# MITSUBISHI

General-Purpose AC Servo



# 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.

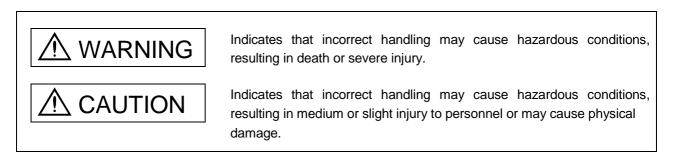


## Safety Instructions

#### (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".



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:

 $\bigcirc$ : 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.

- Windows is a trademark of Microsoft Corporation.
- The "Mitsubishi general-purpose AC servo MELSERVO Capacity Selection Software" is a production of Mitsubishi Electric Corporation. Mitsubishi Electric Corporation reserves the copyright and all other rights of this software.
- This Installation Guide may not be reproduced or copied, in whole or part, without written consent of Mitsubishi Electric Corporation.
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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


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## 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.

	Servo Amplifier Series										
Servo Motor 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-J2- C-S100	MR-H-DN4
HA-ME	0		0								
HA-FE	0		0	/	$\square$				/		
HA-SE	0		0	/							
HA-MH				0			0				
HA-FH			$\square$	0			0				
HA-SH				0			0				
HA-LH		$\square$	$\geq$	/	$\square$		0				
HA-UH	/	/	$\square$		$\square$		0				
HC-PQ	/	0	$\geq$	/	$\geq$				/		
HC-MF	$\geq$	$\square$	/	/	$\square$	0	0		/	0	
HA-FF		$\square$	$\square$	/	/	0	0		/	0	
HC-SF		/	/			0	0			0	
HC-RF		/				0	0			0	
HC-UF			/		/	0	0			0	
HC-KF					/	0	0			0	
HC-AQ	$\backslash$	$\square$	$\square$		0						
HA-LF		$\square$	$\square$		$\square$		0	0			
HC-MFS			$\square$		$\square$				0		
HC-KFS	$\backslash$			$\backslash$					0		
HC-SFS	$\backslash$			$\backslash$					0		
HC-RFS	$\backslash$			$\backslash$					0		
HC-UFS									0		
HR115		$\geq$	$\sum$	$\sum$							0
HR142					$\sim$						0

Combination of Servo Amplifier and Servo Motor
--

### **Specifications List**

lte	em	Specifications		
Model MRZJW3-MOTSZ71E		MRZJW3-MOTSZ71E		
Machine component 9 types: ballscrew (horizontal), ballscrew (vertical), rack and pinion, roll feed, rotary tab elevator, conveyor, generic (direct inertia input)		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 E		Entered specifications, calculation process and selection results are printed.		
Data save Entered specifications are saved on to a floppy disk with a file name.		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 $\times$ 400, color or 16-scale monochrome display which can be used with Windows 3.1 $\cdot$ 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

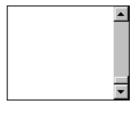
Highlights characters, button or the like when the menu or button is ready to accept an input from the keyboard.

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

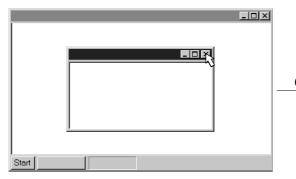
Box used to select one or more of several items. When a choice is made a mark appears in the box.

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

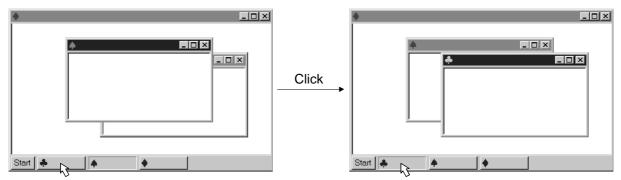
Click the closing bottom at top right corner of the window.





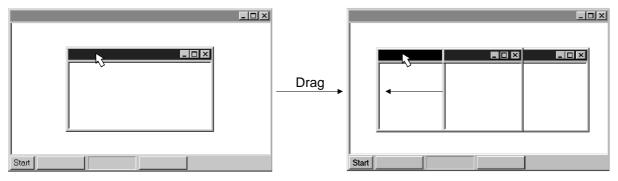
(2) Moving the focus from one window to another

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



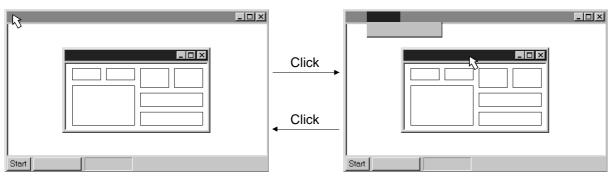
(3) Moving the window

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



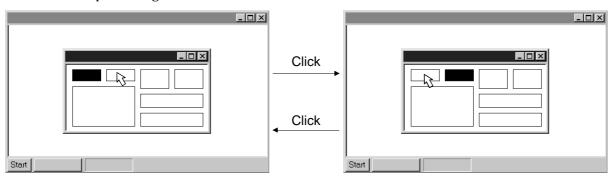
## (4) Moving the focus to the menu bar

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.

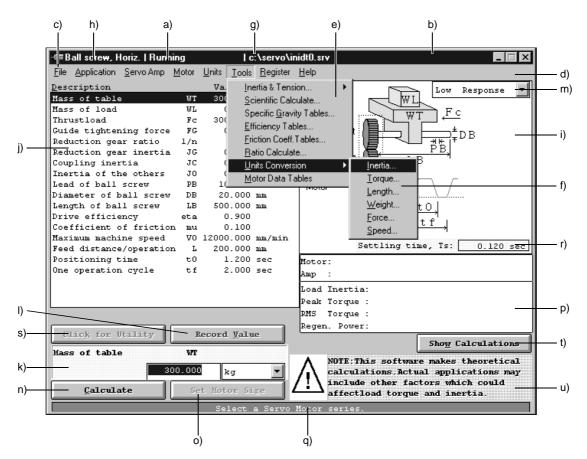


<Short-cut keys>

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.

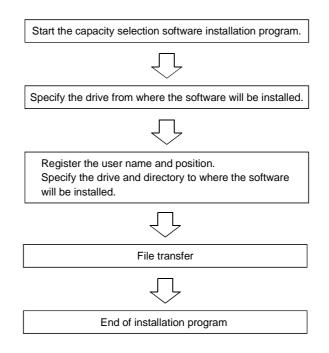
- q) Message display area Shows a comment or error message. This area is normally blue, but turns to red when showing an error message.
- r) Settling time (ts) display area Shows the settling time (ts) in the servo response level which has been set.
- s) Click for Utility button While selecting the item 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

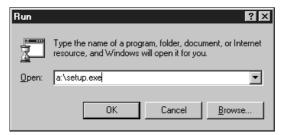


#### 1.7.2 Installation procedure

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

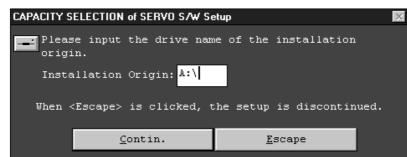
#### (1) Execution of installation program

- 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

A CAPACI	TY SELECTION of SERV	vo s/w		×
A	CAPACITY	SELECTION	of SER	10 S/W
		Set Up		
	N	ame:		
	Belong:	ing:		
	Setup Ahe	ead: C:\SERVO\		
		Start (	Cancel	

- 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:

CAPACITY SELECTION of SERVO S/W Setup	×
The setup to the hard disk was completed. The control returns to Windows with the [OK] button.	
(OK]	

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

POINT	
<ul> <li>To the susp</li> </ul>	pend installation, click the "Escape" or "Cancel" button in the
correspond	ling 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.	
5	Serve motor series selection	Select the motor model and choose the rated speed.	
		When the motor is selected, the Motor Options window will appear	
6	Motor option selection	automatically.	
0	wotor option selection	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.	
		Enter the values of machine specifications displayed on the basis of the	
8	Machine specifications entry	machine components selected.	
0		They may also be calculated and substituted using various tool	
		windows.	
		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.	
9	Selection operation execution	The selected capacities of servo amplifier type, servo motor type and	
5	Selection operation execution	regenerative brake option type are displayed together with calculation	
		results.	
		By clicking the "Set Motor Size" button, the capacity may be specified	
		for calculation.	
		Confirm the selection results.	
10	Result confirmation	To change the machine components or any of the machine	
10		specifications, only that item may be changed and operation performed	
		again.	
11 Printing		In printing, the machine component, machine specifications and	
11	Printing	selection results are printed.	
12	Data save	In data save, machine component, machine specifications (including	
16	Data Save	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

Roll feed			
	F		
to, tf,		- 🌱 Coorbou	DR
Tension	F:	25.000	Ν
Reduction gear ratio	1/n:	1/2	
Reduction gear inertia	J <sub>G</sub> :	0.100	kg-cm <sup>2</sup>
Coupling inertia	Jc:	2.000	kg-cm <sup>2</sup>
Inertia of the others	Jo:	5.000	kg-cm <sup>2</sup>
Diameter of feed roll	D <sub>R</sub> :	50.000	mm
Inertia of feed roll	J <sub>R</sub> :	25.000	kg-cm <sup>2</sup>
Drive efficiency	eta:	0.900	
Maximum machine speed	V0:	20000.000	mm/min
Feed distance/operation	L:	500.000	mm
Feed time per operation	to:	2.000	sec
One operation cycle	t <sub>f</sub> :	3.000	sec
High response			
MR-H-AN series			
Standard noise			
HA-SH2000r/min series			
1/5 precision speed reducer			
	Reduction gear ratio Reduction gear inertia Coupling inertia Inertia of the others Diameter of feed roll Inertia of feed roll Drive efficiency Maximum machine speed Feed distance/operation Feed time per operation One operation cycle High response MR-H-AN series Standard noise HA-SH2000r/min series	L TMotTensionF:Reduction gear ratio1/n:Reduction gear inertiaJG:Coupling inertiaJC:Inertia of the othersJO:Diameter of feed rollDR:Inertia of feed rollJR:Drive efficiencyeta:Maximum machine speedV0:Feed distance/operationL:Feed time per operationt0:One operation cycletf:High responseMR-H-AN seriesStandard noiseHA-SH2000r/min series1/5 precision speed reducerNo brake optiontest1. srvtest1. srv	tototf0tf0tf0rensionF:25.000Reduction gear ratio1/n:1/12Reduction gear inertiaJG:00.100Coupling inertiaJC:2.000Inertia of the othersJo:5.000Diameter of feed rollDR:50.000Inertia of feed rollJR:25.000Drive efficiencyeta:0.900Maximum machine speedV0:20000.000Feed distance/operationL:500.000Feed time per operationto:2.000One operation cycletr:3.000High responseMR-H-AN seriesStandard noiseHA-SH2000r/min series1/5 precision speed reducerNo brake optiontest1. srv

## 2.2.2 Operation

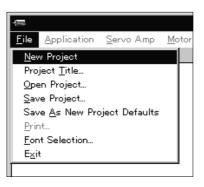
Here, capacity selection is selected based on the machine specifications of section 2.2.1. For the other operation procedures, refer to Sections 1.5 and 3.2.

- (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".

