^2
	Coupling inertia	J_C:	2.000	kg-cm^2
	Inertia of the others	J_O:	5.000	kg-cm^2
	Diameter of feed roll	D_R:	50.000	mm
	Inertia of feed roll	J_R:	25.000	kg-cm^2
	Drive efficiency	eta:	0.900	
	Maximum machine speed	V_0:	20000.000	mm/min
	Feed distance/operation	L:	500.000	mm
	Feed time per operation	t_0:	2.000	sec
	One operation cycle	t_f:	3.000	sec
Servo response level	High response			
Servo amplifier	MR-H-AN series			
Noise mode	Standard noise			
Servo motor	HA-SH2000r/min series			
Servo motor option	1/5 precision speed reducer No brake option			
Data file	test1. srv			
Title name	Test 1			

2.2.2 Operation

Here, capacity selection is selected based on the machine specifications of section 2.2.1.
For the other operation procedures, refer to Sections 1.5 and 3.2.

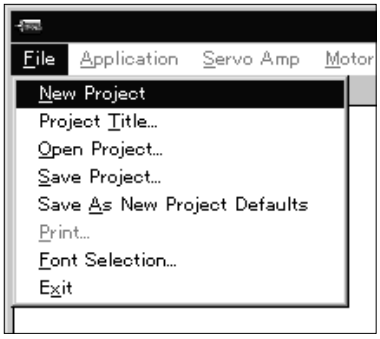
(1) Start-up of the capacity selection software

1) Click the "Start" button of the task bar to open the menu.
2) Point to "Programs" and point to "CAPACITY SELECTION".
3) Click "CAPACITY SELECTION of SERVO".

When the title screen appears, click the mouse icon or press the "Enter".

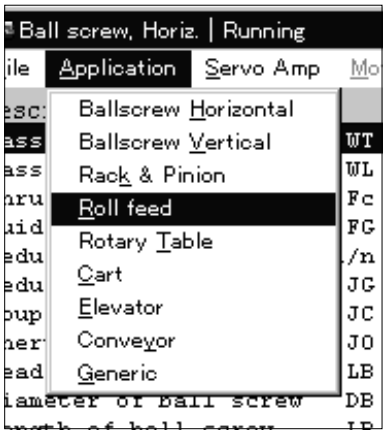
(2) Initialization

1) Click "File" on the menu bar to open the menu.
2) Click "New Project".

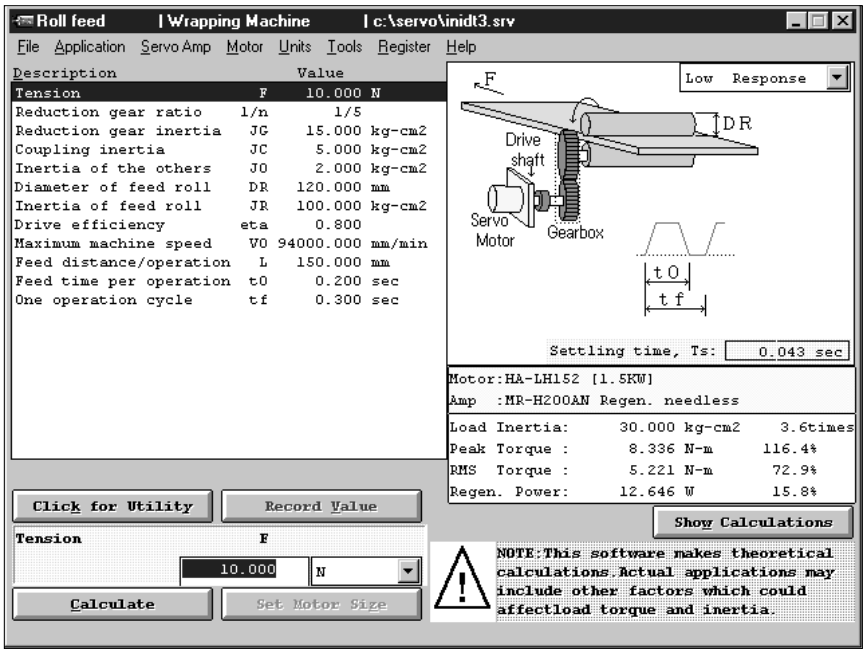


(3) Machine component selection

1) Click "Application" on the menu bar to open the menu.
2) Click "Roll feed".



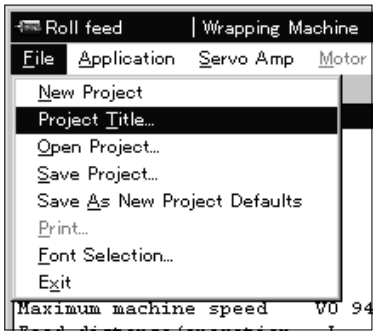
When selection is made, the following screen opens.



(4) Title

1) Click "File" on the menu bar to open the menu.

2) Click "Project Title".



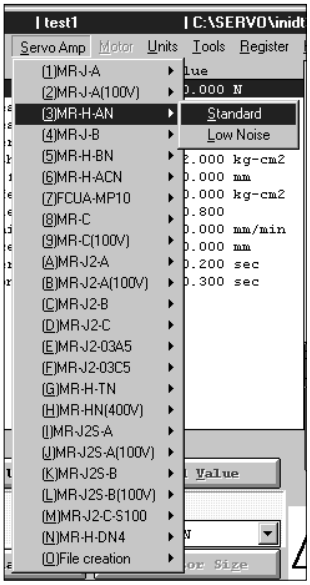
When "Project Title" is clicked, the following window appears:

3) Enter "Test 1" in the New Title field.

4) Click the "OK" button.

(5) Servo amplifier series selection

1) Click "Servo Amp" on the menu bar to open the menu.
2) Point "MR-H-AN".
3) Click "Standard".

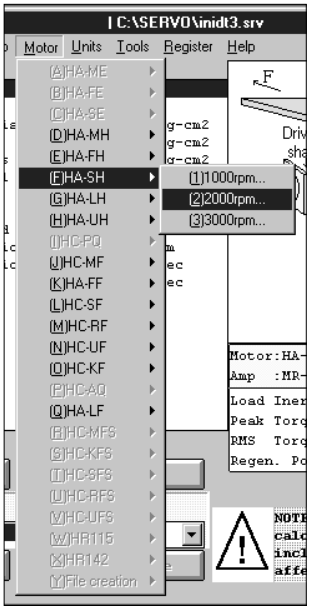


When selection is made, Driver Series is displayed in the selected driver field of the selection/ calculation result display area.

(6) Servo motor selection

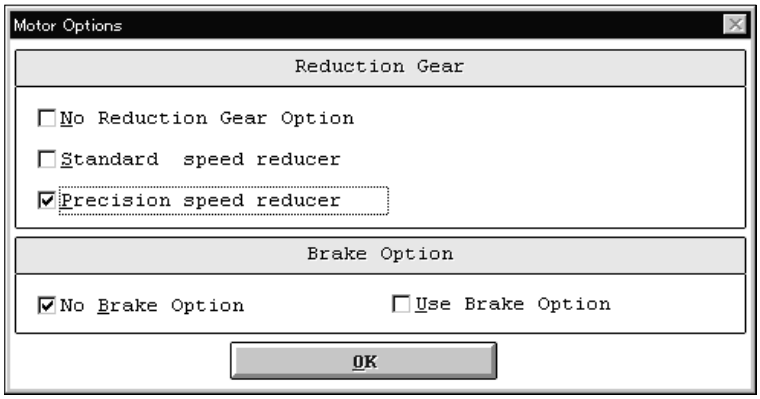
(a) Servo motor series selection

1) Click "Motor" on the menu bar to open the menu.
2) Point "HA-SH".
3) Click "2000rpm".



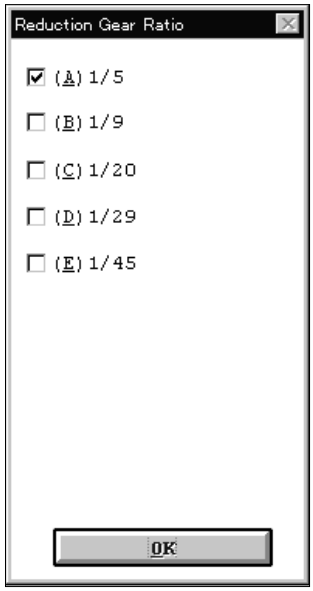
(b) Servo motor option selection

After selecting the motor, the following window appears:



In this window, select Reduction Gear and Brake Option.

1) Click "Precision speed reducer" in the Reduction Gear selection.
   When selecting it the following window appears:



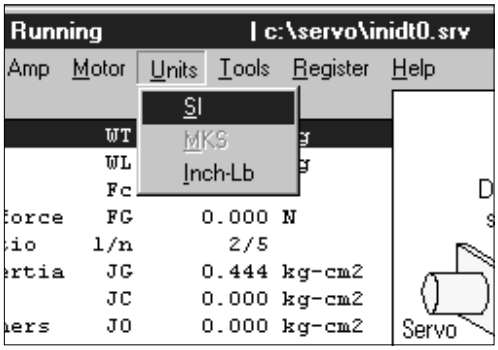
2) Click "1/5".
3) Click the "OK" button in the Reduction Gear Ratio selection window.
4) Click "No Brake Option" in the Brake Option selection.
   Make sure that the check boxes of the options selected have turned to.
5) Click the "OK" button.

When selection is made, the servo motor series is displayed in the selected motor field of the selection/calculation result display area.

(7) Units selection

1) Click "Units" on the menu bar to open the menu.

2) Click "SI".



(8) Machine specifications entry

(a) Entry of machine specifications data

Enter the machine specifications data given in Section 2.2.1.

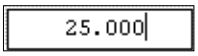
Move the focus to the required item in the machine specifications display area and enter its value in the machine specifications display area.

Example: To enter Tension 25 (N)

1) Click "Tension" in the machine specifications display area.

The machine specifications display area will change as shown below:

2) Enter "25" from the keyboard.



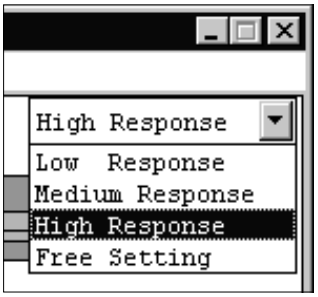
3) Click the "Record Value" button to set.

When setting is made, the old value in the machine specifications display area is replaced by the new value entered. Similarly, set all machine specifications data.

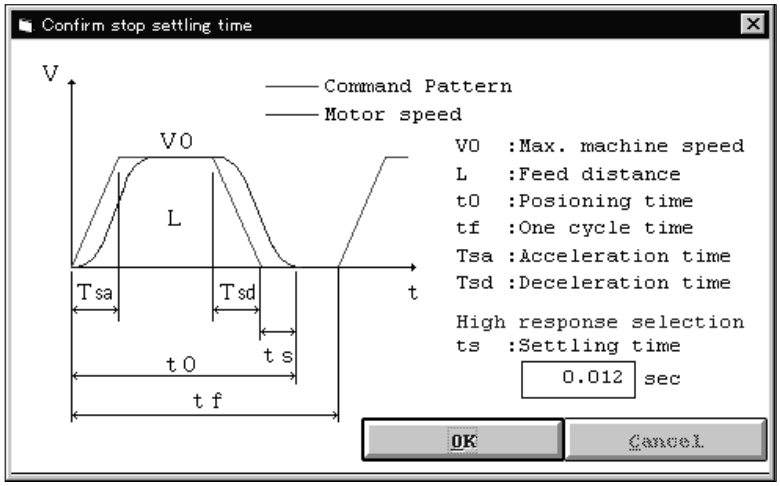
(b) Setting of servo response level

1) Click the servo response level setting area to open the combo box.

2) Click "High Response".



When "High Response" is clicked, the following window is displayed. Settling time at High Response is "0.012s".



3) Click the "OK" button.

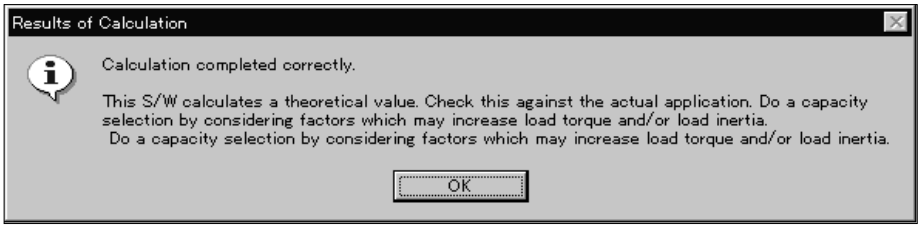
(9) Selection operation execution

1) Click the "Calculate" button.

When calculation is finished, the following window appears:

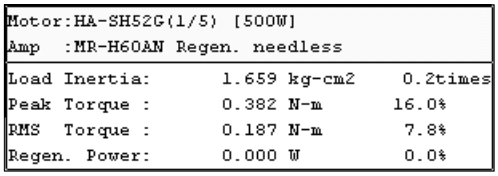
POINT
・When a regenerative brake option is required, the above Message window is not displayed.

2) Click the "OK" button.



3) Click the "OK" button.

The selection and calculation results are displayed in the selection/calculation result display area.



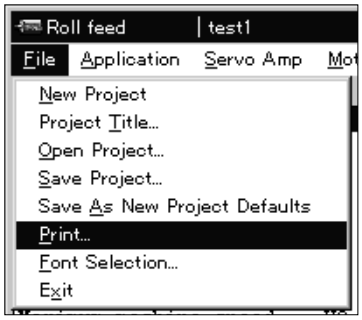
Selection and calculation results

Servo motor	HA-SH52G (1/5 precision speed reducer) [500W]	
Servo amplifier	MR-H60AN Regenerative brake option not required	
Load inertia	1.659 [kg・cm^2]	0.2 times
Peak torque	0.382 [N・m]	16.0%
Effective torque	0.187 [N・m]	7.8%
Regenerative power	0.000 [W]	0.0%

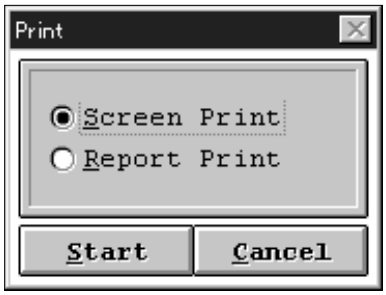
This machine allows use of the HA-SH52G (1/5 precision speed reducer). Load inertia at the servo motor shaft of this machine is 1.659 [kg・cm^2] or 0.2 times larger than the servo motor shaft inertia. Required peak torque is 0.382 [N・m] and effective torque is 0.187 [N・m], which are 16.0% and 7.8% of the rated torque, respectively. Also, this machine does not require a regenerative brake option.

(10) Printing

1) Click "File" on the menu bar to open the menu.
2) Click "Print".

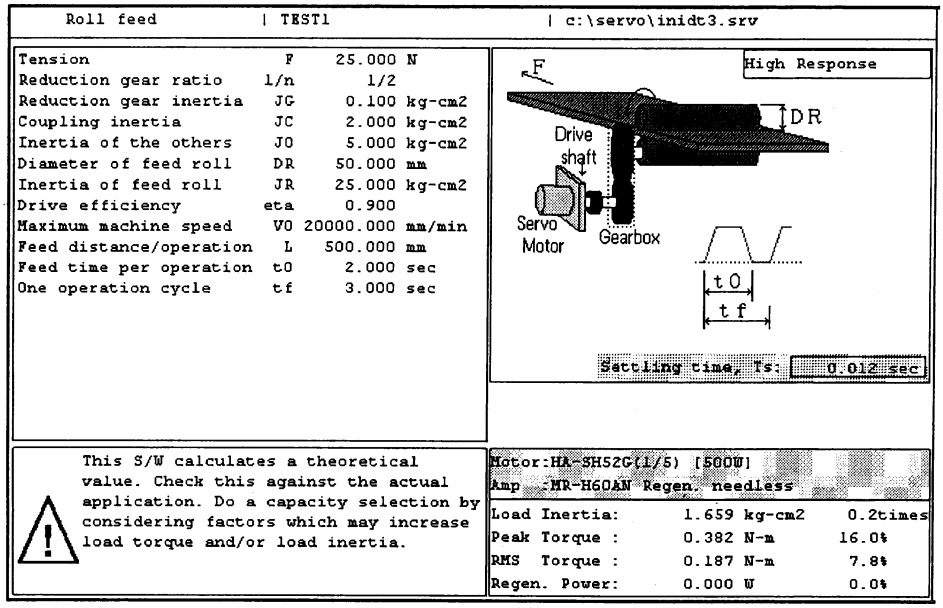


When "Print" is clicked, the following window is displayed:



3) When the screen is printed, "Screen Print" of the print window is clicked.
   The option button turns to ◉.
4) Click the "Start" button.

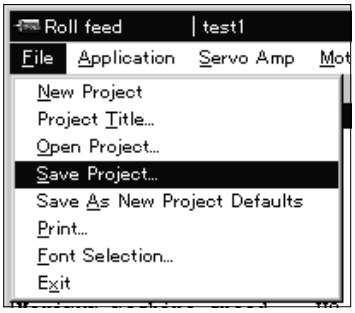
When printing is started, the results are printed out as shown below:



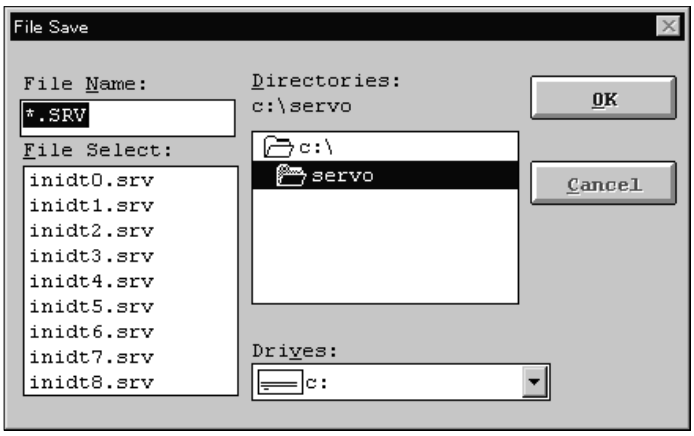
POINT
▪ To print the calculation process, select "Report Print".

(11) Data save

1) Click "File" on the menu bar to open the menu.
2) Click "Save Project".

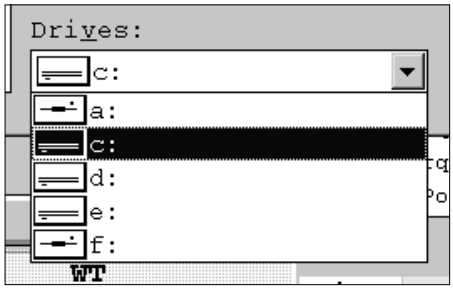


When "Save" is clicked, the following window is displayed:



Enter (specify) the file name of the data to be saved.
Save the data to "Drive C" with file name "test1. srv".

3) Click the Drive setting field to open the combo box.
4) Click "Drive C".



5) Click the File Name setting field.
6) Enter file name "test1.srv".

test1.srv

7) Click the "OK" button to execute save.

(12) End

1) Click "File" on the menu bar to open the menu.
2) Click "Exit".

