BNP-B3984A (ENC

MITSUBISHI CNC

MELDAS AC SERVO

MDS-B-Vx4 Series

Specifications and Instruction Manual

ADVANCED AND EVER ADVANCING
MITSUBISHI ELECTRIC

Introduction

Thank you for purchasing the Mitsubishi AC Servo.
This instruction manual describes the handling and caution points for using this CNC.
Incorrect handling may lead to unforeseen accidents, so always read this instruction manual thoroughly to ensure correct usage.
Make sure that this instruction manual is delivered to the end user.

This is the instruction manual for the MDS-B-Vx4 servo driver. The entire MDS-B Series drive system, which includes the power supply unit and spindle, is not explained in detail in this manual. Refer to the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B)" for the specifications for the entire system.

Precautions for safety

Please read this instruction manual and auxiliary documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation.

The safety precautions in this instruction manual are ranked as "DANGER" and "CAUTION".

◇ **DANGER**	When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
⚠ **CAUTION**	When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as ⚠ **CAUTION** may lead to major results depending on the situation. In any case, important information that must be observed is described.

The signs indicating prohibited and mandatory items are described below.

⊘	This sign indicates that the item is prohibited (must not be carried out). For example, ⊘ is used to indicate "Fire Prohibited".
●	This sign indicates that the item is mandatory (must be carried out). For example, ⏚ is used to indicate grounding.

After reading this instruction manual, keep it in a safe place for future reference.

The precautions, separate functions, etc., in this manual that do not extend to the physical damage level are ranked as "Request", "Notice", and "Memo".

Request	:	This indicates items where this product may fail if handling is mistaken, without leading to physical damage.
Notice	:	This indicates items where separate functions can be carried out by changing the parameters, or where there are other usage methods.
Meno	:	This indicates important items the operator should be aware of when using the servo.

For Safe Use

1. Electric shock prevention

DANGER

Wait at least 10 minutes after turning the power OFF, before starting wiring or inspections. Failure to observe this could lead to electric shocks.

Ground the servo amplifier and servomotor with Class 3 grounding or higher.

Wiring and inspection work must be done by a qualified technician.

Wire the servo amplifier and servomotor after installation. Failure to observe this could lead to electric shocks.

Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.

Do not damage, apply forcible stress, place heavy items or engage the cable. Failure to observe this could lead to electric shocks.

2. Fire prevention

CAUTION

Install the servo amplifier, servomotor and regenerative resistor on noncombustible material. Direct installation on combustible material or near combustible materials could lead to fires.

If the servo amplifier fails, shut off the power supply on the servo amplifier power supply side. If a large current continues to flow, it could lead to fires.

Shut off the power supply if an error signal occurs. The regenerative resistor could abnormally overheat due to regenerative transistor failure, etc., and this could lead to fires.

3. Injury prevention

⚠ CAUTION

Do not apply a voltage other than that specified in Instruction Manual on each terminal. Failure to observe this item could lead to ruptures or damage, etc.

Do not mistake the terminal connections. Failure to observe this item could lead to ruptures or damage, etc.

Do not mistake the polarity(⊕ ,⊖) . Failure to observe this item could lead to ruptures or damage, etc.

Do not touch the servo amplifier fins, regenerative resistor or servomotor, etc., while the power is turned ON or immediately after turning the power OFF. Some parts are heated to high temperatures, and touching these could lead to burns.

4. Various precuations

Observe the following precautions. Incorrect handling of the unit could lead to faults, injuries and electric shocks, etc.

(1) Transportation and installation

⚠ CAUTION

Correctly transport the product according to its weight.

Do not stack the products above the tolerable number.

Do not hold the cables, axis or detector when transporting the servomotor.

Do not hold the front cover when transporting the servo amplifier. The unit could drop.

Follow this Instruction Manual and install the unit in a place where the weight can be borne.

Do not get on top of or place heavy objects on the unit.

Always observe the installation directions.

Secure the specified distance between the servo amplifier and control panel, or between the servo amplifier and other devices.

Do not install or run a servo amplifier or servomotor that is damaged or missing parts.

Do not let conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter the servo amplifier or servomotor.

The servo amplifier and servomotor are precision devices, etc., so do not drop them or apply strong impacts to them.

⚠ CAUTION

⚠ Store and use the units under the following environment conditions.

Environment	Conditions	
	Servo amplifier	**Servomotor**
Ambient temperature	0°C to +55°C (with no dew condensation)	0°C to +40°C (with no dew condensation)
Ambient humidity	90% RH or less (with no dew condensation)	80%RH or less (with no dew condensation)
Storage temperature	–15°C to +70°C (with no freezing)	
Storage humidity	90% RH or less (with no dew condensation)	
Atmosphere	Indoors (Where unit is not subject to direct sunlight) With no corrosive gas, combustible gas, oil mist or dust.	
Altitude	1000m or less above sea level	
Vibration	0.5G	2G

⚠ Securely fix the servomotor to the machine. Insufficient fixing could lead to the servomotor deviating during operation.

⚠ Always install servomotors with reduction gears in the designated direction. Failure to do so could lead to oil leaks.

⚠ Never touch the rotary sections of the servomotor during operations. Install a cover, etc., on the shaft.

⚠ When coupling to a servomotor shaft end, do not apply an impact by hammering, etc. The detector could be damaged.

⚠ Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could break.

❗ When storing for a long time, please contact your dealer.

(2) Wiring

⚠ CAUTION

⚠ Correctly and securely perform the wiring. Failure to do so could lead to runaway of the servomotor.

(3) Trial operation and adjustment

⚠ CAUTION

⚠ Check and adjust each parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.

⚠ Do not make remarkable adjustments and changes as the operation could become unstable.

(4) Usage methods

⚠ CAUTION

⚠ Install an external emergency stop circuit so that the operation can be stopped and power shut off immediately.

⚠ Unqualified persons must not disassemble or repair the unit.

⚠ If the alarm is reset (RST) while the operation start signal (ST) is ON, the servo may start unexpectedly. Always confirm that the operation signal is OFF before resetting. Failure to do so could lead to accidents.

⚠ Never make modifications.

⚠ Reduce magnetic interference by installing a noise filter. The electronic devices used near the servo amplifier could be affected by magnetic noise.

⚠ Always use the servomotor and servo amplifier with the designated combination.

⚠ The servomotor's magnetic brakes are for holding purposes. Do not use them for normal braking.

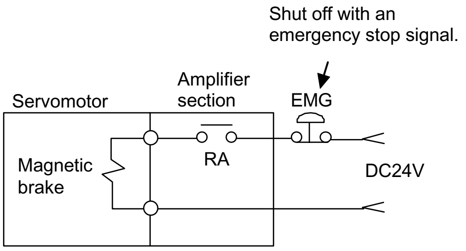
⚠ There may be cases when holding is not possible due to the magnetic brake's life or the machine construction (when ball screw and servomotor are coupled via a timing belt, etc.). Install a stop device to ensure safety on the machine side.

(5) Troubleshooting

CAUTION

If a hazardous situation is predicted during stop or product trouble, use a servomotor with magnetic brakes or install an external brake mechanism.

Use a double circuit configuration that allows the operation circuit for the magnetic brakes to be operated even by the external emergency stop signal.



If an alarm occurs, eliminate its cause and ensure safety before resetting the alarm and starting operation again.

Never go near the machine after restoring the power after a failure, as the machine could start suddenly.
(Design the machine so that personal safety can be ensured even if the machine starts suddenly.)

(6) Maintenance, inspection and part replacement

CAUTION

The capacity of the electrolytic capacitor will drop due to deterioration. To prevent secondary damage due to failures, replacing this part every ten years when used under a normal environment is recommended. Contact the nearest Service Center or Service Station for replacement of parts.

(7) Disposal

CAUTION

Treat this unit as general industrial waste.

(8) General precautions

CAUTION

The drawings given in this Specifications and Maintenance Instruction Manual show the covers and safety partitions, etc., removed to provide a clearer explanation. Always return the covers or partitions to their respective places before starting operation, and always follow the instructions given in this manual.

Contents

Chapter 6

Chapter 7

Chapter 8

Chapter 1　Outline

1-1 Outline

In recent years, there have been increasing demands for higher accuracy, higher speed, and higher efficiency in the machining tool field. To respond to those demands, higher gains in the servo system are required. The MDS-B-V14/V24 units enable higher gains in the servo system by increasing the speed of the servo control process and increasing mechanical resonance suppression control. In this way, improvements in machining accuracy and improvements in machining shapes during high-speed cutting can be expected.

1-2 MDS-B-Vx4 Servo Amplifier Characteristics

(1) Improvement of servo control process capacity

The servo process capacity has been much improved compared to the standard MDS-B-Vx amplifier. A high-gain servo that enables machining at higher speeds and with higher accuracy has been realized by combining high-frequency PWM control, etc.

(2) Improvement of the mechanical resonance suppression filter

Increased gain in entire servo systems including machines is supported by improvement of the mechanical resonance suppression filter.

(3) Compatibility with the MDS-B-Vx Servo Amplifier

Except for the compatibility of the following 1-axis servo drive unit lineup and motor end encoder, this amplifier is basically compatible with the standard MDS-B-Vx amplifier in terms of the unit outline drawings and installation method.

1-3 Differences with the Standard MDS-B-Vx Servo Amplifier

(1) 1-axis servo drive unit lineup

The MDS-B-Vx4 Series lineup consists of 0.1kW to 9.0kW units for the 1-axis amplifier (V14), and (0.1kW + 0.1kW) to (4.5kW + 3.5kW) units for the 2-axis amplifier (V24). There is no compatibility with the 1-axis amplifier (V14) 11.0kW and 15.0kW units. If this is required, select a standard MDS-B-V1-110 or 150 amplifier.

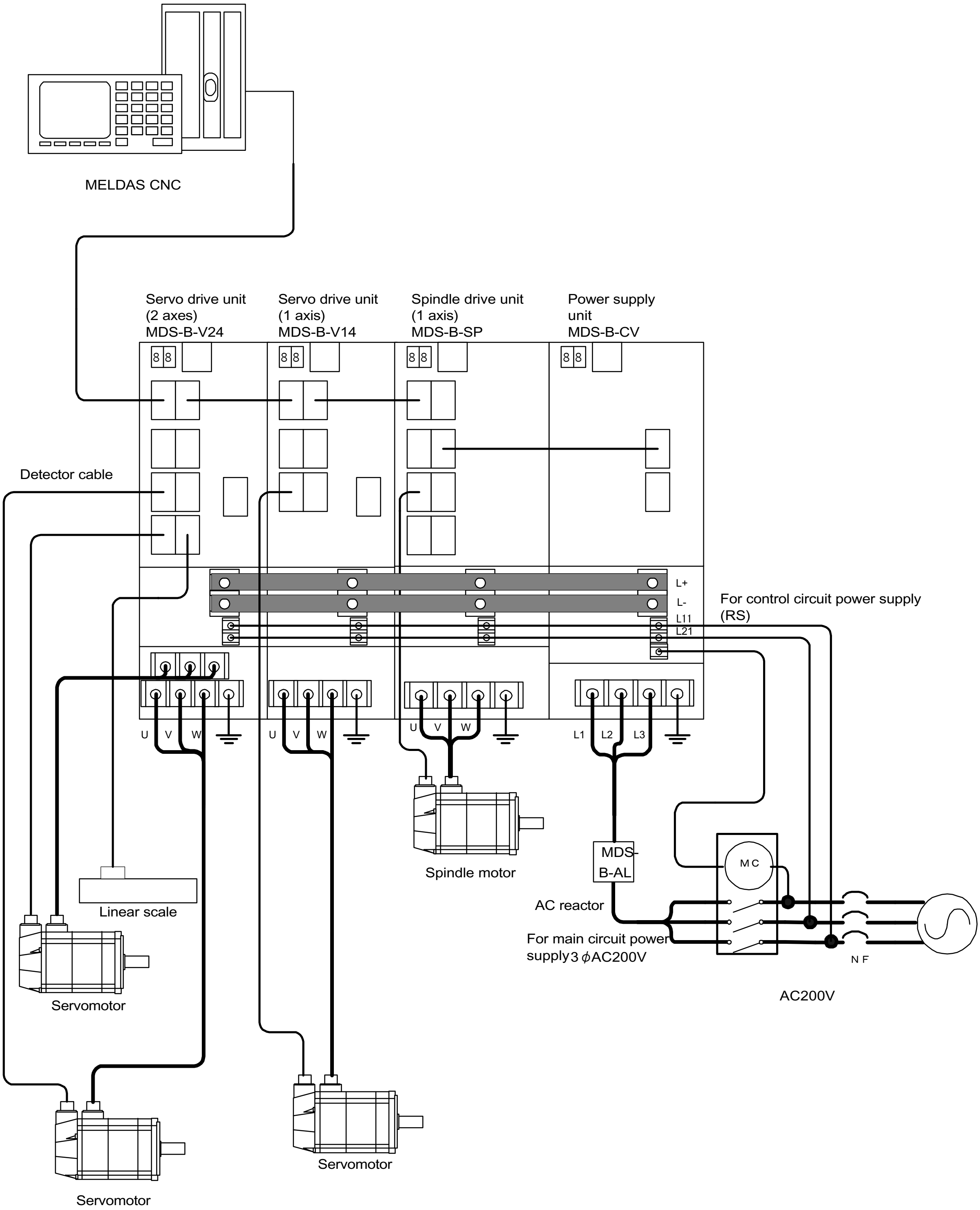
(2) Compatibility with the motor end encoder

Motor end encoders are only compatible with OSA and OSE-type serial encoders. Note that motor end encoders are not compatible with OHE and OHA-type pulse encoders.

Chapter 2 Drive System Configuration

2-1 Basic system configuration

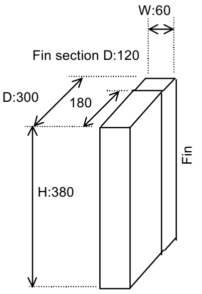
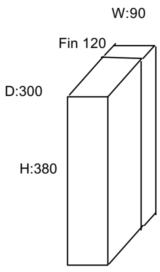
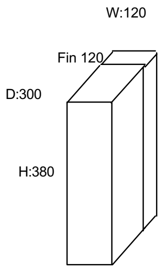
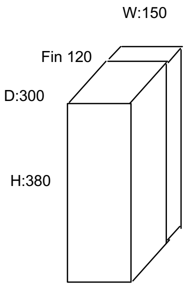
Configuration example for one spindle and three servo axes.



⚠ **CAUTION**	1. In systems having a spindle drive unit, always arrange the spindle drive unit next to the power supply unit as shown in the diagram above. 2. If multiple drive units are used, arrange them in decreasing order with the one having the largest drive capacity next to the power supply. 3. Contactor installation is optional for all units except the MDS-B-CV-370 unit. 4. Always install an AC reactor (item shipped from Mitsubishi). Note that this is not required for an A-CR unit. Wire the AC reactor before the contactor (on the NF side).

2-2 List of units and compatible motors

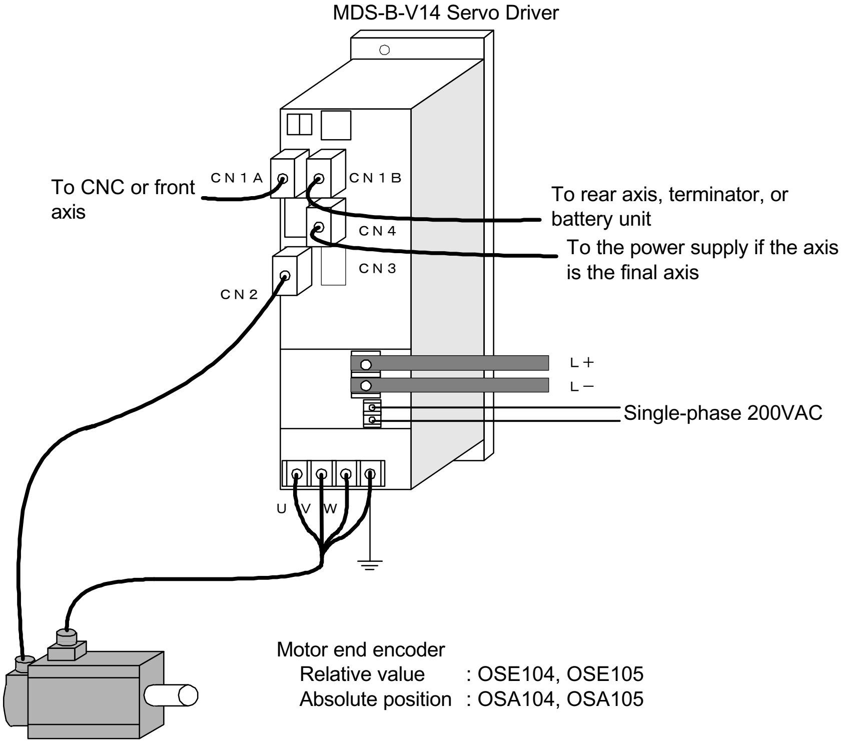
Servo drive unit					Compatible motor														
	Type MDS-B-	Capacity (kW)	External type	Axis	HC														
					52	53	102	103	152	153	202	203	352	353	452	453	702	703	902
1-axis amplifier	V14-01	0.1	A0																
	V14-03	0.3																	
	V14-05	0.5			■	■													
	V14-10	1.0					■	■											
	V14-20	2.0	A1						■	■	■								
	V14-35	3.5										■	■						
	V14-45	4.5	B1											■	■				
	V14-70	7.0	C1													■	■		
	V14-90	9.0																■	■
2-axis amplifier	V24-0101	0.1 + 0.1	A0	LM															
	V24-0301	0.3 + 0.1		L															
				M															
	V24-0303	0.3 + 0.3		LM															
	V24-0501	0.5 + 0.1		L	■	■													
				M															
	V24-0503	0.5 + 0.3		L	■	■													
				M															
	V24-0505	0.5 + 0.5		LM	■	■													
	V24-1005	1.0 + 0.5		L			■	■											
				M	■	■													
	V24-1010	1.0 + 1.0		LM			■	■											
	V24-2010	2.0 + 1.0	A1	L					■	■	■								
				M			■	■											
	V24-2020	2.0 + 2.0		LM					■	■	■								
	V24-3510	3.5 + 1.0	B1	L								■	■						
				M			■	■											
	V24-3520	3.5 + 2.0		L								■	■						
				M					■	■	■								
	V24-3535	3.5 + 3.5		LM								■	■						
	V24-4520	4.5 + 2.0		L										■	■				
				M					■	■	■								
	V24-4535	4.5 + 3.5		L										■	■				
				M								■	■						

Outline dimensions of each external type unit	A0/A1	B1	C1	D1
Outline drawing (mm)	 The A0 type does not have fins. (Depth: 180)			

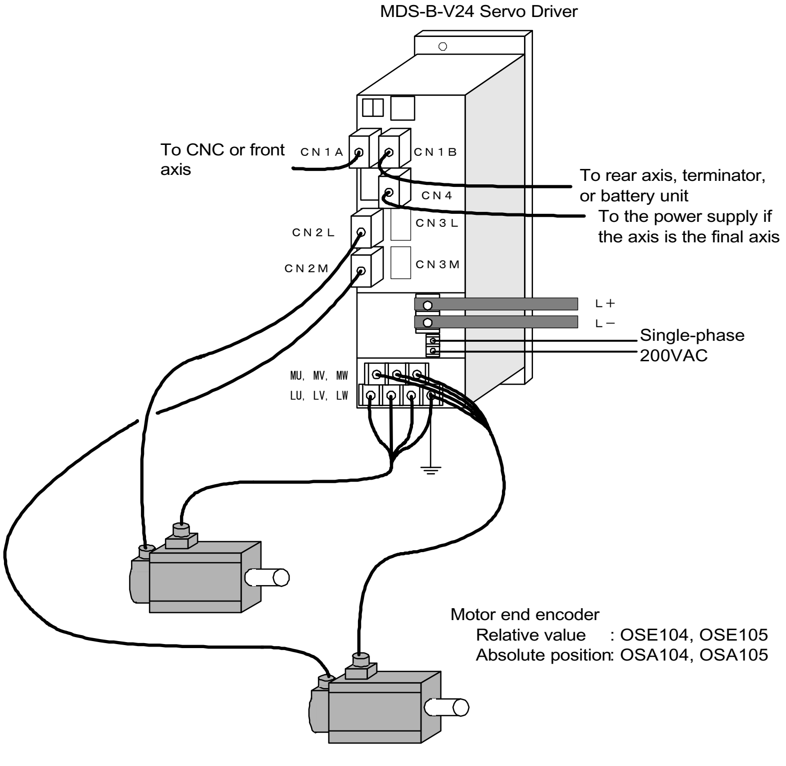
2-3 Semi-closed loop position detection system

⚠ **CAUTION**	Only OSA and OSE-type serial encoders are compatible with semi-closed end (motor end) detectors. Note that semi-closed end detectors are not compatible with OHE and OHA-type pulse encoders.

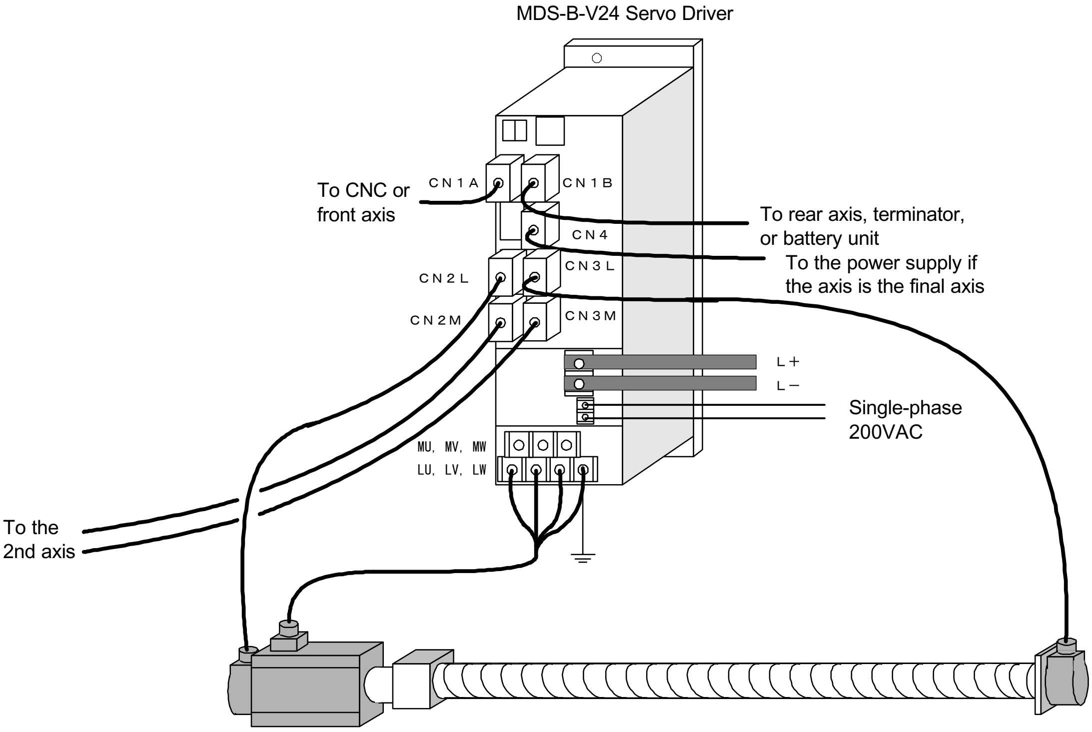
2-3-1 1-axis servo drive unit



2-3-2 2-axis servo drive unit



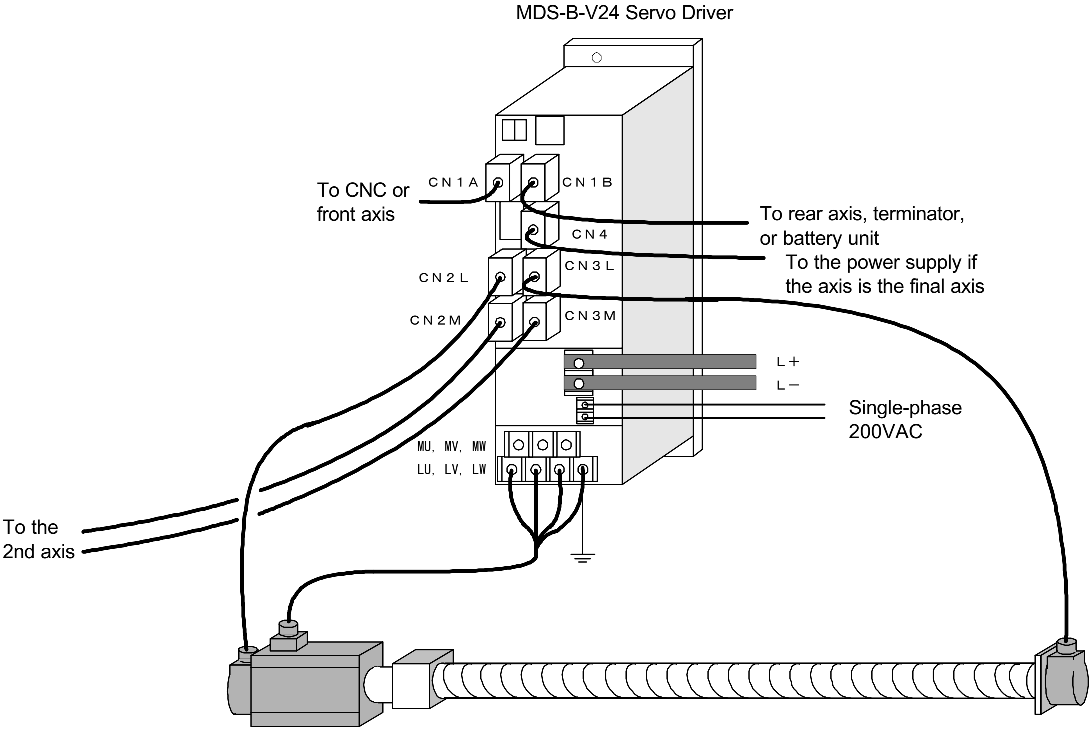
2-4 Ball screw end position detection system



Motor end encoder
Relative value : OSE104, OSE105
Absolute position : OSA104, OSA105

Ball screw end encoder
Relative value : OSE104ET, OSE105ET, OHE25K-ET
Absolute position : OSA104ET, OSA105ET, OHA25K-ET

2-5 Machine end position detection system



Motor end encoder
Relative value : OSE104, OSE105
Absolute position : OSA104, OSA105

Ball screw end encoder
Relative value : OSE104ET, OSE105ET, OHE25K-ET
Absolute position : OSA104ET, OSA105ET, OHA25K-ET

Chapter 3 Selection

3-1 Selection of servo system

POINT

The selection of the servo system is the same as that for the MDS-B-V1/V2 unit.
Refer to section "7.1 Selection of Servo System" in the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B)".

3-2 Selection of power supply unit

POINT

Refer to section "8.1 Selection of Power Supply Unit" in the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B)" for details on selection the power supply unit.

3-3 Selection of power supply capacity

POINT

The selection of the power supply capacity is the same as that for the MDS-B-V1/V2 unit.
Refer to section "8.2 Selection of Power Supply Capacity" in the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B)".

3-4 Selection of wire size

POINT

The selection of the wire size is the same as that for the MDS-B-V1/V2 unit.
Refer to section "8.3 Selection of Wire Size" in the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B)".

3-5 Selection of AC reactor, contactor, and NFB

POINT

Refer to section "8.4 Selection of AC Reactor, Contactor, and NFB" in the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B)" for details on selection of the AC reactor, contactor, and NFB.

Chapter 4 Motor

Both the HA Series and HC Series servomotors are compatible with the MDS-B-V14/V24 Servo Drive Unit, but only the HC Series servomotors are described in this Specifications and Instruction Manual.

POINT Refer to the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B)" for details on the specifications related to HA Series servomotors.

4-1 Type configuration

HC Series servomotor

HC ① ② ③ ④ ⑤ ⑥ – ⑦

Detector

Symbol	Detection method	Resolution (p/rev)	Detector type
E42	INC	100000	OSE104S2
E51	INC	1000000	OSE105S2
A42	ABS	100000	OSA104S2
A51	ABS	1000000	OSA105S2

Protection type

No symbol	IP65
P	IP67

Shaft type

S	Straight
T	Tapered

Only straight shafts are available for intermediate 2.0kW or higher units.

Magnetic brakes

No symbol	No magnetic brakes
B	With magnetic brakes

Motor series

No symbol	Intermediate
R	Low

Rated speed

2	2000r/min
3	3000r/min

There are no 3000r/min specifications for the 9.0kW unit.

Output

5	0.5kW	35	3.5kW
10	1.0kW	45	4.5kW
15	1.5kW	70	7.0kW
20	2.0kW	90	9.0kW

4-2 List of specifications

HC Series servomotors

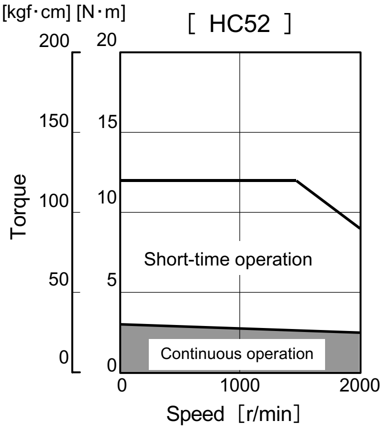
Servomotor type		HC52	HC102	HC152	HC202	HC352	HC452	HC702	HC902
Servo amplifier type		V14-05	V14-10	V14-20	V14-20	V14-35	V14-45	V14-70	V14-90
Rated output	kW	0.5	1.0	1.5	2.0	3.5	4.5	7.0	9.0
Rated torque	N·m	2.39	4.78	7.16	9.55	16.7	21.5	33.4	43.0
	kgf·cm	24.4	48.7	73.1	97.4	170	219	341	438
Stall torque	N·m	2.94	5.88	8.82	13.7	22.5	37.2	49	58.8
	kgf·cm	30	60	90	140	230	380	500	600
Max. torque (Note 1)	N·m	11.8	21.6	35.3	41.7	59.8	87.5	120	153
	kgf·cm	120	220	360	425	610	893	1220	1565
Rated speed	r/min	2000							
Max. speed	r/min	2000							
Power rate at max. torque	kW/s	8.7	16.7	25.6	21.5	34	38.2	69.7	82.5
Rated current	Arms	3.2	6.0	9.0	10.7	16.9	23.3	32.8	40.8
Stall current	Arms	3.9	7.4	11.1	15.4	22.9	40.4	46.2	55.9
Max. current	Arms	17	28	47	47	64	85	113	141
Inertia moment	J (= GD/4) kg·cm^2	6.6	13.7	20.0	42.5	82.0	121.0	160.0	224.0
	jm kg·cm·s^2	0.0067	0.014	0.02	0.043	0.084	0.123	0.163	0.229
	GD kgf·cm^2	26.5	54.8	79.8	170	328	484	640	896
Insulation class		F class							
Protection class		IP65							
Cooling structure		Totally enclosed self-cooling							
Ambient temperature		0 to 40°C (with no freezing)							
Detector		According to the motor type detector symbol							
Weight	kg	5	7	9	12	19	25	32	40
Note that specification and outline details may change.									

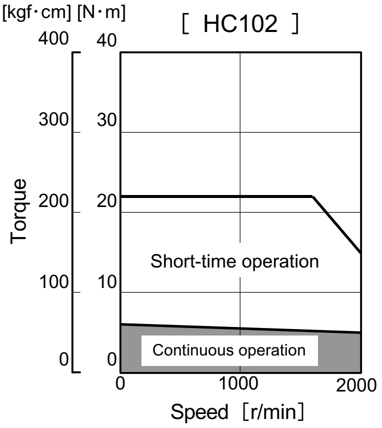
Servomotor type		HC53	HC103	HC153	HC203	HC353	HC453	HC703
Servo amplifier type		V14-05	V14-10	V14-20	V14-35	V14-45	V14-70	V14-90
Rated output kW		0.5	1.0	1.5	2.0	3.5	4.5	7.0
Rated torque	N·m	1.59	3.18	4.77	6.37	11.1	14.3	22.3
	kgf·cm	16.3	32.5	48.7	65.0	114	146	227
Stall torque	N·m	2.94	5.88	8.82	13.7	22.5	37.2	49.0
	kgf·cm	30	60	90	140	230	380	500
Max. torque (Note 1)	N·m	8.82	16.7	28.4	40.2	55.9	79.8	105
	Kgf·cm	90	170	290	410	570	814	1072
Rated speed r/min		3000						
Max. speed r/min		3000						
Power rate at rated torque kW/s		3.8	7.4	11.4	9.5	15	16.9	29.3
Rated current Arms		3.2	5.3	8.6	10.4	16.5	22.1	30.5
Stall current Arms		5.8	9.8	15.9	22.4	33.3	57.3	67.2
Max. current Arms		17	28	47	64	85	113	141
Inertia moment	J (= GD/4) kg·cm^2	6.6	13.7	20.0	42.5	82.0	121.0	170.0
	jm kg·cm·s^2	0.0067	0.014	0.02	0.043	0.084	0.123	0.173
	GD kgf·cm^2	26.5	54.8	79.8	170	328	484	680
Insulation class		F class						
Protection class		IP65						
Cooling structure		Totally enclosed self-cooling						
Ambient temperature		0 to 40°C (with no freezing)						
Detector		According to the motor type detector symbol						
Weight kg		5	7	9	12	19	25	32

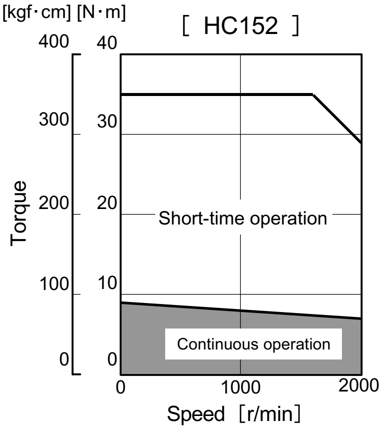
Note that specification and outline details may change.

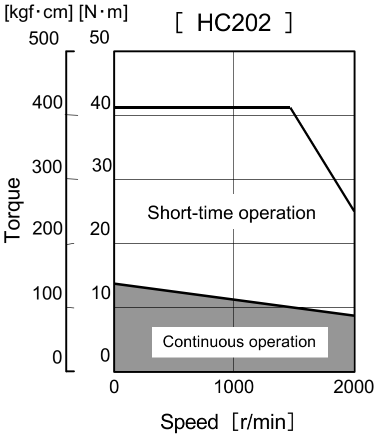
4-3 Torque characteristic drawings

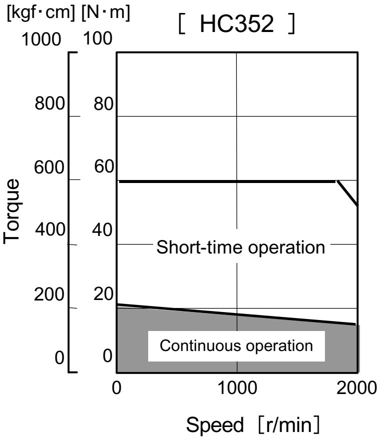
HC Series servomotor

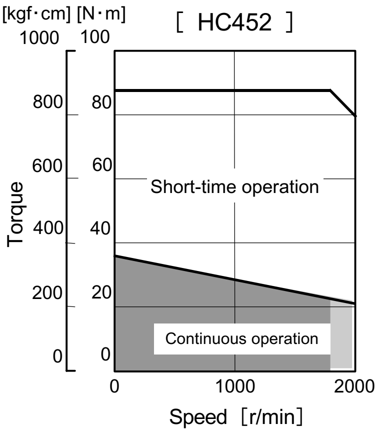

[HC52]

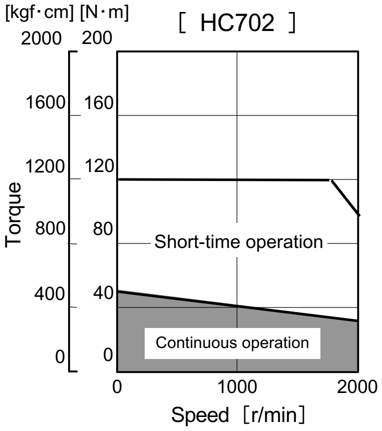

[HC102]

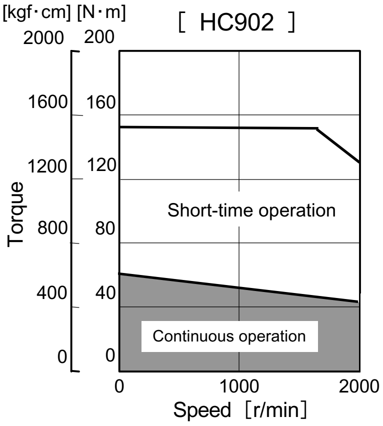

[HC152]


[HC202]

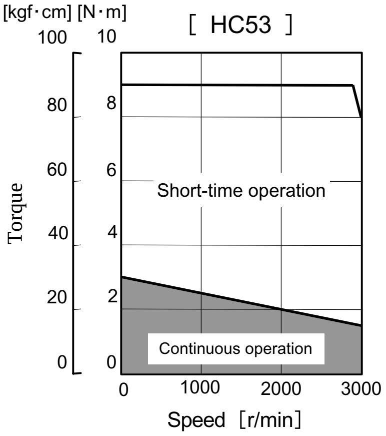

[HC352]

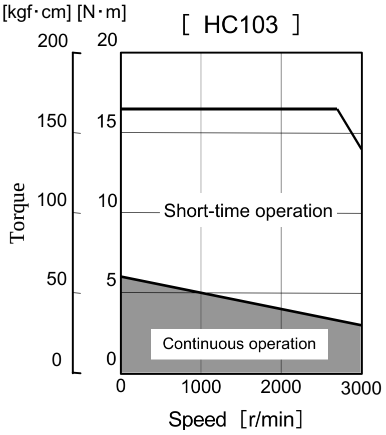

[HC452]

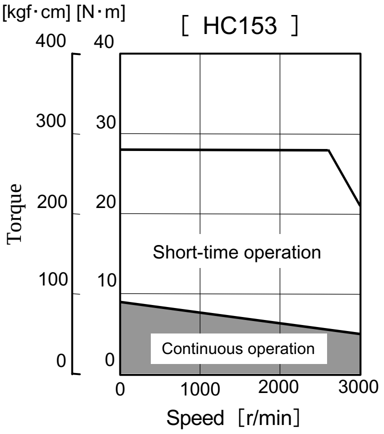

[HC702]

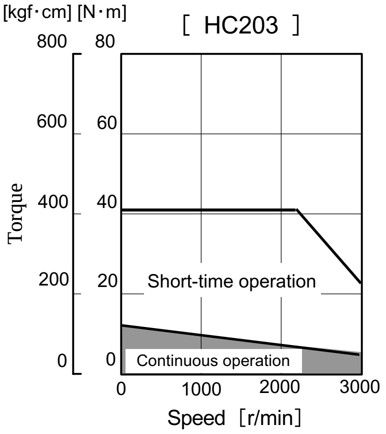

[HC902]

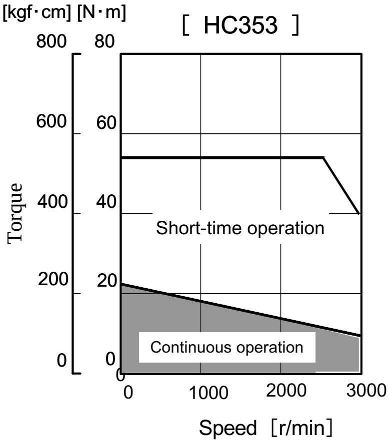
(Caution) The data in these characteristics is for an input voltage of 200VAC.