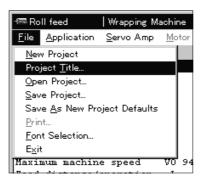
³Ba	II screw, Horiz.   Running		
ile	Application Servo Amp	<u>M</u> o	
esc:	Ballscrew <u>H</u> orizontal		
ass	Ballscrew <u>V</u> ertical	WT	
ass	Rac <u>k</u> & Pinion	WL	
nru	Roll feed	Fe	
aid	Rotary Table	FG	
edu	Cart	/n	
edu		JG	
bup	<u>E</u> levator	JC	
her	Conve <u>v</u> or	JO	
ead	<u>G</u> eneric	LB	
iam	eter of ball screw	DB	
worth of holl corror			

🕾 Roll feed   Wrapping Machine   c:\s	\servo\inidt3.srv 📃 🛛 🗶
File Application Servo Amp Motor Units Tools Reg	egister <u>H</u> elp
Description Value	E Low Response
Tension F 10.000 N	
Reduction gear ratio 1/n 1/5	
Reduction gear inertia JG 15.000 kg-	
Coupling inertia JC 5.000 kg-	-cm2 chaft
Inertia of the others JO 2.000 kg-	
Diameter of feed roll DR 120.000 mm	
Inertia of feed roll JR 100.000 kg-	
Drive efficiency eta 0.800	Gearbox / \ /
Maximum machine speed VO 94000.000 mm/ Feed distance/operation L 150.000 mm	
Feed distance/operation L 150.000 mm Feed time per operation t0 0.200 sec	1 1+01
One operation cycle tf 0.300 sec	
one operación cycle di 0.300 sec	
	Settling time, Ts: 0.043 sec
	Motor:HA-LH152 [1.5KW]
	Amp :MR-H200AN Regen. needless
	Load Inertia: 30.000 kg-cm2 3.6times
	Peak Torque : 8.336 N-m 116.4%
	RMS Torque : 5.221 N-m 72.9%
Click for Utility Record Value	Regen. Power: 12.646 W 15.8%
	Show Calculations
Tension F	A NOTE: This software makes theoretical
10.000 N	Calculations, Actual applications may
	/// include other factors which could
Calculate Set Motor Size	

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".



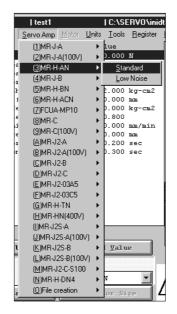
When "Project Title" is clicked, the following window appears:

Project T	ïtle	X
Proje	ct Title	Wrapping Machine
New	Title	test1
	<u>0</u> K	Cancel

- 3) Enter "Test 1" in the New Title field.
- 4) Click the "OK" button.

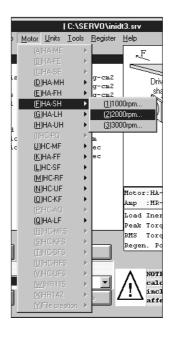
## (5) Servo amplifier series selection

- 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:

Motor Options 🔀		
Reduction Gear		
□No Reduction Gear Option □Standard speed reducer ▼Precision speed reducer		
Brake Option		
☑No Brake Option  ☐ Use Brake Option		
ŪK		

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:

Reduction Gear Ratio 🛛 🕅
🗖 ( <u>B</u> ) 1/9
🗖 ( <u>C</u> ) 1/20
🗖 ( <u>D</u> ) 1/29
🔲 ( <u>E</u> ) 1/45
<u>0</u> K

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 "Sl".

Runn	Running   c:\servo\inidt0.srv				nidt0. srv
Amp	<u>M</u> otor	<u>U</u> nits	<u>T</u> ools	<u>R</u> egister	<u>H</u> elp
		<u>S</u> I			
	WT	M	<s< td=""><td>¥</td><td></td></s<>	¥	
	WL		:h-Lb	a	
	Fel	<u>1</u> 1K	01120		D
orce	FG	(	0.000	N	
io	1/n		2/5		
rtia	JG	(	).444	kg-cm2	
	JC	(	0.000	kg-cm2	$\left[ \left( 1 \right) \right]$
lers	JO	(	0.000	kg-cm2	Servo

## (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.

25.000
--------

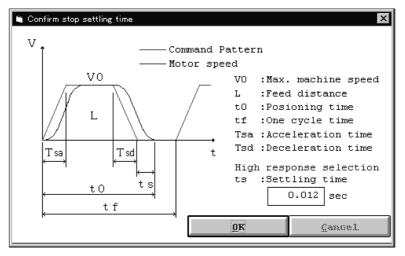
3) Click the "Record Value" button to set.

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".

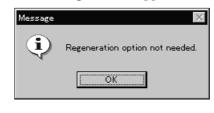


3) Click the "OK" button.

## (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.

Results of	f Calculation
<b>i</b> )	Calculation completed correctly. 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. Do a capacity selection by considering factors which may increase load torque and/or load inertia.

#### 3) Click the "OK" button.

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

Motor	::HA-SH52G(	1/5) [5000	7]	
Amp	: MR-H60AN	Regen. nee	edless	
Load	Inertia:	1.659	kg-cm2	0.2times
Peak	Torque :	0.382	N-m	16.0%
RMS	Torque :	0.187	N-m	7.8%
Reger	n. Power:	0.000	W	0.0%

#### Selection and calculation results

Servo motor	HA-SH52G (1/5 precis	HA-SH52G (1/5 precision speed reducer) [500W]	
Servo amplifier	MR-H60AN Regenera	MR-H60AN Regenerative brake option not required	
Load inertia	1.659 [kg • cm <sup>2</sup> ]	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  $\cdot$  cm<sup>2</sup>] or 0.2 times larger than the servo motor shaft inertia. Required peak torque is 0.382 [N  $\cdot$  m] and effective torque is 0.187 [N  $\cdot$  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".

⊰क≣ Ro	ll feed	test1	
<u>F</u> ile	<u>Application</u>	<u>S</u> ervo Amp	<u>M</u> ot
<u>N</u> ev	v Project		
Pro	ject <u>T</u> itle		
Ope	en Project		
<u>S</u> av	e Project		- 11
Sav	ve <u>A</u> s New Pro	oject Defaults	
<u>P</u> rin	nt		
<u>F</u> or	it Selection		
Exi	t		

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

Print	×
● <u>S</u> creen ○ <u>R</u> eport	
<u>S</u> tart	Cancel

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

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

Roll feed	I TE	ST1		c:\servo\i	nidt3.srv	
Tension Reduction gear ratio Reduction gear inertia Coupling inertia Inertia of the others Diameter of feed roll Inertia of feed roll Drive efficiency Maximum machine speed Feed distance/operation Feed time per operation One operation cycle	F 1/n JC JC JO DR JR eta VO L	25.000 1/2 0.100 2.000 5.000 50.000	kg-cm2 kg-cm2 kg-cm2 mm kg-cm2 mm/min mm sec	F Drive shaft Servo Motor Gearbox	High Re Ligh Re DF	
This S/W calculat value. Check this application. Do a considering facto load torque and/o	aga: capa rs wi	inst the a acity sele nich may in	ctual ction by ncrease	Motor:HA-SH52G(1/ Amp :MR-H60AN Red Load Inertia: Peak Torque : RHS Torque : Regen. Power:		0.2times 16.0% 7.8% 0.0%

Р	O	INT	-

• 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".

ा Roll feed test1	
<u>File</u> <u>Application</u> <u>Servo</u> A	mp <u>M</u> ot
<u>N</u> ew Project	
Project <u>T</u> itle	
Open Project	
<u>S</u> ave Project	
Save <u>A</u> s New Project Defa	ults
Print	
Font Selection	
E <u>x</u> it	

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

File Save		×
File <u>N</u> ame:	<u>D</u> irectories: c:\servo	<u>O</u> K
<u>F</u> ile Select:	[ <del>] ]</del> ⊂: \	]
inidt0.srv inidt1.srv inidt2.srv inidt3.srv inidt4.srv inidt4.srv	servo 🖻	Cancel
inidt6.srv inidt7.srv inidt8.srv	Dri <u>v</u> es:	<b>·</b>

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".

Dri <u>v</u> es:
c: <b>_</b>
-=-`a:
<u> </u>
<u>-</u> d:
<u></u> e:
<u> </u>
there are a second s

- 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".

⊰कड Ro	ll feed	test1	
<u>F</u> ile	<u>Application</u>	<u>S</u> ervo Amp	Mo
<u>N</u> ev	v Project		
Pro	ject <u>T</u> itle		
Ope	en Project		
<u>S</u> av	/e Project		
Sav	/e <u>A</u> s New Pro	oject Defaults	
<u>P</u> rir	nt		
<u> </u>	nt Selection		
– E <u>×</u> i	t		

## **3. OPERATION COMMANDS**

## 3.1 Command list

Command Display Section	Menu Title	Main Menu	Sub menu
		New Project	
		Project Title	
		Open Project	
	<b>F</b> (1)	Save Project	
	File	Save As New Project Defaults	
		Print	
		Font Selection	
		Exit	
		Ballscrew Horizontal	
		Ballscrew Vertical	
		Rack & Pinion	
		Roll feed	
	Application	Rotary Table	
	••	Cart	
		Elevator	
		Conveyor	
		Generic	
			Standard
		MR-J-A	Low Noise
			Standard
		MR-J-A (100V)	Low Noise
			Standard
		MR-H-AN	Low Noise
			Standard
		MR-J-B	Low Noise
Command	Servo Amp	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
			Standard
		MR-H-TN	Low Noise
			Standard
		MR-HN(400V)	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
			Standard
1		MR-H-DN4	Low Noise
		File creation	Standard

## **3. OPERATION COMMANDS**

Command Display Section	Menu Title	Main Menu	Sub menu
		HA-ME	3000rpm
		HA-FE	3000rpm
			1000rpm
		HA-SE	2000rpm
			3000rpm
		HA-MH	3000rpm
		HA-FH	3000rpm
			1000rpm
		HA-SH	2000rpm
		11A-511	3000rpm
		HA-LH	2000rpm
		HA-UH	2000rpm
		HC-PQ	3000rpm
		HC-MF	3000rpm
		HA-FF	3000rpm
		HC-SF	2000rpm
	Motor	HC-RF	3000rpm
		HC-UF	2000rpm
			3000rpm
		HC-KF	3000rpm
		HC-AQ	3000rpm
		HA-LF	2000rpm
		HC-MFS	3000rpm
		HC-KFS	3000rpm
			1000rpm
		HC-SFS	2000rpm
		110-51-5	3000rpm
		HC-RFS	
		HC-RFS	3000rpm
Command		HC-UFS	2000rpm
			3000rpm
		HR115	3000rpm
		HR142	3000rpm
		File creation	rpm
	Units	SI	
	Ollits	Inch-Lb	
			Cylinder
			Square Block
			Converted Load
		Inertia & Tension	Linear Movement
			Hanging
			Tension Calculator
		Scientific Calculate	
		Specific Gravity Tables	
		Efficiency Tables	
	Tools	Friction Coeff. Tables	
		Ratio Calculate	
			Inertia
			Torque
		Units Conversion	Length
			Weight
			Force
			Speed
		Motor Data Tables	
	Register	Data Input	
	0	Help	
	Help	Quick Start	
	Trop	Version Information	
	1		1

## 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

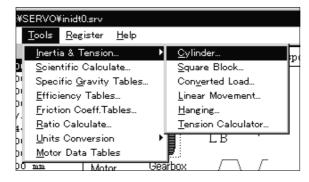
- 1. Clicking method
  - 1) Click the menu title on the menu bar to open the menu.
  - 2) Point to and click the command to be selected.

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. OPERATION COMMANDS

3.2.2 Operation procedures within the window

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

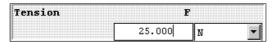
(1) Pressing a button

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.



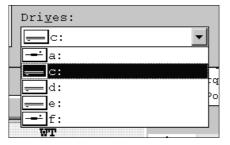
(3) Selecting data

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.



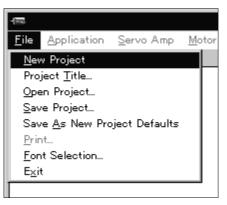
Screen Print

(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:

Project T	itle	×
Proje	ct Title	Wrapping Machine
New	Title	test1
	<u>0</u> K	Cancel

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.

