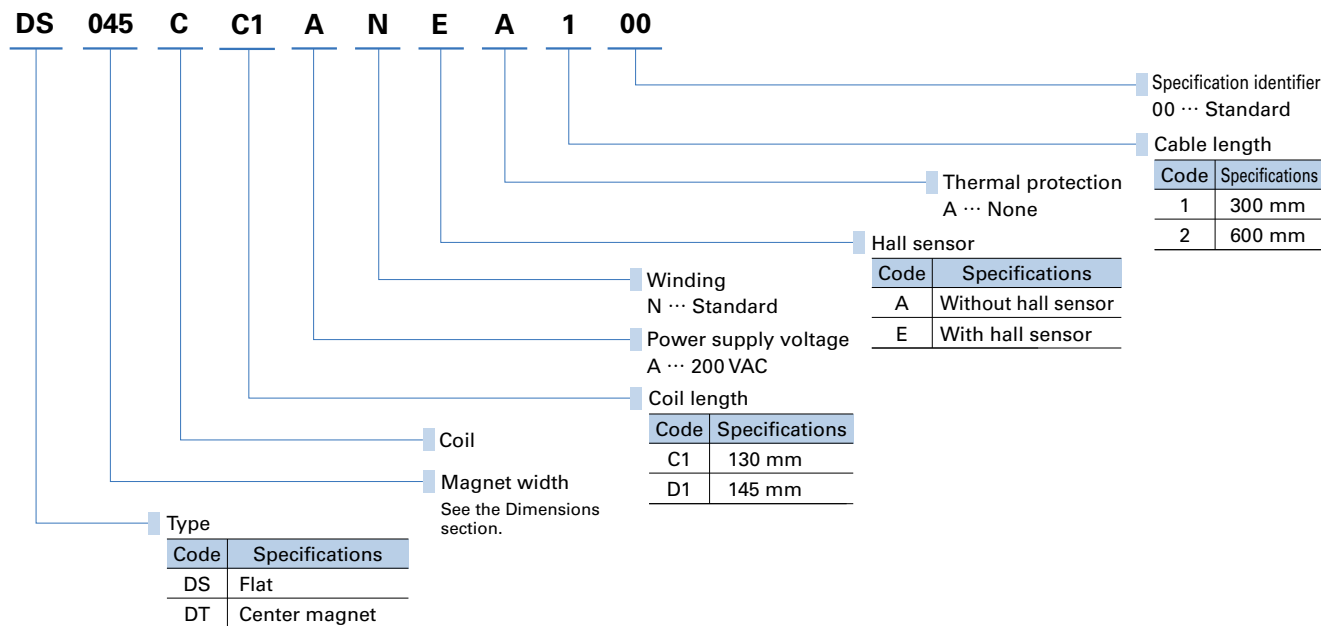# Linear Servo Motors

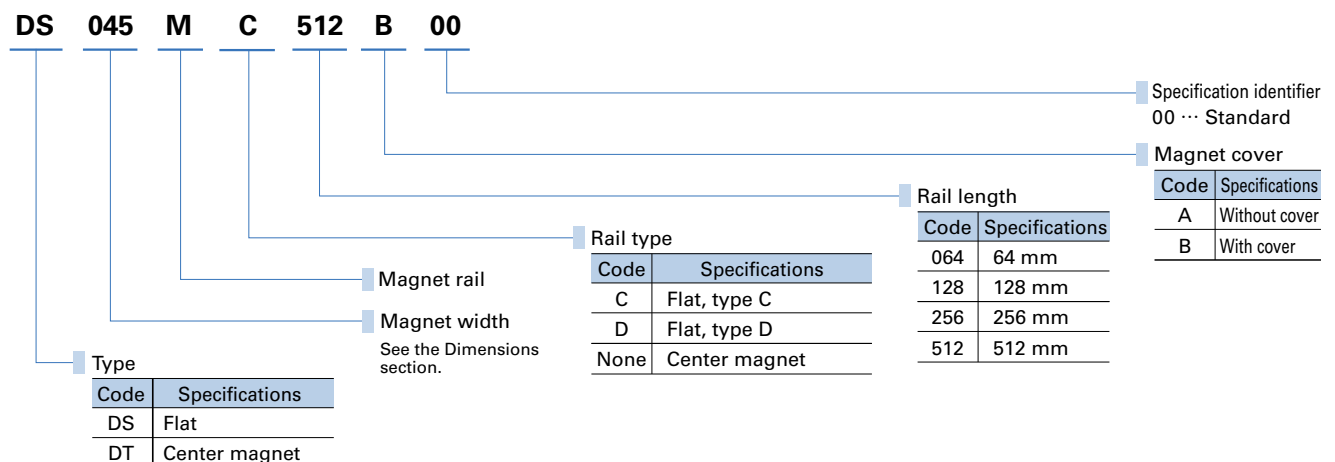## Flat type with core
Center magnet type with core