3. OPERATION COMMANDS

3.1 Command list

Command Display Section	Menu Title	Main Menu	Sub menu
Command	File	New Project	
		Project Title	
		Open Project	
		Save Project	
		Save As New Project Defaults	
		Print	
		Font Selection	
		Exit	
	Application	Ballscrew Horizontal	
		Ballscrew Vertical	
		Rack & Pinion	
		Roll feed	
		Rotary Table	
		Cart	
		Elevator	
		Conveyor	
		Generic	
	Servo Amp	MR-J-A	Standard
			Low Noise
		MR-J-A (100V)	Standard
			Low Noise
		MR-H-AN	Standard
			Low Noise
		MR-J-B	Standard
			Low Noise
		MR-H-BN	Standard
			Low Noise
		MR-H-ACN	Standard
			Low Noise
		FCUA-MP10	Standard
		MR-C	Standard
		MR-C(100V)	Standard
		MR-J2-A	Standard
		MR-J2-A (100V)	Standard
		MR-J2-B	Standard
		MR-J2-C	Standard
		MR-J2-03A5	Standard
		MR-J2-03C5	Standard
		MR-H-TN	Standard
			Low Noise
		MR-HN(400V)	Standard
			Low Noise
		MR-J2S-A	Standard
		MR-J2S-A(100V)	Standard
		MR-J2S-B	Standard
		MR-J2S-B(100V)	Standard
		MR-J2-C-S100	Standard
		MR-H-DN4	Standard
			Low Noise
		File creation	Standard

Command Display Section	Menu Title	Main Menu	Sub menu
Command	Motor	HA-ME	3000rpm
		HA-FE	3000rpm
		HA-SE	1000rpm
			2000rpm
			3000rpm
		HA-MH	3000rpm
		HA-FH	3000rpm
		HA-SH	1000rpm
			2000rpm
			3000rpm
		HA-LH	2000rpm
		HA-UH	2000rpm
		HC-PQ	3000rpm
		HC-MF	3000rpm
		HA-FF	3000rpm
		HC-SF	2000rpm
		HC-RF	3000rpm
		HC-UF	2000rpm
			3000rpm
		HC-KF	3000rpm
		HC-AQ	3000rpm
		HA-LF	2000rpm
		HC-MFS	3000rpm
		HC-KFS	3000rpm
		HC-SFS	1000rpm
			2000rpm
			3000rpm
		HC-RFS	3000rpm
		HC-UFS	2000rpm
			3000rpm
		HR115	3000rpm
		HR142	3000rpm
		File creation	rpm
	Units	SI	
		Inch-Lb	
	Tools	Inertia & Tension	Cylinder
			Square Block
			Converted Load
			Linear Movement
			Hanging
			Tension Calculator
		Scientific Calculate	
		Specific Gravity Tables	
		Efficiency Tables	
		Friction Coeff. Tables	
		Ratio Calculate	
		Units Conversion	Inertia
			Torque
			Length
			Weight
			Force
			Speed
		Motor Data Tables	
	Register	Data Input	
	Help	Help	
		Quick Start	
		Version Information	

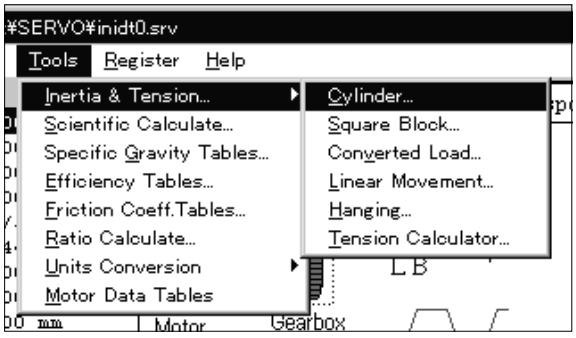
3.2 How to select a command

The method of selecting the command is the operation procedures using the mouse.
There are two types of commands: some are executed immediately by selecting them, and others require the window to be opened after selection and further settings to be made. For commands whose names are followed by ..., open the window after selecting them.
The command names of unavailable commands are grayed out.

3.2.1 Command selection procedures

1. Clicking method
   1) Click the menu title on the menu bar to open the menu.
   2) Point to and click the command to be selected.
      Any command marked ▶ has a sub menu. Similarly click that command to select.

2. Dragging method
   Point to the menu title on the menu bar, hold down the left button and drag the mouse to the command to be selected, and release the button.
   When there is a sub menu, further drag the mouse to the required command and release the button.



3.2.2 Operation procedures within the window

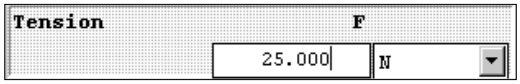
Within the operation window, enter data and/or click the button.

(1) Pressing a button

Click the button in the window.

(2) Entering data

Click the machine specifications entry area to move the focus there, and input the numerical value with the keyboard.



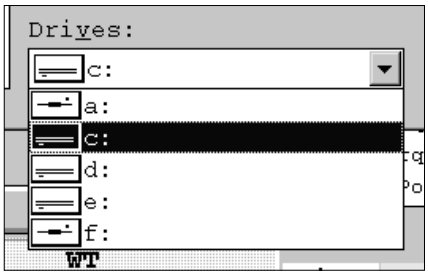
(3) Selecting data

Click the data to be selected.

(4) Selecting the combo box data, etc.

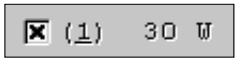
1) Click the arrow area on the right of the setting area to open the combo box.

2) Click the data or the like to be selected to make selection.



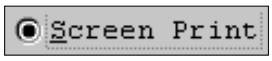
(5) Selecting the item

Click the item or check box.



(6) Pressing the option button

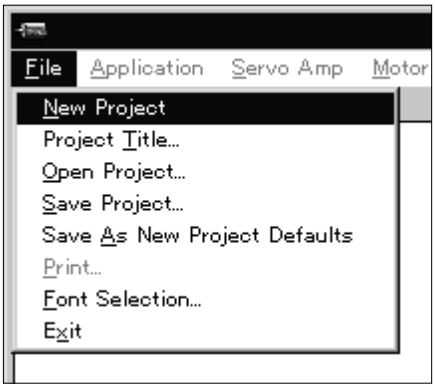
Click the item or button.



3.3 Description of commands

3.3.1 File

Used to save or print the data created, for example. When "File" on the menu bar is clicked, the following menu is displayed:

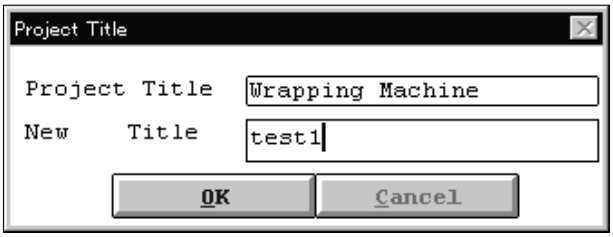


(1) New Project

Used to return all input data to initial values, which are stored in the initial value data file and may be changed.

(2) Project Title

Used to set the title displayed on top of the window. When "Title" of the sub menu is clicked, the following window is displayed:

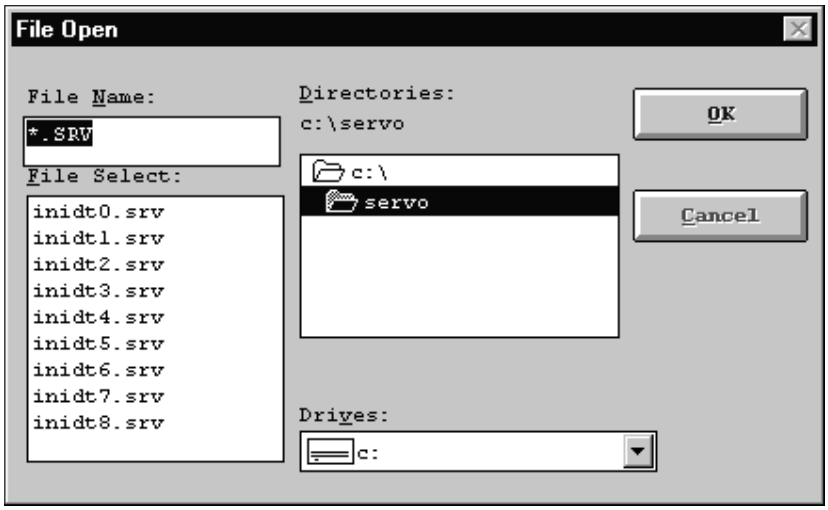


Move the focus to the New Title entry field and enter the title from the keyboard.

(3) Open project

Used to read input data from the saved file.

When "Open Project" of the sub menu is clicked, the File Open window opens and the file to be opened can be specified.



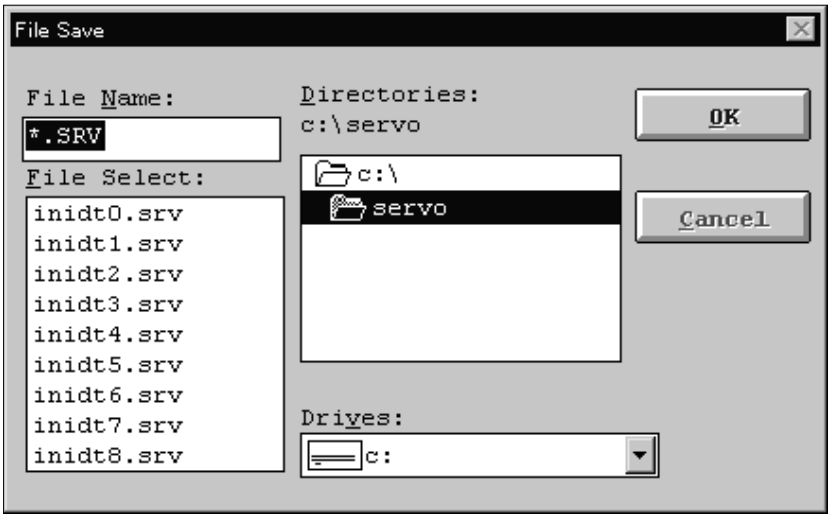
The file name may be typed directly in the File Name box to specify the file to be opened, or it may also be specified directly in the File Select box window.

The drive and directory used for opening can be specified in the Drives box and Directories box windows.

(4) Save Project

Used to save the current input data.

When "Save Project" on the sub menu is clicked, the File Save window opens.



After entering or specifying the file name, click the "OK" button to save the input data by the specified file name.

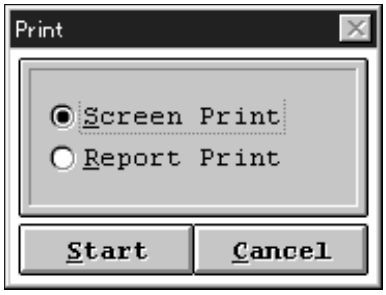
(5) Save As New Project Defaults

Used to save the current input data in the initial value data file. By saving the data to be entered repeatedly, that data can be read by the "New Project" command.

Data that can be saved includes machine component, selected servo amplifier and servo motor models, unit system, machine specifications data and corresponding units, and calculation result.

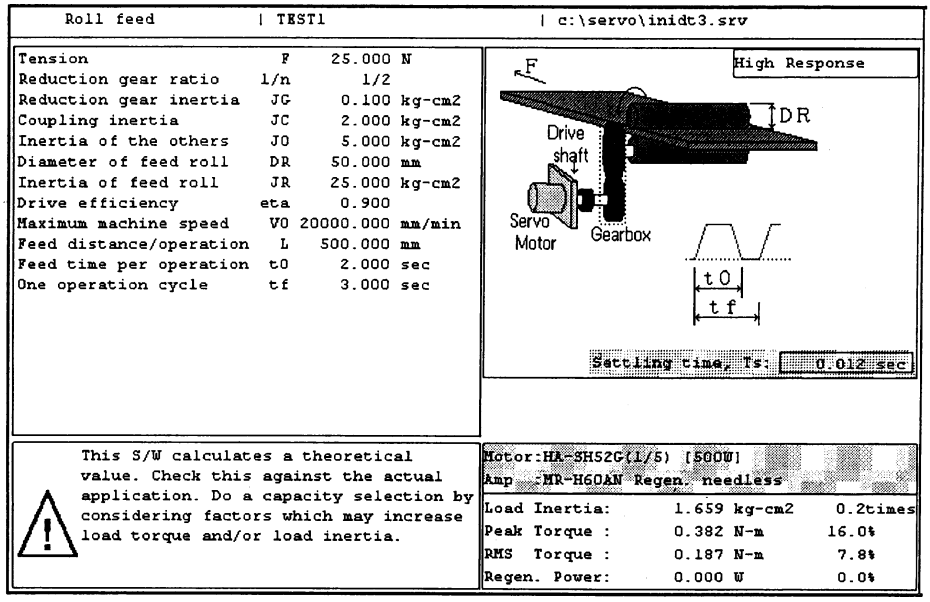
(6) Print

Used to print input data and calculation/selection results. When "Print" on the sub menu is clicked, the following window is displayed:



The Outline "Screen Print" or "Report Print" mode is available.
Select the desired print mode.

(a) Outline Print results (example)



Roll feed | TEST1 | c:\servo\inidt3.srv

Tension	F	25.000	N
Reduction gear ratio	1/n	1/2	
Reduction gear inertia	JG	0.100	kg-cm2
Coupling inertia	JC	2.000	kg-cm2
Inertia of the others	J0	5.000	kg-cm2
Diameter of feed roll	DR	50.000	mm
Inertia of feed roll	JR	25.000	kg-cm2
Drive efficiency	eta	0.900	
Maximum machine speed	V0	20000.000	mm/min
Feed distance/operation	L	500.000	mm
Feed time per operation	t0	2.000	sec
One operation cycle	tf	3.000	sec

This S/W calculates a theoretical value. Check this against the actual application. Do a capacity selection by considering factors which may increase load torque and/or load inertia.

Motor:HA-SH52C(1/5) [500W]
Amp :MR-H60AN Regen. needless

Load Inertia:	1.659 kg-cm2	0.2times
Peak Torque :	0.382 N-m	16.0%
RMS Torque :	0.187 N-m	7.8%
Regen. Power:	0.000 W	0.0%

(b) Report Print results (example)

Calculation details are printed in addition to Screen Print results.

Use Symbol List

(Roll feed | Wrapping Machine | c:\servo\inidt3.srv

Symbol :	Content	Data
F	:Tension	10.000 N
1/n	:Reduction gear ratio	1/5
JG	:Reduction gear inertia	15.000 kg-cm2
JC	:Coupling inertia	5.000 kg-cm2
JO	:Inertia of the others	2.000 kg-cm2
DR	:Outside diameter of feed roll	120.000 mm
JR	:Inertia of feed roll	100.000 kg-cm2
eta	:Drive efficiency	0.800
V0	:Maximum machine speed	94000.000 mm/min
L	:Feed distance per operation	150.000 mm
t0	:Feed time per operation	0.200 sec
tf	:One operation cycle	0.300 sec
*1/nm	:Reduction ratio of motor with reduction	Unused
*Pf	:Encoder resolution	131072 pulse/rev
*Kp	:Position loop gain	70 1/sec
*JMG	:Inertia of reduction gear with motor	0.000 kg-cm2
*JMB	:Inertia of brake with motor	0.000 kg-cm2
*JM	:Motor rotor inertia	20.000 kg-cm2
g	:Gravitational acceleration	9.800 m/sec2
*Tmax	:Motor maximum torque	21.600 N-m
*Ttyp	:Motor rated torque	7.160 N-m
*etam	:Reverse-efficiency of motor	85.000 %
*Wa	:Amplifier loss	0.000 W
*t	:Regenerative operation time	0.061 sec
*Ec	:Energy charged to the capacitors in amp.	40.000 J
*Ptyp	:Rated power of regeneration	0.000 W
*tmax	:Maximum regeneration time	0.000 sec

Note1) '*' marks Amplifier, Motor, and Regenerative Option data selected by this software. When a calculation error occurs, the data becomes '0.000'.
Note2) The Amplifier loss is calculated as '0',for give a margin to the regenerative power calculation.

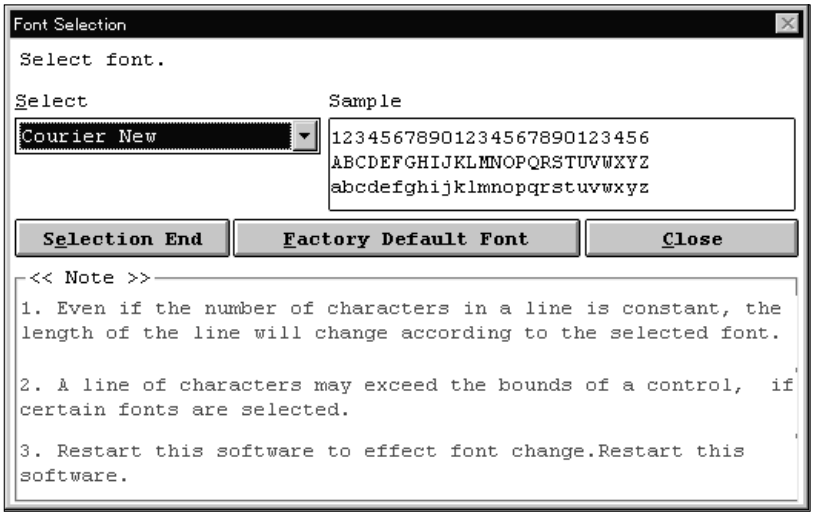
```
 Calculations Process
(Roll feed          | Wrapping Machine          | c:\servo\inidt3.srv            )

*******************************************************************************
All calculations are done in the SI units. If you select MKS, or in-lb,
the data is converted internally to SI units.
Some accuracy may be lost because of the conversion.
Please acknowledge that.
*******************************************************************************

   1.Feed distance/Motor Rev.
      dS = pi * DR * 1/n * 1/nm
         = 3.1416 * 120.000 * 0.200 * 1.000
         =     75.398 [mm/rev]

   2.Electrical accuracy
      dL = (dS/Pf) * 1000
         = (75.398/131072) * 1000
         =   0.575241 [micron/p]

   3.Motor rotational speed
      N0 = V0/dS
         = 94000.000/75.398
         =   1246.717 [r/min]

   4.Stop settling time
      ts = 3 * 1/Kp
         = 3 * 1/70
         =      0.043 [sec]

   5.Accele./Deceleration time
      Tsa = Tsd = t0 - (L/V0 * 60 + ts)
          = 0.200 - (150.000/94000.000 * 60 + 0.043)
          =      0.061 [sec]

   6.Total load inertia
      JL = JMG+JMB+{JG+JC+JO+2*JR*(1/n)^2}*(1/nm)^2
         = 0.000 + 0.000 + {15.000 + 5.000 + 2.000 + 2*100.000*(0.200)^2}
            * (1.000)^2
         =     30.000 [kg-cm2]

   7.Load torque
      TL = F * (DR/2000) * 1/n * 1/nm * (1/eta)
         = 10.000*(120.000/2000)*0.200*1.000*(1/0.800)
         =      0.150 [N-m]

   8.Moment of inertia ratio
      m = JL/JM
        = 30.000/20.000
        =        1.5 [times]

   9.Acceleration torque
      TMa =  {((JL + JM)*N0)/(9.55*10000*Tsa)} + TL
          =  {((30.000 + 20.000)*1246.717)/(9.55*10000*0.061)} + 0.150
          =     10.851 [N-m]

  10.Deceleration torque
      TMd = -{((JL + JM)*N0)/(9.55*10000*Tsd)} + TL
          = -{((30.000 + 20.000)*1246.717)/(9.55*10000*0.061)} + 0.150
          =    -10.551 [N-m]

  11.Peak load factor
      Rp = {(maximum value of |TMa|,|TMd|)/Ttyp} * 100
         = (10.851/7.160)*100
         =    151.550 [%]

  12.Cont. effect load torque
      tc = t0 - Tsa - Tsd - ts
         = 0.200 - 0.061 - 0.061 - 0.043
         =      0.035 [sec]
```

```
    Trms1 = SQRT{(TMa^2*Tsa + TL^2*tc + TMd^2*Tsd)/tf}
          = SQRT{(((10.851)^2)*0.061 + ((0.150)^2)*0.035 + ((-10.551)^2)
             *0.061}/0.300}
          =      6.825 [N-m]

13.Effective load factor
    Rrms = (Trms1/Ttyp) * 100
         = (6.825/7.160)*100
         =     95.321 [%]

14.Acceleration energy
    Ea = (0.1047/2) * N0 * TMa * Tsa
       = (0.1047/2) * 1246.717 * 10.851 * 0.061
       =     43.200 [J]

15.Deceleration energy
    Ed = (0.1047/2) * N0 * TMd * Tsd
       = (0.1047/2) * 1246.717 * -10.551 * 0.061
       =    -42.006 [J]

16.Constant speed energy
    Ef = 0.1047 * N0 * TL * tc
       = 0.1047 * 1246.717 * 0.150 * 0.035
       =      0.685 [J]

17.Absolute of -energy total
    Em = |(total of negative energy in Ea,Ed,Ef)|
       =     42.006 [J]

18.Regenerative power
    Pr = {etam*Em - (Wa*t) - Ec}/tf
       = {(85.000/100)*42.006 - (0.000*0.061) - 40.000}/0.300
       =      0.000 [W]

19.Max. regenerative power
    Emax = section energy when maximum regenerating
    Pmax = {etam*Emax - (Wa*tmax) - Ec}/tmax
         = {(85.000/100)*0.000 - (0.000*0.000) - 40.000}/0.000
         =      0.000 [W]
```

(7) Font Selection

Used to set the character font to be used.