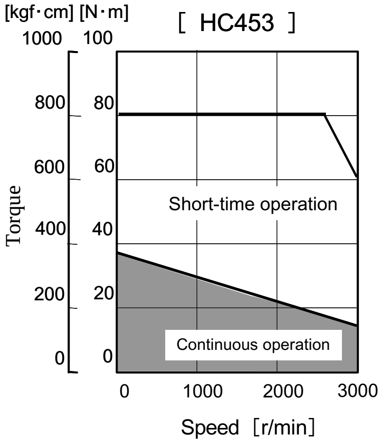

[kgf·cm] [N·m]
[HC53]
100 10
80 8
60 6
40 4
20 2
0 0
Torque
Short-time operation
Continuous operation
0 1000 2000 3000
Speed [r/min]

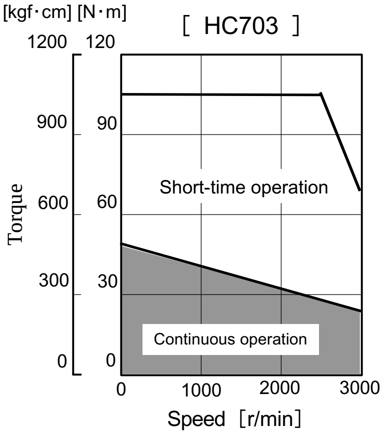

[kgf·cm] [N·m]
[HC103]
200 20
150 15
100 10
50 5
0 0
Torque
Short-time operation
Continuous operation
0 1000 2000 3000
Speed [r/min]


[kgf·cm] [N·m]
[HC153]
400 40
300 30
200 20
100 10
0 0
Torque
Short-time operation
Continuous operation
0 1000 2000 3000
Speed [r/min]


[kgf·cm] [N·m]
[HC203]
800 80
600 60
400 40
200 20
0 0
Torque
Short-time operation
Continuous operation
0 1000 2000 3000
Speed [r/min]


[kgf·cm] [N·m]
[HC353]
800 80
600 60
400 40
200 20
0 0
Torque
Short-time operation
Continuous operation
0 1000 2000 3000
Speed [r/min]


[kgf·cm] [N·m]
[HC453]
1000 100
800 80
600 60
400 40
200 20
0 0
Torque
Short-time operation
Continuous operation
0 1000 2000 3000
Speed [r/min]


[kgf·cm] [N·m]
[HC703]
1200 120
900 90
600 60
300 30
0 0
Torque
Short-time operation
Continuous operation
0 1000 2000 3000
Speed [r/min]

4-4 Magnetic brake characteristics

⚠ **CAUTION**

1. The axis will not be mechanically held even when the dynamic brakes are used. If the machine could drop when the power fails, use a servomotor with magnetic brakes or provide an external brake mechanism as holding means to prevent dropping.
2. The magnetic brakes are used for holding, and must not be used for normal braking. There may be cases when holding is not possible due to the life or machine structure (when ball screw and servomotor are coupled with a timing belt, etc.). Provide a stop device on the machine side to ensure safety.
3. When operating the brakes, always turn the servo OFF (or ready OFF). When releasing the brakes, always confirm that the servo is ON first. Sequence control considering this condition is possible if the amplifier motor brake control connector CN20 is used.
4. When the vertical axis drop prevention function is used, the drop of the vertical axis during an emergency stop can be suppressed to the minimum.

4-4-1 Motor with magnetic brakes

(1) Types

The motor with magnetic brakes is set for each motor. The "B" following the standard motor type indicates the motor with brakes.

(2) Applications

When this type of motor is used for the vertical feed axis in a machining center, etc., slipping and dropping of the spindle head can be prevented even when the hydraulic balancer's hydraulic pressure reaches zero when the power turns OFF.
When used for the feed axis of a grinding machine, a double safety measures is formed with the deceleration stop (dynamic brake stop), and the risks of colliding with the grinding stone and scattering can be prevented.
This motor cannot be used for purposes other than holding and braking during a power failure (emergency stop). (This cannot be used for normal deceleration, etc.)

(3) Features

① The magnetic brakes use a DC excitation method, thus:

- The brake mechanism is simple and the reliability is high.
- There is no need to change the brake tap between 50 Hz and 60 Hz.
- There is no rush current when the excitation occurs, and shock does not occur.
- The brake section is not larger than the motor section.

② The magnetic brakes are built into the motor, and the installation dimensions are the same as the motor without brakes.

4-4-2 Magnetic brake characteristics

Magnetic brake characteristics

Motor type Item			HC∗∗ Series	
			52B ~ 152B 53B ~ 153B	**202B ~ 902B 203B ~ 703B**
Type (Note 1)			Spring braking type safety brakes	
Rated voltage			24 VDC	
Rated current at 20°C		(A)	0.80	1.43
Excitation coil resistance at 20°C		(Ω)	29	16.8
Capacity		(W)	19	34
Attraction current		(A)	0.2	0.4
Dropping current		(A)	0.08	0.2
Static friction torque		(N· m)	8.5	43.1
		(kgf· cm)	85.0	440
Moment of inertia (Note 2)		J (kg· cm^2)	2.0	10
		GD^2 (kgf· cm^2)	8.0	40
Release delay time (Note 3)		(sec)	0.04	0.1
Braking delay time (Note 3)		AC OFF (sec)	0.12	0.12
		DC OFF (sec)	0.03	0.03
Tolerable braking work amount	Per braking	(N· m)	400	4,500
		(kgf· cm)	4,082	46,000
	Per hour	(N· m)	4,000	45,000
		(kgf· cm)	40,816	460,000
Brake play at motor axis (deg.)			0.2 ~ 0.6	0.2 ~ 0.6
Brake life (Note 4)	No. of braking operations (times)		20,000	20,000
	Braking amount per braking	(N· m)	200	1,000
		(kgf· cm)	2,041	10,204

Notes:

1. There is no manual release mechanism. If handling is required such as during the machine core alignment work, prepare a separate 24 VDC power supply, and electrically release the brakes.
2. These are the values added to the servomotor without brakes.
3. This is the value for 20°C at the initial attraction gap.
4. The brake gap will widen through brake lining wear caused by braking. However, the gap cannot be adjusted. Thus, the brake life is reached when adjustments are required.
5. The internal power output (VDD) 24 VDC for digital output cannot be used. Always prepare a separate power supply.
6. A leakage flux will be generated at the shaft end of the servomotor with magnetic brakes.
7. When operating in low speed regions, the sound of loose brake lining may be heard. However, this is not a problem in terms of function.

4-4-3 Magnetic brake power supply

⚠ CAUTION

1. Always prepare an external release power supply dedicated for the magnetic brakes.
2. Always install a surge absorber on the brake terminal when using DC OFF.
3. Do not connector or disconnect the cannon plug while the brake power is ON. The cannon plug pins could be damaged by sparks.

(1) Brake excitation power supply

① Prepare a brake excitation power supply that can accurately ensure the attraction current in consideration of the voltage fluctuation and excitation coil temperature.

② The brake terminal polarity is random. Make sure not to mistake the terminals with other circuits.

(2) Brake excitation circuit

(a) AC OFF and (b) DC OFF can be used to turn OFF the brake excitation power supply (to apply the brakes).

(a) AC OFF

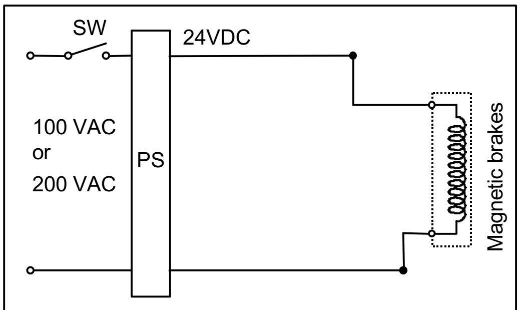
The braking delay time will be longer, but the excitation circuit will be simple, and the relay shutoff capacity will be smaller.

(b) DC OFF

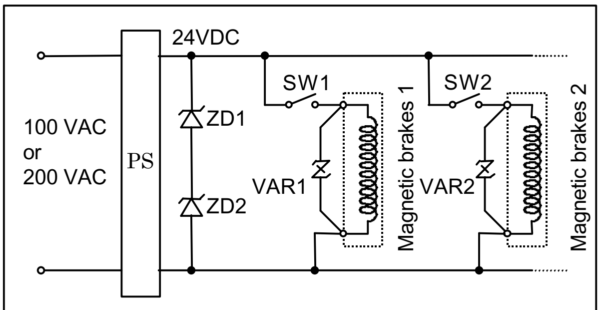
The braking delay time can be shortened, but a surge absorber will be required and the relay shutoff capacity will increase.

<Cautions>

- Provide sufficient DC shutoff capacity at the contact.
- Always use a serge absorber.
- When using the cannon plug type, the surge absorber will be further away, so use shielded wires between the motor and surge absorber.



(a) Example of AC OFF



(b) Example of DC OFF

PS	:	24 VDC stabilized power supply
ZD1, ZD2	:	Zener diode for power supply protection (1W, 24V)
VAR1, VAR2	:	Surge absorber (220V)

Refer to the following table when selecting the power supply.

Motor	Power supply		
	Input voltage AC [V]	Output voltage DC [V]	Output current [A]
52B ~ 152B 53B ~ 153B	100 or 200	24	1.3A or more
202B ~ 902B 203B ~ 703B	100 or 200	24	2.2A or more

4-4-4 Connection of magnetic brakes and MDS-B-V14 servo driver

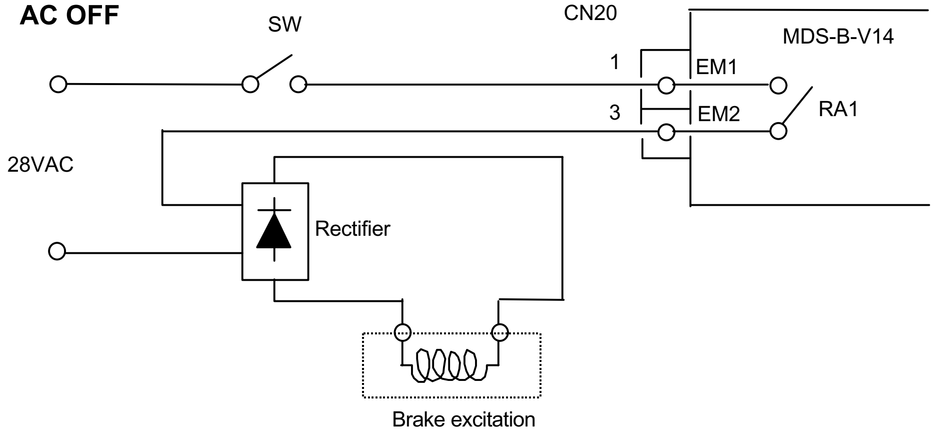
Contact connection terminals (EM1, EM2) for mechanical brakes (magnetic brakes)
Brake terminals have been provided on the MDS-B-V14 1-axis Servo Driver. When controlling the mechanical brakes using these terminals, connect the magnetic brake cable to the CN20 connector.

[Brake contact specifications]

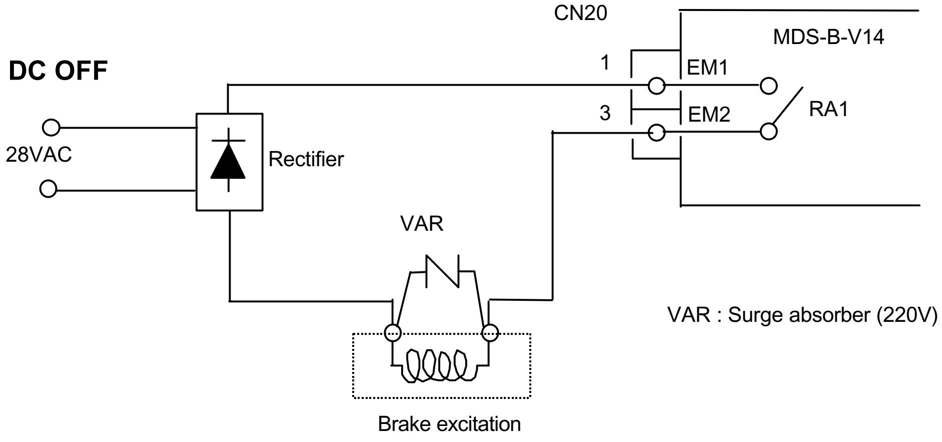
Item	Specification
Rated control capacity (resistance load)	(AC) 8A 250V / (DC) 5A 30V
Contact max. tolerable power (resistance load)	2000VA 150WA
Contact max. tolerable voltage/current	(AC) 380V / 8A

[Example of brake contact connection]

(1) AC OFF



(2) DC OFF



⚠ CAUTION

DC OFF is effective when the braking delay time is a problem. However, the contact DC shutoff capacity and occurrence of incorrect signals to the CNC must be checked, and the following precautions must at least be observed.

1. Allow for ample contact DC shutoff capacity.
2. Use surge absorber.

4-5 Dynamic brake characteristics

A dynamic brake stop will be carried out when an emergency stop occurs due to servo alarm detection, etc., and the deceleration stop function by the servo parameter settings is not used. A dynamic brake stop will also be carried out if a servo alarm occurs in which a deceleration stop cannot be carried out (when a servo alarm occurs in which motor control is impossible).

4-5-1 Coasting amount

The motor coasting amount during an emergency stop (MDS-B-V14/V24 and HC motor combination) can be obtained using the following expression.

$$\mathrm{Lmax} = \frac{F_{GO} \times 10^3}{60} \left\{ 0.03 + (AN^2 + B) \left[1 + \frac{J_L}{J_M} \right] \times 1.1 \right\}$$

Lmax : Machine coasting amount [mm]
F_{GO} : Feedrate (rapid traverse rate) [m/min]
N : Motor speed (speed during rapid traverse) [rpm]
A : } Coefficient Selected from the following table.
B :
J_L : Motor shaft conversion load inertia [kgf·cm·s^2]
J_M : Motor shaft conversion rotor inertia [kgf·cm·s^2]

(Note) Lmax may deviate ±10% due to the motor inductive voltage constant.

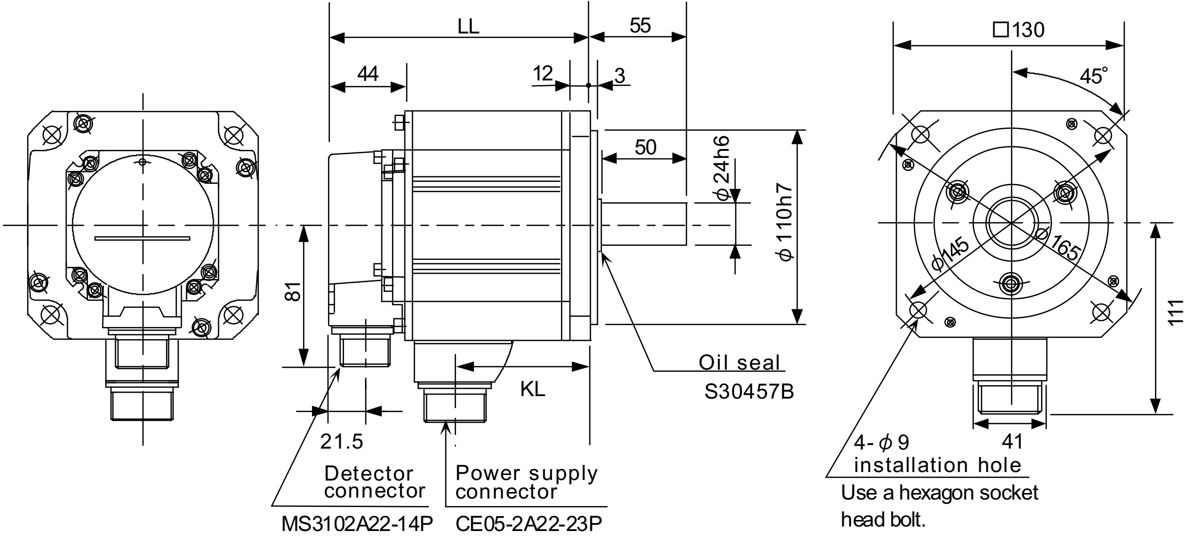
Motor type	Coefficient A	Coefficient B
HC52	3.59×10^{-9}	4.79×10^{-3}
HC102	2.47×10^{-9}	5.69×10^{-3}
HC152	1.76×10^{-9}	5.89×10^{-3}
HC202	1.52×10^{-8}	9.56×10^{-3}
HC352	8.74×10^{-9}	1.30×10^{-2}
HC452	2.80×10^{-9}	1.92×10^{-2}
HC702	1.33×10^{-8}	6.82×10^{-3}
HC902	2.07×10^{-9}	2.65×10^{-2}
HC53	2.56×10^{-9}	6.09×10^{-3}
HC103	1.95×10^{-9}	6.98×10^{-3}
HC153	1.28×10^{-9}	9.13×10^{-3}
HC203	9.77×10^{-9}	1.64×10^{-2}
HC353	4.97×10^{-9}	2.42×10^{-2}
HC453	2.44×10^{-9}	3.28×10^{-2}
HC703	1.58×10^{-9}	3.66×10^{-2}
HC202S	1.11×10^{-8}	1.23×10^{-2}

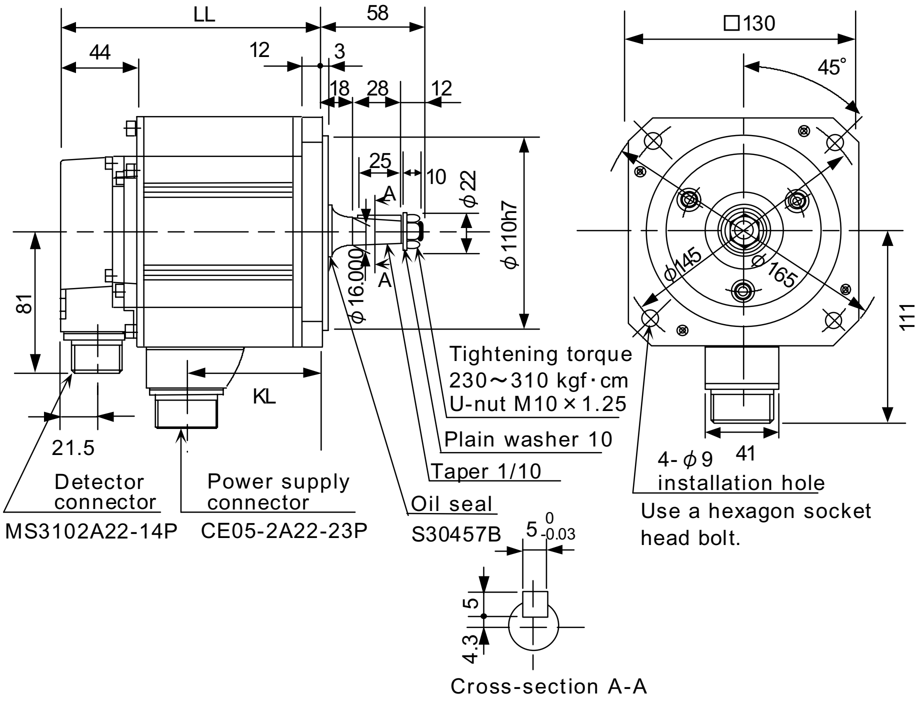
4-6 Outline dimension drawings

HC Series servomotor

- HC52(B)S☐-A42/E42/A51/E51
- HC102(B)S☐-A42/E42/A51/E51
- HC152(B)S☐-A42/E42/A51/E51
- HC52(B)T☐-A42/E42/A51/E51
- HC102(B)T☐-A42/E42/A51/E51
- HC152(B)T☐-A42/E42/A51/E51
- HC53(B)S☐-A42/E42/A51/E51
- HC103(B)S☐-A42/E42/A51/E51
- HC153(B)S☐-A42/E42/A51/E51
- HC53(B)T☐-A42/E42/A51/E51
- HC103(B)T☐-A42/E42/A51/E51
- HC153(B)T☐-A42/E42/A51/E51

[Unit:mm]





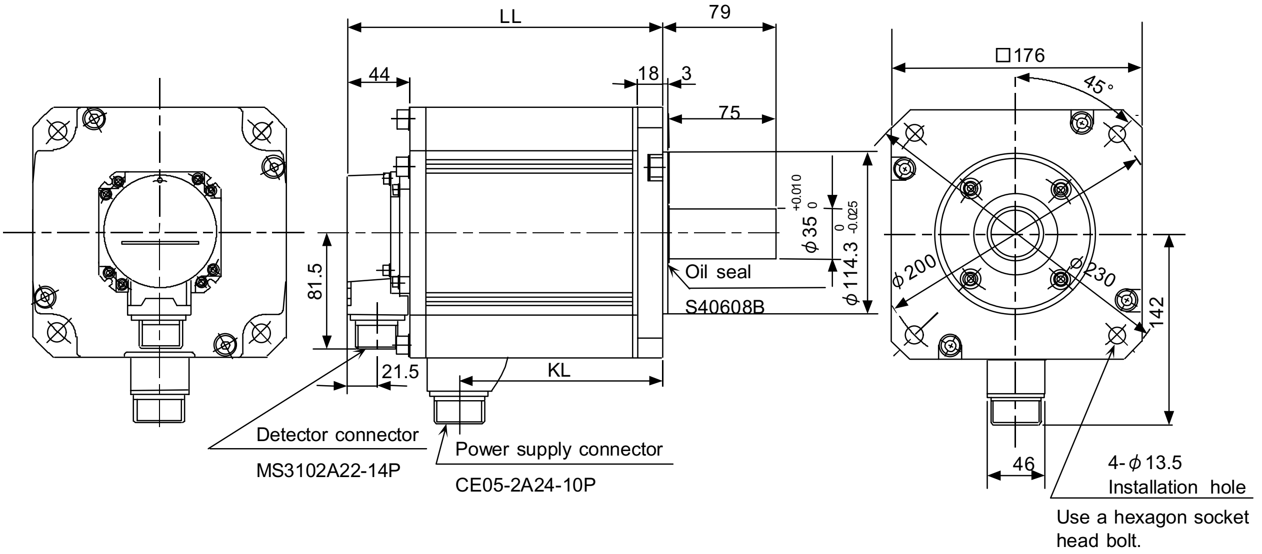
Servomotor type		LL (Note 1)	KL
2000r/min	3000r/min		
HC52(B)☐	HC53(B)☐	125 (158)	52
HC102(B)☐	HC103(B)☐	150 (183)	77
HC152(B)☐	HC153(B)☐	175 (208)	102

Note 1. The dimensions given in parentheses are for when magnetic brakes are provided.

Note 2. Use a friction coupling (Spun ring, etc.) to connect with the load.

- HC202S□-A42/E42/A51/E51
- HC352S□-A42/E42/A51/E51
- HC452S□-A42/E42/A51/E51
- HC203S□-A42/E42/A51/E51
- HC353S□-A42/E42/A51/E51

[Unit:mm]

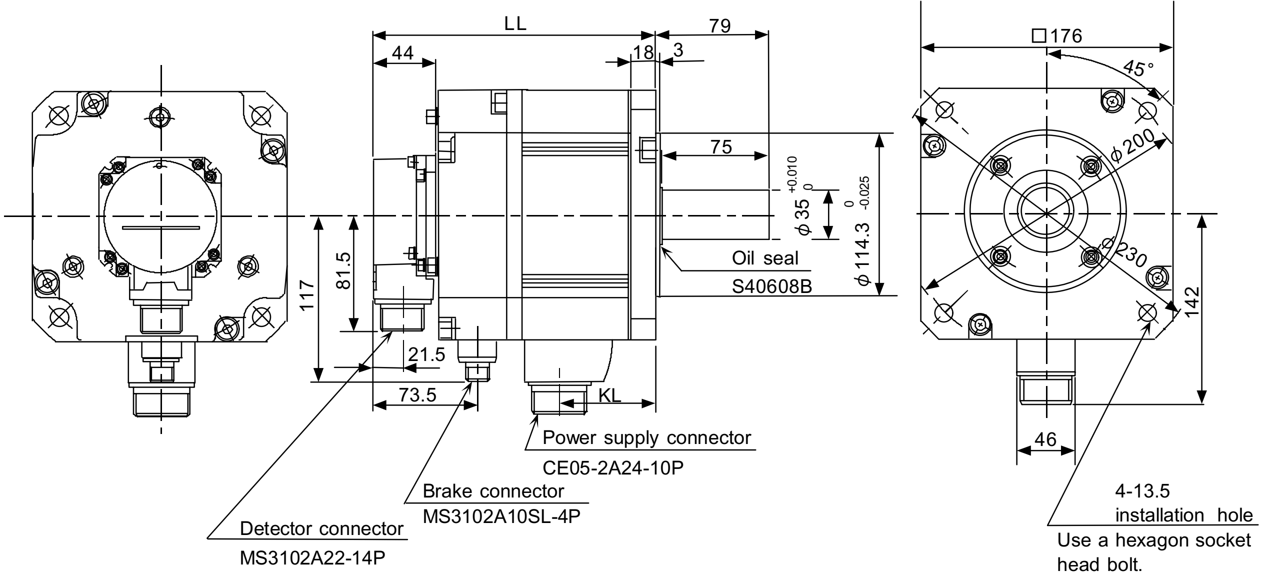


Servomotor type		LL	KL
2000r/min	3000r/min		
HC202S	HC203S	149.5	68.5
HC352S	HC353S	191.5	110.5
HC452S	—	233.5	152.5

Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.

- HC202BS□-A42/E42/A51/E51
- HC352BS□-A42/E42/A51/E51
- HC452BS□-A42/E42/A51/E51
- HC203BS□-A42/E42/A51/E51
- HC353BS□-A42/E42/A51/E51

[Unit:mm]

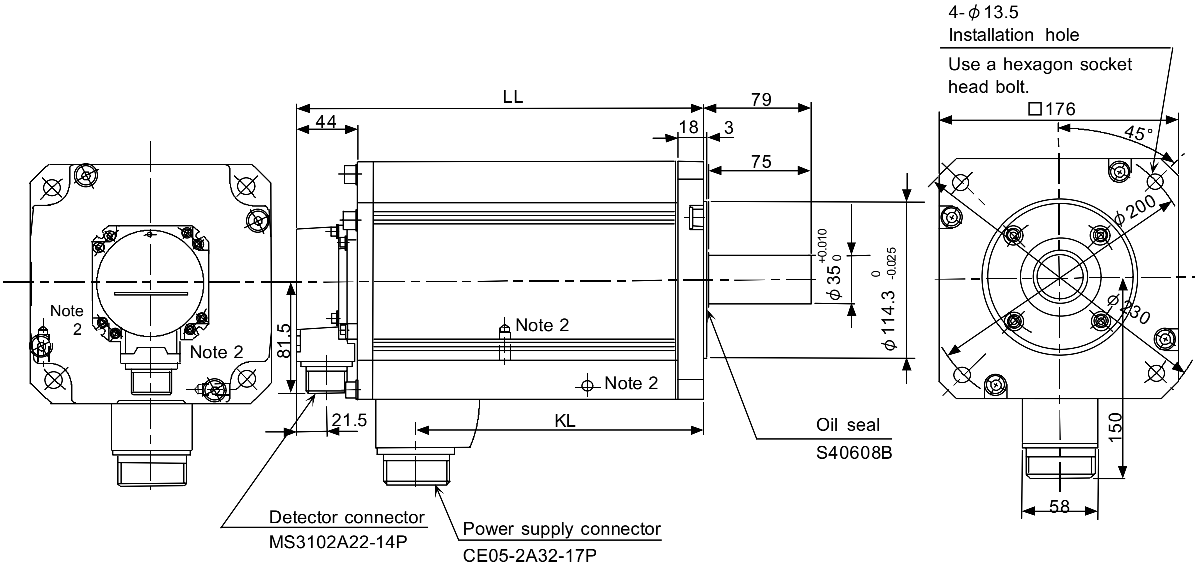


Servomotor type		LL	KL
2000r/min	3000r/min		
HC202BS	HC203BS	197.5	68.5
HC352BS	HC353BS	239.5	110.5
HC452BS	—	281.5	152.5

Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.

- HC702S☐-A42/E42/A51/E51
- HC453S☐-A42/E42/A51/E51
- HC703S☐-A42/E42/A51/E51

[Unit:mm]

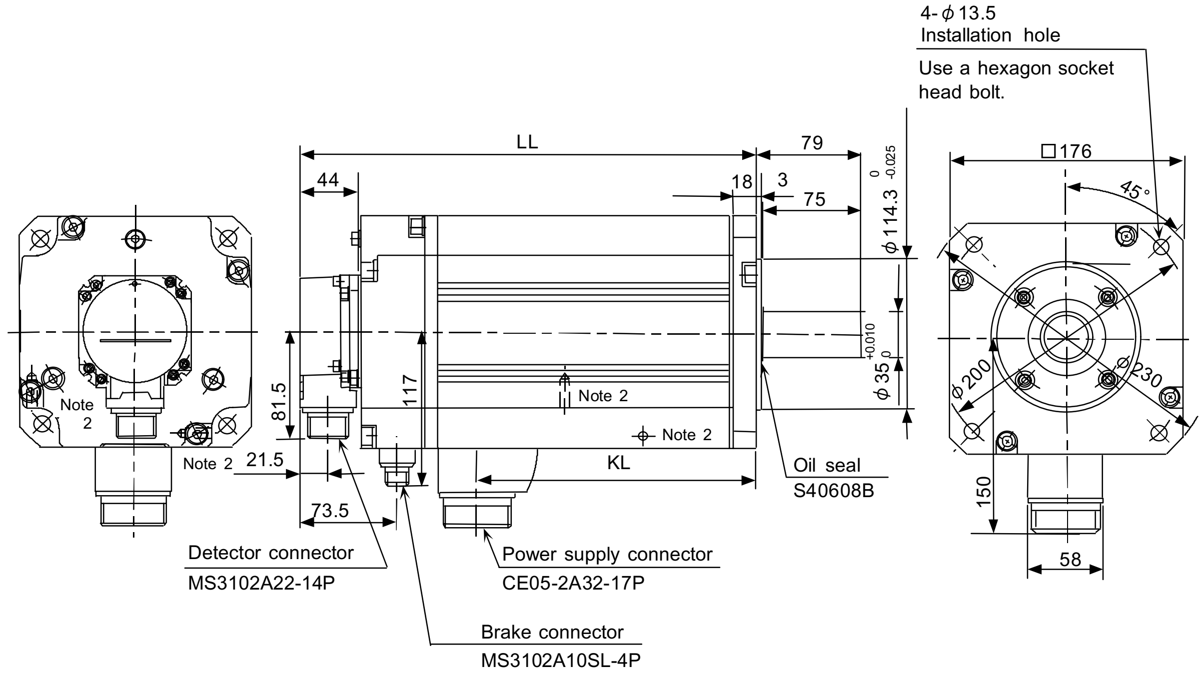


Servomotor type		LL	KL
2000r/min	3000r/min		
—	HC453S	233.5	147.5
HC702S	HC703S	296.5	210.5

Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. For HC702S and HC703S type motors. There is no bolt hole (M8) for the suspension bolt on the HC453S type motor.

- HC702BS☐-A42/E42/A51/E51
- HC453BS☐-A42/E42/A51/E51
- HC703BS☐-A42/E42/A51/E51

[Unit:mm]

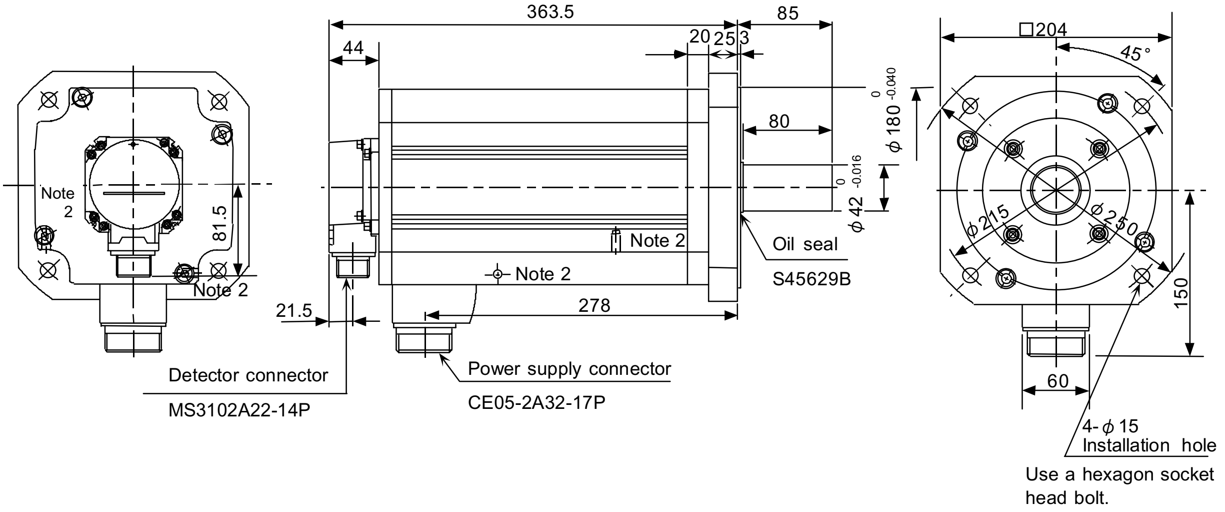


Servomotor type		LL	KL
2000r/min	3000r/min		
—	HC453BS	281.5	147.5
HC702BS	HC703BS	344.5	210.5

Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. For HC702BS and HC703BS type motors. There is no bolt hole (M8) for the suspension bolt on the HC453BS type motor.

- HC902S☐-A42/E42/A51/E51

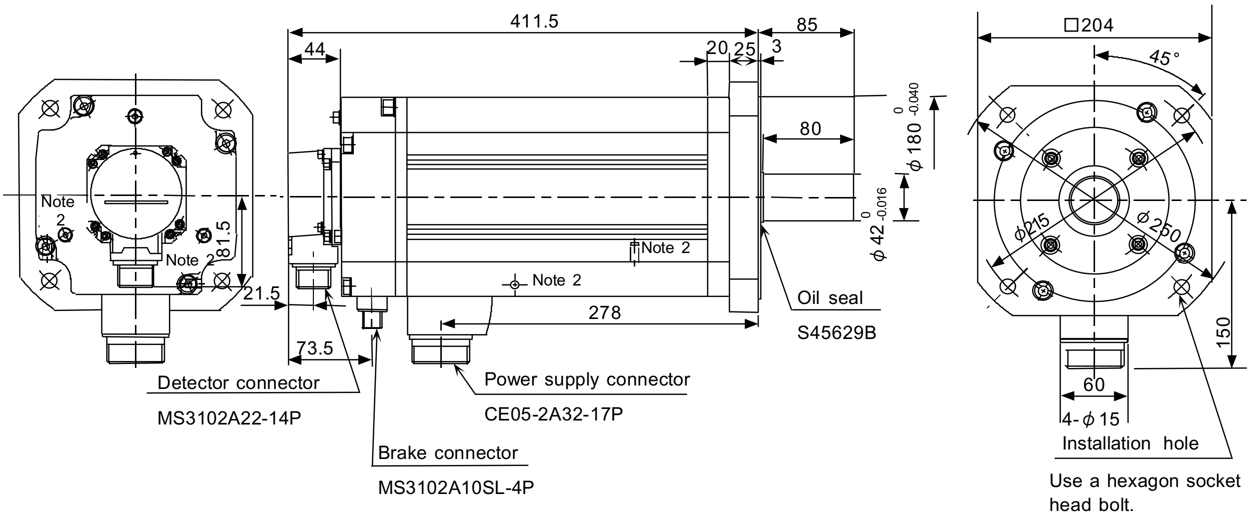
[Unit:mm]



Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. This is the bolt hole (M8) for the suspension bolt.

- HC902BS☐-A42/E42/A51/E51

[Unit:mm]



Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. This is the bolt hole (M8) for the suspension bolt.

4-7 Installation of servomotor

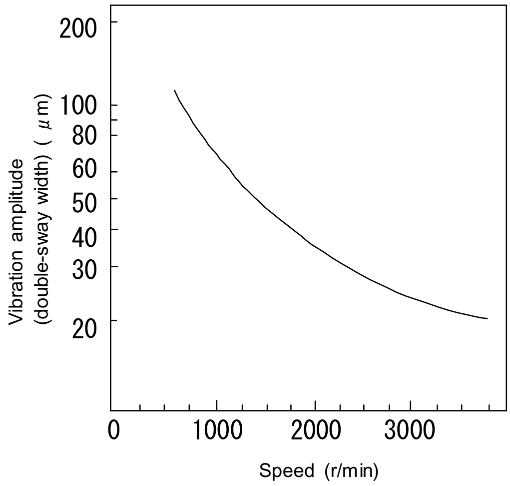
⚠ CAUTION

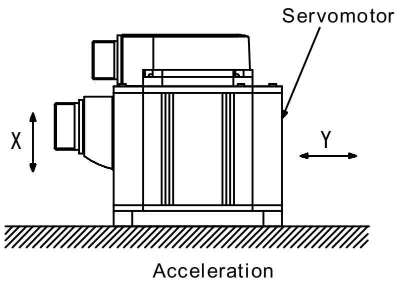
1. Do not hold the cables, axis or detector when transporting the servomotor. Failure to observe this could lead to faults or injuries.
2. Securely fix the servomotor to the machine. Insufficient fixing could lead to the servomotor deviating during operation. Failure to observe this could lead to injuries.
3. When coupling to a servomotor shaft end, do not apply an impact by hammering, etc. The detector could be damaged.
4. Never touch the rotary sections of the servomotor during operations. Install a cover, etc., on the shaft.
5. Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could break.

4-7-1 Environmental conditions

Environment	Conditions	
Ambient temperature	0°C to +40°C (with no freezing)	
Ambient humidity	80% RH or less (with no dew condensation)	
Storage temperature	–15°C to +70°C (with no freezing)	
Storage humidity	90% RH or less (with no dew condensation)	
Atmosphere	• Indoors (Where unit is not subject to direct sunlight) • With no corrosive gas or combustible gas, dust	
Vibration	HC52/102/152 HC53/103/153	X: 9.8 m/sec^2 (1G) or less Y: 24.5m/sec^2 (2.5G) or less
	HC202/352 HC203/353	X: 19.6 m/sec^2 (2G) or less Y: 49 m/sec^2 (5G) or less
	HC452/702 HC453/703	X: 11.7 m/sec^2 (1.2G) or less Y: 24.5 m/sec^2 (2.5G) or less
	HC902	X: 9.8 m/sec^2 (1G) or less Y: 24.5 m/sec^2 (2.5G) or less

The vibration conditions are as shown below.





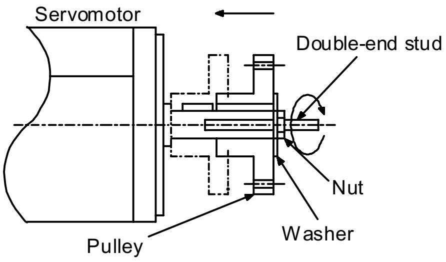
4-7-2 Cautions for mounting load (prevention of impact on shaft)

① When using the servomotor with key way, use the screw hole at the end of the shaft to mount the pulley onto the shaft. To install, first place the double-end stud into the shaft screw holes, contact the coupling end surface against the washer, and press in as if tightening with a nut. When the shaft does not have a key way, use a frictional coupling, etc.

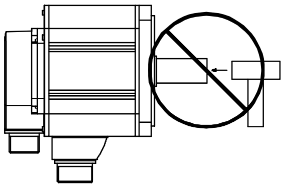
② When removing the pulley, use a pulley remover, and make sure not to apply an impact on the shaft.

③ Install a protective cover on the rotary sections such as the pulley installed on the shaft to ensure safety.

④ The direction of the detector installation on the servomotor cannot be changed.



⚠ **CAUTION** Never hammer the end of the shaft during assembly.



4-7-3 Tolerable load of axis

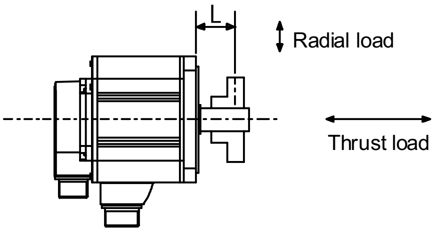
① Use a flexible coupling, and keep the shaft core deviation to below the tolerable radial load of the axis.

② When using a pulley, socket and timing belt, select so that the load is within the tolerable radial load.

③ Do not use a rigid coupling as an excessive bending load will be applied on the shaft and could cause the shaft to break.

Servomotor	Tolerable radial load	Tolerable thrust load
HC52T/102T/152T HC53T/103T/153T	392N (40kgf), L=55	490N (50kgf)
HC52S/102S/152S HC53S/103S/153S	980N (100kgf), L=55	490N (50kgf)
HC202S/352S/452S/702S HC203S/353S/453S/703S	2058N (210kgf), L=79	980N (100kgf)
HC902	2450N (250kgf), L=85	980N (100kgf)

Caution: The symbols in the table follow the drawing below.



L : Length from flange isntallation surface to center of load weight [mm]

4-7-4 Oil and waterproofing measures

As a discrete unit, HC motors satisfy the IP65 (dustproof/jet-proof type) protection type for IEC standards.

IP65 test details (reference)

(1) Protection IP×6 against foreign solid matter: Must be dustproof type, with no dust infiltration.