■ How to read model numbers

Note that not all possible combinations of field values may yield valid products. Also, some of the values listed below are for options.

Coil

DS 045 C C1 A N E A 1 00

Specification identifier
00 ⋯ Standard

Cable length

Code	Specifications
1	300 mm
2	600 mm

Thermal protection
A ⋯ None

Hall sensor

Code	Specifications
A	Without hall sensor
E	With hall sensor

Winding
N ⋯ Standard

Power supply voltage
A ⋯ 200 VAC

Coil length

Code	Specifications
C1	130 mm
D1	145 mm

Coil

Magnet width
See the Dimensions section.

Type

Code	Specifications
DS	Flat
DT	Center magnet

Magnet rail

DS 045 M C 512 B 00

Specification identifier
00 ⋯ Standard

Magnet cover

Code	Specifications
A	Without cover
B	With cover

Rail length

Code	Specifications
064	64 mm
128	128 mm
256	256 mm
512	512 mm

Rail type

Code	Specifications
C	Flat, type C
D	Flat, type D
None	Center magnet

Magnet rail

Magnet width
See the Dimensions section.

Type

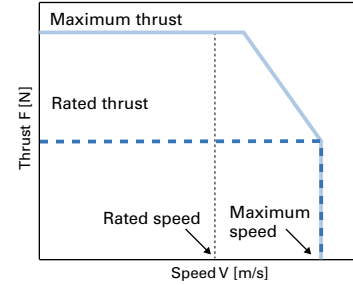| Code	Specifications
DS	Flat
DT	Center magnet

Flat type with core [Unit in drawings: mm]

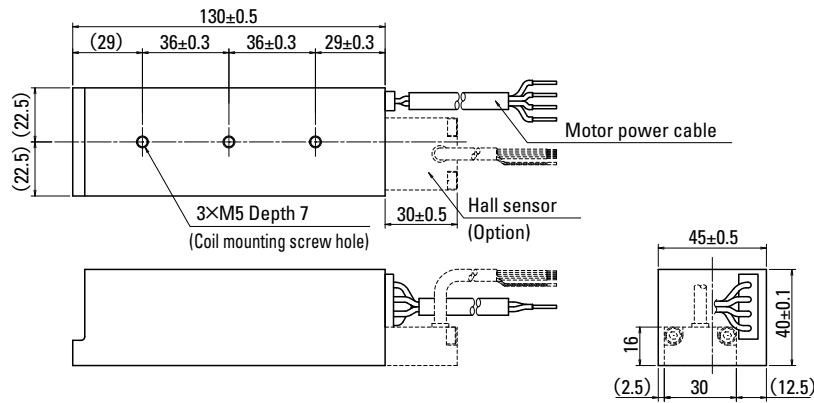## ■ Specifications

Coil model no.	Rated thrust [N]	Maximum thrust [N]	Rated speed [m/s]	Max. speed [m/s]	Magnetic attraction force [N]	Coil mass [kg]	Compatible magnet rail model no.	Compatible servo amplifier model no.
DS025CC1AN□A□00	140	270	2.3	3.2	940	1.1	DS025MC□□□	GADSA02

Magnet rail model no.	Magnet rail mass [kg]	Dimensions [mm]			
		L1	L2	N1	N2
DS025MC064□00	0.1	64	32	1	4
DS025MC128□00	0.3	128	96	3	8
DS025MC256□00	0.5	256	224	7	16
DS025MC512□00	1.0	512	480	15	32