File Open		×
File <u>N</u> ame:	Directories:	ок
*.SRV	c:\servo	
File Select:		
inidt0.srv	je servo	Cancel
inidtl.srv		
inidt2.srv		
inidt3.srv		
inidt4.srv		
inidt5.srv		
inidt6.srv		
inidt7.srv	Drives:	
inidt8.srv		<b>_</b>

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.

I	File Save		×
	File <u>N</u> ame: *.SRV	Directories: c:\servo	<u>0</u> K
	File Select:		
	inidt0.srv	jervo jervo	Cancel
	inidt1.srv		
	inidt2.srv		
	inidt3.srv		
	inidt4.srv		
	inidt5.srv		
	inidt6.srv		
	inidt7.srv	Drives:	
	inidt8.srv	c:	<b>-</b>

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

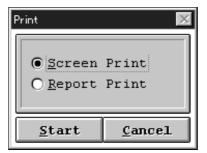
(5) Save As New Project Defaults

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	I TE	ST1		C:\servo\i	nidt3.srv	
Tension	F	25.000	N	F	High Res	sponse
Reduction gear ratio	1/n	1/2			L	-
Reduction gear inertia	JG	0.100	kg-cm2			
Coupling inertia	JC	2.000	kg-cm2	Drive :	<u> </u>	
Inertia of the others	JO	5.000	kg-cm2		and the second	2
Diameter of feed roll	DR	50.000	mm	shaft		
Inertia of feed roll	JR	25.000	kg-cm2			
Drive efficiency	eta	0.900				
Maximum machine speed	VO	20000.000	mm/min	Servo Gearbox	$\Box$ $c$	
Feed distance/operation		500.000	mm	Motor Gearbox	$/ \setminus /$	
Feed time per operation	tO	2.000	sec		1+01	
One operation cycle	tf	3.000	sec		t0,	
					tf	
					r 1	
				Secuur	ıg time, Ts:	0.012 sec
This S/W calculat				Motor:HA-SH52G(1/	5) [ <b>500</b> W]	
value. Check this				Amp :MR-H60AN Rec	gen, needless	
application. Do a considering facto	-	-	-	Load Inertia:	1.659 kg-cm2	0.2time
load torque and/o				Peak Torque :	0.382 N-m	16.0%
	1 10	au inercia	•	RMS Torque :	0.187 N-m	7.8%
				Regen. Power:		0.0%

## (b) Report Print results (example)

Calculation details are printed in addition to Screen Print results.

Use (Roll	Symbol List feed   Wrapping Machine	c:\servo\ini	dt3.srv
Symbol	: Content	Data	
 F	:Tension	10.000	
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	
eta	:Drive efficiency	0.800	
v0	:Maximum machine speed	94000.000	
L	:Feed distance per operation	150.000	
t0	:Feed time per operation	0.200	
tf	:One operation cycle	0.300	
*1/nm	Reduction ratio of motor with reduction	Unused	
*Pf	:Encoder resolution	131072	pulse/rev
*Кр	Position loop gain	70	1/sec
*JMG	:Inertia of reduction gear with motor	0.000	kg-cm2
*JMB	:Inertia of brake with motor		kg-cm2
*JM	:Motor rotor inertia	20.000	kg-cm2
g	:Gravitational acceleration	9.800	m/sec2
*Tmax	:Motor maximum torque	21.600	
*Ttyp	:Motor rated torque	7.160	N-m
*etam		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	
	Rated power of regeneration	0.000	
*tmax	:Maximum regeneration time	0.000	sec

