DS Controller

Operating Manual

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This publication was written to assist you in better understanding this part of your IA system. If you require further assistance, please contact IA Technical Support at +49-6196-8895-0 or Fax +49-6196-8895-24 during regular business hours.

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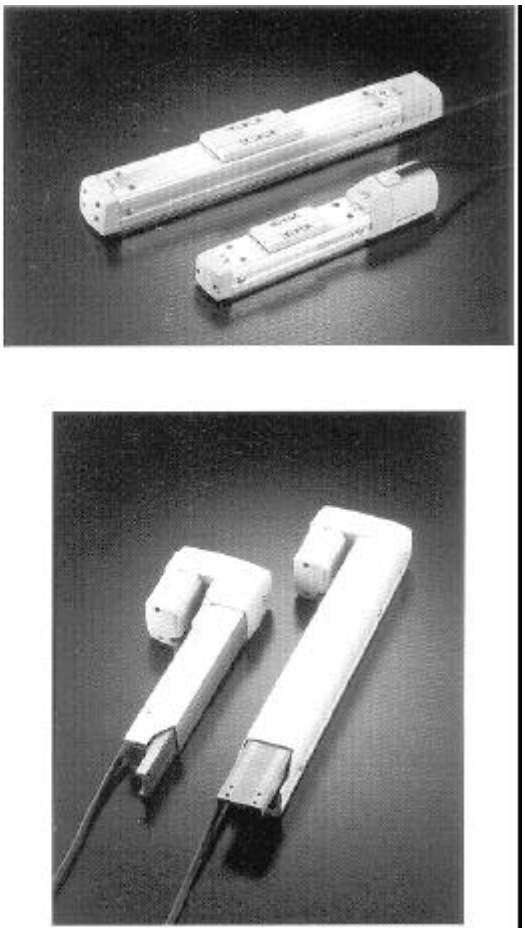
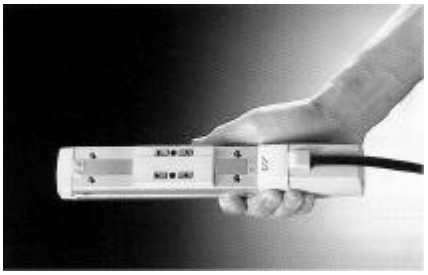


DS Series

- **Ultra compact, coupling-free design.**
  (Minimum width: 40 mm, height: 46 mm, length: 210 mm)
- **Assembly parts made exclusively for the DS Series.**
  (Ballscrew, guide, motor encoder, rubber seal and cable)
- **Up to 500 positions programmable.**
- **Effectively dust guard made of stainless steel.**
- **Easy programming.**
- **Variable acceleration and deceleration, high speed motion control.**
- **Extremely competitively priced.**



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Thank you very much for selecting the Intelligent Actuator, DS series actuator/controller system.

The DS series is compact, easy to use and can control the actuator and peripheral devices with ease. Also, the SEL language used in the DS series makes it possible to perform high level control with simple expressions. Please read through this manual carefully to gain an understanding of the proper method of operating and handling the DS controller and actuator.

Proper Use of the DS Actuator

Safety Precautions

Basic Use:

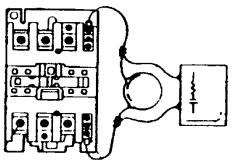
- Please do not operate the actuator other than as described in this booklet.
- Do not come within the moving range of the actuator when the actuator is in operation or is ready to be operated.

Maintenance:

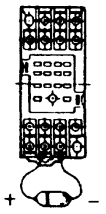
- Always unplug the electric cord prior to doing any maintenance work.
- While doing maintenance work, make sure that a sign indicating work in progress is clearly visible.
- Make sure that no one can inadvertently turn the power back on.
- If there is more than one person working, let the other person know what work you are about to perform.

Noise Prevention

- AC load - Install a surge suppressor parallel to the coil.

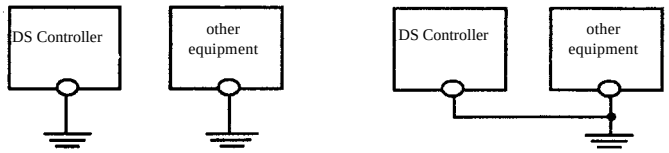


- DC load (24 V DC) - Attach a diode parallel to the coil.



Grounding

[good] [poor]



0 Safety

The DS Positioning system has been designed and constructed in accord with the EC Machinery Directive.

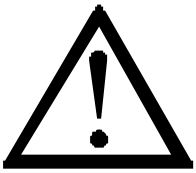
WARNING

Residual risk

Misuse or improper operation can lead to severe injury as well as damage to property or the environment.
Observe warnings and safety notes!
Only adequately qualified personnel must operate the DS Positioning System!
Each operator must have read and understood these operating instructions!

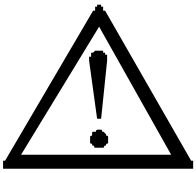
0.1 Classification of Safety Notes

Warnings and Notes in this operating manual are identified by a symbol with keyword printed in the page margin.
The warnings and notes appear in bold type and are highlighted by a frame.
These warnings are hierarchically classified:



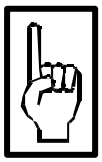
WARNING

The keyword **WARNING** is used for warnings from imminent hazards.
Possible consequences may be death or severest injury (injury to people).



ATTENTION

Possible consequences may be death, severe or moderate injury (injury to people), damage of property or the environment.



NOTE

The keyword **NOTE** is used for user hints.
The possible consequence of failure to comply may be damage to property,
e. g. at the DS Positioning System.

0.2 Intended Use

The DS Positioning System is **exclusively** designed and constructed **to position *an* DS Drive,** either

- in slider version or
- in arm version

ATTENTION

Danger due to misuse of the DS Positioning System

The consequences of unintended use may be injury to users or other people as well as damage to the DS Positioning System or environmental pollution.

Only use the DS Positioning System as intended!
Observe the warnings!

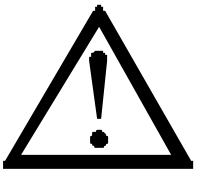
Unintended Use:

The DS Positioning System must not be used in explosive atmospheres.

Limit Values:

- Humidity: max. 95 % relative humidity, non condensing
- Storage temperature
  - min. -20 °C
  - max. 85 °C
- Operating temperature
  - min. 0 °C
  - max. 50 °C
- Height above sea level: max. 1000 m above sea level
- Enclosure type: IP 54 (according to EN 60529)
  must be achieved by environment/integration.

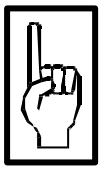
The DS Positioning System has been designed and constructed to operate safely.



ATTENTION

Hazards from Changes or Supplementation

Do not make unauthorized changes!
Do not supplement equipment components or devices of other manufacturers before you have contacted IAI Industrieroboter GmbH especially concerning the suitability of these parts!



NOTE

The DS Positioning System requires little maintenance, but is not entirely maintenance-free.

Irregular Maintenance

The consequences of irregular maintenance may be damage to the DS Positioning System and production downtime.

Observe the following maintenance notes!

0.3 Electrical Connection

ATTENTION

The DS Positioning System must be connected to electrical mains (see Chapter Installation).

Electrical mains voltage presents a considerable hazard.

Consequences may be death or severest injury or damage to property.

The connection to the electrical mains must be made by a qualified electrician!
On the primary side, suitable fusing must be provided for!

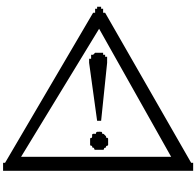
Power Supply: DC 24 V +/- 10 %

0.4 Emergency Stop Circuit

As defined in the General safety requirements each machine must be equipped with command devices for safe stoppage.
When the machine has stopped, the energy supply to the drive system must be interrupted.

The DS Positioning System is designed for integration into machinery (plant). Depending on the risk assessment made by the manufacturer of the plant, a circuit for safe stoppage of the plant must be realized. This applies to normal stoppage and to stoppage in case of emergency.

In plants with linked machinery all preceding and/or following equipment must be stopped safely if its continued operation could present a hazard.



ATTENTION

Not safely stopped DS Positioning System

People may be injured by the DS Positioning System if it is not stopped safely.

Realize a circuit ensuring that the DS Positioning System is stopped safely both in normal operation and emergencies!

0.5 Operators

The DS Positioning System must be operated exclusively by authorized persons.

The operating manual must be available to operators.

ATTENTION

Adherence to Safety Notes

The consequences of improper operation may be severe or moderate injury (injury of people), damage to property or the environment.

Do not operate the DS Positioning System before you have read and understood the entire operating manual and especially the Chapter "Safety"!

ATTENTION

Maintenance Work

The maintenance personnel may be seriously injured, if the DS Positioning System is not properly shut down.
Switch power supply to the DS Positioning System off.
Secure it from restart!
Maintenance work must be carried out by qualified personnel only!

0.6 Workplaces

The DS Positioning System has two workplaces:

Operate the control unit

- from the programming station with the PC programming system or
- from the machine operating panel, for instance with the Start button in Automatic operation.

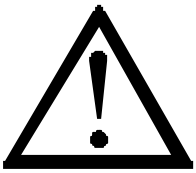
0.7 Equipment for Personal Protection

Depending on the kind of positioning job, the workpiece to be handled or the tools used, it may be necessary to use equipment for personal protection.

0.8 Sound Pressure Level

The A-weighted equivalent sound pressure level of the DS Positioning System is below 70 dB(A).

0.9 Disposal



ATTENTION

Decommissioning

Electrical waste (components, monitor, etc.) may pollute the environment.

Properly dispose of the DS Positioning System!

0.10 Guards

The DS Positioning System is equipped with

- covers,
- warning signs.

0.10.1 Covers

The covers

- prevent you from touching live components,
- prevent foreign bodies from entering, and
- provide electromagnetic shielding.

The covers must be removed only temporarily and only by authorized persons for maintenance work.

0.10.2 Warning Signs

Warning signs on the DS Positioning System alert to risidual risk:

Warning of hazardous electrical voltage:

- DS Control
- DS Drive

0.11 Emergencies, Fire Extinguishing Equipment

In case of emergency switch off power supply to the DS Positioning System.

lf the DS Positioning System is on fire, extinguish it with an **ABC-type powder extinguisher** or with **carbon dioxide.** lf you use **water,** be sure to stay at the required minimum distance! The minimum distance among other factors depends on nozzle diameter, spraying angle or full beam. lf a C-size hose is used with nozzle (12 mm) and spraying beam, the minimum distance is one metre.

1 DS Controller

1.1 Safety Precautions

This product was developed as components for driving automated equipment and is designed not to produce greater torquing or speed than is necessary. However, strictly observe the following items to prevent any accidents from occurring.

1. As a rule, any handling or operating methods not described in this manual should be viewed as things that should not be attempted. Please contact the company if any portion of the contents of this manual are unclear.
2. Use only the products specified for wiring between the actuator and controller.
3. Stand clear of the operating range of the machine when it is in motion or is ready to operate. Surround the system with safety partitions if there is a possibility that people can enter the area where the machine is being used.
4. When assembling, adjusting, or performing maintenance on the machine, always disengage the power supply to the controller. During work, display a sign stating work in progress where it is readily visible. Also, keep the power cable close to the operator so that another person cannot inadvertently switch on the power.
5. When more than one person is working on the system, agree on signals beforehand to ensure everyone's safety before beginning work. In particular, when doing work involving axis movement, always call out for everyone's safety regardless of whether power is ON or OFF, or the axis is to be mechanically driven or manually moved.
6. When the user needs to lengthen the cables, check the wiring carefully to make sure it is correct before turning the power ON since miswiring can lead to misoperation.

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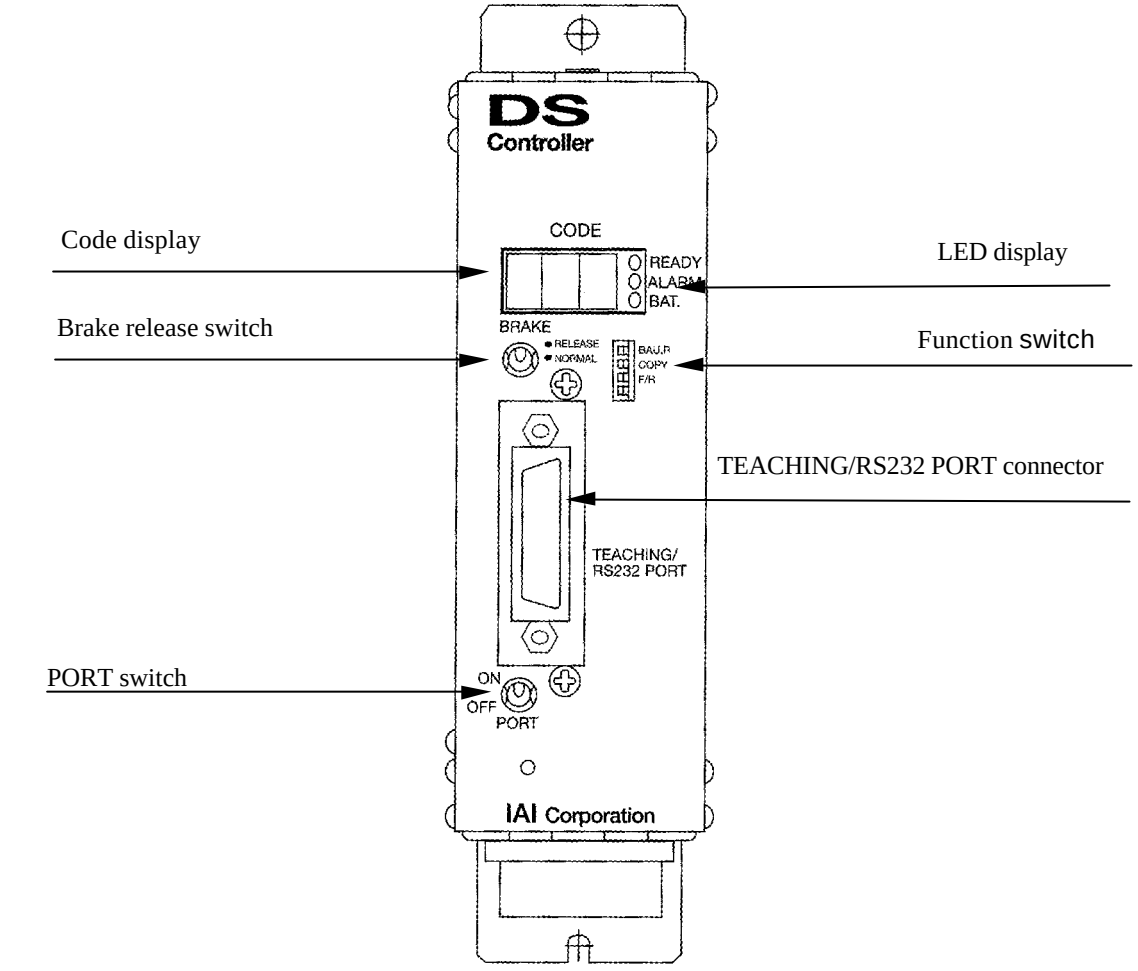
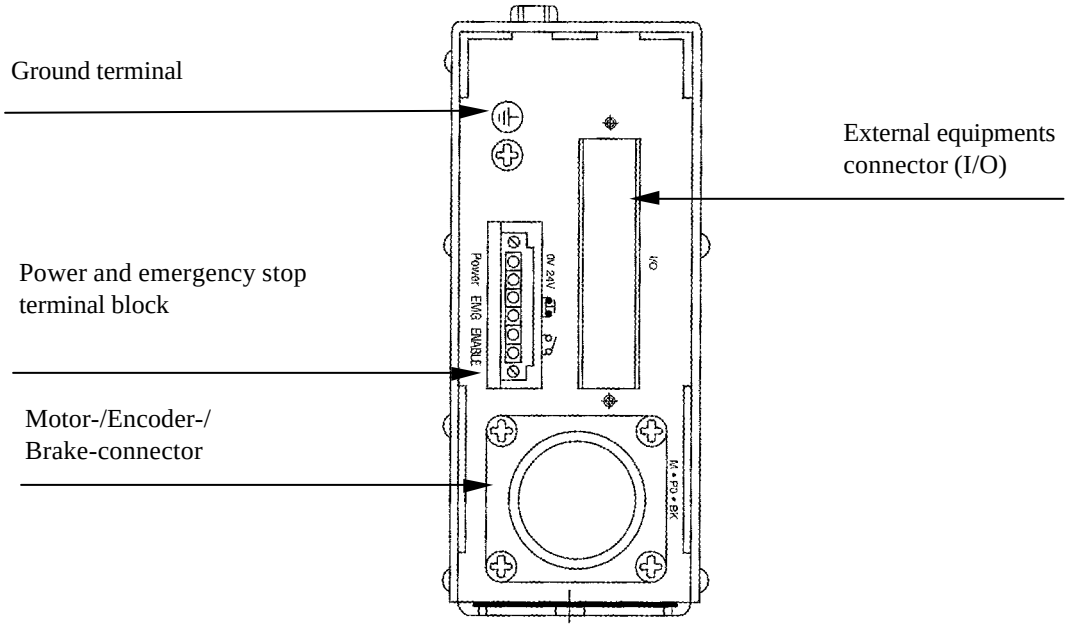
1.2 Warranty Period and Scope of Warranty

1. This product is under warranty for a period of one year from the date it is shipped to the customer. If the product breaks down due to a manufacturing defect during this period, IAI will repair it at no cost.
2. The following are not covered under the warranty, even if the product is still under the warranty period.
   - Damage due to incorrect handling or use that does not adhere to the instructions in the user's manual.
   - When electrical or mechanical revisions have been performed on the product.
   - Part wear when traveling distance has exceeded 5 000 km.
   - Breakdown or damage caused by fire, earthquake or other natural disasters.
   - Any other breakdown or damage that is not recognized as the company's responsibility.

1.3 Part Names and Functions

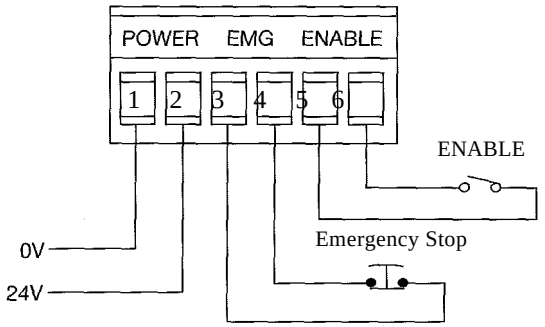
1.3.1 Part Names





1.3.2 Functions

CODE display:	**CODE:** This is a 3-digit display device that indicates the operating status of the controller.
LED display:	• **READY:** This indicates that the controller is ready to be operated. • **ALARM**: This is the display when there is a malfunction in the DS system. • **BAT.:** This indicates battery voltage is low.
Brake release switch:	**BRAKE:** • **RELEASE:** The brake is released. • **NORMAL:** The brake is ON. (This is the normal setting) The brake release switch is ENABLEd during the servo free state indicated below**:** 1. From the time the power is turned ON until the homing routine is performed. 2. When [SVOF] is selected during direct teaching. 3. When an alarm occurs..
PORT switch:	**PORT:** • **ON:** The TEACHING/RS232PORT is ENABLEd. However, when the TEACHING/RS232 PORT connector is not connected, an emergency stop occurs. • **OFF:** The TEACHING/RS232PORT is disengaged. However, even when the TEACHING/RS232PORT connector is not connected, the emergency stop is released. **Note:** When the controller is powered up, plug in or remove the TEACHING/RS232PORT connector when the PORT switch is OFF.
Function switch:	• **BAU.R:** This is the switch for changing the Baud rate. • **COPY:** This is the switch for COPY from ROM to FLASH memory. • **F/R:** This is the switch for changing FLASH and ROM. **Note:** At the time the unit is shipped, all switches are set to OFF so use them as is under normal circumstances.
TEACHING/RS232 PORT connector:	**TEACHING/RS232 PORT:** This is the connector for connecting the teaching pendant or a personal computer.