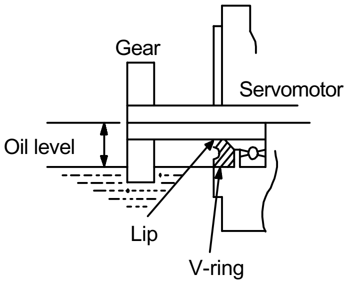
(2) Protection IP×5 against water infiltration: Protection from jets of water from all directions. (Application of a jet of water in all directions from a distance of 3m. Flow rate of 12.5 liters/min., 30kPa of pressure, for 3 min.)

Note that the following precautions must be taken when actually using the motor.

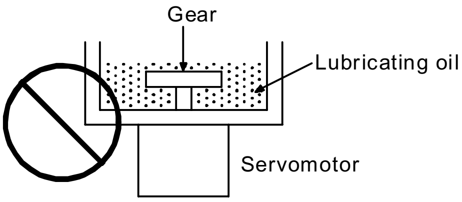
① Take all possible precautions so that oil and water do not fall on the servomotor. This also applies to the IP65 HC motors.

② When the gearbox is installed horizontally, make sure the oil level height from the center of the shaft is higher than the values given in the following table.
If the oil surface is higher than the oil seal lip, oil will infiltrate into the motor, and lead to failure.
Open a breathing hole in the gearbox so that the internal pressure does not rise.

Servomotor	Oil level (mm)
HC52/102/152 HC53/103/153	20
HC202/352/452/702 HC203/353/453/703	25
HC902	30



③ When installing on the top of the shaft end, make sure that oil from the gear box, etc., does not enter the servomotor.



④ Do not remove the detector from HC motors. (The detector installation screws have been sealed.)

⑤ When installing the servomotor horizontally, set the power cable and detector cable to face downward.
When installing vertically or on an inclination, provide a cable trap.

⑥ Do not use the unit with the cable submerged in oil or water.

4-7-5 Installation direction

There are no restrictions on the installation direction. Installation in any direction is possible, but as a standard the servomotor is installed so that the motor power supply wire and detector cable cannon plugs (lead-in wires) face downward. When the servomotor is not installed in the standard direction, refer to section "Oil and waterproofing measures" and take the appropriate measures.
The brake plates may make a sliding sound when a servomotor with magnetic brake is installed with the shaft facing upward, but this is not a fault.

Chapter 5 MDS-B-Vx4 Servo Drive

⚠ **CAUTION** Only OSA and OSE-type serial encoders are compatible with semi-closed end (motor end) detectors. Note that semi-closed end detectors are not compatible with OHE and OHA-type pulse encoders.

5-1 Type configuration

5-1-1 1-axis servo drive unit

MDS – B – V14 – ☐

Capacity class symbol	01	03	05	10	20	35	45	70	90
Capacity (kW)	0.1	0.3	0.5	1.0	2.0	3.5	4.5	7.0	9.0

5-1-2 2-axis servo drive unit

MDS – B – V24 – ☐ ☐

M axis servo drive capacity class

L axis servo drive capacity class

Capacity class symbol	01	03	05	10	20	35	45
Capacity (kW)	0.1	0.3	0.5	1.0	2.0	3.5	4.5

5-2 List of specifications

Amplifier type	MDS-B-V14-								
Capacity class symbol	01	03	05	10	20	35	45	70	90
Output voltage	155								
Continuous output current (Arms)	1.4	3.0	5.0	8.8	18.2	25.0	44.0	55.0	68.0
Max. output current (Arms)	3.9	8.1	17.0	28.0	42.0	57.0	85.0	113	141
Control method	Sine wave PWM method								
Main current method	Transistor and inverter (Intelligent power module using IGBT)								
Braking	Dynamic brakes and deceleration stop								
Tolerable load inertia	As a guideline, 2.5-times the motor inertia								
Tolerable ambient temperature	0°C to 55°C (with no freezing)								
Tolerable ambient humidity	90%RH or less (with no dew condensation)								
Storage temperature	−15°C to 70°C (with no freezing)								
Storage humidity	90%RH or less (with no dew condensation)								
Atmosphere	Indoors (where unit is not subject to direct sunlight) With no corrosive gas, combustible gas, oil mist, or dust.								
Tolerable vibration	0.5G								
Tolerable impact	Acceleration of 5G when packed.								
Max. heat generation (W)	∗26	∗32	∗45	∗65	104	150	208	318	370
Weight (kg)	3.5	3.5	3.5	4.5	4.5	4.5	6.0	7.0	7.0
Capacity (kW)	0.1	0.3	0.5	1.0	2.0	3.5	4.5	7.0	9.0
Torque limit range	0 to 100%								
Noise dB(A)	Less than 55dB								

(Note 1) The amount of heat generation is the value at the rated output.

(Note 2) Use the following formula as a guideline for the amount of outside panel heat generation when installing a sealed type unit.

Amount of outside panel heat generation =
(Amount of heat generation in list of specifications above − 15) × 0.85

Note that unit types in the list of specifications above indicated by an asterisk (∗) do not have fins, thus the amount of heat generation is completely inside the panel.

(Note 3) Heat can easily accumulate due to the structure of each unit. Thus, install a fan in the top of the power distribution panel to disperse the heat from the top of the unit. (Wind speed: 2m/sec. or more)

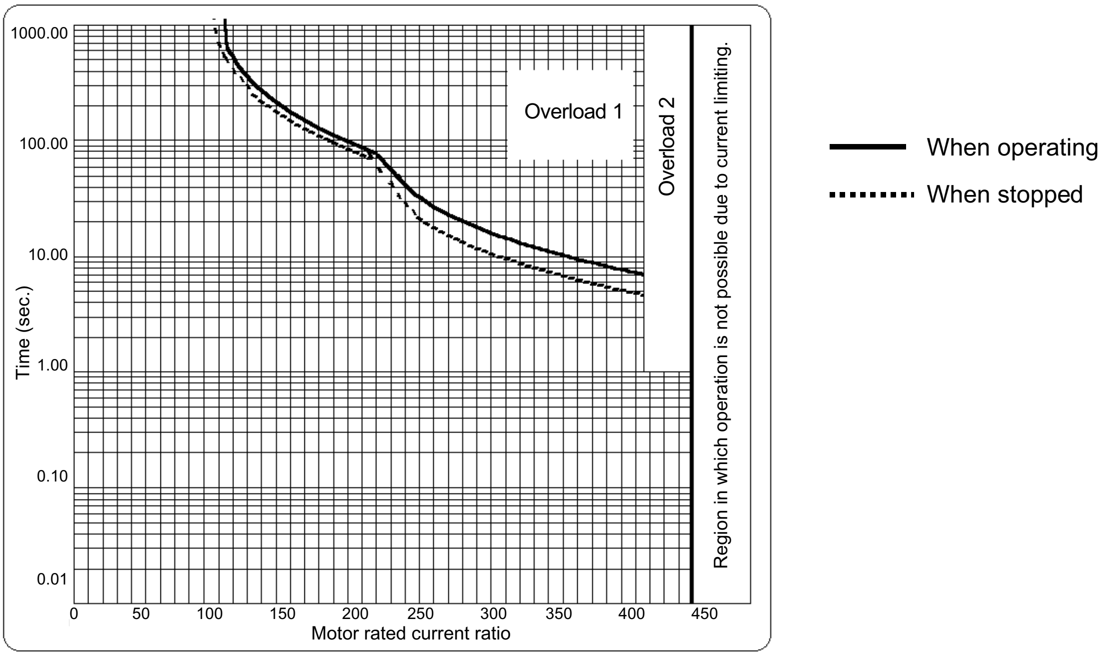
Amplifier type	MDS-B-V24-						
Capacity class symbol	0101	0301	0303	0501	0503	0505	1005
Continuous output current (Arms)	(L) 1.4 (M) 1.4	(L) 3.0 (M) 1.4	(L) 3.0 (M) 3.0	(L) 5.0 (M) 1.4	(L) 5.0 (M) 3.0	(L) 5.0 (M) 5.0	(L) 8.8 (M) 5.0
Max. output current (Arms)	(L) 3.9 (M) 3.9	(L) 8.1 (M) 3.9	(L) 8.1 (M) 8.1	(L) 17.0 (M) 3.9	(L) 17.0 (M) 8.1	(L) 17 (M) 17	(L) 28.0 (M) 17.0
Max. heat generation (W)	46	49	52	62	65	78	98
Weight (kg)	4.5	4.5	4.5	4.5	4.5	4.5	5.5
Capacity (kW)	0.1+0.1	0.3+0.1	0.3+0.3	0.5+0.1	0.5+0.3	0.5+0.5	1.0+0.5

Amplifier type	MDS-B-V24-							
Capacity class symbol	1010	2010	2020	3510	3520	3535	4520	4535
Continuous output current (Arms)	(L) 8.8 (M) 8.8	(L)18.2 (M) 8.8	(L)18.2 (M)18.2	(L) 25.0 (M)8.8	(L)25.0 (M)18.2	(L)25.0 (M)25.0	(L)44.0 (M)18.2	(L)44.0 (M)25.0
Max. output current (Arms)	(L)28.0 (M)28.0	(L)42.0 (M)28.0	(L)42.0 (M)42.0	(L)57.0 (M)28.0	(L)57.0 (M)42.0	(L)57.0 (M)57.0	(L)85.0 (M)42.0	(L)85.0 (M)57.0
Max. heat generation (W)	117	178	202	215	241	293	300	345
Weight (kg)	5.5	5.5	5.5	6.0	6.0	6.0	6.0	6.0
Capacity (kW)	1.0+1.0	2.0+1.0	2.0+2.0	3.5+1.0	3.5+2.0	3.5+3.5	4.5+2.0	4.5+3.5

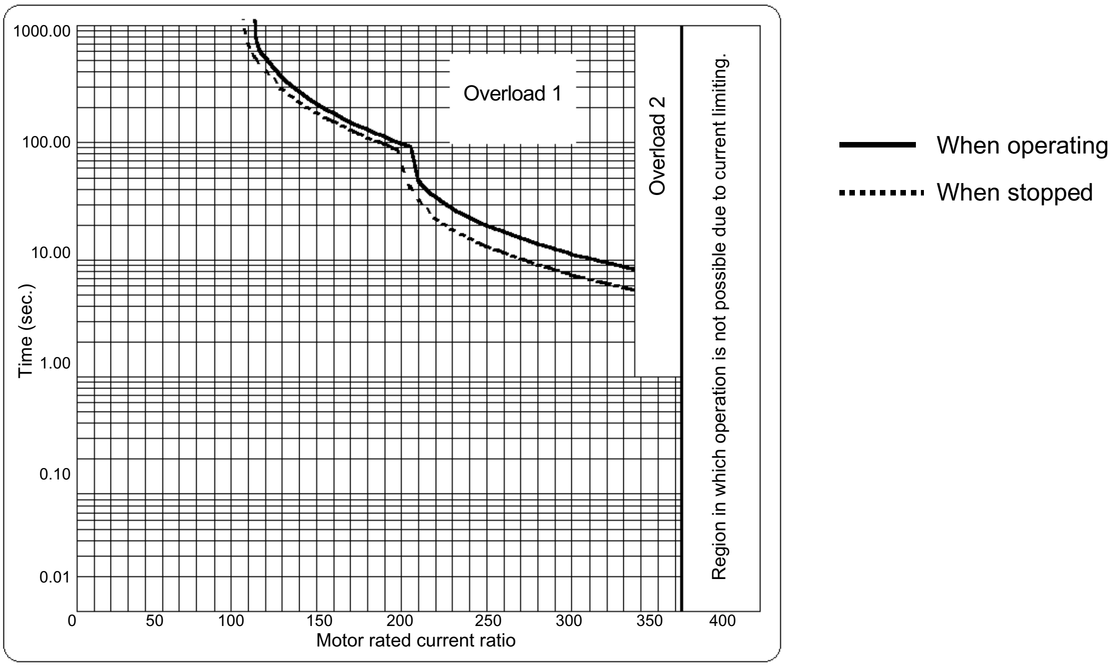
5-3 Overload protection characteristics

The servo amplifier has an electronic thermal to protect the servomotor and servo amplifier from overloads. The operation characteristics of the electronic thermal are shown below.
If an overload operation over the electronic thermal protection curve shown below is carried out, overload 1 (alarm 50) will occur. If 95% or higher of the maximum current continuously flows for one second or more due to a machine collision, etc., overload 2 (alarm 51) will occur.

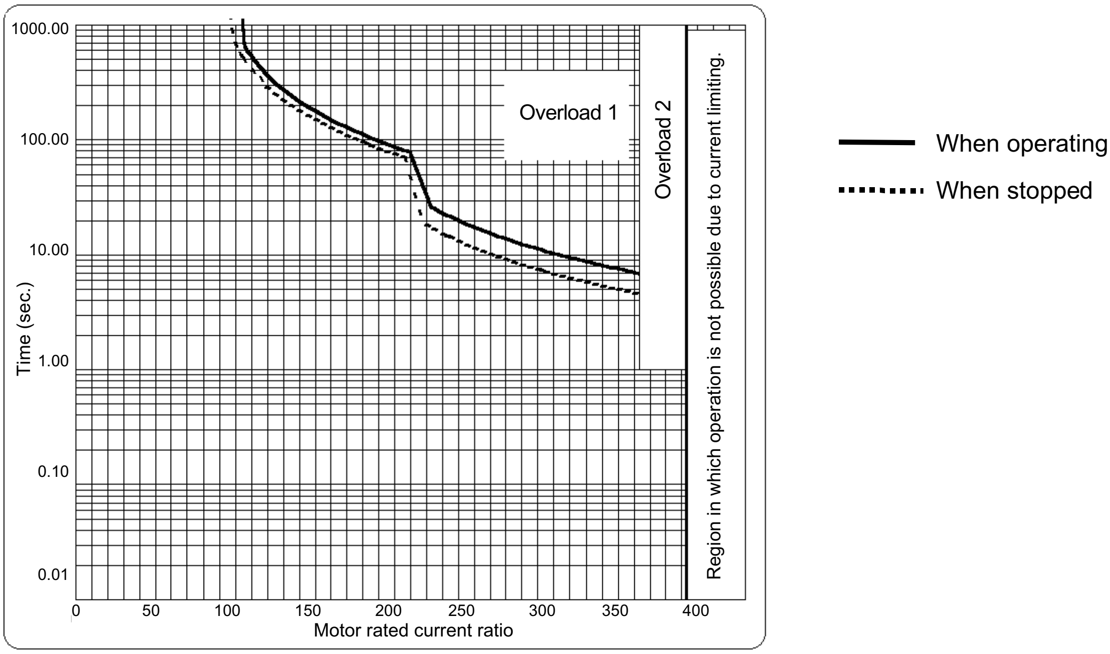
Motor used : HC52
Amplifier used : MDS-B-V14-05



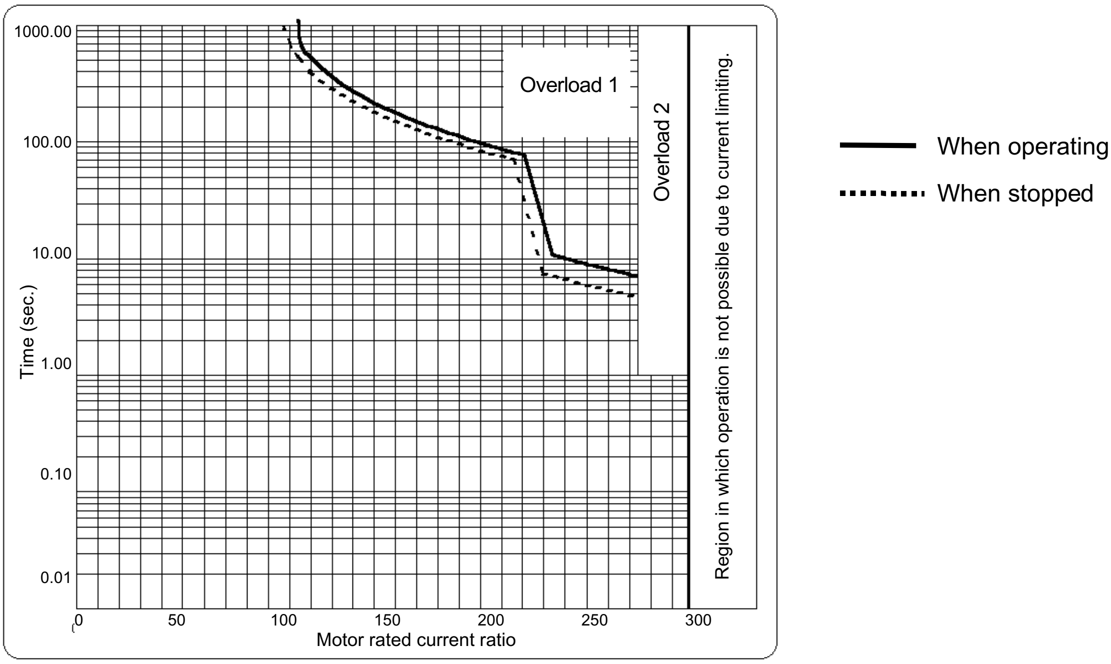
Motor used : HC53
Amplifier used : MDS-B-V14-05



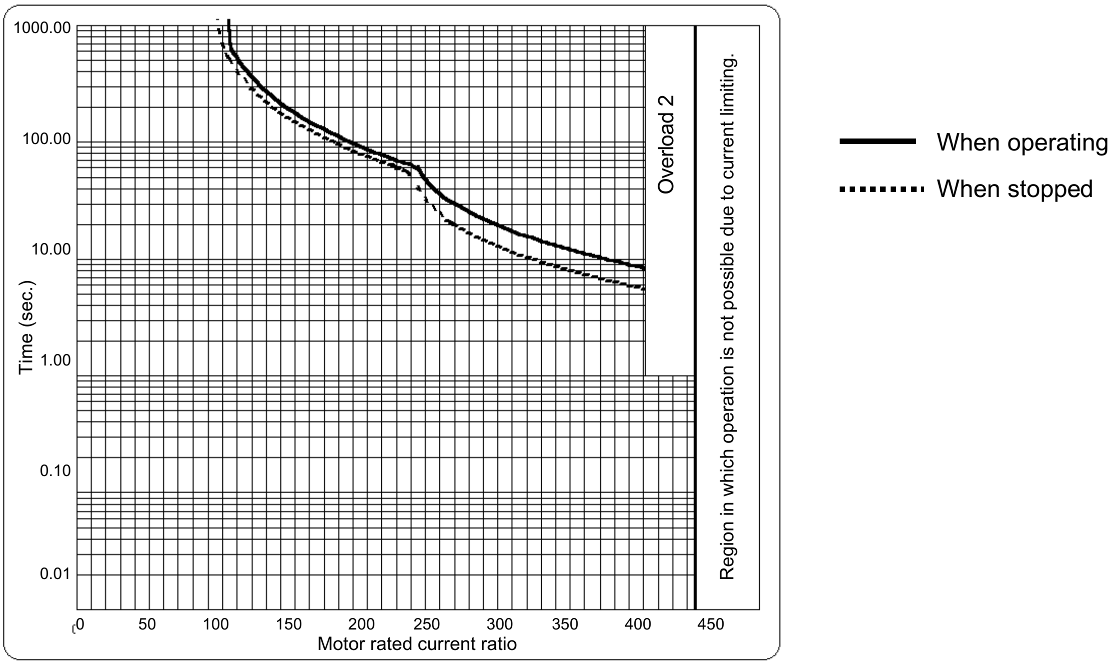
Motor used : HC102
Amplifier used : MDS-B-V14-10



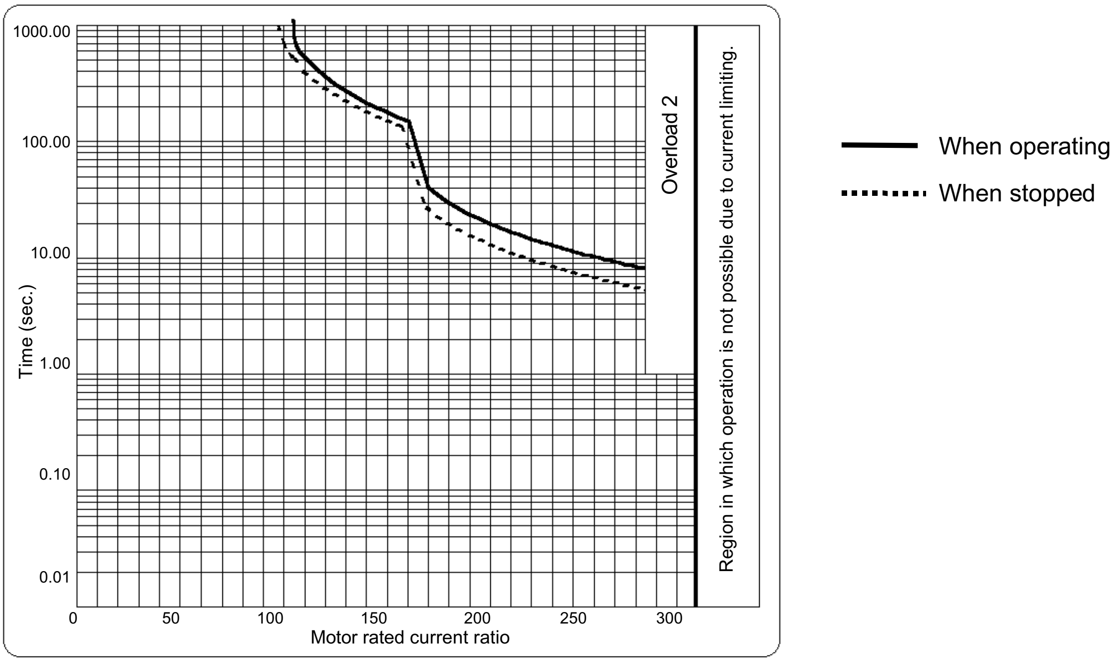
Motor used : HC103
Amplifier used : MDS-B-V14-10



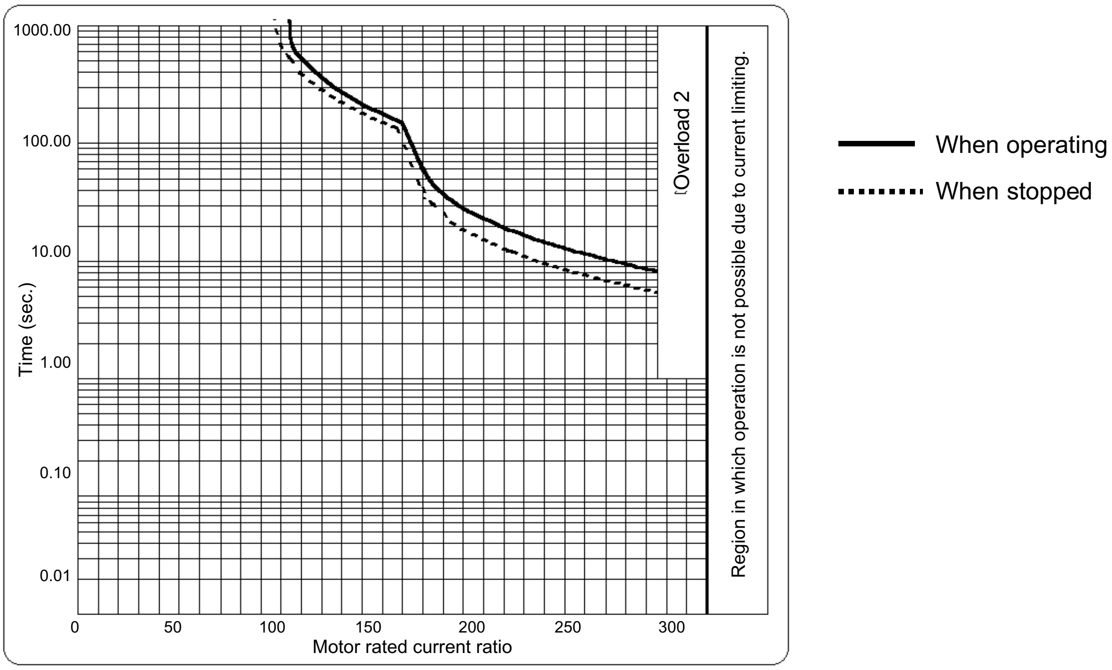
Motor used : HC152
Amplifier used : MDS-B-V14-20



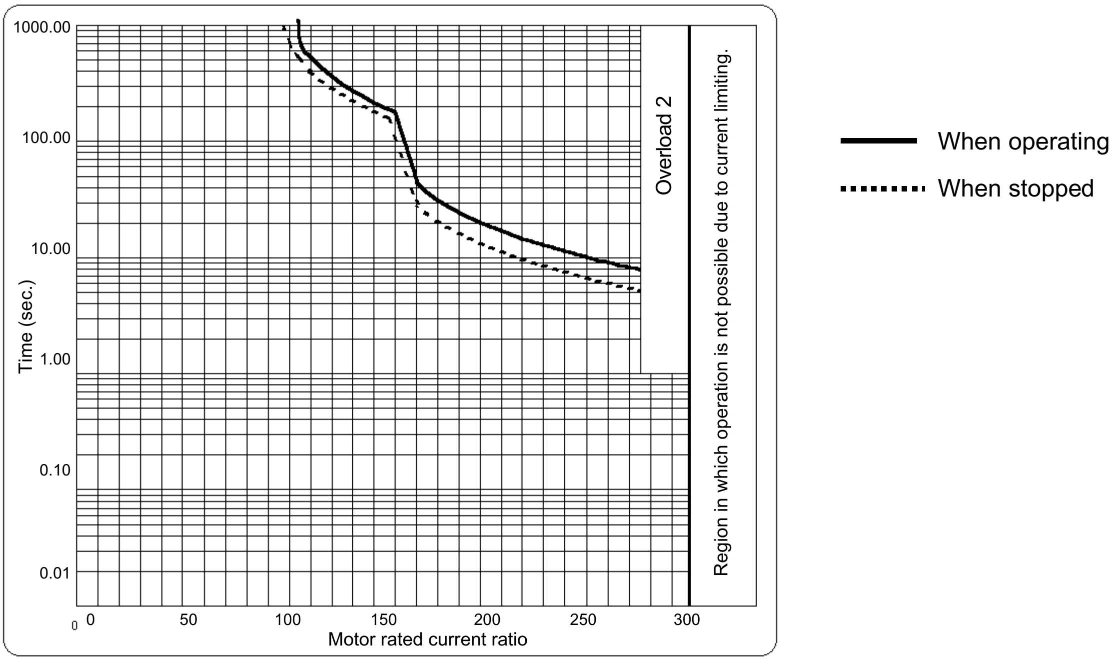
Motor used : HC153
Amplifier used : MDS-B-V14-20



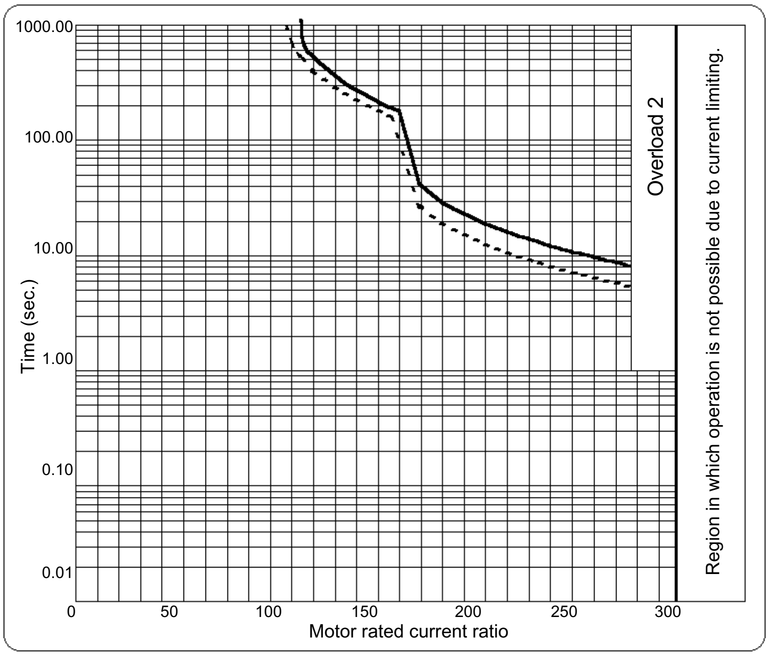
Motor used : HC202
Amplifier used : MDS-B-V14-20



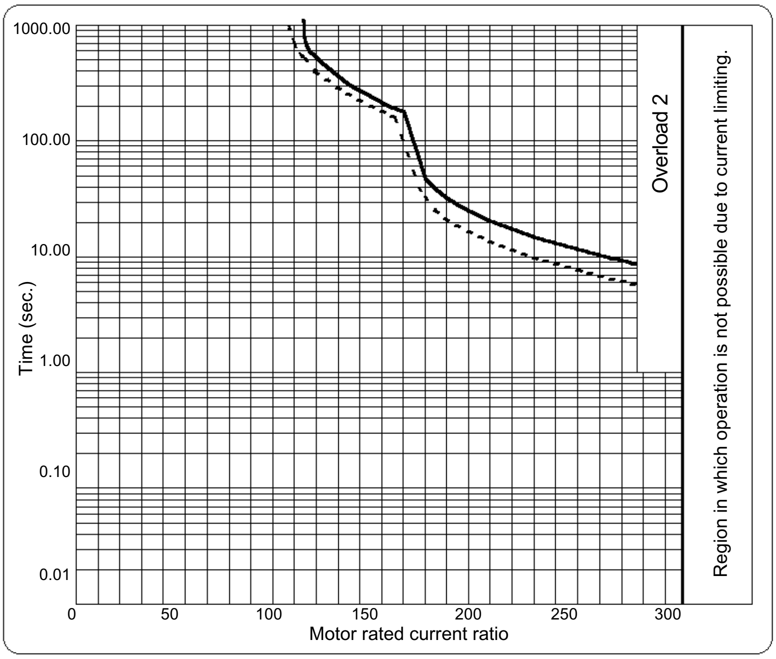
Motor used : HC203
Amplifier used : MDS-B-V14-35



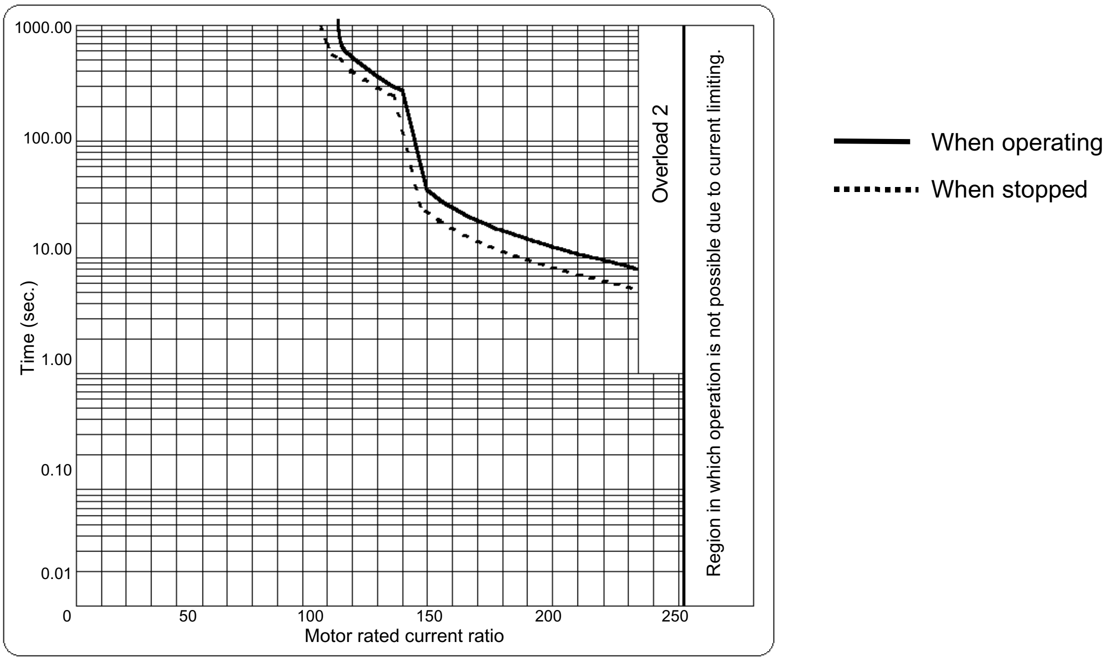
Motor used : HC352
Amplifier used : MDS-B-V14-35



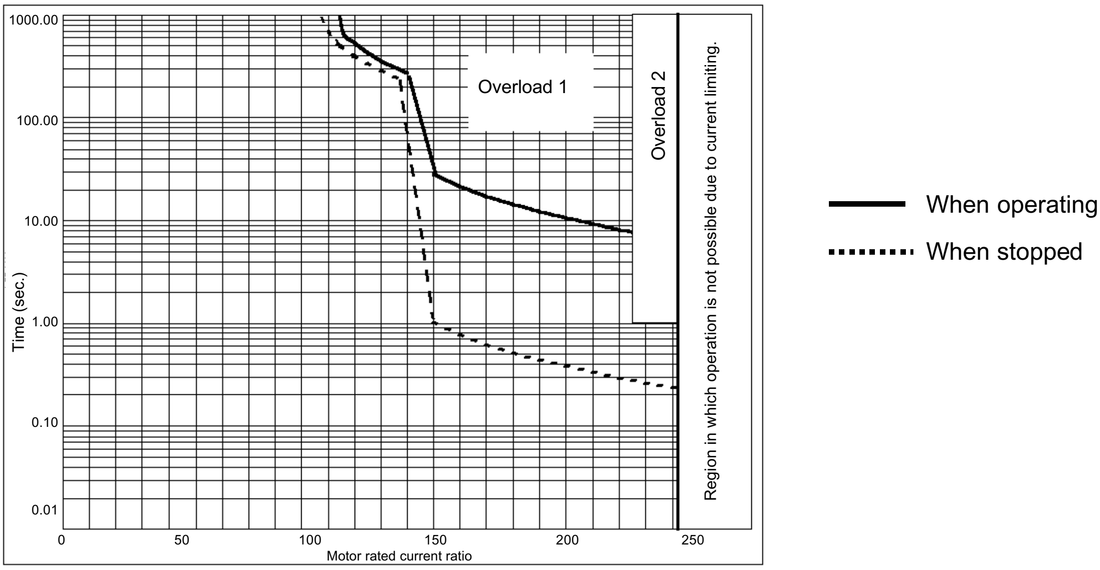
Motor used : HC353
Amplifier used : MDS-B-V14-45



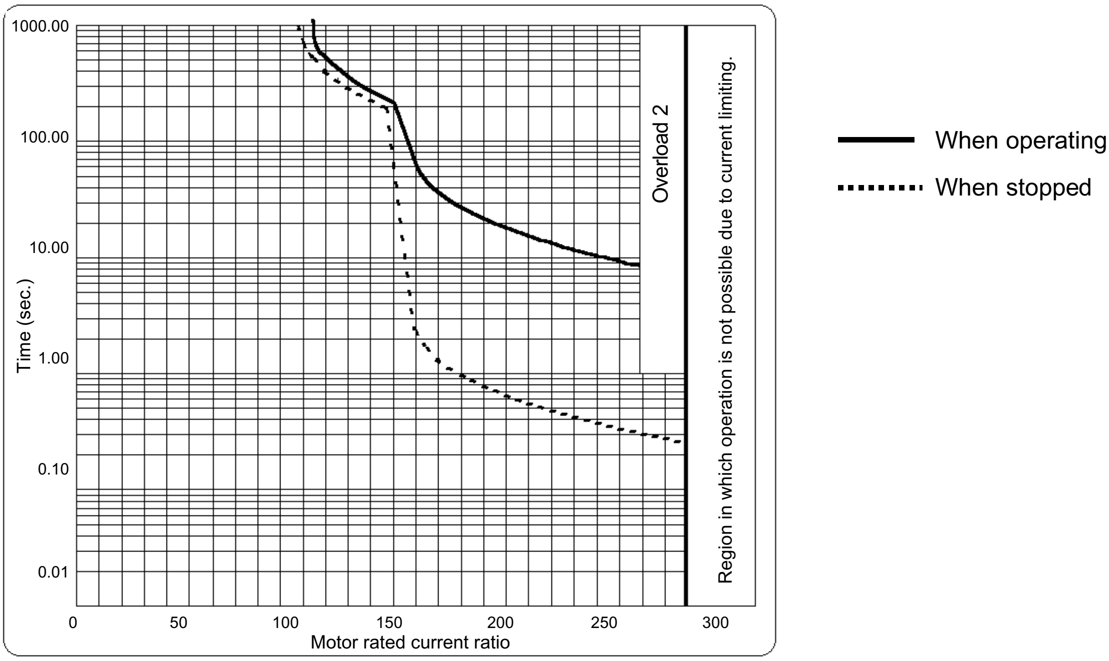
Motor used : HC452
Amplifier used : MDS-B-V14-45



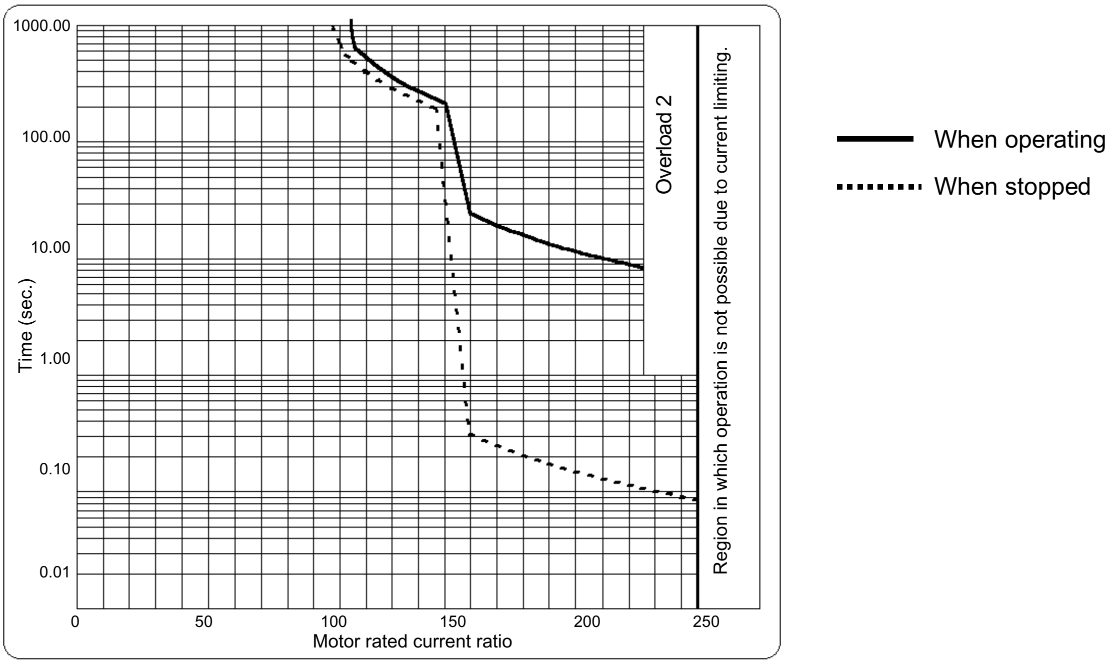
Motor used : HC453
Amplifier used : MDS-B-V14-70



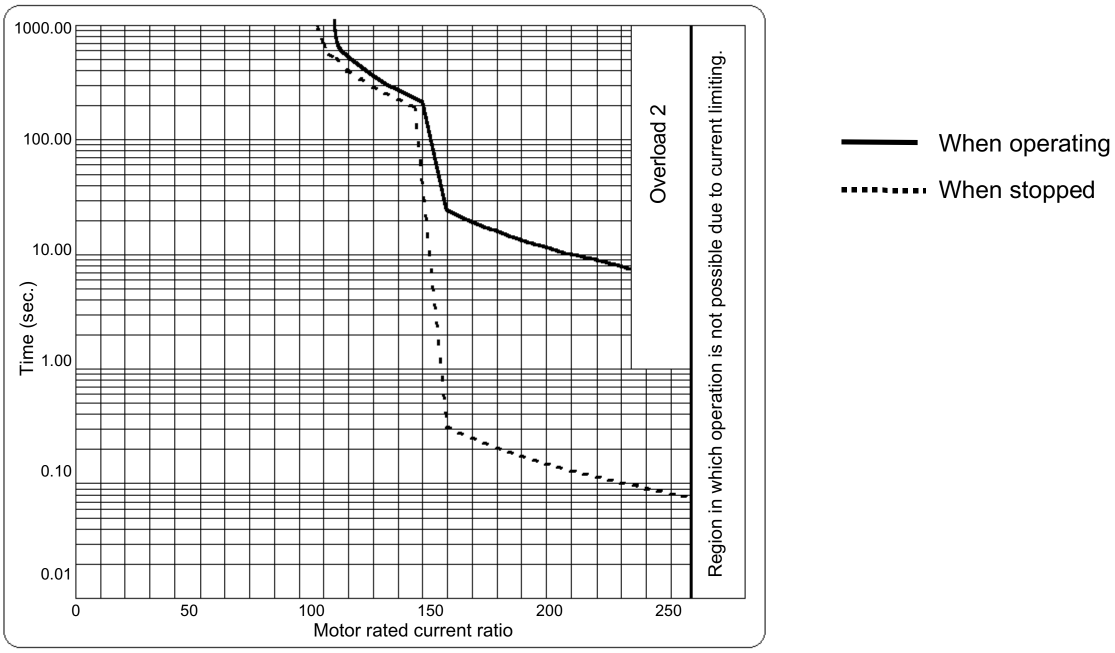
Motor used : HC702
Amplifier used : MDS-B-V14-70