Thrust-Speed Characteristics

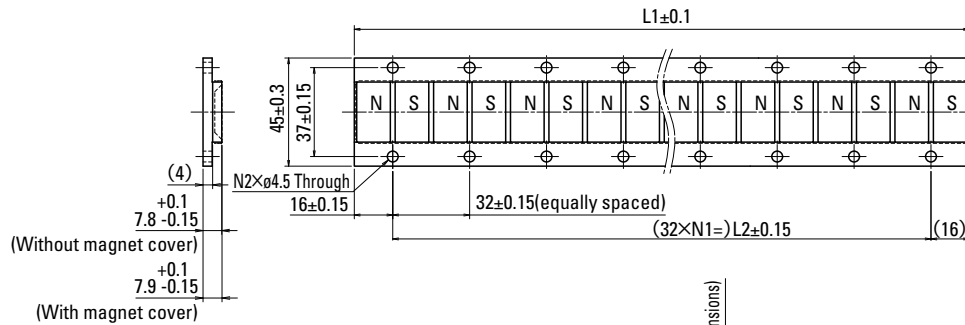
■ Coil dimensions

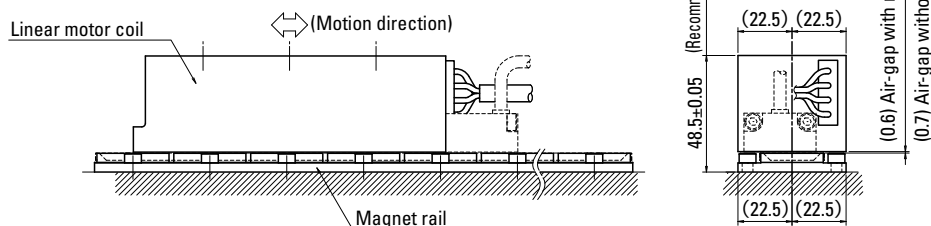## ■ Magnet rail dimensions

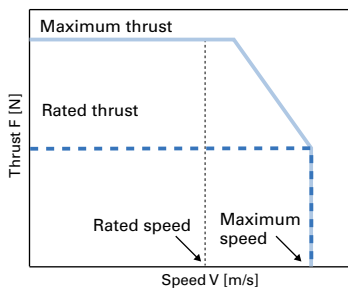## ■ Diagram of recommended assembly example
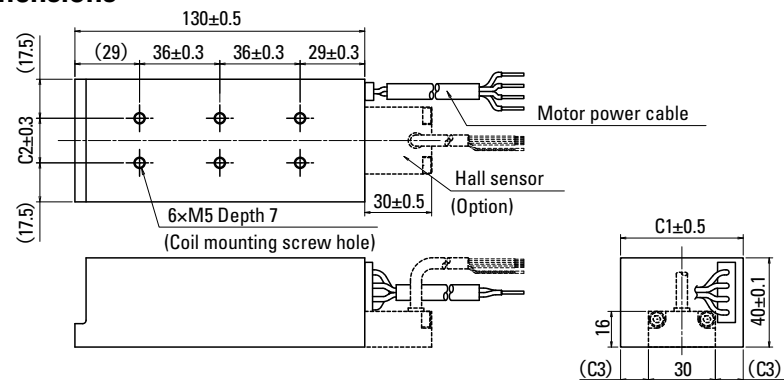
■ Specifications

Coil model no.	Rated thrust [N]	Maximum thrust [N]	Rated speed [m/s]	Max. speed [m/s]	Magnetic attraction force [N]	Coil mass [kg]	Dimensions [mm]			Compatible magnet rail model no.	Compatible servo amplifier model no.
							C1	C2	C3		
DS035CC1AN☐A☐00	200	390	1.9	2.6	1300	1.5	55	20	12.5	DS035MC☐☐☐	GADSA03
DS045CC1AN☐A☐00	260	500	1.8	3.0	1700	1.8	65	30	17.5	DS045MC☐☐☐	GADSA03
DS055CC1AN☐A☐00	310	600	1.9	3.0	2300	2.1	75	40	22.5	DS055MC☐☐☐	GADSA03
DS065CC1AN☐A☐00	340	700	2.1	3.0	2700	2.5	85	50	27.5	DS065MC☐☐☐	GADSA05