Motor-/Encoder-/ Brake-connector:	This is the connector for connecting the actuator motor encoder cable incl. brake.
Ground terminal:	M3 screw for the ground connection of I/0-cable.
External equipments connector:	This is the connector for connecting external equipments and for the 24-V-power of I/0 board.
Power and emergency stop terminal block:	This ist the terminal for 24-V-power. The two ENABLE terminals must be always kept shorted either with wire or contact point. (The driver power will go off and become Driver Alarm (EA1), if the short at ENABLE ist released when servo is on. In this case, it will recover after the controller is powered on again.) **Note:** Please do not connect the two ENABLE terminals to other circuits. At the time the unit is shipped, EMG terminals and ENABLE terminals are shorted and connected to emergency stop connector. 

The user should satisfy the conditions given in the table below with respect to the power lines that are connected:

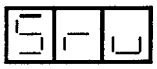
Suitable power line:	2 x 1,5 mm²
Standard line length of the MPG-cable:	5 m (11 leads)

Note:
This controller does not have a power switch.

1.3.3 Explanation of the Code Displays

 ⇒ Open display

 ⇒ Serial I/O check display

 ⇒ Servo check display

 ⇒ Program check display

 ⇒ Ready display

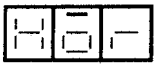
 ⇒ Flash memory copy display

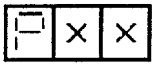
 ⇒ Flash memory copy complete display

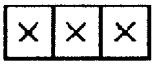
 ⇒ Update display

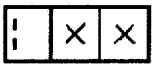
 ⇒ Emergency stop display

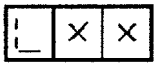
 ⇒ CPU reset

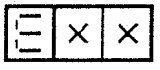
 ⇒ Homing display

 ⇒ Startup program No. display

 ⇒ Position No. display (001~500)

 ⇒ Interrupt error display

 ⇒ Software error display

 ⇒ Other error display

1.4 Specification

1.4.1 Controller Specification

Item	Description
Power Supply	DC 24 V ± 10 %, 1 A rated (Maximum 2A during acceleration)
Ambient Temperature & Humidity	• Temperature: 0 ~ 50 °C • Humidity: max. 95 % relative humidity (non condensing)
Operating Environment	• Free of corrosive gas • No excessive dust (IP 20)
Isolation Resistance	> 10 MΩ (500 V DC)
Immunity to Interference	Acc. to DIN EN 50082-2
Unit Weight	860 g
Safety Features	• Driver alarm (Motor excess current - Excess voltage - Driver temperature check) • Overload check • Software limit check (length of stroke)
Motor	AC Servo Motor
Control Functions	Multi-tasking Control: Super SEL Controller
Memory Capacity	• 32 programs • 1000 steps • 500 positions
Memory Device CMOS	CMOS buffer battery
Input/Output (24 V DC) Non-insulated	• Dedicated inputs: 7 (PRG No. 1, 2, 4, 8, 10, 20, CPU Reset) • Dedicated inputs: 1 (START) • User inputs: 15 • User inputs: 2 (READY, ALARM) • User outputs: 6
Data Input Method RS232	• Teaching pendant or • RS232 Communication
Communication Standard RS232	RS232 Standard Asynchronous
Firmware Update	Software update (via floppy disk)

1.4.2 External I/O Specification

External Input Circuit

Item	Specification
External Power Voltage	24 V DC ± 10 %
Input Current	7 mA / 24 V DC
ON/OFF Voltage	• ON voltage: min. 18,0 V DC • OFF voltage: max. 6,0 V DC
Insulation	non-insulated
External Connection Device	• No-voltage contact point (minimum load about 5 V DC - 1mA) • Photoelectric - proximity sensor (type PNP) • PLC Transistor output (type PNP, open collector) • PLC Contact point output (minimum load about 5 V DC - 1mA)

Note:
When a no-contact circuit is connected to an external circuit, make sure that the leakage current is under 1mA when the switch is OFF or, it could cause faulty operation.

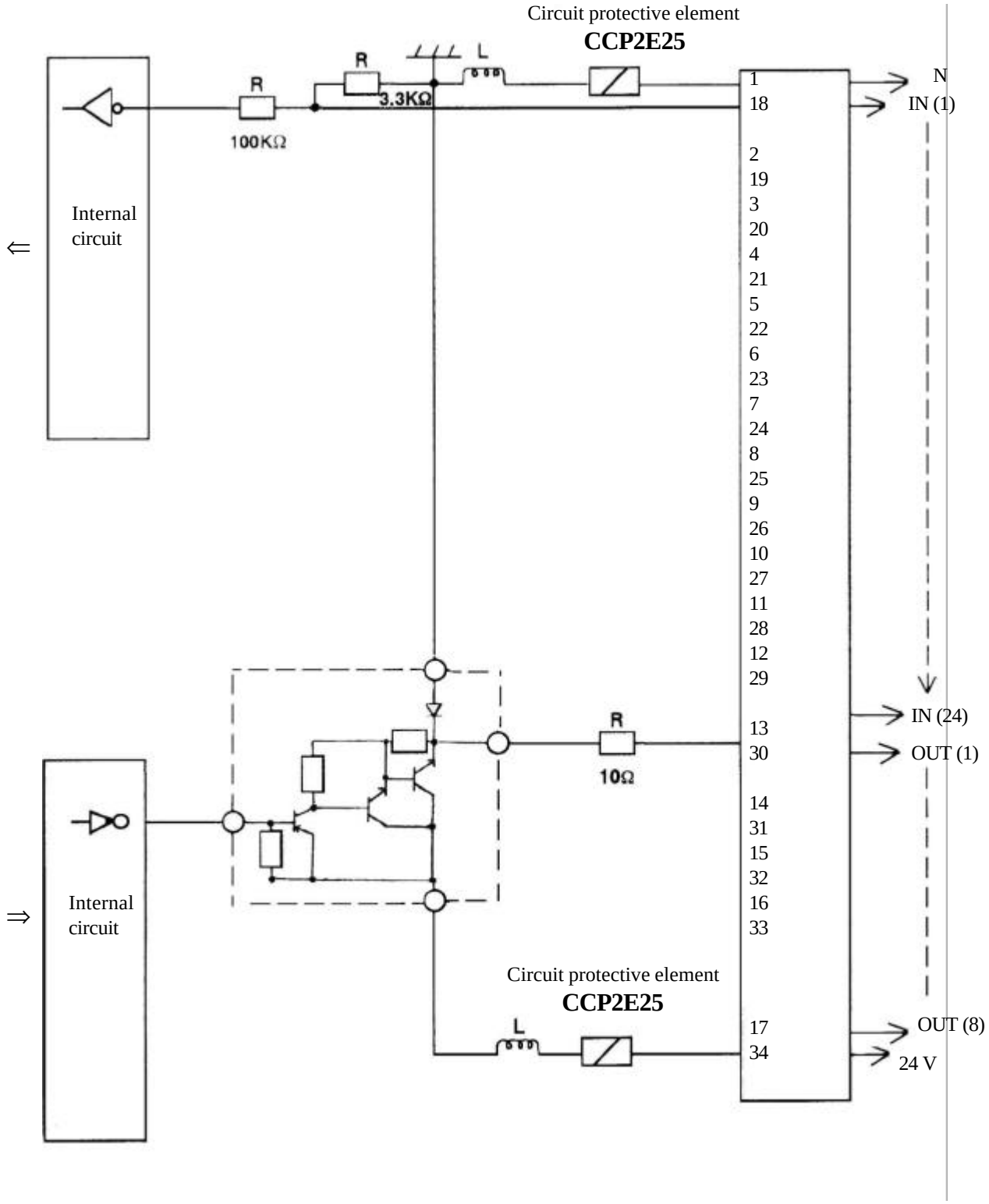
External Output Circuit

Item	Specification
Load Voltage	24 V DC*)
Maximum Load Voltage	100 mA / 1 point 400 mA peak*) (all current)
Recommended Load Voltage	20 mA / 1 point*)
Leakage Current	Max. 0,1 mA
Insulation	No-insulated
External Connection Device	• Miniature relay • PLC input unit (type PNP)

*) Application for TD62084

Notes:
- For all of the external outputs, the flywheel diode (D) is connected on the inside.
- Take care when connecting because if the load short circuits or the current exceeds the maximum load current, this will cause a failure in the output circuit.

External I/O Circuit



1.4.3 Interface List

Specifications for the I/O Connector during program mode and position mode are different.
The interface list for each is indicated in the table below.

Position Mode
I/O Connector (34 Pin)

Pin No.	Distribution	I/O No.	Function	Cable Colour
1	0V	--	Distribution Voltage 0 V	orange/red A
18	Input		NC	orange/blue A
2			NC	grey/red A
19			NC	grey/blue A
3			NC	white/red A
20			NC	white/blue A
4			NC	yellow/red A
21			Reserve	yellow/blue A
5			CPU RESET	pink/red A
22		000	Start Input (Position)	pink/blue A
6		001	Hold Input	orange/red B
23		002	NC	orange/blue B
7		003	NC	grey/red B
24		004	Position No. 1 Input	grey/blue B
8		005	Position No. 2 Input	white/red B
25		006	Position No. 4 Input	white/blue B
9		007	Position No. 8 Input	yellow/red B
26		008	Position No. 10 Input	yellow/blue B
10		009	Position No. 20 Input	pink/red B
27		010	Position No. 40 Input	pink/blue B
11		011	Position No. 80 Input	orange/red C
28		012	Position No. 100 Input	orange/blue C
12		013	Position No. 200 Input	grey/red C
29		014	Position No. 400 Input	grey/blue C
13		015	NC	white/red C
30	Output	300	Alarm Output	white/blue C
14		301	Ready Output	yellow/red C
31		302	Positioning Complete Output	yellow/blue C
15		303	NC	pink/red C
32		304	NC	pink/blue C
16		305	NC	orange/red D
33		306	NC	orange/blue D
17		307	NC	grey/red D
34	+ 24 V	--	Distribution Voltage + 24 V Input	grey/blue D

Note:
NC = No contact

- Do not use number Pin No. 18 (NC) to Pin No. 4 (NC) since these are for program number input.
- Position mode can be used when program number inputs are "0" (OFF).
- When using the controller in position mode, use pin number 24 (Port No.004) to Pin No. 29 (Port No. 014) for position number input.
- Homing is performed when position number inputs are "0" (OFF).
- Please note that when the I/O connector (external 24V power) is not connected, the controller considers all input ports and program inputs to be "0" (OFF).

Program Mode
I/O Connector (34 pin)

Pin No.	Distribution	I/O No.	Function	Cable Colour
1	0V	--	Distribution Voltage 0 V	orange/red A
18	Input		PRG No. 1	orange/blue A
2			PRG No. 2	grey/red A
19			PRG No. 4	grey/blue A
3			PRG No. 8	white/red A
20			PRG No. 10	white/blue A
4			PRG No. 20	yellow/red A
21			Reserve	yellow/blue A
5			CPU RESET	pink/red A
22		000	Start Input (Program)	pink/blue A
6		001	User Input	orange/red B
23		002	User Input	orange/blue B
7		003	User Input	grey/red B
24		004	User Input	grey/blue B
8		005	User Input	white/red B
25		006	User Input	white/blue B
9		007	User Input	yellow/red B
26		008	User Input	yellow/blue B
10		009	User Input	pink/red B
27		010	User Input	pink/blue B
11		011	User Input	orange/red C
28		012	User Input	orange/blue C
12		013	User Input	grey/red C
29		014	User Input	grey/blue C
13		015	User Input	white/red C
30	Output	300	Alarm Output	white/blue C
14		301	Ready Output	yellow/red C
31		302	User Output	yellow/blue C
15		303	User Output	pink/red C
32		304	User Output	pink/blue C
16		305	User Output	orange/red D
33		306	User Output	orange/blue D
17		307	User Output	grey/red D
34	+ 24 V	--	Distribution Voltage + 24 V Input	grey/blue D

Note:
PRG = Program

Please use Pin No. 18 (NC) to Pin No. 4 (NC) for inputting program numbers.

1.4.4 TEACHING/RS232PORT

D-Sub 25 DTE (Special *)

Pin No.	Signal Name
1	FG
2	TXD
3	RXD
4	(RTS)
5	(CTS)
6	DSR
7	SG (GND)
8	NC
9	NC
10	NC
11	NC
12	EMG-STOP S2 *
13	EMG-STOP S1 *

Short Circuit

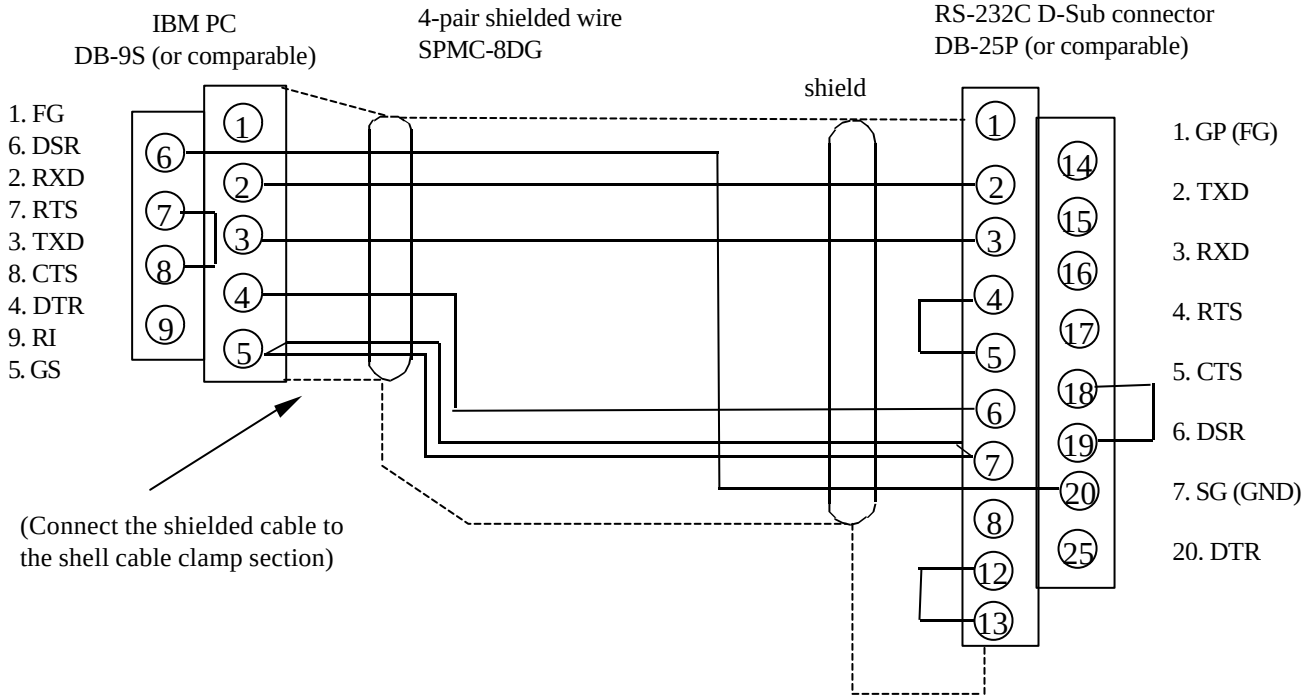
EMG-SW

Pin No.	Signal Name
14	NC
15	NC
16	NC
17	NC
18	+ 6 V Output *
19	ENABLE*
20	DTR
21	NC
22	NC
23	EMG-STOP*
24	NC
25	GND *

ENABLE-SW

Connection cable to an IBM PC (9 pins, RS232):

PORT SW



- In the case of RS232C, never connect pin numbers 12, 13, 18, 19, 23 and 25 since these are signal wires for the teaching pendant.
- Pin numbers 4 and 5 are shorted.
- Since pin numbers 18 and 19 are connecting terminals for the ENABLE SW, it is necessary to connect these when the servo is ON.

- TEACHING/RS232 PORT SW
  - **PORT SW (ON)**

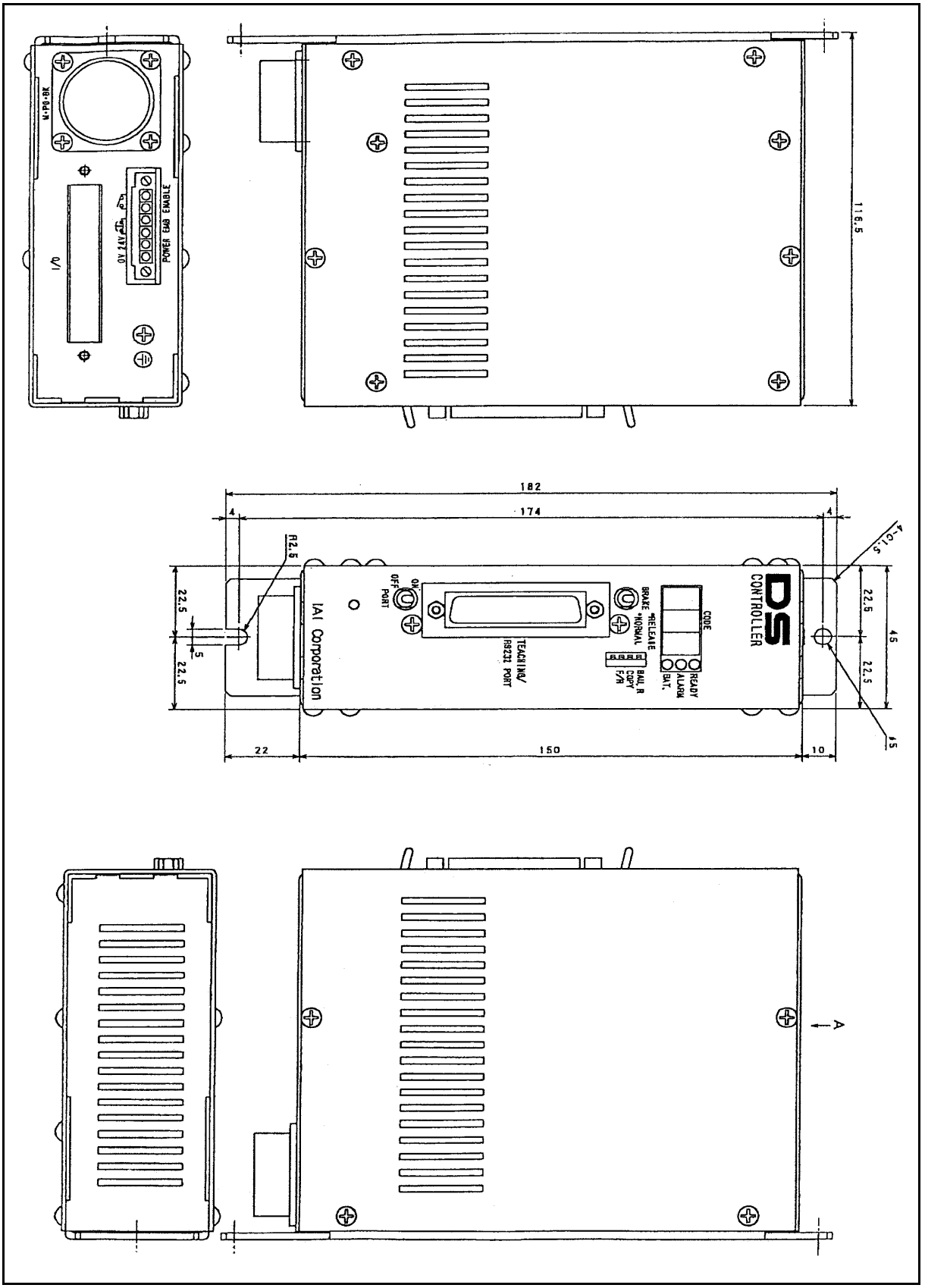
    ⇒ The teaching pendant or RS232 communication lines can be used.
  - **PORT SW (OFF)**

    ⇒ The connector function stops.
    The pin numbers 12 and 13 EMG SW and the pin numbers 18 and 19 ENABLE SW are shorted internally.