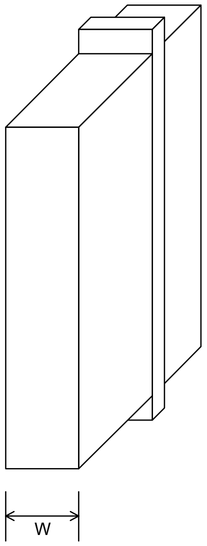
Motor used : HC703
Amplifier used : MDS-B-V14-90



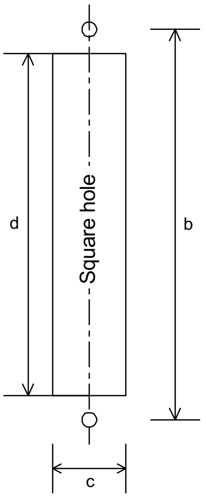
Motor used : HC902
Amplifier used : MDS-B-V14-90



5-4 Outline dimensions

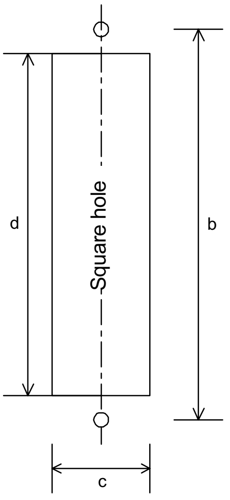


(Front view)



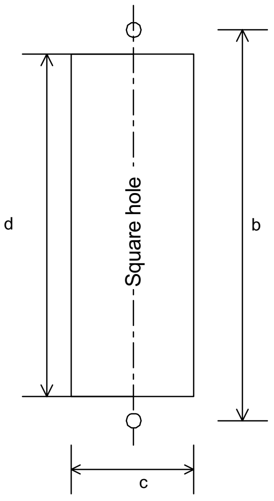
W = 60

(Installation)



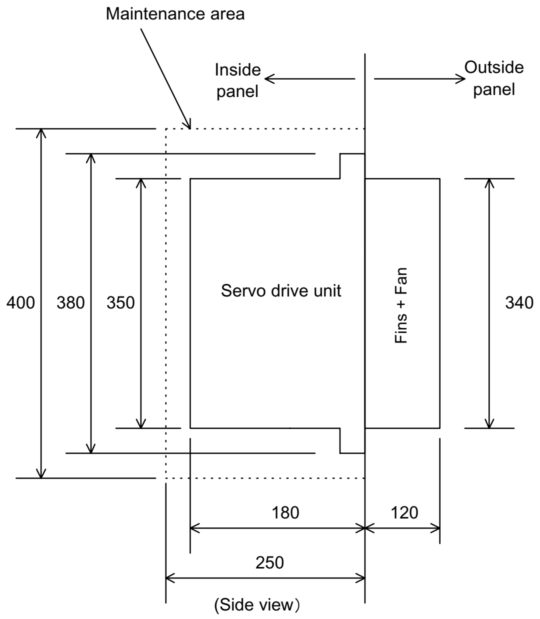
W = 90, 120

(Installation)



W = 150

(Installation)

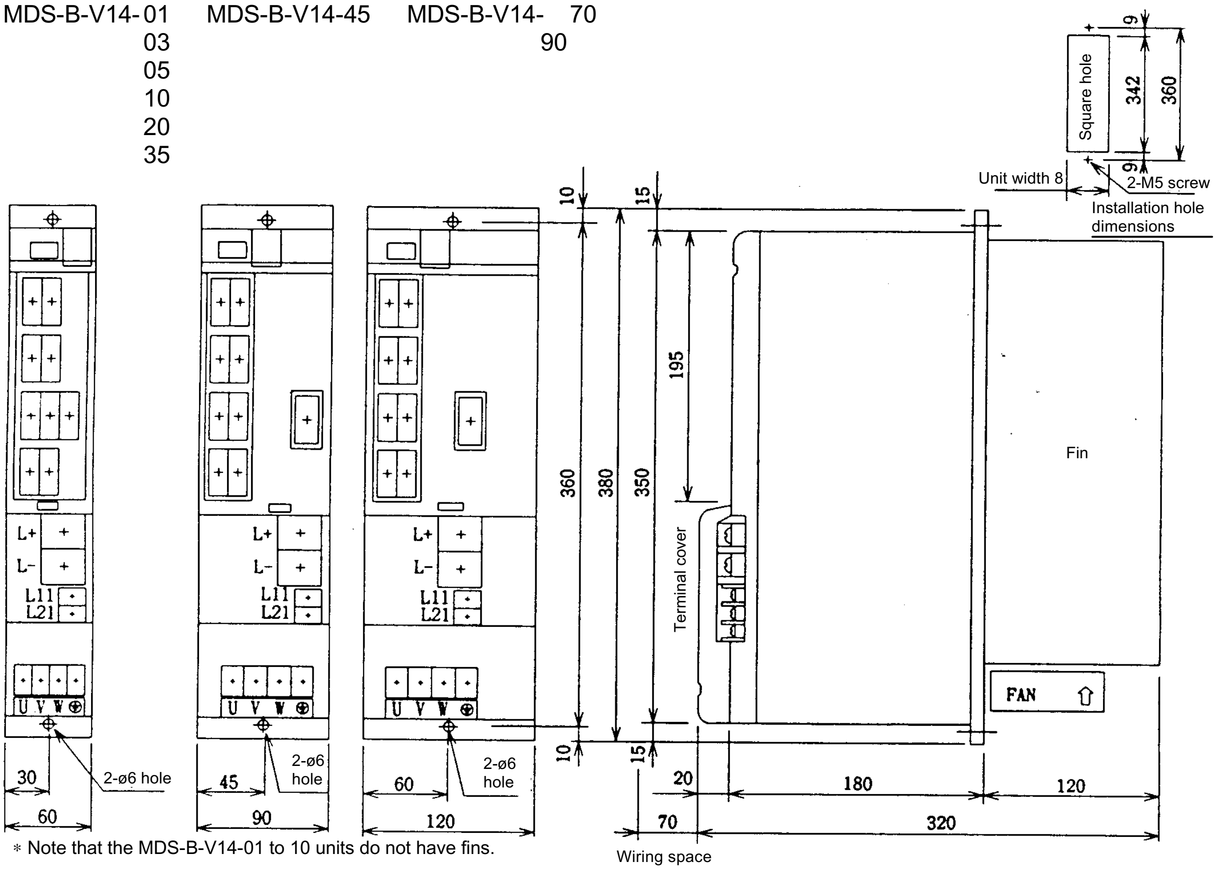


(Side view)

(Note) The outline dimension A0 type units shown in section "2-2 List of units and compatible motors" do not have a fin or fan section.

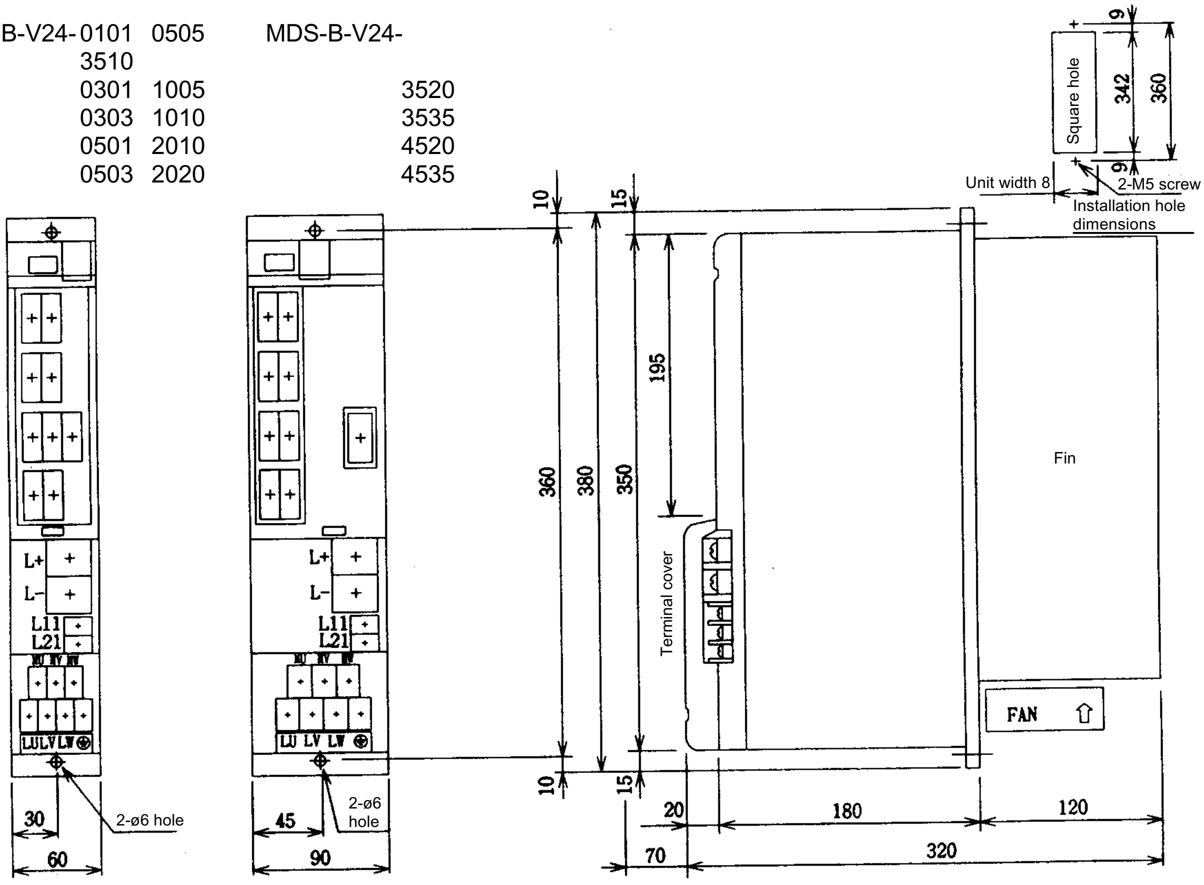
Capacity	**Servo drive unit**					
	1-axis				**2-axis**	
	~ 3.5kW	**4.5kW**	**7 ~ 9kW**	**11 ~ 15kW**	**~ 2kW × 2**	**~ 4.5kW+3.5kW**
W	60	90	120	150	60	90
b	360	360	360	360	360	360
c	52	82	112	142	52	82
d	342	342	342	342	342	342

MDS-B-V14-01 03 05 10 20 35	MDS-B-V14-45	MDS-B-V14- 70 90



∗ Note that the MDS-B-V14-01 to 10 units do not have fins.

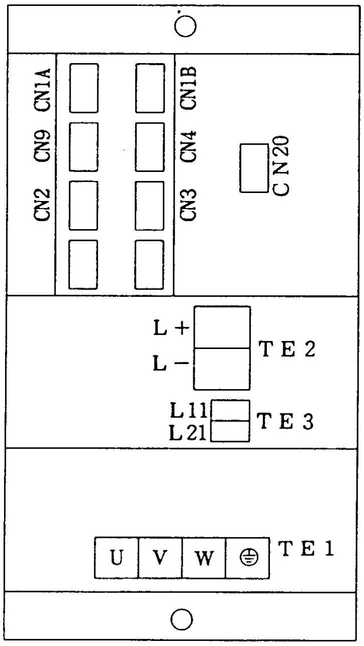
MDS-B-V24-0101 0505 3510 0301 1005 0303 1010 0501 2010 0503 2020	MDS-B-V24- 3520 3535 4520 4535



∗ Note that the MDS-B-V24-0101 to 1010 units do not have fins.

5-5 Explanation of connectors and terminal blocks

		Name	Application	Remarks
Connector		CN1A	For connection with the CNC and master axis.	
		CN1B	For connection with the battery unit and slave axis.	
		CN9	For maintenance (normally not used).	
		CN4	For connection with the power supply.	
		CN2	For connection with the motor end detector.	
		CN3	For connection with the machine end detector.	
		CN20	External brake output contact	
Terminal block	TE2	L+	Converter voltage input (+)	
		L–	Converter voltage input (–)	
	TE3	L11 L21	200VAC single phase input	
	TE1	U	Motor drive U-phase output	
		V	Motor drive V-phase output	
		W	Motor drive W-phase output	



5-6 Installation of the servo amplifier

5-6-1 Unit installation

The unit is installed in the same manner as the MDS-B-V1/V2 units.
Refer to the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B), Section 3. Unit installation" for details.

5-6-2 Connection of each unit

The units are connected in the same manner as the MDS-B-V1/V2 units.
Refer to the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B), Section 4. Connection of each unit" for details.

5-7 Connector and cable specifications

The connector and cable specifications are the same as those for the MDS-B-V1/V2 units.
Refer to the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B), Section 5. Connector and cable specifications" for details.

⚠ **CAUTION** Only OSA and OSE-type serial encoders are compatible with semi-closed end (motor end) detectors. Note that semi-closed end detectors are not compatible with OHE and OHA-type pulse encoders.

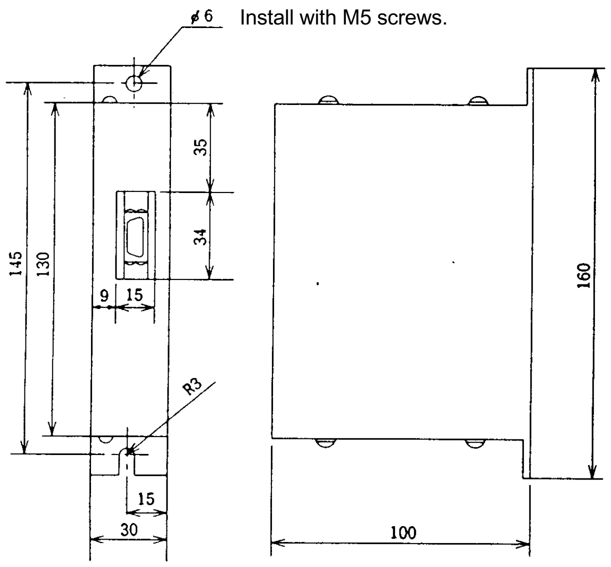
5-8 Battery unit

The following battery unit is required for an absolute position system.

5-8-1 Connection of the battery unit

The battery unit is connected in the same manner as the MDS-B-V1/V2 units.
Refer to the "MELDAS AC Servo and Spindle, MDS-A Series/MDS-B Series Specification Manual (BNP-B3759B), Section 4.6. Connection of the battery unit" for details.

5-8-2 Battery unit outline dimensions



Install with M5 screws.

MDS-A-BT-2
4
6
8

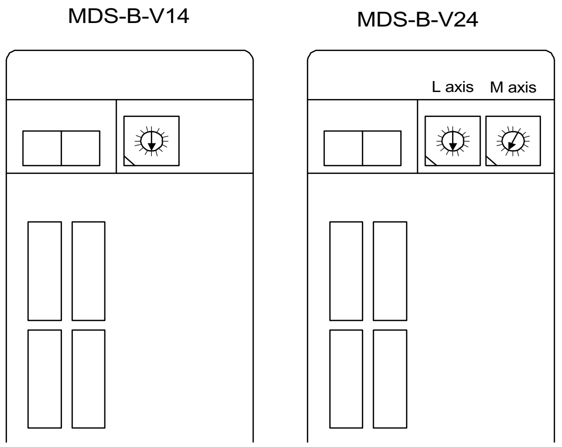
∗ Common for both the MDS-A Series and MDS-B Series.

Chapter 6 Setup

6-1 Initial setup of servo drive unit

6-1-1 Setting the rotary switches

Before turning ON the power, the axis No. must be set with the rotary switches. The rotary switch settings will be validated when the servo driver (servo drive unit) power is turned ON.



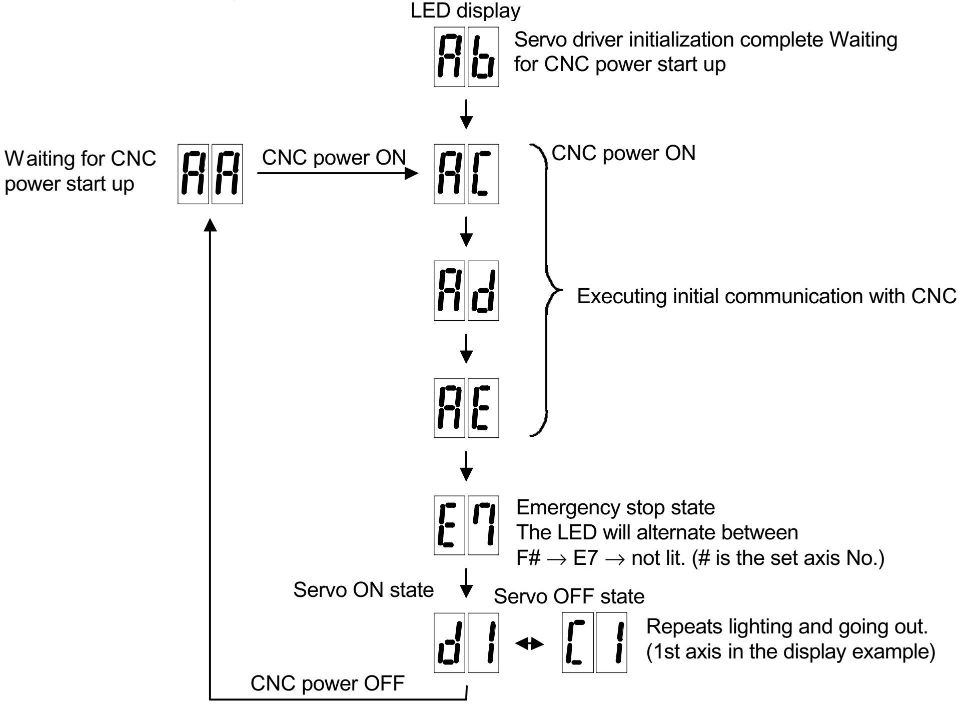
Rotary switch setting	Set axis No.
0	1st axis
1	2nd axis
2	3rd axis
3	4th axis
4	5th axis
5	6th axis
6	7th axis
7	Not usable
8	
9	
A	
B	
C	
D	
E	
F	Axis not used

POINT

When an axis that is not used is selected, that axis will not be controlled when the power is turned ON, and "Ab" will remain displayed on the LED.
If the power of the axis not in use is disconnected, the system's emergency stop cannot be released.

6-1-2 Transition of LED display after power is turned ON

When the axis No. has been set and the servo driver power and CNC power have been turned ON, the servo driver will automatically execute self-diagnosis and initial settings for operation, etc. The LEDs on the front of the servo driver will change as shown below according to the progression of these processes.
If an alarm occurs, the alarm No. will appear on the LEDs. Refer to "Chapter 8 Alarms and Warnings" for details on the alarm displays.



6-2 Setting the initial parameters

6-2-1 Setting the initial parameters

(1) Electronic Gears (SV001: PC1, SV002: PC2)

The commanded travel increment and machine end travel increment can be matched by correctly setting the ball screw lead, deceleration ratio (or acceleration ratio), and detector resolution in the parameters.
The following parameters are related to the electronic gears, and have a direct effect on the machine operation.
Be sure to correctly set these parameters.

Parameters related to the electronic gears

SV001:PC1, SV002:PC2, SV003:PGN1 (SV049:PGN1sp), SV018:PIT, SV019:RNG1, SV020:RNG2

PC1 and PC2 setting range

As a principle, the setting range for SV001: PC1 and SV002: PC2 is from 1 to 30, but these parameters can be set to a value of 30 or higher if the following conditions are satisfied. The following conditions must be satisfied even if the setting range is between 1 and 30.

Semi-closed loop

PC1' < 32767 / PIT' / IUNIT, PC2' < 32767 / RNG1'

Closed loop

PC1' < 32767 / RNG1C / 30, PC2' < 32767 / RNG2C / PGN1

Symbol meanings

PC1'	Value in which PC1 is divided by its greatest common divisor with PC2.
PC2'	Value in which PC2 is divided by its greatest common divisor with PC1.
PIT'	Value in which PIT is divided by its greatest common divisor with RNG1.
RNG1'	Value in which RNG1 is divided by its greatest common divisor with PIT.
RNG1C	Value in which RNG1 is divided by its greatest common divisor with RNG2.
RNG2C	Value in which RNG2 is divided by its greatest common divisor with RNG1.
IUNIT	CNC interpolation unit

CNC interpolation unit	IUNIT
0.500µm	2
0.050µm	20
0.005µm	200

PC1, PC2 setting range calculation example

In a semi-closed loop, with a ball screw lead of 10mm and interpolation units of 0.5µm, when an OSE104 or OSA104 type motor end detector is used.

The following parameters are determined by the conditions above.

SV018 : PIT = 10, SV019 : RNG1 = 100, SV20 : RNG2 = 100, IUNIT = 2

PIT' and RNG1' are obtained

PIT1' = 1, RNG1' = 10, (greatest common divisor = 10)

The maximum value of PC1 and PC2 is obtained from the calculation method for a semi-closed loop.

PC1' < 32767 / 1 / 2 < 16383, PC2' < 32767 / 10 < 3276

From the above calculation, the PC1 setting range becomes 1 to 16383, and the PC2 setting range becomes 1 to 3276.

In a semi-closed loop, with a rotating table and interpolation units of 0.5µm,
when an OSE104 or OSA104 type motor end detector is used.

The following parameters are determined by the conditions above.

SV018 : PIT = 360, SV019 : RNG1 = 100, SV20 : RNG2 = 100, IUNIT = 2

PIT' and RNG1' are obtained

PIT1' = 18, RNG1' = 5, (greatest common divisor = 20)

The maximum value of PC1 and PC2 is obtained from the calculation method for a semi-closed loop.

PC1' < 32767 / 18 / 2 < 910, PC2' < 32767 / 5 < 6553

From the above calculation, the PC1 setting range becomes 1 to 910, and the PC2 setting range becomes 1 to 6553.

In a closed loop, with a ball screw lead of 10mm, interpolation units of 0.5µm, and a position loop gain of 33,
when an OSE104 or OSA104 type motor end detector is used, and a 1µm scale is used in the machine end detector.

The following parameters are determined by the conditions above.

SV018 : PIT = 10, SV019 : RNG1 = 10, SV20 : RNG2 = 100, IUNIT = 2, PGN1 = 33

RNG1C and RNG2C are obtained

RNG1C = 1, RNG2C = 10, (greatest common divisor = 10)

The maximum value of PC1 and PC2 is obtained from the calculation method for a semi-closed loop.

PC1' < 32767 / 1 / 30 < 1092, PC2' < 32767 / 0 / 33 < 99

From the above calculation, the PC1 setting range becomes 1 to 1092, and the PC2 setting range becomes 1 to 99.

(2) Command polarity/feedback polarity (SV017: SPEC)

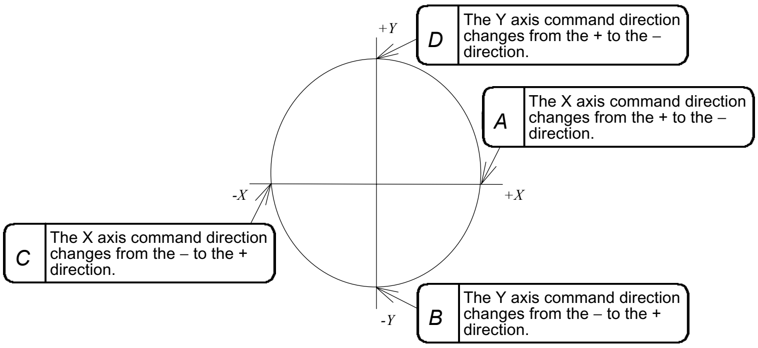
Command polarity

When commands are issued in the + direction, the command direction is considered CW when the motor rotates clockwise as seen from the load side. The command direction is considered CCW when the motor rotates counterclockwise as seen from the load side.
This rotation direction can be set using the CNC machine parameters. Be careful, as the ± meaning of some servo parameters is reversed by this motor rotation direction. The following shows the servo parameters affected by the CW/CCW rotation.

SV016 : LMC1 SV041 : LMC2 (When differing values are set in SV016 and SV041)
SV031 : OVS1 SV042 : OVS2 (When differing values are set in SV031 and SV042)

<Example> When changing the compensation amount of the lost motion compensation by the rotation direction, the compensation amount at each quadrant changeover point of the circle in which the lost motion compensation is operating is shown in the following table.

	CW	CCW
A	X : SV041	X : SV016
B	Y : SV016	Y : SV041
C	X : SV016	X : SV041
D	Y : SV041	Y : SV016



Feedback polarity

When the feedback data polarity of the machine end detector (ball screw end encoder, machine end scale, etc.) differs from the motor end encoder polarity in a closed loop system, the following bit must be set to 1.

Name	Abbrev.	Explanation	Setting range (unit)
SV017	SPEC	Servo specifications	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
spm				krvall	drvup	mpt3	mp	abs	vmh	Vdir	fdir		seqh	dfbx	vdir2

bit	Name	Meaning when set to 0.	Meaning when set to 1.
4	fdir	Position feedback forward polarity	Position feedback reverse polarity

(3) Servo specifications (SV017: SPEC)

Set the following parameters according to the system specifications such as the servomotor type, motor and driver (servo drive unit) combination, absolute or relative position system, etc.

Name	Abbrev.	Explanation	Setting range (unit)
SV017	SPEC	Servo specifications	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
spm				drvall	drvup	mpt3	mp	abs	vmh	vdir	fdir		seqh	dfbx	vdir2

bit	Name	Meaning when set to 0.	Meaning when set to 1.
0	vdir2	Set to 0	
1	dfbx	Dual feedback control invalid	Dual feedback control valid
2	seqh	Ready/servo ON time, normal mode	Ready/servo ON time, reduced time mode
3		Set to 0	
4	fdir	Position feedback forward polarity	Position feedback reverse polarity
5	vdir	Motor end detector installation direction AC	Motor end detector installation direction BD
6	vmh	Set to 0	
7	abs	Relative position detection	Absolute position detection
8	mp	MP scale 360P (2mm pitch)	MP scale 720P (1mm pitch)
9	mpt3	MP scale absolute position detection type 1/2 selection	MP scale absolute position detection type 3 selection
A	drvup	Combination with motor standard driver	Set when combining a driver with a capacity one rank above or below the motor standard driver.
B	drvall	Normal setting	Set when combining a driver with a different capacity than the motor standard driver.
C	spm	**Special motor selection** Standard rotary motor : 0 Standard linear motor : 6 Special rotary motor : 1 Special linear motor : 7 Refer to the list of motor types in section 6-2-1 (6).	
D			
E			
F			

(4) Ball screw pitch (SV018: PIT)

When using a machine with a ball screw mechanism, set the pitch (lead) of the ball screw being used.

Name	Abbrev.	Explanation	Setting range (unit)
SV018	PIT	Set the ball screw lead. Normally set to 360 for a rotation axis. (Refer to "(1) Electronic gears".)	1 ~ 32767 (mm)

(5) Detector resolution (SV019: RNG1, SV020: RNG2)

Set the following parameters according to the detector resolution.

Name	Abbrev.	Explanation	Setting range (unit)
SV019	RNG1	Set the No. of pulses (K pulses) per rotation of the detector being used in the position control.	1 ~ 9999
		For a semi-closed loop Set the No. of pulses (K pulses) per motor rotation. Also set SV020: RNG2 to the same value.	(Kp/rev)
		For a closed loop Set the No. of pulses (K pulses) per ball screw lead.	(Kp/PIT)
SV020	RNG2	Set the No. of pulses (K pulses) per motor end detector rotation.	1 ~999 (Kp/rev)

Semi-closed loop

Motor end detector	OSE104		OSA104		OSE105		OSA105		HA-FH		OBA13		OSA14		OBA17	
	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2
	100	100	100	100	1000	1000	1000	1000	8	8	8	8	16	16	100	100

Closed loop (detector type)

Machine end detector Motor end detector	OHE25K-ET		OHA25K-ET		OSE104-ET		OSA104-ET		OSE105-ET		OSA105-ET	
	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2
OSE104	100	100	100	100	100	100	100	100	1000	100	1000	100
OSA104	100	100	100	100	100	100	100	100	1000	100	1000	100
OSE105	100	1000	100	1000	100	1000	100	1000	1000	1000	1000	1000
OSA105	100	1000	100	1000	100	1000	100	1000	1000	1000	1000	1000
HA-FH	100	8	100	8	100	8	100	8	1000	8	100	8
OBA13	100	8	100	8	100	8	100	8	1000	8	100	8
OSA14	100	16	100	16	100	16	100	16	1000	16	1000	16
OBA17	100	100	100	100	100	100	100	100	1000	100	1000	100

Closed loop (scale type)

Machine end detector Motor end detector	SCALL		ABS SCALL (low-speed serial)		ABS SCALL (high-speed serial)	
	RNG1	RNG2	RNG1	RNG2	RNG1	RNG2
OSE104	∗1	100	∗1	100	∗1	100
OSA104	∗1	100	∗1	100	∗1	100
OSE105	∗1	1000	∗1	1000	∗1	1000
OSA105	∗1	1000	∗1	1000	∗1	1000
HA-FH	∗1	8	∗1	8	∗1	8
OBA13	∗1	8	∗1	8	∗1	8
OSA14	∗1	16	∗1	16	∗1	16
OBA17	∗1	100	∗1	100	∗1	100

∗1 Set the resolution per ball screw lead in RNG1.

(6) Motor type (SV025: MTYP)

Set "mtyp" of SV025: MTYP in combination with "spm" of SV017: SPEC.

Name	Abbrev.	Explanation	Setting range (unit)
SV017	SPEC	Servo specifications	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
spm				drvall	drvup	mpt3	mp	abs	vmh	vdir	fdir		seqh	dfbx	

bit	Name	Meaning when set to 0.	Meaning when set to 1.
C D E F	spm	**Special motor selection** Standard rotary motor : 0 Special rotary motor : 1	

Name	Abbrev.	Explanation	Setting range (unit)
SV025	MTYP	Motor/detector type	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
pen				ent				mtyp							

Standard rotary motor

SV017 : SPEC = 0xxx

Set a No. from the following table for SV025: mtyp (bit0 to bit7).

Motor series	2000rpm Standard	2000rpm Flat	2000rpm Low-inertia	3000rpm Low-inertia	3000rpm Ultra-low inertia		3000rpm Special	3000rpm General-purpose	3000rpm Standard			HC 2000rpm Medium inertia	HC 3000rpm Medium inertia		HC 3000rpm Ultra-low inertia	HC Special
No.	**0x**	**1x**	**2x**	**3x**	**4x**	**5x**	**6x**	**7x**	**8x**	**9x**	**Ax**	**Bx**	**Cx**	**Dx**	**Ex**	**Fx**
x0	HA40N	HA50U	HA50L	HA53L	HA43LN		HAN43	HA-FE43	HA43N			HC52	HC53			HC202-S1
x1	HA80N	HA100U	HA100L	HA103L	HA83LN			HA-FE63	HA83N			HC102	HC103			
x2	HA100N	HA200U	HA200L	HA203L	HA103LN				HA103N			HC152	HC153		HC153R	
x3	HA200N	HA300U	HA300L	HA303L	HA203LN				HA203N			HC202	HC203	HC202U	HC203R	
x4	HA300N	HA500U	HA500L	HA503L	HA303LN				HA303N			HC352	HC353			
x5	HA700N								HA703N			HC452	HC453			
x6	HA900N											HC702	HC703			
x7			HA-A11KL									HC902				
x8			HA-A15KL				TMG23									
x9							TMG253									
xA		HA150U	HA150L	HA153L	HA93LN		TMG203		HA93N							
xB																
xC								HA-FE053	HA053							
xD								HA-FE13	HA13							
xE							HA-N23	HA-FE23	HA23N							
xF		HA30U					HA-N33	HA-FE33	HA33N							

Note : HA-FE motor types in the table include HA-FH types.

Special rotary motor

SV017 : SPEC=1xxx

Set a No. from the following table for SV025: mtyp (bit0 to bit7).

Motor series				HC 2000rpm Medium inertia	HC 3000rpm Medium inertia			
No.	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0				HC52-SZ	HC53-SZ			
x1				HC102-SZ	HC103-SZ			
x2				HC152-SZ	HC153-SZ			
x3								
x4								
x5								
x6								
x7								
x8								
x9								
xA								
xB								
xC								
xD								
xE								
xF								

(7) Detector type (SV025: MTYP)

Set the following parameter according to the detector type to be used.

Name	Abbrev.	Explanation	Setting range (unit)
SV025	MTYP	Motor/detector type	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
pen				ent				mtyp							

pen : Set the position detector type.
ent : Set the speed detector type.

Set "pen/ent" of SV025: MTYP according to the following table.

No.	Detection method	Detector type				Class	Remarks
0	ABZ + UVW	Cannot be used.				Motor end detector	
	High-speed serial	OSE104					
1	ABZ + low-speed serial	Cannot be used.					
	High-speed serial	OSA104					
2	High-speed serial	OSE105	OSA105				
		HA-FH	OBA13	OSA14	OBA17		
3	ABZ + UVW (no OHM)	Cannot be used.					
4	ABZ	OHE25K-ET				Ball screw end detector	Setting not possible for speed detector type (ent).
	High-speed serial	OSE104-ET					
5	ABZ + low-speed serial	OHA25K-ET					
	High-speed serial	OSA104-ET					
6	High-speed serial	OSE105-ET	OSA105-ET				
7							
8	ABZ	SCALL				Machine end detector	
9	ABZ + low-speed serial	ABS SCALL ∗Note 1					
A	High-speed serial	ABS SCALL ∗Note 2	MDS-B-HR				
B							
C							
D							
E							
F							

Note 1 : ABS SCALL is compatible with the following absolute position detection scales.

Mitsutoyo Ltd.	AT41
Futaba Denshi Kogyo Ltd.	FME type, FLE type

Note 2 : ABS SCALL is compatible with the following absolute position detection scales.

Mitsutoyo Ltd.	AT342
Heidenhain Ltd.	LC191M

Detection system and MTYP

Set SV025: MTYP according to the detection system, following the table below.

Semi-closed loop

Motor end detector	OSE104		OSA104		OSE105		OSA105		HA-FH		OBA13		OSA14		OBA17	
	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system
	00xx	INC	11xx	ABS possible	22xx	INC	22xx	ABS possible	22xx	ABS possible	22xx	ABS possible	22xx	ABS possible	22xx	ABS possible

Closed loop (detector type)

Machine end detector Motor end detector	OHE25K-ET		OHA25K-ET		OSE104-ET		OSA104-ET		OSE105-ET		OSA105-ET	
	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system
OSE104	40xx	INC	50xx	ABS possible	40xx	INC	50xx	ABS possible	60xx	INC	60xx	ABS possible
OSA104	41xx	INC	51xx	ABS possible	41xx	INC	51xx	ABS possible	61xx	INC	61xx	ABS possible
OSE105	42xx	INC	52xx	ABS possible	42xx	INC	52xx	ABS possible	62xx	INC	62xx	ABS possible
OSA105	42xx	INC	52xx	ABS possible	42xx	INC	52xx	ABS possible	62xx	INC	62xx	ABS possible
HA-FH	42xx	INC	52xx	ABS possible	42xx	INC	52xx	ABS possible	62xx	INC	62xx	ABS possible
OBA13	42xx	INC	52xx	ABS possible	42xx	INC	52xx	ABS possible	62xx	INC	62xx	ABS possible
OSA14	42xx	INC	52xx	ABS possible	42xx	INC	52xx	ABS possible	62xx	INC	62xx	ABS possible
OBA17	42xx	INC	52xx	ABS possible	42xx	INC	52xx	ABS possible	62xx	INC	62xx	ABS possible

Closed loop (scale type)

Machine end detector Motor end detector	SCALL		ABS SCALL (low-speed serial)		ABS SCALL (high-speed serial)	
	MTYP	Detection system	MTYP	Detection system	MTYP	Detection system
OSE104	80xx	INC	90xx	ABS possible	A0xx	ABS possible
OSA104	81xx	MP ABS possible	91xx	ABS possible	A1xx	ABS possible
OSE105	82xx	INC	92xx	ABS possible	A2xx	ABS possible
OSA105	82xx	MP ABS possible	92xx	ABS possible	A2xx	ABS possible
HA-FH	82xx	MP ABS possible	92xx	ABS possible	A2xx	ABS possible
OBA13	82xx	MP ABS possible	92xx	ABS possible	A2xx	ABS possible
OSA14	82xx	MP ABS possible	92xx	ABS possible	A2xx	ABS possible
OBA17	82xx	MP ABS possible	92xx	ABS possible	A2xx	ABS possible

(8) Power supply type (SV036: PTYP)

Name	Abbrev.	Explanation	Setting range (unit)
SV036	PTYP	Power supply type	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
amp				rtyp				ptyp							

bit	Name	Explanation
0	ptyp	Set the power supply type.
1		
2		
3		
4		
5		
6		
7		
8	rtyp	Set to 0 when the power supply unit is a power regeneration type. Set the resistor type to be used when the power supply unit is a resistance regeneration type.
9		
A		
B		
C	amp	Set the model No. of the driver. 0 : MDS-B-V14/V24, MDS-B-V1/V2/SP, MDS-A-V1/V2/SP 1 : MDS-A-SVJ 2 : MDS-A-SPJ
D		
E		
F		

Set "ptyp" of SV036: PTYP according to the following table.

No.	0xKw 0x	1xKw 1x	2xKw 2x	3xKw 3x	4xKw 4x	5xKw 5x	6x	7x	0xKw 8x
0	PS not connected.			CV-300					
1		CV-110							CR-10
2			CV-220						CR-15
3									CR-22
4	CV-37								CR-37
5		CV-150			CV-450	CV-550			
6	CV-55		CV-260						CR-55
7				CV-370					
8	CV-75								CR-75
9		CV-185							CR-90
A									
B									
C									
D									
E									
F									

List of regenerative resistors

Set "port" of SV036: PTYP according to the following table.
(For MDS-B-V14/24 models)

No.	Regenerative resistor type	Resistance value (Ω)	No. of watts (W)	No.	Regenerative resistor type	Resistance value (Ω)	No. of watts (W)
0				8	R-UNIT-2	15	700
1	GZG200W260HMJ	26	80	9	R-UNIT-3	15	2100
2	GZG300W130HMJ × 2	26	150	A			
3	MR-RB30	13	300	B			
4	MR-RB50	13	500	C			
5	GZG200W200HMJ × 3	6.7	350	D			
6	GZG300W200HMJ × 3	6.7	500	E			
7	R-UNIT-1	30	700	F			

6-2-2 Parameters set according to feedrate

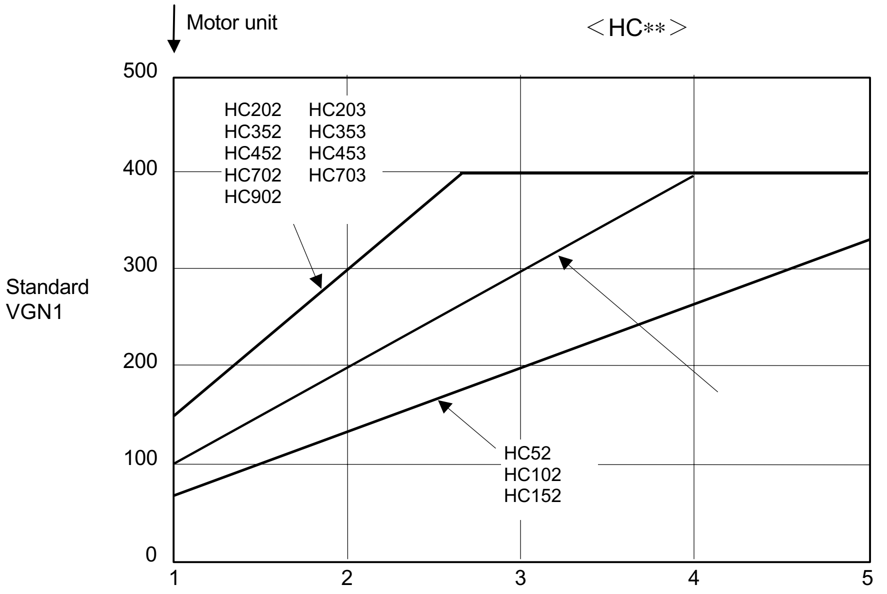
The following parameter settings are determined by the feedrate of each axis.