When "Font Selection" on the sub menu is clicked, the following window is displayed:



1) Select the font to be used in the font combo box.

2) After making selection, click the "Selection End" button.

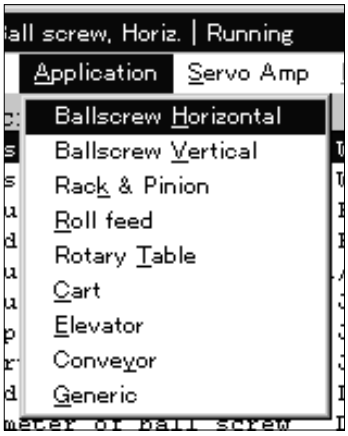
POINT
▪ Click the "Factory Default Font" button to return to the initial setting. Click the "Close" button to cancel the selected font and terminate the Font Selection window.

(8) Exit

Used to terminate the capacity selection software.

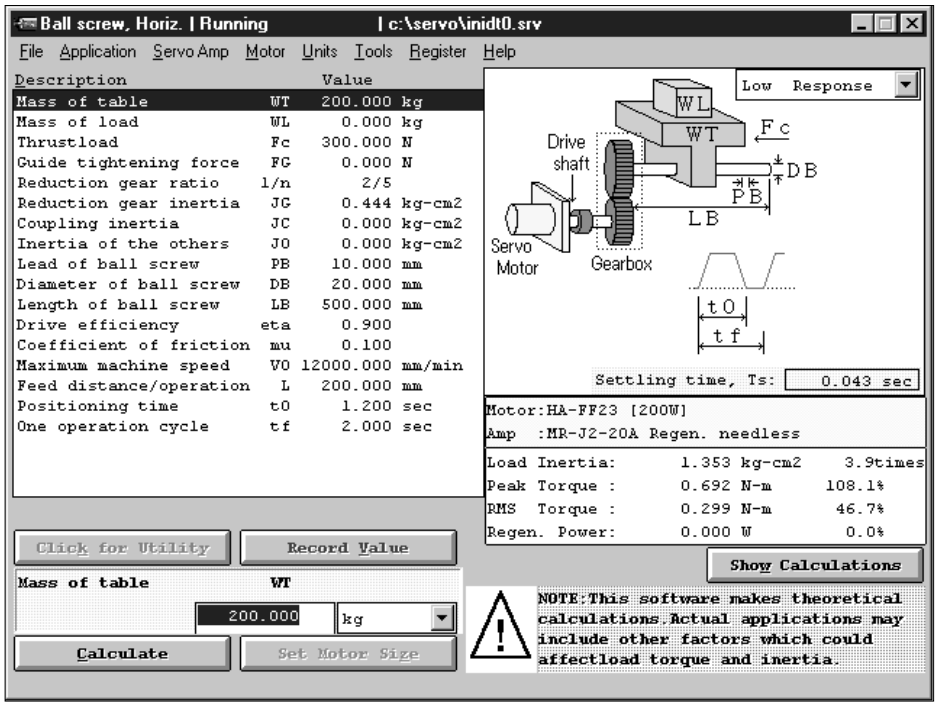
3.3.2 Application

Used to select the machine component. When "Application" on the menu bar is clicked, the following menu appears:

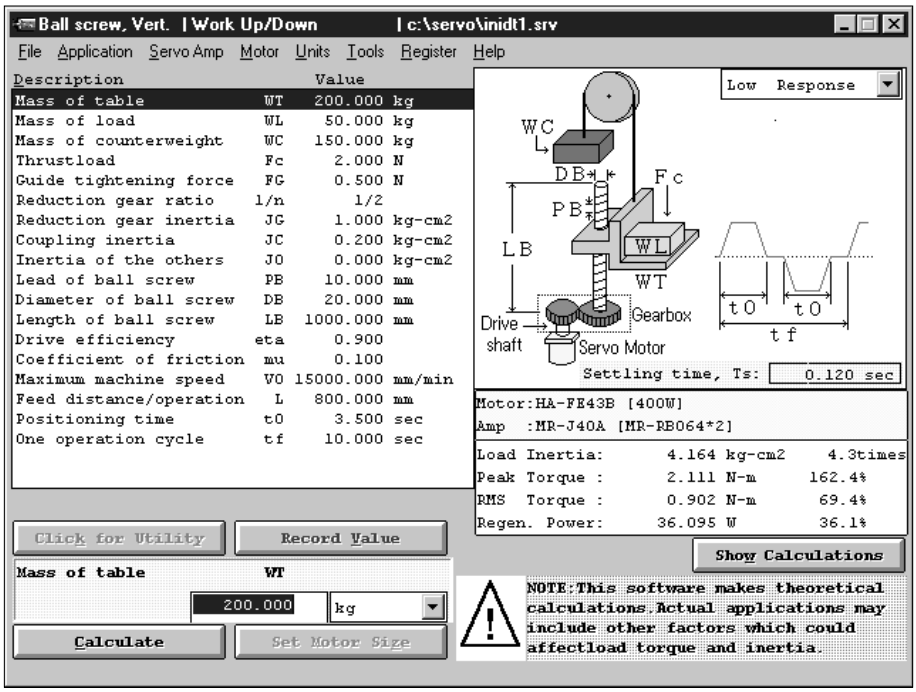


The following machine components are available:

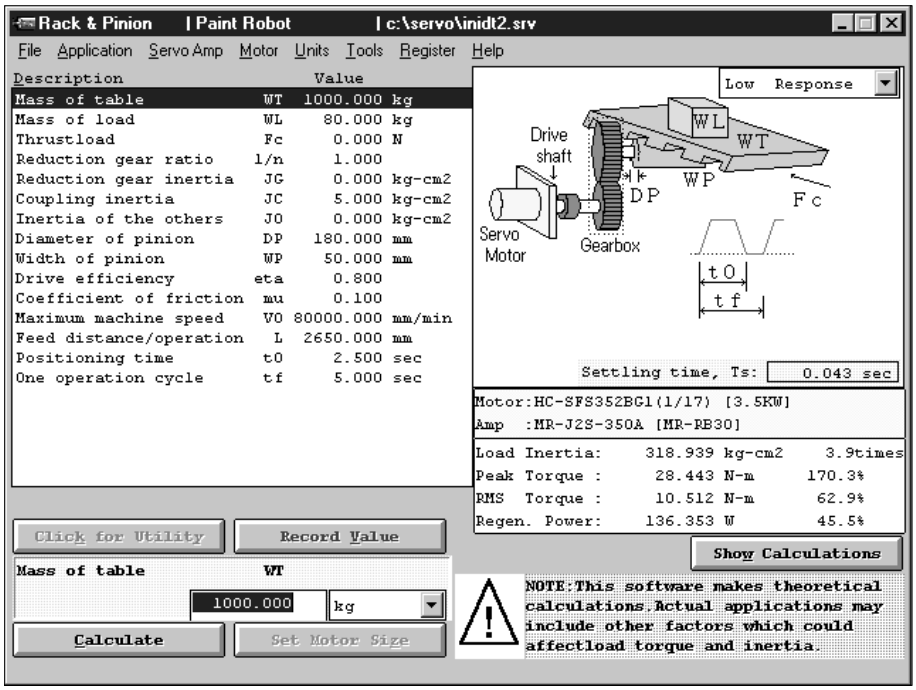
(1) Ballscrew Horizontal



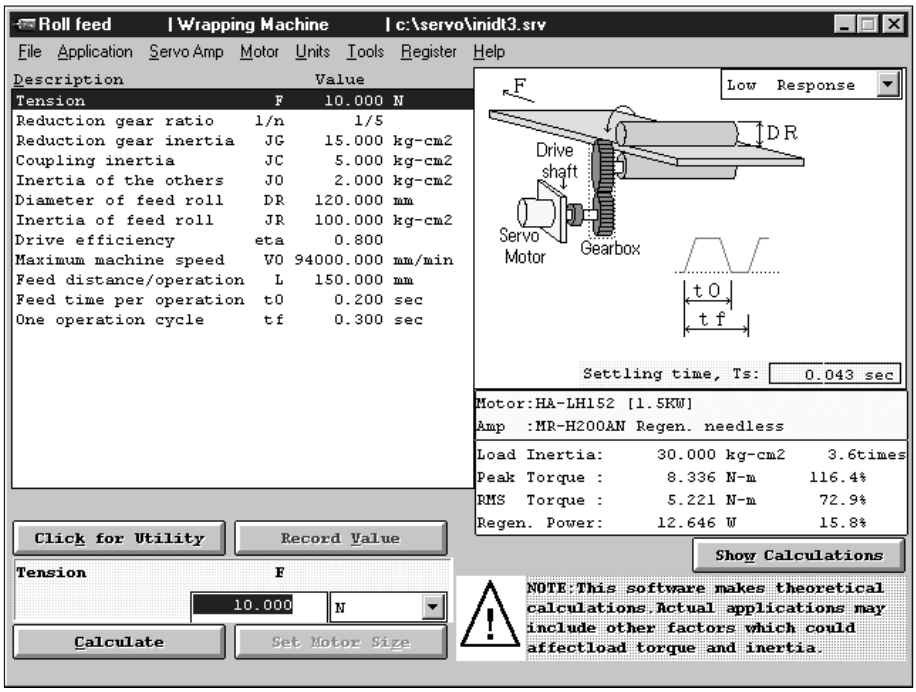
(2) Ballscrew Vertical



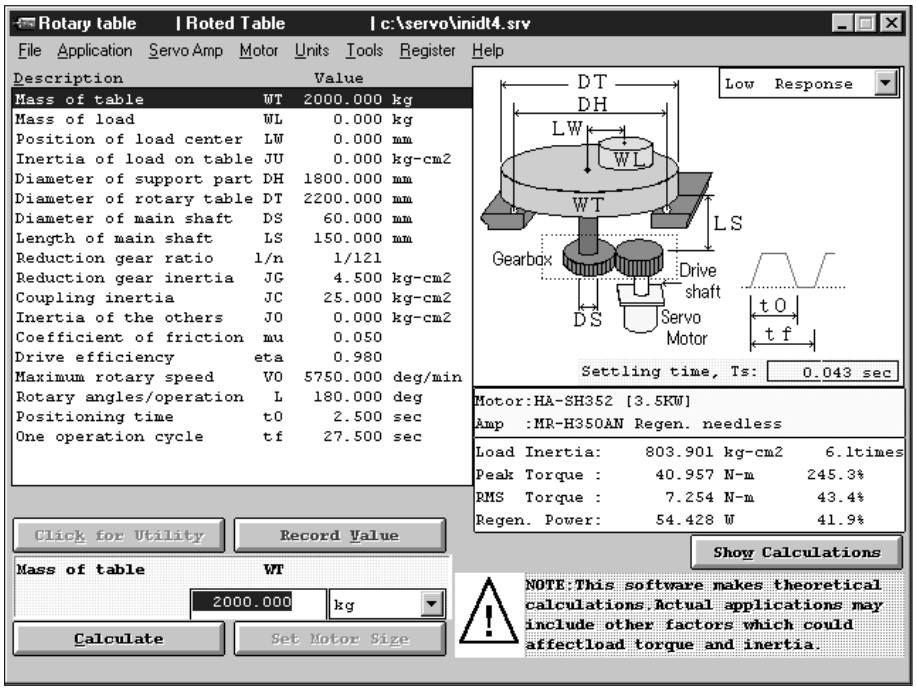
(3) Rack & Pinion



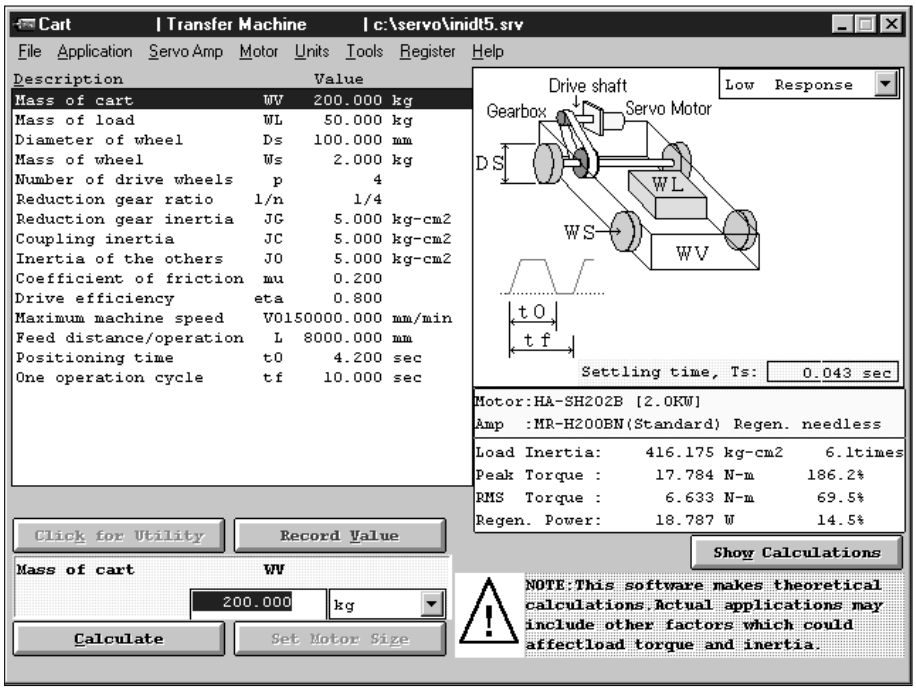
(4) Roll feed



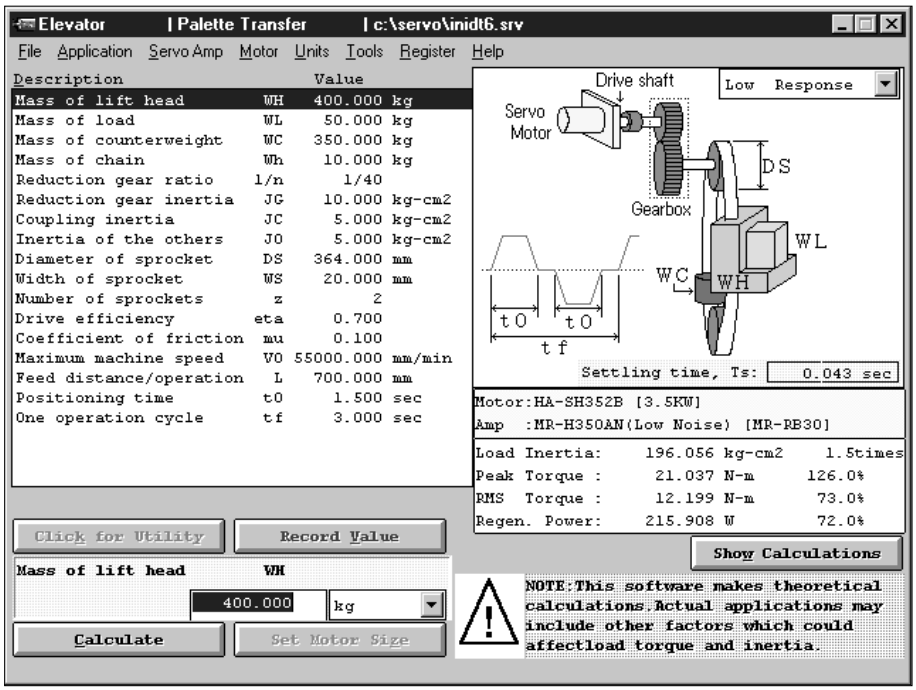
(5) Rotary Table



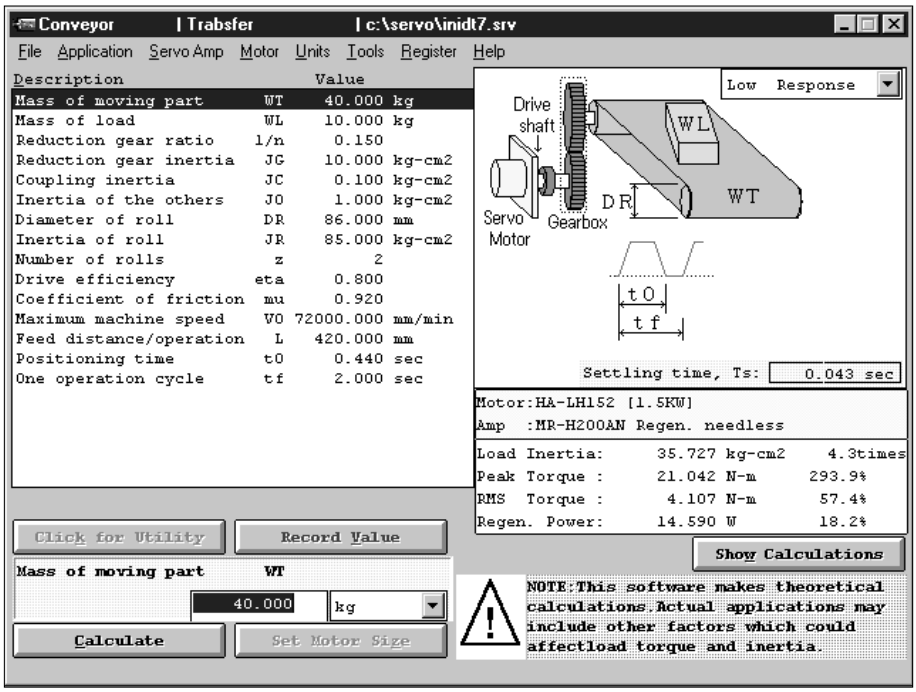
(6) Cart



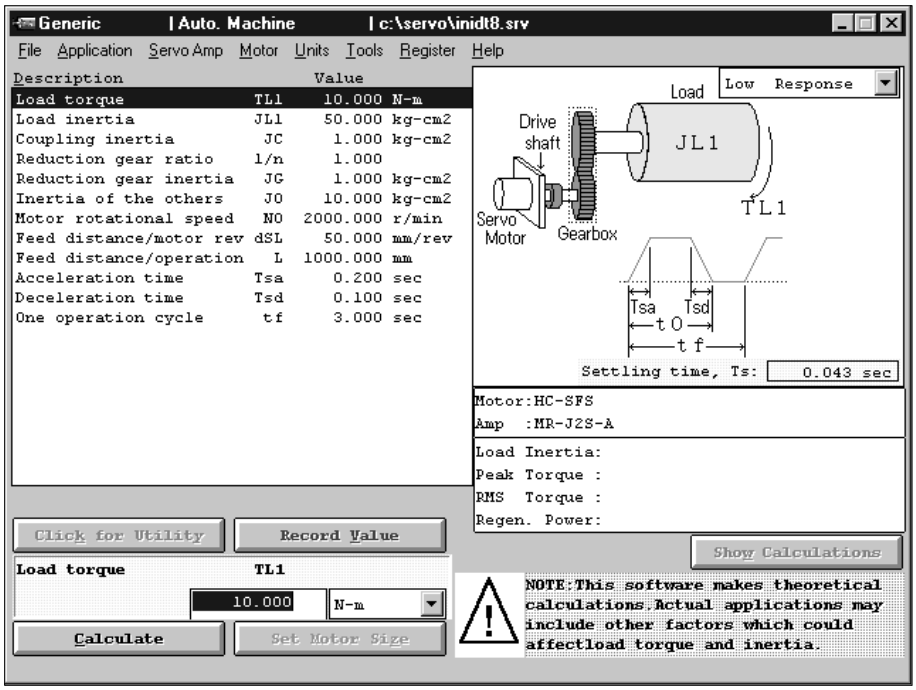
(7) Elevator



(8) Conveyor

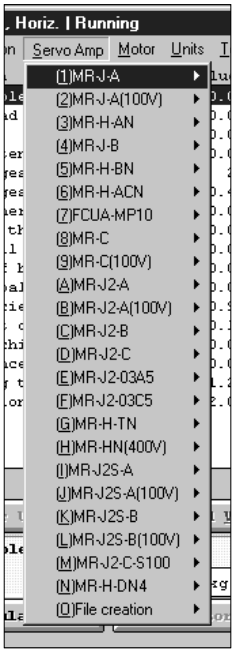


(9) Generic



3.3.3 Servo Amp

Used to select the series and noise mode of the servo amplifier. When "Servo Amp" on the menu bar is clicked, the following menu is displayed:



There is the next table in the servo amplifier series. Choose the required servo amplifier series and noise mode with the corresponding commands.