Notel) '\*' 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
                                            c:\servo\inidt3.srv
(Roll feed
                     | Wrapping Machine
                                                                                         )
    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]
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]
                      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 [Ŵ]
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 [Ŵ]
```

### (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:

Font Selection		×
Select font.		
<u>S</u> elect	Sample	
Courier New	12345678901234567890123 ABCDEFGHIJKLMNOPQRSTUV abcdefghijklmnopqrstuv	WXYZ
S <u>e</u> lection End	<u>F</u> actory Default Font	<u>C</u> lose
	mber of characters in a line is e will change according to the	
2. A line of chars certain fonts are	acters may exceed the bounds of selected.	f a control, if
3. Restart this so software.	oftware to effect font change.I	Restart this

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

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

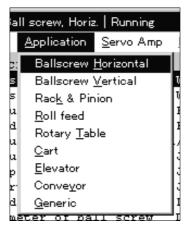
POINT
 Click the "Factory Default Font" button to return to the initial setting. Click the "Close" button to cancel the selected font and terminate the Font Selection window.

## (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

Elle       Application       Serve Amp       Motor       Units       Low       Register       Help         Description       Value       Value </th <th>e 💌</th>	e 💌
Mass of table     WI 200.000 kg       Mass of load     WL 0.000 kg       Thrustload     Fc 300.000 N       Guide tightening force     FG 0.000 N	e 💌
Mass of table WT 200.000 kg Mass of load WL 0.000 kg Thrustload Fc 300.000 N Guide tightening force FG 0.000 N	<u> </u>
Thrustload Fc 300.000 N Drive WT FC Guide tightening force FG 0.000 N shaft	
Guide tightening force FG 0.000 N shaft	
Reduction gear ratio 1/n 2/5 Reduction gear inertia IC 0.444 kg-gm2	
Coupling inertia JC 0.000 kg-cm2 () )	
Inertia of the others JO 0.000 kg-cm2 Servo	
Lead of ball screw PB 10.000 mm Motor Gearbox / /	
Diameter of ball screw DB 20.000 mm	
Length of ball screw LB 500.000 mm t0	
Drive efficiency eta 0.900	
coefficient of friction mu 0.100	
Maximum machine speed V0 12000.000 mm/min Read distance (maration L 200.000 mm Settling time, Ts: 0.04	3 sec
	3 sec
Positioning time t0 1.200 sec Motor:HA-FF23 [200W]	
One operation cycle tf 2.000 sec Amp :MR-J2-20A Regen. needless	
Load Inertia: 1.353 kg-cm2 3.	9times
Peak Torque : 0.692 N-m 108.	1%
RMS Torque : 0.299 N-m 46.	7%
	0%
Click for Vtility Record Value Show Calculat	ions
Mass of table WT	ical
200.000 kg 🔽 🔨 calculations, Actual applications	may
/ include other factors which coul	đ
Calculate Set Notor Size affectload torque and inertia.	

# (2) Ballscrew Vertical

<u>F</u> ile <u>A</u>	P			own		10.10011	o\inidt1.srv 📃 🗖 🛛
	Application	Servo Amp	<u>M</u> otor	<u>U</u> nits	<u>T</u> ools	<u>R</u> egister	<u>H</u> elp
Descri	iption			Val	ue		Low Response 🔻
Mass (	of table		WT	200	. 000	kq	
Mass (	of load		WL	50	.000	kg	
Mass (	of count	erweight	WC	150	. 000	kg	
Thrust	tload		Fc	2	.000	N	
Guide	tighten	ing force	FG	0	. 500	N	<u></u> F_c
Reduct	tion gea	r ratio	1/n		1/2		PB#
Reduct	tion gea	r inertia	JG	1	. 000	kg-cm2	
	ing iner		JC	0	. 200	kg-cm2	
		e others	JO			kg-cm2	
	of ball		PB		. 000		
		all screw	DB		. 000		
-	h of bal		LB	1000		mm	Drive
	efficie		eta	-	.900		shaft FiServo Motor
		f friction		-	.100		Settling time, Ts: 0.120 sec
		ne speed				mm/min	
		/operatior			. 000		Motor:HA-FE43B [400W]
	ioning t		tO	-	. 500		Amp :MR-J40A [MR-RB064*2]
Une oj	peration	cycle	tf	10	. 000	sec	Load Inertia: 4.164 kg-cm2 4.3time
							Peak Torque : 2.111 N-m 162.4%
							RMS Torque : 0.902 N-m 69.4%
							Regen. Power: 36.095 W 36.1%
Cli	c <u>k</u> for V	tility	F	lecord	Yalu	ue -	
Mass	of table		WT				Show Calculations
	Calcula	20	0.000	k t Moto	-	<u>v</u> e	NOTE: This software makes theoretical calculations. Actual applications may include other factors which could affectload torque and inertia.

#### (3) Rack & Pinion

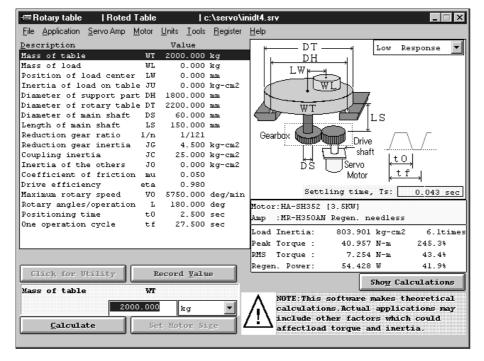
Б

📾 Rack & Pinion 💦   Paint	Robot	c:\servo\	inidt2.srv 📃 🗖 🗙
Eile Application Servo Amp	<u>M</u> otor <u>U</u> nits <u>T</u> ool	s <u>R</u> egister	Help
<u>D</u> escription	Value		Low Response 🔻
Mass of table	WT 1000.000	) kg	
Mass of load	WL 80.00	) kg	
Thrustload	Fc 0.000	) N	Drive WT
Reduction gear ratio	1/n 1.000	)	shaft
Reduction gear inertia	JG 0.000	) kg-cm2	
Coupling inertia	JC 5.000	) kg-cm2	() Fc P Fc
Inertia of the others	JO 0.000	) kg-cm2	
Diameter of pinion	DP 180.000		Servo Gearbox / /
Width of pinion	WP 50.000		Motor L+ o L
Drive efficiency	eta 0.800		( <u>t0</u> ,
Coefficient of friction		-	, tf j
Maximum machine speed	VO 80000.000		r 1
Feed distance/operation			
Positioning time		) sec	Settling time, Ts: 0.043 sec
One operation cycle	tf 5.000	) sec	Secciing cime, is: 0.043 sec
			Motor:HC-SFS352BG1(1/17) [3.5KW]
			Amp :MR-J2S-350A [MR-RB30]
			Load Inertia: 318.939 kg-cm2 3.9time
			Peak Torque : 28.443 N-m 170.3%
-			RMS Torque : 10.512 N-m 62.9%
a (			Regen. Power: 136.353 W 45.5%
Click for Utility	Record <u>V</u> al	.ue	Show Calculations
Mass of table	WT		
100 Calculate	00.000 kg Set Motor S	• je	NOTE: This software makes theoretical calculations. Actual applications may include other factors which could affectload torque and inertia.

#### (4) Roll feed

🛲 Roll feed 💦   Wrapping Ma	chine   c:\servo\	kinidt3.srv 📃 🗷
<u>File</u> <u>Application</u> <u>Servo Amp</u> <u>M</u> otor	<u>U</u> nits <u>T</u> ools <u>R</u> egister	Help
Description	Value	F Low Response
Tension F	10.000 N	
Reduction gear ratio 1/n	1/5	
Reduction gear inertia JG	15.000 kg-cm2	Drive Dr.
Coupling inertia JC	5.000 kg-cm2	shaft
Inertia of the others JO	2.000 kg-cm2	
Diameter of feed roll DR		
Inertia of feed roll JR		
Drive efficiency eta		Servo Searbox
	94000.000 mm/min	Motor
Feed distance/operation L	150.000 mm	[t0]
Feed time per operation t0		
One operation cycle tf	0.300 sec	
		Settling time, Ts: 0.043 sec
		Motor:HA-LH152 [1.5KW]
		Amp :MR-H200AN Regen. needless
		Load Inertia: 30.000 kg-cm2 3.6times
		Peak Torque : 8.336 N-m 116.4%
		RMS Torque : 5.221 N-m 72.9%
		Regen. Power: 12.646 W 15.8%
Click for Utility	Record <u>V</u> alue	Show Calculations
10.00		NOTE: This software makes theoretical calculations. Actual applications may include other factors which could
Calculate	et Motor Sige	affectload torque and inertia.

#### (5) Rotary Table



# (6) Cart

📾 Cart 🛛 🛛 🛛 Transfer Machi	ne lo:	\servo\in	idt5.srv 🗖 🗖 🗵 🗵
<u>File Application Servo Amp Motor</u>	<u>U</u> nits <u>T</u> ools	<u>R</u> egister	<u>H</u> elp
Description	Value		Drive shaft Low Response 🔻
Mass of cart WV	200.000	kg	
Mass of load WL	50.000	kg	Gearbox
Diameter of wheel Ds	100.000	mm	
Mass of wheel Ws	2.000	kg	
Number of drive wheels p	4		
Reduction gear ratio 👘 1/n	1/4		
Reduction gear inertia JG	5.000	kg-cm2	ws
Coupling inertia JC	5.000	kg-cm2	
Inertia of the others JO		kg-cm2	
Coefficient of friction mu	0.200		
Drive efficiency eta			
Maximum machine speed VO			$\downarrow$
Feed distance/operation L			l tf j
Positioning time tO			Settling time, Ts: 0.043 sec
One operation cycle tf	10.000	sec	Secciing cime, is. 0.043 sec
			Motor:HA-SH202B [2.0KW]
			Amp :MR-H200BN(Standard) Regen. needless
			Load Inertia: 416.175 kg-cm2 6.1time:
			Peak Torque : 17.784 N-m 186.2%
			RMS Torque : 6.633 N-m 69.5%
a (			Regen. Power: 18.787 W 14.5%
Click for Utility	tecord <u>V</u> alu	ue 🛛	
Mass of cart WW			Show Calculations
200.00	kg t Notor Si	▼ Ze	NOTE: This software makes theoretical calculations. Actual applications may include other factors which could affectload torgue and inertia.

# (7) Elevator

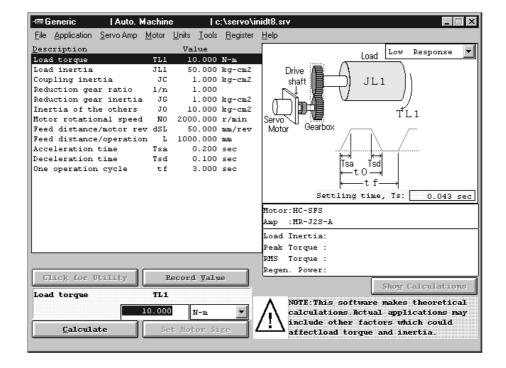
🛲 Elevator 🔰 Palette 🕯	Transf	er lc:	\servo\ini	idt6.srv 📃 🗖 🗙
File Application Servo Amp	<u>M</u> otor	$\underline{U}$ nits $\underline{T}$ ools	<u>R</u> egister	<u>H</u> elp
Description		Value		_ Drive shaft Low Response 🔻
Mass of lift head	WH	400.000	kg	
Mass of load	WL	50.000	kg	Servo
Mass of counterweight	WC	350.000	-	Motor V
Mass of chain	Wh	10.000	kg	
Reduction gear ratio	1/n	1/40		
Reduction gear inertia	JG		kg-cm2	Gearbox
Coupling inertia	JC		kg-cm2	
Inertia of the others	J0		kg-cm2	
Diameter of sprocket	DS	364.000		wc w w w w w w w w w w w w w w w w w w
Width of sprocket	WS	20.000 2	1010	
Number of sprockets Drive efficiency	z	0.700		
Coefficient of friction	eta mu	0.100		to <sup>1</sup> to <sup>1</sup>
Maximum machine speed		55000.000	toto (to i to	tf 1
Feed distance/operation		700.000	•	Settling time, Ts: 0.043 sec
Positioning time	t0			Motor:HA-SH352B [3.5KW]
One operation cycle	tf	3.000		
				Amp :MR-H350AN(Low Noise) [MR-RB30]
				Load Inertia: 196.056 kg-cm2 1.5times
				Peak Torque : 21.037 N-m 126.0%
				RMS Torque : 12.199 N-m 73.0%
				Regen. Power: 215.908 W 72.0%
Click for Utility	R	ecord <u>V</u> alu	le	Show Calculations
Mass of lift head	WH			
	0.000	ΙΙ.		NOTE: This software makes theoretical
40	0.000	kg		A calculations. Actual applications may
Calculate	Se	t Motor Si	ze	include other factors which could affectload torque and inertia.
				arrectioad torque and inertia.

-1

#### (8) Conveyor

<u>-रक</u> ा (	Conveyor	Trabs	fer	L.	::\servo\ini	dt7.srv 🗖 🗖 🛛
File	Application	<u>S</u> ervo Amp	<u>M</u> otor	<u>U</u> nits <u>T</u> oo	ols <u>R</u> egister	<u>H</u> elp
Des	cription			Value		Low Response
Mas	s of movi	ng part	WT	40.00	0 kg	
Mas	s of load		WL	10.00	0 kg	shaft R (WL)
Red	uction ge:	ar ratio	l/n	0.15	0	
Red	uction ge:	ar inertis	, JG	10.00	0 kg-cm2	
Cou	pling ine:	rtia	JC	0.10	0 kg-cm2	
Ine	rtia of tl	he others	J0	1.00	0 kg-cm2	
	meter of :		DR			Servo <sup>NU</sup> Gearbox
	rtia of r		JR	85.00	0 kg-cm2	Motor
	ber of ro		z		2	
	ve effici		eta	0.80	-	1+01
		of frictic		0.92	-	t0,
	inum mach:	-			0 mm/min	tf,
		e/operatic		420.00		<u>к</u> 1