1.4.5 Port

Port	Pin No.	Signal Name	Cable Colour
Encoder	1	5 V	Red
	2	GND	Black
	3	A	Grey
	4	B	Yellow
	5	Z	Green
	6	$\overline{Z}$	Brown
	7		Clear
Motor	8	U	Red
	9	V	White
	10	W	Black
Brake	11	BK +	Orange
	12	BK -	Blue
NC	13		
	14		
	15		
	16		

1.5 Dimensions



1.6 Installation Environment and Noise Measures

1.6.1 Installation Environment

1. Do NOT block the air vents of your controller during installation and wiring.
   (Not only will insufficient ventillation prevent optimal performance, but it may lead to a malfunction in the controller)
2. Your DS Controller is NOT dust, water, or oil proof. Take steps to prevent foreign matter from getting into the controller air vents. Avoid using your controller in environments subject to contamination by dust, oil mist, or cutting oil.
3. Do not expose your controller to direct sunlight or place it near a heat source.
4. The controller should be used in an environment where the ambient temperature is 0 °C - 50 °C, humidity 95 % or less (no condensation) and is free of corrosive or inflammable gases.
5. Avoid external vibration, unnecessary impact, or excessive shocks to your controller.
6. Take steps to shield all cables and wires from electromagnetic noise

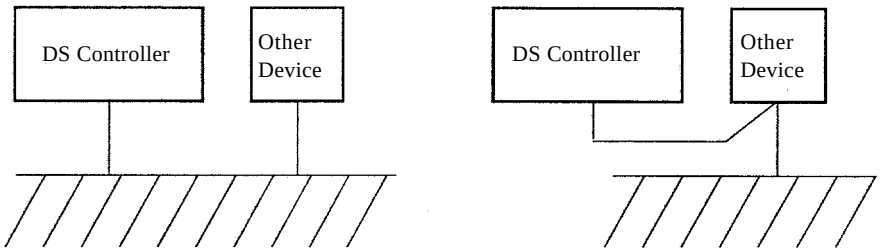
1.6.2 POWER Source

Power supply is DC 24V.

1.6.3 Noice Supression

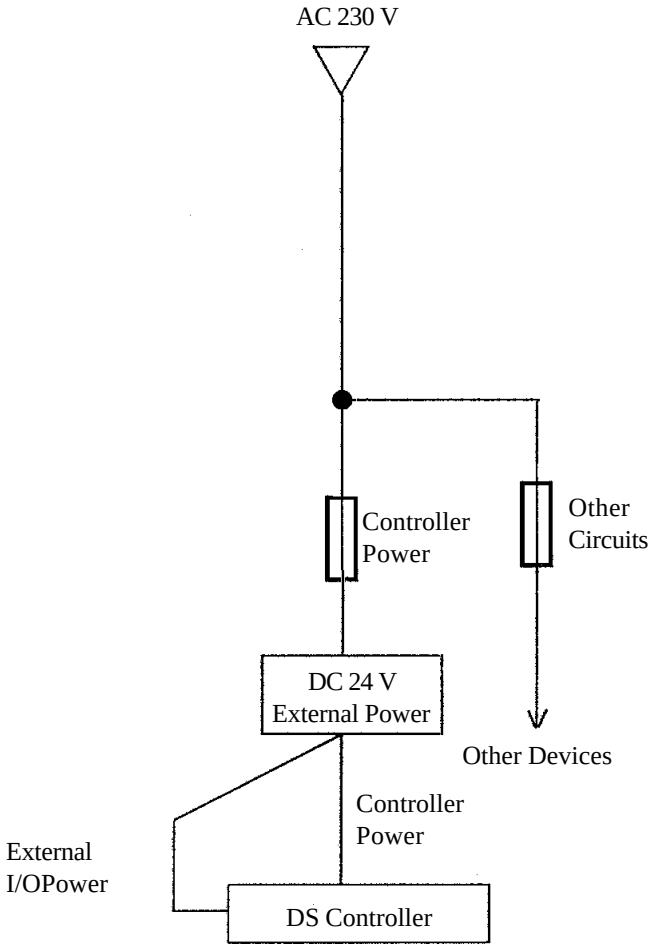
This section explains noise suppression measures when using the controller.

1. For grounding, please use a dedicated ground of Class 3 or better.
   The thickness of the cable should be 2,0 - 5,5 mm^2 or larger.



Class 3 ground Correct Avoid this method

2. Separate the wiring systems for the controller power and for other devices.



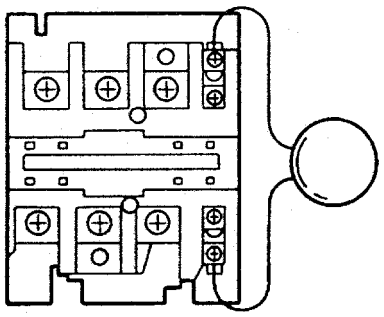
3. Wiring Notes

- Twist the cable for the DC 24 V external power.
- Isolate the controller cable from high power lines such as motor circuits.
  (Do not bundle, and do not place in the same piping circuit)
- The controller encoder cable is particularly sensitive to noise so make sure to keep it separate from load wiring for other equipment.

4. Noise Source and Noise Suppression
Noise comes from many sources but the most immediate when building a system are solenoid valves, magnetic switches and relays. Noise from the devices can be prevented by taking the following steps:

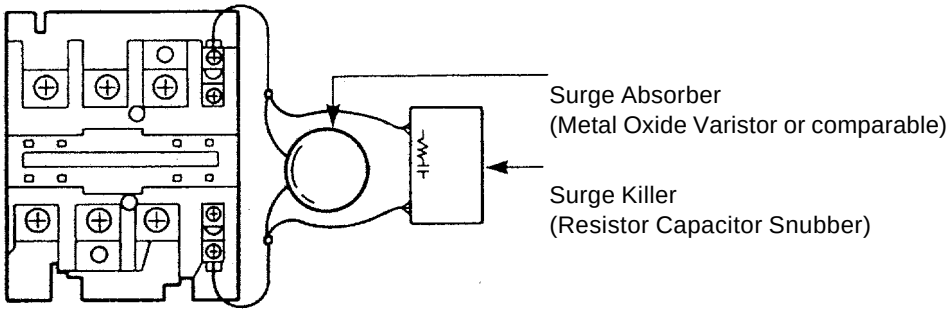
① AC solenoid valve - magnetic switch - relay:

– Install a surge absorber parallel to the reactance load (solenoid and relay coils).



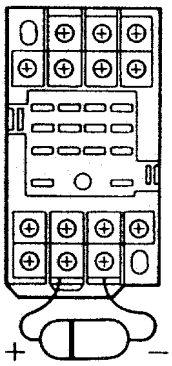
Note:
Use the shortest possible wiring between the surge absorber and the noise-creating device. Use of excessively long wiring will decrease the performance of the surge absorber.

– The most effective method is to install a surge absorber and surge killer in parallel to reactance load (solenoid and relay coils). This will reduce noise in a wide band of frequencies.



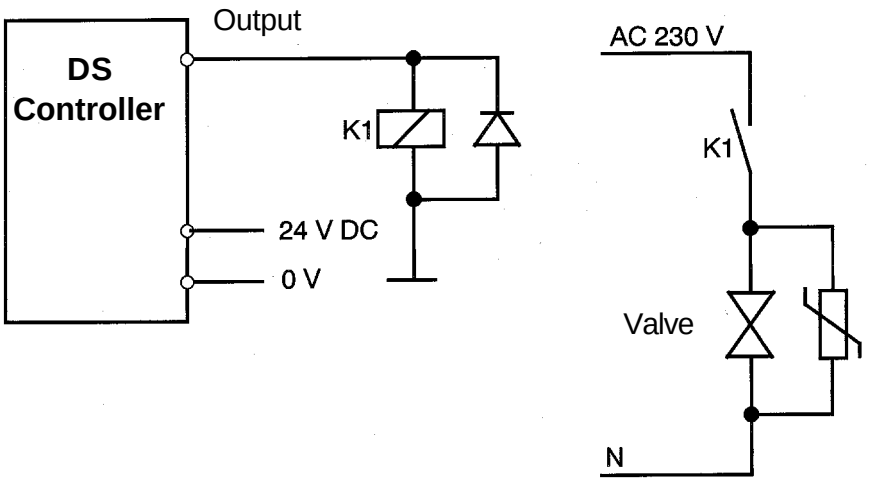
② DC solenoid valve - magnetic switch - relay:

Install a diode in parallel with a coil. Diode Capacity is determined by the load capacity.



Note:
In the case of DC power, be carefull not to exceed the diode polarity as this can lead to a breakdown of the diode, inside the controler or of the DC power.

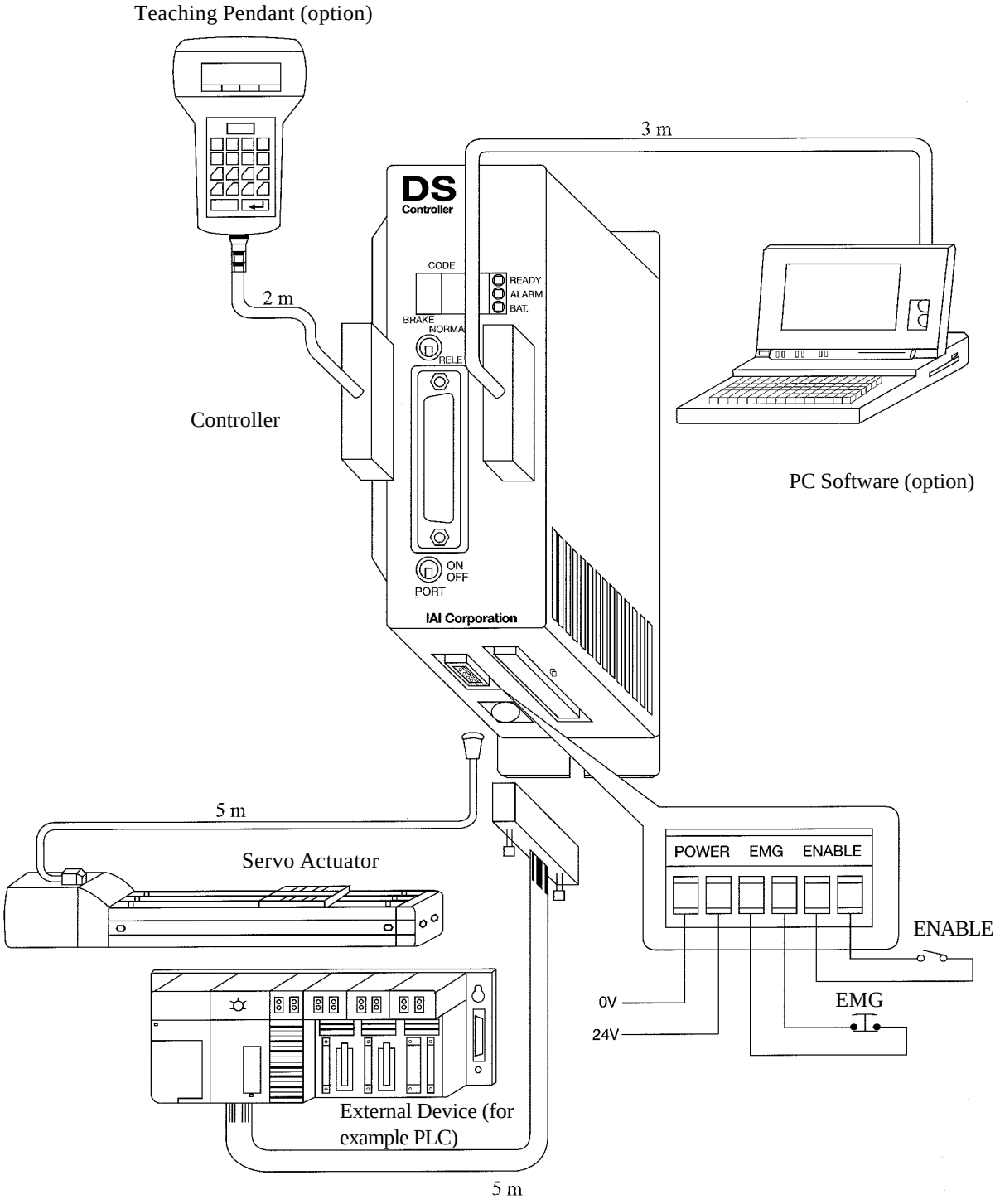
Circuit Example



1.7 Connections

1.7.1 Connection Method

Please make sure that all connectors are plugged in correctly and securely.
Excluding the TEACHING/RS232 PORT, do **NOT** plug or unplug the connectors while the power is ON.



1. Connect the motor-/encoder-/brake-cable coming from the actuator to the connector.
2. Connect the teaching pendant to the controller. After connecting, turn the PORT Switch ON.
   (If it is OFF, the teaching pendant will not work when the power is turned ON)
3. Supply the DC 24 V power to the controller terminal block (power).
4. If the Code display shows
   - [oPn → bio → Sru → Pro → rdy] in sequence,
     then, the DS Controller is ready to operate.
   - [ErG]
     then, the EMERGENCY STOP input will release.
   - [rES]
     then, either a CPU reset has been input
     or I/O current is disconnected.

The controller preparation is now complete.

Note:
The controller terminal block (EMG) is for connecting an emergency stop switch and is a b-type contact input (normally closed). When the unit is shipped, it is shorted and the emergency stop is released.

1.7.2 Diagram of the External Device Connector

The following is an example of connections with an external device in the **program** mode.

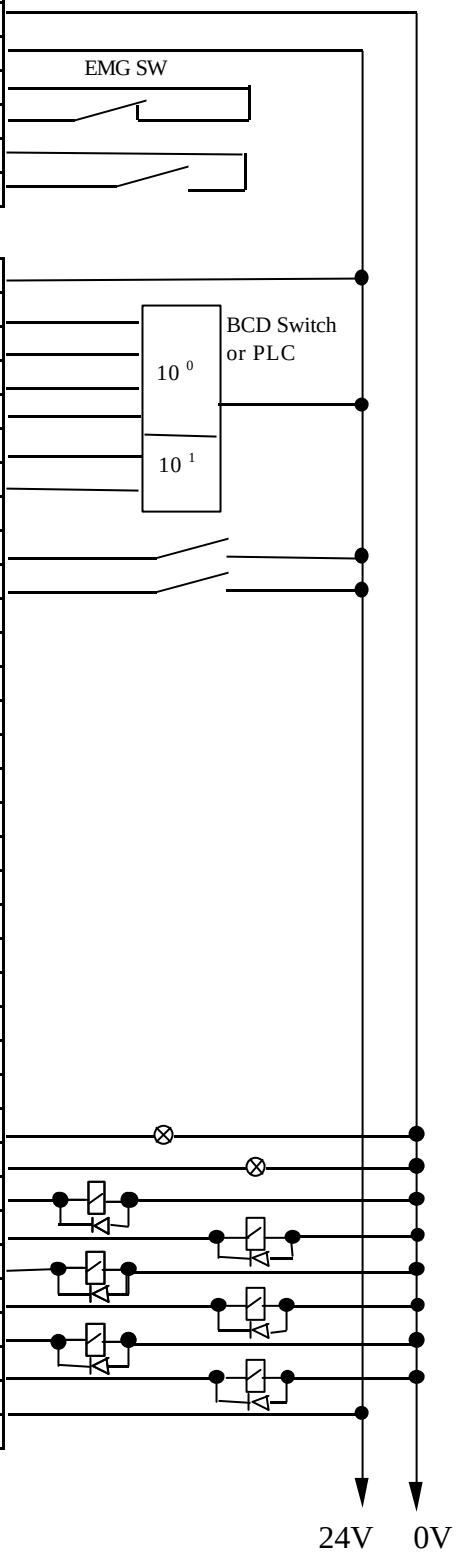
Program Mode

Terminal Block (6 pin)

Pin-No	Signal Name
1	0 V
2	+ 24 V
3	24 V (Output)
4	EMG SW
5	ENABLE
6	ENABLE

I/O Connector (34 pin)

Pin No.	Distribution	I/O No.	Function
1	0 V	--	Distribution Voltage 0 V
18	Input		PRG No. 1 Input
2			PRG No. 2 Input
19			PRG No. 4 Input
3			PRG No. 8 Input
20			PRG No. 10 Input
4			PRG No. 20 Input
21			Reserve
5			CPU RESET
22		000	Start Input (Program)
6		001	User Input
23		002	User Input
7		003	User Input
24		004	User Input
8		005	User Input
25		006	User Input
9		007	User Input
26		008	User Input
10		009	User Input
27		010	User Input
11		011	User Input
28		012	User Input
12		013	User Input
29		014	User Input
13		015	User Input
30	Output	300	Alarm Output
14		301	Ready Output
31		302	User Output
15		303	User Output
32		304	User Output
16		305	User Output
33		306	User Output
17		307	User Output
4	+ 24 V	--	Distribution Voltage + 24 V Input



The following is an example of connections with an external device in the position mode.