Command		Servo Amplifier Series	Noise Mode
MR-J-A	Standard	MR-J-(M)A	Standard Noise
	Low Noise		Low Noise
MR-J-A(100V)	Standard	MR-J-(M)A1(100V power supply specification)	Standard Noise
	Low Noise		Low Noise
MR-H-AN	Standard	MR-H-AN	Standard Noise
	Low Noise		Low Noise
MR-J-B	Standard	MR-J-B	Standard Noise
	Low Noise		Low Noise
MR-H-BN	Standard	MR-H-BN	Standard Noise
	Low Noise		Low Noise
MR-H-ACN	Standard	MR-H-ACN	Standard Noise
	Low Noise		Low Noise
FCUA-MP10	Standard	FCUA-MP10(Model E)	Standard Noise
MR-C	Standard	MR-C-A	Standard Noise
MR-C(100V)	Standard	MR-C-A1(100V power supply specification)	Standard Noise
MR-J2-A	Standard	MR-J2-A	Standard Noise
MR-J2-A(100V)	Standard	MR-J2-A1(100V power supply specification)	Standard Noise
MR-J2-B	Standard	MR-J2-B	Standard Noise
MR-J2-C	Standard	MR-J2-C	Standard Noise
MR-J2-03A5	Standard	MR-J2-03A5	Standard Noise
MR-J2-03C5	Standard	MR-J2-03C5	Standard Noise
MR-H-TN	Standard	MR-H-TN	Standard Noise
	Low Noise		Low Noise

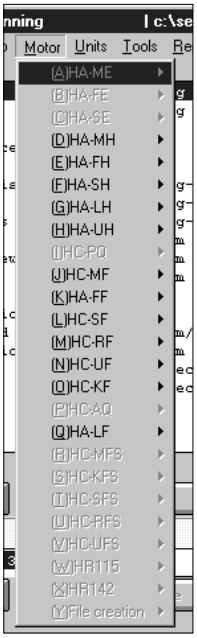
Command		Servo Amplifier Series	Noise Mode
MR-HN(400V)	Standard	MR-HN4(400V power supply specification)	Standard Noise
	Low Noise		Low Noise
MR-J2S-A	Standard	MR-J2S-A	Standard Noise
MR-J2S-A(100V)	Standard	MR-J2S-A1(100V power supply specification)	Standard Noise
MR-J2S-B	Standard	MR-J2S-B	Standard Noise
MR-J2S-B(100V)	Standard	MR-J2S-B1(100V power supply specification)	Standard Noise
MR-J2-C-S100	Standard	MR-J2-C-S100	Standard Noise
MR-H-DN4(400V)	Standard	MR-H-DN4(400V power supply specification)	Standard Noise
	Low Noise		Low Noise
File creation	Standard	Data register by "Register"	Standard Noise

3.3.4 Motor

(1) Servo motor series and rated speed selection

Used to select the series and rated speed of the servo motor.

When "Motor" on the menu bar is clicked, the following menu appears:



The servo motor series which cannot be driven by the servo amplifier selected are grayed out and unavailable.

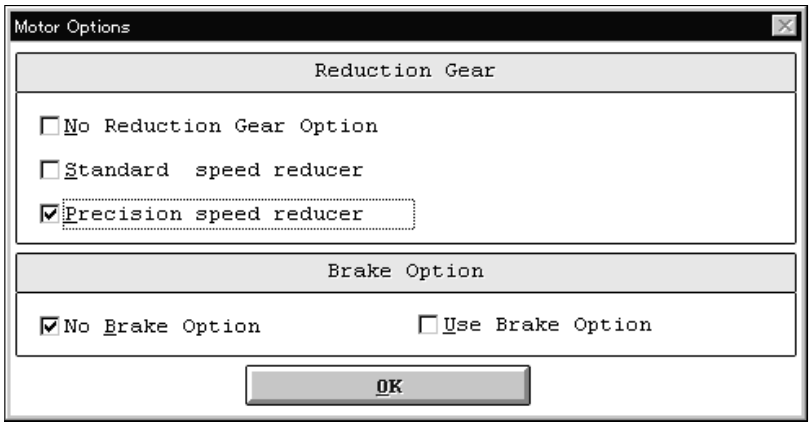
There is the next table in the servo motor series. Choose the servo motor and rated speed with the corresponding commands.

Command		Servo Motor Series	Rated Speed [r/min]
HA-ME	3000rpm	HA-ME	3000
HA-FE	3000rpm	HA-FE	3000
HA-SE	1000rpm	HA-SE	1000
	2000rpm		2000
	3000rpm		3000
HA-MH	3000rpm	HA-MH	3000
HA-FH	3000rpm	HA-FH	3000
HA-SH	1000rpm	HA-SH	1000
	2000rpm		2000
	3000rpm		3000

Command		Servo Motor Series	Rated Speed [r/min]
HA-LH	2000rpm	HA-LH	2000
HA-UH	2000rpm	HA-UH	2000
HC-PQ	3000rpm	HC-PQ	3000
HC-MF	3000rpm	HC-MF	3000
HA-FF	3000rpm	HA-FF	3000
HC-SF	1000rpm	HC-SF	1000
	2000rpm		2000
	3000rpm		3000
HC-RF	3000rpm	HC-RF	3000
HC-UF	2000rpm	HC-UF	2000
	3000rpm		3000
HC-KF	3000rpm	HC-KF	3000
HC-AQ	3000rpm	HC-AQ	3000
HA-LF	2000rpm	HA-LF	2000
HC-MFS	3000rpm	HC-MFS	3000
HC-KFS	3000rpm	HC-KFS	3000
HC-SFS	1000rpm	HC-SFS	1000
	2000rpm		2000
	3000rpm		3000
HC-RFS	3000rpm	HC-RFS	3000
HC-UFS	2000rpm	HC-UFS	2000
	3000rpm		3000
HR115	3000rpm	HR115	3000
HR142	3000rpm	HR142	3000
File creation	rpm	Data registered by "Register"	

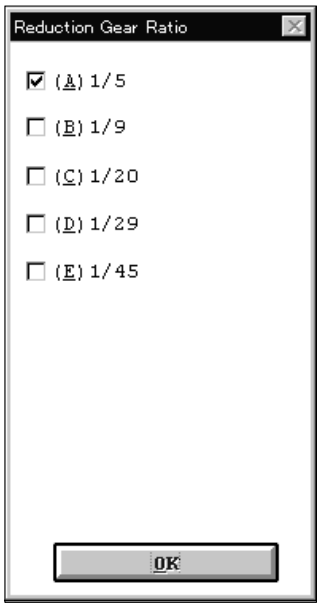
(2) Servo motor option selection

The servo motor series provides reduction gear and electromagnetic brake options. After the operation in (1) of this section is performed, the Motor Options window is displayed automatically.



1) Select the reduction gear (No Reduction Gear Option, Standard speed reducer, Precision speed reducer) and brake option (No Brake Option, Use Brake Option) by clicking the corresponding check boxes.

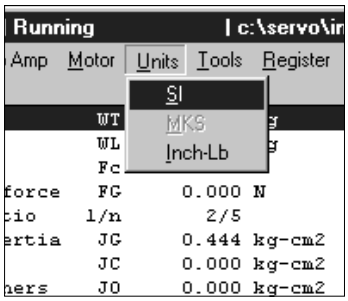
When Standard or Precision speed reducer has been selected as the servo motor option, the Reduction Gear Ratio window as shown below is further displayed. Choose the reduction gear ratio. The reduction gear ratio may only be chosen out of those available for the speed reducer selected in the Motor Options window.



2) Select the check box in Reduction Gear Ratio window in the clicking.
3) After selecting the reduction gear ratio, click the "OK" button to close the Reduction Gear Ratio Selection window.
4) After selecting all motor options, click the "OK" button in the Motor Options window to terminate the window.

3.3.5 Units

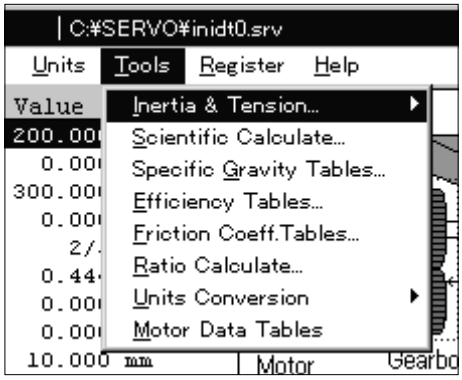
Used to select the units used for calculation. When "Units" on the menu bar is clicked, the following menu is displayed:



On this menu, the absolute system of units SI and inch-pound system of units are available.
Changing the unit system converts the units of the input data and calculation results.
For example, when SI is switched to inches-pounds, items in "m" will be expressed in "ft".
Also, when the unit system is changed, the data and calculation results are converted to numerical values in new units.

3.3.6 Tools

Operation can be suspended temporarily to perform other operation such as inertia calculation.
When "Tools" on the menu bar is clicked, the following menu appears:



(1) Inertia & Tension

Used to calculate the cylinder, square block, converted load, linear movement or hanging inertia and tension.

When this command is selected, the Inertia or Tension calculation window appears. In the inertia specifications display area, each data on the selected inertia is displayed. Enter data in all items and start calculation.

The operation procedure for inertia calculation will be described here.

Perform similar operation for tension calculation.

1) Selection of input items

Move the focus to the item (Reduction gear inertia/Coupling inertia/Inertia of feed roll) of the inertia of the machine specifications display area. Enter a space to set, double-click the required item of inertia, or click the "Click for Utility" button.

2) Calculation of inertia

Enter data required for inertia calculation and click the "Calculate" button.

After calculation is over, double-click the machine structure illustration area or click the "Show Calculations" button to show the calculation process.

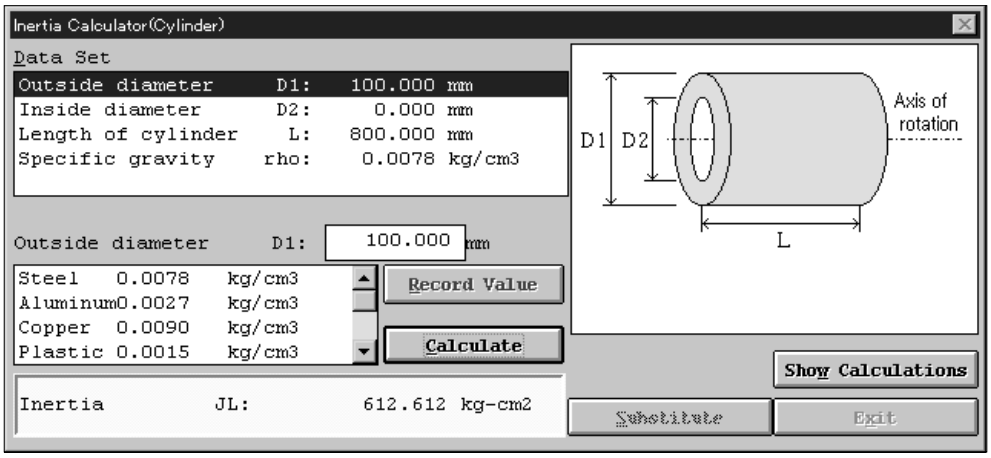
3) Substitution for machine specifications data

Click the "Substitute" button to substitute the calculated value for the item of the inertia of the machine specifications display area. At this time, Inertia & Tension window ends automatically.

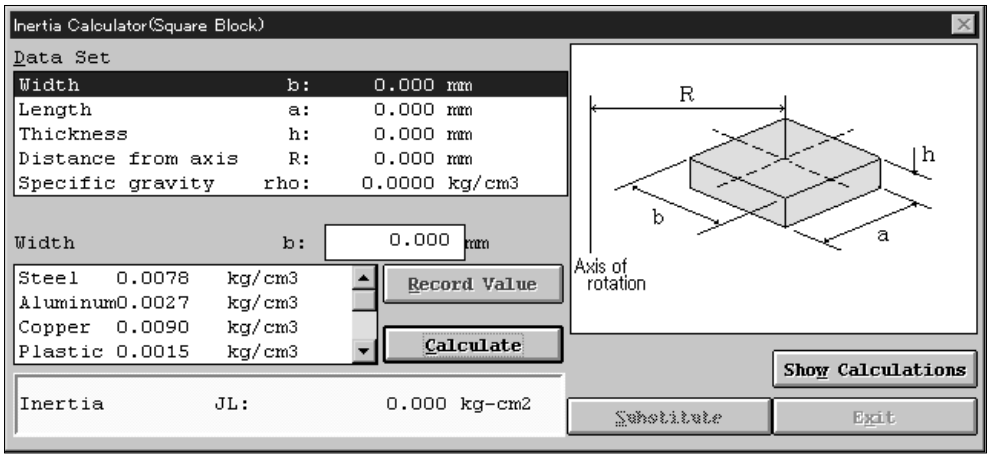
4) End

Click the "Exit" button to end.