Magnet rail model no.	Magnet rail mass [kg]	Dimensions [mm]													
		L1	L2	N1	N2	E1	E2	E3	E4	E5	S1	S2	S3	S4	S5
DS035MC064☐00	0.2	64	32	1	4	55	47	4	7.8	7.9	27.5	27.5	48.5	0.6	0.7
DS035MC128☐00	0.3	128	96	3	8	55	47	4	7.8	7.9	27.5	27.5	48.5	0.6	0.7
DS035MC256☐00	0.7	256	224	7	16	55	47	4	7.8	7.9	27.5	27.5	48.5	0.6	0.7
DS035MC512☐00	1.3	512	480	15	32	55	47	4	7.8	7.9	27.5	27.5	48.5	0.6	0.7
DS045MC064☐00	0.2	64	32	1	4	62	54	4	7.8	7.9	32.5	31	48.5	0.6	0.7
DS045MC128☐00	0.4	128	96	3	8	62	54	4	7.8	7.9	32.5	31	48.5	0.6	0.7
DS045MC256☐00	0.8	256	224	7	16	62	54	4	7.8	7.9	32.5	31	48.5	0.6	0.7
DS045MC512☐00	1.5	512	480	15	32	62	54	4	7.8	7.9	32.5	31	48.5	0.6	0.7
DS055MC064☐00	0.3	64	32	1	4	75	67	5.5	9.5	9.6	37.5	37.5	50	0.4	0.5
DS055MC128☐00	0.6	128	96	3	8	75	67	5.5	9.5	9.6	37.5	37.5	50	0.4	0.5
DS055MC256☐00	1.2	256	224	7	16	75	67	5.5	9.5	9.6	37.5	37.5	50	0.4	0.5
DS055MC512☐00	2.4	512	480	15	32	75	67	5.5	9.5	9.6	37.5	37.5	50	0.4	0.5
DS065MC064☐00	0.4	64	32	1	4	85	77	5.5	9.5	9.6	42.5	42.5	50	0.4	0.5
DS065MC128☐00	0.7	128	96	3	8	85	77	5.5	9.5	9.6	42.5	42.5	50	0.4	0.5
DS065MC256☐00	1.4	256	224	7	16	85	77	5.5	9.5	9.6	42.5	42.5	50	0.4	0.5
DS065MC512☐00	2.8	512	480	15	32	85	77	5.5	9.5	9.6	42.5	42.5	50	0.4	0.5

Thrust-Speed Characteristics

■ Coil dimensions

6×M5 Depth 7
(Coil mounting screw hole)

Motor power cable
Hall sensor (Option)

■ Magnet rail dimensions

N2×ø4.5 Through
32±0.15 (equally spaced)
(32×N1=) L2±0.15
(Without magnet cover)
(With magnet cover)

■ Diagram of recommended assembly example

(Motion direction) Linear motor coil
Magnet rail
(Recommended assembly dimensions)
(S4) Air-gap with magnet cover
(S5) Air-gap without magnet cover

Features
Lineup
Standard Model Number List
Servo Motors
Linear Servo Motors
Servo Amplifiers Analog/Pulse
Servo Amplifiers EtherCAT
Options
Selection Guide
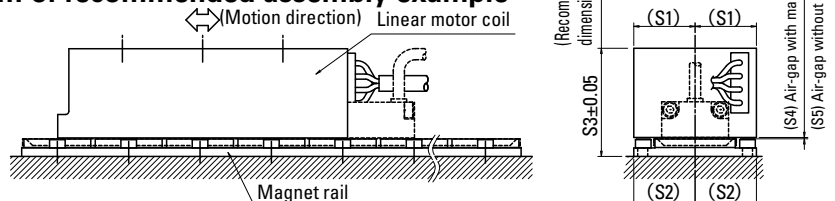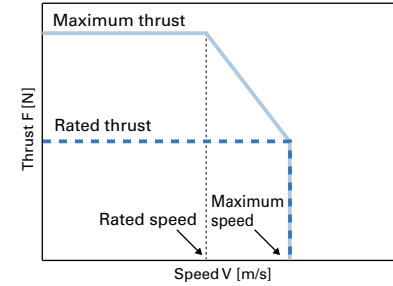
Flat type with core [Unit in drawings: mm]