No.	Abbrev.	Parameter name	Explanation
SV023	OD1	Excessive error detection width during servo ON	The unit's protective functions operate when the error of the position command and the position feedback becomes excessive. If problems occur with the standard setting because the machine load is heavy, raise the setting value in gradual stages until the problem does not occur. <Calculation of the standard setting value> $\text{OD1} = \text{OD2} = \frac{\text{Max. rapid traverse rate (mm/min)}}{60 \times \text{PGN1}} \times 0.5 \text{ (mm)}$
SV026	OD2	Excessive error detection width during servo OFF	

6-2-3 Parameters set according to machine load inertia

The following parameters are set according to the machine inertia.

No.	Abbrev.	Parameter name	Explanation
SV005	VGN1	Speed loop gain	Refer to the load inertia magnification and contrast graph for the standard setting value.
SV008	VIA	Speed loop leading compensation	Set the standard value 1364. Set the standard value 1900 for SHG control. When the load inertia is large and is in the standard VIA change region, set the value from the contrast graph regardless of whether using normal or SHG control.



Load inertia magnification (total load inertia/motor inertia)

6-2-4 List of standard parameters by motor type

Motor	Standard motor																				
	HA 40N	HA 43N	HA 80N	HA 83N	HA 93N	HA 100N	HA 103N	HA 200N	HA 203N	HA 300N	HA 303N	HA 700N	HA 703N	HA 900N	HA 053	HA 13	HA 23N	HA 33N	HA-N23	HA-N33	HA-N43
Driver	05	05	10	10	20	20	35	35	45	45	70	70	90	90	01	01	03	03	03	03	05
SV001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV003	33	33	33	33	33	33	33	33	33	33	33	25	25	25	33	33	33	33	33	33	33
SV004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV005	150	150	150	150	150	150	150	150	150	150	150	250	250	250	70	70	100	100	70	70	35
SV006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364
SV009	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
SV010	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
SV011	512	256	512	256	256	256	256	256	256	256	256	200	200	200	256	256	224	224	256	256	512
SV012	512	512	512	512	512	512	512	512	512	512	512	256	256	256	256	256	224	224	256	256	512
SV013	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SV014	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SV015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-	-
SV020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-	-
SV021	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
SV022	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
SV023	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
SV024	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
SV025	xx00	xx80	xx01	xx81	xx8A	xx02	xx82	xx03	xx83	xx04	xx84	xx05	xx85	xx06	338C	338D	xx8E	xx8F	xx6E	xx6F	xx60
SV026	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
SV027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
SV028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV034	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV035	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV047	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SV048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV049	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
SV050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV063	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV064	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OS1	2400	3600	2400	3600	3600	2400	3600	2400	3600	2400	3600	2400	3600	2400	3600	3600	3600	3600	3600	3600	3600
OS2	2400	3600	2400	3600	3600	2400	3600	3000	3600	3000	3600	2400	3600	2400	3600	3600	3600	3600	3600	3600	3600

List of standard parameters by motor type (continued)

Motor	Flat motor							2000rpm low-inertia motor								3000rpm low-inertia motor					
	HA 30U	HA 50U	HA 100U	HA 150U	HA 200U	HA 300U	HA 500U	HA 50L	HA 100L	HA 150L	HA 200L	HA 300L	HA 500L	HA-A11KL	HA-A15KL	HA 53L	HA 103L	HA 153L	HA 203L	HA 303L	HA 503L
Driver	03	05	10	20	20	35	45	05	10	10	20	35	45	110	150	10	20	20	35	45	70
SV001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV003	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
SV004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV005	30	30	30	30	30	30	30	30	30	30	30	30	50	150	150	30	30	30	30	30	50
SV006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364
SV009	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
SV010	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
SV011	256	512	512	512	512	256	256	512	512	512	512	256	256	512	512	512	512	512	512	256	256
SV012	512	512	512	512	512	512	512	512	512	512	512	512	512	512	512	512	512	512	512	512	512
SV013	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SV014	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
SV015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SV021	60	60	60	60	60	60	60	60	60	60	60	60	60	60	3	60	60	60	60	60	60
SV022	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
SV023	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
SV024	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
SV025	xx1F	xx10	xx11	xx1A	xx12	xx13	xx14	xx20	xx21	xx2A	xx22	xx23	xx24	xx27	xx28	xx30	xx31	xx3A	xx32	xx33	xx34
SV026	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
SV027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
SV028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV034	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV035	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV047	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
SV048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV049	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
SV050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV063	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SV064	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OS1	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2400	2400	3600	3600	3600	3600	3600	3600
OS2	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2400	2400	3600	3600	3600	3600	3600	3600

List of standard parameters by motor type (continued)

Motor	General-purpose motor													Ultra-low inertia motor							
	HA-FE053	HA-FE13	HA-FE23	HA-FE33	HA-FE43	HA-FE63		HA-FH053	HA-FH13	HA-FH23	HA-FH33	HA-FH43	HA-FH63	HA 43LN	HA 83LN	HA 93LN	HA 103LN	HA 203LN	HA 303LN		
Driver	01	01	03	03	05	05		01	01	03	03	05	05	10	20	35	35	45	70		
SV001	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-		
SV002	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-		
SV003	33	33	33	33	33	33		33	33	33	33	33	33	33	33	33	33	33	33		
SV004	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV005	35	35	35	35	35	35		35	35	35	35	35	35	30	30	30	30	30	50		
SV006	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV007	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV008	1364	1364	1364	1364	1364	1364		1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364		
SV009	2048	2048	2048	2048	2048	2048		2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048		
SV010	2048	2048	2048	2048	2048	2048		2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048		
SV011	256	256	256	256	512	512		256	256	256	256	512	512	512	512	512	512	256	256		
SV012	256	256	256	256	512	512		256	256	256	256	512	512	512	512	512	512	512	512		
SV013	500	500	500	500	500	500		500	500	500	500	500	500	500	500	500	500	500	500		
SV014	500	500	500	500	500	500		500	500	500	500	500	500	500	500	500	500	500	500		
SV015	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV016	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV017	0000	0000	0000	0000	0000	0000		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000		
SV018	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-		
SV019	4	4	4	4	4	4		8	8	8	8	8	8	-	-	-	-	-	-		
SV020	4	4	4	4	4	4		8	8	8	8	8	8	-	-	-	-	-	-		
SV021	60	60	60	60	60	60		60	60	60	60	60	60	60	60	60	60	60	60		
SV022	150	150	150	150	150	150		150	150	150	150	150	150	150	150	150	150	150	150		
SV023	6	6	6	6	6	6		6	6	6	6	6	6	6	6	6	6	6	6		
SV024	50	50	50	50	50	50		50	50	50	50	50	50	50	50	50	50	50	50		
SV025	337C	337D	337E	337F	3370	3371		227C	227D	227E	227F	2270	2271	xx40	xx41	xx4A	xx42	xx43	xx44		
SV026	6	6	6	6	6	6		6	6	6	6	6	6	6	6	6	6	6	6		
SV027	4000	4000	4000	4000	4000	4000		4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000		
SV028	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV029	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV030	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV031	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV032	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV033	0000	0000	0000	0000	0000	0000		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000		
SV034	0000	0000	0000	0000	0000	0000		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000		
SV035	0000	0000	0000	0000	0000	0000		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000		
SV036	0000	0000	0000	0000	0000	0000		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000		
SV037	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV038	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV039	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV040	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV041	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV042	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV043	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV044	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV045	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV046	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV047	100	100	100	100	100	100		100	100	100	100	100	100	100	100	100	100	100	100		
SV048	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV049	15	15	15	15	15	15		15	15	15	15	15	15	15	15	15	15	15	15		
SV050	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV051	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV052	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV053	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV054	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV055	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV056	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV057	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV058	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV059	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV060	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV061	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV062	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV063	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
SV064	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0		
OS1	3600	3600	3600	3600	3600	3600		3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600		
OS2	3600	3600	3600	3600	3600	3600		3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600		

List of standard parameters by motor type (continued)

Motor	HC standard motor																				
	HC 52	HC 53	HC 102	HC 103	HC 152	HC 153	HC 202	HC 203	HC 352	HC 353	HC 452	HC 453	HC 702	HC 703	HC 902						
Driver	05	05	10	10	20	20	20	35	35	45	45	70	70	90	90						
SV001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
SV002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
SV003	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33						
SV004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV005	100	100	100	100	100	100	100	100	100	100	100	100	150	100	150						
SV006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364						
SV009	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048						
SV010	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048						
SV011	512	256	512	256	512	256	256	256	256	256	256	256	200	256	200						
SV012	512	512	512	512	512	512	512	512	512	512	512	512	256	512	256						
SV013	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500						
SV014	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500						
SV015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000						
SV018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
SV019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
SV020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
SV021	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60						
SV022	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150						
SV023	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6						
SV024	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50						
SV025	xxB0	xxC0	xxB1	xxC1	xxB2	xxC2	xxB3	xxC3	xxB4	xxC4	xxB5	xxC5	xxB6	xxC6	xxB7						
SV026	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6						
SV027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000						
SV028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000						
SV034	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003						
SV035	0000	0000	0000	0000	0040	0040	0040	0040	0040	0040	0040	0040	0040	0040	0040						
SV036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000						
SV037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV040	0	0	0	0	0	0	10240	10240	10240	10240	10240	10240	10240	10240	10240						
SV041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV047	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100						
SV048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV049	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15						
SV050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV063	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
SV064	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
OS1	3600	3600	3600	3600	3600	3600	3000	3600	3000	3600	3000	3600	3000	3600	3000						
OS2	3600	4200	3600	4200	3600	4200	3000	4200	3000	4200	3000	4200	3000	4200	3000						

Chapter 7 Adjustment

7-1 Measurement of adjustment data

The MDS-B-Vx4 servo driver has a function to D/A output the various control data. To adjust the

7-1-3 Setting the output scale

No.	Abbrev.	Parameter name	Explanation	Setting range
SV063	DA1MPY	D/A output channel 1 output scale	The scale is set with a 1/256 unit. When 256 is set, the magnification becomes 1.	–32768 ~ 32767
SV064	DA2MPY	D/A output channel 2 output scale		

Analog output voltage = {(output data value) × (SV063 or SV064 setting value) × 76.3/1,000,000} + 2.5V

7-2 Gain adjustment

7-2-1 Current loop gain

No.	Abbrev.	Parameter name	Explanation	Setting range
SV009	IQA	Current loop q axis leading compensation	This setting is determined by the motor's electrical characteristics. Set the standard parameters for all parameters. (These are used for maker adjustments.)	1 ~ 20480
SV010	IDA	Current loop d axis leading compensation		1 ~ 20480
SV011	IQG	Current loop q axis gain		1 ~ 4096
SV012	IDG	Current loop d axis gain		1 ~ 4096

7-2-2 Speed loop gain

(1) Setting the speed loop gain

The speed loop gain (SV005: VGN1) is an important parameter for determining the responsiveness of the servo control. During servo adjustment, the highest extent that this value can be set to becomes important. The setting value has a large influence on the machine cutting precision and cycle time.

① To adjust the VGN1 value, first obtain the standard VGN1 to judge how much VGN1 is required for the machine load inertia.
The standard VGN1 is the value that corresponds to the size of the machine load inertia.
Refer to the graph in section 6-2-3.

<When machine resonance does not occur at the standard VGN1>

Set the standard VGN1. Use the standard value if no problem (such as machine resonance) occurs. If sufficient cutting precision cannot be obtained at the standard VGN1, the VGN1 can be raised higher than the standard value by maintaining a margin of 70% of the limit at which the mechanical resonance occurs. The cutting accuracy can also be improved by using the disturbance observer and adjusting.

<When machine resonance occurs at the standard VGN1>

Machine resonance is occurring if the shaft makes abnormal sounds when operating or stopping, and a fine vibration can be felt when the machine is touched while stopped. Machine resonance occurs because the servo control responsiveness includes the machine resonance points. (Speed control resonance points occur, for example, at parts close to the motor such as ball screws.) Machine resonance can be suppressed by lowering VGN1 and the servo control responsiveness, but the cutting precision and cycle time are sacrificed. Thus, set a vibration suppression filter and suppress the machine resonance (Refer to section "7-3-2 Vibration suppression measures"), and set a value as close as possible to the standard VGN1. If the machine resonance cannot be sufficiently eliminated even by using a vibration suppression filter, then lower the VGN1.

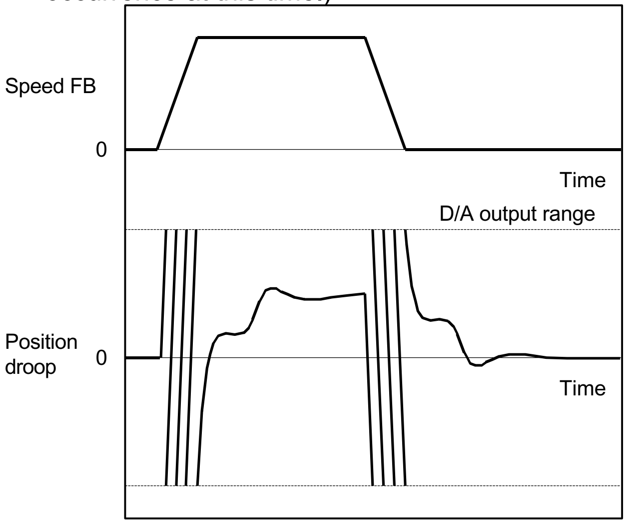
No.	Abbrev.	Parameter name	Explanation	Setting range
SV005	VGN1	Speed loop gain	Set this according to the motor inertia size. If vibration occurs, adjust by lower the setting by 20% to 30% at a time.	1 ~ 999

POINT

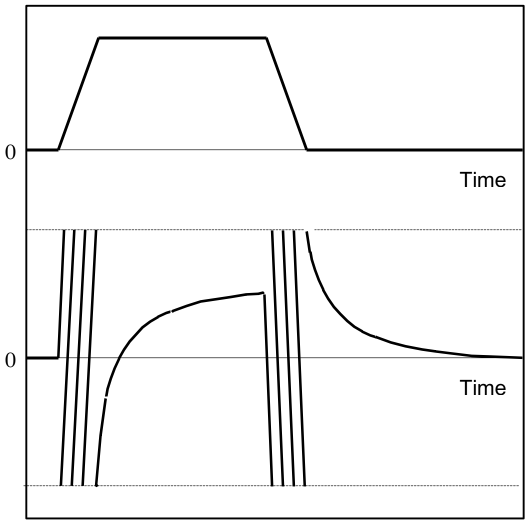
The final VGN1 setting value should be 70 to 80% of the largest value at which machine resonance does not occur.
If the vibration suppression functions are used to suppress the resonance and the VGN1 setting value is raised, the subsequent servo adjustment becomes more favorable.

(2) Setting the speed loop advance compensation

The speed loop advance compensation (SV008: VIA) determines the characteristics of the speed loop mainly at low frequency regions. 1364 is set as a standard, and 1900 is set as a standard during SHG control. The standard value may drop as shown in the graph in section 6-2-3 in respect to loads with a large inertia.
When the VGN1 is set lower than the standard value because the load inertia is large or because machine resonance occurred, the speed loop control band is lowered. If the standard value is set in the advance compensation in this status, the advance compensation control itself will induce vibration. In concrete terms, a vibration of 10 to 20Hz could be caused during acceleration/ deceleration and stopping, and the position droop waveform could be disturbed when accelerating to a constant speed and when stopped. (Refer to the following graphs.)
This vibration cannot be suppressed by the vibration suppression functions. Lower the VIA in increments of 100 from the standard setting value. Set a value where vibration does not occur and the position droop waveform converges smoothly. Because lowering the VIA causes a drop in the position control's trackability, the vibration suppression is improved even when a disturbance observer is used without lowering the VIA. (Be careful of machine resonance occurrence at this time.)



Vibration waveform with leading compensation control



Adjusted position droop waveform

If VIA is lowered, the position droop waveform becomes smooth and overshooting does not occur. However, because the trackability regarding the position commands becomes worse, that amount of positioning time and precision are sacrificed. VIA must be kept high (set the standard value) to guarantee precision, especially in high-speed contour cutting (generally F = 1000 or higher). In other words, a large enough value must be set in VGN1 so that the VIA does not need to be lowered in machines aimed at high-speed high-precision. When adjusting, the cutting precision will be better if adjustment is carried out to a degree where overshooting does not occur and a high VIA is maintained, without pursuing position droop smoothness.
If there are no vibration or overshooting problems, the high-speed contour cutting precision can be further improved by setting the VIA higher than the standard value. In this case, adjust by raising the VIA in increments of 100 from the standard value.
Setting a higher VIA improves the trackability regarding position commands in machines for which cycle time is important, and the time to when the position droop converges on the in-position width is shortened.
It is easier to adjust the VIA to improve precision and cycle time if a large value (a value near the standard value) can be set in VGN1, or if VGN1 can be raised equivalently using the disturbance observer.

No.	Abbrev.	Parameter name	Explanation	Setting range
SV008	VIA	Speed loop leading compensation	1364 is set as a standard. 1900 is set as a standard during SHG control. Adjust in increments of approx. 100. Raise the VIA and adjust to improve the contour tracking precision in high-speed cutting. If the position droop vibrates (10 to 20Hz), lower the VIA and adjust.	1 ~ 9999 (0.0687rad/s)

POINT

Position droop vibration of 10Hz or less is not leading compensation control vibration. The position loop gain must be adjusted.

7-2-3 Position loop gain

(1) Setting the position loop gain

The position loop gain (SV003:PGN1) is a parameter that determines the trackability to the command position. 33 is set as a standard. Set the same position loop gain value between interpolation axes.

When PGN1 is raised, the position tracking will improve and the settling time will be shortened, but a speed loop that has a responsiveness that can track the position loop gain with increased response will be required. If the speed loop responsiveness is insufficient, several Hz of vibration or overshooting will occur during acceleration/deceleration. Vibration or overshooting will also occur when VGN1 is smaller than the standard value during VIA adjustment, but the vibration that occurs in the position loop is generally 10Hz or less. (The VIA vibration that occurs is 10 to 20Hz.) When the position control includes machine resonance points (Position control resonance points occur at the machine end parts, etc.) because of insufficient machine rigidity, the machine will vibrate during positioning, etc. In either case, lower PGN1 and adjust so vibration does not occur.

If the machine also vibrates due to machine backlash when the motor stops, the vibration can be suppressed by lowering the PGN1 and smoothly stopping.

If SHG control is used, an equivalently high position loop gain can be maintained while suppressing these vibrations.

To adjust the SHG control, gradually raise the gain from a setting where 1/2 of a normal control PGN1 where vibration did not occur was set in PGN1. If the PGN1 setting value is more than 1/2 of the normal control PGN1 when SHG control is used, there is an improvement effect in position control. (Note that for the settling time the improvement effect is at $1/\sqrt{2}$ or more.)

No.	Abbrev.	Parameter name	Explanation	Setting range
SV003	PGN1	Position loop gain 1	Set 33 as a standard. If PGN1 is increased, the settling time will be shortened, but a sufficient speed loop response will be required.	1 ~ 200 (rad/s)
SV004	PGN2	Position loop gain 2	Set 0 as a standard. (For SHG control)	0 ~ 999
SV057	SHGC	SHG control gain	Set 0 as a standard. (For SHG control)	0 ~ 1200

⚠ CAUTION Always set the same value for position loop gain between interpolation axes.

(2) Setting the position loop gain for spindle synchronous control

During spindle synchronous control (synchronous tapping control, etc.), there are three sets of position loop gain parameters besides the normal control.

No.	Abbrev.	Parameter name	Explanation		Setting range
SV049	PGN1sp	Position loop gain 1 during spindle synchronization	Set 15 as a standard.	Set the same parameter as the position loop gain for the spindle synchronous control.	1 ~ 200 (rad/s)
SV050	PGN2sp	Position loop gain 2 during spindle synchronization	Set 0 as a standard. (For SHG control)		0 ~ 999
SV058	SHGCsp	SHG control gain during spindle synchronization	Set 0 as a standard. (For SHG control)		0 ~ 1200

⚠ CAUTION Always set the same value for the position loop gain between the spindle and servo synchronous axes.

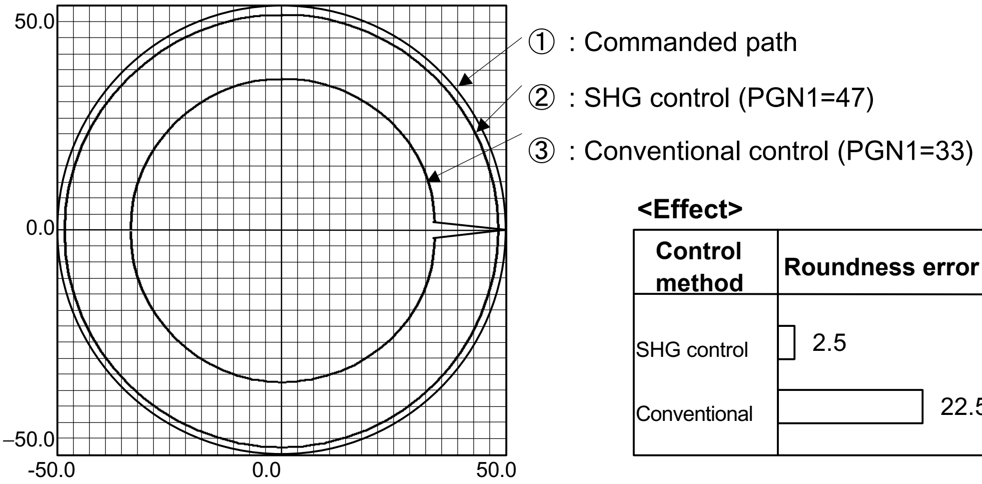
(3) SHG control (option function)

If the position loop gain is increased or feed forward control (CNC function) is used to shorten the settling time or increase the precision, the machine system may vibrate easily.
SHG control changes the position loop to a high-gain by stably compensating the servo system position loop through a delay. This allows the settling time to be reduced and a high precision to be achieved.

(Feature 1) When the SHG control is set, even if PGN1 is set to the same value as the conventional control, the position loop gain will be doubled.

(Feature 2) The SHG control response is smoother than conventional position control during acceleration/deceleration, so the gain can be increased further with SHG control compared to the conventional position control.

(Feature 3) With SHG control, a high gain is achieved so a high precision can be achieved during contour control.
The following drawing shows an example of the improvement in roundness characteristics with SHG control.



（F=3000mm/min, ERROR=5.0μm／div）

<Effect>

Control method	Roundness error (μm)
SHG control	2.5
Conventional	22.5

Shape error characteristics

During SHG control, PGN1, PGN2 and SHGC are set with the following ratio.

$$\text{PGN1} : \text{PGN2} : \text{SHGC} = 1 : \frac{8}{3} : 6$$

During SHG control even if the PGN1 setting value is the same, the actual position loop gain will be higher, so the speed loop must have a sufficient response. If the speed loop response is low, vibration or overshooting could occur during acceleration/deceleration in the same manner as normally control. If the speed loop gain has been lowered because machine resonance occurs, lower the position loop gain and adjust.

No.	Abbrev.	Parameter name	Setting ratio	Setting example					Explanation	Setting range
SV003 (SV049)	PGN1 (PGN1sp)	Position loop gain 1	1	23	26	33	38	47	Always set a combination of the three parameters.	1 ~ 200
SV004 (SV050)	PGN2 (PGN2sp)	Position loop gain 2	$\frac{8}{3}$	62	70	86	102	125		0 ~ 999
SV057 (SV058)	SHGC (SHGCsp)	SHG control gain	6	140	160	187	225	281		0 ~ 1200
SV008	VIA	Speed loop leading compensation	Set 1900 as a standard for SHG control.							1 ~ 9999
SV015	FFC	Acceleration feed forward gain	Set 100 as a standard for SHG control.							0 ~ 999

POINT The SHG control is an optional function. If the option is not set in the CNC, the alarm 37 (at power ON) or warning E4, Error Parameter No. 104 (2304 for M50/M64 Series CNC) will be output.

7-3 Characteristics improvement

7-3-1 Optimal adjustment of cycle time

The following items must be adjusted to adjust the cycle time. Refer to the Instruction Manuals provided with each CNC for the acceleration/deceleration pattern.

① Rapid traverse rate (rapid) : This will affect the maximum speed during positioning.
② Clamp speed (clamp) : This will affect the maximum speed during cutting.
③ Acceleration/deceleration time constant (G0t∗, G1t∗): Set the time to reach the feedrate.
④ In-position width (SV024) : This will affect each block's movement command end time.
⑤ Position loop gain (SV003) : This will affect each block's movement command settling time.

(1) Adjusting the rapid traverse

To adjust the rapid traverse, the CNC axis specification parameter rapid traverse rate (rapid) and acceleration/deceleration time constant (G0t∗) are adjusted. The rapid traverse rate is set so that the motor speed matches the machine specifications in the range below the maximum speed in the motor specifications. For the acceleration/deceleration time constants, carry out rapid traverse reciprocation operation, and set so that the maximum current command value at acceleration/ deceleration is within the range shown below.
For motors in which the maximum speed is greater than the rated speed (HC, HC-R, HC-MF, HA-FF), the output torque is particularly restricted in the region at or above the rated speed. When adjusting, watch the current FB waveform during acceleration/deceleration, and adjust so that the torque is within the specified range. Be careful, as insufficient torque can easily occur when the driver input voltage is low (170 to 190V), and an excessive error can easily occur during acceleration/deceleration.

(2) Adjusting the cutting rate

To adjust the cutting rate, the CNC axis specification parameter clamp speed (clamp) and acceleration/deceleration time constant (G1t∗) are adjusted. The in-position width at this time must be set to the same value as actual cutting.

- Determining the clamp speed and adjusting the acceleration/deceleration time constant

  (Features) The maximum cutting rate (clamp speed) can be determined freely.

  (Adjustment) Carry out cutting feed reciprocation operation with no dwell at the maximum cutting rate and adjust the acceleration/deceleration time constant so that the maximum current command value during acceleration/deceleration is within the range shown below.

- Setting the step acceleration/deceleration and adjusting the clamp speed

  (Features) The acceleration/deceleration time constant is determined with the position loop in the servo, so the acceleration/deceleration F⊿T can be reduced.

  (Adjustment) Set 1 (step) for the acceleration/deceleration time constant and carry out cutting feed reciprocation operation with no dwell.
  Adjust the cutting feed rate so that the maximum current command value during acceleration/deceleration is within the range shown below, and then set the value in the clamp speed.

2000rpm HC Series		3000rpm HC Series	
Motor type	**Max. current command value**	**Motor type**	**Max. current command value**
HC52	300 ~ 340%	HC53	225 ~ 255%
HC102	275 ~ 310%	HC103	210 ~ 240%
HC152	450 ~ 510%	HC153	240 ~ 270%
HC202	230 ~ 258%	HC203	220 ~ 250%
HC352	200 ~ 225%	HC353	185 ~ 210%
HC452	160 ~ 185%	HC453	160 ~ 182%
HC702	183 ~ 210%	HC703	160 ~ 182%
HC902	195 ~ 220%		

2000rpm HA motor		3000rpm HA motor	
Motor type	**Max. current command value**	**Motor type**	**Max. current command value**
HA40	355 ~ 400%	HA053	210 ~ 240%
HA80	325 ~ 365%	HA13	210 ~ 240%
HA100	230 ~ 260%	HA23	205 ~ 230%
HA200	200 ~ 225%	HA33	205 ~ 230%
HA300	180 ~ 200%	HA43	260 ~ 295%
HA700	185 ~ 205%	HA83	245 ~ 275%
HA900	195 ~ 220%	HA103	220 ~ 245%
		HA203	185 ~ 210%
		HA303	160 ~ 180%
		HA703	160 ~ 180%

(3) Adjusting the in-position width

Because there is a response delay in the servomotor drive due to position loop control, a "settling time" is also required for the motor to actually stop after the command speed from the CNC reaches 0. The movement command in the next block is generally started after it is confirmed that the machine has entered the "in-position width" range set for the machine.

Set the in-position width to the precision required for the machine. If an excessively high precision is set, the cycle time will increase due to a delay in the settling time.

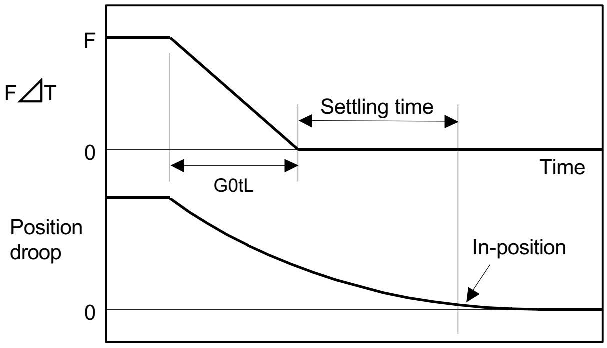
The in-position width is effective even when the standard servo parameters are set. However, it may follow the CNC parameters, so refer to the CNC Instruction Manual for the setting.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV024	INP	In-position detection width	µm	Set 50 as a standard. Set the precision required for the machine.	0 ~ 32767

POINT The in-position width setting and confirmation availability depend on the CNC parameters.

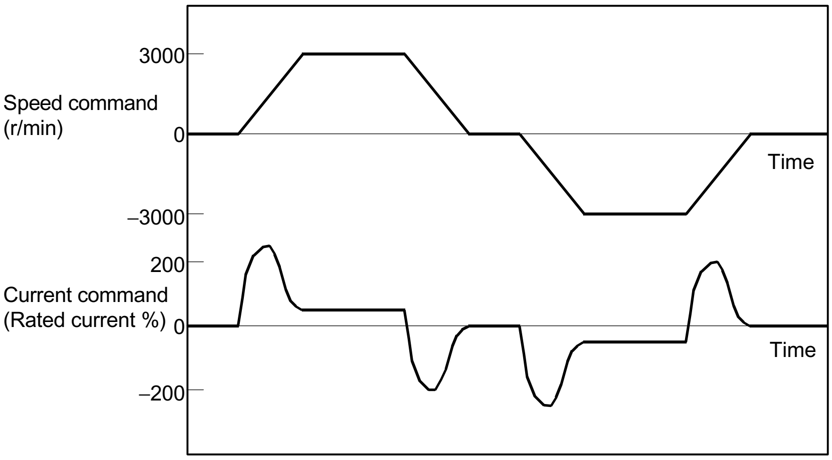
(4) Adjusting the settling time

The settling time is the time required for the position droop to enter the in-position width after the feed command (F⊿T) from the CNC reaches 0.
The settling time can be shortened by raising the position loop gain or using SHG control. However, a sufficient response (sufficiently large VNG1 setting) for the speed loop is required to carry out stable control.
The settling time during normal control when the CNC is set to linear acceleration/deceleration can be calculated using the following equation.
During SHG control, estimate the settling time by multiplying PGN1 by $\sqrt{2}$.



$$\text{Settling time (msec)} = -\frac{10^3}{PGN1} \times \ell n\left\{ \frac{INP}{\dfrac{F\times 10^6}{60\times G0tL\times PGN1^2} \times \left\{ 1 - \exp\left(-\dfrac{PGN1\times G0tL}{10^3} \right) \right\}} \right\}$$

PGN1 : Position loop gain1 (SV003) (rad/sec)
F : Rapid traverse rate (mm/min)
G0tL : Rapid traverse linear acceleration/deceleration time constant (msec)
INP : In-position width (SV024) (μm)



Example of speed/current command waveform during acceleration/deceleration

(Reference) The rapid traverse acceleration/deceleration time setting value G0tL for when linear acceleration/deceleration is set is calculated with the following expression.

$$G0tL = \frac{(J_L + J_M)\times N_O}{95.5\times(0.8\times T_{MAX} - T_L)} - \frac{6000}{(PGN1\times K)^2} \quad \text{(msec)}$$

N_O : Motor reach speed (r/min)
J_L : Motor shaft conversion load inertia (kg· cm^2)
J_M : Motor inertia (kg· cm^2)
T_{MAX} : Motor max. torque (N· m)
T_L : Motor shaft conversion load (friction, unbalance) torque (N· m)
PGN1 : Position loop gain 1 (rad/sec)
K : "1" during normal control, "2" during SHG control

7-3-2 Vibration suppression measures

If vibration (machine resonance) occurs, it can be suppressed by lowering the speed loop gain (VGN1). However, cutting precision and cycle time will be sacrificed. (Refer to "7-2-2 Speed loop gain".) Thus, try to maintain the VGN1 as high as possible, and suppress the vibration using the vibration suppression functions.
If the VGN1 is lowered and adjusted because vibration cannot be sufficiently suppressed with the vibration suppression functions, adjust the entire gain (including the position loop gain) again.

<Examples of vibration occurrence>

- A fine vibration is felt when the machine is touched, or a groaning sound is heard.
- Vibration or noise occurs during rapid traverse.

POINT Suppress the vibration using the vibration suppression functions, and maintain the speed loop gain (SV005: VGN1) as high as possible.

(1) Machine resonance suppression filter

The machine resonance suppression filter will function at the set frequency. Use the D/A output function to output the current feedback and measure the resonance frequency. Note that the resonance frequency that can be measured is 0 to 500 Hz. For resonance exceeding 500 Hz, directly measure the phase current with a current probe, etc.
When the machine resonance suppression filter is set, vibration may occur again at a separate resonance frequency that existed latently at first. In this case, the servo control is stabilized when the machine resonance suppression filter depth is adjusted and the filter is adjusted so as not to operate more than required.

<Setting method>

1. Set the resonance frequency in the machine resonance suppression filter frequency (SV038: FHz1, SV046:FHz2).
2. If the machine starts to vibrate at another frequency, raise (make shallower) the machine resonance suppression filter depth compensation value (SV033: SSF2.nfd), and adjust to the optimum value at which the resonance can be eliminated.
3. When the vibration cannot be completely eliminated, use another vibration suppression control (jitter compensation, adaptive filter) in combination with the machine resonance suppression filter.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Unit</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV038</td><td>FHz1</td><td>Machine resonance suppression filter center frequency 1</td><td>Hz</td><td>Set the resonance frequency to be suppressed. (Valid at 36 or more).
Set 0 when the filter is not to be used.</td><td>0 ~ 9000
(Hz)</td></tr>
<tr><td>SV046</td><td>FHz2</td><td>Machine resonance suppression filter center frequency 2</td><td>Hz</td><td>Set the resonance frequency to be suppressed. (Valid at 36 or more).
Set 0 when the filter is not to be used.</td><td>0 ~ 9000
(Hz)</td></tr>
<tr><td>SV033</td><td>SSF2</td><td>Special servo function selection 2</td><td colspan="3">The machine resonance suppression filter depth compensation is set with the following parameters.
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">dos</td><td colspan="4">dis</td><td colspan="3">nfd2</td><td>nfd3</td><td colspan="3">nfd1</td><td>zck</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Explanation</th></tr>
<tr><td>1~3</td><td>nfd1</td><td>Set the filter depth for the No.1 machine resonance suppression filter.
The control stability can be improved by setting the vibration elimination amount.
Deeper ← → Shallower
Setting value 000 001 010 011 100 101 110 111
Depth (dB) –∞ –18 –12 –9 –6 –4 –3 –1</td></tr>
<tr><td>4</td><td>nfd3</td><td>Validate the No. 3 machine resonance suppression filter (center frequency 1125Hz).</td></tr>
<tr><td>5~7</td><td>nfd2</td><td>Set the filter depth for the No.2 machine resonance suppression filter.
The control stability can be improved by setting the vibration elimination amount.
Deeper ← → Shallower
Setting value 000 001 010 011 100 101 110 111
Depth (dB) –∞ –18 –12 –9 –6 –4 –3 –1</td></tr>
</table>
</td></tr>
</table>

(2) Jitter compensation

The load inertia becomes extremely small if the motor position enters the machine backlash when the motor is stopped. Because this means that an extremely large VGN1 is set for the load inertia, vibration may occur.
Jitter compensation is the suppression of vibration occurring when the motor stops by ignoring the backlash amount of speed feedback pulses when the speed feedback polarity changes.
Increase the number of ignored pulses by one pulse at a time, and set a value at which the vibration can be suppressed. (Because the position feedback is controlled normally, there is no worry of positional deviation.)
When an axis that does not vibrate is set, vibration could be induced, so take care.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Special servo function selection 1</td><td>Set the jitter compensation with the following parameter.
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td>afrg</td><td>afse</td><td>ovs2</td><td>ovs1</td><td>lmc2</td><td>lmc1</td><td>omr</td><td></td><td>vfct2</td><td>vfct1</td><td></td><td>upc</td><td>vcnt2</td><td>vcnt1</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>No jitter compensation</th><th>One pulse compensation</th><th>Two pulse compensation</th><th>Three pulse compensation</th></tr>
<tr><td>4</td><td>vfct1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>5</td><td>vfct2</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>
</td></tr>
</table>

POINT Jitter compensation vibration suppression is only effective when the motor is stopped.

(3) Adaptive filter (option function)

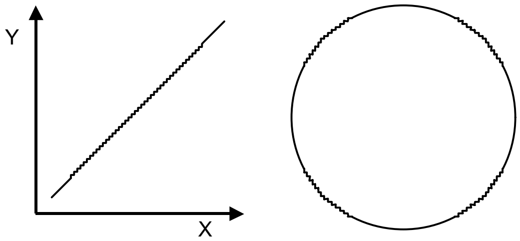
With the adaptive filter, the servo driver detects the machine resonance point and automatically sets the filter constant. Even if the ball screw and table position relation changes causing the resonance point to change, the filter will track these changes.
Set the special servo function selection 1 (SV027: SSF1) bit 15 to activate the adaptive filter.
Set (SV027: SSF1) bits 12 and 13 when the adaptive filter sensitivity is low and the machine resonance cannot be fully suppressed.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Special servo function selection 1</td><td>Activate the adaptive filter by setting the following parameters.
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td>afrg</td><td>afse</td><td>ovs2</td><td>ovs1</td><td>lmc2</td><td>lmc1</td><td>omr</td><td></td><td>vfct2</td><td>vfct1</td><td></td><td>upc</td><td>vcnt2</td><td>vcnt1</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set.</th><th>Meaning when "1" is set.</th></tr>
<tr><td>15</td><td>aflt</td><td>Adaptive filter stopped</td><td>Adaptive filter activated</td></tr>
<tr><td>13</td><td>afrg</td><td rowspan="2">00: Normal adaptive filter sensitivity</td><td rowspan="2">11: Increased adaptive filter sensitivity</td></tr>
<tr><td>12</td><td>afse</td></tr>
</table>
</td></tr>
</table>

POINT The adaptive filter is an optional function. If the option is not set in the CNC, alarm 37 (at power ON) or warning E4, Error Parameter No. 105 (2305 for M50/M64 Series CNC) will be output.

7-3-3 Improving the cutting surface precision

If the cutting surface precision or roundness is poor, improvements can be made by increasing the speed loop gain (VGN1, VIA) or by using the disturbance observer function.



<Examples of faults>

- The surface precision in the 45° direction of a taper or arc is poor.
- The load fluctuation during cutting is large, causing vibration or surface precision defects to occur.

POINT Adjust by raising the speed loop gain equivalently to improve cutting surface precision, even if the measures differ. In this case, it is important how much the machine resonance can be controlled, so adjust making sufficient use of vibration suppression functions.