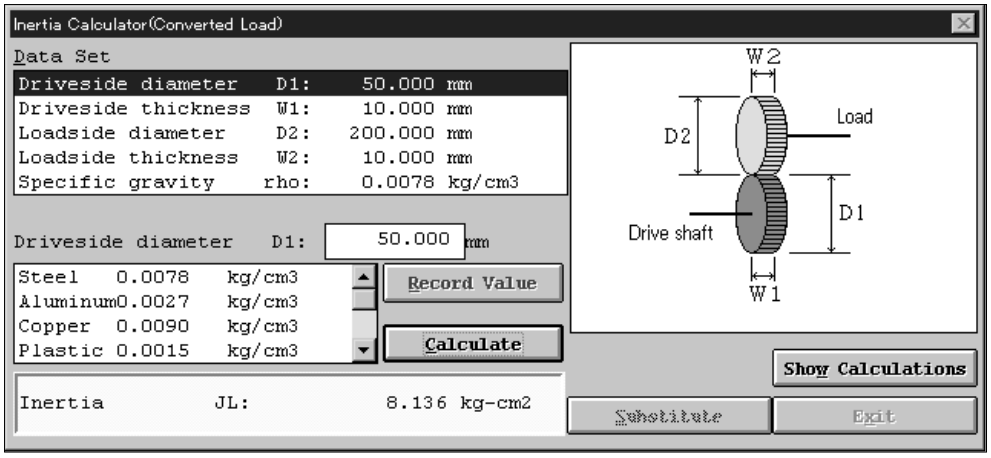
(a) Cylinder



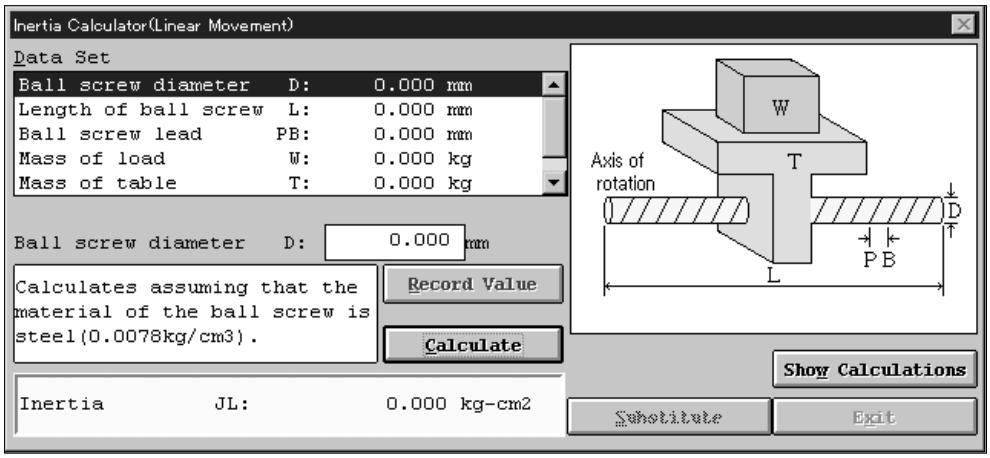
(b) Square Block



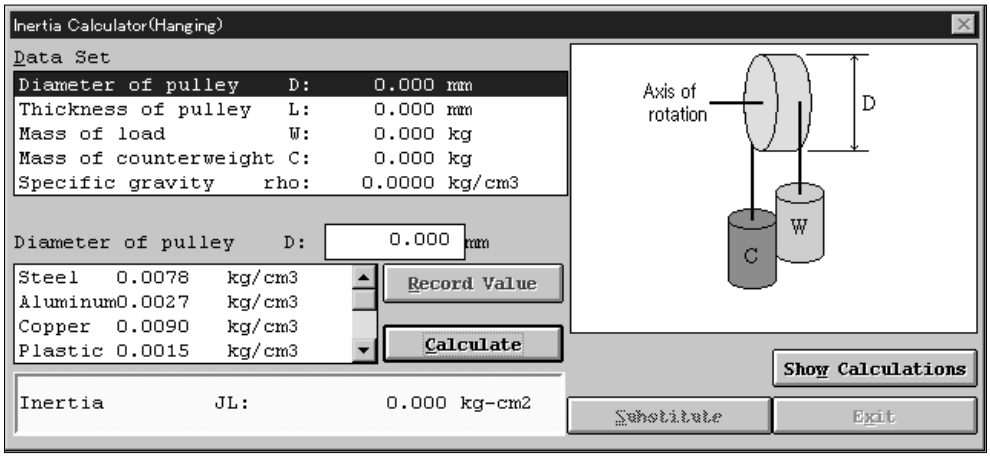
(c) Converted Load



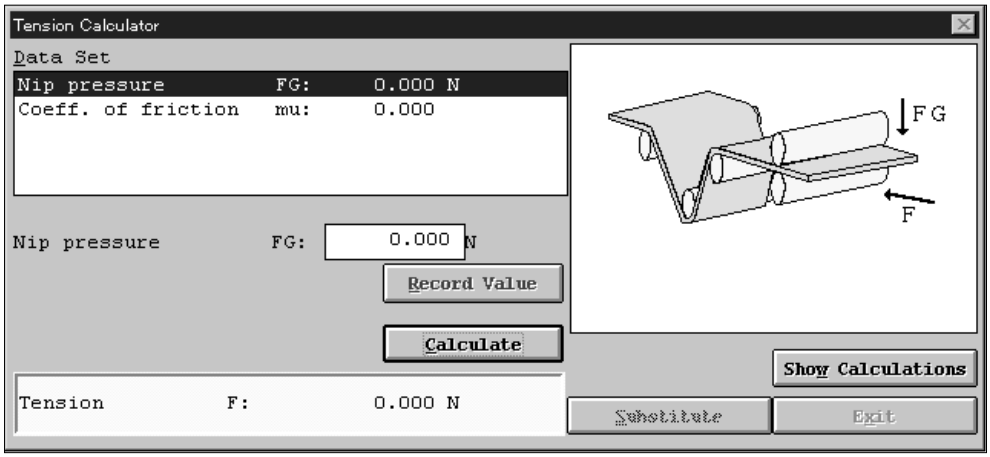
(d) Liner Movement



(e) Hanging

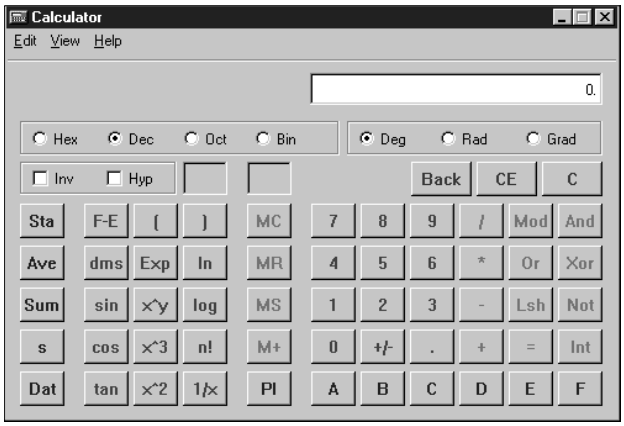


(f) Tension Calculator



(2) Scientific Calculate

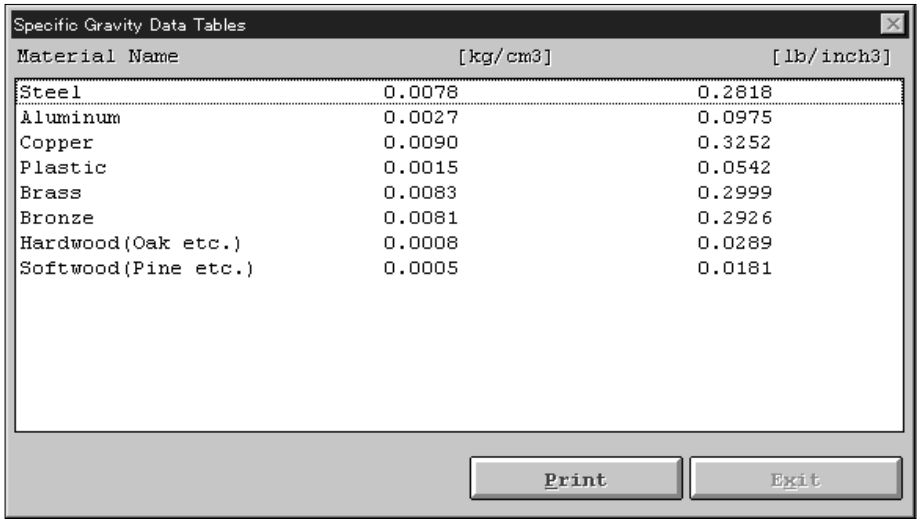
Used to display the “Calculator” of Windows. For usage, refer to the Windows user's guide.



(3) Specific Gravity Tables

Used to display the specific gravities of materials as reference data.

When “Specific Gravity Tables” on the sub menu is clicked, the following window is displayed:



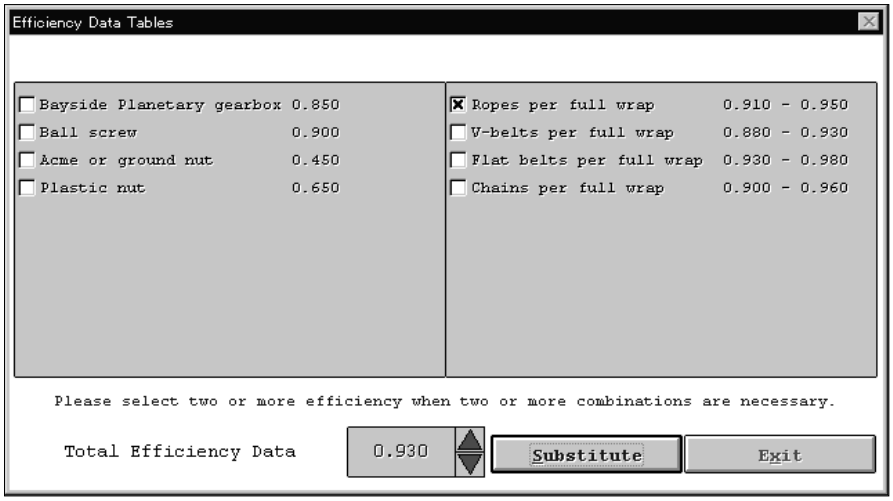
POINT

- Click the “Print” button to print the window contents. Click the “Exit” button to end.

(4) Efficiency Tables

Used to display the efficiencies of drives as reference data depending on conditions.

When "Efficiency Tables" on the sub menu is clicked, the following window appears:



When required, two or more efficiencies can be selected.

1) Selection of input item

Move the focus to "Drive efficiency" in the machine specifications display area. Enter a space to set, or double-click "Drive efficiency".

2) Selection of efficiency

By clicking the option button to, select the required efficiency. More than one efficiency may be selected. When the data has a range, click the button on the right of the data display section to change the data.

3) Substitution for machine specifications data

Click the "Substitute" button to substitute the value for "Drive efficiency" in the machine specifications display area. At this time, Efficiency Data Tables window ends automatically.

4) End

Click the "Exit" button to end.

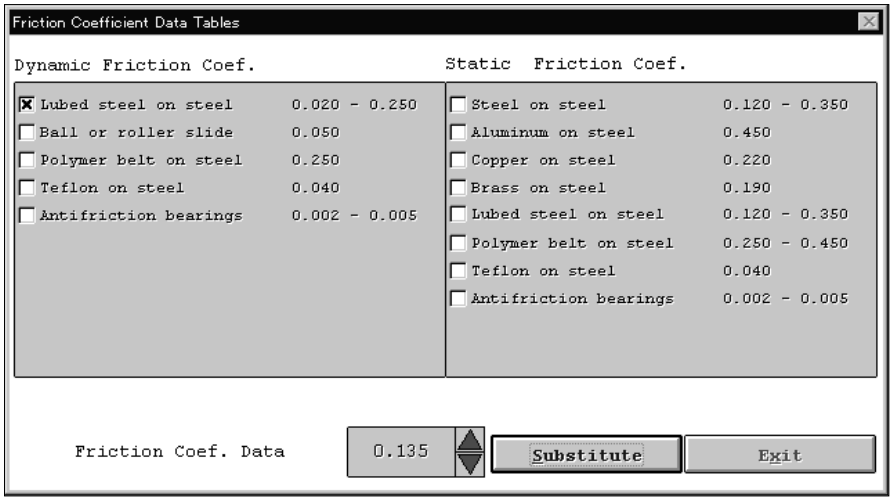
POINT

- "Efficiency Tables" has been selected on the "tools" menu, clicking the "Substitute" button automatically enters the selected efficiency in "Drive efficiency" of the machine specifications display area. If the machine component selected does not have drive efficiency, error message "Can't find substitution selection" is displayed in the message display area.

(5) Friction Coeff. Tables

Used to display friction coefficients as reference data depending on conditions.

When "Friction Coeff. Tables" on the sub menu is clicked.



1) Selection of input item

Move the focus to "Coefficient of friction" in the machine specifications display area. Enter a space to set, or double-click "Coefficient of friction".

2) Selection of friction coefficient

By clicking the option button to ☒ , select the required friction coefficient. When the data has a range, click the ▲▼ button on the right of the data display section to change the data.

3) Substitution for machine specifications data

Click the "Substitute" button to substitute the value for "Coefficient of friction" in the machine specifications display area. At this time, Friction Coefficient Data Tables window ends automatically.

4) End

Click the "Exit" button to end.

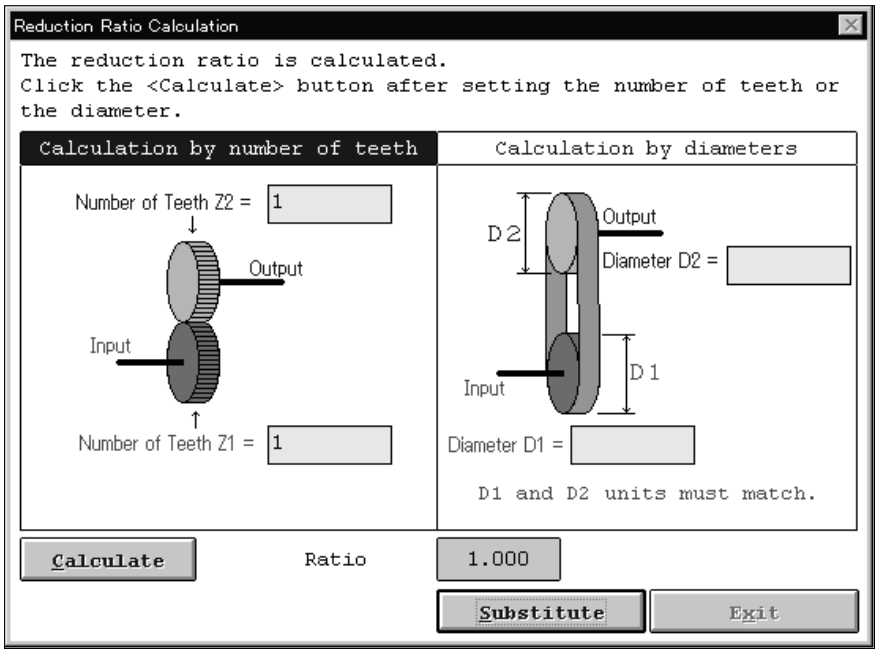
POINT

- "Friction Coeff. Tables" has been selected on the "tools" menu, clicking the "Substitute" button automatically enters the selected friction coefficient in "Coefficient of friction" of the machine specifications display area. If the machine component selected does not have the Coefficient of friction, error message "Can't find substitution selection" is displayed in the message display area.

(6) Radio Calculate

Used to calculate a reduction gear ratio when gears, sprockets, pulleys or the like are used to reduce speed. Calculation by number of teeth and Calculation by diameters are available.

When "Ratio Calculate" on the sub menu is clicked, the following window is displayed:



1) Selection of input item

Move the focus to "Reduction gear ratio (NL/NM)" in the machine specifications display area. Enter a space to set, or double-click "Reduction gear ratio (NL/NM)".

2) Input and calculation of data

Enter required data and click the "Calculate" button.

3) Substitution for machine specifications data

Click the "Substitute" button to substitute the value for "Reduction gear ratio (NL/NM)" in the machine specifications display area. At this time, Reduction Ratio Calculation window ends automatically.

4) End

Click the "Exit" button to end.

POINT

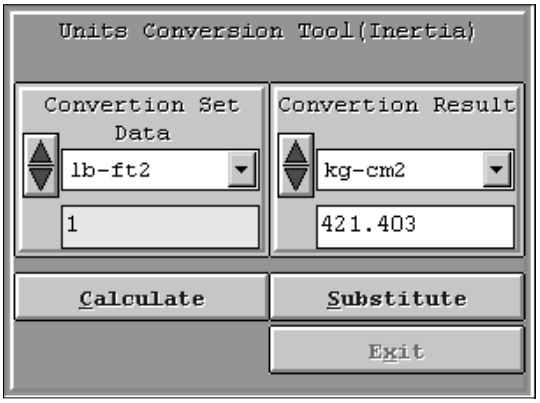
- "Radio Calculate" has been selected on the "tools" menu, clicking the "Substitute" button automatically enters the calculated reduction gear ratio in "Reduction gear ratio (NL/NM)" of the machine specifications display area. If the machine component selected does not have the reduction gear ratio, error message "Can't find substitution selection" is displayed in the message display area.

(7) Units Conversion

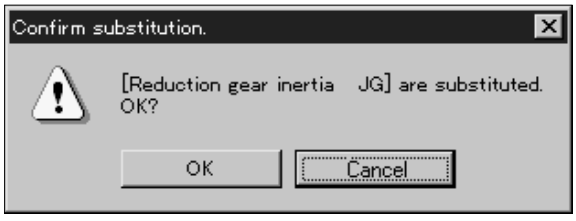
Calculation tool designed to convert the inertia, torque, length, weight, force or speed unit.
Any of the following units may be converted:

Inertia	Torque	Length	Weight	Force	Speed
kg・m^2	N・m	m	kg	N	m/min
kg・cm^2	kgf・m	cm	g	kgf	cm/min
kgf・m^2	kgf・cm	mm	lb	gf	mm/min
kgf・cm^2	gf・cm	ft	oz	lb	m/sec
kg・m・sec^2	lb-ft	inch		oz	cm/sec
kg・cm・sec^2	lb-inch				mm/sec
lb-ft^2	oz-inch				ft/min
lb-inch^2					inch/min
oz-inch^2					ft/sec
lb-ft-sec^2					inch/sec
lb-inch-sec^2					
oz-inch-sec^2					

When any command is selected, the following window appears (example: for inertia):

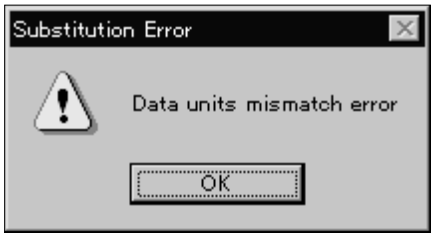


1) Click "Tools" of the menu bar to open the menu.
2) Point to the "Units conversion" and click "Inertia".
3) Open the Conversion Set Data combo box, choose the unit, and enter the data to be converted into the entry field.
4) Open the Conversion Result combo box and select the unit.
5) Click the "Calculate" button to start unit conversion.
6) By clicking the "Substitute" button, "Please click substituting value destination." is displayed in the message display section. By selecting the machine specification in which the data is to be substituted, the following window is displayed:



7) If the item in which the data is to be substituted is correct, click the "OK" button.

If the unit of the machine specification does not match the new unit, substitution cannot be made. In this case, the following window is displayed:



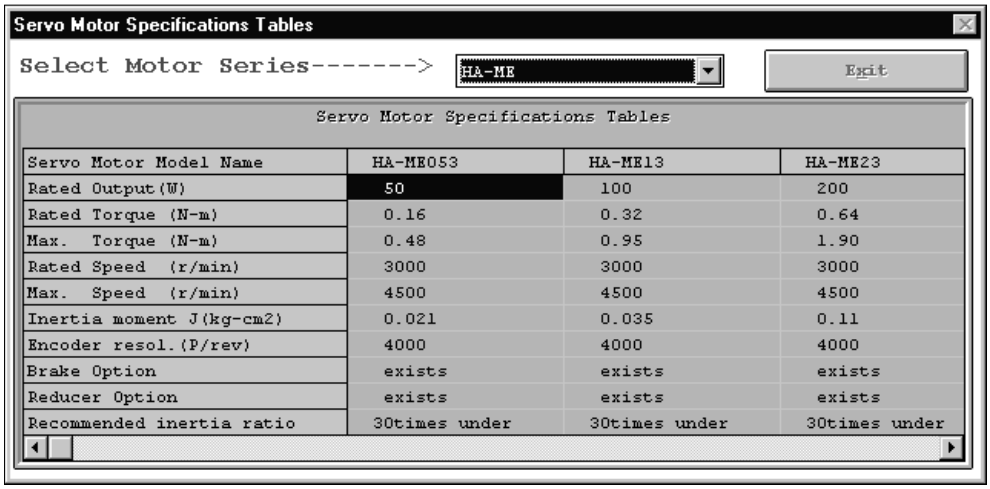
8) Click the "Exit" button to end.

(8) Motor Data Tables

Used to display the servo motor specifications as reference data. The following specifications are displayed:

Rated Output	(W)
Rated Torque	(N・m)
Max. Torque	(N・m)
Rated Speed	(r/min)
Max. Speed	(r/min)
Inertia moment J	($kg \cdot cm^2$)
Encoder resol.	(P/rev)
Brake Option	
Reducer Option	
Recommended inertia ratio	

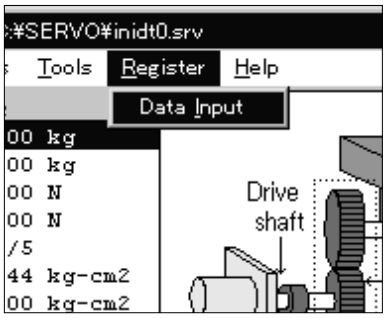
When "Motor Data Tables" on the sub menu clicked, the following window appears:



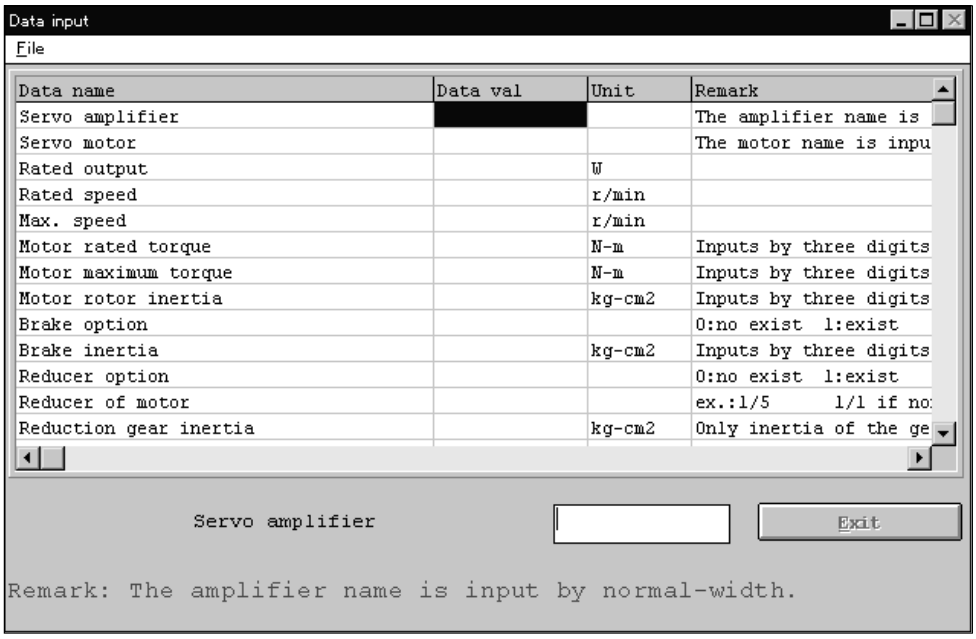
1) Open the Select Motor Series combo box and select the servo motor series.
2) Click the "Exit" button to end.

3.3.7 Register

By entering data which does not exist in the "Servo Amp" and "Motor" commands of this software, capacity calculation can be made with the registered data.
When "Register" of the menu bar is clicked, the following menu appears:



Clicking "Data Input" of the sub menu, enter the data values required for capacity calculation.
When "Data Input" is selected, the following window opens.



Refer to the catalog and Installation Guide of the corresponding servo amplifier and enter all data.