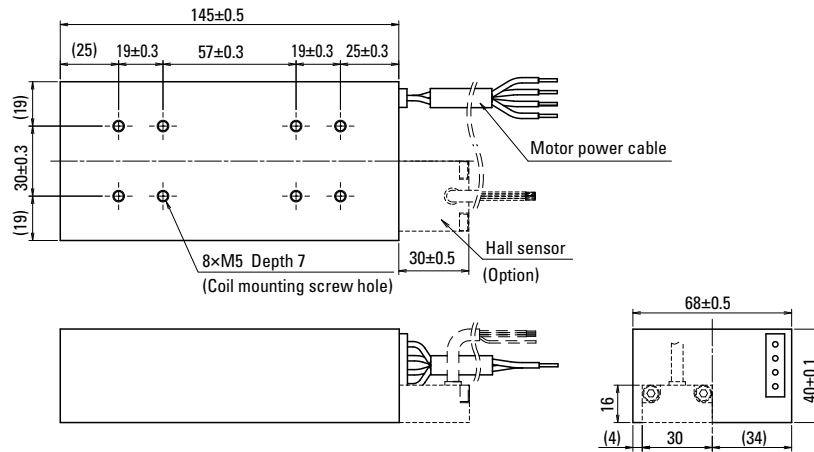## ■ Specifications

Coil model no.	Rated thrust [N]	Maximum thrust [N]	Rated speed [m/s]	Max. speed [m/s]	Magnetic attraction force [N]	Coil mass [kg]	Compatible magnet rail model no.	Compatible servo amplifier model no.
DS050CD1AN□A□00	340	630	2.0	3.0	2000	2.15	DS050MD□□□	GADSA03

Magnet rail model no.	Magnet rail mass [kg]	Dimensions [mm]			
		L1	L2	N1	N2
DS050MD064□00	0.2	64	32	1	4
DS050MD128□00	0.5	128	96	3	8
DS050MD256□00	0.9	256	224	7	16
DS050MD512□00	1.8	512	480	15	32

Thrust-Speed Characteristics

■ Coil dimensions

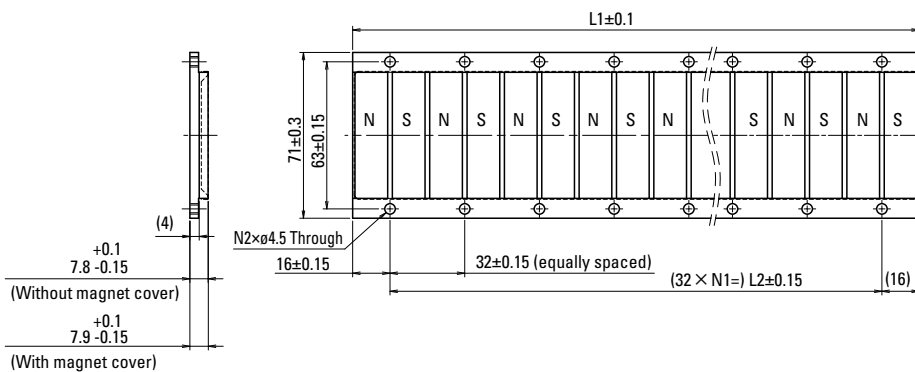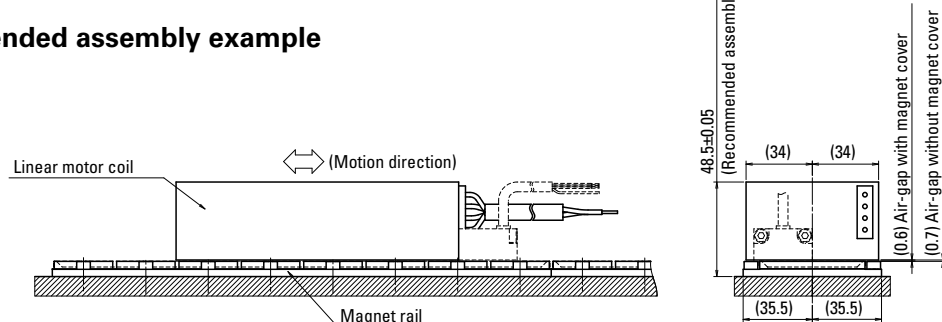
■ Magnet rail dimensions