(1) Adjusting the speed loop gain (VGN1)

If the speed loop gain is increased, the cutting surface precision will be improved but the machine will resonate easily.
The final VGN1 setting should be approx. 70 to 80% of the maximum value where resonance does not occur.
(Refer to "7-2-2 (1) Setting the speed loop gain")

(2) Adjusting the speed loop leading compensation (VIA)

The VIA has a large influence on the position trackability, particularly during high-speed cutting (generally F1000 or more). Raising the setting value improves the position trackability, and the contour precision during high-speed cutting can be improved. For high-speed high-precision cutting machines, adjust so that a value equal to or higher than the standard value can be set.
When the VIA is set lower than the standard value and set to a value differing between interpolation axes, the roundness precision may become worse (the circle may distort). This is due to differences occurring in the position trackability between interpolation axes. The distortion can be improved by matching the VIA with the smaller of the values. Note that because the position trackability is not improved, the surface precision will not be improved.
(Refer to "7-2-2 (2) Setting the speed loop leading compensation")

No.	Abbrev.	Parameter name	Explanation	Setting range
SV005	VGN1	Speed loop gain	Increase the value by 10 to 20% at a time. If the machine starts resonating, lower the value by 20 to 30% at a time. The setting value should be 70 to 80% of the value where resonance does not occur.	1 ~ 999
SV008	VIA	Speed loop leading compensation	1364 is set as a standard. 1900 is set as a standard during SHG control. Adjust in increments of approx. 100. Raise the VIA and adjust to improve the contour tracking precision in high-speed cutting. If the position droop vibrates (10 to 20Hz), lower the VIA and adjust.	1 ~ 9999 (0.0687rad/s)

(3) Disturbance observer

The disturbance observer can reduce the effect caused by disturbance, frictional resistance or torsion vibration during cutting by estimating the disturbance torque and compensating it. It also is effective in suppressing the vibration caused by speed advance compensation control.

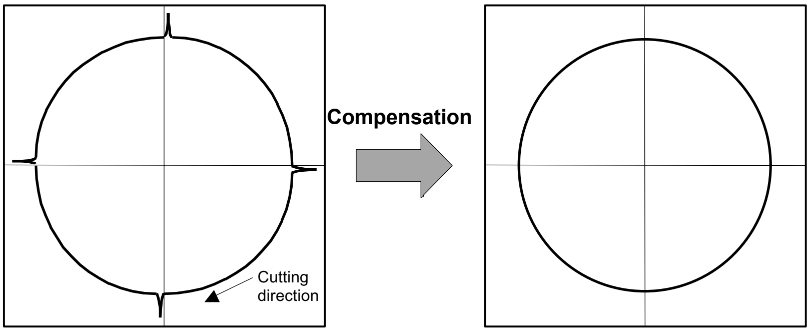
<Setting method>

1. Adjust VGN1 to the value where vibration does not occur, and then lower it 10 to 20%.
2. Set the load inertia scale (SV037:JL) with a percentage in respect to the motor inertia of the total load inertia.
3. Set the observer filter band (observer pole) in the disturbance observer 1 (SV043:OBS1), and estimate the high frequency disturbance to suppress the vibration. Set 600 as a standard.
4. Set the observer gain in disturbance observer 2 (SV044:OBS2). The disturbance observer will function here for the first time. Set 100 first, and if vibration does not occur, increase the setting by 50 at a time to increase the observer effect.
5. If vibration occurs, lower OBS1 by 50 at a time. The vibration can be eliminated by lowering OBS2, but the effect of the disturbance observer can be maintained by keeping OBS2 set to a high value.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV037	JL	Load inertia scale	%	Set the load inertia that includes the motor in respect to the motor inertia. (When the motor is a single unit, set 100%) $JL = \frac{Jl + Jm}{Jm}$ Jm : Motor inertia Jl : Machine inertia	0 ~ 5000 (%)
SV043	OBS1	Disturbance observer 1	rad/sec	Set the observer filter band (observer pole). Set 600 as a standard, and lower the setting by 50 at a time if vibration occurs.	0 ~ 1000 (rad)
SV044	OBS2	Disturbance observer 2	%	Set the observer gain. Set 100 to 300 as a standard, and lower the setting if vibration occurs.	0~ 500 (%)

7-3-4 Improvement of protrusion at quadrant changeover

The response delay (caused by non-sensitive band from friction, torsion, expansion/contraction, backlash, etc.) caused when the machine advance direction reverses is compensated with the lost motion compensation (LMC compensation) function.
With this, the protrusions that occur with the quadrant changeover in the DBB measurement method, or the streaks that occur when the quadrant changes during circular cutting can be improved.



Circle cutting path before compensation **Circle cutting path after compensation**

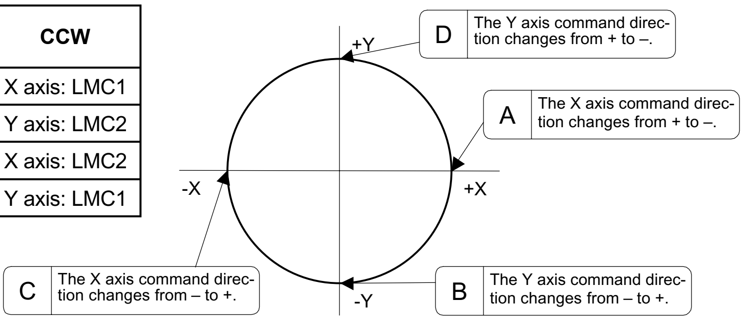
(1) Lost motion compensation (LMC compensation)

The lost motion compensation compensates the response delay during the reversal by adding the torque command set with the parameters when the speed direction changes. There are two methods for lost motion compensation. Type 2 is used as a standard.
(The explanation for type 1 method is omitted because it is interchangeable with the old method.)

<Setting method>

1. Set the special servo function selection 1 (SV027:SSF1) bit 9. (The LMC compensation type 2 will start).
2. Set the compensation amount with a stall % (rated current % for the general-purpose motor) unit in the lost motion compensation 1 (SV016:LMC1). The LMC1 setting value will be used for compensation in the positive and negative directions when SV041:LMC2 is 0.
3. If the compensation amount is to be changed in the direction to be compensated, set LMC2. The compensation direction setting will be as shown below with the CW/CCW setting in the CNC parameter. If only one direction is to be compensated, set the side not to be compensated as -1.

Compensation point	CW	CCW
A	X axis: LMC2	X axis: LMC1
B	Y axis: LMC1	Y axis: LMC2
C	X axis: LMC1	X axis: LMC2
D	Y axis: LMC2	Y axis: LMC1



<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Special servo function selection 1</td><td>The lost motion compensation starts with the following parameter.
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td>afrg</td><td>afse</td><td>ovs2</td><td>ovs1</td><td>lmc2</td><td>lmc1</td><td>omr</td><td></td><td>vfct2</td><td>vfct1</td><td></td><td>upc</td><td>vcnt2</td><td>vcnt1</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>No LMC</th><th>LMC type 1</th><th>LMC type 2</th><th>Setting prohibited.</th></tr>
<tr><td>8</td><td>lmc1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>9</td><td>lmc2</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>
</td></tr>
</table>

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV016	LMC1	Lost motion compensation 1	Stall % (rated current %)	While measuring the quadrant protrusion amount, adjust with a 5% unit. The ± direction setting value will be applied when LMC2 is set to 0.	–1 ~ 200 (%)
SV041	LMC2	Lost motion compensation 2	Stall % (rated current %)	Set 0 as a standard. Set this when the compensation amount is to be changed according to the direction.	–1 ~ 200 (%)

<Adjustment method>

First confirm whether the axis to be compensated is an unbalance axis (vertical axis, slant axis). If it is an unbalance axis, carry out the adjustment after performing step "(2) Unbalance torque compensation".

Next, measure the frictional torque. Carry out reciprocation operation (approx. F1000) with the axis to be compensated and measure the load current % when fed at a constant speed on the CNC servo monitor screen. The frictional torque of the machine at this time is expressed with the following expression.

$$\text{Frictional torque (\%)} = \left| \frac{(+\text{ feed load current \%}) \quad - \quad (-\text{ feed load current \%})}{2} \right|$$

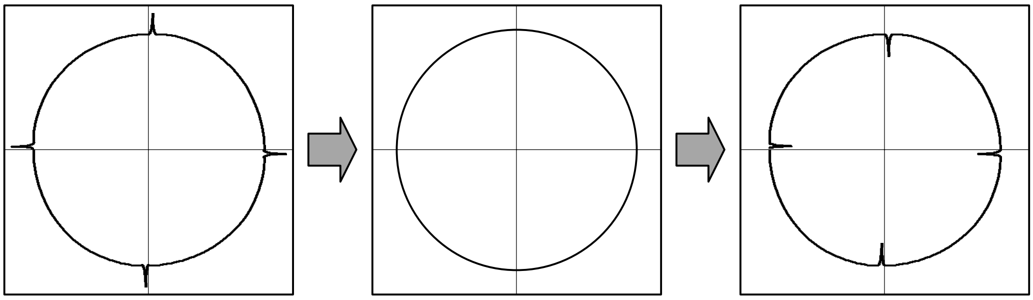
The standard setting value for the lost motion compensation 1 (LMC1) is double the frictional torque above.

(Example)

Assume that the load current % was 25% in the + direction and –15% in the – direction when JOG feed was carried out at approx. F1000. The frictional torque is as shown below, so 20% × 2 = 40% is set for LMC1. (LMC2 is left set at 0.) With this setting, 40% compensation will be carried out when the command reverses from the + direction to the - direction, and when the command reverses from the – direction to the + direction.

$$\left| \frac{25 - (-15)}{2} \right| = 20\%$$

For the final adjustment, measure the CNC sampling measurement (DBB measurement) or while carrying out actual cutting. If the compensation amount is insufficient, increase LMC1 or LMC2 by 5% at a time. Note that if the setting is too high, biting may occur.



Compensation 0 **Optimum** **Too high**

POINT

1. When either parameter SV016: LMC1 or SV041: LMC2 is set to 0, the same amount of compensation is carried out in both the positive and negative direction with the setting value of the other parameter (the parameter not set to 0).
2. To compensate in only one direction, set -1 in the parameter (LMC1 or LMC2) for the direction in which compensation is prohibited.
3. The value set based on the friction torque is the standard value for LMC compensation. The optimum compensation amount changes with the cutting conditions (cutting speed, cutting radius, blade type, workpiece material, etc.). Be sure to ultimately make test cuts matching the target cutting and determine the compensation amount.
4. Once LMC compensation type 1 is started, the overshooting compensation and the adaptive filter cannot be simultaneously started. A parameter error will occur.

(2) Unbalance torque compensation

If the load torque differs in the positive and negative directions such as with a vertical axis or slant axis, the torque offset (SV032:TOF) is set to carry out accurate lost motion compensation.

<Setting method>

Measure the unbalance torque. Carry out reciprocation operation (approx. F1000) with the axis to be compensated and measure the load current % when fed at a constant speed on the CNC servo monitor screen. The unbalance torque at this time is expressed with the following expression.

$$\text{Unbalance torque (\%)} = \left| \frac{(+\text{ feed load current \%}) \ + \ (-\text{ feed load current \%})}{2} \right|$$

The unbalance torque value above is set for the torque offset (TOF).
If there is a difference in the protrusion amount according to the direction, make an adjustment with LMC2. Do not adjust with TOF.

(Example)

Assume that the load current % was –40% in the + direction and –20% in the – direction when JOG feed was carried out at approx. F1000. The unbalance torque is as shown below, so 30% is set for TOF.

$$\left| \frac{-40 + (-20)}{2} \right| = 30\%$$

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV032	TOF	Torque offset	Stall % (rated current %)	Set this when carrying out lost motion compensation. Set the unbalance torque amount.	–100 ~ 100

POINT

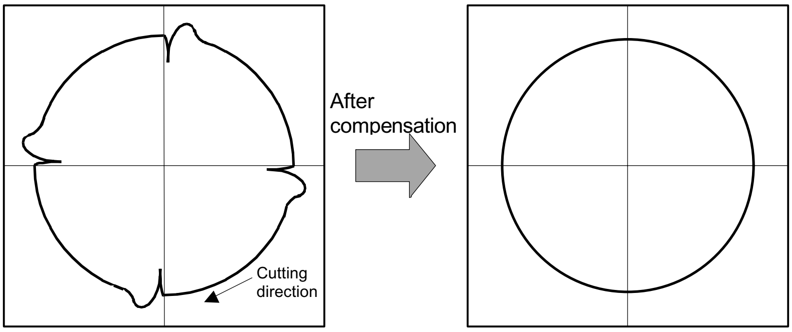
Even when TOF is set, the torque output characteristics of the motor and load current display of the CNC servo monitor will not change.
Only LMC compensation characteristics are affected.

(3) Adjusting the lost motion compensation timing

If the speed loop gain has been lowered from the standard setting value because the machine rigidity is low or because machine resonance occurs easily, or when cutting at high speeds, the quadrant protrusion may appear later than the quadrant changeover point on the servo control. In this case, suppress the quadrant protrusion by setting the lost motion compensation timing (SV039: LMCD) to delay the LMC compensation.

<Adjustment method>

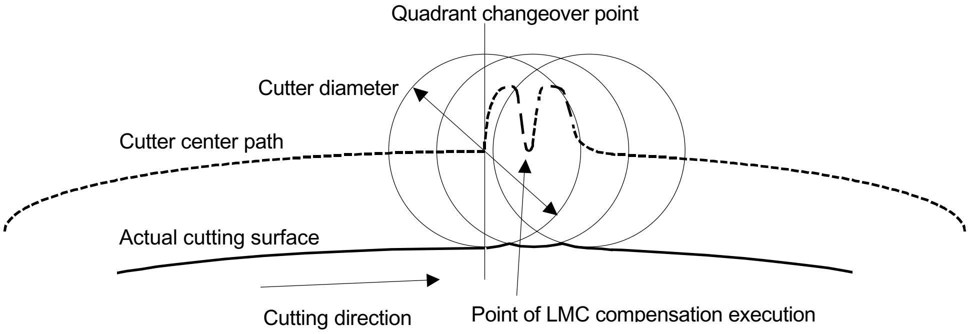
If a delay occurs in the quadrant protrusion in the circle or arc cutting as shown below in respect to the cutting direction when CNC sampling measurement (DBB measurement) or actual cutting is carried out, and the compensation appears before the protrusion position, set the lost motion compensation timing (SV039:LMCD).
While measuring the arc path, increase LMCD by 10 msec at a time, to find the timing that the protrusion and compensation position match.



Before timing delay compensation **After timing delay compensation**

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV039	LMCD	Lost motion compensation timing	msec	Set this when the lost motion compensation timing does not match. Adjust while increasing the value by 10 at a time.	0 ~ 2000 (msec)

When the LMCD is gradually raised, a two-peaked contour may occur at the motor end FB position DBB measurement. However, due to the influence of the cutter diameter in cutting such as end milling, the actual cutting surface becomes smooth.
Because satisfactory cutting can be achieved even if this two-peaked contour occurs, consider the point where the protrusion becomes the smallest and finest possible without over compensating (bite-in) as the optimum setting.



(4) Adjusting for feed forward control

In LMC compensation, a model position considering the position loop gain is calculated based on the position command sent from the CNC, and compensation is carried out when the feed changes to that direction. When the CNC carries out feed forward (fwd) control, overshooting equivalent to the operation fraction unit occurs in the position commands, and the timing of the model position direction change may be mistaken. As a result, the LMC compensation timing may deviate, or compensation may be carried out twice.

If feed forward control is carried out and the compensation does not operate correctly, adjust with the non-sensitive band (SV040: LMCT) during feed forward control. In this non-sensitive band control, overshooting of a set width or less is ignored during feed forward. The model position direction change point is correctly recognized, and the LMC compensation is correctly executed.

This parameter is meaningless when feed forward control is not being carried out.

<Adjustment method>

If the compensation timing deviates during feed forward control, increase the LMCT setting by 1µm at a time.

Note that 2µm are set even when the LMCT is set to 0.

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV040	LMCT	Non-sensitive band during feed forward control	µm	This setting is valid only during feed forward control. 2 µm is set when this is set to 0. Adjust by increasing the value by 1 µm at a time.	0 ~ 100 (µm)

POINT

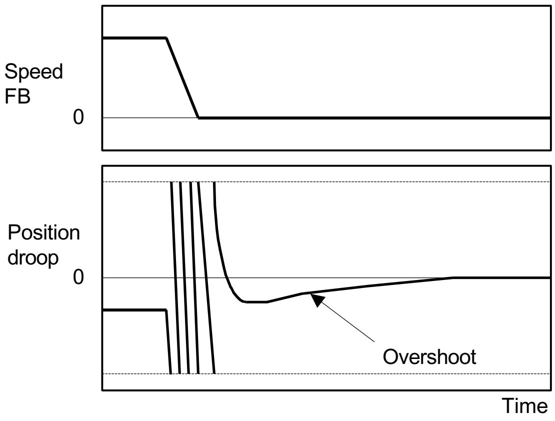
Setting of the non-sensitive band (SV040: LMCT) during feed forward control is effective for improving overshooting compensation mis-operation during feed forward control.

7-3-5 Improvement of overshooting

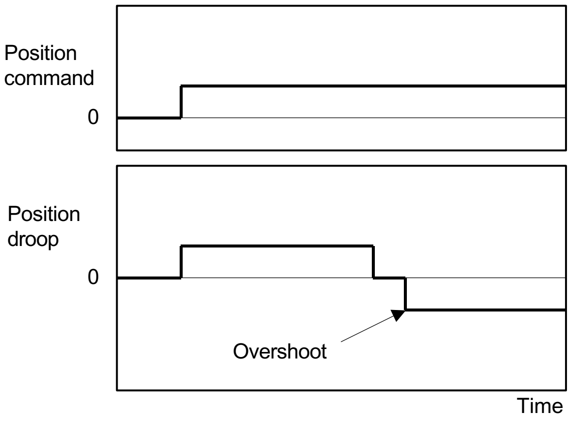
The phenomenon when the machine position goes past or exceeds the command during feed stopping is called overshooting. Overshooting is compensated by overshooting compensation (OVS compensation).
Overshooting occurs due to the following two causes.

① Machine system torsion : Overshooting will occur mainly during rapid traverse settling
② Machine system friction : Overshooting will occur mainly during one pulse feed

Either phenomenon can be confirmed by measuring the position droop.



Overshooting during rapid traverse settling



Overshooting during pulse feed

(1) Overshooting compensation (OVS compensation)

In OVS compensation, the overshooting is suppressed by subtracting the torque command set in the parameters when the motor stops. There are two types of OVS compensation. The standard method is type 2.
OVS compensation type3 has a compensation effect for the overshooting during either rapid traverse settling or pulse feed. Note that there is no compensation if the next feed command has been issued before the motor positioning (stop). (Therefore, there is no compensation during circle cutting.) There is also no compensation in the non-sensitive band when the CNC is carrying out feed forward control. To compensate overshooting during feed forward control, refer to the following section "(2) Adjusting for feed forward control".

<Setting and adjustment methods>

1. Set the special servo function selection 1 (SV027:SSF1) bit 11. (OVS compensation type 2 will start.)
2. Observe the position droop waveform using the D/A output, and increase the overshooting compensation 1 (SV031: OVS1) value 1% at a time. Set the smallest value where the overshooting does not occur. If SV042:OVS2 is 0, the overshooting will be compensated in both the forward/reverse directions with the OVS1 setting value.
3. If the compensation amount is to be changed in the direction to be compensated, set the + direction compensation value in OVS1 and the – direction compensation value in OVS2. If only one direction is to be compensated, set the side not to be compensated as -1. The compensation direction setting will be as reversed with the CNC parameter CW/CCW setting.

POINT

In OVS compensation type 2, there is no compensation in the following cases.

1. There is no compensation if the next feed command has been issued before the motor positioning (stop). (There is no compensation in circle cutting.)
2. There is no compensation when the CNC is carrying out feed forward (fwd) control.

(2) Adjusting for feed forward control

Use OVS compensation type 3 if overshooting is a problem in contour cutting during feed forward control.
If OVS compensation type 3 is used to attempt to compensate overshooting, the overshooting may conversely become larger, or protrusions may appear during arc cutting. This is because overshooting equivalent to the operation fraction unit occurs in the position commands when the CNC is carrying out feed forward (fwd) control. Because of this, the OVS compensation recognizes a change in the command direction, and executes the compensation in the opposite direction.
If the compensation is in the opposite direction when carrying out feed forward control, adjust with the non-sensitive band (SV034: SSF3 bits 12 to 15:ovsn) during feed forward control. By ignoring overshooting of a set width in the OVSN or less, the command direction change point is correctly recognized, and the OVS compensation is correctly executed.
This parameter is insignificant when feed forward control is not used.

<Adjustment method>

If the OVS compensation is carried out in reverse during feed forward control, increase the LMCT setting by 1μm at a time.
Note that 2μm are set even when the LMCT is set to 0.

POINT OVS compensation type 3 is used if overshooting is a problem in contour cutting during feed forward control.

No.	Abbrev.	Parameter name	Explanation
SV027	SSF1	Special servo function selection 1	The overshooting compensation starts with the following parameter.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
aflt	zrn2	afrg	afse	ovs2	ovs1	lmc2	lmc1	omr		vfct2	vfct1		upc	vcnt2	vcnt1

Bit		Meaning when "0" is set.	Meaning when "1" is set.
10	Ovs1	Overshooting compensation type 2 stop	Overshooting compensation type 2 start
11	ovs2	Overshooting compensation type 3 stop	Overshooting compensation type 3 start

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV031	OVS1	Overshooting compensation 1	Stall % (rated current %)	Increase the value by 1% at a time, and find the value where overshooting does not occur. When OVS2 is set to 0, the setting value will be applied in both the ± directions.	–1 ~ 100 (%)
SV042	OVS2	Overshooting compensation 2	Stall % (rated current %)	Set 0 as a standard. Set this when the compensation amount is to be changed according to the direction.	–1 ~ 100 (%)

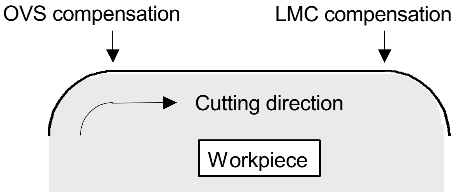
No.	Abbrev.	Parameter name	Explanation
SV034	SSF3	Special servo function selection 3	The overshooting compensation starts with the following parameter.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ovsn				linN				toff	os2		dcd	test	mohn	has2	has1

bit		Explanation
12	ovsn	Set the non-sensitive band for overshooting compensation type 3.
13		
14		
15		

POINT

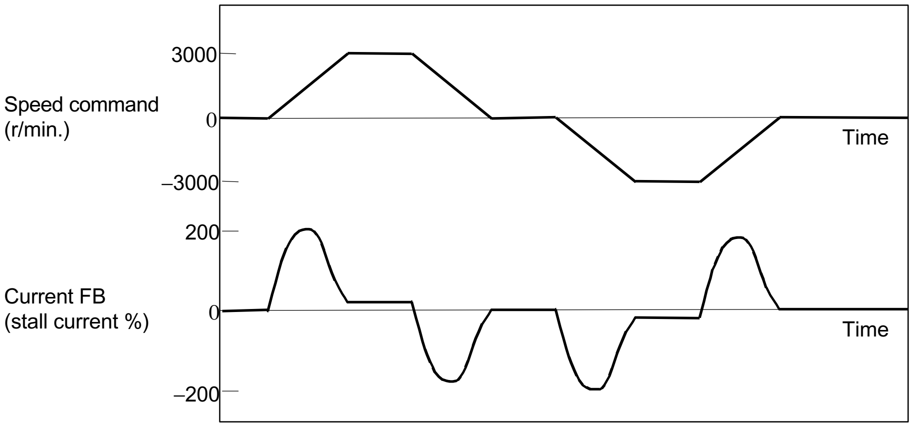
1. When either parameter SV031: OVS1 or SV042: OVS2 is set to 0, the same amount of compensation is carried out in both the positive and negative direction, using the setting value of the other parameter (the parameter not set to 0).
2. To compensate in only one direction, set -1 in the parameter (OVS1 or OVS2) for the direction in which compensation is prohibited.
3. For contour cutting, the protrusion at the arc end point is compensated with OVS compensation. LMC compensation is carried out at the arc starting point.



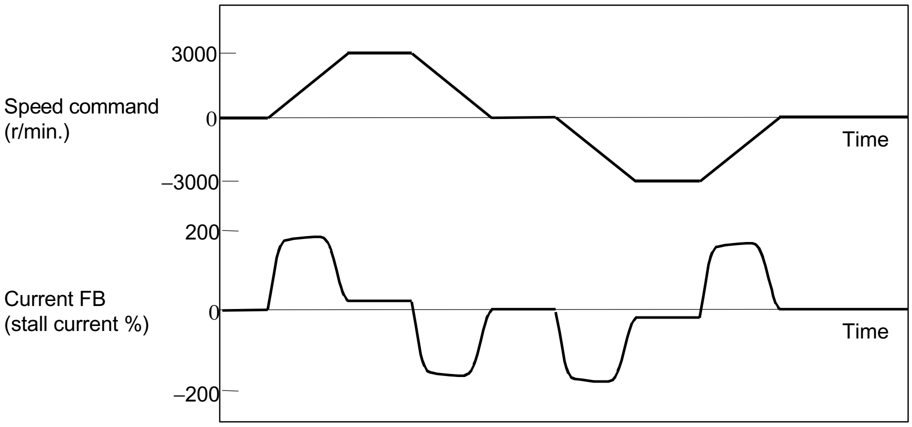
7-3-6 Improvement of characteristics during acceleration/deceleration

(1) SHG control (option function)

Because SHG control has a smoother response than conventional position controls, the accelera-tion/deceleration torque (current FB) has more ideal output characteristics (A constant torque is output during acceleration/deceleration.) The peak torque is kept low by the same acceleration/ deceleration time constant, enabling the time constant to be shortened.
Refer to item "(3) SHG control" in section "7-2-3 Position loop gain" for details on setting SHG control.



Acceleration/deceleration characteristics during conventional control

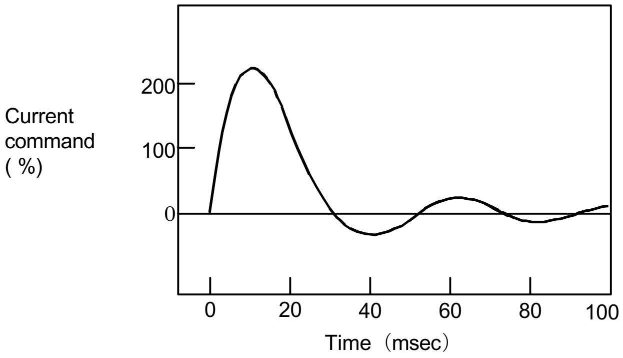


Acceleration/deceleration characteristics during SHG control

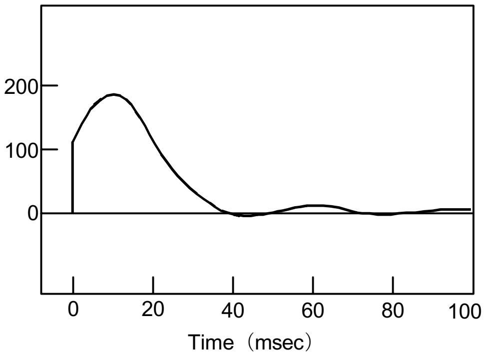
No.	Abbrev.	Parameter name	Setting ratio	Setting example					Explanation	Setting range
SV003 (SV049)	PGN1 (PGN1sp)	Position loop gain 1	1	23	26	33	38	47	Always set a combination of 3 parameters.	1 ~ 200 (rad/s)
SV004 (SV050)	PGN2 (PGN2sp)	Position loop gain 2	$\frac{8}{3}$	62	70	86	102	125		0 ~ 999
SV057 (SV058)	SHGC (SHGCsp)	SHG control gain	6	140	160	187	225	281		0 ~ 1200
SV008	VIA	Speed loop advance compensation	Set 1900 as a standard value during SHG control.							1 ~ 9999
SV015	FFC	Acceleration feed forward gain	Set 100 as a standard value during SHG control.							0 ~ 999

(2) Acceleration feed forward

Vibration may occur at 10 to 20 Hz during acceleration/deceleration when a short time constant of 30 msec or less is applied, and a position loop gain (PGN1) higher than the general standard value or SHG control is used. This is because the torque is insufficient when starting or when starting deceleration, and can be resolved by setting the acceleration feed forward gain (SV015:FFC). This is also effective in reducing the peak current (torque).
While measuring the current command waveform, increase FFC by 50 to 100 at a time and set the value where vibration does not occur.



No FFC setting



With FFC setting

Acceleration feed forward gain means that the speed loop gain during acceleration/deceleration is raised equivalently. Thus, the torque (current command) required during acceleration/deceleration starts sooner. The synchronization precision will improve if the FFC of the delayed side axis is raised between axes for which high-precision synchronous control (such as synchronous tap control and superimposition control).

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV015	FFC	Acceleration feed forward gain	%	The standard setting value is 0. To improve the acceleration/deceleration characteristics, increase the value by 50 to 100 at a time. During SHG control, the standard setting value is 100.	1 ~ 999

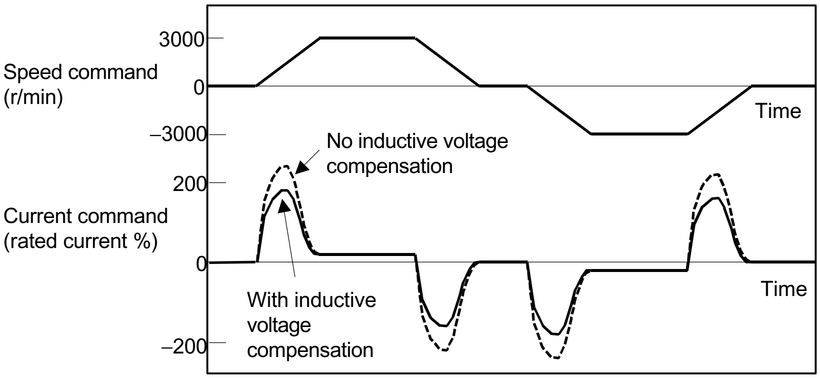
POINT Overshooting occurs easily when a value above the standard value is set during SHG control.

(3) Inductive voltage compensation

The current loop response is improved by compensating the back electromotive force element induced by the motor rotation. This improved the current command efficiency, and allows the acceleration/deceleration time constant to the shortened.

<Adjustment method>

1. While accelerating/decelerating at rapid traverse, adjust the inductive voltage compensation gain (SV047:EC) so that the current FB peak is a few % smaller than the current command peak.



Inductive voltage compensation

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV047	EC	Inductive voltage compensation gain	%	Set 100 as a standard. Lower the gain if the current FB peak exceeds the current command peak.	0 ~ 200

POINT If the current FB peak becomes larger than the current command peak (over compensation), an overcurrent (alarm 3A) will occur easily. Note that over compensation will occur easily if the load inertia is large.

7-4 Setting for emergency stop

7-4-1 Vertical axis drop prevention control

The vertical axis drop prevention control is a function that prevents the vertical axis from dropping due to a delay in the brake operation when an emergency stop occurs. The servo driver ready OFF will be delayed by the time set in the parameter from when the emergency stop occurs. Thus, the no-control time until the brakes activate can be eliminated.

(1) Operating conditions

1) Emergency stop input :

   The emergency stop input signal is detected on the driver side, and the machine enters the mode for this function.

2) CNC power OFF (driver section power ON) :

   The power OFF message from the CNC is detected by the driver, and the machine changes to this operation.

3) When an alarm occurs :

   This function may or may not operate depending on the alarm, so be careful.
   (Refer to the table of driver alarm types)

4) Input power OFF (instantaneous power failure, etc.) :

   Normally the CNC power OFF signal is detected on the driver side in the same manner as 2) above, and the machine enters this operation.
   Note that in this mode the input power is suddenly shut off, and there may be no effect due to the operating status of the axes to which power is being supplied from the input power voltage and power supply (axes connected by L+ and L–). Therefore, caution is advised.

⚠ CAUTION

This does not mean the drop prevention function can prevent dropping in all of the above conditions. To prevent dropping in all the conditions, take measures on the machine side such as balanced installation, etc.

(2) Function outline and parameter settings

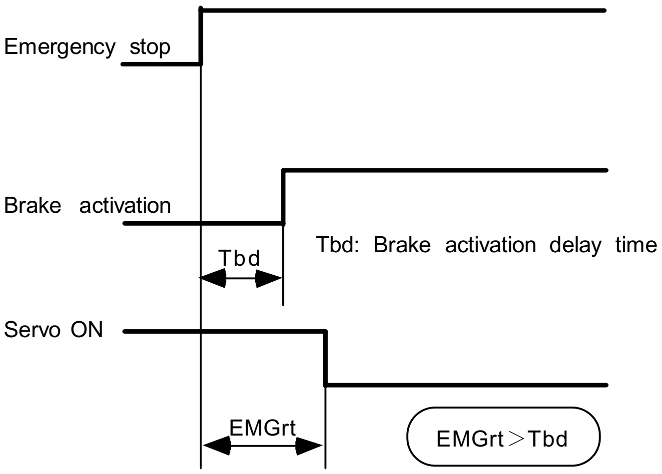
While stopped .... The driver enters a ready OFF state after the vertical axis drop prevention time (SV048) has elapsed.

While moving .... A deceleration stop is carried out, and the driver enters a ready OFF state after the larger value of the vertical axis drop prevention time (SV048) and emergency stop max. delay time (SV055) has elapsed.

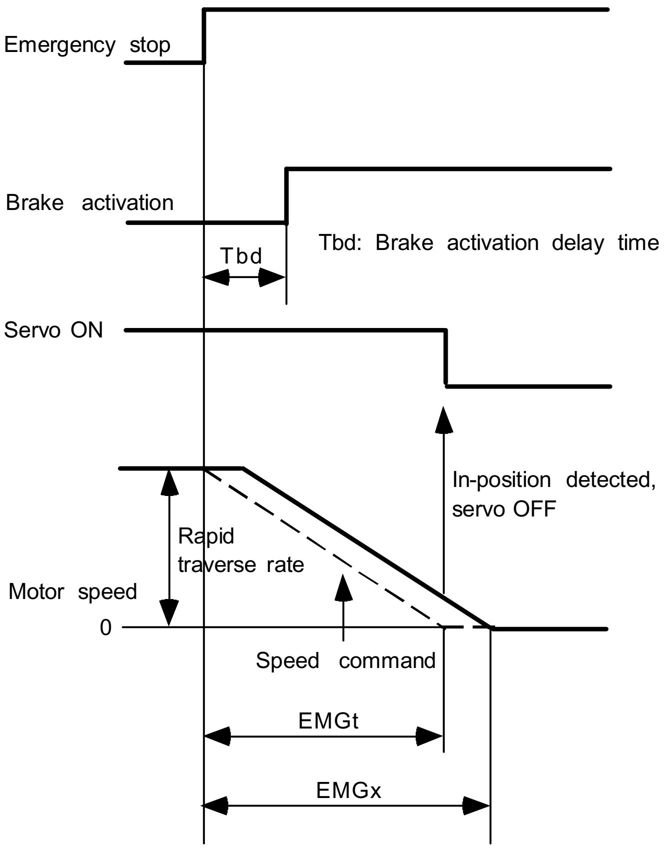
No.	Abbrev.	Parameter name	Explanation	Setting range
SV048	EMGrt	Vertical axis drop prevention time (ms)	Set the time to delay the ready OFF when an emergency stop occurs. Set a value larger than the brake activation time. The set vertical drop prevention time cannot always be assured if the input power is OFF.	0 ~ 2000 (msec)
SV055	EMGx	Emergency stop Max. delay time (ms)	Set the max. ready OFF delay time. This is normally set to the same value as SV048. To put the machine in a ready OFF state after a deceleration stop, set the same value as SV056. Note the this value is valid if SV056 is larger than SV048. When a value smaller than SV048 is input, the same value as SV048 will be automatically set. The set max. ready OFF time cannot always be assured if the input power is OFF.	0 ~ 2000 (msec)
SV056	EMGt	Deceleration control time constant at emergency stop (ms)	A deceleration stop will be carried out if moving when SV048 is set, so set that deceleration stop time constant. Set the same value as the rapid traverse time constant. When this parameter is set, a constant inclination direct deceleration stop will be carried out at emergency stops. A step stop will be carried out when this parameter is set to 0.	0 ~ 2000 (msec)

⚠ CAUTION

1. The drop prevention function is invalidated if both SV048 and SV055 are set to 0.
2. The settings of SV048 and SV055 are for each axis. However, if the settings between two axes in the same driver differ, the larger value of the two is validated.
3. The deceleration stop will become a step stop if only SV048 is set.



Drop prevention function sequence at emergency stop



Deceleration stop function sequence at emergency stop

(3) Adjustment procedure

- Set the drop prevention function parameters in the vertical axis servo parameters SV048, 055, and 056.
    1) Carry out emergency stops with SV048 (vertical axis drop prevention time) for the vertical axis set to 50, 100, etc., and use the smallest drop amount value on the CNC screen for the setting value. (A few µm will remain due to the brake play.)
    2) Set SV056 (deceleration control time constant at emergency stop). This is normally set to the same value as the rapid traverse time constant.
    3) Set SV055 (emergency stop Max. delay time). This is normally set to the same value as SV048. To put the machine in a ready OFF state after a deceleration stop, set the same value as SV056. Note that this value is valid if SV056 (deceleration control time constant at emergency stop) is larger than SV048 (vertical axis drop prevention time).

- If the axis controlling the power supply providing the power to the target vertical axis is another servo axis (axis connected to a CN4 cable), set the same values as those for the vertical axis in the servo parameters SV048, 055, and 056 for that axis.

  (Set the largest value if there are several vertical axes.)

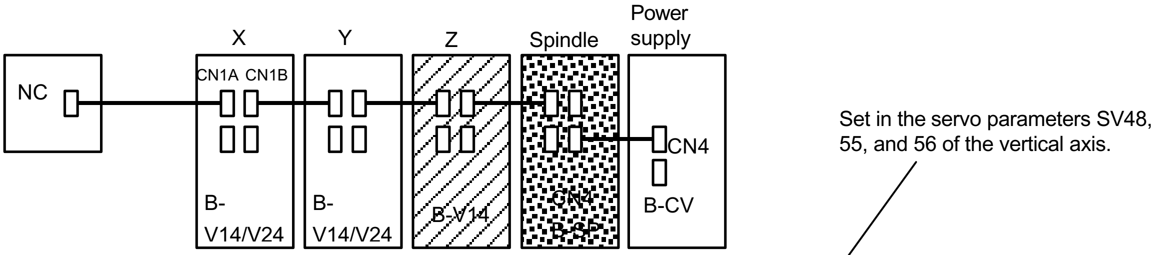
- If the 2-axis driver is an axis controlling a vertical axis or the power supply, set the servo parameters SV048, 055, and 056 for both the L and M axes.

- If the axis controlling the power supply is the spindle, confirm that the spindle driver software being used is a compatible version, and set bitF of spindle parameter SP033 to 1.

Caution is required when setting the parameters for each system, such as when using an axis to control the power supply or a 2-axis integrated driver, as shown above. The parameter setting method for each drive system is explained on the following pages.

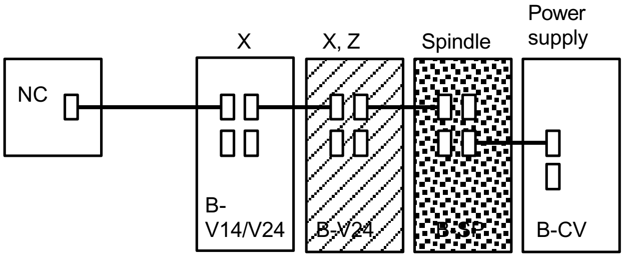
1) When the power supply control axis is the spindle (Ex: When the vertical axis is the Z axis.)

1) -1 : When the vertical axis is a 1-axis driver



Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V14/V24)	Z axis (B-V14)	Spindle (B-SP)
			Vertical axis 1-axis servo driver	Power supply connected axis
SV48	0	0	Set by adjustment.	A5 or later version spindle software is required. (Set 1 in bitF of spindle parameter SP033.)
SV55	0	0	Set the same value as SV48.	
SV56	0	0	Set the same value as the rapid traverse time constant.	

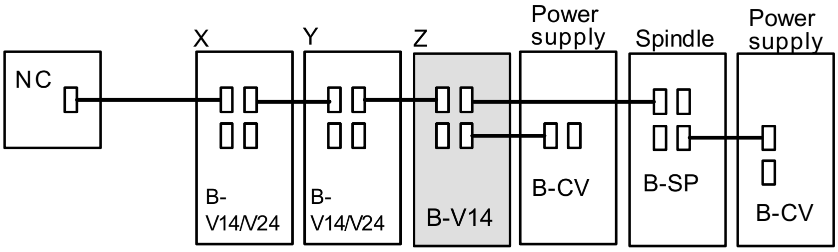
1) -2 : When the vertical axis is a 2-axis driver



Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V24)	Z axis (B-V24)	Spindle (B-SP)
		Vertical axis 2-axis servo driver	Vertical axis 2-axis servo driver	Power supply connected axis
SV48	0	Set the same value as the Z axis.	Set by adjustment.	A5 or later version spindle software is required. (Spindle parameter SP033/bitF=1.)
SV55	0	Set the same value as the Z axis.	Set the same value as SV48.	
SV56	0	Set the same value as the rapid traverse time constant.	Set the same value as the rapid traverse time constant.	