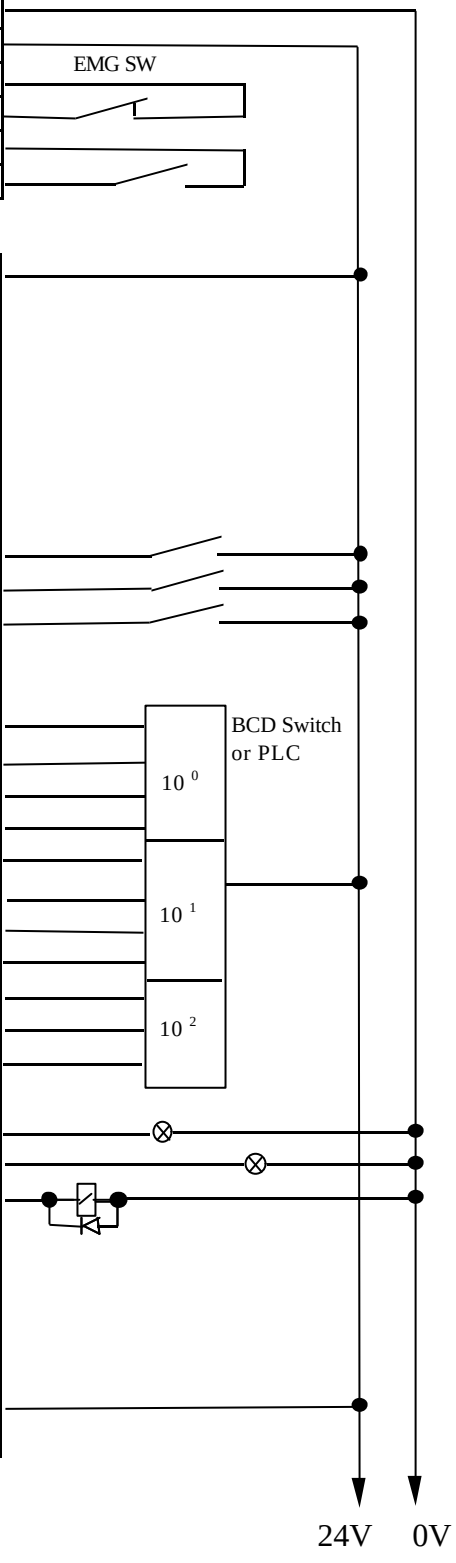
Position Mode

Terminal Block (6 pin)

Pin No.	Signal Name
1	0 V
2	+ 24 V
3	24 V (Output)
4	EMG
5	Enable
6	Enable

I/O Connector (34 pin)

Pin No.	Distribution	I/O No.	Function
1	0 V	--	Distribution Voltage 0 V
18	Input		NC
2			NC
19			NC
3			NC
20			NC
4			NC
21			NC
5			CPU RESET
22		000	External Start Input
6		001	Hold Input
23		002	NC
7		003	NC
24		004	Position No. 1 Input
8		005	Position No. 2 Input
25		006	Position No. 4 Input
9		007	Position No. 8 Input
26		008	Position No. 10 Input
10		009	Position No. 20 Input
27		010	Position No. 40 Input
11		011	Position No. 80 Input
28		012	Position No. 100 Input
12		013	Position No. 200 Input
29		014	Position No. 400 Input
13		015	NC
30	Output	300	Alarm Output
14		301	Ready Output
31		302	Position Complete
15		303	NC
32		304	NC
16		305	NC
33		306	NC
17		307	NC
34	+ 24 V	--	Distribution Voltage + 24 V Input



Note:
NC = No Contact

1.8 Moving the Actuator

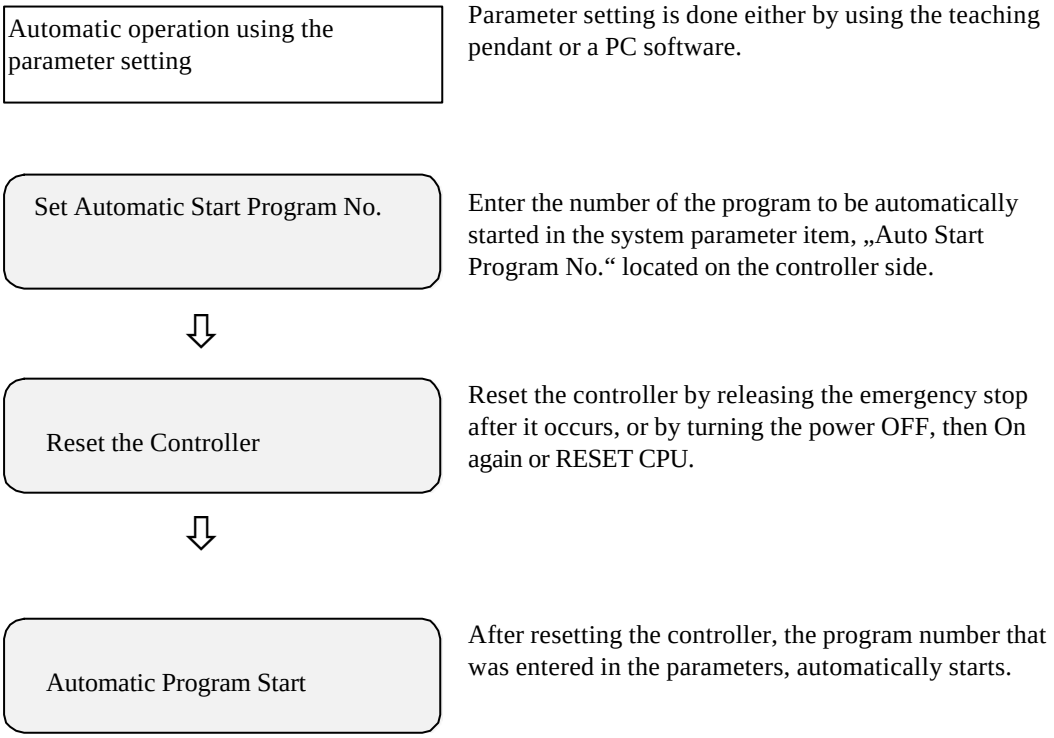
There are two ways to move the actuator. One is the program mode where a program in the memory drives the actuator, and the other is the positioning mode where the actuator is moved between stored positions..

1.8.1 Program Mode

There are two methods of operating the actuator in the program mode.

The first is "operation from the teaching pendant" and "operation using a PC software" which are used for simple operating checks (during program debugging on a trial run).

The second is "automatic operation based on parameter settings“ and "operation based on selection of external signals" which are used in general application examples on site. The following section explains the second method.



Precautions when using an auto start program:

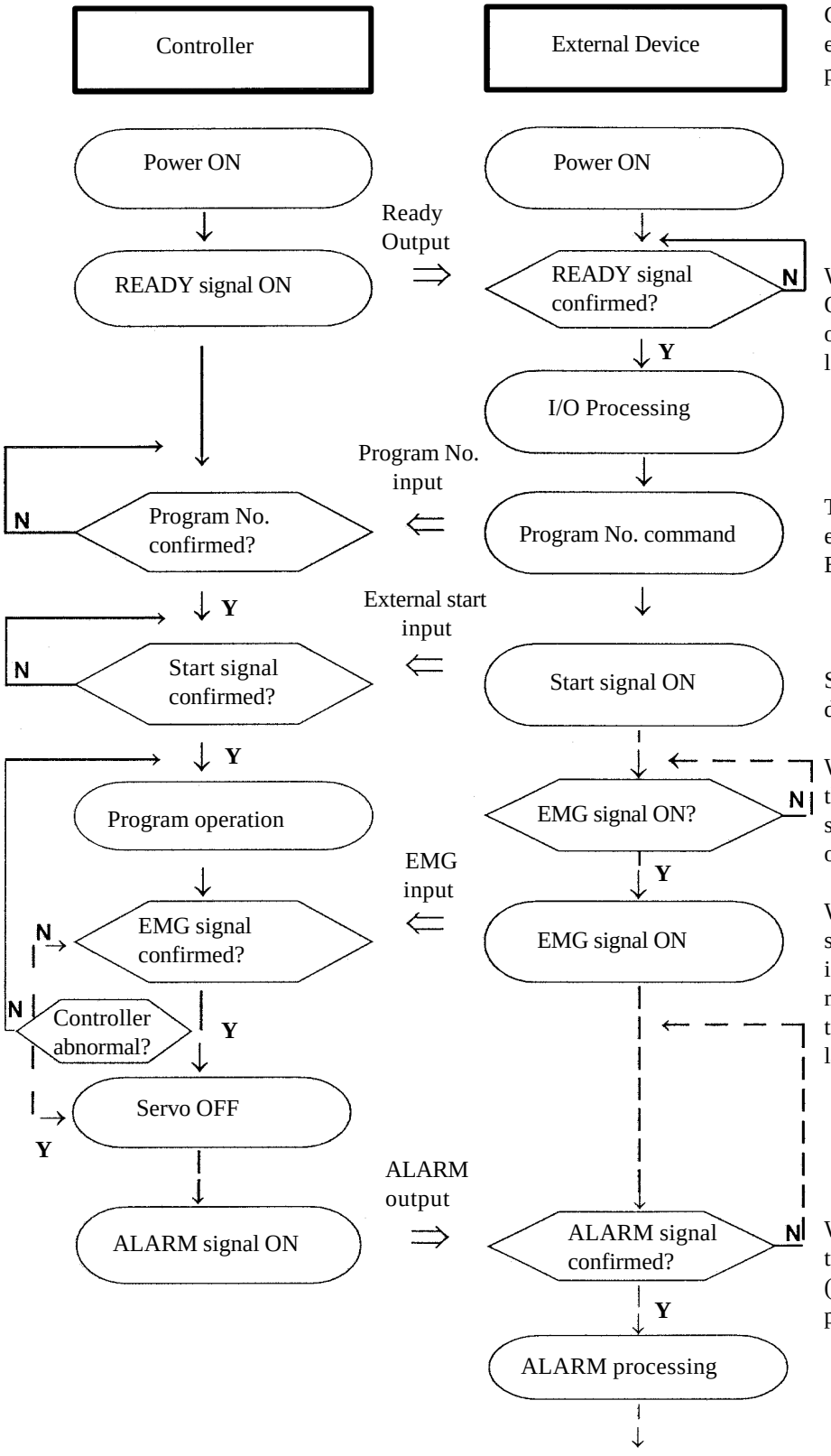
The servo actuator will start automatically, immediately after the controller is reset which may startle the operator.

To ensure safety, always use an interlock at the start of a program, such as having the actuator operate after receiving a confirmation signal.

As always, please take safety precautions when using an auto start program.

Operation Based on the External Start Signal Selection

1. Program Operation



Connect the controller to the external devices using the program mode.

When the READY signal turns ON, the READY lamp (green) on the controller front panel lights up.

The program number from the external device is input as a BCD code.

Start signal from the external device is input.

When the program is executed, the number of that program shows up in the CODE display on the controller front panel.

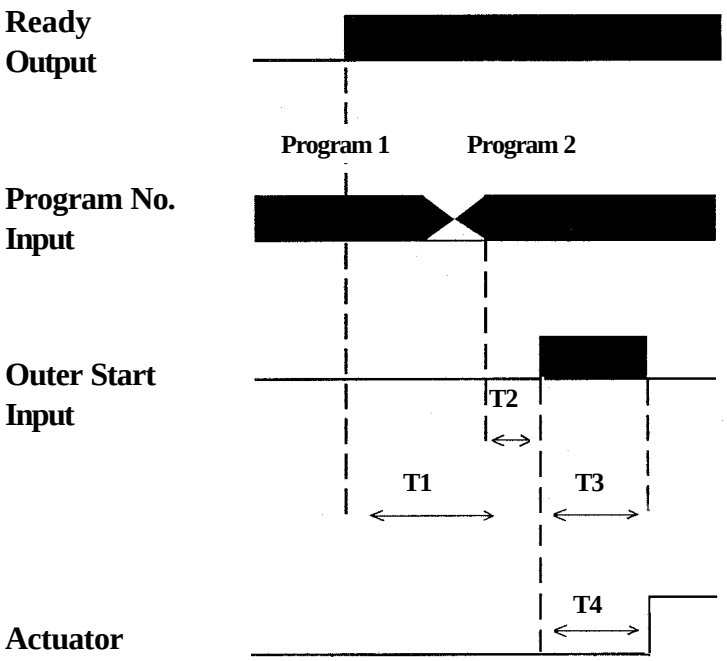
When an emergency stop signal from the extrenal device is input or, if the controller malfunctions, the controller turns the servo OFF (READY lamp turns OFF).

When the ALARM signal turns ON, the ALARM lamp (red) on the controller front panel lights up.

2. Timing of Each Signal

When exchanging signals with an external device, timing is critical. See the timing charts that follow.

Timing of Each Signal



T1:
The time from when the READY output turns ON until the external start signal can be input.
T1 = 50 ms or more

T2:
The time from the program number is input until the external start signal can be input.
T2 = 30 ms or more

T3:
The time from the input of the external start signal.
T3 = 30 ms or more

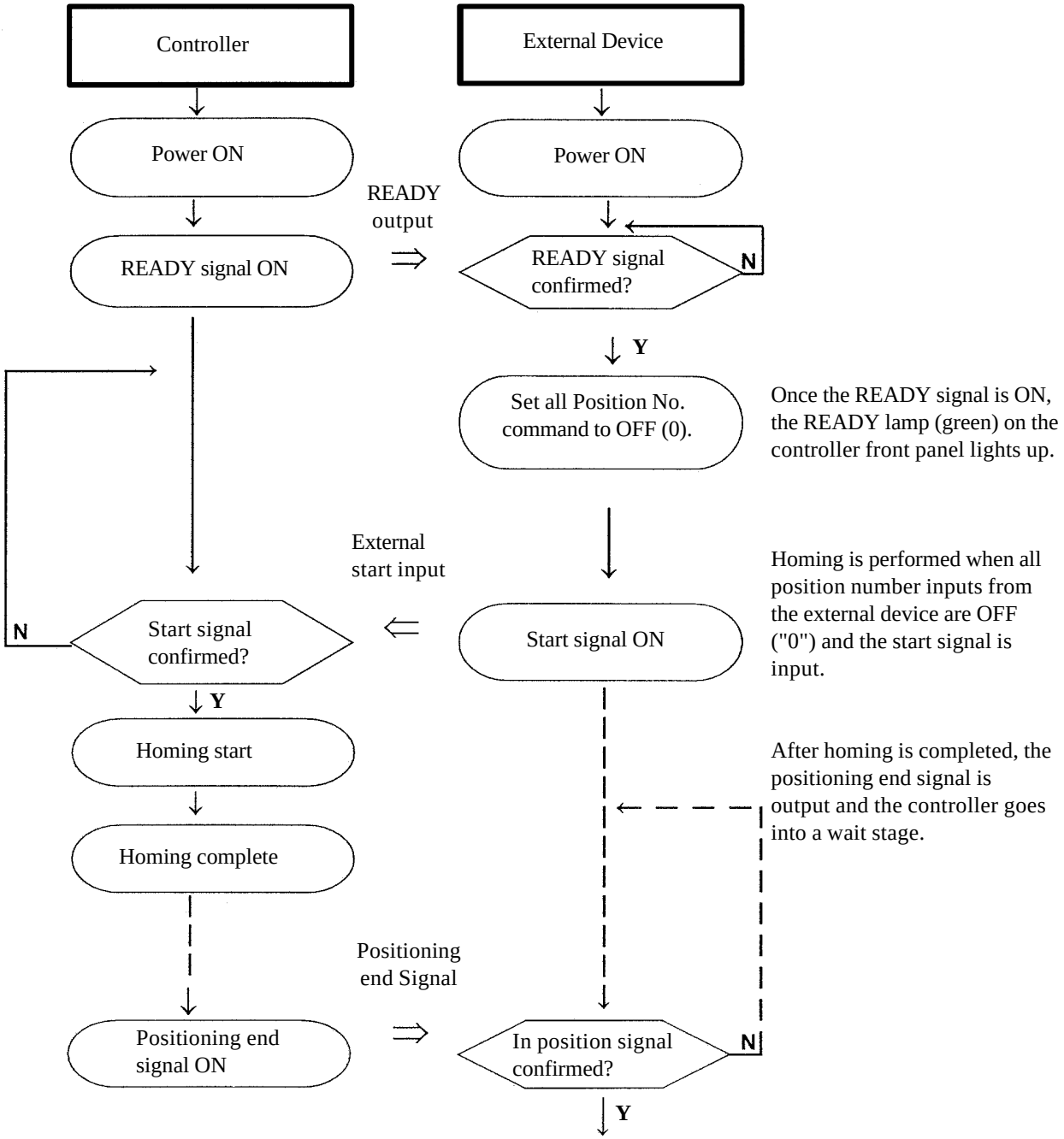
T4:
The time after the input of the external start signal until the Start of movement.
T4 = app. 50 ms

1.8.2 Operation Using the Positioning Mode

The positioning mode consists of "operation from the teaching pendant," "operation using a PC software," and "operation based on the external start signal selection." This section explains the last method.

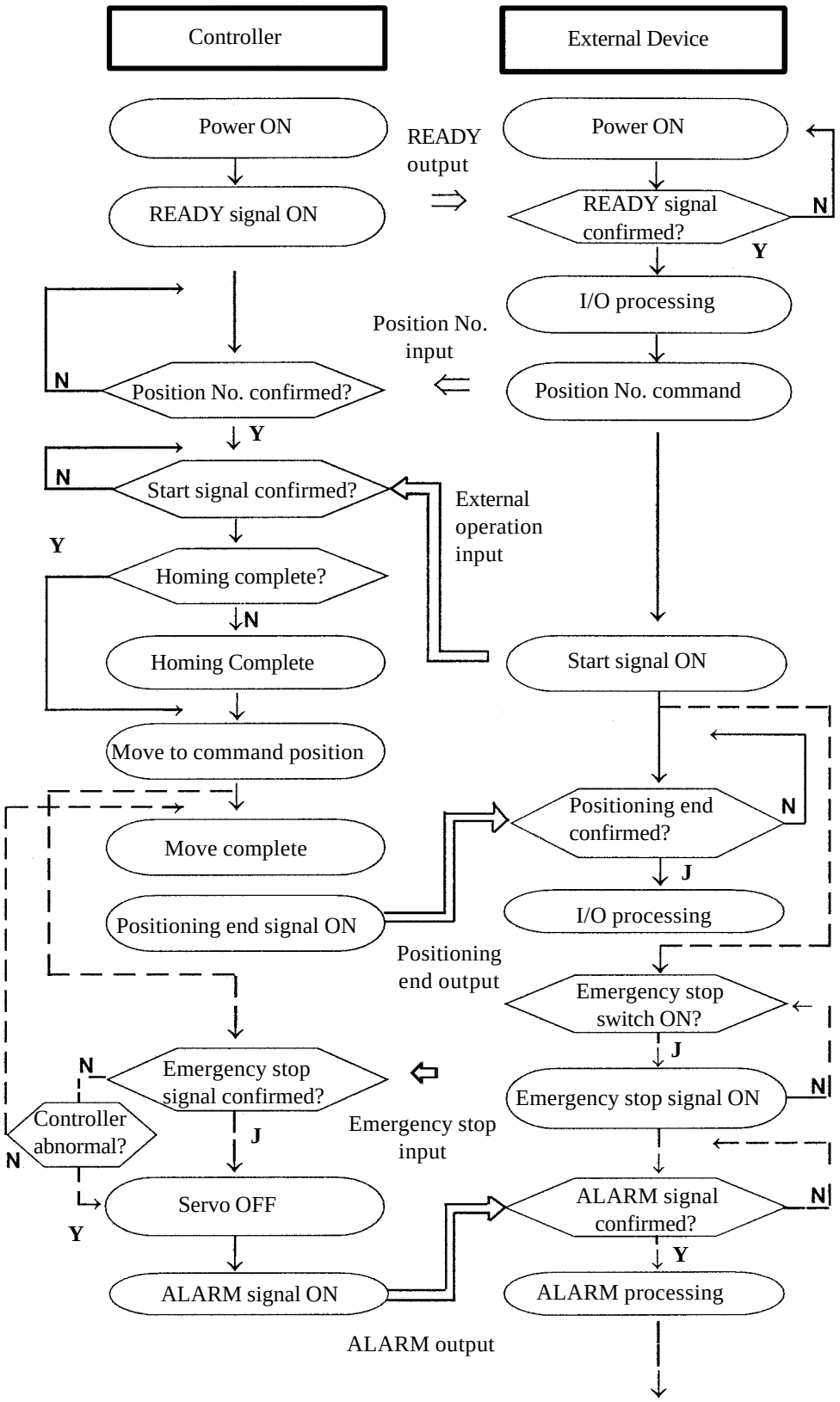
Operation Based on the External Start Signal Selection

1. Homing



NOTE:
After homing based on external devices, commands from the external device have priority. When switching over to an operation from the teaching pendant or using a PC software, perform homing after cutting the power once.

2. Positioning



When the READY signal turns ON, the READY lamp (green) on the controller front panel lights up.

The program number from the external device is input as a BCD code.

Note 1:
When a position number greater than 501 is designated, the signal is disregarded.
Note 2:
When there is no data in the designated position number, the signal is disregarded.
Note 3:
If homing has not been performed and a position is designated and a start signal input, the actuator will home first and then, move to the position.

When the move is completed, a positioning end signal is output.

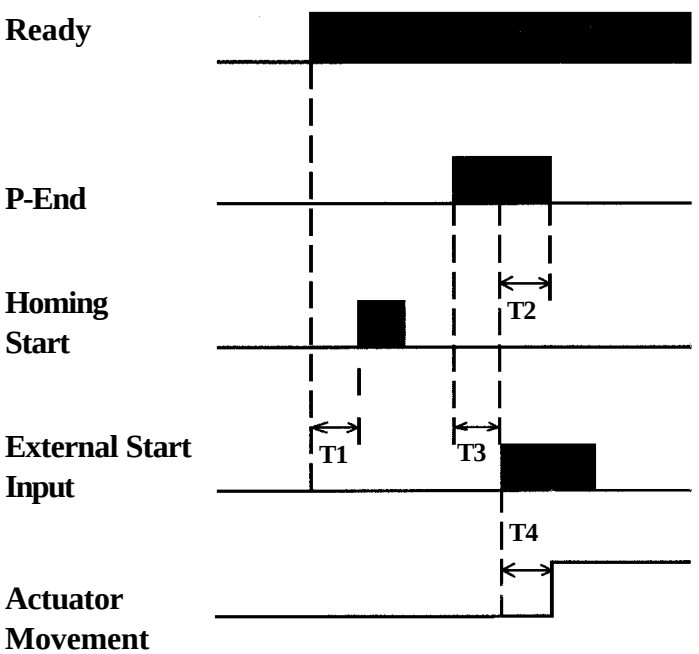
When an emergency stop signal from the external device is input or, if the controller malfunctions, the controller turns the servo OFF (READY lamp turns OFF).