The following data are required for capacity calculation:

Servo amplifier data

Data Name		Unit
Servo amplifier		
Position loop gain	(Note)	1/sec
Capacitor charging energy	(Note)	J
Built-in regenerat. brake rated power		W
Built-in regenerat. brake max. power	(Note)	W
Built-in regenerat. brake time const.	(Note)	sec

Servo motor data

Data Name		Unit
Servo motor		
Rated output		W
Rated speed		r/min
Max. speed		r/min
Brake option		
Reducer option		
Recommended inertia		times
Reducer of motor		
Encoder resolution		pulse/rev
Reduction gear inertia	(Note)	kg・cm^2
Brake inertia		kg・cm^2
Motor rotor inertia		kg・cm^2
Motor maximum torque		N・m
Motor rated torque		N・m
Reverse-efficiency of motor	(Note)	%
Torque bend point rot. speed	(Note)	r/min
Max. speed max. torque	(Note)	N・m

Regenerative brake resistor data

Data Name		Unit
Regenerative option name		
Regenerative option rated power		W
Regenerative option brake max. power	(Note)	W
Regenerative option time const.	(Note)	sec

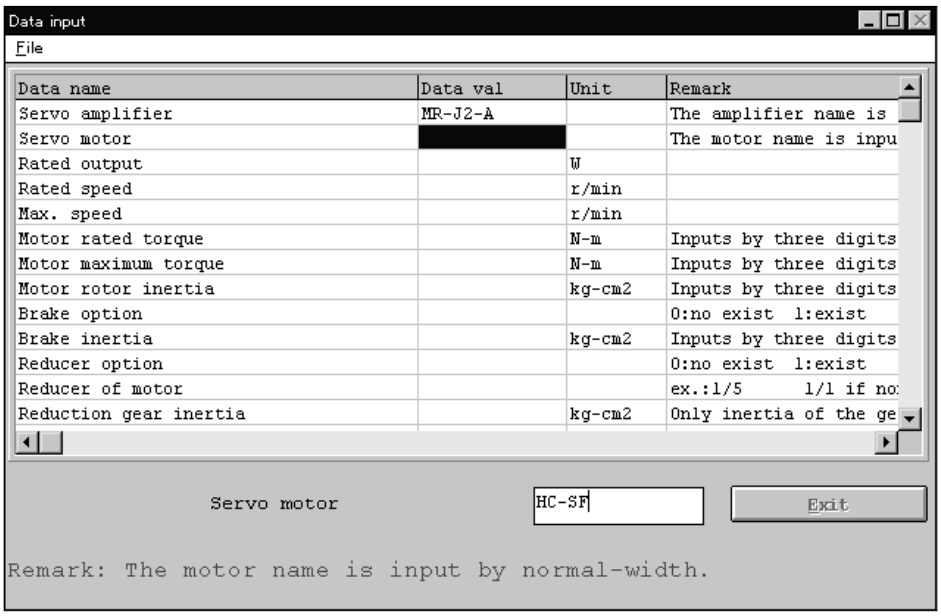
Note: These data are not given in the catalog and Installation Guide of the corresponding servo amplifier. Contact us.

(1) Entering data

1) Move the cursor to the item into which data will be entered.
2) Enter data into the data value entry area.
3) Press the "Enter" to set that data.

In a similar manner, set all data.

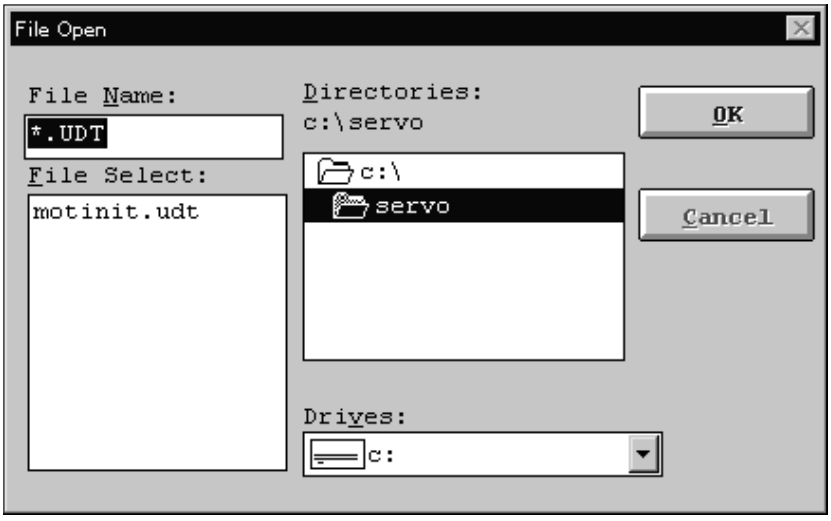
Data should be entered in the International System of Units (SI). Capacity calculation and result display are performed in the selected system of units.



(a) Open

Used to read input information from the saved file.

When "Open" of the sub menu is clicked, the File Open window opens and the file to be read can be specified.



After entering (at this time, the default extension of the file should be "udt") or specifying the file name, click the "OK" button to read the specified file.

The drive and directory used for reading can be specified in the Drives and Directories boxes.

(b) Save

Used to save the entered information into the file.

When "Save" of the sub menu is clicked, a window similar to the one opened in "Open" opens.

After entering (at this time, the default extension of the file should be "udt") or specifying the file name, click the "OK" button to save the input information by the specified file name.

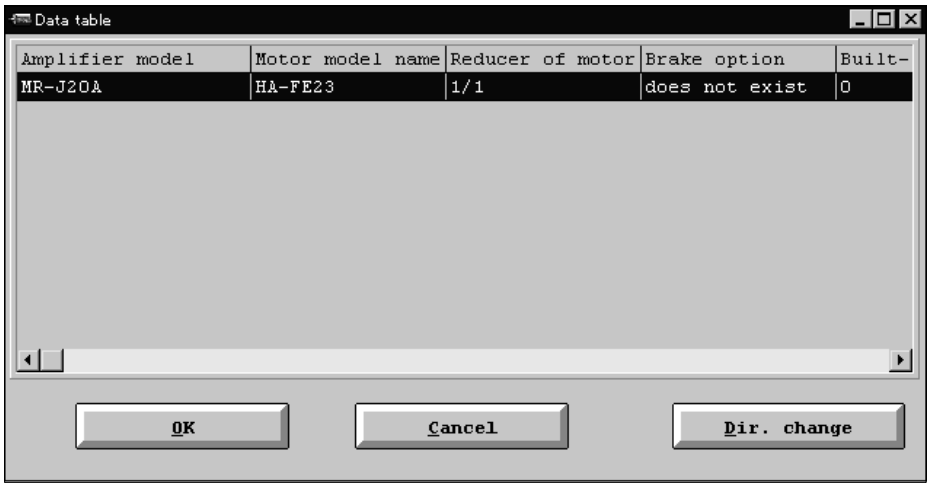
(c) Exit

Used to close the Data input window.

Click the "Exit" button may also be used to close the window.

(2) Using the registered data for capacity calculation

1) Click "Servo Amp" of the menu bar, point to "File creation" and click the "Standard".
2) Click "Motor" of the menu bar, point to "File creation" and click the "rpm".
3) Enter the machine specifications data.
   Since the response level is set according to the position loop gain registered, the setting of "High Response", "Medium Response" and "Low Response" cannot be made.
   Only "Free Setting" is made valid and use the settling time set here to make capacity calculation.
4) Click the "Calculate" button.
   The following Data table window appears:

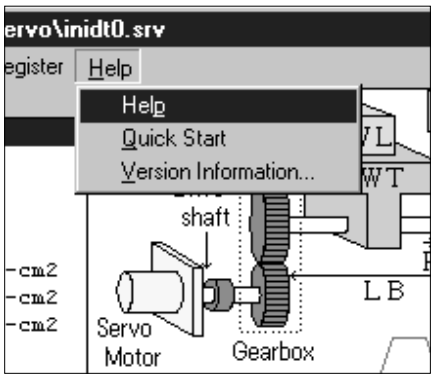


5) Choose the file and click the "OK" button to start calculation. Use the "Dir. change" button to change the drive and directory of the file to be selected.
   At this time, click the "Cancel" button to suspend capacity calculation and close this window.
6) When calculation ends, the calculation end message appears.
   Click the "OK" button to show the calculation result in the calculation result display area.

If the capacity seems to be outside the setting range as a result of calculation, the result is shown red in the calculation result display area. Reconsider the data set values and file selection.

3.3.8 Help

When "Help" on the menu bar is clicked, the following menu appears:



(1) Help

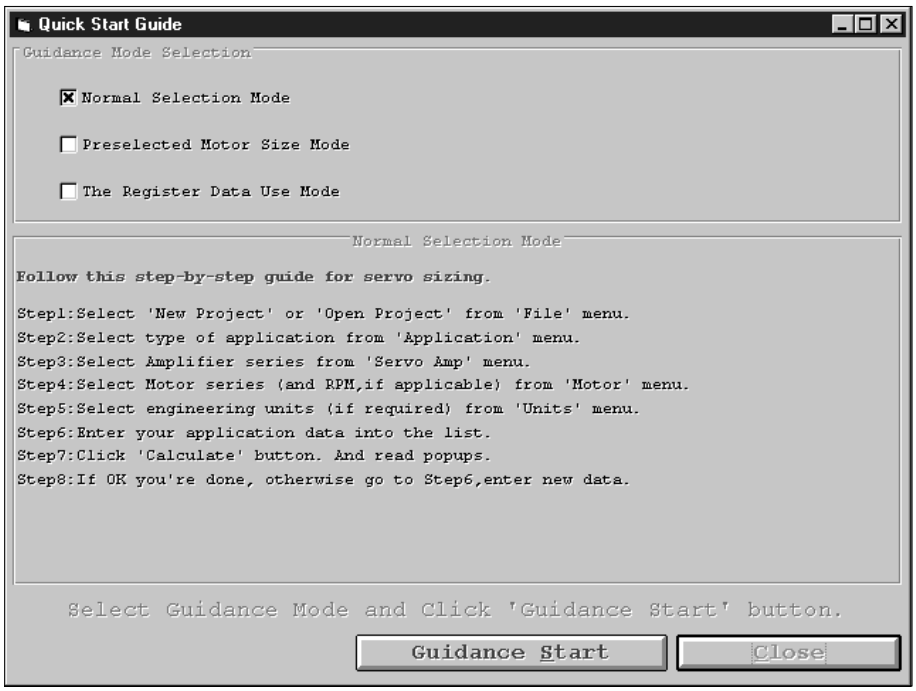
Used to display the error message.

1) Click "File" on the menu bar to open the menu.
2) Click "Exit".

(2) Quick Start

Used to display the operation method.

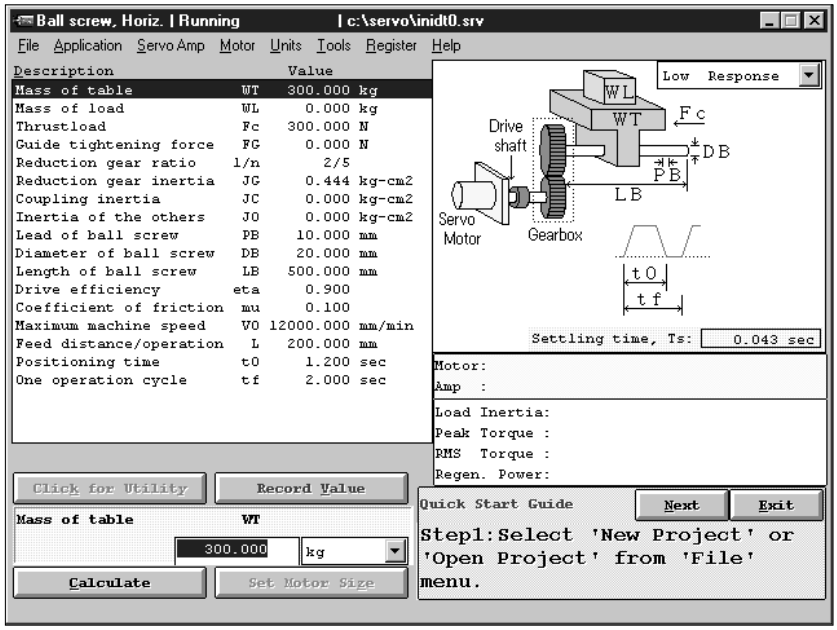
When "Quick Start" on the sub menu is clicked, the following window appears:



When you choose the guidance mode to be used, the operation procedure corresponding to that mode appears.

Click the "Close" button to end.

Click the "Guidance Start" button in any mode to return to the main screen and show the operation guidance on the bottom right of the screen.



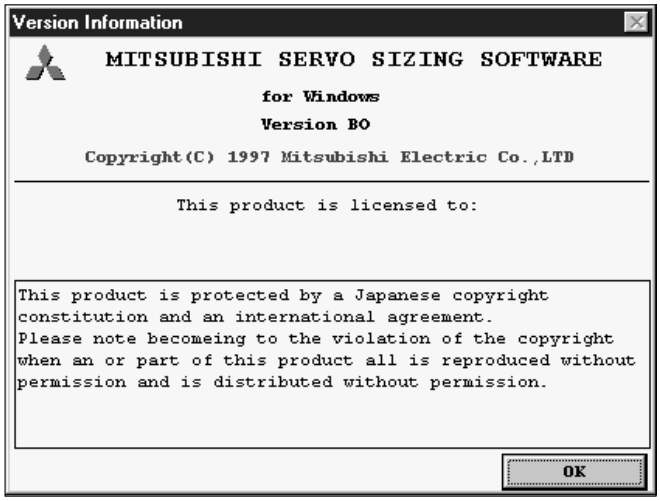
Perform operation according to the operation guidance and click the "Next" button to proceed to the next step.

Click the "Exit" button to quit the operation guidance.

(3) Version Information

Used to display the version of the capacity selection software.

Click the "OK" button to end.



3.4 Entry of machine specifications and execution of selection/calculation

In the machine specifications display area, each data on the selected machine component is displayed. Enter data in all items and start selection/calculation.

(1) Entry of machine specifications data

(a) Selection of input item

Move the focus to the item in the machine specifications display area in which data will be entered.

(b) Display of input unit

By moving the focus to the unit area, the menu of the units that can be selected is displayed. Choose the unit to be used.

(c) Data entry

Move the focus to the machine specifications entry area and enter data from the key board.

> POINT
>
> ・To change the unit of data to be entered, move the focus to the unit field, open the combo box, and select the unit.

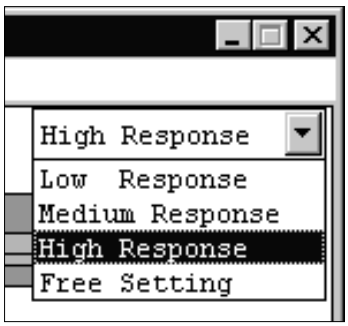
(d) Data setting

Click the "Record Value" button or press the "Enter" to set the data. Upon data setting, the corresponding data in the machine specifications display area is updated.

> POINT
>
> ・Entering a space in "Reduction gear inertia", "Coupling inertia" or "Inertia of feed roll or tension" and clicking the "Record Value" button will automatically display the Inertia Calculate window. For more information, refer to "Tools".

(e) Setting of servo response level

> POINT
>
> ・Set the servo response level correctly. Otherwise, correct selection/ calculation results are not available.

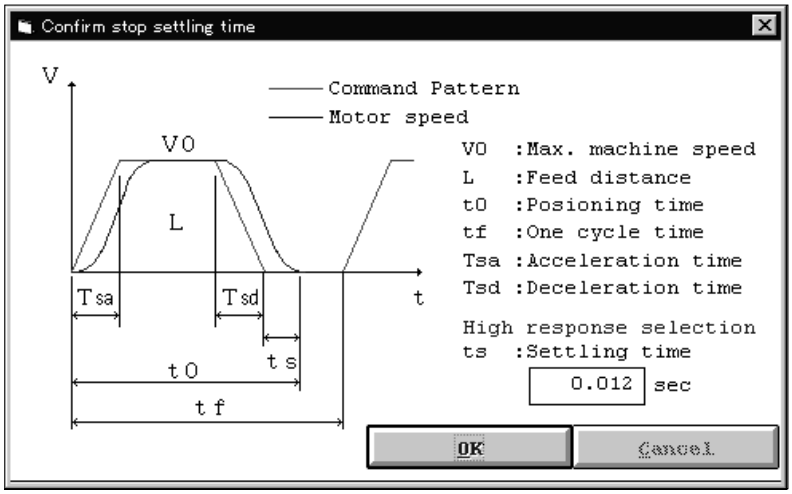


Set the response level of the servo according to the tracking performance of the machine. Servo response levels available are "Low, Medium and High Responses". Select "Low Response" for low tracking performance of the machine or "High Response" for high tracking performance. The position loop gain (K_p) calculated will vary with the setting. Move the focus to the servo response setting field, open the combo box, and set the servo response level.

Servo response list

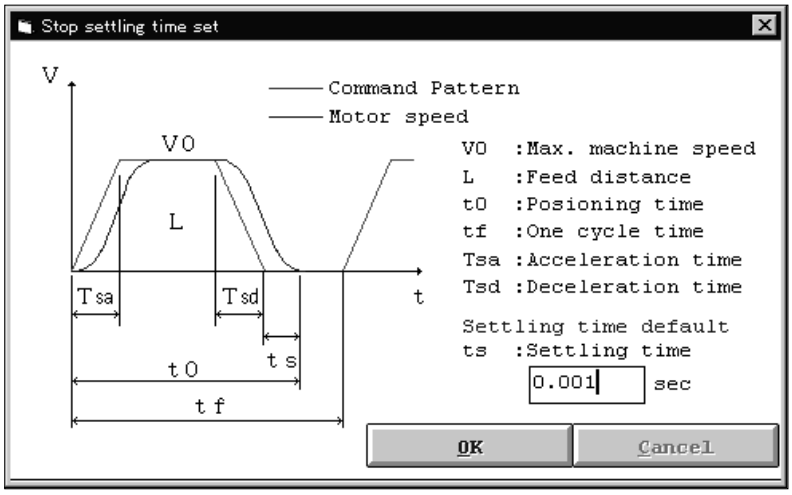
Servo Amplifier Series	Position Loop Gain Kp (Stop Setting Time ts [s])		
	Low Response	Medium Response	High Response
MR-J-A	25 (0.120)	75 (0.040)	150 (0.020)
MR-J-A [100V]			
MR-H-AN	70 (0.043)	150 (0.020)	250 (0.012)
MR-J-B	25 (0.120)	75 (0.040)	150 (0.020)
MR-H-BN	70 (0.043)	150 (0.020)	250 (0.012)
MR-H-ACN			
FCUA-MP10	25 (0.120)	75 (0.040)	150 (0.020)
MR-C	70 (0.043)	150 (0.020)	250 (0.012)
MR-C [100V]			
MR-J2-A			
MR-J2-A [100V]			
MR-J2-B			
MR-J2-C			
MR-J2-03A5			
MR-J2-03C5			
MR-H-TN			
MR-HN [400V]			
MR-J2S-A			
MR-J2S-A [100V]			
MR-J2S-B			
MR-J2S-B [100V]			
MR-J2-C-S100			
MR-H-DN4			

When the response level is set, the following window (example: for High Response) is displayed to indicate the settling time (t_s) of the servo motor.



Click the "OK" button to end.

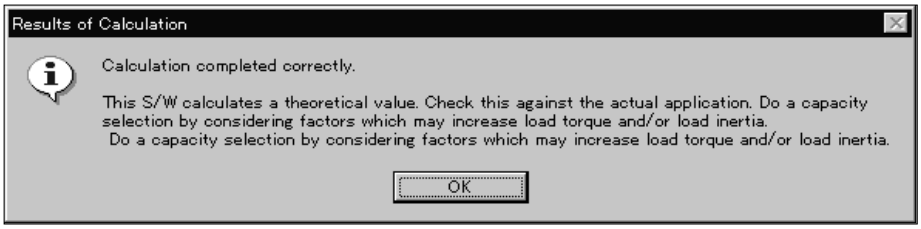
By clicking "Free Setting", the following window is displayed to allow the optional setting of the settling time (t_s).