■ Diagram of recommended assembly example

Center magnet type with core   [Unit in drawings: mm]

■ Specifications

Coil model no.	Rated thrust [N]	Maximum thrust [N]	Rated speed [m/s]	Max. speed [m/s]	Magnetic attraction force [N]	Coil mass [kg]	Compatible magnet rail model no.	Compatible servo amplifier model no.
DT030CD1AN□A□00	350	650	1.9	2.5	0	2.4	DT030M□□□	GADSA03

Magnet rail model no.	Magnet rail mass [kg]	Dimensions [mm]				
		L1	L2	L3	N1	N2
DT030M128□00	0.5	128	96	80	7	6
DT030M256□00	0.9	256	224	208	15	14
DT030M512□00	1.9	512	480	464	31	30

Thrust-Speed Characteristics
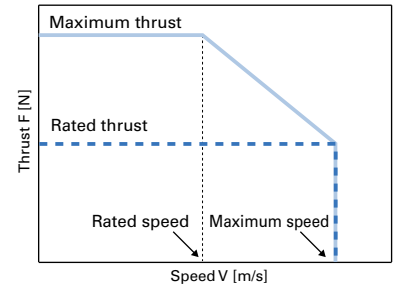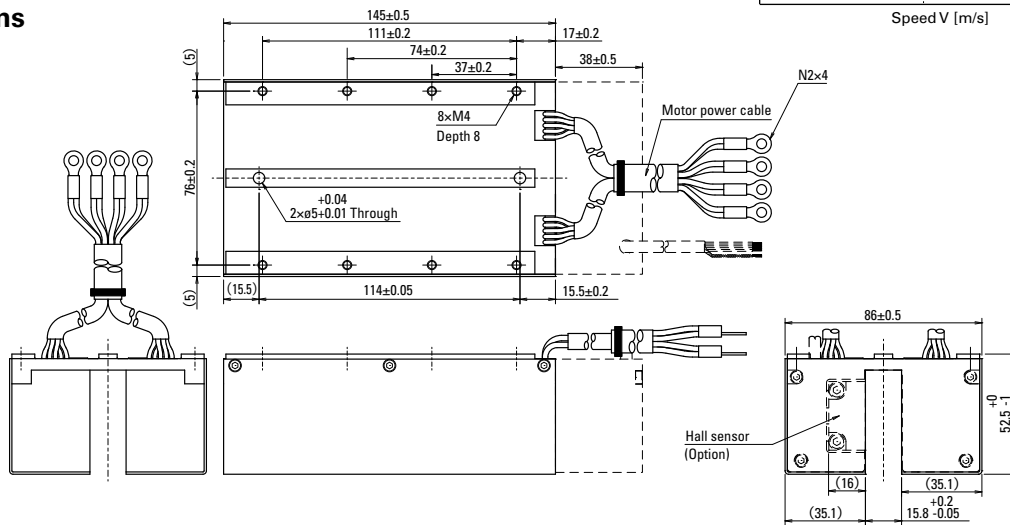
■ Coil dimensions