	itioning (		tO		0 sec	Settling time, Ts: 0.043 sec
Une	operation	n cycle	tf	2.00	10 sec	
						Motor:HA-LH152 [1.5KW]
						Amp :MR-H200AN Regen. needless
						Load Inertia: 35.727 kg-cm2 4.3times
						Peak Torque : 21.042 N-m 293.9%
						RMS Torque : 4.107 N-m 57.4%
						Regen. Power: 14.590 W 18.2%
ļ	lic <u>k</u> for			tecord ⊻a	Lue	Show Calculations
Mas	s of movi: <u>C</u> alcul;		WT 40.000 Se	kg	• Sige	NOTE: This software makes theoretical calculations. Actual applications may include other factors which could affectload torque and inertia.
						arrections torgue and Inertia.

#### (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:

, H	oriz.   Running		
n	Servo Amp Motor U	nits	Ī
	(1)MRJ·A	$\mathbf{F}$	lu
)1e	(2)MR-J-A(100V)	•	).(
ıd	( <u>3</u> )MR-H-AN	•	p.(
er	( <u>4</u> )MR-J-B	•	
rea	(5)MR-H-BN	•	
res	(6)MR-H-ACN	•	þ. (
lei	(Z)FCUA-MP10	×	þ.(
tł 1	(8)MR-C	•	p.(
- 1 - 1	(9)MR-C(100V)	•	р. ц h и
al	(A)MR-J2-A	•	5.0
ie	(B)MR-J2-A(100V)	•	þ. s
9	(C)MR-J2-B	•	þ.:
hi ce	(D)MR-J2-C	•	p. (
r t	(E)MR-J2-03A5	•	
or	(E)MR-J2-03C5	•	2.0
	(G)MR-H-TN	•	
	(H)MR-HN(400V)	•	
_	(I)MR-J2S-A	•	
	(J)MR-J2S-A(100V)	•	
ι	(K)MR-J2S-B	•	L L
<b>1</b> €	(L)MR-J2S-B(100V)	•	
ιτε	(M)MR-J2-C-S100	•	
	(N)MR-H-DN4	•	εg
d a	(O)File creation	•	07
		_	10.1

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

Comm	and	Servo Amplifier Series	Noise Mode
	Standard		Standard Noise
MR-J-A	Low Noise	MR-J-(M)A	Low Noise
	Standard		Standard Noise
MR-J-A(100V)	Low Noise	MR-J-(M)A1(100V power supply specification)	Low Noise
	Standard		Standard Noise
MR-H-AN	Low Noise	MR-H-AN	Low Noise
	Standard		Standard Noise
MR-J-B	Low Noise	MR-J-B	Low Noise
	Standard		Standard Noise
MR-H-BN	Low Noise	MR-H-BN	Low Noise
	Standard		Standard Noise
MR-H-ACN	Low Noise	MR-H-ACN	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
	Standard		Standard Noise
MR-H-TN	Low Noise	MR-H-TN	Low Noise

# 3. OPERATION COMMANDS

Commar	nd	Servo Amplifier Series	Noise Mode
	Standard		Standard Noise
MR-HN(400V)	-HIN(400V) Low Noise	MR-HN4(400V power supply specification)	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	MB H DN4(400V never supply specification)	Standard Noise
MR-n-DN4(400V)	Low Noise	MR-H-DN4(400V power supply specification)	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:

nning	9		1	c:'	١se
M	otor	<u>U</u> nits	Tool	s	<u>R</u> e
	(A)	)HA-ME		×.	
	B	HA-FE		Þ	a
		)HA-SE		Þ	a
e	D	)НА-МН		۲	
	(E)	)HA-FH		۲	
.ε	(E)	HA-SH		۲	a-
	G	)HA-LH		۲	a-
	Œ	)HA-UH		F	a-
T.		HC-PQ		Þ.	
	(J)	HC-MF		۲	<u>m</u>
	(K)	)HA-FF		۲	
.c 1		HC-SF		۲	L
۰ ۲	(M	)HC-RF		۲	21
		)HC-UF		۲	Ed
	0	)HC-KF		۲	ed
		)HC:AQ		Þ.	
	Q	)HA-LF		۲	
		)HC-MF		Þ.	Н
1		)HC-KFS		Þ.	$\square$
		)HC-SFS		Þ	
		)HC-RF		Þ.	F
		)HC-UF		Þ	H
3		/)HB118		Þ	$\Box$
	$\mathbb{X}$	)HR142		Þ	2
J	Y	)File cre	ation	Þ	F

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		1000
	2000rpm	HA-SH	2000
	3000rpm		3000

# **3. OPERATION COMMANDS**

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
	1000rpm		1000
HC-SF	2000rpm	HC-SF	2000
	3000rpm		3000
HC-RF	3000rpm	HC-RF	3000
	2000rpm		2000
HC-UF	3000rpm	HC-UF	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
	1000rpm		1000
HC-SFS	2000rpm	HC-SFS	2000
	3000rpm		3000
HC-RFS	3000rpm	HC-RFS	3000
HC-UFS	2000rpm		2000
	3000rpm	HC-UFS	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.

Motor Options 🔀		
Reduction Gear		
□ <u>N</u> o Reduction Gear Option □ <u>S</u> tandard speed reducer ▼ <u>P</u> recision speed reducer		
Brake Option		
▼No Brake Option □Use Brake Option		
<u>0</u> K		

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.

Reduction Gear Ratio 🛛 🕅
🗖 ( <u>B)</u> 1/9
🗖 ( <u>C</u> ) 1/20
🗖 ( <u>D</u> ) 1/29
□ ( <u>E</u> ) 1/45
<u> </u>
<u> </u>

- 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:

Runn	ing	c:\servo\in		
Amp	<u>M</u> otor	<u>U</u> nits <u>T</u> ools		<u>R</u> egister
		<u>S</u> I		
	WT	MI	<s< th=""><th>а Т</th></s<>	а Т
	WL	Inc	:h-Lb	ų.
	Fel	<u>1</u> 1K		
force	FG	(	0.000	N
cio	1/n		2/5	
ertia	JG	(	0.444	kg-cm2
	JC	(	0.000	kg-cm2
hers	JO	(	0.000	kg-cm2

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.

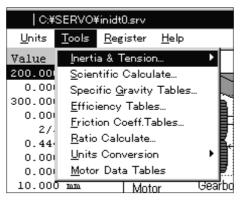
For example, when SI is switched to inches-pounds, items in "m" will be expressed in "ft".

Also, when the unit system is changed, the data and calculation results are converted to numerical values in new units.

# 3. OPERATION COMMANDS

#### 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.

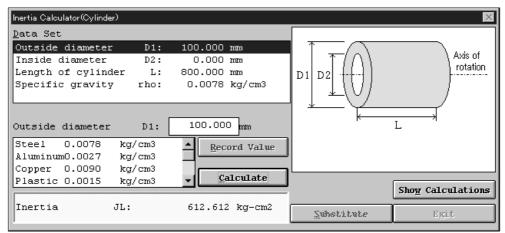
3) Substitution for machine specifications data

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.

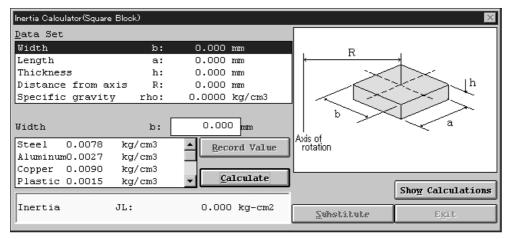
4) End

Click the "Exit" button to end.

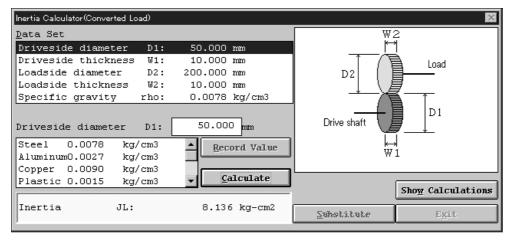
#### (a) Cylinder



#### (b) Square Block



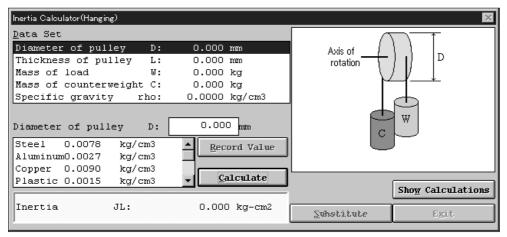
#### (c) Converted Load



#### (d) Liner Movement

Inertia Calculator(Linear Moveme	ent)		×
<u>D</u> ata Set			
Ball screw diameter	D:	0.000 mm 🔼	
Length of ball screw	L:	0.000 mm	
Ball screw lead	PB:	0.000 mm	
Mass of load	W:	0.000 kg 🛁	Axis of T
Mass of table	Т:	0.000 kg 🗾	rotation 🗍 🗍 🗸
Ball screw diameter	D: hat	0.000 mm	
material of the ball steel(0.0078kg/cm3).	scre	cw is	Show Calculations
Inertia JL:		0.000 kg-cm2 (	Substitute Exit

#### (e) Hanging



(f) Tension Calculator

Tension Calculator			×
<u>D</u> ata Set			
Nip pressure	FG:	0.000 N	
Coeff. of friction	mu:	0.000	FG
Nip pressure	FG:	0.000 N Record Value	F
		<u>C</u> alculate	Show Calculations
Tension F:		0.000 N	Supolitate Exit

## (2) Scientific Calculate

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

Edit ⊻iew Help			
			0.
C Hex C Dec C Oct C Bin C Deg	O Rad	0.0	àrad
Inv Hyp Ba	ck (	CE	С
Sta F-E [ ] MC 7 8 9	1	Mod	And
Ave dms Exp In MR 4 5 6	*	Or	Xor
Sum sin x'y log MS 1 2 3	-	Lsh	Not
s cos x^3 n! M+ 0 +/	+	=	Int
Dat tan ×2 1/× PI A B C	D	E	F

#### (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:

Specific Gravity Data Tables		×
Material Name	[kg/cm3]	[lb/inch3]
Steel	0.0078	0.2818
Aluminum	0.0027	0.0975
Copper	0.0090	0.3252
Plastic	0.0015	0.0542
Brass	0.0083	0.2999
Bronze	0.0081	0.2926
Hardwood(Oak etc.)	0.0008	0.0289
Softwood(Pine etc.)	0.0005	0.0181
	Print	Exit

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:

Efficiency Data Tables			×
Bayside Planetary gearbox	0.850	🕱 Ropes per full wrap	0.910 - 0.950
Ball screw	0.900	🗌 V-belts per full wrap	0.880 - 0.930
Acme or ground nut	0.450	Flat belts per full wrap	0.930 - 0.980
Plastic nut	0.650	Chains per full wrap	0.900 - 0.960
Please select two or mor	e efficiency when	n two or more combinations a	re necessary.
Total Efficiency Dat	a 0.930		
ICCAL EITICIENCY DAD	.a 0,930	Substitute	Exit

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.

Friction Coefficient Data Tables			×
Dynamic Friction Coef.		Static Friction Coef.	
X       Lubed steel on steel         Ball or roller slide         Polymer belt on steel         Teflon on steel         Antifriction bearings	0.050 0.250 0.040	Steel on steel Aluminum on steel Copper on steel Brass on steel Lubed steel on steel Polymer belt on steel	0.450 0.220 0.190 0.120 - 0.350
		Teflon on steel	0.040
Friction Coef. Dat	a 0.135	Substitute	E⊻it

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  $\mathbf{\overline{x}}$ , 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

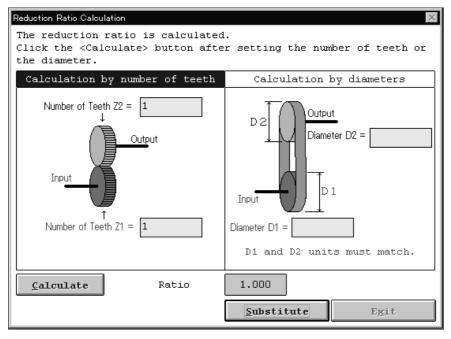
Click the "Exit" button to end.

POINT						
"Friction Co	• "Friction Coeff. Tables" has been selected on the "tools" menu, clicking the					
"Substitute	" button automatically enters the selected friction coefficient in					
"Coefficien	t of friction" of the machine specifications display area. If the					
machine co	omponent selected does not have the Coefficient of friction, error					
message "(	Can't find substitution selection" is displayed in the message					
display are	ea.					

## (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.

• "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 • m²	N•m	m	kg	Ν	m/min
kg • cm²	kgf • m	cm	g	kgf	cm/min
kgf • m <sup>2</sup>	kgf • cm	mm	lb	gf	mm/min
kgf • cm <sup>2</sup>	gf ▪ cm	ft	OZ	lb	m/sec
kg • m • sec <sup>2</sup>	lb-ft	inch		0Z	cm/sec
kg cm sec <sup>2</sup>	lb-inch				mm/sec
lb-ft <sup>2</sup>	oz-inch				ft/min
lb-inch <sup>2</sup>					inch/min
oz-inch <sup>2</sup>					ft/sec
lb-ft-sec <sup>2</sup>					inch/sec
lb-inch-sec <sup>2</sup>					
oz-inch-sec <sup>2</sup>					

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

Units Conversion Tool(Inertia)					
Convertion Set Data lb-ft2 1	Convertion Result kg-cm2 421.403				
Calculate	<u>S</u> ubstitute				
	Exit				

- 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 • cm <sup>2</sup> )
Encoder resol.	(P/rev)
Brake Option	
Reducer Option	
Recommended inertia ratio	

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

elect Motor Series-	> HA-ME		E <u>m</u> it
Se	ervo Motor Specific	ations Tables	
Servo Motor Model Name	HA-ME053	HA-ME13	HA-ME23
Rated Output(W)	50	100	200
Rated Torque (N-m)	0.16	0.32	0.64
Max. Torque (N-m)	0.48	0.95	1.90
Rated Speed (r/min)	3000	3000	3000
Max. Speed (r/min)	4500	4500	4500
Inertia moment J(kg-cm2)	0.021	0.035	0.11
Encoder resol.(P/rev)	4000	4000	4000
Brake Option	exists	exists	exists
Reducer Option	exists	exists	exists
Recommended inertia ratio	30times under	30times under	30times under

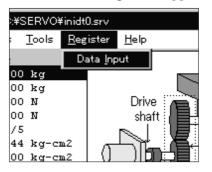
1) Open the Select Motor Series combo box and select the servo motor series.

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.

Data name	Data val	Unit	Remark
Servo amplifier			The amplifier name is
Servo motor			The motor name is inpu
Rated output		ឃ	
Rated speed		r/min	
Max. speed		r/min	
Motor rated torque		N-m	Inputs by three digits
Motor maximum torque		N-m	Inputs by three digits
Motor rotor inertia		kg-cm2	Inputs by three digits
Brake option			0:no exist l:exist
Brake inertia		kg-cm2	Inputs by three digits
Reducer option			0:no exist l:exist
Reducer of motor			ex.:1/5 1/1 if no:
Reduction gear inertia		kg-cm2	Only inertia of the ge
<b>ا</b>			<u> </u>