When the ALARM signal turns ON, the ALARM lamp (red) on the controller front panel lights up.

3. Timing of Signals

When exchanging signals with an external device, timing is critical. See the timing charts that follow.

Timing of Signals



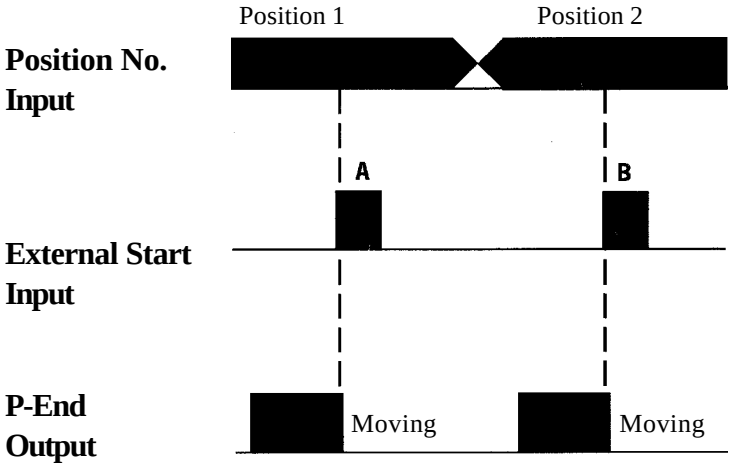
T1:
The time from the READY signal ON to homing start input.
T1 = 50 ms or more

T2:
The time from the start signal ON to the P-End signal OFF.
T2 = within 15 ms

T3:
The time from the P-End signal ON to when the external start signal input can be entered.
T3 = 50 ms or more

T4:
The time after the input of the external start signal until the Start of movement.
T4 = app. 50 ms

4. Timing for Position No. Switching

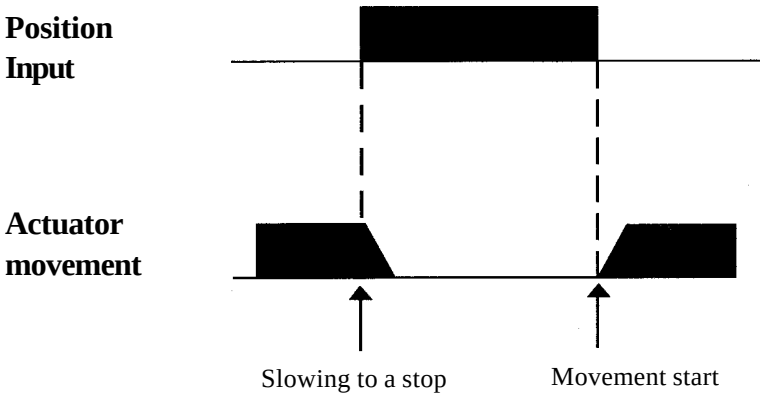


A:
Position 1 execution start

B:
Position 2 execution start

The timing for the position number shifting is the time from after the position presently being executed is completed until the next external start input (start signal) can be input.

5. Timing of Motion Using the Hold Signal

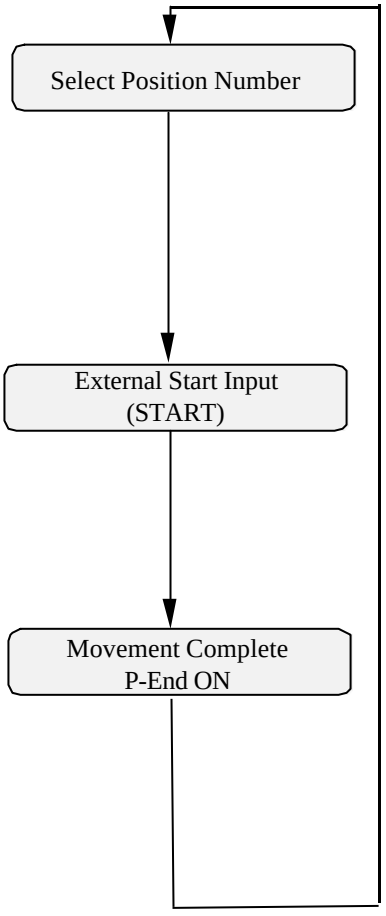


The servo actuator is slowed to a stop by turning the hold signal ON while the actuator is moving and starts up again by turning the hold signal OFF.

6. Movement in Random Sequence

To move the actuator in a random order, select the position number and input external start signal for each movement.

Pos.-No.	Acceleration	Velocity	Position	
1	0,3	100	50.000	
2	0,3	100	200.000	← ①
3	0,3	200	100.000	← ④
4	0,3	200	250.000	
5	x,x	xxx	xxx.xxx	
6	0,3	300	150.000	← ②
7	0,3	300	150.000	
8	x,x	xxx	xxx.xxx	
9	x,x	xxx	xxx.xxx	
. . .	. . .	. . .	. . .	
492	x,x	xxx	xxx.xxx	
493	x,x	xxx	xxx.xxx	
494	0,3	200	150.000	← ③
495	0,3	200	380.000	
496	0,3	200	400.000	
497	0,3	200	200.000	← ⑤
498	0,3	100	250.000	
499	x,x	xxx	xxx.xxx	
500	x,x	xxx	xxx.xxx	



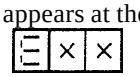
1.9 Error Code list

When an error occurs, the alarm LED (red colour) on the controller's front side will light up. At the same time, the I/0 alarm output will turn ON and the READY output will turn OF'F.

Error Code list

Error Code	Error Name	Explanation
A1	External Interrupt Error	1. Motor over current 2. Over regenerative current (over negative load) 3. Driver overheat
A2	Motor Overload Error	Mechanical oveload of motor
A3	Deviation Error	Motor is unable to perform properly due to mechanical ovedoad
A4	Software Limit Error	Exceeded software limit
A5	Pole Sense Error	Unable to sense pole. Unable to a appoint phase-sequence.
B0	No Program Error	Program does not exist
B1	Program Execution Error	Execution of a currently executing program
B2	Program Over Error	Number of tasks exceeds those set as parameters
B3	Double Subroutine Number Error	Two or more of the same subroutine number are used
B4	Double Tag Number Error	Two or more of the same tag number are used
B5	Undefined Subroutine Number	Subroutine number is not defined
B6	Undefined TAG Number	TAG number is not defined
B7	Subroutine Pair Error	BGSR and EDSR are not the same quantity
B8	Step 1 BGSR Error	Step 1 is a BGSR Error. Not use BGSR in line 1.
B9	DO, EDDO Pair Error	DO and EDDO are not the same quantity
BA	DO Nest Over Error	DO was used more than 15 times
BB	IF Pair Error	IF and ELSE are not the same quantity
BC	ELSE Error	ELSE was used in a place which was not between IF and EDIF
CO	No Homing Routine Error	Homing routine was not peformed before running actuators
C1	Point Data Error	Attempt has been made to executed unregistered point data
C2	Axis Double Execution Error	Move command given to axis currently moving
C3	Software Limit Error	Software limit exceeded in program
CA	Column Error	Column number was set outside the range of 1 - 999.
CB	Channel No. Error	Source number was set outside the range of 1 - 2..
CC	Terminator Error	Terminator character not defined
CD	Source No. Error	Source number was set outside the range of 1 - 9
CE	S Motion Percent Error	S motion percent was set outside the range of 0 - 50 %
CF	Arch Trigger Error	Arch Trigger was set outside the range of 50 - 100 %
DO	Acceleration Error	Acceleration exceeds limits
D1	No Velocity Error	Velocity has not been set
D2	Override Error	Velocitiy Override was set outside the range of 1 - 100 %
D3	Angle Error	Angle was set outside the range of 0,1 - 120 degree
D4	Axis Pattern Error	Axis pattern was not set correctly. Displays D4 also for C1 (point data error)
D5	Axis Number Error	Axis number was set outside the range of 1 - 8
D6	Axis Over Error	Appointing of more than two axis for circular-/circular arc motion
D7	Program Number Error	Program number exceeds the limit
D8	Position Number Error	Position number exceeds the limit
D9	Point Number Error	Negative number was input in the point number
DA	Flag Number Error	Flag is not assigned correctly
DB	Variable Error	Variable is not assigned correctly
DC	Digits Over Error	Assigned number exceeds 8 digits (binary 32 bits)
DD	Division (0) Error	Result of the division is „0“
DE	Circular Motion Computation Error	Actual positions do not execute circular motion
DF	Task Level Error	Task level was set outside of the range of 1 - 5
E0	Undefined Command Error	Attempted to execute undefined command
E1	Subroutine Over Nesting Error	Nesting of more than 15 subroutines
E2	Subroutine Under Nesting Error	EXSR and EDSR are not making a pair
E3	Controlling Column Error	Use of condition is not correct
EG	EMG Error	Emergency (Emergency Stop) was asserted
F0	Interrupt Error	Motor CPU and lnterrupt management do not match

Note: An „E“ appears at the head of the error code, followed by 2 digits.



Error Code (xx)

1.10 Maintenance

To ensure safe and trouble-free operation of your system, a regular maintenance and inspection program should be implemented. Be sure to turn OFF the power before initiating any maintenance or inspection work.

An inspection is recommended at least once every 6 to 12 months.

However, depending on the environment, a more frequent inspection schedule may be advisable.

1. Inspection Guidelines

- Check and make sure that the power supply to your controller is within the specification range (24 V DC ± 10%).
- Check the controller vents and clean any accumulated dirt or dust.
- Check the controller cable (controller → axis) and make sure that there are no loose screws or disconnections.
- Check for loose controller mounting screws. Tighten if necessary.
- Check each cable (axis cables, general I/O cables, system I/O cables, power supply cable). Check for loose connections, damage, or excessive wear. Replace if necessary.

2. Recommended Spare Parts

Should a breakdown occur, even if it is discovered early, repairs cannot be done if there are no spare parts.

It is advisable to keep a small supply of spare parts, especially for those parts that wear down with use.

The following spare parts are recommended:

- Cables
- Batteries (Ni-Cd batteries have a general shelf life of about 6 years but this varies depending on use conditions and environment)

3. Memory Backup

When the the controller is fully charged, the backup memory is guaranteed for 3 months. In actuality, the backup memory is not erased for 6 - 8 months.

But if the controller is to be left for a long period (more than 3 months) without having current run through it, please take precautions to save your program, position data, and parameters.

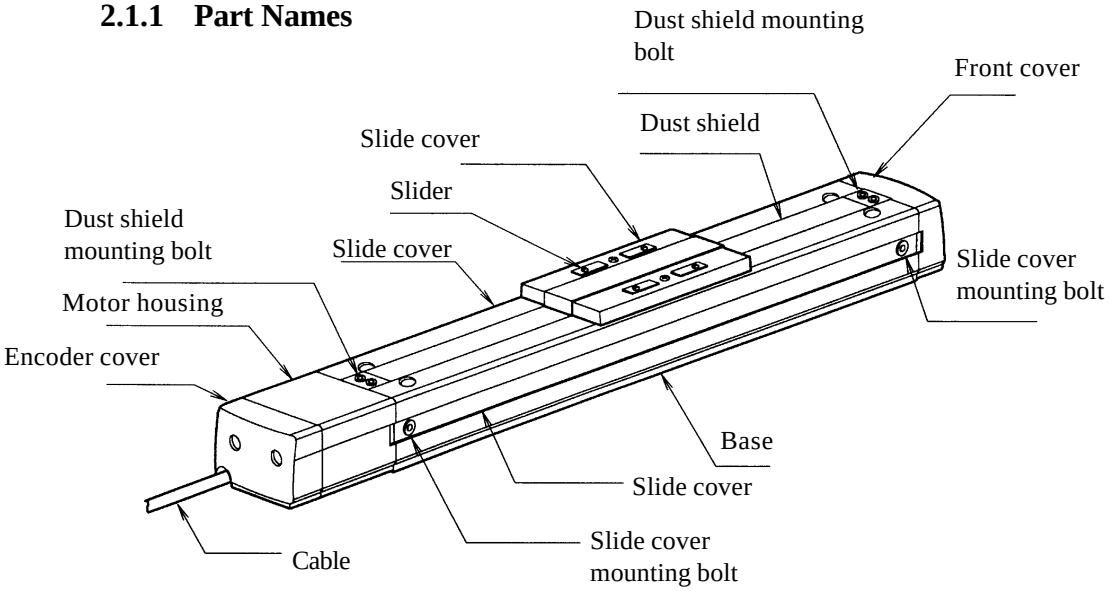
To fully charge the controller if it does not contain any data, you will need to leave the controller with the power ON for 3 days.

If the memory is erased, the system's preset parameters will be set but the actuator will not run properly in this condition.

2 DS Slider Type

2.1 Part Names and function

2.1.1 Part Names



Please note the following when handling the actuator.

- To handle the actuator, support it from underneath or grasp the area around the side cover mounting bolts.
- Do not place excessive load on the cable.
- Do not place heavy loads on the encoder cover, slider cover or other plastic parts.

2.1.2 Operating Environment

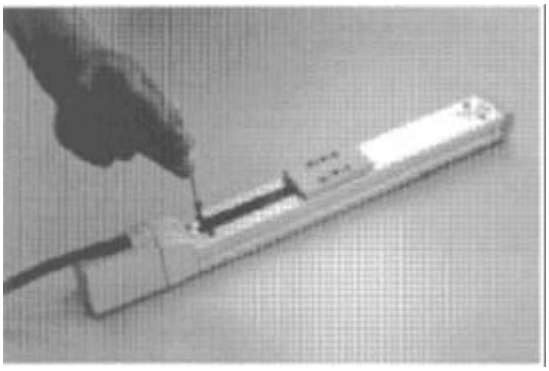
Install the actuator in a place where the operator can work without a protective gear. See the table below for specific operating environment criteria.

No.	Operating Conditions
1	Ambient temperature 0 ~ 50 °C
2	Relative humidity 35 ~ 95 % (non condensing)
3	Avoid direct sunlight
4	Avoid exposure to water, cutting oil and other liquids
5	Avoid exposure to corrosive or combustible gas
6	Minimal dust
7	Do not subject to vibrations or shock greater than 0,5 g
8	Avoid strong electromagnetic waves, ultraviolet rays and radiation

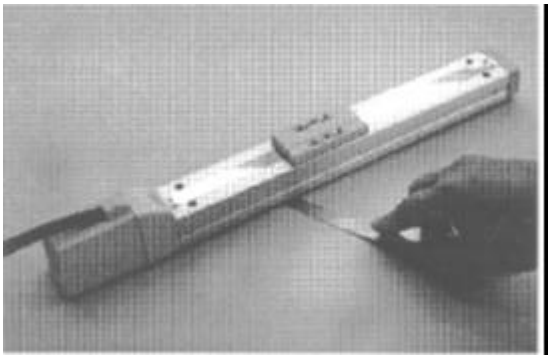
2.2 Installation

2.2.1 Installing the Actuator

Mount the actuator to a machined surface or one of comparable precision. Install the actuator as shown below.

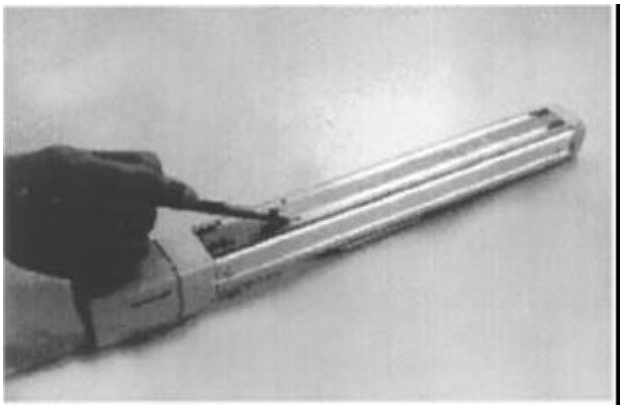


The actuator base and lower surface are parallel to the guide. When travelling precision is required, use this surface as a reference to mount the actuator. For basic mounting, use the four mounting holes located on the upper surface of the actuator.



Rest the actuator on the mounting surface and check to see that a 0.1mm thickness gauge cannot be inserted at the four mounting holes. If the bolts go in a steel surface with tapped holes, then use hexagon sockets with length shown in (1) and if the surface is a light metal, use the length in (2).

Actuator	(1)	(2)
DS-S5	M4x40	M4x45
DS-S4	M3x35	



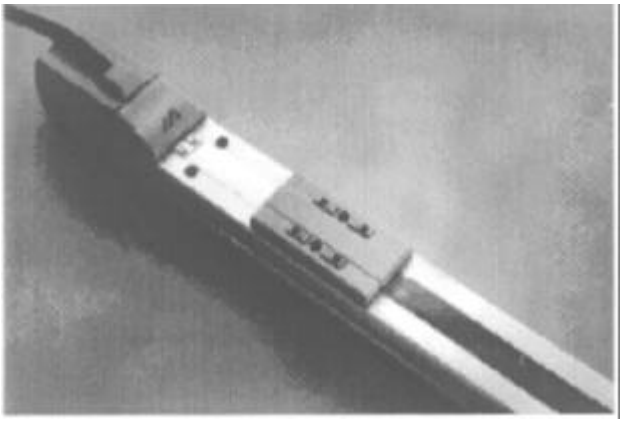
If the actuator has an overhang, you can use the two mounting holes at the motor end and the tapped holes (*) on the underside of the base but please make note of the following.

(*)

DS-A5	M4
DS-S4	M3

- The depth of the tapped hole is 5mm
  Select a bolt with an engagement length of greater than 3mm and less than 5mm and adjust the washer length if necessary.
- The flatness of the mounting surface should be more precise than for basic mounting. If the level of the flatness is poor when the overhang is mounted, the actuator could warp and cause travelling impedence. Corrct the flatness if the slider motion slows at the home end or generates noise since ths will reduce the life of the actuator.

2.2.2 Attaching the Workpiece



Use the four tapped holes at the top of the slider to attach the workpiece.

DS-S5	M4
DS-S4	M3

To attach the workpiece, select bolts that will have the engagement lengths indicated in the table below and adjust the length of the washer if necessary. Also, make sure that the workpiece does not touch the slider cover.

Actuator	Slider Mounting Area	Engagement Length
DS-S5	M4 depth 9 mm	> 4 mm and < 9 mm
DS-S4	M3 depth7 mm	> 3 mm and < 7 mm

2.2.3 Wiring Cable

The actuator cable is resistant to bending fatigue but it is not robot cable so avoid housing the cable in movable wire duct with a small radius. In an application where the cable cannot be properly anchored, try to place the cable so that it sags only under its own weight or use self-standing type cable hose as large radial wire duct to limit the load on the cable.

2.2.4 Adjusting the Home Position

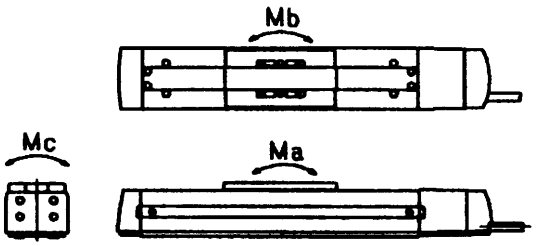
After installing the actuator, perform the homing operation to confirm home. Home direction can be changed with the parameters. If you allow a large offset amount, the moving range is limited by that amount. If you specify an offset amount greater than 1mm, you will have to reset the software limit and reduce the stroke by that amount.

Note:
To change the home offset amount requires the optional PC software.
By changing the homing direction please contact the technical office of IAI.

2.2.5 Load on the Actuator

Do not exceed the load shown in the specification table at Chapter 4. Please note in particular the thrust and allowable overhang length and the load weight.

The base of the actuator warps easily when it is used with an overhang so please keep the Ma and Mc moments under ½ of the rated value.