∗ Set to both L and M axes when the vertical axis is a 2-axis driver.

2) When the power supply control axis is the vertical axis servo axis
(Ex: When the Z axis is both the vertical axis and power supply connected axis)

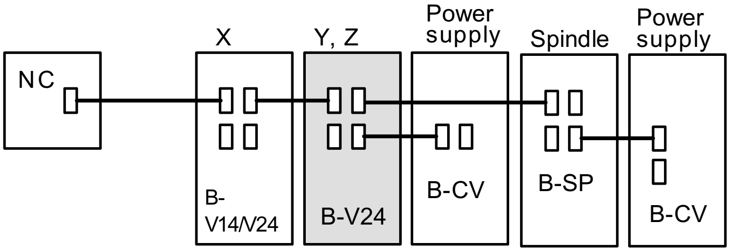


When the vertical axis and power supply connection are the same driver, only the servo parameters for the vertical axis need to be set.

2) -1 : When the vertical axis is a 1-axis driver

Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V14/V24)	Z axis (B-V14)	Spindle (B-SP)
			Vertical axis and power supply connected axis	Separate power supply connected (spindle only)
SV48	0	0	Set by adjustment.	Not dependent on software.
SV55	0	0	Set the same value as SV48.	
SV56	0	0	Set the same value as the rapid traverse time constant.	

2) -2 : When the vertical axis is a 2-axis driver

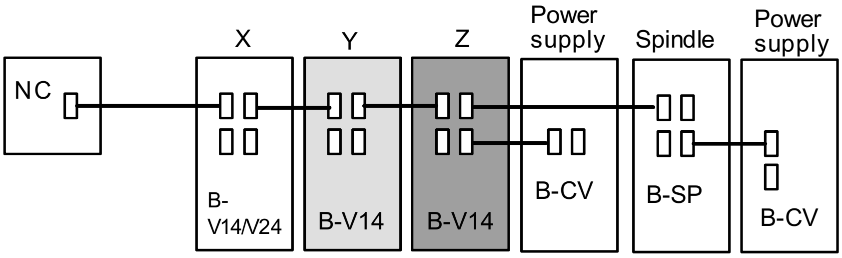


Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V24)	Z axis (B-V24)	Spindle (B-SP)
		Vertical axis 2-axis servo driver	Vertical axis 2-axis servo driver	Separate power supply connected (spindle only)
SV48	0	Set the same value as Z axis.	Set by adjustment.	Not dependent on software.
SV55	0	Set the same value as Z axis.	Set the same value as SV48.	
SV56	0	Set the same value as the rapid traverse time constant.	Set the same value as the rapid traverse time constant.	

∗ Set to both L and M axes when the vertical axis is a 2-axis driver.

3) When the power supply control axis is a different driver from the vertical axis servo axis
(Ex: When the vertical axis is the Y axis, and the power supply connected axis is the Z axis.)

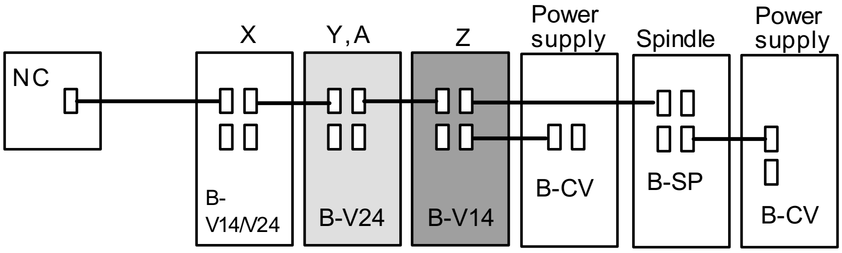
3) -1 : When the vertical axis and power supply control axis are a 1-axis driver



Axis Parameter setting	X axis (B-V14/V24)	Y axis (B-V14)	Z axis (B-V14)	Spindle (B-SP)
		Vertical axis	Power supply connected axis	Separate power supply connected (spindle only)
SV48	0	Set by adjustment.	Set the same value as Y axis.	Not dependent on software.
SV55	0	Set the same value as SV48.	Set the same value as Y axis.	
SV56	0	Set the same value as the rapid traverse time constant.	Set the same value as the rapid traverse time constant.	

∗ When the vertical axis and power supply connected axis are different, the servo parameters of both axes must be set.

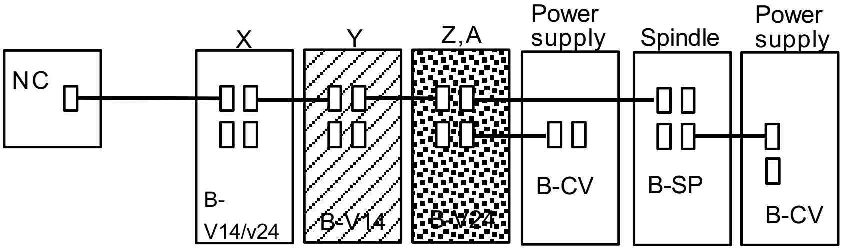
3) -2 : When the vertical axis is a 2-axis driver



Axis Parameter setting	X axis (B-V14/V24)	Y axis (B-V24)	A axis (B-V24)	Z axis (B-V14)	Spindle (B-SP)
		Vertical axis 2-axis servo driver	Vertical axis 2-axis servo driver	Power supply connected axis	Separate power supply connected (spindle only)
SV48	0	Set by adjustment.	Set the same value as Y axis.	Set the same value as Y axis.	Not dependent on software.
SV55	0	Set the same value as SV48.	Set the same value as Y axis.	Set the same value as Y axis.	
SV56	0	Set the same value as the rapid traverse time constant.	Set the same value as the rapid traverse time constant.	Set the same value as the rapid traverse time constant.	

∗ Set to both L and M axes when the vertical axis is a 2-axis driver.

3) - 3 : When the power supply connected amplifier is a 2-axis driver



Axis / Parameter setting	X axis (B-V14/V24)	Y axis (B-V24)	Z axis (B-V14)	A axis (B-V24)	Spindle (B-SP)
		Vertical axis	Power supply connected driver 2-axis servo driver	Power supply connected driver 2-axis servo driver	Separate power supply connected axis (spindle only)
SV48	0	Set by adjustment.	Set the same value as Y axis.	Set the same value as Y axis.	Not dependent on software.
SV55	0	Set the same value as SV48.	Set the same value as Y axis.	Set the same value as Y axis.	
SV56	0	Set the same value as the rapid traverse time constant.	Set the same value as the rapid traverse time constant.	Set the same value as the rapid traverse time constant.	

∗ Set to both L and M axes when the power supply connected driver is a 2-axis driver.

7-4-2 Deceleration control

This MDS-B-Vx4 servo driver basically stops using the dynamic brake method when an emergency stop occurs, but if the deceleration stop function is validated, the motor will decelerate following a set time constant while the ready ON state is maintained.
A ready OFF state will occur after the motor stops, and the dynamic brakes will be activated.

<Features>

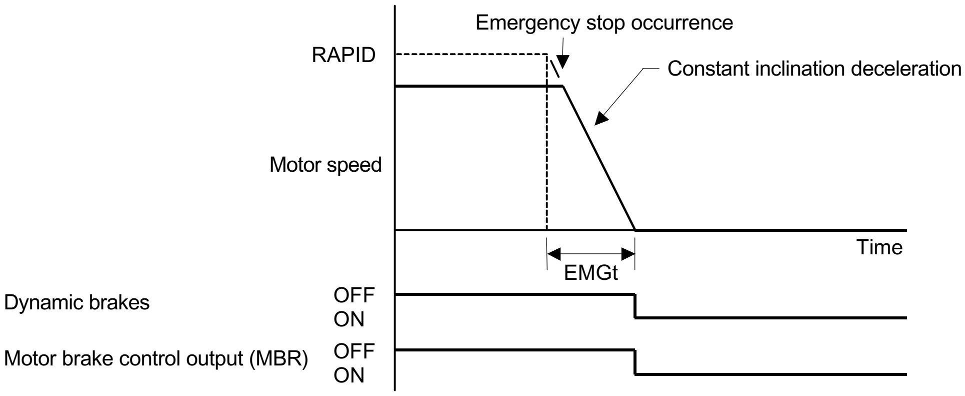
1. When the load inertia is large, deceleration and stop are possible with a short time constant using the dynamic brakes. (Stopping is possible with a basically normal acceleration/ deceleration time constant.)

(1) Setting the deceleration control time constant

The time to stopping from the rapid traverse rate (rapid: axis specification parameter) is set in the deceleration control time constant (SV056: EMGt). A position loop step stop is carried out when 0 is set.
When linear (straight line) acceleration/deceleration is selected for the rapid traverse, the same value as the acceleration/deceleration time constant (G0tL) becomes the standard value. When another acceleration/deceleration pattern is selected, set the rapid traverse to linear acceleration/ deceleration. Adjust to the optimum acceleration/deceleration time constant, and set that value as the standard value.

<Operation>

When an emergency stop occurs, the motor will decelerate at the same inclination from each speed.



No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV055	EMGx	Emergency stop Max. delay time	msec	Normally set to the same value as ENGt of SV056. Set to 0 when not using the deceleration stop or drop prevention functions.	0 ~ 5000 (msec)
SV056	EMGt	Deceleration control time constant	msec	Set the time to stop from rapid traverse rate (rapid). Set the same value as the rapid traverse acceleration/deceleration time constant (G0tL) as a standard. Set to 0 when not using the deceleration stop function.	0 ~ 5000 (msec)

POINT

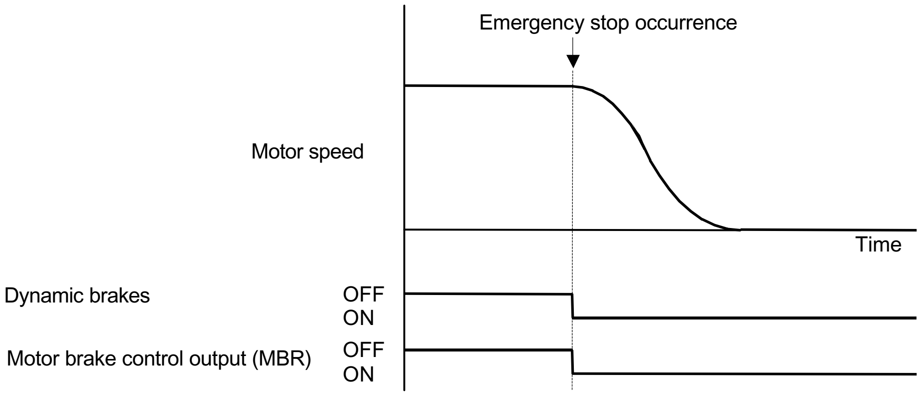
1. The deceleration will not be controlled when a servo alarm that uses the dynamic brake stopping method occurs. Stopping is by the dynamic brake method regardless of the parameter setting.
2. When a power failure occurs, the stopping method may change over to a dynamic brake stop during deceleration control if the deceleration time constant is set comparatively long. This is because of low bus voltage in the driver.

⚠ CAUTION

If the deceleration control time constant (EMGt) is set longer than the acceleration/deceleration time constant, the overtravel point (stroke end point) may be exceeded.
A collision may be caused on the machine end, so be careful.

(2) Dynamic brake stop

A dynamic brake stop is carried out if the deceleration stop function is not used.
In a dynamic brake stop, the dynamic brakes operate at the same time the emergency stop occurs, and the motor brake control output also operates at the same time.



7-5 Collision detection

The purpose of the collision detection function is to quickly detect collisions and carry out a deceleration stop. This enables the occurance of abnormal torque to the machine tool to be held to a minimum, and it becomes difficult for that abnormal state to occur.

Even when the collision detection function is used, the collision itself cannot be prevented when a collision occurs. Therefore, the use of this function does not guarantee that the machine tool will be protected from failure or that the machine accuracy will be held after a collision occurs. Thus as with conventional models, caution is necessary to prevent the occurrence of machine collision, etc.

Collisions are detected using the following two methods. In either method, a servo alarm will occur after the deceleration stop.

(1) Method 1

The required torque for the position command issued from the CNC is estimated from that command, and the disturbance torque is obtained from its difference with the actual torque. When this disturbance torque exceeds the collision detection level set in the parameters, a deceleration stop is carried out at the max. torque of the driver. An alarm occurs after the deceleration stop, and the system stops.

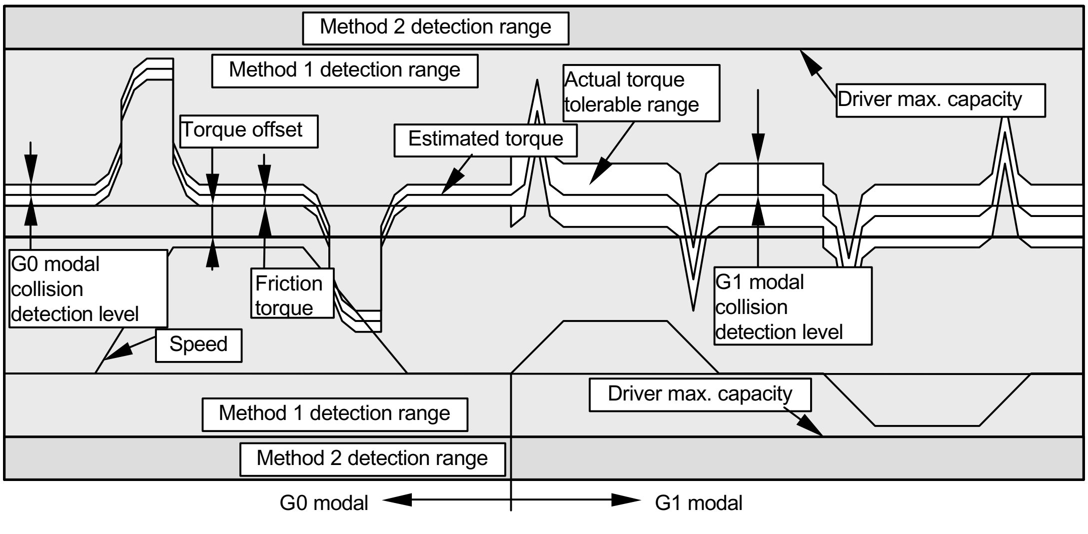
Method 1 only operates when the SHG control is being used. (If an acceleration/deceleration operation is carried out when not using SHG control, a LOAD ERROR ALARM (58/59) will immediately occur.)

Method 1 enables independent setting of the collision detection levels during rapid traverse and cutting feed. The collision detection level during cutting feed is set at 0 to 7-fold (integer magnification) of the collision detection level during rapid traverse. When 0-fold is set, collision detection method 1 will not function during cutting feed.

(2) Method 2

When the current command reaches the max. capacity of the driver, deceleration stop is carried out at the max. torque of the driver. An alarm occurs after the deceleration stop, and the system stops.

Note that this method can be ignored by setting the servo parameter SV035: SSF4/cl2n to 1.



<Setting and adjustment method>

1. Confirm that the control being used is SHG control.
2. SV032 : TOF Torque offset
   Use the JOG mode, etc., to move the axis to be adjusted at F1000mm/min, and check the load current on the [I/F DIAGNOSIS SCREEN AND SERVO MONITOR]. If the current load is positive during movement, check the max. value. If the current load is negative during movement, check the min. value. Set the average value of the + and - directions.
3. SV045 : TRUB Friction torque
   Use the JOG mode, etc., to move the axis to be adjusted at F1000mm/min in both directions, and check the load current on the [I/F DIAGNOSIS SCREEN AND SERVO MONITOR]. Subtract the current load value during movement in the - direction from the current load value during movement in the + direction, and set the absolute position of that value divided by 2.
4. SV059 : TCNV Torque estimated gain
   Set SV035: SSF4/clt (bit F) of the axis to be adjusted to 1.
   Use the JOG mode, etc., to move the axis to be adjusted at the max. rapid traverse rate in both directions until the MPOF display on the [I/F DIAGNOSIS SCREEN AND SERVO MONITOR] stabilizes.
   Set the MPOF display value of the [I/F DIAGNOSIS SCREEN AND SERVO MONITOR].
   Return the SV035: SSF4/clt (bit F) setting to 0.
5. SV035 : SSF4/cl2n (bit B)
   Set this bit to 1 when the acceleration/deceleration time constant is short and the current is limited.
6. SV060 : TLMT Collision detection level (for method 1, G0 modal)
   Initially set to 100. (When SV035: SSF4/clet is set to 1, the MPOF value shows the estimated disturbance torque peak value for the last 2 seconds, so this can be used as a reference when setting. However, this value is averaged, so initially set a value 2-fold of the display value.)
   Carry out a no-load operation at the max. rapid traverse rate. If it appears an alarm will occur, raise the setting value in increments of 20.
   If it appears an alarm will not occur, lower the setting value in increments of 10.
   Set a value 1.5-fold of the limit where an alarm does not occur.
7. SV035 : SSF4/clG1 (bit 12-14)
   Divide the max. cutting load by the SV060: TLMT setting value. (Round up values below the decimal.) Set that value.

(Example) When the max. cutting load is 200%, and the SV060: TLMT setting value is 80%.

200/80 = 2.5 → The setting value is rounded up to 3, so 3xxx is set in SV035: SSF4.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV035</td><td>SSF4</td><td>Special servo function selection 4</td><td>The collision detection is set with the following parameters.
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>clt</td><td colspan="3">clG1</td><td>cl2n</td><td>clet</td><td colspan="2">cltq</td><td></td><td>iup</td><td colspan="6">tdt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>8, 9</td><td>cltq</td><td colspan="2">Set the deceleration torque at collision detection.</td></tr>
<tr><td>10</td><td>clet</td><td>Setting for normal use.</td><td>The estimated disturbance torque peak value of the last two seconds is displayed in MPOF of the SERVO MONITOR screen.</td></tr>
<tr><td>11</td><td>cl2n</td><td>Setting for normal use.</td><td>Invalidate collision detection method 2.</td></tr>
<tr><td>12~14</td><td>clG1</td><td colspan="2">Set the collision detection level for collision detection method 1 and G1 modal.
When 0 is set : Collision detection is not carried out for method 1 and G1 modal.
When 1 to 7 is set : The collision detection level during method 1 and G1 modal is considered a value 2-fold of the collision detection level during method 1, G0 modal set in (SV060: TLMT).</td></tr>
<tr><td>15</td><td>clt</td><td>Setting for normal use.</td><td>The guideline value for the SV059: TCNV setting is displayed in MPOF of the SERVO MONITOR screen.</td></tr>
</table>
</td></tr>
</table>

No.	Abbrev.	Parameter name	Unit	Explanation	Setting range
SV032	TOF	Torque offset	Stall % (rated current %)	Set the unbalance torque amount of axes having an unbalance torque (such as vertical axes) as a percentage (%) of the stall rated current.	−100 ~ 100
SV045	TRUB	Current compensation/ friction torque	Stall % (rated current %)	When using the collision detection function, set the friction torque as a percentage of the stall rated current. Use the eight low-order bits. Set to 0 when not using the collision detection function.	0 ~ 100
SV059	TCNV	Torque estimated gain		When using the collision detection function, set the estimated torque gain. A guideline setting value can be displayed in MPOF of the SERVO MONITOR screen by setting SV035: SSF4/clt to 1. Set to 0 when not using the collision detection function.	0 ~ 32767
SV060	TLMT	G0 Collision detection level	Stall % (rated current %)	When using the collision detection function, set the collision detection level during method G0 modal as a percentage of the stall rated current. Set to 0 when not using the collision detection function.	0 ~ 100

⚠ **CAUTION**

1. Even when this function is valid, mechanical failure or accuracy loss may occur due to machine collision. As with conventional models, take all precautions possible so that accidents do not occur when operating the machine.
2. If the collision detection level is set very close to its limit, a collision may be mistakenly detected in a normal status, so set a slightly larger collision detection level.
3. After adjusting the machine for maintenance, etc., or replacing the motor or detector, adjust the parameters related to collision detection again.
4. In particular, the SV059: TCNV torque estimated gain must be changed when the detector resolution changes due to detector replacement, or when the position control system is changed (when the closed loop and semi-closed loop are changed, etc.).

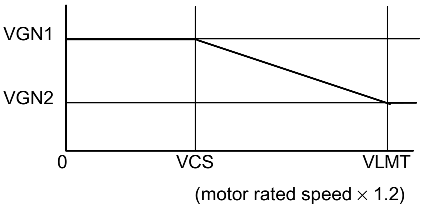
7-6 List of parameters

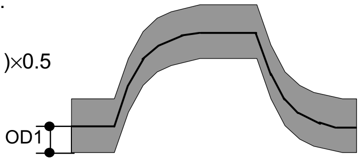
There are 64 servo parameters. The servo parameter setting and display methods differ according to the CNC being used.
Refer to the instruction manual for each CNC for details.

No.	Abbrev.	Explanation	Setting screen	B-Vx compati-bility	Change method	Setting unit	Min. value	Max. value	Type		
									Machine spec-ifica-tion	Servo spec-ifica-tion	Adjust-ment
SV001	PC1	Motor side gear ratio	Specification	○	Initialization		1	32767	○		
SV002	PC2	Machine side gear ratio	Specification	○	Initialization		1	32767	○		
SV003	PGN1	Position loop gain 1	Specification	○	Normal	1/sec	1	200			○
SV004	PGN2	Position loop gain 2	Adjustment	○	Normal	1/sec	0	999		○	
SV005	VGN1	Speed loop gain 1	Adjustment	○	Normal		1	999			○
SV006	VGN2	Speed loop gain 2		○	Normal		–1000	1000			○
SV007	VIL	Speed loop delay compensation	Adjustment	○	Normal		0	32767			○
SV008	VIA	Speed loop advance compensation	Adjustment	○	Normal		1	9999			○
SV009	IQA	Current loop q axis advance compensation		○	Normal		1	20480		○	
SV010	IDA	Current loop d axis advance compensation		○	Normal		1	20480		○	
SV011	IQG	Current loop q axis gain		○	Normal		1	4096		○	
SV012	IDG	Current loop d axis gain		○	Normal		1	4096		○	
SV013	ILMT	Current limit value		○	Normal	Stall current %	0	999			○
SV014	ILMTsp	Current limit value during special operation		○	Normal	Stall current %	0	999			○
SV015	FFC	Acceleration feed forward gain	Adjustment	○	Normal	%	0	999		○	
SV016	LMC1	Lost motion compensation 1	Adjustment	○	Normal	Stall current %	–1	200			○
SV017	SPEC	Servo specifications	Specification	△	Initialization	HEX setting	*	*	○	○	○
SV018	PIT	Ball screw lead	Specification	○	Initialization	mm	1	32767	○		
SV019	RNG1	Position detector resolution	Specification	○	Initialization	Kp/rev, Kp/PIT	1	9999		○	
SV020	RNG2	Speed detector resolution	Specification	○	Initialization	Kp/rev	1	9999		○	
SV021	OLT	Overload detection time constant		○	Normal	sec	1	300		○	
SV022	OLL	Overload detection level		○	Normal	Stall current %	1	500		○	
SV023	OD1	Excessive error detection width during servo ON		○	Normal	mm	0	32767	○		
SV024	INP	In-position detection width		○	Normal	μm	0	32767	○		
SV025	MTYP	Motor/detector type	Specification	△	Initialization	HEX setting	*	*		○	
SV026	OD2	Excessive error detection width during servo OFF		○	Normal	mm	0	32767	○		
SV027	SSF1	Special servo function selection 1	Specification	△	Normal	HEX setting	*	*		○	○
SV028	MSFT			◎	Initialization	μm	*	*			○
SV029	VCS	Speed loop gain and change start speed		○	Normal	rpm	0	9999			○
SV030	IVC	Current/voltage compensation		○	Normal		–32768	32767			○
SV031	OVS1	Overshooting compensation 1	Adjustment	○	Normal	%	–1	100			○
SV032	TOF	Torque offset	Adjustment	○	Normal	Stall current %	–100	100			○
SV033	SSF2	Special servo function selection 2	Specification	△	Normal	HEX setting	*	*		○	○
SV034	SSF3	Special servo function selection 3		○	Normal	HEX setting	*	*		○	○
SV035	SSF4	Special servo function selection 4		○	Normal	HEX setting	*	*		○	○
SV036	PTYP	Power supply type	Specification	○	Initialization	HEX setting	*	*		○	
SV037	JL	Load inertia scale (Jm + Jl) / Jm	Adjustment	○	Normal	%	0	5000			○
SV038	FHz1	Machine resonance suppression filter center frequency 1	Adjustment	△	Normal	Hz	0	9000	○		
SV039	LMCD	Lost motion compensation timing		○	Normal	msec	0	2000			○
SV040	LMCT	Current compensation/lost motion compensation non-sensitive band	Adjustment	○	Normal	–/μm	–32768	32767			○
SV041	LMC2	Lost motion compensation 2	Adjustment	○	Normal	Stall current %	–1	200			○
SV042	OVS2	Overshooting compensation 2		○	Normal	Stall current %	–1	100			○
SV043	OBS1	Observer 1		○	Normal	rad	0	1000			○
SV044	OBS2	Observer 2		○	Normal	%	0	500			○
SV045	TRUB	Current compensation/friction torque		○	Normal	–/Stall current %	–32768	32767			○
SV046	FHz2	Machine resonance suppression filter center frequency 2	Adjustment	◎	Normal	Hz	0	9000	○		
SV047	EC1	Inductive voltage compensation		○	Normal	%	*	*			○
SV048	EMGrt	Brake activation delay time		○	Normal	msec	0	2000	○		
SV049	PGN1sp	Position loop gain 1 during special operation		○	Normal	1/sec	1	200			○
SV050	PGN2sp	Position loop gain 2 during special operation		○	Normal	1/sec	0	999		○	
SV051	DFBT	Dual feedback control time constant		○	Normal	msec	0	9999			○
SV052	DFBN	Dual feedback control non-sensitive band		○	Normal	μm	0	9999			○
SV053	OD3	Excessive error detection width during special operation		○	Normal	mm	0	32767	○		
SV054	ORE	Closed loop and overrun detection width		○	Normal	mm	–1	32767	○		
SV055	EMGx	Emergency stop Max. delay time		○	Normal	msec	0	2000	○		
SV056	EMGt	Deceleration time constant at emergency stop		○	Normal	msec	0	2000	○		
SV057	SHGC	SHG control gain		○	Normal	1/sec	0	1200		○	
SV058	SHGCsp	SHG control gain during special operation		○	Normal	1/sec	0	1200		○	
SV059	TCNV	Torque estimated gain		○	Normal		0	32767			○
SV060	TLMT	G0 Collision detection LEVEL		○	Normal	Stall current %	0	500			○
SV061	DA1NO	D/A output channel 1 data No.		△	Normal		*	*			
SV062	DA2NO	D/A output channel 2 data No.		△	Normal		*	*			
SV063	DA1MPY	D/A output channel 1 output scale		△	Normal		*	*			
SV064	DA2MPY	D/A output channel 2 output scale		○	Normal		*	*			

Setting screen	Specification : Set on the SERVO SPECIFICATION screen.	Adjustment : Set on the SERVO ADJUSTMENT screen.
B-Vx compatibility	○ : No change from the MDS-B-Vx. ▲ : Same settings as the MDS-B-Vx possible, but details have changed.	△ : Includes the new parameters for the MDS-B-Vx. ◎ : New parameters for the MDS-B-Vx.
Change method	Initialization : Setting value validated when the CNC power is turned ON.	Normal : Setting value validated when changed.

Parameter explanations

No.	Abbrev.	Explanation	Setting range
SV001	PC1	Set the motor side gear ratio. Set so PC1 and PC2 become the smallest integer ratio. (Refer to "6-2-1 (1) Electronic gears" for details.)	1 ~ 32767
SV002	PC2	Set the machine side gear ratio. Set so PC1 and PC2 become the smallest integer ratio. (Refer to "6-2-1 (1) Electronic gears" for details.)	1 ~ 32767
SV003	PGN1	Set the position loop gain. Set in increments of 1. Normally set to 33.	1 ~ 200 (1/sec)
SV004	PGN2	When using SHG control, set this together with SV057: SHGC. Set to 0 when not used.	0 ~ 999 (1/sec)
SV005	VGN1	Set the speed loop gain. The standard setting is 150. If raised above that setting the responsiveness will be raised, but rotation and noise will also increase.	1 ~ 999
SV006	VGN2	If noise is a problem during high-speed rotation such as rapid traverse, set the speed loop gain (value smaller than VGN1) for high-speed rotation (1.2-fold of the rated speed). Set beginning of the speed drop for the speed gain in SV029: VCS. Set to 0 when not used. 	–1000 ~ 1000
SV007	VIL	Set this parameter when a limit cycle occurs in a closed loop, or when overshooting occurs during positioning. Set to 0 when not used. Related parameters: SV027: SSF1/vcnt1, vcnt2	0 ~ 32767
SV008	VIA	Set the speed loop advance compensation.	1 ~ 9999 (0.0687rad/sec)
SV009	IQA	This is the internal compensation for the current loop. The setting value is fixed according to the motor being used. (Refer to "6-2-4 List of standard parameters by motor type" for details.)	1 ~ 20480
SV010	IDA	This is the internal compensation for the current loop. The setting value is fixed according to the motor being used. (Refer to "6-2-4 List of standard parameters by motor type" for details.)	1 ~ 20480
SV011	IQG	This is the internal compensation for the current loop. The setting value is fixed according to the motor being used. (Refer to "6-2-4 List of standard parameters by motor type" for details.)	1 ~ 4096
SV012	IDG	This is the internal compensation for the current loop. The setting value is fixed according to the motor being used. (Refer to "6-2-4 List of standard parameters by motor type" for details.)	1 ~ 4096
SV013	ILMT	Set the current limit value as a percentage (%) of the stall rated current. Set to 500 when the use is required to the max. torque of the driver. (This is the limit value for both + and – directions.)	0 ~ 999 (Stall rated current %)
SV014	ILMTsp	Set the current limit value during special operations (absolute position initialization setting, stopper operations, etc.) as a percentage (%) of the stall rated current. Set to 500 when the use is required to the max. torque of the driver. (This is the limit value for both + and – directions.)	0 ~ 999 (Stall rated current %)
SV015	FFC	Set this parameter when the relative error in the overshoot amount, synchronization control, etc., with feed forward control is large. Set to ☐ when not used.	0 ~ 999 (%)
SV016	LMC1	Set this parameter when the protrusion amount during circle quadrant changeover is large. (Caused by a non-sensitive band due to friction, torsion, backlash, etc.) This parameter is only valid when lost motion compensation (SV027: lmc1, lmc2) is selected.	–1 ~ 200
		Type 1 SV027: SSF1/lmc1=1/lmc2=0 The protrusion is eliminated by this type compensation for low-speed interpolation. The compensation gain becomes 0 when this parameter is set to 0. The compensation is 100% when this parameter is set to 100.	0 ~ 200 (%)
		Type 2 SV027: SSF1/lmc1=0/lmc2=1 This type is the standard for the MDS Series. During high-speed, high-accuracy interpolation, etc., this type is used when sufficient compensation cannot be obtained with type 1. Set as a percentage (%) of the stall rated current.	0 ~ 100 (Stall rated current %)

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV016</td><td>LMC1</td><td>**When changing the compensation gain (type 1) or compensation amount (type 2) according to the direction:**
Set together with SV041:LMC2 when setting a different value according to the command direction.
When the command speed changes from the – to the + direction (when the command direction is CW), set the value in SV016: LMC1.
When the command speed changes from the + to the – direction (when the command direction is CW), set the value in SV041: LMC2.
When –1 is set, compensation will not be carried out when that command speed direction changes.</td><td></td></tr>
<tr><td>SV017</td><td>SPEC</td><td>Servo specifications
<table>
<tr><th>F</th><th>E</th><th>D</th><th>C</th><th>B</th><th>A</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td colspan="4">spm</td><td>drvall</td><td>drvup</td><td>mpt3</td><td>mp</td><td>abs</td><td>vmh</td><td>vdir</td><td>fdir</td><td></td><td>seqh</td><td>dfbx</td><td>vdir2</td></tr>
</table>
<table>
<tr><th>Bit</th><th>Name</th><th>Meaning when "0" is set.</th><th>Meaning when "1" is set.</th></tr>
<tr><td>0</td><td>vdir2</td><td colspan="2">Set to 0.</td></tr>
<tr><td>1</td><td>dfbx</td><td>Dual feedback control invalid.</td><td>Dual feedback control valid.</td></tr>
<tr><td>2</td><td>seqh</td><td>Ready/servo ON time, normal mode.</td><td>Ready/servo ON time, reduced time mode</td></tr>
<tr><td>3</td><td></td><td colspan="2">Set to 0.</td></tr>
<tr><td>4</td><td>fdir</td><td>Position feedback forward polarity</td><td>Position feedback reverse polarity</td></tr>
<tr><td>5</td><td>vdir</td><td>Motor end detector installation direction AC</td><td>Motor end detector installation direction BD</td></tr>
<tr><td>6</td><td>vmh</td><td colspan="2">Set to 0.</td></tr>
<tr><td>7</td><td>abs</td><td>Relative position detection</td><td>Absolute position detection</td></tr>
<tr><td>8</td><td>mp</td><td>MP scale 360P (2mm pitch)</td><td>MP scale 720P (1mm pitch)</td></tr>
<tr><td>9</td><td>mpt3</td><td>MP scale absolute position detection type 1/2 selection</td><td>MP scale absolute position detection type 3 selection</td></tr>
<tr><td>A</td><td>drvup</td><td>Combination with motor standard driver</td><td>Set when combining a driver with a capacity one rank above or below the motor standard driver.</td></tr>
<tr><td>B</td><td>drvall</td><td>Normal setting</td><td>Set when combining a driver with a different capacity than the motor standard driver.</td></tr>
<tr><td>C</td><td rowspan="4">spm</td><td colspan="2" rowspan="4">Special motor selection
Standard rotary motor : 0 Standard linear motor : 6
Special rotary motor : 1 Special linear motor : 7
Refer the list of motor types in section 6-2-1 (6).</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table></td><td>HEX setting</td></tr>
<tr><td>SV018</td><td>PIT</td><td>Set the ball screw lead. Normally set to 360 for a rotation axis.
(Refer to section "6-2-1 (1) Electronic gears".)</td><td>1 ~ 32767
(mm)</td></tr>
<tr><td rowspan="3">SV019</td><td rowspan="3">RNG1</td><td>Set the No. of pulses (K pulses) per rotation of the detector being used in the position control.</td><td>1 ~ 9999</td></tr>
<tr><td>**For a semi-closed loop**
Set the No. of pulses (K pulses) per motor rotation. Also set SV020: RNG2 to the same value.</td><td>(Kp/rev)</td></tr>
<tr><td>**For a closed loop**
Set the No. of pulses (K pulses) per ball screw lead.</td><td>(Kp/PIT)</td></tr>
<tr><td>SV020</td><td>RNG2</td><td>Set the No. of pulses (K pulses) per motor end detector rotation.</td><td>1 ~ 9999
(Kp/rev)</td></tr>
<tr><td>SV021</td><td>OLT</td><td>Set the detection time constant of overload 1 (OL1).
Normally set to 60.</td><td>1 ~ 300
(sec)</td></tr>
<tr><td>SV022</td><td>OLL</td><td>Set the current detection level of overload 1 (OL1) as a percentage (%) of the stall rated current.
Normally set to 150.</td><td>1 ~ 500
(Stall rated current %)</td></tr>
<tr><td>SV023</td><td>OD1</td><td>Set the excessive error detection width during servo ON.
Setting formula
SV023:OD1=SV026:OD2=SV053:OD3=F/(60×PGN1)×0.5
F : Max. rapid traverse rate (mm/min)
PGN1 : Position loop gain 1 (1/sec)
If 0 is set, the excessive error is not detected during servo ON.
 </td><td>0 ~ 32767
(mm)</td></tr>
<tr><td>SV024</td><td>INP</td><td>Set the in-position detection width.
Normally set to 50.</td><td>0 ~ 32767
(µm)</td></tr>
</table>

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV025</td><td>MTYP</td><td>Motor/detector type
<table>
<tr><th>F</th><th>E</th><th>D</th><th>C</th><th>B</th><th>A</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td colspan="4">pen</td><td colspan="4">ent</td><td colspan="8">mtyp</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Descriptions</th></tr>
<tr><td>0</td><td rowspan="8">mtyp</td><td rowspan="8">Set the motor type.
(Refer the list of motor types in section 6-2-1 (6)).</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="4">ent</td><td rowspan="4">Set the speed detector type.
(Refer the list of detector types in section 6-2-1 (7)).</td></tr>
<tr><td>9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="4">pen</td><td rowspan="4">Set the position detector type.
(Refer the list of detector types in section 6-2-1 (7)).</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
</td><td>HEX setting</td></tr>
<tr><td>SV026</td><td>OD2</td><td>Set the excessive error detection width during servo OFF. Normally, set the same value as SV023: OD1. If 0 is set, the excessive error is not detected during servo OFF.</td><td>0 ~ 32767
(mm)</td></tr>
<tr><td>SV027</td><td>SSF1</td><td>Special servo function selection 1
<table>
<tr><th>F</th><th>E</th><th>D</th><th>C</th><th>B</th><th>A</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>aflt</td><td>Zrn2</td><td>afrg</td><td>afse</td><td>ovs2</td><td>ovs1</td><td>lmc2</td><td>lmc1</td><td>omr</td><td></td><td>vfct2</td><td>vfct1</td><td></td><td>upc</td><td>vcnt2</td><td>vcnt1</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set.</th><th>Meaning when "1" is set.</th></tr>
<tr><td>0</td><td>Vcnt1</td><td rowspan="2">00: Delay compensation changeover invalid
01: Delay compensation changeover type 1</td><td rowspan="2">10: Delay compensation changeover type 2
11: Reserved</td></tr>
<tr><td>1</td><td>Vcnt2</td></tr>
<tr><td>2</td><td>upc</td><td>Starting torque compensation invalid</td><td>Starting torque compensation valid</td></tr>
<tr><td>3</td><td></td><td colspan="2">Set to 0.</td></tr>
<tr><td>4</td><td>vfct1</td><td rowspan="2">00: Jitter compensation invalid
01: Jitter compensation 1 pulse</td><td rowspan="2">10: Jitter compensation 2 pulse
11: Jitter compensation 3 pulse</td></tr>
<tr><td>5</td><td>vfct2</td></tr>
<tr><td>6</td><td></td><td colspan="2">Set to 0.</td></tr>
<tr><td>7</td><td>omr</td><td>OMR control invalid</td><td>OMR control valid</td></tr>
<tr><td>8</td><td>lmc1</td><td rowspan="2">00: Lost motion compensation invalid
01: Lost motion compensation type 1</td><td rowspan="2">10: Lost motion compensation type 2
11: Reserved</td></tr>
<tr><td>9</td><td>lmc2</td></tr>
<tr><td>A</td><td>ovs1</td><td rowspan="2">00: Overshooting compensation invalid
10: Overshooting compensation type 1</td><td rowspan="2">10: Overshooting compensation type 2
11: Overshooting compensation type 3</td></tr>
<tr><td>B</td><td>ovs2</td></tr>
<tr><td>C</td><td>afse</td><td>Normal use setting.</td><td>Increased adaptive filter sensitivity ∗ Note 1</td></tr>
<tr><td>D</td><td>afrg</td><td>Normal use setting.</td><td>Set when the adaptive filter is effective in the speed band.</td></tr>
<tr><td>E</td><td>zrn2</td><td>Reference point return type 1</td><td>Reference point return type 2</td></tr>
<tr><td>F</td><td>aflt</td><td>Adaptive filter invalid</td><td>Adaptive filter valid</td></tr>
</table>
</td><td>HEX setting
∗ Note 1
When setting afse (bitC) to "1", also set afrg (bitD) to "1".</td></tr>
<tr><td>SV028</td><td>MSFT</td><td>Normally set to 0.</td><td>–30000 ~ 30000
(µm)</td></tr>
<tr><td>SV029</td><td>VCS</td><td>If noise is a problem during high-speed rotations such as rapid traverse:
Set beginning of the motor speed drop for the speed loop gain.
Set the target speed loop gain for the speed loop gain drop in SV006: VGN2.
Set to 0 when not used.</td><td>0 ~ 9999
(rpm)</td></tr>
</table>