Servo amplifie	r		Exit
Nerio daspilito	-		Enc.

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 <sup>2</sup>
Brake inertia		kg • cm²
Motor rotor inertia		kg • cm²
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.

Data name	Data val	Unit	Remark
Servo amplifier	MR-J2-A		The amplifier name is
Servo motor			The motor name is inpu
Rated output		W	
Rated speed		r/min	
Max. speed		r/min	
Motor rated torque		N-m	Inputs by three digits
Motor maximum torque		N-m	Inputs by three digits
Motor rotor inertia		kg-cm2	Inputs by three digits
Brake option			0:no exist l:exist
Brake inertia		kg-cm2	Inputs by three digits
Reducer option			0:no exist l:exist
Reducer of motor			ex.:1/5 1/1 if no:
Reduction gear inertia		kg-cm2	Only inertia of the ge .
•			►
Servo motor		HC-SF	Exit

(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.

File Open		×
File <u>N</u> ame: *.UDT <u>F</u> ile Select:	Directories: c:\servo	<u></u> K
motinit.udt	jervo 🚰 servo	Cancel
	Dri <u>v</u> es:	

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.

# 3. OPERATION COMMANDS

#### (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:

नन्न Data table				_ 🗆 ×
Amplifier model	Motor model na	me Reducer of motor	Brake option	Built-
MR-J2OA	HA-FE23	1/1	does not exist	0
•				•
<u>0</u> K		Cancel	<u>D</u> ir. chang	je 🛛

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.

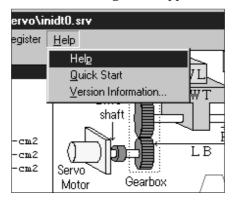
6) When calculation ends, the calculation end message appears.

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:

📽 Quick Start Guide 📃 🗖 🔀
Guidance Mode Selection
🕱 Normal Selection Mode
TPreselected Motor Size Mode
The Register Data Use Mode
Normal Selection Mode
Follow this step-by-step guide for servo sizing.
<pre>Step1:Select 'New Project' or 'Open Project' from 'File' menu. Step2:Select type of application from 'Application' menu. Step3:Select Amplifier series from 'Servo Amp' menu. Step4:Select Motor series (and RPM, if applicable) from 'Notor' menu. Step5:Select engineering units (if required) from 'Units' menu. Step5:Enter your application data into the list. Step7:Click 'Calculate' button. And read popups. Step8:If OK you're done, otherwise go to Step6,enter new data.</pre>
Select Guidance Mode and Click 'Guidance Start' button.
Guidance Start Close

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.

🛲 Ball screw, Horiz.   Running	c:'	\servo\inidt0.srv 📃 🗖 🔀
File Application Servo Amp Moto	r <u>U</u> nits <u>T</u> ools	<u>R</u> egister <u>H</u> elp
Description	Value	Low Response
Mass of table 0	T 300.000 ¥	
Mass of load 5	L 0.000 k	
Thrustload H	c 300.000 M	N Drive Drive
Guide tightening force A	G 0.000 M	
Reduction gear ratio 1/	n 2/5	
,,,	G 0.444 k	
	C 0.000 k	
	0 0.000 %	
	B 10.000 m	
	B 20.000 m	
	В 500.000 в	mm _tO
Drive efficiency et		tf'ı
Coefficient of friction n		<u> </u>
1	0 12000.000 1	Catalian time Test o oro
Feed distance/operation		
	0 1.200 s	nocor.
One operation cycle t	f 2.000 s	sec Amp :
		Load Inertia:
		Peak Torque :
-		RMS Torque :
		Regen. Power:
Click for Utility	Record <u>V</u> alue	
Mass of table	т	Quick Start Guide <u>Next</u> Exit
		Step1:Select 'New Project' or
300.0	00 kg	'Open Project' from 'File'
	IL	
Calculate	Set Motor Sig	menu.

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

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

_ 🗆 X
High Response  🚽
Low Response
Medium Response
High Response
Free Setting

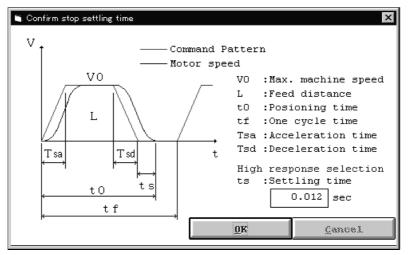
Set the response level of the servo according to the tracking performance of the machine. Servo response levels available are "Low, Medium and High Responses". Select "Low Response" for low tracking performance of the machine or "High Response" for high tracking performance. The position loop gain ( $K_p$ ) 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.

# 3. OPERATION COMMANDS

Servo Amplifier Series	Position Loop Gain Kp (Stop Setting Time ts [s])					
Servo Ampliner Series	Low Response	Medium Response	High Response			
MR-J-A	05 (0.100)	75 (0.040)	150 (0.000)			
MR-J-A [100V]	25 (0.120)	75 (0.040)	150 (0.020)			
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 (0.040)	150 (0.000)	050 (0.010)			
MR-H-ACN	70 (0.043)	150 (0.020)	250 (0.012)			
FCUA-MP10	25 (0.120)	75 (0.040)	150 (0.020)			
MR-C						
MR-C [100V]						
MR-J2-A						
MR-J2-A [100V]						
MR-J2-B						
MR-J2-C						
MR-J2-03A5						
MR-J2-03C5	70 (0.042)	150 (0.000)	950 (0.019)			
MR-H-TN	70 (0.043)	150 (0.020)	250 (0.012)			
MR-HN [400V]						
MR-J2S-A						
MR-J2S-A [100V]						
MR-J2S-B						
MR-J2S-B [100V]						
MR-J2-C-S100						
MR-H-DN4						

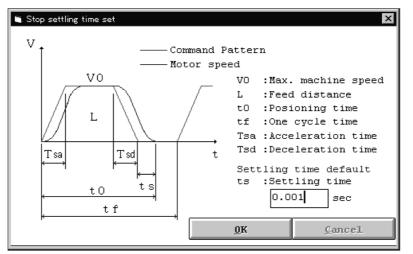
Servo response list

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:

Results of	í Calculation 🔀
•	Calculation completed correctly. 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. Do a capacity selection by considering factors which may increase load torque and/or load inertia.

#### 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.

Motor	:HA-SH352B	[3.5KW]			a)
Amp	:MR-H350AN	[MR-RB30]	l		— b)
Load	Inertia:	196.056	kg-cm2	l.5times	(
Peak	Torque :	21.037	N-m	126.0%	— d)
RMS	Torque :	12.199	N-m	73.0%	— e)
Reger	n. Power:	215.908	W	72.0%	f)

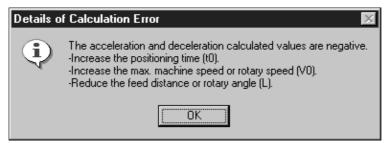
The above window represents the following contents:

- 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  $\cdot$  cm<sup>2</sup>) 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  $[\rm N$   $\mbox{-}\,m]$  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.

Inertia ra	tio warning! 🛛 🕅 🕅
Â	The calculated Load Inertia has exceeded, the maximum inertia ratio of selected servo motor series.Suggested solutions: -Select a servo motor series with greater motor moment of inertia. -Increase the reduction gear ratio (1/n). -Reduce the load moment of inertia.
	(OK)

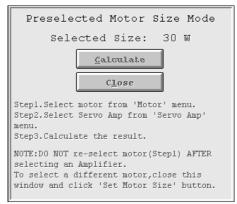
(3) Starting calculation with servo motor capacity specified

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:

Serv	vo Motor	∙k₩ Se	elec	tion				$\times$
	(1)         (2)         (3)         (4)         (5)         (6)         (7)         (8)	30 50 200 300 400 500	U U U	(E) (C) (D) (E) (E) (E) (G) (H) (I)	1.2 1.5 2.0 2.2 3.0 3.5	kU kU kU kU kU kU	□ ( <u>L</u> ) 11.0 □ ( <u>M</u> ) 15.0 □ ( <u>N</u> ) 22.0	kW
	( <u>9</u> ) ( <u>A</u> )		W W	□ ( <u>K</u> )				
		<u>o</u> k					Exit	

- 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.

Preselected Motor Size Mode
Selected Size: 30 W
<u>C</u> alculate
Cancel
Stepl.Select motor from 'Motor' menu. Step2.Select Servo Amp from 'Servo Amp' menu. Step3.Calculate the result.
NOTE:DO NOT re-select motor(Stepl) AFTER selecting an Amplifier. To select a different motor,close this window and click 'Set Motor Size' button.

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	d capacity designation, click the "Cancel" or "Close" button in the
correspond	ling 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

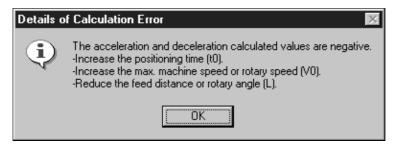
If wrong input data is set or capacity selection cannot be made, the corresponding error message is shown in the message display area or window. Refer to the message definition and continue operation.

#### (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 (V0) has exceeded the maximum speed of the motor selected.
<ul> <li>Reduce the max. machine speed or rotary speed (V<sub>0</sub>).</li> </ul>
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.
<ul> <li>Increase the positioning time (to).</li> </ul>
Increase the max. machine speed or rotary speed (V <sub>0</sub> ).
• 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 <sub>0</sub> ).
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.
<ul> <li>Select a servo motor series with a greater motor moment of inertia.</li> </ul>
• 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 <sub>0</sub> ).
Reduce the load torque and inertia.
The RMS torque has exceeded the rated torque of the motor.
Select a different Servo Motor series.
<ul> <li>Load torque and accel./decel. torque must be reduced</li> </ul>
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 <sub>0</sub> ).
• Reduce the positioning time (t <sub>0</sub> ).

# 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
WT	Mass of table	kg
WL	Mass of load	kg
Fc	Thrustload	N
FG	Guide tightening force	N
1/n	Reduction gear ratio	
JG	Reduction gear inertia	kg • cm <sup>2</sup>
J <sub>C</sub>	Coupling inertia	kg • cm <sup>2</sup>
Jo	Inertia of the others	kg • cm <sup>2</sup>
PB	Lead of ball screw	mm
DB	Diameter of ball screw	mm
LB	Length of ball screw	mm
eta	Drive efficiency	
mu	Drive coefficient of friction	
V0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
to	Positioning time	sec
tf	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
J <sub>MG</sub>	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
J <sub>MB</sub>	Inertia of brake with motor	kg • cm <sup>2</sup>
J <sub>M</sub>	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N•m
T <sub>typ</sub>	Motor rated torque	N • m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
Ptyp	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

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 <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of ball screw	$J_B = \{(pi*0.0078*(L_B/10))/32\}*(D_B/10)^4$	kg - cm <sup>2</sup>
Inertia of Table & Load	$J_{F}=(W_{T}+W_{L})^{*}(dS/20p_{i})^{2}$	kg • cm²
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+J_B^*(1/n)^2\}^*(1/n_m)^2$	kg - cm <sup>2</sup>
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=JL/JM	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	Rp={(maximum value of  T <sub>Ma</sub>  ,  T <sub>Md</sub>  )/T <sub>typ</sub> }*100	%
Cont. effect load torque	$\label{eq:tc=t0-Tsa-Tsd-ts} t_c = t_0 - T_{sa} - T_{sd} - t_s \\ T_{rms1} = S_{QRT} \{ (T_{Ma}^2 * T_{sa} + T_L^2 * t_c + T_{Md}^2 * T_{sd}) / t_f \}$	N•m
Effective load factor	Rrms=(Trms1/Ttyp)*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	Ef=0.1047*N0*TL*tc	J