2.3 Maintenance

2.3.1 Maintenance Schedule

Perform maintenance work according to the schedule below.

Maintenance Checkpoints

	Visual inspection	Check for loose dust shield	Check interior	Lubrication
Start of operation	❍			
After 1 month of operation	❍	❍		
After 6 months of operation	❍	❍	❍	
After 1 year of operation	❍	❍	❍	❍
Seminually thereafter	❍	❍		
Annually thereafter	❍	❍	❍	❍

Note 1:
The above schedule assumes running time is 8 hours per day. When running time is high such as continuous day and night operation, shorten the maintenance intervals as required.

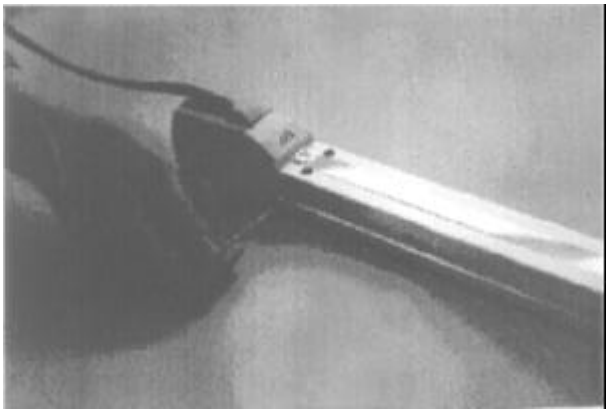
Note 2:
The end cover supports the ballscrew so please do not remove it. Do not remove the encoder cover as this contains precision equipment.

2.3.2 Cleaning the Exterior

1. Wipe off dirt with a soft cloth.
2. Wipe the dust shield gently so that it does not bend.
3. Do not use strong compressed air on the actuator as this may force dust does into the crevices.
4. Do not use petroleum-based solvents on plastic parts or painted surfaces.
5. If the unit is badly soiled, apply a neutral detergent or alcohol to a soft cloth and wipe lightly.

6. Inspecting the Interior

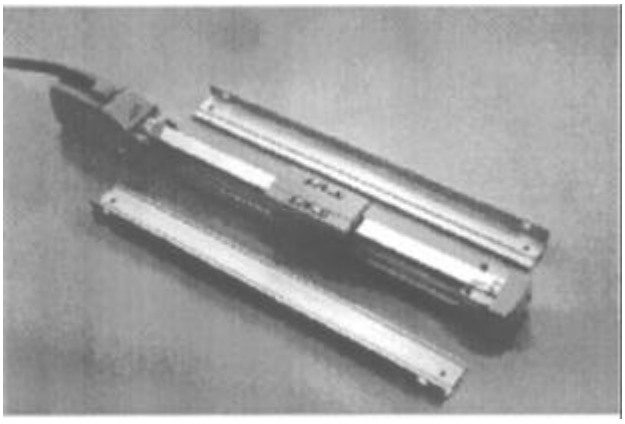
1. Removing the cover



Turn the power OFF.

Using a 1.5mm hexagonal wrench, remove the cover as shown in the picture and visually inspect the interior.

2. Visual check ot the interior

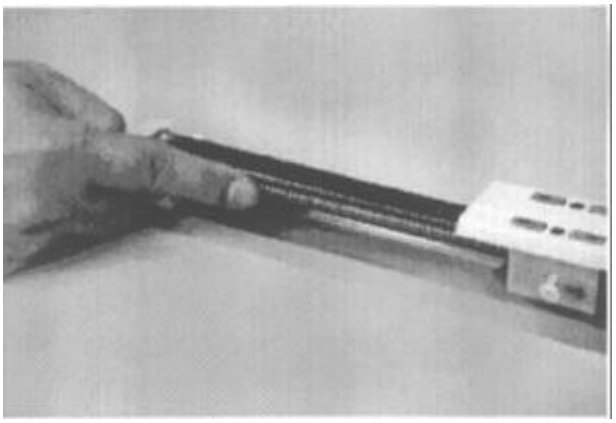


Make a visual check of the interior to see if there is any dust or foreign matter in the unit and check the lubrication.
Even if the grease you see around the parts is brown, the lubrication is fine as long as the travelling surfaces appear shiny.

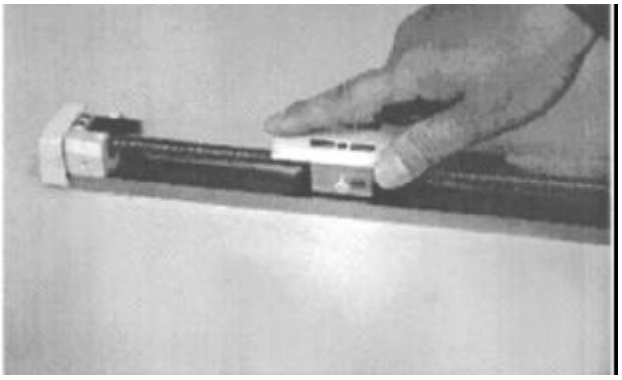
2.3.3 Lubrication

When the grease contains dust, becomes dull in colour or begins to wear away through extended use, lubricate the actuator using the procedure below.

1. How to lubricate



To lubricate the ballscrew, apply grease to the screw with your finger then spread it out by moving the slider back and forth.



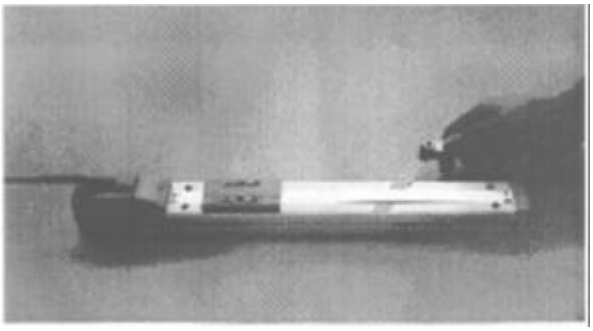
To lubricate the guide, apply grease with your finger, then spread it out by moving the slider back and forth.

2. What grease to use:
   IAI uses lithium grease No. 2. There are other brands of grease commercially available for the ballscrew and slider. These are acceptable as long as they are a lithium-type grease.

   Note:
   Never use a fluorine-based grease. Mixing this with a lithium grease produces a chemical reaction which damages the actuator.

3. Replacing the cover

Inside the slider cover is a spring that allows it to follow along the dust shield. Lift the shield up from the bottom and attach the side cover.

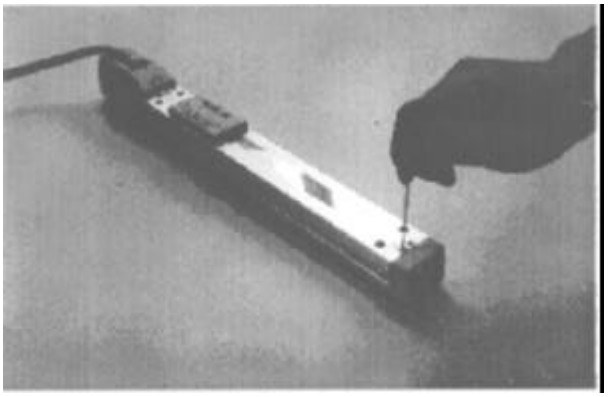


If the shield is not straight, move the slider slightly to straighten out the shield. Or, lift the shield gently to straighten it out. Tighten the bolts on the side cover. The torque should be for a small plus screw (0.6Nm, 6 kgcm).

After completing the inspection, replace the cover.

2.3.4 Checking the Dust Shield

The dust shield is made from stainless steel and is adjusted at the time of shipment. If the shield slackens with use, make the following adjustments.



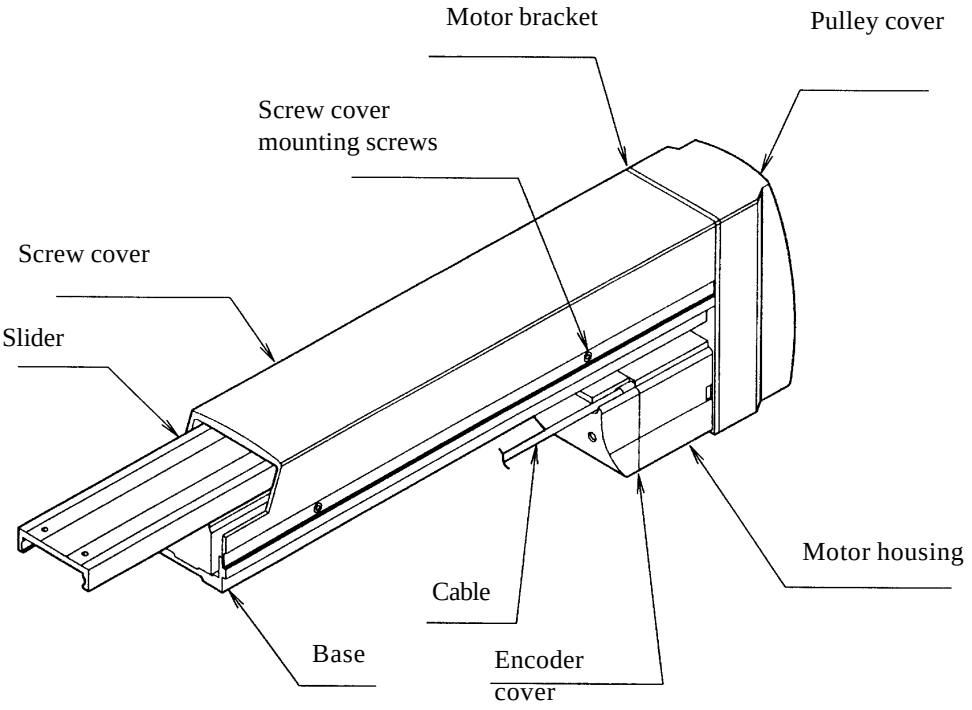
Move the slider to the end. Loosen the screw at the front end with a 1.5mm wrench.

Pull the shield just enough to make it taut. Move the slider manually to make sure it moves easily. If there is resistance in the movement, there is too much tension in the shield.

3 DS Arm Type

3.1 General

3.1.1 Part Names



Please note the following when handling the actuator.

- Support the base when handling the actuator.
- Do not place excessive load on the cable.
- Do not place heavy loads on the pulley cover, encoder cover or other plastic parts.

3.1.2 Operating Environment

Install the actuator in a place where the operator can work without protective gear. Specific criteria for the operating environment are shown in the table below.

No.	Operating Conditions
1	Ambient temperature 0 ~ 50 °C
2	Relative humidity 35 ~ 95 % (non condensing)
3	Avoid direct sunlight
4	Avoid exposure to water, cutting oil and other liquids
5	Avoid exposure to corrosive or combustible gas
6	Minimal dust
7	Do not subject to vibrations or shock greater than 0,5 g

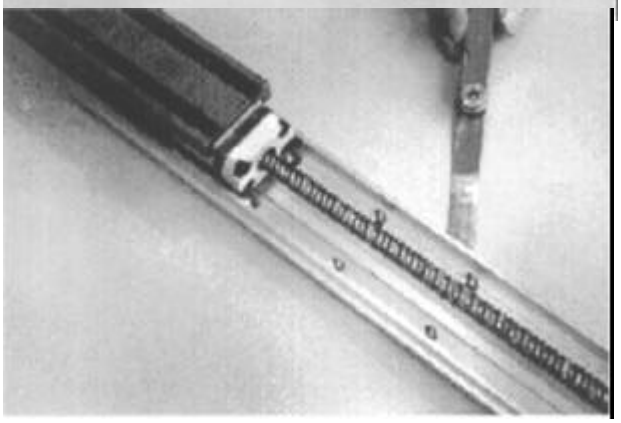
8	Avoid strong electromagnetic waves, ultraviolet rays and radiation

3.2 Installation

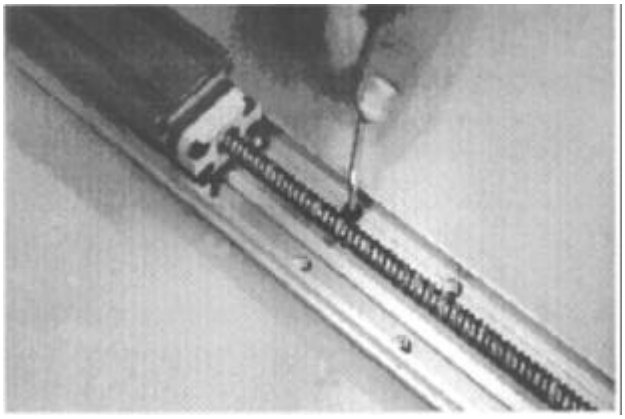
3.2.1 Installing the Actuator

Mount the actuator to a machined surface or one of comparable precision.

The DS actuator has a built-in brake. Connect the controller to the unit, then release the brake with the brake switch. After releasing the brake, pull the slider to the stroke end. Turn off the controller power before proceeding to the next step. Remove the four mounting screws from the screw cover. (The cover can be removed using a 1.5mm hexagonal wrench).



Rest the actuator on the mounting surface and check to see that a 0.1mm thickness gauge cannot be inserted at the four mounting holes.

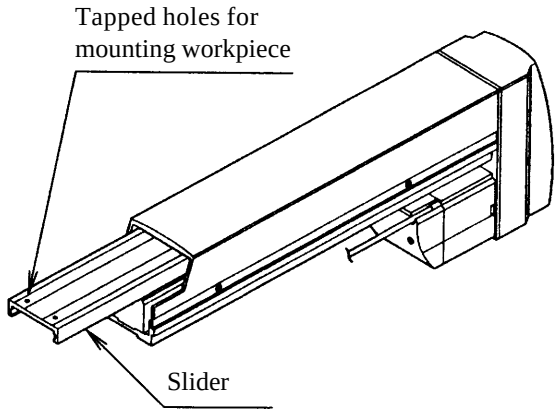


Affix the actuator using the mounting holes in the base. If the bolts go into a steel surface, then use hexagon sockets with the length shown in (1) and if the surface is a light metal, use the length in (2).

Actuator	(1)	(2)
DS-S5	M4x8	M4x12
DS-S4	M3x8	M3x12

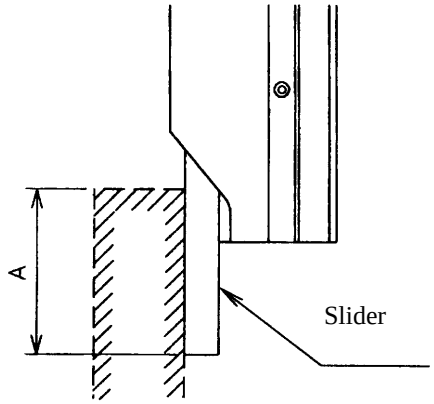
After mounting the actuator, reattach the screw cover.

3.2.2 Attaching the Workpiece



Use the four tapped holes at the top of the slider to attach the workpiece.

There are 4 M4 screws for attaching the workpiece to the slider. To ensure the slider does not become deformed when the workpiece is attached, check to make sure the surface where the workpiece rests is flat. A deformity in the slider causes stiff movement and shortens the life of the actuator.



Do not exceed the load indicated in the specification tables at chapter 4. Please note in particular the thrust, allowable overhang length and the load weight.

Keep the overhang at the upper portion of the workpiece to the measurements below to prevent interference between the screw cover and workpiece.

DS-A5: A = 65 mm
DS-A4 : A = 53 mm

3.2.3 Wiring Cable

The actuator cable is resistant to bending fatigue but it is not robot cable so avoid housing the cable in movable wire duct with a small radius. In an application where the cable cannot be properly anchored, try to place the cable so that it sags only under its own weight or use self-standing type cable hose as large radial wire duct
to limit the load on the cable.

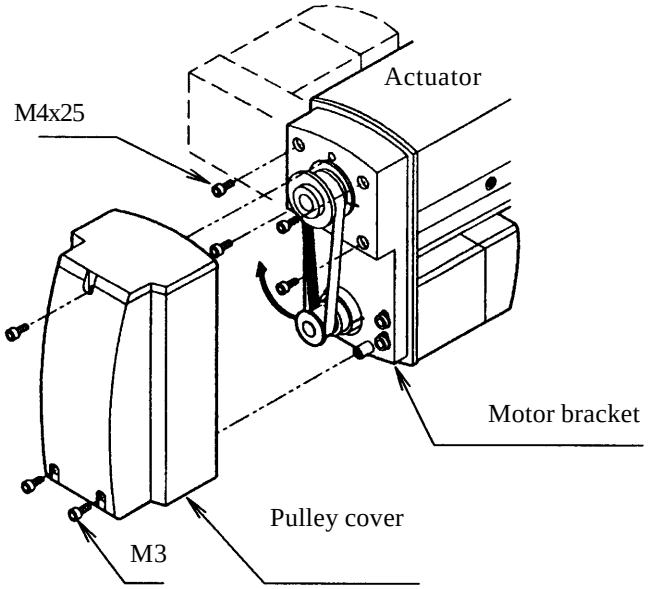
3.2.4 Adjusting the Home Position

After installing the actuator, perform the homing operation to confirm home. Home direction can be changed with the parameters. If you allow a large offset amount, the moving range is limited by that amount. If you specify an offset amount greater than 1mm, you will have to reset the software limit and reduce the stroke by that amount.

Note:
To change the home offset amount requires the optional PC software.
By changing the homing direction please contact the technical office of IAI.

3.2.5 Changing the Motor Position

You can change the position of the motor for greater flexibility when installing the actuator.



1. Remove the pulley cover.
1. Remove the four bolts (M4x25) used to mount the motor bracket.
1. While pushing the motor bracket lightly against the actuator, rotate it and set the position.
1. Reattach the motor bracket with M4x25 bolts.
1. Reattach the pulley cover.

Changing the motor position will affect the home position so always make sure to readjust home. (For a ball screw lead of 6 mm, home will move 1,5 mm for every 90° change).

3.3 Maintenance

3.3.1 Maintenance Schedule

Perform maintenance work according to the schedule below.

	Visual Inspection	Internal Check	Lubrication
Start of operation	❍		
After 1 month of operation	❍		
After 6 months of operation	❍	❍	
After 1 year of operation	❍	❍	❍
Semiannually thereafter	❍		
Annually thereafter	❍	❍	❍

Note 1:
The above schedule assumes running time is 8 hours per day. When running time is high such as continuous day and night operation, shorten the maintenance intervals as required.

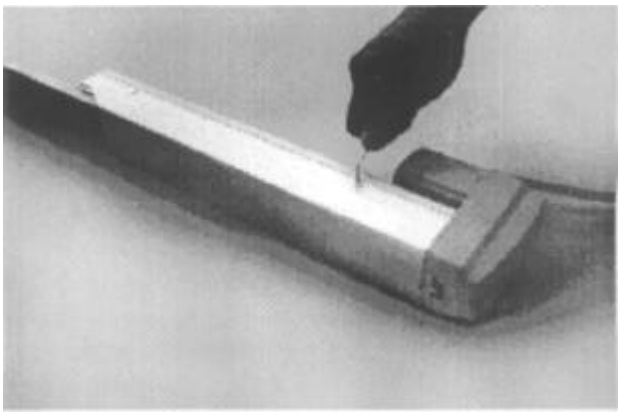
Note 2:
The end cover supports the ballscrew so please do not remove it. Do not remove the encoder cover as this contains precision equipment.

3.3.2 Cleaning the Exterior

1. Wipe off dirt with a soft cloth.
2. Do not use strong compressed air on the actuator as this may force dust does into the crevices.
3. Do not use petroleum-based solvents on plastic parts or painted surfaces.
4. If the unit is badly soiled, apply a neutral detergent or alcohol to a soft cloth and wipe lightly.

3.3.3 Inspection the Interior

1. Remove the cover



Turn the power OFF. Using a 1.5mm hexagonal wrench, remove the cover as shown in the picture and visually inspect the interior.