■ Magnet rail dimensions
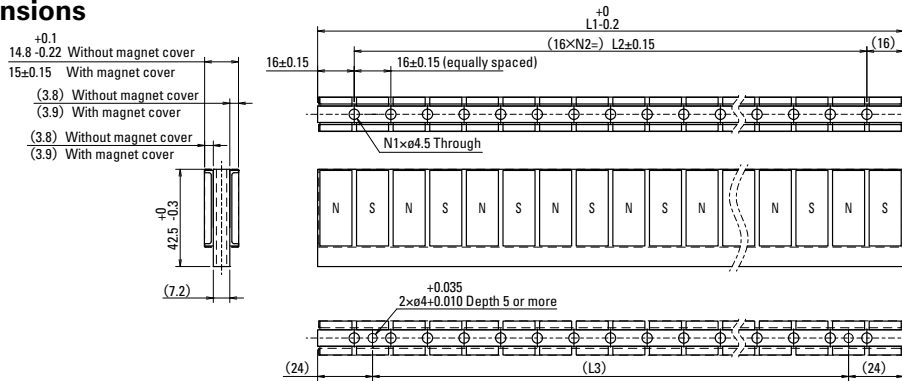
■ Diagram of recommended assembly example
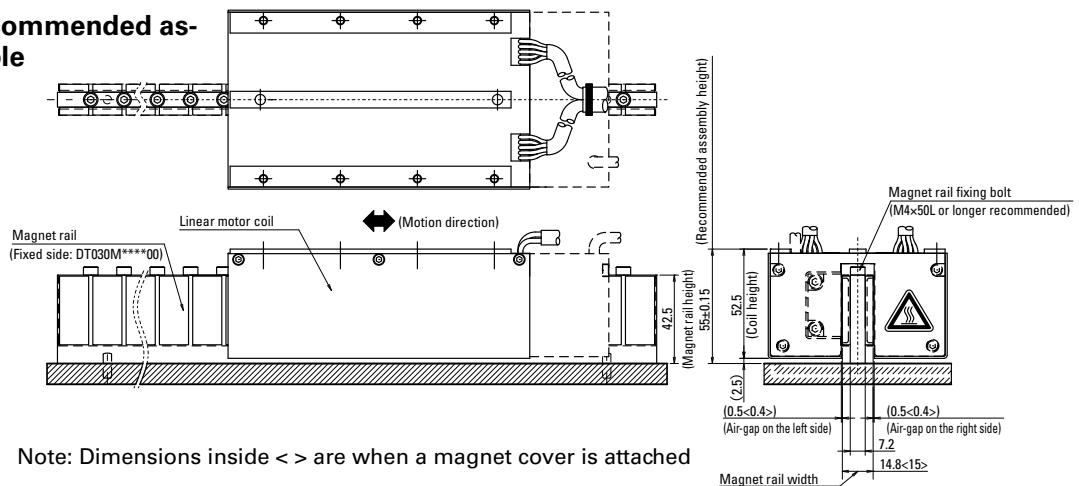
Note: Dimensions inside < > are when a magnet cover is attached

Features

Lineup

Standard Model Number List

Servo Motors

Linear Servo Motors

Servo Amplifiers Analog/Pulse

Servo Amplifiers EtherCAT

Options

Selection Guide

Servo Amplifiers

Analog/Pulse input type

Amplifier capacity: 10 to 50 A

■ How to read model numbers

Note that not all possible combinations of field values may yield valid products. Also, some of the values listed below are for options.
Refer to the Standard Model Number List section for standard models with valid model numbers.

GA D SA 01 A A 2 2

Option 2

Code	STO function	Tandem operation function	Standard/Option
0	—	—	Option
2	✓ (Without delay circuit)	✓	Standard
4	✓ (With delay circuit)	✓	Option

Motor encoder type

Code	Connector X3 (Upper)	Connector X4 (Lower)	Standard/Option
0	Absolute encoder	—	Option
1	Absolute encoder	Absolute encoder	Option
2	Absolute encoder	Incremental encoder	Standard
8	Incremental encoder	—	Option
9	Incremental encoder	Absolute encoder	Option
A	Incremental encoder	Incremental encoder	Option

Interface

Code	Specifications
A	Analog/Pulse, sinking type general-purpose output
B	Analog/Pulse, sourcing type general-purpose output

Option 1

Code	Specifications
A	With built-in regenerative resistor & With DB resistor
L	Without built-in regenerative resistor & With DB resistor

Amplifier capacity

Code	Specifications
01	10 A
02	20 A
03	30 A
05	50 A

Input power supply voltage

Code	Specifications
SA	200 VAC
SE	100 VAC

D···Servo amplifier

GA···SANMOTION G series

System Configuration

10 to 50 A The photo shows a 30 A model.