Absolute of –energy total	E <sub>m</sub> =  (total of negative energy in E <sub>a</sub> , E <sub>d</sub> , E <sub>f</sub> )	J
Regenerative power	$P_r={etam^*E_m-(W_a^*t)-E_c}/t_f$	W
Regeneration load factor	Ld=(Pr/Ptyp)*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	Content	Unit
WT	Mass of table	kg
WL	Mass of load	kg
Wc	Mass of counterweight	kg
Fc	Thrustload	N
FG	Guide tightening force	N
1/n	Reduction gear ratio	
JG	Reduction gear inertia	kg • cm <sup>2</sup>
J <sub>C</sub>	Coupling inertia	kg • cm <sup>2</sup>
Jo	Inertia of the others	kg • cm <sup>2</sup>
PB	Lead of ball screw	mm
DB	Diameter of ball screw	mm
L <sub>B</sub>	Length of ball screw	mm
eta	Drive efficiency	
mu	Drive coefficient of friction	
V0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
to	Positioning time	sec
tſ	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
JMG	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
$J_{\text{MB}}$	Inertia of brake with motor	kg • cm <sup>2</sup>
JM	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N•m
Ttyp	Motor rated torque	N•m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
Ptyp	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	dS=P <sub>B</sub> *1/n*1/n <sub>m</sub>	mm/rev
Electrical accuracy	dL=(dS/P <sub>f</sub> )*1000	micron/pulse
Motor rotational speed	N <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of ball screw	$J_{B} = \{(pi^{*}0.0078^{*}(L_{B}/10))/32\}^{*}(D_{B}/10)^{4}$	kg • cm <sup>2</sup>
Inertia of Table & Load	JF=(WT+WL+WC)*(dS/20pi)^2	kg • cm <sup>2</sup>
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+J_B^*(1/n)^2\}^*(1/n_m)^2$	kg · cm <sup>2</sup>
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
	In case $(-T_U+T_F) > 0$ : $T_{Ld}=(-T_U+T_F)/eta$	N
Downward load torque	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 <sub>Mau</sub> ={((J <sub>L</sub> +J <sub>M</sub> )*N <sub>0</sub> )/(9.55*10000*T <sub>sa</sub> )}+T <sub>Lu</sub>	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	Rp={(maximum value of   TMxx data   )/Ttyp}*100	%
	$t_c = t_0 - T_{sa} - T_{sd} - t_s$	
Cont. effect load torque	$T_{rms2} = S_{QRT} \{ \{T_{Mau}^{2} + T_{Mad}^{2}\}^* T_{sa} + (T_{Mdu}^{2} + T_{Mdd}^{2})^* T_{sd} + $	N • m
	$(T_{Lu}^2+T_{Ld}^2)^*t_c+T_U^2^*(t_f-2^*t_0+2^*t_s))/t_f$	
Effective load factor	$R_{rms}=(T_{rms2}/T_{typ})^*100$	%
Upward accele. energy	Eau=(0.1047/2)*No*T <sub>Mau</sub> *T <sub>sa</sub>	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*N0*TLd*tc	J
Absolute of –energy total	E <sub>m</sub> = (total of negative energy in Exx data)	J
Regenerative power	$Pr=\{etam^*E_m-(W_a^*t)-E_c\}/t_f$	W
Regeneration load factor	$L_{d}=(P_{r}/P_{typ})^{*}100$	%
Max. regenerative power	E <sub>max</sub> =section energy when maximum regenerating P <sub>max</sub> ={etam*E <sub>max</sub> -(Wa*t <sub>max</sub> )-E <sub>c</sub> }/t <sub>max</sub>	W

#### 4.3 Rack & pinion

Symbol	Content	Unit
WT	Mass of table	kg
WL	Mass of load	kg
Fc	Thrustload	N
1/n	Reduction gear ratio	
JG	Reduction gear inertia	kg • cm <sup>2</sup>
Jc	Coupling inertia	kg • cm <sup>2</sup>
Jo	Inertia of the others	kg • cm <sup>2</sup>
DP	Diameter of pinion	mm
WP	Width of pinion	mm
eta	Drive efficiency	
mu	Drive coefficient of friction	
V <sub>0</sub>	Maximum machine speed	mm/min
L	Feed distance per operation	mm
to	Positioning time	sec
tſ	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
Jmg	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
$J_{\text{MB}}$	Inertia of brake with motor	kg - cm <sup>2</sup>
J <sub>M</sub>	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N • m
Ttyp	Motor rated torque	N • m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
Ptyp	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=pi^*DP^*1/n^*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_{f})*1000$	micron/pulse
Motor rotational speed	N <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	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 • cm²
Inertia of Table & Load	$J_{F}=(W_{T}+W_{L})^{*}(dS/20p_{i})^{2}$	kg • cm²
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 <sup>2</sup>
Load torque	TL={(Fc+mu*(WT+WL)*g)*dS}/(2000*pi*eta)	N • m
Moment of inertia ratio	m=JL/JM	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 <sub>p</sub> ={(maximum value of  T <sub>Ma</sub>  ,  T <sub>Md</sub>  )/T <sub>typ</sub> }*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 <sub>rms</sub> =(T <sub>rms1</sub> /T <sub>typ</sub> )*100	%
Acceleration energy	Ea=(0.1047/2)*N0*TMa*Tsa	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 <sub>m</sub> =  (total of negative energy in E <sub>a</sub> , E <sub>d</sub> , E <sub>f</sub> )	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 <sub>max</sub> =section energy when maximum regenerating P <sub>max</sub> ={etam*E <sub>max</sub> -(Wa*t <sub>max</sub> )-E <sub>c</sub> }/t <sub>max</sub>	W

#### 4.4 Roll feed

Symbol	Content	Unit
F	Tension	N
1/n	Reduction gear ratio	
$J_{G}$	Reduction gear inertia	kg • cm²
Jc	Coupling inertia	kg • cm²
Jo	Inertia of the others	kg • cm <sup>2</sup>
DR	Outside diameter of feed roll	mm
Jr	Inertia of feed roll	kg • cm²
eta	Drive efficiency	
V <sub>0</sub>	Maximum machine speed	mm/min
L	Feed distance per operation	mm
to	Feed time per operation	sec
tf	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
JMG	Inertia of reduction gear with motor	kg • cm²
$J_{\text{MB}}$	Inertia of brake with motor	kg • cm <sup>2</sup>
JM	Motor rotor inertia	kg • cm²
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N • m
Ttyp	Motor rated torque	N•m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
P <sub>typ</sub>	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=pi^*DR^*1/n^*1/n_m$	mm/rev
Electrical accuracy	$dL = (dS/P_f) * 1000$	micron/pulse
Motor rotational speed	N <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	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 - cm <sup>2</sup>
Load torque	$T_L=F^*(D_R/2000)^*1/n^*1/n_m^*(1/eta)$	N • m
Moment of inertia ratio	m=JL/JM	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	$R_p = \{(maximum value of  T_{Ma} ,  T_{Md} )/T_{typ}\}*100$	%
Cant affect load tongue	tc=t0-Tsa-Tsd-ts	N•m
Cont. effect load torque	$T_{rms1} = S_{QRT} \{ (T_{Ma}^{2}T_{sa} + T_{L}^{2}t_{c} + T_{Md}^{2}T_{sd})/t_{f} \}$	IN • III
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 =  $ (total of negative energy in $E_a$ , $E_d$ , $E_f$ )	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 <sub>max</sub> =section energy when maximum regenerating	W
wax. regenerative power	$P_{max} = \{etam^*E_{max} - (Wa^*t_{max}) - E_c\}/t_{max}$	vv

#### 4.5 Rotary table

Symbol	Content	Unit
WT	Mass of table	kg
WL	Mass of load	kg
Lw	Position of load center	mm
$J_U$	Inertia of load on table	kg • cm <sup>2</sup>
DH	Diameter of support part	mm
DT	Diameter of rotary table	mm
Ds	Diameter of main shaft	mm
Ls	Length of main shaft	mm
1/n	Reduction gear ratio	
JG	Reduction gear inertia	kg • cm <sup>2</sup>
Jc	Coupling inertia	kg • cm <sup>2</sup>
Jo	Inertia of the others	kg • cm <sup>2</sup>
mu	Drive coefficient of friction	
eta	Drive efficiency	
V0	Maximum rotary speed	deg/min
L	Rotary angles per operation	deg
t <sub>0</sub>	Positioning time	sec
tſ	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
Jmg	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
$J_{\text{MB}}$	Inertia of brake with motor	kg • cm <sup>2</sup>
JM	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N • m
Ttyp	Motor rated torque	N • m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
Ptyp	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=360*1/n*1/n_m$	deg/rev
Electrical accuracy	dL=dS/Pf	deg/pulse
Motor rotational speed	N <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of rotary table	$J_{K}=(W_{T}^{*}(D_{T}/10)^{2})/8$	kg - cm <sup>2</sup>
Inertia of load on table	$J_{W}=J_{U}+W_{L}*(L_{W}/10)^{2}$	kg • cm <sup>2</sup>
Inertia of main shaft	Js={(pi*0.0078*(Ls/10))/32}*(Ds/10)^4	kg - cm <sup>2</sup>
Total load inertia	$J_L=J_{MG}+J_{MB}+\{J_G+J_C+J_O+(J_K+J_W+J_S)^*(1/n)^2\}^*(1/n_m)^2$	kg • cm <sup>2</sup>
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=JL/JM	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	$R_p = \{(maximum value of  T_{Ma} ,  T_{Md} )/T_{typ}\}^* 100$	%
Cont. effect load torque	$\label{eq:tc=t0-T_sa-T_sd-ts} t_c = t_0 - T_{sa} - T_{sd} - t_s \\ T_{rms1} = S_{QRT} \{ (T_{Ma}^2 + T_{sa} + T_L^2 + t_c + T_{Md}^2 + T_{sd}) / t_f \}$	N•m
Effective load factor	$R_{rms}=(T_{rms1}/T_{typ})*100$	%
Acceleration energy	Ea=(0.1047/2)*No*TMa*Tsa	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 =  $ (total of negative energy in $E_a$ , $E_d$ , $E_f$ )	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 <sub>max</sub> )- $E_c$ }/t <sub>max</sub>	W

#### 4.6 Cart

Symbol	Content	Unit
Wv	Mass of cart	kg
WL	Mass of load	kg
Ds	Diameter of wheel	mm
Ws	Mass of wheel	kg
р	Number of drive wheels	
1/n	Reduction gear ratio	
JG	Reduction gear inertia	kg • cm <sup>2</sup>
J <sub>C</sub>	Coupling inertia	kg • cm <sup>2</sup>
J <sub>0</sub>	Inertia of the others	kg • cm <sup>2</sup>
mu	Drive coefficient of friction	
eta	Drive efficiency	
V <sub>0</sub>	Maximum machine speed	mm/min
L	Feed distance per operation	mm
to	Positioning time	sec
tf	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
Jmg	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
$J_{\text{MB}}$	Inertia of brake with motor	kg • cm <sup>2</sup>
J <sub>M</sub>	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N • m
Ttyp	Motor rated torque	N • m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
P <sub>typ</sub>	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	dS=pi*Ds*1/n*1/nm	mm/rev
Electrical accuracy	$dL=(dS/P_{f})*1000$	micron/pulse
Motor rotational speed	N <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	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 <sup>2</sup>
Inertia of wheels	$J_T = \{(W_s^*(D_s/10)^2)/8\}^*p$	kg • cm²
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 <sup>2</sup>