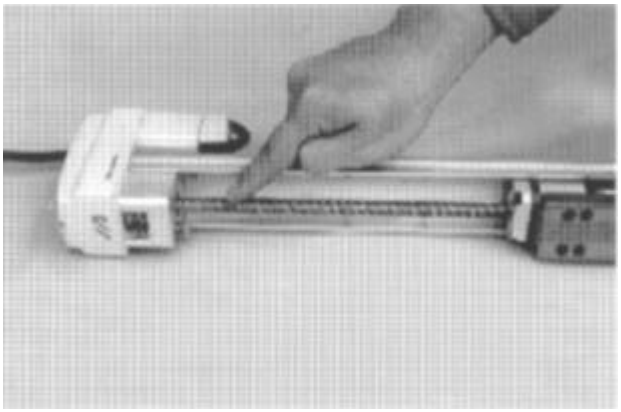
2. Visual check of the interior

Make a visual check of the interior to see if there is any dust or foreign matter in the unit and check the lubrication.
Even if the grease you see around the parts is brown, the lubrication is fine as long as the travelling surfaces appear shiny.

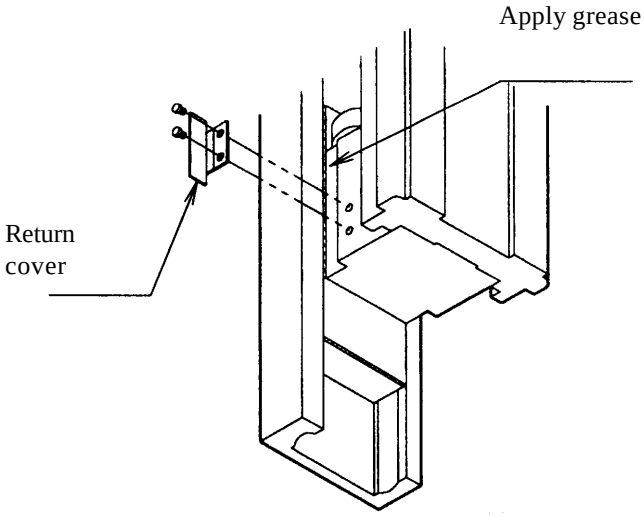
3.3.4 Lubrication

When the grease contains dust, becomes dull in colour or begins to wear away through extended use, lubricate the actuator using the procedure below.

1. How to lubricate



To lubricate the ballscrew, apply grease to the screw with your finger then spread it out by moving the slider back and forth.



To lubricate the guide, remove the return cover attached to the guide block and apply grease directly on the bearing.

2. What grease to use:

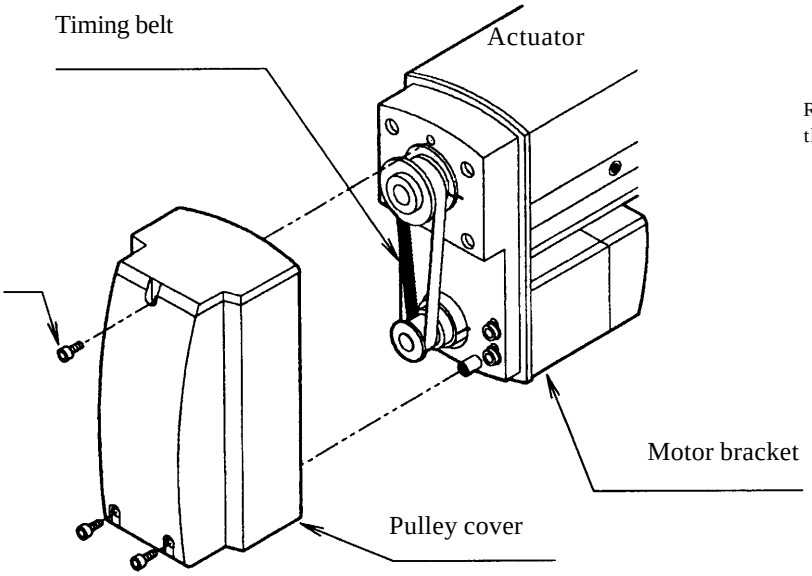
IAI uses lithium grease No. 2. There are other brands of grease commercially available for the ball screw and slider. These are acceptable as long as they are a lithium-type grease.

Note:

Never use a fluorine-based grease. Mixing this with a lithium grease produces a chemical reaction which damages the actuator.

3.3.5 Inspection and Replacing the Timing Belt

1. Removing the belt cover



Remove the pulley cover as shown at left and inspect the timing belt.

2. Inspection the timing belt

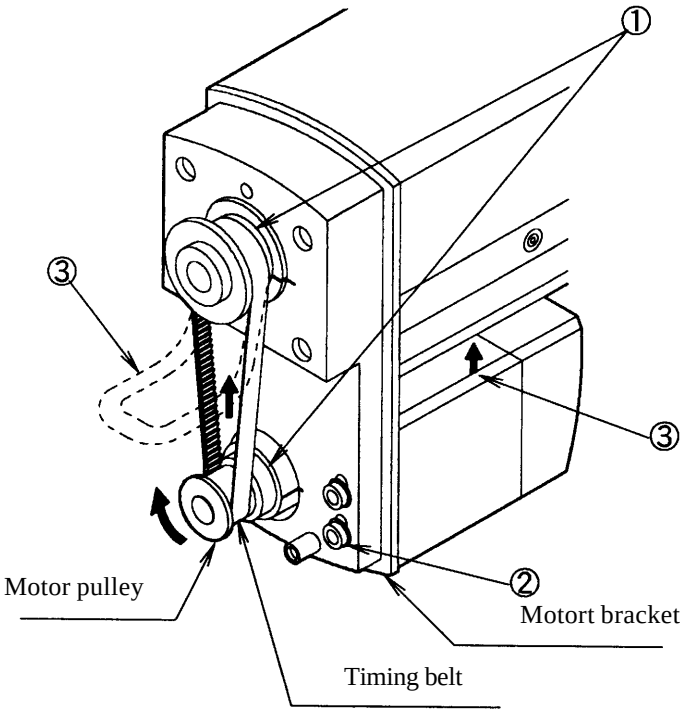
The durability of the timing belt is largely dependent on the operating conditions. It is difficult to give an absolute rule regarding when to replace the timing belt but generally the belt has a lifetime of so many millions of rotations. The more practical approach is to replace the belt if any of the following conditions occur.

- The belt end or belt teeth have worn away.
- There are cracks in or other damage to the belt or teeth.
- The belt breaks.

If you need to replace the belt, please contact IAI.

3. Replacing the timing belt

Follow the procedure below to replace the timing belt.



(1) Mark the pulley and motor bracket so that you do not change the home position.

(1) Loosen the four bolts.

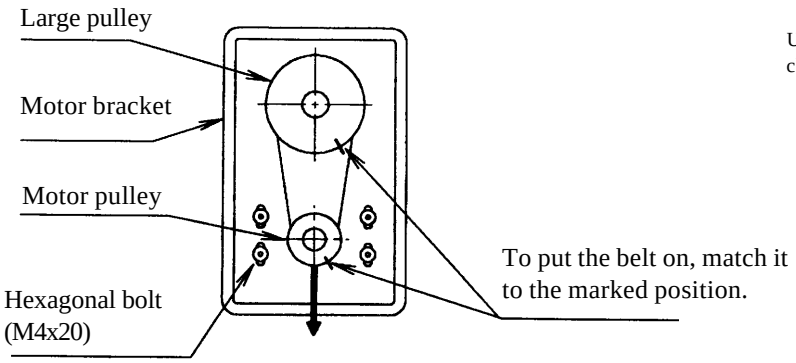
(1) Put the new belt on while pushing the motor up.

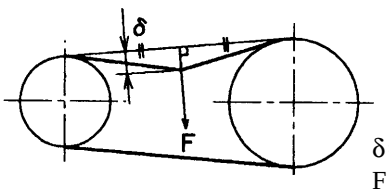
(1) After the new belt is in place, do the same procedure in reverse to reassemble.

4. Adjusting the tension of the timing belt

After you change the timing belt, it is necessary to readjust the tension. As shown in the upper diagram at left, push the motor pulley up, then adjust the tension and set it.

Use the method shown in the left lower diagram to check whether the tension of the timing belt is suitable.



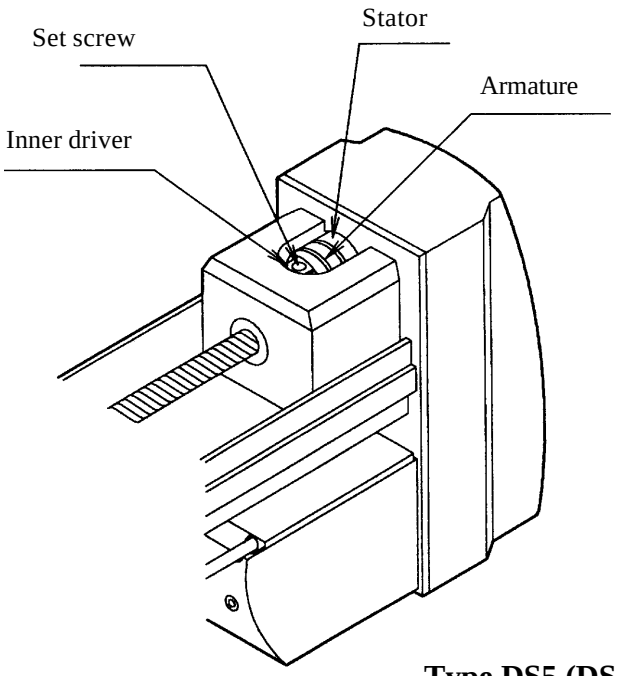


δ = 1 mm
F = 100 N

Check tension

3.3.6 Inspecting and Adjusting the Brake

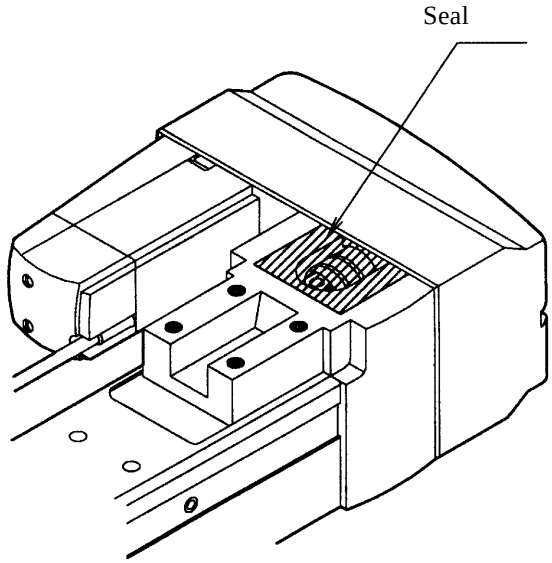
1. Brake inspection



Type DS5 (DS-A5)

(1) Remove the screw cover to inspect the brake.

(1) Visually check the conditions of the brake.



Type DS4 (DSA-A4)

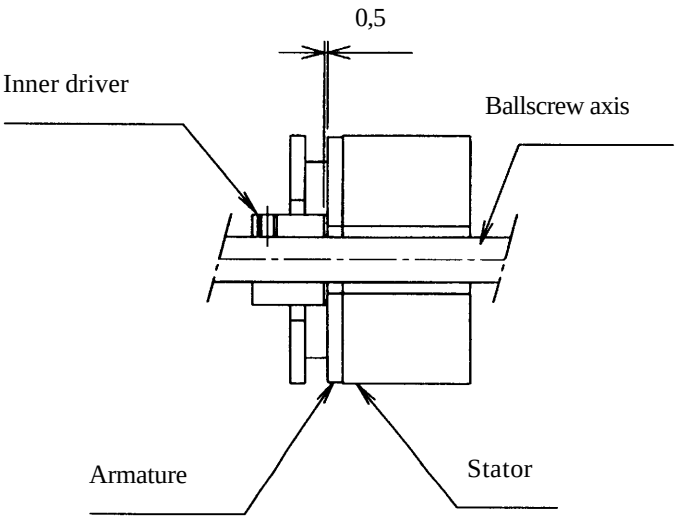
(1) Peel off the seal to inspect the brake.

(1) Visually check the condition of the brake..

Note:
When the motor is folded backwards (S type), you must change the direction to the right or the left..

2. Adjusting the brake gap

Normally, the inner driver requires no maintenance but if adjustments are necessary, use the following procedure.



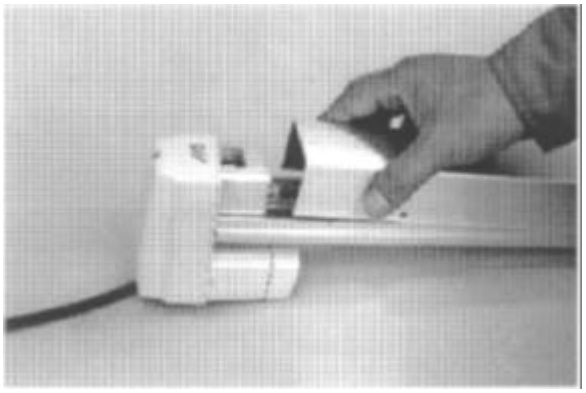
Brake Cross Section

(1) We recommend the actuator be placed on a horizontal surface when adjusting the brake gap. If you are doing the adjustment with the actuator in a vertical position, first move the slider to the stroke end.

(1) Release the brake and loosen the two set screws.

(1) Set the inner driver about 0.5mm from where it would hit up against the armature.

3. Attaching the cover



Follow the procedure used to remove the cover in reverse order and reattach the screw cover and pulley cover.

After you finish the inspection, replace the cover as it was at the start.

4 Data of the DS Series Specifications

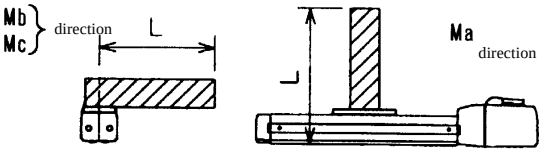
4.1 Specifications for the Slider Type

4.1.1 High Speed Type DS-S5H

Specification	**Model**	**DS-S5H**	50	100	150	200	250	300	350	400
	Stroke	mm	50	100	150	200	250	300	350	400
	Rated Output	W	20							
	Rated Speed	mm/sec	800							
	Rated Thrust	N	16,7							
	Repeatability	mm	± 0,05							
	Unit Weight	kg	1,4	1,5	1,6	1,7	1,8	1,9	2,0	2,1
Structure of Main Components	Motor	AC Servo Motor								
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase, B Phase, Z Phase (Homing pulse: 1 pulse ½rotation)								
	Ballscrew	Ø 10 mm,Lead 12 mm, Rolled thread C10, Backlash 0,1 mm or less								
	Guide	Integrated with base, **DS** dedicated								
	Motor/Ballscrew Connection	Integrated motor axis and ballscrew achsis								
	Base, Slide	Hardened alloyed Steel								
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated								
	Dust Shield	Stainless steel								
	Motor Housing	Aluminium die-cast, baked finish								
	Encoder Cover, Front Cover, Slide Cover	Polyacetal plastic								
	Motor Cable	11-conductor composite cable 5 m (standard length)								
Application Limit	Grease	Ballscrew: Lithium type grease								
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2								
	Maximum Thrust (1)	N	33,3							
	Payload (2, 3)	kg	Horizontal: 4 kg, Vertical: 1 kg							
	Moment (2, 4)	Nm	5.000 km life expectancy							
			Ma: 4,9, Mb: 6,8, Mc: 11, 7,						MC: 7,8	
	Overhang Load Length L (5)	mm	Ma 150 or less, Mb, Mc 150 or less							
	Optional brake	Magnetic brake, energized to release Brake torque: 11,76 Ncm								

1. At a speed of 10mm/sec for 5 seconds..
1. Even load distribution on the slider. (When disigning work, consider load moment). Fix base securely to a flat, strong frame
1. At an acceleration of 0,3 G and a speed of 800 mm/sec.
1. Direction of load moment is:

5. When the centre of gravity for the attached object is ½ the overhang length.



4.1.2 Medium Speed Type DS-S5M

Specification	**Model**	**DS-S5M**	50	100	150	200	250	300	350	400
	Stroke	mm	50	100	150	200	250	300	350	400
	Rated Output	W	20							
	Rated Speed	mm/sec	400							
	Rated Thrust	N	33,3							
	Repeatability	mm	± 0,02							
	Unit Weight	kg	1,4	1,5	1,6	1,7	1,8	1,9	2,0	2,1
Structure of Main Component	Motor	AC Servo Motor								
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase, B Phase, Z Phase (Homing pulse: 1 pulse ½rotation)								
	Ballscrew	Ø 10 mm,Lead 6 mm, Rolled thread C10, Backlash 0,1 mm or less								
	Guide	Integrated with base, **DS** dedicated								
	Motor/Ballscrew Connection	Integrated motor axis and ballscrew achsis								
	Base, Slide	Hardened alloyed Steel								
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated								
	Dust Shield	Stainless steel								
	Motor Housing	Aluminium die-cast, baked finish								
	Encoder Cover, Front Cover, Slide Cover	Polyacetal plastic								
	Motor Cable	11-conductor composite cable 5m (standard length)								
	Grease	Ballscrew: Lithium type grease								
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2								
Application Limit	Maximum Thrust (1)	N	65,7							
	Payload (2, 3)	kg	Horizontal: 8 kg, Vertical: 2 kg							
	Moment (2, 4)	Nm	5.000 km life expectancy							
			Ma: 4,9, Mb: 6,8, Mc: 11, 7,					MC: 7,8		
	Overhang Load Length L (5)	mm	Ma 150 or less, Mb, Mc 150 or less							

1. At a speed of 10mm/sec for 5 seconds..
1. Even load distribution on the slider. (When disigning work, consider load moment). Fix base securely to a flat, strong frame
1. At an acceleration of 0,3 G and a speed of 400 mm/sec.
1. Direction of load moment is:

5. When the centre of gravity for the attached object is ½ the overhang length.

Optional brake	Magnetic brake, energized to release Brake torque: 11,76 Ncm

4.1.3 Low Speed Hugh Thrust Type DS-S5L

Specification / Structure of Main Component / Application Li

Model	**DS-S5L**	50	100	150	200	250	300	350	400
Stroke	mm	50	100	150	200	250	300	350	400
Rated Output	W	20							
Rated Speed	mm/sec	200							
Rated Thrust	N	65,7							
Repeatability	mm	± 0,02							
Unit Weight	kg	1,4	1,5	1,6	1,7	1,8	1,9	2,0	2,1
Motor		AC Servo Motor							
Encoder		Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase B Phase Z Phase (Homing pulse: 1 pulse ½rotation)							
Ballscrew		Ø 10 mm,Lead 3 mm, Rolled thread C10, Backlash 0,1 mm or less							
Guide		Integrated with base, **DS** dedicated							
Motor/Ballscrew Connection		Integrated motor axis and ballscrew achsis							
Base, Slide		Hardened alloyed Steel							
Side Cover		Extruded aluminium (A6063S-T5) White alumite treated							
Dust Shield		Stainless steel							
Motor Housing		Aluminium die-cast, baked finish							
Encoder Cover, Front Cover, Slide Cover		Polyacetal plastic							
Motor Cable		11-conductor composite cable 5m (standard length)							
Grease		Ballscrew: Lithium type grease							
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2							
Maximum Thrust (1)	N	131,4							
Payload (2, 3)	kg	Horizontal: 8 kg, Vertical: 4 kg							

1. At a speed of 10mm/sec for 5 seconds..

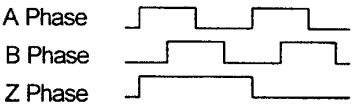
5. When the centre of gravity for the attached object is ½ the

Moment (2, 4)	Nm	5.000 km life expectancy	
		Ma: 4,9, Mb: 6,8, Mc: 11, 7,	MC: 7,8
Overhang Load Length L (5)	mm	Ma 150 or less, Mb, Mc 150 or less	
Optional brake		Magnetic brake, energized to release Brake torque: 11,76 Ncm	