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV030</td><td>IVC</td><td>■ Voltage non-sensitive band compensation : Use the eight low-order bits.
■ Current bias : Use the eight high-order bits. (Icx)
Use in combination with the eight high-order bits of SV040 and SV045.</td><td>–32768 ~ 32767</td></tr>
<tr><td>SV031</td><td>OVS1</td><td>Set when overshooting occurs during deceleration stops with sub-micron control, closed loop control, etc. The overshooting improves the larger this value is set.
Normally, set approx. 2 to 10% (percentage of the stall rated current) as a guideline.
(Raise the value in 2% increments to find the value where overshooting does not occur.)
This parameter is only valid when overshooting compensation (SV027: SSF1/ovs1, ovs2) is selected.</td><td>–1 ~ 100
(Stall rated current %)</td></tr>
<tr><td>SV032</td><td>TOF</td><td>Set the unbalance torque amount of axes having an unbalance torque (such as vertical axes) as a percentage (%) of the stall rated current.
This is used when SV027: SSF1/lmc1, lmc2, or SV027: SSF1/vcnt1, vcnt2 is set.</td><td>–100 ~ 100</td></tr>
<tr><td>SV033</td><td>SSF2</td><td>Special servo function selection 2
<table>
<tr><th>F</th><th>E</th><th>D</th><th>C</th><th>B</th><th>A</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td colspan="4">Dos</td><td colspan="4">dis</td><td colspan="3">nfd2</td><td>Nf3</td><td colspan="3">nfd1</td><td>zck</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set.</th><th>Meaning when "1" is set.</th></tr>
<tr><td>0</td><td>zck</td><td>Z phase check valid (part of alarm 42)</td><td>Z phase check invalid</td></tr>
<tr><td>1
2
3</td><td>nfd1</td><td colspan="2">Adjust the attenuation amount of the No. 1 machine resonance suppression filter.
The effect of the machine resonance suppression filter decreases the larger this value is set, and the effect on the speed control decreases.
000 : –∞ 010 : –12dB 100 : –6dB 110 : –3dB
001 : –18dB 011 : –9dB 101 : –4dB 111 : –1dB</td></tr>
<tr><td>4</td><td>nf3</td><td colspan="2">This validates the No. 3 machine resonance suppression filter (center frequency fixed at 1125Hz.)</td></tr>
<tr><td>5
6
7</td><td>nfd2</td><td colspan="2">Adjust the attenuation amount of the No. 2 machine resonance suppression filter.
The effect of the machine resonance suppression filter decreases the larger this value is set, and the effect on the speed control decreases.
000 : –∞ 010 : –12dB 100 : –6dB 110 : –3dB
001 : –18dB 011 : –9dB 101 : –4dB 111 : –1dB</td></tr>
<tr><td>8
9
A
B</td><td>dis</td><td colspan="2">Digital signal input selection.
Set to 0000.</td></tr>
<tr><td>C
D
E
F</td><td>dos</td><td colspan="2">Digital signal output selection.
0000 : MP scale absolute position detection system and offset request signal output
0001 : Specified speed signal output</td></tr>
</table></td><td>HEX setting</td></tr>
<tr><td>SV034</td><td>SSF3</td><td>Special servo function selection 3
<table>
<tr><th>F</th><th>E</th><th>D</th><th>C</th><th>B</th><th>A</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td colspan="4">ovsn</td><td colspan="4">linN</td><td>toff</td><td>os2</td><td></td><td>dcd</td><td>test</td><td>mohn</td><td>has2</td><td>(has1)</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when "0" is set.</th><th>Meaning when "1" is set.</th></tr>
<tr><td>0</td><td>has1</td><td>Normal use setting</td><td>(HAS control 1 valid. High-speed acceleration correspondence)</td></tr>
<tr><td>1</td><td>has2</td><td>Normal use setting</td><td>HAS control 2 valid. Overshooting correspondence.</td></tr>
<tr><td>2</td><td>mohn</td><td>Normal use setting</td><td>Ignore MDS-B-HR motor thermal error</td></tr>
<tr><td>3</td><td>test</td><td>Normal use setting</td><td>Shipment test (sensitive error detection carried out)</td></tr>
<tr><td>4</td><td>dcd</td><td>Normal use setting</td><td>DC excitation mode</td></tr>
<tr><td>5</td><td></td><td colspan="2">Set to 0.</td></tr>
<tr><td>6</td><td>os2</td><td>Normal use setting</td><td>Change overspeed detection level ∗ Note 1</td></tr>
<tr><td>7</td><td>toff</td><td>Normal use setting</td><td>Low-speed serial ABS scale communication OFF ∗ Note 2</td></tr>
<tr><td>8
9
A
B</td><td>linN</td><td colspan="2">Set to 0.</td></tr>
<tr><td>C
D
E
F</td><td>ovsn</td><td colspan="2">Set the non-sensitive band for overshooting compensation type 3.</td></tr>
</table></td><td>HEX setting

∗ Note 1
The following modes are target modes.
HA200,300:
2400→3000rpm
HC53,103,153,
HC203,353,453
HC153R,203R
3600→4200rpm

∗ Note 2
toff (bit 7) is for testing. When set to 1, the absolute position cannot be initialized, so be careful when setting this bit.</td></tr>
</table>

No.	Abbrev.	Explanation	Setting range
SV035	SSF4	Special servo function selection 4	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
clt	**clG1**			**cl2n**	**clet**	**cltq**			**iup**	**tdt**					

bit	Name	Meaning when "0" is set.	Meaning when "1" is set.
0	tdt	Td creation time setting (driver fixed) Setting time (μsec) = (tdt+1) × 0.569 Setting time when set to 0. Under 7kW 5.69μsec 7kW or higher 8.52μsec When tdt < 9, it is handled as tdt = 0. Normally set to 0.	
1			
2			
3			
4			
5			
6	iup	Normal use setting.	Do not set. (Used for special applications)
7		Set to 0.	
8	cltq	Set the deceleration torque when a collision is detected. 00 : 100% 01 : 90% 10 : 80% 11 : 70%	
9			
A	clet	Normal use setting.	The MPOF value on the SERVO MONITOR screen shows the estimated disturbance torque peak value for the last 2 seconds.
B	cl2n	Normal use setting.	Invalidate collision detection method 2.
C	clG1	Set the collision detection level for collision detection method 1 and G1 modal. When 0 is set : Collision detection is not carried out for method 1 and G1 modal. When 1 to 7 is set : The collision detection level during method 1 and G1 modal is considered a value 2-fold of the collision detection level during method 1, G0 modal set in (SV060: TLMT).	
D			
E			
F	clt	Normal use setting.	The guideline value for the SV059: TCNV setting is displayed in MPOF of the SERVO MONITOR screen.

No.	Abbrev.	Explanation	Setting range
SV036	PTYP	Power supply type	HEX setting

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
amp				**rtyp**				**ptyp**							

bit	Name	Explanation
0	ptyp	Set the power supply type. Refer to the list of power supply types in section 6-2-1 (8).
1		
2		
3		
4		
5		
6		
7		
8	rtyp	Set to 0 when the power supply unit is a power regeneration type. Set the resistor type to be used when the power supply unit is a resistance regeneration type. Refer to the list of power supply types in section 6-2-1 (8).
9		
A		
B		
C	amp	Set the model No. of the driver. 0 : MDS-B-V14/V24, MDS-B-V1/V2/SP, MDS-A-V1/V2/SP 1 : MDS-A-SVJ 2 : MDS-A-SPJ
D		
E		
F		

No.	Abbrev.	Explanation	Setting range
SV037	JL	Set the motor inertia + motor shaft equivalent load inertia as a percentage of the motor inertia. SV037 : JL = (Jm + Jl) / Jm × 100 Jm: motor inertia, Jl: motor shaft equivalent load inertia	0 ~ 5000 (%)

No.	Abbrev.	Explanation	Setting range
SV038	FHz1	Set the center frequency of the No. 1 machine resonance suppression filter. Note that a value of 36Hz or higher is set. Set to 0 when not used. Especially be sure to set to match SV033: SSF2/nfd1 when setting low frequencies of 100Hz or less.	0 ~ 9000 (Hz)
SV039	LMCD	Set this parameter when the lost motion compensation timing does not match. Adjust while increasing the value in 10 (msec) increments.	0 ~ 2000 (msec)
SV040	LMCT	■ Set the non-sensitive band of the lost motion compensation. Use the eight low-order bits. Normally set to 0. During feed forward control, set only when the lost motion compensation timing does not match. ■ Current bias : Use the eight high-order bits. (Icy) Use in combination with the eight high-order bits of SV030 and SV045.	■ Lost motion compensation non-sensitive band 0 ~ 100 (μm) ∗ Setting range: –32768 ~ 32767
SV041	LMC2	Normally set to 0. Set together with SV016:LMC1 only when setting the compensation gain (type 1), or compensation amount (type 2) of the lost motion compensation to a different value according to the command direction. When the command speed changes from the – to the + direction (when the command direction is CW), set the value in SV016: LMC1. When the command speed changes from the + to the – direction (when the command direction is CW), set the value in SV041: LMC2. When –1 is set, compensation will not be carried out when that command speed direction changes. This parameter is only valid when lost motion compensation (SV027: lmc1, lmc2) is selected.	–1 ~ 200 (%) (Stall rated current %)
SV042	OVS2	Overshooting compensation 2 Set the overshooting compensation amount for movement in the – direction (when the command direction is CW). When 0 is set, the SV031: OVS1 setting value is regarded as this setting value. When –1 is set, compensation will not be carried out during movement in the – direction. This parameter is only valid when overshooting compensation (SF027: SSF1/ovs1) is selected.	–1 ~ 200 (Stall rated current %)
SV043	OBS1	Observer 1 Set the observer pole. Normally set to approx. 628 (rad). To activate the observer function, set in combination with SV037: JL and SV044: OBS2. Set to 0 when not used.	0 ~ 1000 (rad)
SV044	OBS2	Observer 2 Set the execution gain of the observer. Normally set to 100. To activate the observer function, set in combination with SV037: JL and SV043: OBS1. Set to 0 when not used.	0 ~ 500 (%)
SV045	TRUB	■ When using the collision detection function, set the friction torque as a percentage of the stall rated current. Use the eight low-order bits. Set to 0 when the collision detection function is not used. ■ Current bias : Use the eight high-order bits. (Ib1) Use in combination with the eight high-order bits of SV030 and SV040.	■ Collision detection and friction 0 ~ 100 (stall rated current %) ∗ Setting range: –32768 ~ 32767
SV046	FHz2	Set the center frequency of the No. 2 machine resonance suppression filter. Note that a value of 36Hz or higher is set. Set to 0 when not used. Especially be sure to set to match SV033: SSF2/nfd2 when setting low frequencies of 100Hz or less.	0 ~ 9000 (Hz)
SV047	EC1	Inductive voltage compensation Set the execution gain of the inductive voltage compensation. Normally set to 100.	–32768 ~ 32767 (%)
SV048	EMGrt	When using the drop prevention function, set the brake activation delay time. Set a value larger than the actual brake activation time. Set to 0 when the drop prevention function is not used. When using this function, parameters SV055: EMGx and SV056: EMGt must also be set.	0 ~ 2000 (msec)
SV049	PGN1sp	Set the position loop gain for special operations (synchronous tap, interpolation with spindle C, etc.). Normally set the spindle position loop gain.	1 ~ 200 (1/sec)
SV050	PGN2sp	Set together with SV058: SHGCsp when using SHG control for special operations (synchronous tap, interpolation with spindle C, etc.) Set to 0 when not used.	0 ~ 999 (1/sec)

No.	Abbrev.	Explanation	Setting range
SV051	DFBT	Set the dual feedback control time constant.	0 ~ 9999 (msec)
SV052	DFBN	Set the control non-sensitive band for dual feedback control.	0 ~ 9999 (μm)
SV053	OD3	Set the excessive error detection width during servo ON for special operations (absolute position initialization setting, stopper operations, etc.) If 0 is set, the excessive error is not detected during servo ON for special operations.	0 ~ 32767 (mm)
SV054	ORE	Set the overrun detection width in closed loops. If -1 is set, the overrun detection is not carried out. If 0 is set, the overrun detection is carried out at a width of 2 (mm).	–1 ~ 32767 (mm)
SV055	EMGx	When using the drop prevention function, set the max. delay time for the emergency stop. Normally set to the same value as SV056: EMGt. Set to 0 when the drop prevention function is not used.	0 ~ 2000 (msec)
SV056	EMGt	When using the drop prevention function, set the deceleration time constant from the max. rapid traverse rate. Normally this is set to the same value as the G0 acceleration/deceleration time constant for the CNC. Set to 0 when the drop prevention function is not used.	0 ~ 2000 (msec)
SV057	SHGC	When using SHG control, set this parameter together with SV004: PGN2. Set to 0 when not used.	0 ~ 1200 (1/sec)
SV058	SHGCsp	Set this parameter together with SV050: PGN2sp when using SHG control for special operations (synchronous tap, interpolation with spindle C, etc.). Set to 0 when not used.	0 ~ 1200 (1/sec)
SV059	TCNV	When using the collision detection function, set the estimated torque gain. A guideline setting value can be displayed in MPOF of the SERVO MONITOR screen by setting SV035: SSF4/clt to 1. Set to 0 when the collision detection function is not used.	0 ~ 32767
SV060	TLMT	When using the collision detection function, set the collision detection level during method 1, G0 modal as a percentage of the stall rated current. Set to 0 when not using the collision detection function.	0 ~ 100 (Stall rated current %)
SV061	DA1NO	Set the output data No. of D/A output channel 1. If –1 is set, D/A output for that axis is not carried out. For DC excitation, set the initial excitation level.	–32768 ~ 32767
SV062	DA2NO	Set the output data No. of D/A output channel 2. If –1 is set, D/A output for that axis is not carried out. For DC excitation, set the final excitation level.	–32768 ~ 32767
SV063	DA1MPY	Set the output magnification for D/A output channel 1. The output magnification becomes the (setting value)/256. When 0 is set, 256 is regarded as this setting value. (Output magnification of 1-fold) For DC excitation, set the initial excitation time. (msec)	–32768 ~ 32767
SV064	DA2MPY	Set the output magnification for D/A output channel 2. The output magnification becomes the (setting value)/256. When 0 is set, 256 is regarded as this setting value. (Output magnification of 1-fold)	–32768 ~ 32767

Chapter 8　Alarms and Warnings

8-1 Points of caution and confirmation

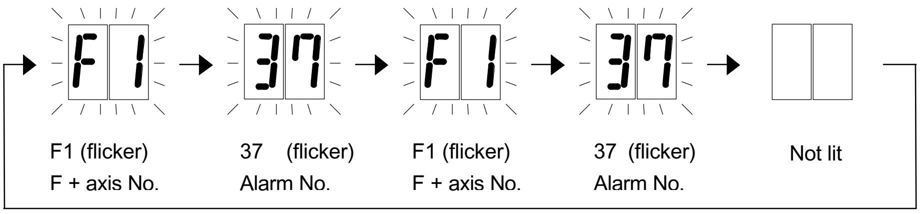
If an error occurs in the servo system, the servo warning or servo alarm will occur. When a servo warning or alarm occurs, check the state while observing the following points, and inspect or remedy the unit according to the details given in this section.

⚠ CAUTION

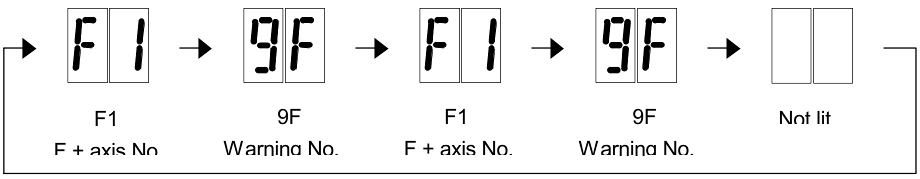
1. This servo system uses a large capacity electrolytic capacitor. When the charge lamp on the front of the power supply unit (MDS-B-CV, MDS-A-CR) in the system is lit, there is still voltage in the unit. Take care to prevent electric shocks and short circuits. (The voltage will remain for several minutes after the power is turned OFF.)
2. The conductivity in the driver cannot be checked due to the structure.
3. Do not carry out a megger test as the driver could be damaged.

<Points of confirmation>

1. What is the alarm code display?
2. Can the error or trouble be repeated? (Check alarm history)
3. Is the motor and servo driver temperature and ambient temperature normal?
4. Are the servo driver, control unit and motor grounded?
5. Was the unit accelerating, decelerating or running at a set speed? What was the speed?
6. Is there any difference during forward and backward run?
7. Was there a instantaneous power failure?
8. Did the trouble occur during a specific operation or command?
9. At what frequency does the trouble occur?
10. Is a load applied or removed?
11. Has the drive unit been replaced, parts replaced or emergency measures taken?
12. How many years has the unit been operating?
13. Is the power voltage normal? Does the state change greatly according to the time band?



LED display during servo alarm



LED display during servo warning

8-2 Troubleshooting at start up

If the CNC system does not start up correctly and a system error occurs when the CNC power is turned ON, the servo driver may not have been started up correctly.
Confirm the LED display on the driver, and take measures according to this section.

LED display	Symptom	Cause of occurrence	Investigation method	Remedy
AA	Initial communication with the CNC was not completed correctly.	The driver axis No. setting is incorrect.	Is there any other driver that has the same axis No. set?	Set correctly.
		The CNC setting is incorrect.	Is the No. of CNC controlled axes correct?	Set correctly.
		Communication with CNC is incorrect.	Is the connector (CN1A, CN1B) disconnected?	Connect correctly.
			Is the cable broken? Check the conductivity with a tester.	Replace the cable.
Ab	Initial communication with the CNC was not carried out.	The axis is not used, the setting is for use inhibiting.	Is the axis setting rotary switch set to "7" to "F"?	Set correctly.
		Communication with CNC is incorrect.	Is the connector (CN1A, CN1B) disconnected?	Connect correctly.
			Is the cable broken? Check the conductivity with a tester	Replace the cable.

8-3 List of servo alarms and warnings

No.	Abbrev.	Name	RS	A/C	No.	Abbrev.	Name	RS	A/C	No.	Abbrev.	Name	RS	A/C
10					50	OL1	Overload detection 1	NR	A	90	WST	Low-speed serial initial communication error	PR	A
11	ASE	Axis selection error	AR	C	51	OL2	Overload detection 2	NR	A	91	WAS	Low-speed serial communication error	*	A
12	ME	Memory error	AR	C	52	OD1	Excessive error 1 (during servo ON)	NR	A	92	WAF	Low-speed serial protocol error	*	A
13	SWE	Software processing error	PR	C	53	OD2	Excessive error 2 (during servo OFF)	NR	A	93	WAM	Absolute position fluctuation	PR	A
14	SWE2	Software processing error 2	PR	C	54	OD3	Excessive error 3 (no power)	NR	A	94				
15					55					95				
16	RD1	Magnetic pole position detection error 1	PR	BV	56					96	MPE	MP scale feedback error	*	A
17	ADE	A/D converter error	PR	A	57					97	MPO	MP scale offset fluctuation	PR	A
18	WAT	Initial communication error	PR	A	58	CLG0	Collision detection method 1, G0	NR	A	98				
19					59	CLG1	Collision detection method 1, G1	NR	A	99				
1A	Stei	Initial communication error (SUB)	PR	A	5A	CLT2	Collision detection method 2	NR	A	9A				
1B	Scpu	CPU error (SUB)	PR	A	5B					9B	WMS	HR unit, magnetic pole shift warning	*	A
1C	Sled	EEPROM/LED error (SUB)	PR	A	5C	ORFE	Orientation feedback error	NR	SP	9C	WMG	HR unit, magnetic pole warning	*	A
1D	Sdat	Data error (SUB)	PR	A	5D					9D	Wmg	HR unit, magnetic pole warning (SUB)	*	A
1E	Sohe	ROM, RAM/thermal error (SUB)	PR	A	5E					9E	Wan	High-speed serial multi-rotation counter error	*	A
1F	Stre	Serial detector communication error (SUB)	PR	A	5F					9F	WAB	Battery voltage drop	*	C
20	NS1	No signal 1	PR	BV	60	0	Instantaneous power failure	PR	R	A0				
21	NS2	No signal 2	PR	A	61	1	Power module overcurrent	PR	V	A1				
22					62	2				A2				
23	OSE	Excessive speed error	PR	SP	63	3	Auxiliary regeneration error	PR	V	A3				
24					64	4				A4				
25	ABSE	Absolute position lost	AR	A	65	5	Rush relay error	PR	V/R	A5				
26	NAE	Not used axis error	PR	C	66	6				A6				
27	SCcpu	Scale CPU error (SUB)	PR	A	67	7	Open phase	PR	V	A7				
28	Sosp	Scale overspeed (SUB)	PR	A	68	8	Watch dog	AR	V/R	A8	WTW	Turret index command error warning	*	SP
29	Sabs	Absolute position detection circuit error (SUB)	PR	A	69	9	Ground fault	PR	V	A9				
2A	Sinc	Relative position detection circuit error (SUB)	PR	A	6A	A	Contactor fusing	PR	V	AA		CNC initial communication, No. 1 phase wait		
2B	SCPU	CPU error	PR	A	6B	B	Rush relay fusing	PR	V/R	AB		CNC initial communication, No. 1 phase wait		
2C	SLED	EEPROM/LED error	PR	A	6C	C	Main circuit error	PR	V/R	AC		CNC initial communication, No. 2 phase wait		
2D	SDAT	Data error	PR	A	6D	D				AD		CNC initial communication, No. 3 phase wait		
2E	SRRE	ROM, RAM error	PR	A	6E	E	Memory error	AR	V/R	AE		CNC initial communication, No. 4 phase wait		
2F	STRE	Serial detector communication error	PR	A	6F	F	AD error (PS error)	AR	V/R	AF		Reserved		
30	OR	Over-regeneration	PR	SVJ	70	G				E0	WOR	Over-regeneration warning	*	SVJ
31	OS	Overspeed	PR	A	71	H	Instantaneous power failure/external emergency stop	NR	V	E1	WOL	Overload warning	*	A
32	PMOC	Overcurrent (IPM error)	PR	A	72	I				E2				
33	OV	Overvoltage	PR	SVJ	73	J	Over-regeneration	PR	R	E3	WAC	Absolute position counter warning	*	A
34	DP	CNC communication, CRC error	PR	C	74	K	Regeneration resistor overheating	PR	R	E4	WPE	Parameter error warning	*	A
35	DE	CNC communication, data error	PR	A	75	L	Overvoltage	NR	V/R	E5				
36	TE	CNC communication, communication error	PR	C	76	M	External emergency stop setting error	AR	V	E6	AXE	Control axis removed warning	*	A
37	PE	Initial parameter error	PR	A	77	N	Power module (V)/fin (R) overheating	PR	V/R	E7	NCE	CNC emergency stop	*	C
38	TP1	CNC communication, protocol error 1	PR	C	78					E8	O	Over-regeneration warning	*	V/R
39	TP2	CNC communication, protocol error 2	PR	A	79					E9	P	Instantaneous stop warning	*	V
3A	OC	Overcurrent	PR	A	7A					EA	Q	External emergency stop input	*	V
3B	PMOH	Overheating (IPM error)	PR	A	7B					EB	R			
3C					7C					EC	S			
3D					7D					ED	T			
3E					7E					EE	U			
3F					7F					EF	V			
40	KE1	A-TK unit, changeover error	PR	SP	80	HCN	HR unit, connection error	PR	A	00				
41	KE2	A-TK unit, communication error	PR	SP	81	HHS	HR unit, HSS communication error	PR	A	01	When rewriting software	FLASH, programming error		
42	FE1	Feedback error 1	PR	A	82	NSP	No power supply signal	PR	AV	02		FLASH, erasure error		
43	FE2	Feedback error 2	PR	A	83	HSC	HR unit, scale identification error	PR	A	03		Vpp error		
44	CAXC	C axis changeover alarm	NR	SP	84	HCPU	HR unit, CPU error	AR	A	04		Checksum error		
45					85	HDAT	HR unit, data error	PR	A	05		Comparison error		
46	OHM	Motor overheat	NR	A	86	HMAG	HR unit, magnetic pole error	PR	A	06				
47					87					07				
48	SCCPU	Scale CPU error	PR	A	88	WD	Watch dog	AR	C	08		Bank designation error		
49	SOSP	Scale overspeed	PR	A	89	Hcn	HR unit, connection error (SUB)	PR	A	09		Initial address error		
4A	SABS	Absolute position detection circuit error	PR	A	8A	HhS	HR unit, HSS communication error (SUB)	PR	A	0A		Bank changeover error		
4B	SINC	Relative position detection circuit error	PR	A	8B					0B		Address error		
4C					8C	Hsc	HR unit, scale identification error (SUB)	PR	A	0C		Reception timeout		
4D					8D	Hcpu	HR unit, CPU error (SUB)	AR	A	0D				
4E					8E	Hdat	HR unit, data error (SUB)	PR	A	0E				
4F					8F	Hmag	HR unit, magnetic pole error (SUB)	PR	A	0F		Command sequence error		

Bn		Ready OFF (n is the control axis No.)	Dn		Servo ON (n is the control axis No.)
Cn		Servo OFF (n is the control axis No.)	Fn		Control axis No. display (n is the control axis No.)

(Note 1) RS column PR: Reset by CNC power OFF, AR: Reset by servo driver power OFF, *: Warning display, not in servo OFF.

(Note 2) A/C column A: Alarm occurring for each axis, C: Common alarm in the driver, SP: Spindle alarm, SVJ: MDS-A-SVJ alarm, AV: MDS-A-Vx alarm, BV: MDS-B-Vx alarm, V: Power regeneration power supply alarm, R: Resistance generation power supply alarm.

8-4 Alarm details

Servo alarms

No.	Abbrev.	Name	Explanation	RS	A/C
11	ASE	Axis selection error	The axis selection rotary switch is set to the same value for 2 axes in the MDS-B-V2 driver. Or, an illegal value is set.	AR	C
12	ME	Memory error	In the self-check carried out when the driver power is turned ON, an error was detected in the memory IC/FB IC. (Refer to section "8-5 LED display Nos. during memory errors" for details.)	AR	C
13	SWE	Software processing error	The software data process did not finish within the specified time.	PR	C
14	SWE2	Software processing error 2	The current process processor is not operating correctly.	PR	C
17	ADE	A/D converter error	In the self-check carried out by the driver, an error was detected in the A/D converter for current detection.	PR	A
18	WAT	Serial detector, initial communication error	Communication cannot be carried out with the detector in a system using an OHA25K/OHA25K-ET or high-speed serial detector as the motor end or machine end detector.	PR	A
1A	Stei	Serial detector, initial communication error (SUB)	Initial communication cannot be carried out with the detector in a system using an OHA25K-ET as the machine end detector.	PR	A
1B	Scpu	CPU error (SUB)	An error was detected in the data stored in the EEROM in the high-speed serial detector connected to the machine end.	PR	A
1C	Sled	LED error (SUB)	LED deterioration was detected in the high-speed serial detector connected to the machine end.	PR	A
1D	Sdat	Data error (SUB)	An error was detected in the position within one rotation in the high-speed serial detector connected to the machine end.	PR	A
1E	Sohe	Serial detector, thermal error (SUB)	The detector's built-in thermal protector operated in the high-speed serial detector connected to the machine end.	PR	A
1F	Stre	Serial detector communication error (SUB)	The communication with the detector was interrupted in the high-speed serial detector connected to the machine end.	PR	A
21	NS2	No signal 2	An error was detected in the ABZ phase in the closed loop system.	PR	A
25	ABSE	Absolute position lost	The backup voltage in the absolute position detector dropped. The absolute position cannot be compensated.	AR	A
26	NAE	No used axis error	An error occurred in the power module of the axis in which the axis selection rotary switch is set to [F].	PR	C
27	SCcpu	Absolute position detection, scale CPU error (SUB)	The CPU in the scale is not operating correctly in the absolute position detection linear scale connected to the machine end.	PR	A
28	Sosp	Absolute position overspeed (SUB)	When the CNC power was turned ON, the scale detected a speed of 45m/sec or higher in the absolute position linear scale connected to the machine end.	PR	A
29	Sabs	Absolute position, detection circuit error (SUB)	An error was detected in the scale or scale side circuit in the absolute position linear scale connected to the machine end.	PR	A
2A	Sinc	Relative position, detection circuit error (SUB)	A speed that exceeded the max. movement speed was detected in the absolute position linear scale connected to the machine end.	PR	A
2B	SCPU	CPU error	An error was detected in the data stored in the EEROM in the high-speed serial detector connected to the motor end.	PR	A
2C	SLED	LED error	LED deterioration was detected in the high-speed serial detector connected to the motor end.	PR	A
2D	SDAT	Data error	An error was detected in the position within one rotation in the high-speed serial detector connected to the motor end.	PR	A
2E	SRRE	Scale ROM/RAM error	An error was detected in the ROM or RAM in the scale of the absolute position linear scale connected to the motor end.	PR	A
2F	STRE	Serial detector communication error	The communication with the detector was interrupted in the high-speed serial detector connected to the motor end. The communication with the detector was interrupted in the low-speed serial detector connected to the machine end.	PR	A
31	OS	Overspeed	A speed that exceeded the tolerable motor speed was detected. (Motor max. speed ×1.2)	PR	A
32	PMOC	Power module error (overcurrent)	The IPM used in the inverter detected an overcurrent.	PR	A
34	DP	CNC communication, CRC error	An error was detected in the data sent from the CNC to the driver.	PR	C
35	DE	CNC communication, data error	An error was detected in the movement command data from the CNC.	PR	A
36	TE	CNC communication, communication error	The communication from the CNC was interrupted.	PR	C
37	PE	Initial parameter error	An illegal parameter was detected in the parameters sent when the CNC power was turned ON. (Refer to section "8-6 Error parameter Nos. during initial parameter errors".)	PR	A
38	TP1	CNC communication, protocol error 1	An error was detected in the communication frame sent from the CNC.	PR	C

No.	Abbrev.	Name	Explanation	RS	A/C
39	TP2	CNC communication, protocol error 2	An error was detected in the axis information data sent from the CNC.	PR	A
3A	OC	Overcurrent	An excessive current was detected in the motor drive current.	PR	A
3B	PMOH	Power module error (overheating)	The IPM used in the inverter detected overheating.	PR	A
42	FE1	Feedback error 1	A feedback pulse omission or Z phase error was detected in the position detector.	PR	A
43	FE2	Feedback error 2	In the closed loop, excessive deviation was detected in the feedback amount of the motor end detector and machine end detector. An FBIC error was detected in the semi-closed loop.	PR	A
46	OHM	Motor overheating	A temperature error was detected in the drive motor.	NR	A
48	SCCPU	Absolute position detection, scale CPU error	During linear servo system use, the CPU in the absolute position detection linear scale is not operating correctly.	PR	A
49	SOSP	Absolute position, overspeed	When the CNC power was turned ON during linear servo system use, the absolute position linear scale detected a speed of 45m/sec or higher.	PR	A
4A	SABS	Absolute position, detection circuit error	During linear servo system use, the absolute position linear scale detected an error in the scale or scale side circuit.	PR	A
4B	SINC	Relative position, detection circuit error	During linear servo system use, the absolute position linear scale detected a speed that exceeded the max. movement speed of the absolute position scale.	PR	A
50	OL1	Overload 1	The servomotor or servo driver load level obtained from the motor current reached the overload level set in overload detection level (SV022: OLL) and overload time constant (SV021: OLT).	NR	A
51	OL2	Overload 2	A current command of 95% or higher of the driver's max. capacity continued for 1 second or more.	NR	A
52	OD1	Excessive error 1	During servo ON, the error between the ideal position and actual position exceeded that set in parameter SV023: OD1 (or SV053: OD3).	NR	A
53	OD2	Excessive error 2	During servo OFF, the error between the ideal position and actual position exceeded that set in parameter SV026: OD2.	NR	A
54	OD3	Excessive error 3	The motor current is not flowing when the excessive error alarm 1 is detected. This alarm occurs when there is an incorrect connection or broken wire in the power line, or when there is no bus voltage.	NR	A
58	CLE0	Collision detection 0	During the G0 modal (rapid traverse), a collision detection, method 1 error was detected.	NR	A
59	CLE1	Collision detection 1	During the G1 modal (cutting feed), a collision detection, method 1 error was detected.	NR	A
5A	CLE2	Collision detection 2	A collision detection, method 2 error was detected.	NR	A
6F	PSE	Power supply alarm	The power supply is not connected. Or, an error was detected in the AD converter of the power supply.	AR	C
80	HCN	HR unit, connection error	In a system with an MDS-B-HR unit connected to the motor end, an incorrect connection or broken wire was detected between the MDS-B-HR unit and the scale.	PR	A
81	HHS	HR unit, HSS error	In a system with an MDS-B-HR unit connected to the motor end, an error was detected in the communication between the MDS-B-HR unit and the absolute position detection scale.	PR	A
83	HSC	HR unit, scale identification error	The MDS-B-HR connected to the motor end could not identify the analog frequency of the connected scale.	PR	A
84	HCPU	HR unit, CPU error	The CPU of the MDS-B-HR connected to the motor end is not operating correctly.	AR	A
85	HDAT	HR unit, data error	An error was detected in the analog interpolation code data of the MDS-B-HR connected to the motor end.	PR	A
86	HMAG	HR unit, magnetic pole error	In a system with an MDS-B-HR unit connected to the motor end, an error was detected in the MDS-B-HR unit magnetic pole position data before the passing of the Z phase.	PR	A
88	WD	Watch dog	The servo system is not operating correctly.	AR	C
89	Hcn	HR unit, connection error (SUB)	In a system with an MDS-B-HR unit connected to the machine end, an incorrect connection or broken wire was detected between the MDS-B-HR unit and the scale.	PR	A
8A	Hhs	HR unit, HSS error (SUB)	In a system with an MDS-B-HR unit connected to the machine end, an error was detected in the communication between the MDS-B-HR unit and the absolute position detection scale.	PR	A
8C	Hsc	HR unit, scale identification error (SUB)	The MDS-B-HR connected to the machine end could not identify the analog frequency of the connected scale.	PR	A
8D	Hcpu	HR unit, CPU error (SUB)	The CPU of the MDS-B-HR connected to the machine end is not operating correctly.	AR	A
8E	Hdat	HR unit, data error (SUB)	An error was detected in the analog interpolation code data of the MDS-B-HR connected to the machine end.	PR	A

No.	Abbrev.	Name	Explanation	RS	A/C
8F	Hmag	HR unit, magnetic pole error (SUB)	In a system with an MDS-B-HR unit connected to the motor end, an error was detected in the MDS-B-HR unit magnetic pole position data before the passing of the Z phase.	PR	A
90	WST	Low-speed serial, initial communication error	Initial communication with the absolute position linear scale cannot be carried out.	PR	A
91	WAS	Low-speed serial, communication error	In an absolute position detection system using an OHA25K/OHA25K-ET/absolute position linear scale, an error was detected in the communication with the detector.	*	A
92	WAF	Low-speed serial, protocol error	In an absolute position detection system using an OHA25K/OHA25K-ET/absolute position linear scale, an error was detected in the data from the detector.	*	A
93	WAM	Absolute position fluctuation	When the CNC was turned ON, fluctuation above the tolerable value was detected in the absolute position.	PR	A
96	MPE	MP scale, feedback error	In an MP scale absolute position detection system, excessive deviation was detected in the feedback amount of the motor end detector and MP scale.	*	A
97	MPO	MP scale, offset error	In an MP scale absolute position detection system, an error was detected in the offset data read when the CNC power was turned ON.	PR	A
9B	WMS	Magnetic pole shift warning	During linear servo system use, an error was detected in the magnetic pole shift amount set in SV028 (MSFT).	*	A
9C	WMG	Magnetic pole warning	During linear servo system use, an error was detected in the magnetic pole position data of the MDS-B-HR connected to the MAIN side after the passing of the Z phase.	*	A
9D	Wmg	Magnetic pole warning (SUB)	During linear servo system use, an error was detected in the magnetic pole position data of the MDS-B-HR connected to the SUB side after the passing of the Z phase.	*	A
9E	WAn	High-speed serial, multi-rotation counter error	OSE104/OSA104/OSE105/OSA105 An error was detected in the multi-rotation counter in the OSE104-ET/OSA104-ET/OSE105-ET/OSA105-ET. The absolute position cannot be compensated.	*	A
9F	WAB	Battery voltage drop	The voltage of the absolute position detector battery has dropped.	*	C
E1	WOL	Overload warning	An 80% level of the overload alarm 1 was detected.	*	A
E3	WAC	Absolute position counter warning	A deviation was detected in the absolute position and relative position.	*	A
E4	WPE	Parameter error warning	A parameter that exceeds the setting range was set.	*	A
E6	AXE	Control axis removed warning	The control axis has been removed.	*	A
E7	NCE	CNC emergency stop	The CNC is in an emergency stop status.	*	C

8-5 LED display Nos. during memory errors

When a memory error (alarm 12) occurs, connection with the CNC cannot usually be carried out. Regardless of whether the servo is normally connected to the CNC, if connection cannot be carried out, check the servo driver's LED display to see whether a memory error (alarm 12) has occurred.

The location of the fault can be determined using the No. displayed at this time in the LED. (Refer to the following table.)

No.	Explanation	Alarm occur when	Alarm display
–	Power print PCB ID error	When the CNC power is turned ON.	Alarm normally displayed
01	LSI built-in RAM error 1	When the servo driver power is turned ON.	Only "12" and the number's flickering LED display. (Connection with the CNC cannot be carried out.)
02	LSI built-in RAM error 2		
03	LSI transmission buffer error		
04	LSI reception buffer error		
05	External SRAM error		
11	LSI timing status error		
21	LSI encoder I/F counter error, L axis MAIN		
22	LSI encoder I/F counter error, L axis SUB		
23	LSI encoder I/F counter error, L axis MAIN		
24	LSI encoder I/F counter error, L axis SUB		
31	External FLASH boot code error 1		
32	External FLASH checksum error 1		
33	External FLASH boot code error 2		
34	External FLASH checksum error 2		
41	CPU built-in RAM error 1		
42	CPU built-in RAM error 2	When the CNC power is turned ON.	
51	Driver model error		

8-6 Error parameter Nos. during initial parameter errors

When an initial parameter error (alarm 37) occurs, the parameter in which the error exists is displayed on the DIAGNOSIS screen of the CNC.
The display method differs according to the CNC being used, so refer to the appropriate instruction manual for each CNC.

The No. displayed at this time normally shows the parameter No. (SV00xx).
Otherwise, a special 3-digit No. is displayed. (Refer to the following table.)
In this case, errors are occurring in several related parameters, so also be sure to correctly set the related parameters.

No.	Explanation	Related parameters
69	There is an error in the max. rapid traverse rate setting value of the CNC setting. This normally does not occur, but there may be a problem with the CNC system software.	CNC axis parameter rapid
71	There is an error is the max. cutting rate setting value of the CNC setting. This normally does not occur, but there may be a problem with the CNC system software.	CNC axis parameter clamp
101	The constants used in the following functions are overflowing. Electronic gears Position loop gain Speed feedback conversion Confirm that all related parameters are correctly set.	SV001:PC1, SV002:PC2 SV003:PGN1, SV018:PIT SV019:RNG1, SV020:RNG2 SV049:PGN1sp
102	When the high-speed serial incremental detector (OSE104, OSE105) is connected, the absolute position detection parameter turns ON. Turn the absolute position detection parameter OFF. The connected detector has incremental specifications. To carry out absolute position detection, it must be replaced with a detector having absolute position specifications.	SV017:SPEC, SV025:MTYP
103	There is no servo option. Closed loop (including ball screw end detection) and dual feedback control functions are optional functions.	SV025:MTYP/pen SV017:SPEC/dfbx
104	There is no servo option. The SHG control function is an optional function.	SV057:SHGC SV058:SHGCsp
105	There is no servo option. The adaptive filter function is an optional function.	SV027:SSF1/aflt
106	There is no servo option. The MP scale absolute position detection function is an optional function.	SV017:SPEC/mp, mpt3
107	Turn OFF the high-speed process mode parameters. To use with the high-speed process mode, change to 1-axis specifications. The compatible detectors are the MDS-B-HR or the ABS SCALL (Note 1).	SV017:SPEC/vmh

(Note 1) The ABS SCALL is compatible with the following absolute position linear scales.

Mitsutoyo Ltd.	AT342
Heidenhain Ltd.	LC191M