Load torque	TL=(mu*(WL+Wv)*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	$R_p = \{(maximum value of  T_{Ma} ,  T_{Md} )/T_{typ}\}*100$	%
Cont. effect load torque	$t_{c}=t_{0}-T_{sa}-T_{sd}-t_{s}$ Trms1=SQRT{(TMa^2*T_{sa}+T_{L}^2*t_{c}+T_{Md}^2*T_{sd})/t_{f}}	N•m
Effective load factor	Rrms=(Trms1/Ttyp)*100	%
Acceleration energy	$E_a = (0.1047/2) N_0 T_{Ma} T_{sa}$	J
Deceleration energy	Ed=(0.1047/2)*No*TMd*Tsd	J
Constant speed energy	Ef=0.1047*N0*TL*tc	J
Absolute of –energy total	$E_m =  $ (total of negative energy in $E_a$ , $E_d$ , $E_f$ )	J
Regenerative power	$P_r = \{etam^*E_m - (W_a^*t) - E_c\}/t_f$	W
Regeneration load factor	Ld=(Pr/Ptyp)*100	%
Max. regenerative power	E <sub>max</sub> =section energy when maximum regenerating P <sub>max</sub> ={etam*E <sub>max</sub> -(Wa*t <sub>max</sub> )-E <sub>c</sub> }/t <sub>max</sub>	W

#### 4.7 Elevator

Symbol	Content	Unit
WH	Mass of lift head	kg
WL	Mass of load	kg
Wc	Mass of counterweight	kg
Wh	Mass of chain	kg
1/n	Reduction gear ratio	
$J_{G}$	Reduction gear inertia	kg • cm <sup>2</sup>
J <sub>C</sub>	Coupling inertia	kg • cm <sup>2</sup>
Jo	Inertia of the others	kg • cm <sup>2</sup>
Ds	Diameter of sprocket	mm
Ws	Width of sprocket	mm
Z	Number of sprockets	
eta	Drive efficiency	
mu	Drive coefficient of friction	
V0	Maximum machine speed	mm/min
L	Feed distance per operation	mm
to	Positioning time	sec
tf	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
J <sub>MG</sub>	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
J <sub>MB</sub>	Inertia of brake with motor	kg • cm <sup>2</sup>
J <sub>M</sub>	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N • m
T <sub>typ</sub>	Motor rated torque	N • m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
Ptyp	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	dS=pi*Ds*1/n*1/nm	mm/rev
Electrical accuracy	dL=(dS/Pf)*1000	micron/pulse
Motor rotational speed	N <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of sprockets	$J_{Z}=\{(pi^{*}0.0078^{*}(W_{S}/10))/32\}^{*}(D_{S}/10)^{4}z$	kg • cm <sup>2</sup>
Inertia of Table & Load	JF=(WH+WL+WC+Wh)*(dS/20*pi)^2	kg • cm <sup>2</sup>
Total load inertia	$J_L=J_{MG}+J_{MB}+J_F+\{J_G+J_C+J_O+J_Z^*(1/n)^2\}^*(1/n_m)^2$	kg • cm <sup>2</sup>
Imbalance torque	TU={((WH+WL-WC)*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
	In case $(-T_U+T_F) > 0$ : $T_{Ld}=(-T_U+T_F)/eta$	N
Downward load torque	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 <sub>Mau</sub> ={((J <sub>L</sub> +J <sub>M</sub> )*N <sub>0</sub> )/(9.55*10000*T <sub>sa</sub> )}+T <sub>Lu</sub>	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	Rp={(maximum value of   TMxx data   )/Ttyp}*100	%
	$t_c = t_0 - T_{sa} - T_{sd} - t_s$	
Cont. effect load torque	$T_{rms2} = S_{QRT} \{ \{T_{Mau}^{2} + T_{Mad}^{2}\}^* T_{sa} + (T_{Mdu}^{2} + T_{Mdd}^{2})^* T_{sd} + $	N • m
	$(T_{Lu}^{2}+T_{Ld}^{2})*t_{c}+T_{U}^{2}*(t_{f}-2*t_{0}+2*t_{s}))/t_{f}$	
Effective load factor	$R_{rms}=(T_{rms2}/T_{typ})^*100$	%
Upward accele. energy	Eau=(0.1047/2)*No*T <sub>Mau</sub> *T <sub>sa</sub>	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 <sub>m</sub> = (total of negative energy in Exx data)	J
Regenerative power	$Pr=\{etam^*E_m-(W_a^*t)-E_c\}/t_f$	W
Regeneration load factor	$L_{d}=(P_{r}/P_{typ})*100$	%
Max. regenerative power	E <sub>max</sub> =section energy when maximum regenerating P <sub>max</sub> ={etam*E <sub>max</sub> -(Wa*t <sub>max</sub> )-E <sub>c</sub> }/t <sub>max</sub>	W

#### 4.8 Conveyor

Symbol	Content	Unit
WT	Mass of conveyor moving part	kg
WL	Mass of load	kg
1/n	Reduction gear ratio	
JG	Reduction gear inertia	kg • cm <sup>2</sup>
Jc	Coupling inertia	kg • cm <sup>2</sup>
Jo	Inertia of the others	kg • cm <sup>2</sup>
DR	Diameter of roll	mm
J <sub>R</sub>	Inertia of roll	kg • cm <sup>2</sup>
Z	Number of rolls	
eta	Drive efficiency	
mu	Drive coefficient of friction	
V <sub>0</sub>	Maximum machine speed	mm/min
L	Feed distance per operation	mm
t <sub>0</sub>	Positioning time	sec
tf	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
Jmg	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
$J_{\text{MB}}$	Inertia of brake with motor	kg • cm <sup>2</sup>
J <sub>M</sub>	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N•m
Ttyp	Motor rated torque	N•m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
P <sub>typ</sub>	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item Calculation formulas		Unit
Feed distance/Motor Rev.	$dS=pi^*DR^*1/n^*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_{f})*1000$	micron/pulse
Motor rotational speed	N <sub>0</sub> =V <sub>0</sub> /dS	r/min
Stop settling time	ts=3*1/Kp	sec
Accele./Deceleration time	$T_{sa}=T_{sd}=t_0-(L/V_0*60+t_s)$	sec
Inertia of Table & Load	$J_F=(W_L+W_L)^*(dS/20^*pi)^2$	kg • cm <sup>2</sup>
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 <sup>2</sup>
Load torque	TL=(mu*(WT+WL)*g*dS)/(2000*pi*eta)	N • m
Moment of inertia ratio	m=JL/JM	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 <sub>p</sub> ={(maximum value of  T <sub>Ma</sub>  ,  T <sub>Md</sub>  )/T <sub>typ</sub> }*100	%
Cont. effect load torque $t_c=t0-T_{sa}-T_{sd}-t_s$ $T_{rms1}=S_{QRT}\{(T_{Ma}^2*T_{sa}+T_L^2*t_c+T_{Md}^2*T_{sa}+T_{$		N • m
Effective load factor	R <sub>rms</sub> =(T <sub>rms1</sub> /T <sub>typ</sub> )*100	%
Acceleration energy	Ea=(0.1047/2)*N0*TMa*Tsa	J
Deceleration energy	$E_d = (0.1047/2) N_0 T_{Md} T_{sd}$	J
Constant speed energy	Ef=0.1047*No*TL*tc	J
Absolute of –energy total	$E_m =  $ (total of negative energy in $E_a$ , $E_d$ , $E_f$ )	J
Regenerative power	$P_r = \{etam^*E_m - (W_a^*t) - E_c\}/t_f$	W
Regeneration load factor	Ld=(Pr/Ptyp)*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	Content	Unit
TL1	Converted load torque to the motor shaft	N•m
J <sub>L1</sub>	Moment of load inertia	kg • cm <sup>2</sup>
J <sub>C</sub>	Coupling inertia	kg • cm <sup>2</sup>
1/n	Reduction gear ratio	
JG	Reduction gear inertia	kg • cm <sup>2</sup>
Jo	Inertia of the others	kg • cm <sup>2</sup>
N0	Motor rotational speed	r/min
$dS_L$	Feed distance per motor revolution	mm
L	Feed distance per operation	mm
Tsa	Acceleration time	sec
Tsd	Deceleration time	sec
t <sub>f</sub>	One operation cycle	sec
1/nm	Reduction ratio of motor with reduction	
Pf	Encoder resolution	pulse/rev
Kp	Position loop gain	1/sec
Jmg	Inertia of reduction gear with motor	kg • cm <sup>2</sup>
$J_{\text{MB}}$	Inertia of brake with motor	kg • cm <sup>2</sup>
J <sub>M</sub>	Motor rotor inertia	kg • cm <sup>2</sup>
g	Gravitational acceleration	m/sec <sup>2</sup>
T <sub>max</sub>	Motor maximum torque	N • m
T <sub>typ</sub>	Motor rated torque	N • m
etam	Reverse-efficiency of motor	%
Wa	Amplifier loss	W
t	Regenerative operation time	sec
Ec	Energy charged to the capacitors in amp.	J
P <sub>typ</sub>	Rated power of regeneration	W
t <sub>max</sub>	Maximum regeneration time	sec

Item	Calculation formulas	Unit
Feed distance/Motor Rev.	$dS=dSL*1/n*1/n_m$	mm/rev
Electrical accuracy	$dL=(dS/P_{f})*1000$	micron/pulse
Feed speed	V <sub>0</sub> =N <sub>0</sub> *dS	mm/min
Stop settling time	ts=3*1/Kp	sec
Positioning time	t0=1/2*(Tsa+Tsd)+ts+(60*L)/V0	sec
Total load inertia	$J_L=J_{MG}+J_{MB}+\{J_G+J_C+J_O+J_{L1}^*(1/n)^2\}^*(1/n_m)^2$	kg • cm <sup>2</sup>
Load torque	$T_L=T_L1*1/n_m$	N • m
Moment of inertia ratio	m=JL/JM	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	$R_p = \{(maximum value of  T_{Ma} ,  T_{Md} )/T_{typ}\}*100$	%
	tc=t0-Tsa-Tsd-ts	N•m
Cont. effect load torque	$T_{rms1} = S_{QRT} \{ (T_{Ma}^{2}T_{sa} + T_{L}^{2}t_{c} + T_{Md}^{2}T_{sd})/t_{f} \}$	IN • 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 =  (total of negative energy in E_a, E_d, E_f) $	J
Regenerative power		
Regeneration load factor	$L_{d}=(P_{r}/P_{typ})*100$	%
May regenerative news	E <sub>max</sub> =section energy when maximum regenerating	
Max. regenerative power	$P_{max} = \{etam^*E_{max} - (Wa^*t_{max}) - E_c\}/t_{max}$	W

### 5. TROUBLESHOOTING

#### 5.1 Software uninstallable

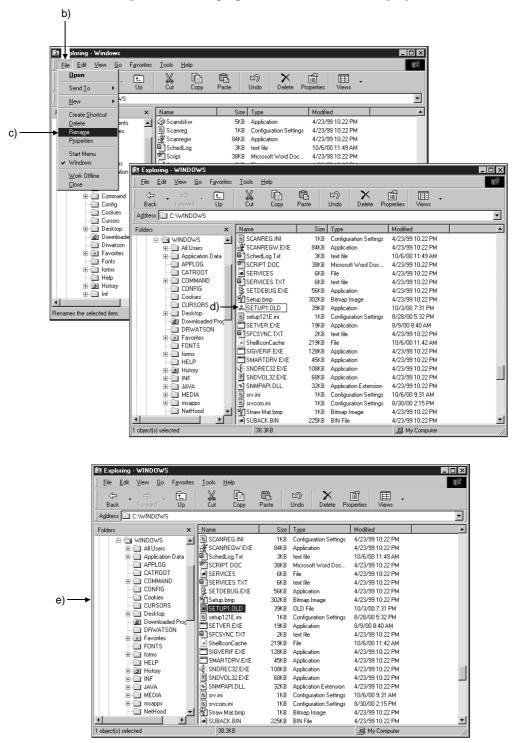
Action to be taken when the software cannot be installed Take the following steps if installation is suspended and an error is indicated by the following window:



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

🕅 Exploring - Windows						
<u>File E</u> dit <u>V</u> iew <u>G</u> o	F <u>a</u> vorites	<u>T</u> ools <u>H</u> elp				(B)
Back Forward	1 Up	Cut Copy	Paste	네 X Undo Delete Pri	operties Views	
Address C:\WINDOWS						•
Folders	×	Name	Size	Туре	Modified	
😟 💮 My Documents	<b></b>	Scandskw 🧼	5KB	Application	4/23/99 10:22 PM	
🗄 🛄 Program Files	_	📓 Scanreg	1KB	Configuration Settings	4/23/99 10:22 PM	
🖓 Recycled		📲 Scanregw	84KB	Application	4/23/99 10:22 PM	
🛅 Servo		ChedLog SchedLog	ЗКВ	text file	10/6/00 11:49 AM	
🖻 📹 Windows		🖥 Script	38KB	Microsoft Word Doc	4/23/99 10:22 PM	
🕀 🧰 All Users		Services	6KB	File	4/23/99 10:22 PM	
🕀 🧰 Application	Data	E Services	6KB	text file	4/23/99 10:22 PM	
- Applog		🐉 Setdebug	56KB	Application	4/23/99 10:22 PM	
Catroot		📲 Setup	302KB	Bitmap Image	4/23/99 10:22 PM	
⊡ Command	a) —	🖡 🛵 Setup1	39KB	Application	10/3/00 7:31 PM	
Config		setup121E	1KB	Configuration Settings	8/28/00 5:32 PM	
Cursors		E Setver	19KB	Application	8/9/00 8:40 AM	
+ Desktop		E Sfcsync	2KB	text file	4/23/99 10:22 PM	
Downloade	d Proc	Shell conCache	219KB	File	10/6/00 11:42 AM	
Drwatson	11102	📰 Sigverif	128KB	Application	4/23/99 10:22 PM	
+ 🕞 Favorites		🛅 Smartdrv	45KB	Application	4/23/99 10:22 PM	
- Di Fonts		<b>Q</b> €Sndrec32	108KB	Application	4/23/99 10:22 PM	_
🕀 🛄 forms		🛐 Sndvol32	68KB	Application	4/23/99 10:22 PM	
🛅 Help		🔊 Snmpapi.dll	32KB	Application Extension	4/23/99 10:22 PM	
🕀 🞯 History		SIV III	1KB	Configuration Settings	10/6/00 9:31 AM	
🕀 🛄 Inf	-	Srvcom	1KB	Configuration Settings	8/30/00 2:15 PM	
4	►	📳 Straw Mat	1KB	Bitmap Image	4/23/99 10:22 PM	
1 object(s) selected		38.3KB			🗐 My Computer	

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.

SETUP	$\times$
Initializing Setup	

# MEMO


## REVISIONS

## $\ensuremath{^*\mathrm{The}}$ 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