4.1.4 Low Speed Hugh Thrust Type DS-S4H

Specification

Structure of Main Component

Model	**DS-S4H**	50	100	150	200	250	300
Stroke	mm	50	100	150	200	250	300
Rated Output	W	20					
Rated Speed	mm/sec	665					
Rated Thrust	N	19,6					
Repeatability	mm	± 0,05					
Unit Weight	kg	1,1	1,2	1,3	1,4	1,5	1,6
Motor		AC Servo Motor					
Encoder		Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals:  (Homing pulse: 1 pulse ½rotation)					
Ballscrew		Ø 8 mm,Lead 10 mm, Rolled thread C10, Backlash 0,1 mm or less					
Guide		Integrated with base, **DS** dedicated					
Motor/Ballscrew Connection		Integrated motor axis and ballscrew achsis					
Base, Slide		Hardened alloyed Steel					
Side Cover		Extruded aluminium (A6063S-T5) White alumite treated					
Dust Shield		Stainless steel					
Motor Housing		Aluminium die-cast, baked finish					
Encoder Cover, Front Cover, Slide Cover		Polyacetal plastic					
Motor Cable		11-conductor composite cable 5m (standard length)					
Grease		Ballscrew: Lithium type grease					

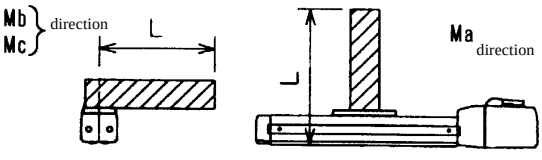
	Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2	
Maximum Thrust (1)	N	39,2
Payload (2, 3)	kg	Horizontal: 4 kg, Vertical: 1 kg
Moment (2, 4)	Nm	5.000 km life expectancy
		Ma: 2,7, Mb: 3,9, Mc: 6,8
Overhang Load Length L (5)	mm	Ma 120 or less, Mb, Mc 120 or less
Optional brake	Magnetic brake, energized to release Brake torque: 11,76 Ncm	

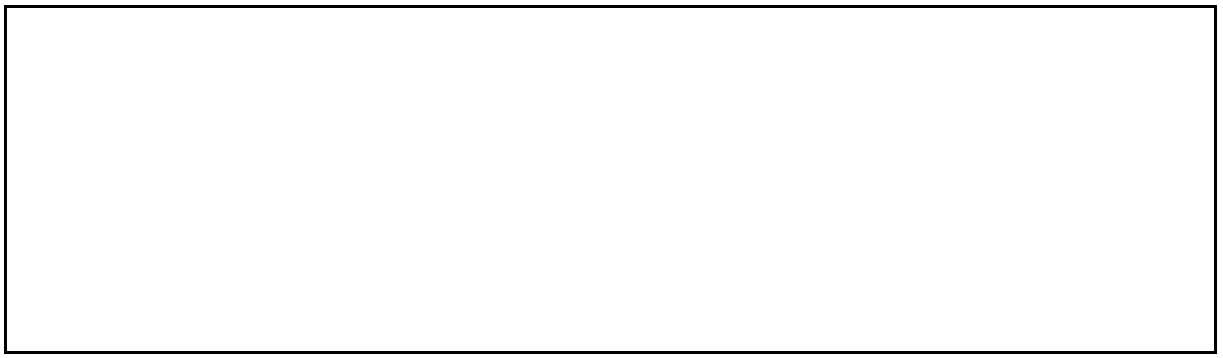
4.1.5 Medium Speed Type DS-S4M

Specification	**Model**	**DS-S4M**	50	100	150	200	250	300
	Stroke	mm	50	100	150	200	250	300
	Rated Output	W	20					
	Rated Speed	mm/sec	330					
	Rated Thrust	N	39,2					
	Repeatability	mm	± 0,02					
	Unit Weight	kg	1,1	1,2	1,3	1,4	1,5	1,6
Structure of Main Component	Motor	AC Servo Motor						
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase B Phase Z Phase (Homing pulse: 1 pulse ½rotation)						
	Ballscrew	Ø 8 mm,Lead 5 mm, Rolled thread C10, Backlash 0,1 mm or less						
	Guide	Integrated with base, **DS** dedicated						
	Motor/Ballscrew Connection	Integrated motor axis and ballscrew achsis						
	Base, Slide	Hardened alloyed Steel						
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated						
	Dust Shield	Stainless steel						
	Motor Housing	Aluminium die-cast, baked finish						
	Encoder Cover, Front Cover, Slide Cover	Polyacetal plastic						
	Motor Cable	11-conductor composite cable 5m (standard length)						
	Grease	Ballscrew: Lithium type grease						
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2						
Application Limit	Maximum Thrust (1)	N	78,4					
	Payload (2, 3)	kg	Horizontal: 5 kg, Vertical: 2,5 kg					
	Moment (2, 4)	Nm	5.000 km life expectancy					
			Ma: 2,7, Mb: 3,9, Mc: 6,8					
	Overhang Load Length L (5)	mm	Ma 120 or less, Mb, Mc 120 or less					
	Optional brake	Magnetic brake, energized to release Brake torque: 11,76 Ncm						

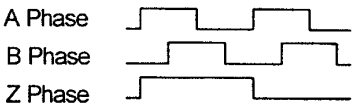
1. At a speed of 10 mm/sec for 5 seconds..
1. Even load distribution on the slider. (When disigning work, consider load moment). Fix base securely to a flat, strong frame
1. At an acceleration of 0,3 G and a speed of 330 mm/sec.
1. Direction of load moment is:

5. When the centre of gravity for the attached object is ½ the overhang length.



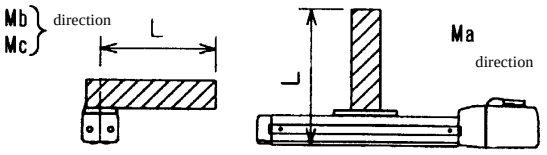


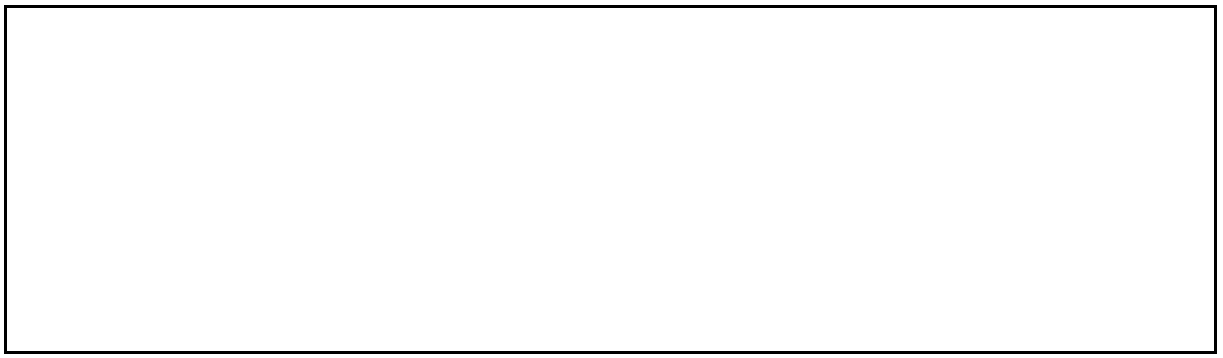
4.1.6 Low Speed High Thrust Type DS-S4L

Specification	**Model**	**DS-S4L**	50	100	150	200	250	300
	Stroke	mm	50	100	150	200	250	300
	Rated Output	W	20					
	Rated Speed	mm/sec	165					
	Rated Thrust	N	78,4					
	Repeatability	mm	± 0,02					
	Unit Weight	kg	1,1	1,2	1,3	1,4	1,5	1,6
Structure of Main Component	Motor	AC Servo Motor						
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals:  (Homing pulse: 1 pulse ½rotation)						
	Ballscrew	Ø 8 mm,Lead 2,5 mm, Rolled thread C10, Backlash 0,1 mm or less						
	Guide	Integrated with base, **DS** dedicated						
	Motor/Ballscrew Connection	Integrated motor axis and ballscrew achsis						
	Base, Slide	Hardened alloyed Steel						
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated						
	Dust Shield	Stainless steel						
	Motor Housing	Aluminium die-cast, baked finish						
	Encoder Cover, Front Cover, Slide Cover	Polyacetal plastic						
	Motor Cable	11-conductor composite cable 5m (standard length)						
Application Limit	Grease	Ballscrew: Lithium type grease						
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2						
	Maximum Thrust (1)	N	156,8					
	Payload (2, 3)	kg	Horizontal: 5 kg, Vertical: 4,5 kg					
	Moment (2, 4)	Nm	5.000 km life expectancy					
			Ma: 2,7, Mb: 3,9, Mc: 6,8					
	Overhang Load Length L (5)	mm	Ma 120 or less, Mb, Mc 120 or less					
	Optional brake	Magnetic brake, energized to release Brake torque: 11,76 Ncm						

1. At a speed of 10mm/sec for 5 seconds..
1. Even load distribution on the slider. (When disigning work, consider load moment). Fix base securely to a flat, strong frame
1. At an acceleration of 0,2 G and a speed of 165 mm/sec.
1. Direction of load moment is:

5. When the centre of gravity for the attached object is ½ the overhang length.





4.2 Specifications for the Arm Type

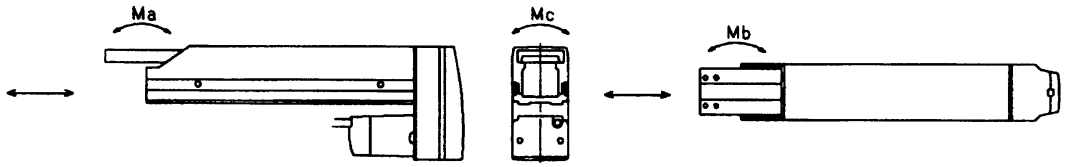
4.2.1 Medium Speed Type DS-A5M

Specification	**Model**	**DS-A5M**	50	100	150	200
	Stroke	mm	50	100	150	200
	Rated Output	W	20			
	Rated Speed	mm/sec	400			
	Rated Thrust	N	33,3			
	Repeatability	mm	± 0,02			
	Unit Weight	kg	2,2	2,4	2,6	2,8
Structure of Main Component	Motor	AC Servo Motor				
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase, B Phase, Z Phase (Homing pulse: 1 pulse ½ rotation)				
	Brake	Specification	Dry, single head, on when deenergized, electromagnetic brake			
		Model	MB33			
		Holding torque N	51,0	Single brake torque Nm	0,098	
		Mounting position	Ballscrew axis			
		Rated voltage	24 V DC			
	Ballscrew	Ø 10 mm, Lead 12 mm, Rolled thread C10, Backlash 0,1 mm or less				
	Guide	Integrated with base, **DS** dedicated				
	Motor/Ballscrew Connection	Timing belt, Reduction ratio 1/2				
	Slider	Hardened alloyed Steel				
	Base	Extruded aluminium (A6N01S-T5), White alumite treated				
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated				
	Motor Housing	Aluminium die-cast, baked finish				
	Encoder Cover, Pulley Cover	Polyacetal plastic				
	Motor Cable	11-conductor composite cable, 5 m (standard length)				
Application Limit	Grease	Ballscrew: Lithium type grease				
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2				
	Maximum Thrust (1)	N	65,7			
	Payload (2, 3)	kg	Vertical: 2 kg			
	Moment (2, 4)	Nm	5.000 km life expectancy			
			Ma: 4,5, Mb: 5,4, Mc: 4,1			

Thrust direction

Thrust direction

1. At a speed of 10 mm/sec for 5 seconds.
2. Even load distribution on the slider. Fix base securely to a flat, strong frame. For horizontal use, load should be applied in the thrust direction as shown in the drawing. If the slider becomes deformed, it will cause poor movement.
3. At an acceleration of 0,2 G and a speed of 400 mm/sec.
4. Direction of load moment is:

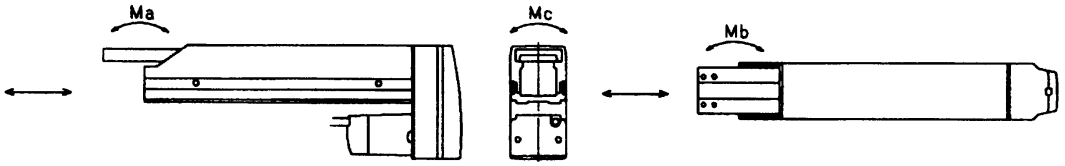


4.2.2 Low Speed High Thrust Type DS-A5L

Specification	**Model**	**DS-A5L**	50	100	150	200
	Stroke	mm	50	100	150	200
	Rated Output	W	20			
	Rated Speed	mm/sec	200			
	Rated Thrust	N	65,7			
	Repeatability	mm	± 0,02			
	Unit Weight	kg	2,2	2,4	2,6	2,8
Structure of Main Component	Motor	AC Servo Motor				
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase, B Phase, Z Phase (Homing pulse: 1 pulse ½ rotation)				
	Brake	Specification	Dry, single head, on when deenergized, electromagnetic brake			
		Model	MB33			
		Holding torque N	103,0	Single brake torque Nm	0,098	
		Mounting position	Ballscrew axis			
		Rated voltage	24 V DC			
	Ballscrew	Ø 10 mm, Lead 6 mm, Rolled thread C10, Backlash 0,1 mm or less				
	Guide	Integrated with base, **DS** dedicated				
	Motor/Ballscrew Connection	Timing belt, Reduction ratio 1/2				
	Slider	Hardened alloyed Steel				
	Base	Extruded aluminium (A6N01S-T5), White alumite treated				
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated				
	Motor Housing	Aluminium die-cast, baked finish				
	Encoder Cover, Pulley Cover	Polyacetal plastic				
	Motor Cable	11-conductor composite cable, 5m (standard length)				
	Grease	Ballscrew: Lithium type grease				
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2				
Application Limit	Maximum Thrust (1)	N	131,4			
	Payload (2, 3)	kg	Vertical: 4 kg			

Moment (2, 4)	Nm	5.000 km life expectancy
		Ma: 4,5, Mb: 5,4, Mc: 4,1

1. At a speed of 10 mm/sec for 5 seconds.
2. Even load distribution on the slider. Fix base securely to a flat, strong frame. For horizontal use, load should be applied in the thrust direction as shown in the drawing. If the slider becomes deformed, it will cause poor movement.
3. At an acceleration of 0,2 G and a speed of 200 mm/sec.
4. Direction of load moment is:

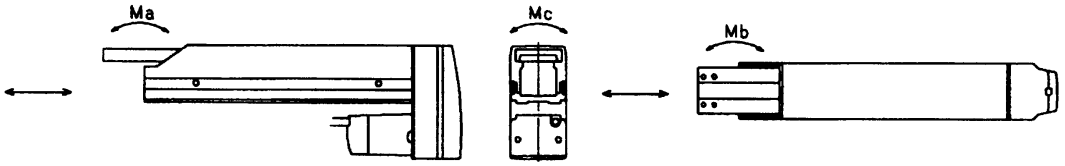


4.2.3 Medium Speed Type DS-A4M

Specification	**Model**	**DS-A4M**	50	100	150	200
	Stroke	mm	50	100	150	200
	Rated Output	W	20			
	Rated Speed	mm/sec	330			
	Rated Thrust	N	39,2			
	Repeatability	mm	± 0,02			
	Unit Weight	kg	1,7	1,8	2,0	2,1
Structure of Main Component	Motor	AC Servo Motor				
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase, B Phase, Z Phase (Homing pulse: 1 pulse ½ rotation)				
	Brake	Specification	Dry, single head, on when deenergized, electromagnetic brake			
		Model	MB33			
		Holding torque N	61,7	Single brake torque Nm	0,098	
		Mounting position	Ballscrew axis			
		Rated voltage	24 V DC			
	Ballscrew	Ø 8 mm, Lead 10 mm, Rolled thread C10, Backlash 0,1 mm or less				
	Guide	Integrated with base, **DS** dedicated				
	Motor/Ballscrew Connection	Timing belt, Reduction ratio 1/2				
	Slider	Hardened alloyed Steel				
	Base	Extruded aluminium (A6N01S-T5), White alumite treated				
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated				
	Motor Housing	Aluminium die-cast, baked finish				
	Encoder Cover, Pulley Cover	Polyacetal plastic				
	Motor Cable	11-conductor composite cable, 5m (standard length)				

Grease	Ballscrew: Lithium type grease	
	Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2	
Maximum Thrust (1)	N	78,4
Payload (2, 3)	kg	Vertical: 2,5 kg
Moment (2, 4)	Nm	5.000 km life expectancy
		Ma: 2,7, Mb: 3,1, Mc: 2,9

1. At a speed of 10 mm/sec for 5 seconds.
2. Even load distribution on the slider. Fix base securely to a flat, strong frame. For horizontal use, load should be applied in the thrust direction as shown in the drawing. If the slider becomes deformed, it will cause poor movement.
3. At an acceleration of 0,2 G and a speed of 330 mm/sec.
4. Direction of load moment is:



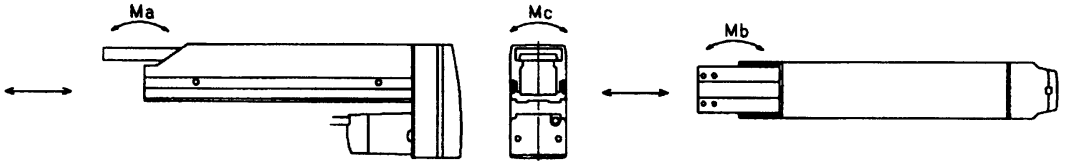
4.2.4 Low Speed High Thrust Type DS-A4L

Specification	**Model**	**DS-A4L**	50	100	150	200
	Stroke	mm	50	100	150	200
	Rated Output	W	20			
	Rated Speed	mm/sec	165			
	Rated Thrust	N	78,4			
	Repeatability	mm	± 0,02			
	Unit Weight	kg	1,7	1,8	2,0	2,1
Structure of Main Component	Motor	AC Servo Motor				
	Encoder	Together with the motor on the spindle A B Z phase Voltage output Input voltage + 5 V Encoder Signals: A Phase, B Phase, Z Phase (Homing pulse: 1 pulse ½ rotation)				
	Brake	Specification	Dry, single head, on when deenergized, electromagnetic brake			
		Model	MB33			
		Holding torque N	122,5	Single brake torque Nm	0,098	
		Mounting position	Ballscrew axis			
		Rated voltage	24 V DC			
	Ballscrew	Ø 8 mm, Lead 5 mm, Rolled thread C10, Backlash 0,1 mm or less				
	Guide	Integrated with base, **DS** dedicated				
	Motor/Ballscrew Connection	Timing belt, Reduction ratio 1/2				
	Slider	Hardened alloyed Steel				
	Base	Extruded aluminium (A6N01S-T5), White alumite treated				
	Side Cover	Extruded aluminium (A6063S-T5) White alumite treated				
	Motor Housing	Aluminium die-cast, baked finish				
	Encoder Cover, Pulley Cover	Polyacetal plastic				
	Motor Cable	11-conductor composite cable, 5m (standard length)				
Application Limit	Grease	Ballscrew: Lithium type grease				
		Guide: Shell Albania Grease No. 2, Mobil Mobilux No. 2				
	Maximum Thrust (1)	N	156,8			
	Payload (2, 3)	kg	Vertical: 4,5 kg			
	Moment (2, 4)	Nm	5.000 km life expectancy			
			Ma: 2,7, Mb: 3,1, Mc: 2,9			

Thrust direction

Thrust direction

1. At a speed of 10 mm/sec for 5 seconds.
2. Even load distribution on the slider. Fix base securely to a flat, strong frame. For horizontal use, load should be applied in the thrust direction as shown in the drawing. If the slider becomes deformed, it will cause poor movement.
3. At an acceleration of 0,2 G and a speed of 165 mm/sec.
4. Direction of load moment is:



5 Parameter