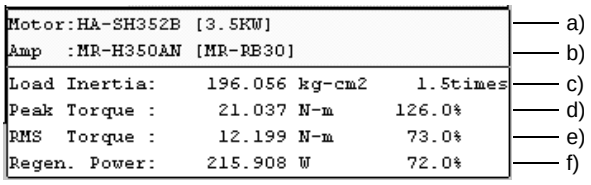
After entering the settling time, click the "OK" button to set.

(2) Execution of capacity selection

1) Click the "Calculate" button to start calculation.
On completion of selection/calculation, the following window will appear:



2) Click the "OK" button to continue.
In the selection/calculation display area, the types of the servo motor, servo amplifier and regenerative brake option are displayed as selection results, and the load inertia, peak torque, effective torque and regenerative power are displayed as calculation results.



The above window represents the following contents:

a) The servo motor used is the HA-SH352B.

b) The servo amplifier used is the MR-H350AN and the regenerative option used is the MR-RB30.

c) The load inertia at the servo motor shaft of the machine is 196.056 (kg · cm^2) or 1.5 times greater than the servo motor shaft inertia.

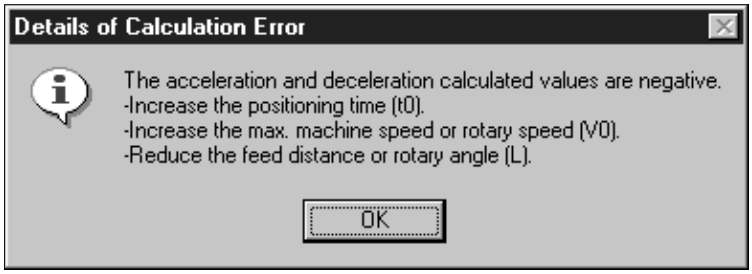
d) The peak torque is 21.037 [N · m] or 126.0% of the rated servo motor torque.

e) The required effective torque is 12.199 [N · m] or 73.0% of the rated servo motor torque.

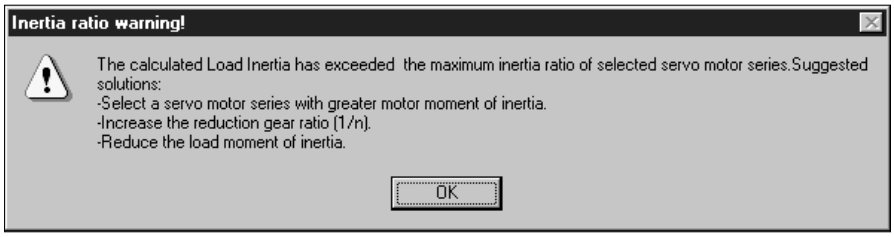
f) The regenerative power generated is 215.908 [W] or 72.0% of the permissible regenerative power of the MR-RB30 regenerative brake option.

When the regenerative brake option is not required, the following window is displayed.
Click the "OK" button to continue selection.

If selection cannot be made, the following error window appears. As its cause is displayed in the message display area, reexamine the set values and selection of the data to eliminate the error.



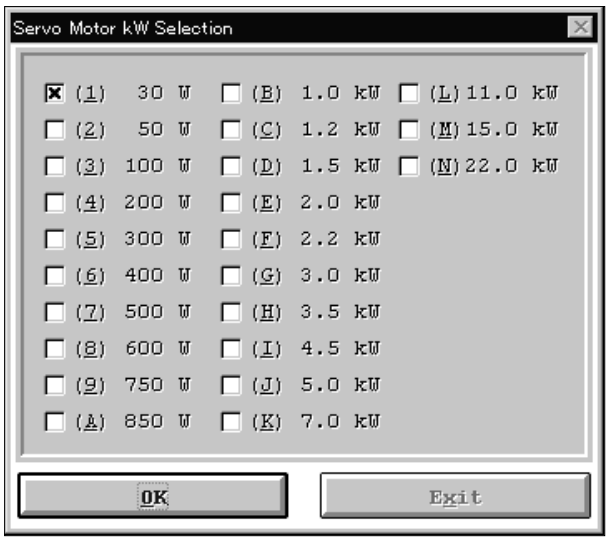
If the load inertia of the machine to the servo motor shaft has exceeded the recommended load inertia ratio as a result of calculation, the following warning window appears. In this case, an error will not occur but the load inertia ratio in the calculation/selection results is displayed in red number. Follow the prompt in the window and reexamine the set values and selection of the data to eliminate the warning.



(3) Starting calculation with servo motor capacity specified

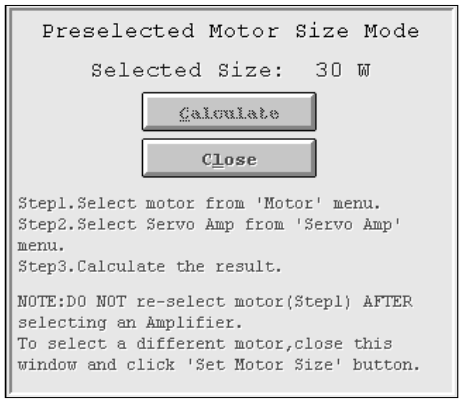
Before starting selection/calculation, the servo motor capacity can be specified. When starting calculation with the servo motor capacity specified, the servo motor series and servo amplifier series must be reselected. Make selection according to the prompt in the message display area.

1) By clicking the "Set Motor Size" button, the following window is displayed:

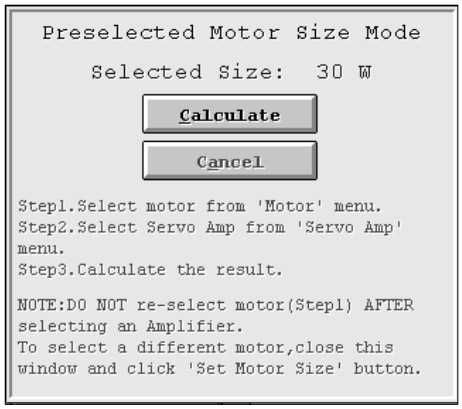


2) Move the focus to the capacity to be specified.

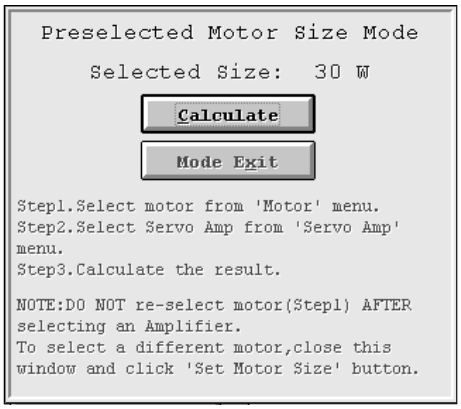
3) By clicking the "OK" button to complete the designation of the servo motor capacity, the following window appears:



4) Select the servo motor series and servo amplifier series according to the prompt in the message display area. When selection is complete, the following window is displayed.



5) Click the "Calculate" button to start calculation. Results as shown in this Chapter (2) Execution of capacity selection and the following window are displayed:



6) Click the "Mode Exit" button to exit from the capacity designation mode.

POINT

- To suspend capacity designation, click the "Cancel" or "Close" button in the corresponding window.

(4) Display of calculation process

Click the machine structure illustration area or click the "Show Calculations" button to display the calculation process.

3.5 Error messages

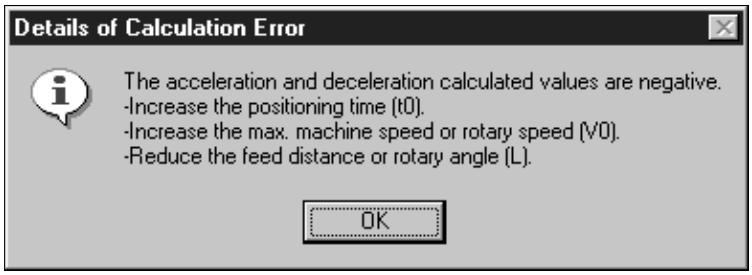
If wrong input data is set or capacity selection cannot be made, the corresponding error message is shown in the message display area or window. Refer to the message definition and continue operation.

(1) Message display area

Error Message
The Set data is not selected!!
Only numerical values allowed!
Must be greater than zero.
The given data cannot be used by the calculator.
File error.
Motor speed error.
There is no Servo Motor in this series with the required output torque.
Acceleration and deceleration time value error.
Acceleration and deceleration time error.
There is no Servo Motor in this series with the required output torque rating.
There is no regeneration resistor of the required power rating.
Select a Servo Motor series.
Select a Servo Motor RPM.
Select a Servo amplifier.
Can't find substitution selection.
There is no substitution data.
Error of load torque when the motor stopped.
Error of positioning length underestimate.

(2) Error details explanation of calculation window

When capacity selection cannot be made, the following window will appear to display the error message.



Error Message
Maximum machine speed or rotary speed (V_0) has exceeded the maximum speed of the motor selected. ・Reduce the max. machine speed or rotary speed (V_0). ・Reduce the reduction gear ratio setting (1/n). ・Increase feed distance per motor revolution. Ex. Use a greater ball screw lead value.
The acceleration and deceleration calculated values are negative. ・Increase the positioning time (t_0). ・Increase the max. machine speed or rotary speed (V_0). ・Reduce the feed distance or rotary angle (L).
The time required for acceleration and deceleration is greater than the positioning time. ・Reduce the positioning time (t_0). ・Increase the feed distance or rotary angle (L).
The torque requirement has exceeded the maximum rating of the largest motor in this series. ・Select a servo motor series with a greater output torque capacity. ・Increase the reduction gear ratio (1/n). ・Reduce the mass of the load.
The moment of inertia ratio exceeds the allowable ratio of the selected motor series. ・Select a servo motor series with a greater motor moment of inertia. ・Increase the reduction gear ratio (1/n). ・Reduce the load moment of inertia.
Accel/Decel torque exceeds the maximum torque of the largest motor in this series. ・Select a servo motor series with a greater output capacity. ・Increase the positioning time (t_0). ・Reduce the load torque and inertia.
The RMS torque has exceeded the rated torque of the motor. ・Select a different Servo Motor series. ・Load torque and accel./decel. torque must be reduced
Imbalance torque exceeds the maximum torque of the largest motor in this series. ・Select a servo motor series with a greater output capacity. ・Increase counter weight value to reduce the imbalance torque.
Imbalance torque exceeds the rated torque of the largest motor in this series. ・Select a servo motor series with a greater output capacity. ・Reduce the imbalance to reduce the imbalance torque.
The feed distance or rotary angles (L) is too short. ・Increase the feed distance or rotary angles (L). ・Reduce the max machine speed or rotary speed (V_0). ・Reduce the positioning time (t_0).

MEMO

4. CALCULATION FORMULAS

Calculation formulas in the absolute unit system (SI) used in each machine structure are listed in this chapter for your reference. In any unit system, clicking the machine structure illustration area will display the calculation process window, and starting details print will print the symbol list and calculation process.

4.1 Ballscrew horizontal

Symbol list

Symbol	Content	Unit
W_T	Mass of table	kg
W_L	Mass of load	kg
F_c	Thrustload	N
F_G	Guide tightening force	N
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
P_B	Lead of ball screw	mm
D_B	Diameter of ball screw	mm
L_B	Length of ball screw	mm
eta	Drive efficiency	
mu	Drive coefficient of friction	
V_0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t_0	Positioning time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

4. CALCULATION FORMULAS

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=P_B*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of ball screw	$J_B=\{(pi*0.0078*(L_B/10))/32\}*(D_B/10)\text{^}4$	kg・cm^2
Inertia of Table & Load	$J_F=(W_T+W_L)*(dS/20pi)\text{^}2$	kg・cm^2
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+J_B*(1/n)\text{^}2\}*(1/n_m)\text{^}2$	kg・cm^2
Load torque	$T_L=\{(F_C+mu*(W_T+W_L)*g+F_G)*dS\}/(2000*pi*eta)$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Acceleration torque	$T_{Ma}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_L$	N・m
Deceleration torque	$T_{Md}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_L$	N・m
Peak load factor	$R_p=\{(\text{maximum value of } \lvert T_{Ma}\rvert, \lvert T_{Md}\rvert)/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=S_{QRT}\{(T_{Ma}\text{^}2*T_{sa}+T_L\text{^}2*t_c+T_{Md}\text{^}2*T_{sd})/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	$E_a=(0.1047/2)*N_0*T_{Ma}*T_{sa}$	J
Deceleration energy	$E_d=(0.1047/2)*N_0*T_{Md}*T_{sd}$	J
Constant speed energy	$E_f=0.1047*N_0*T_L*t_c$	J
Absolute of −energy total	$E_m=\lvert$(total of negative energy in E_a, E_d, E_f)$\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

4.2 Ballscrew vertical

Symbol list

Symbol	Content	Unit
W_T	Mass of table	kg
W_L	Mass of load	kg
W_C	Mass of counterweight	kg
F_c	Thrustload	N
F_G	Guide tightening force	N
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
P_B	Lead of ball screw	mm
D_B	Diameter of ball screw	mm
L_B	Length of ball screw	mm
eta	Drive efficiency	
mu	Drive coefficient of friction	
V_0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t_0	Positioning time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

4. CALCULATION FORMULAS

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=P_B*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of ball screw	$J_B=\{(pi*0.0078*(L_B/10))/32\}*(D_B/10)\text{^}4$	kg・cm^2
Inertia of Table & Load	$J_F=(W_T+W_L+W_C)*(dS/20pi)\text{^}2$	kg・cm^2
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+J_B*(1/n)\text{^}2\}*(1/n_m)\text{^}2$	kg・cm^2
Imbalance torque	$T_U=\{(F_C+(W_T+W_L-W_C)*g)*dS\}/(2000*pi)$	N・m
Friction torque	$T_F=\{m_u*((W_T+W_L+W_C)*g+F_G)*ds\}/(2000*pi)$	N・m
Upward load torque	$T_{Lu}=(T_U+T_F)/eta$	N・m
Downward load torque	In case $(-T_U+T_F)>0$: $T_{Ld}=(-T_U+T_F)/eta$ In case $(-T_U+T_F)<0$: $T_{Ld}=(-T_U+T_F)*eta$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Upward accele. torque	$T_{Mau}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_{Lu}$	N・m
Upward decele. torque	$T_{Mdu}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_{Lu}$	N・m
Downward accele. torque	$T_{Mad}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_{Ld}$	N・m
Downward decele. torque	$T_{Mdd}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_{Ld}$	N・m
Peak load factor	$R_p=\{(\text{maximum value of }\lvert TMxx\ data\rvert)/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms2}=SQRT\{\{T_{Mau}\text{^}2+T_{Mad}\text{^}2)*T_{sa}+(T_{Mdu}\text{^}2+T_{Mdd}\text{^}2)*T_{sd}+(T_{Lu}\text{^}2+T_{Ld}\text{^}2)*t_c+T_U\text{^}2*(t_f-2*t_0+2*t_s)\}/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms2}/T_{typ})*100$	%
Upward accele. energy	$E_{au}=(0.1047/2)*N_0*T_{Mau}*T_{sa}$	J
Upward decele. energy	$E_{du}=(0.1047/2)*N_0*T_{Mdu}*T_{sd}$	J
Upward const.speed energy	$E_{fu}=0.1047*N_0*T_{Lu}*t_c$	J
Downward accele. energy	$E_{ad}=(0.1047/2)*N_0*T_{Mad}*T_{sa}$	J
Downward decele. energy	$E_{dd}=(0.1047/2)*N_0*T_{Mdd}*T_{sd}$	J
Downward con.speed energy	$E_{fd}=0.1047*N_0*T_{Ld}*t_c$	J
Absolute of −energy total	$E_m=\lvert(\text{total of negative energy in Exx data})\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

4.3 Rack & pinion

Symbol list

Symbol	Content	Unit
W_T	Mass of table	kg
W_L	Mass of load	kg
F_c	Thrustload	N
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
D_P	Diameter of pinion	mm
W_P	Width of pinion	mm
eta	Drive efficiency	
mu	Drive coefficient of friction	
V_0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t_0	Positioning time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=pi*D_P*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of pinion	$J_P=\{(pi*0.0078*(W_P/10))/32\}*(D_P/10)^4$	kg・cm^2
Inertia of Table & Load	$J_F=(W_T+W_L)*(dS/20p_i)^2$	kg・cm^2
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+J_P*(1/n)^2\}*(1/n_m)^2$	kg・cm^2
Load torque	$T_L=\{(F_C+mu*(W_T+W_L)*g)*dS\}/(2000*pi*eta)$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Acceleration torque	$T_{Ma}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_L$	N・m
Deceleration torque	$T_{Md}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_L$	N・m
Peak load factor	$R_p=\{$(maximum value of $\lvert T_{Ma}\rvert, \lvert T_{Md}\rvert$)$/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=S_{QRT}\{(T_{Ma}^2*T_{sa}+T_L^2*t_c+T_{Md}^2*T_{sd})/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	$E_a=(0.1047/2)*N_0*T_{Ma}*T_{sa}$	J
Deceleration energy	$E_d=(0.1047/2)*N_0*T_{Md}*T_{sd}$	J
Constant speed energy	$E_f=0.1047*N_0*T_L*t_c$	J
Absolute of −energy total	$E_m=\lvert$(total of negative energy in E_a, E_d, E_f)$\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

4.4 Roll feed

Symbol list

Symbol	Content	Unit
F	Tension	N
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
D_R	Outside diameter of feed roll	mm
J_R	Inertia of feed roll	kg・cm^2
eta	Drive efficiency	
V_0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t_0	Feed time per operation	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=pi*D_R*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Total load inertia	$J_L=J_{MG}+J_{MB}+\{J_G+J_C+J_O+2*J_R*(1/n)^2\}*(1/n_m)^2$	$kg \cdot cm^2$
Load torque	$T_L=F*(D_R/2000)*1/n*1/n_m*(1/eta)$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Acceleration torque	$T_{Ma}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_L$	N・m
Deceleration torque	$T_{Md}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_L$	N・m
Peak load factor	$R_p=\{$(maximum value of $\lvert T_{Ma}\rvert, \lvert T_{Md}\rvert$)$/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=S_{QRT}\{(T_{Ma}^2*T_{sa}+T_L^2*t_c+T_{Md}^2*T_{sd})/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	$E_a=(0.1047/2)*N_0*T_{Ma}*T_{sa}$	J
Deceleration energy	$E_d=(0.1047/2)*N_0*T_{Md}*T_{sd}$	J
Constant speed energy	$E_f=0.1047*N_0*T_L*t_c$	J
Absolute of −energy total	$E_m=\lvert$(total of negative energy in E_a, E_d, E_f)$\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

4.5 Rotary table

Symbol list

Symbol	Content	Unit
W_T	Mass of table	kg
W_L	Mass of load	kg
L_W	Position of load center	mm
J_U	Inertia of load on table	kg・cm^2
D_H	Diameter of support part	mm
D_T	Diameter of rotary table	mm
D_S	Diameter of main shaft	mm
L_S	Length of main shaft	mm
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
mu	Drive coefficient of friction	
eta	Drive efficiency	
V_0	Maximum rotary speed	deg/min
L	Rotary angles per operation	deg
t_0	Positioning time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=360*1/n*1/n_m$	deg/rev
Electrical accuracy	$dL=dS/P_f$	deg/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of rotary table	$J_K=(W_T*(D_T/10)\text{^}2)/8$	kg・cm^2
Inertia of load on table	$J_W=J_U+W_L*(L_W/10)\text{^}2$	kg・cm^2
Inertia of main shaft	$J_S=\{(pi*0.0078*(L_S/10))/32\}*(D_S/10)\text{^}4$	kg・cm^2
Total load inertia	$J_L=J_{MG}+J_{MB}+\{J_G+J_C+J_O+(J_K+J_W+J_S)*(1/n)\text{^}2\}*(1/n_m)\text{^}2$	kg・cm^2
Load torque	$T_L=mu*(W_T+W_L)*g*(D_H/2000)*(1/n)*(1/n_m)*(1/eta)$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Acceleration torque	$T_{Ma}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_L$	N・m
Deceleration torque	$T_{Md}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_L$	N・m
Peak load factor	$R_p=\{(\text{maximum value of } \lvert T_{Ma}\rvert, \lvert T_{Md}\rvert)/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=SQRT\{(T_{Ma}\text{^}2*T_{sa}+T_L\text{^}2*t_c+T_{Md}\text{^}2*T_{sd})/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	$E_a=(0.1047/2)*N_0*T_{Ma}*T_{sa}$	J
Deceleration energy	$E_d=(0.1047/2)*N_0*T_{Md}*T_{sd}$	J
Constant speed energy	$E_f=0.1047*N_0*T_L*t_c$	J
Absolute of −energy total	$E_m=\lvert$(total of negative energy in E_a, E_d, E_f)$\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

4.6 Cart

Symbol list

Symbol	Content	Unit
W_V	Mass of cart	kg
W_L	Mass of load	kg
D_s	Diameter of wheel	mm
W_s	Mass of wheel	kg
p	Number of drive wheels	
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
mu	Drive coefficient of friction	
eta	Drive efficiency	
V_0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t_0	Positioning time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=pi*D_S*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of cart	$J_D=(W_L+W_V)*(dS/20*pi)^2$	kg・cm^2
Inertia of wheels	$J_T=\{(W_s*(D_s/10)^2)/8\}*p$	kg・cm^2
Total load inertia	$J_L=J_{MG}+J_{MB}+J_D+\{J_G+J_C+J_O+J_T*(1/n)^2\}*(1/n_m)^2$	kg・cm^2
Load torque	$T_L=(mu*(W_L+W_V)*g*dS)/(2000*pi*eta)$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Acceleration torque	$T_{Ma}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_L$	N・m
Deceleration torque	$T_{Md}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_L$	N・m
Peak load factor	$R_p=\{$(maximum value of $\lvert T_{Ma}\rvert, \lvert T_{Md}\rvert$)$/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=SQRT\{(T_{Ma}^2*T_{sa}+T_L^2*t_c+T_{Md}^2*T_{sd})/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	$E_a=(0.1047/2)*N_0*T_{Ma}*T_{sa}$	J
Deceleration energy	$E_d=(0.1047/2)*N_0*T_{Md}*T_{sd}$	J
Constant speed energy	$E_f=0.1047*N_0*T_L*t_c$	J
Absolute of −energy total	$E_m=\lvert$(total of negative energy in E_a, E_d, E_f)$\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(Wa*t_{max})-E_c\}/t_{max}$	W

4.7 Elevator

Symbol list

Symbol	Content	Unit
W_H	Mass of lift head	kg
W_L	Mass of load	kg
W_C	Mass of counterweight	kg
W_h	Mass of chain	kg
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
D_S	Diameter of sprocket	mm
W_S	Width of sprocket	mm
z	Number of sprockets	
eta	Drive efficiency	
mu	Drive coefficient of friction	
V_0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t_0	Positioning time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=pi*D_S*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of sprockets	$J_Z=\{(pi*0.0078*(W_S/10))/32\}*(D_S/10)\text{^}4*z$	kg・cm^2
Inertia of Table & Load	$J_F=(W_H+W_L+W_C+W_h)*(dS/20*pi)\text{^}2$	kg・cm^2
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+J_Z*(1/n)\text{^}2\}*(1/n_m)\text{^}2$	kg・cm^2
Imbalance torque	$T_U=\{((W_H+W_L-W_C)*g)*dS\}/(2000*pi)$	N・m
Friction torque	$T_F=\{mu*((W_H+W_L+W_C+W_h)*g)*dS\}/(2000*pi)$	N・m
Upward load torque	$T_{Lu}=(T_U+T_F)/eta$	N・m
Downward load torque	In case $(-T_U+T_F)>0$: $T_{Ld}=(-T_U+T_F)/eta$ In case $(-T_U+T_F)<0$: $T_{Ld}=(-T_U+T_F)*eta$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Upward accele. torque	$T_{Mau}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_{Lu}$	N・m
Upward decele. torque	$T_{Mdu}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_{Lu}$	N・m
Downward accele. torque	$T_{Mad}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_{Ld}$	N・m
Downward decele. torque	$T_{Mdd}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_{Ld}$	N・m
Peak load factor	$R_p=\{$(maximum value of |TMxx data|)$/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms2}=SQRT\{\{T_{Mau}\text{^}2+T_{Mad}\text{^}2)*T_{sa}+(T_{Mdu}\text{^}2+T_{Mdd}\text{^}2)*T_{sd}+(T_{Lu}\text{^}2+T_{Ld}\text{^}2)*t_c+T_U\text{^}2*(t_f-2*t_0+2*t_s)\}/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms2}/T_{typ})*100$	%
Upward accele. energy	$E_{au}=(0.1047/2)*N_0*T_{Mau}*T_{sa}$	J
Upward decele. energy	$E_{du}=(0.1047/2)*N_0*T_{Mdu}*T_{sd}$	J
Upward const.speed energy	$E_{fu}=0.1047*N_0*T_{Lu}*t_c$	J
Downward accele. energy	$E_{ad}=(0.1047/2)*N_0*T_{Mad}*T_{sa}$	J
Downward decele. energy	$E_{dd}=(0.1047/2)*N_0*T_{Mdd}*T_{sd}$	J
Downward con.speed energy	$E_{fd}=0.1047*N_0*T_{Ld}*t_c$	J
Absolute of −energy total	$E_m=$|(total of negative energy in Exx data)|	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	$E_{max}=$section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

4.8 Conveyor

Symbol list

Symbol	Content	Unit
W_T	Mass of conveyor moving part	kg
W_L	Mass of load	kg
1/n	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
D_R	Diameter of roll	mm
J_R	Inertia of roll	kg・cm^2
z	Number of rolls	
eta	Drive efficiency	
mu	Drive coefficient of friction	
V_0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t_0	Positioning time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=pi*D_R*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Motor rotational speed	$N_0=V_0/dS$	r/min
Stop settling time	$t_s=3*1/K_p$	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t0-(L/V_0*60+t_s)$	sec
Inertia of Table & Load	$J_F=(W_L+W_L)*(dS/20*pi)^2$	kg・cm^2
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+z*J_R*(1/n)^2\}*(1/n_m)^2$	kg・cm^2
Load torque	$T_L=(mu*(W_T+W_L)*g*dS)/(2000*pi*eta)$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Acceleration torque	$T_{Ma}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_L$	N・m
Deceleration torque	$T_{Md}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_L$	N・m
Peak load factor	$R_p=\{(\text{maximum value of } \lvert T_{Ma}\rvert, \lvert T_{Md}\rvert)/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=SQRT\{(T_{Ma}^2*T_{sa}+T_L^2*t_c+T_{Md}^2*T_{sd})/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	$E_a=(0.1047/2)*N_0*T_{Ma}*T_{sa}$	J
Deceleration energy	$E_d=(0.1047/2)*N_0*T_{Md}*T_{sd}$	J
Constant speed energy	$E_f=0.1047*N_0*T_L*t_c$	J
Absolute of −energy total	$E_m=\lvert$(total of negative energy in E_a, E_d, E_f)$\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

4.9 Generic

Symbol list

Symbol	Content	Unit
T_{L1}	Converted load torque to the motor shaft	N・m
J_{L1}	Moment of load inertia	kg・cm^2
J_C	Coupling inertia	kg・cm^2
$1/_n$	Reduction gear ratio	
J_G	Reduction gear inertia	kg・cm^2
J_O	Inertia of the others	kg・cm^2
N_0	Motor rotational speed	r/min
dS_L	Feed distance per motor revolution	mm
L	Feed distance per operation	mm
T_{sa}	Acceleration time	sec
T_{sd}	Deceleration time	sec
t_f	One operation cycle	sec
$1/n_m$	Reduction ratio of motor with reduction	
P_f	Encoder resolution	pulse/rev
K_p	Position loop gain	1/sec
J_{MG}	Inertia of reduction gear with motor	kg・cm^2
J_{MB}	Inertia of brake with motor	kg・cm^2
J_M	Motor rotor inertia	kg・cm^2
g	Gravitational acceleration	m/sec^2
T_{max}	Motor maximum torque	N・m
T_{typ}	Motor rated torque	N・m
etam	Reverse-efficiency of motor	%
W_a	Amplifier loss	W
t	Regenerative operation time	sec
E_c	Energy charged to the capacitors in amp.	J
P_{typ}	Rated power of regeneration	W
t_{max}	Maximum regeneration time	sec

Calculation process

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=dS_L*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_f)*1000$	micron/pulse
Feed speed	$V_0=N_0*dS$	mm/min
Stop settling time	$t_s=3*1/K_p$	sec
Positioning time	$t_0=1/2*(T_{sa}+T_{sd})+ts+(60*L)/V_0$	sec
Total load inertia	$J_L=J_{MG}+J_{MB}+\{J_G+J_C+J_O+J_{L1}*(1/n)\text{^}2\}*(1/n_m)\text{^}2$	kg・cm^2
Load torque	$T_L=T_L1*1/n_m$	N・m
Moment of inertia ratio	$m=J_L/J_M$	times
Acceleration torque	$T_{Ma}=\{((J_L+J_M)*N_0)/(9.55*10000*T_{sa})\}+T_L$	N・m
Deceleration torque	$T_{Md}=-\{((J_L+J_M)*N_0)/(9.55*10000*T_{sd})\}+T_L$	N・m
Peak load factor	$R_p=\{$(maximum value of $\lvert T_{Ma}\rvert, \lvert T_{Md}\rvert)/T_{typ}\}*100$	%
Cont. effect load torque	$t_c=t_0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=S_{QRT}\{(T_{Ma}\text{^}2*T_{sa}+T_L\text{^}2*t_c+T_{Md}\text{^}2*T_{sd})/t_f\}$	N・m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	$E_a=(0.1047/2)*N_0*T_{Ma}*T_{sa}$	J
Deceleration energy	$E_d=(0.1047/2)*N_0*T_{Md}*T_{sd}$	J
Constant speed energy	$E_f=0.1047*N_0*T_L*t_c$	J
Absolute of −energy total	$E_m=\lvert$(total of negative energy in E_a, E_d, $E_f)\rvert$	J
Regenerative power	$P_r=\{etam*E_m-(W_a*t)-E_c\}/t_f$	W
Regeneration load factor	$L_d=(P_r/P_{typ})*100$	%
Max. regenerative power	E_{max}=section energy when maximum regenerating $P_{max}=\{etam*E_{max}-(W_a*t_{max})-E_c\}/t_{max}$	W

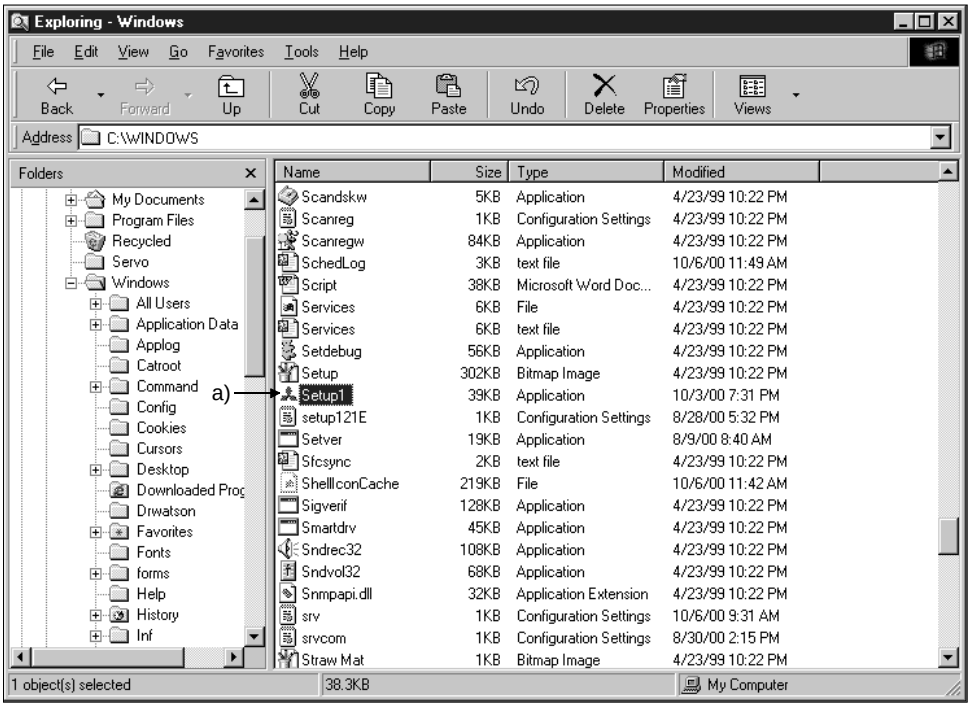
5. TROUBLESHOOTING

5.1 Software uninstallable

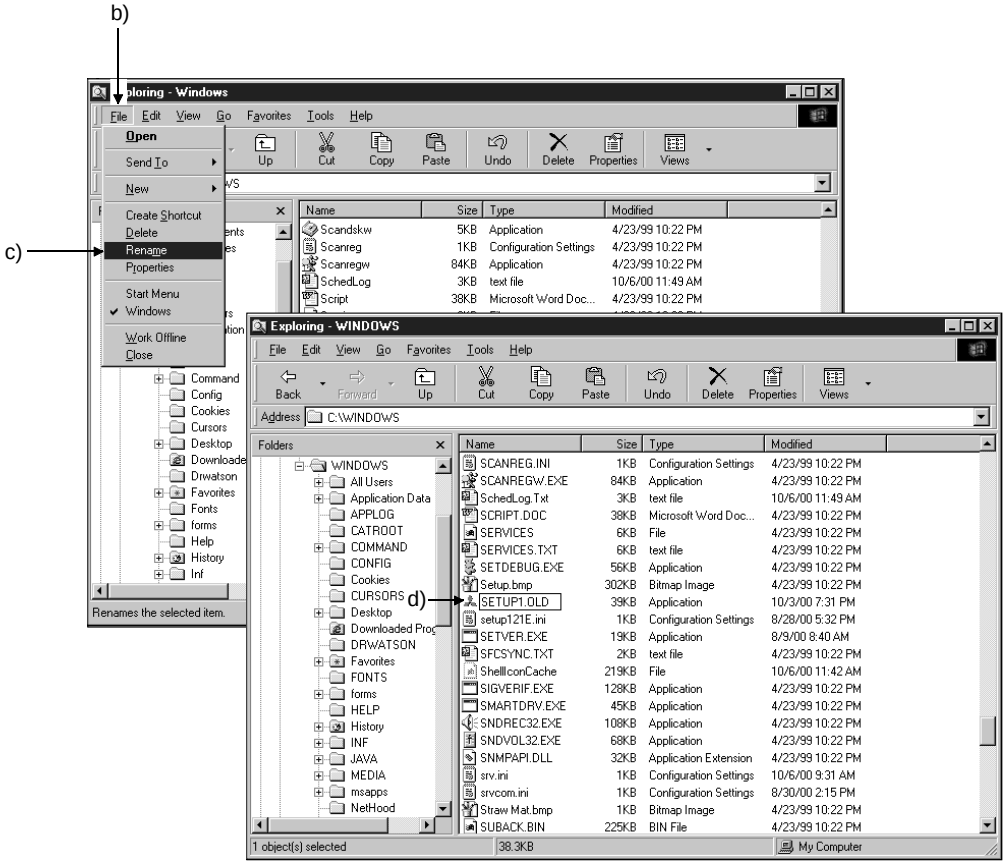
Action to be taken when the software cannot be installed

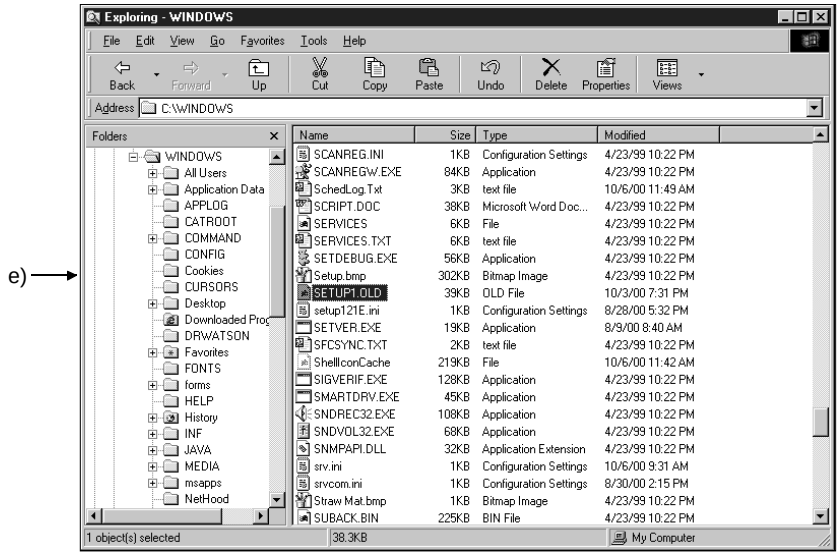
Take the following steps if installation is suspended and an error is indicated by the following window:

1) Open the "Exploring" window and select the file "SETUP1.EX_" a) displayed in the Error window.



2) Open the file menu b), choose the "Rename" command c), and change the selected file name. Enter "SETUP1.OLD", where the extension of the file name has been changed from "EX_" to "OLD", as shown in d). Press the "Enter" to complete the changing of the file name and display the window e).





3) Start installation from the beginning according to Section 1.7.

5.2 Changing the print paper

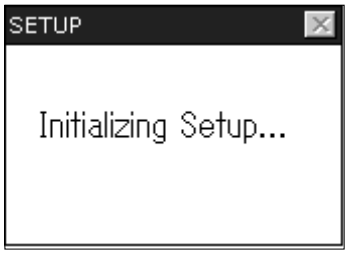
To change the paper used to print results, open Printer in the control panel and set the printer. For use, refer to the Windows user's guide.

5.3 Screen unprintable

If calculation results are not printed after printing is started, open the Windows Setup window and change the display setting to 256 colors or less.

5.4 Installation does not end

After installation is finished, the next screen may remain displayed depending on the personal computer you are using. In this case, since installation has ended normally, open the forced ending of the program (press the “Ctrl” + “Alt” + “Del”) and exit from the capacity selection software.



MEMO

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Data	Manual Number	Revision
Nov., 1996	IB (NA) 67252-A	First edition
Jan., 1998	IB (NA) 67252-B	Reconsideration of command names, etc. Description changed for compatibility with Windows 95 Addition of MR-J2-A (100V), MR-J2-B servo amplifiers Addition of HC-SF, HC-RF servo motors Section 1-1: Addition of HC-SF, HC-RF Section 3-3: Addition of amplifier menu Addition of motor menu Addition of data registration Addition of Help and Quick Start commands Section 3-4: Addition of MR-J2-B
Oct., 2000	IB (NA) 67252-C	Addition of MR-H-AN/BN/ACN/HN/DN4, MR-J2-C/C-S100 and MR-J2-03A5/03C5 servo amplifiers Addition of HC-UF, HC-KF, HC-AQ, HC-LF, HC-MFS, HC-KFS, HC-SFS, HC-RFS, HC-UFS, HR-115 and HR-142 servo motors Section 1-1: Overall changing of servo amplifier-servo motor combination table Section 3-5 (2): Reexamination of table Section 5-4: Addition
Apr., 2001	IB (NA) 67252-D	Overall changes to the form