T S R

8 Molded case circuit breaker (MCCB)

9 Noise filter

Electromagnetic contactor

Servo amplifier

Setup software

1

USB serial adapter **2**

XA
L1
12
L2
L3
XC
L1C
14
L2C
RB1
RB2
RB4

4

External regenerative resistor

XB
U
13
V
W

3 Amplifier-amplifier cable for tandem operation

SANMOTION G
AC SERVO SYSTEMS
SANYO DENKI
X0
CHARGE
GADSA03AB22
X6

X1

17
X1

Host controller

18 **X2**

20 **X3**

20
X4
Fully closed-loop encoder connection

X3
X4
X5

5 Servo motor power cable

Servo motor encoder cable **6**

11

Holding brake power supply

Servo motor

7

Safety unit, safety PLC, etc.

In the case of a linear servo motor →**XB**

X3
20 **X3**
X4
20
X4
X5

Linear servo motor

Hall sensor

Linear encoder

Features

Lineup

Standard Model Number List

Servo Motors

Linear Servo Motors

Servo Amplifiers Analog/Pulse

Servo Amplifiers EtherCAT

Options

Selection Guide

Options and Peripheral Items (10 to 50 A)

No.	Name	Model no.	Description	
❶	Setup software	Can be downloaded from Product Information on our website.	Parameters can be set and monitored via communication with a PC.	
❷	USB communication cable	AL-Y0020355-0□	PC side: Type A, amplifier side: Type C	PC communication cable for setup software
		AL-Y0021049-0□	PC side: Type C, amplifier side: Type C	
❸	Amplifier-to-amplifier cable for tandem operation	AL-01134653-0□	Connects between amplifiers for tandem operation (X6 ⇔ X6) Consult us if using the tandem operation function.	
❹	External regenerative resistor	AL-R□□□W□□B	Used when more regenerative capacity is needed, e.g., high-frequency movements	
❺	Servo motor power cable	p. 65, p. 66	For rotary motors only	
❻	Servo motor encoder cable	p. 66		
❼	Safety unit, safety PLC, etc. To be provided by the customer	To be provided by the customer	Connects I/O signals from the STO function to devices such as a safety unit and safety PLC.	
❽	Molded case circuit breaker (MCCB)	To be provided by the customer	Used to protect power lines	
❾	Noise filter	To be provided by the customer	Used to prevent external noise from power lines	
❿	Electromagnetic contactor	To be provided by the customer	Used to switch the power on and off (prepare a protective circuit)	
⓫	Holding brake	To be provided by the customer	Used for servo motors with holding brake	

Individual connectors

No.	Connector code	Details		Model no.	Mfr. part no.	Manufacturer
⓬	XA	Power connector	For main circuit power supply connection	AL-01111794-01	03JFAT-SAXGDK-KT10	J.S.T.
⓭	XB		For servo motor/linear servo motor connection	AL-01111795-01	03JFAT-SAYGDK-KT10	
⓮	XC		For control circuit power supply / external regenerative resistor connection	AL-01111793-01	06JFAT-SAXGDK-K5.0	
⓯	XC		For control circuit power supply / built-in regenerative resistor connection (with short-circuit jumper)	AL-AP000439-01	06JFAT-SAXGDK-K5.0 + Shorting bar	
⓰	OT	Connector tool for XA/XB/XC		AL-00961844-01	J-FAT-OT(N)	
⓱	X1	GPIO connector		AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan, Ltd
⓲	X2	Signal connector	STO wiring connector	AL-00718252-01	2013595-3	Tyco Electronics Japan G.K.
⓳	X2		STO short-circuit connector*	AL-00849548-02	1971153-2	
⓴	X3, X4		For encoder connection (With linear servo motors, linear encoder / hall sensor connection)	AL-00530312-01	54599-1019	Molex Japan Co., Ltd.

* If not wiring X2, be sure to insert a supplied short-circuit STO connector to X2.

Power connector sets

Name	Model no.	Connectors included in the set (see above, numbers in the "Individual connectors" table)				
		⓬ XA	⓭ XB	⓮ XC	⓯ XC with shorting bar	⓰ OT
Power connector set A (With built-in regenerative resistor)	AL-01135740-01	✓	✓	–	✓	✓
Power connector set B (With external regenerative resistor)	AL-01133414-01	✓	✓	✓	–	✓

Signal connector sets

Name	Model no.	Connectors included in the set (see above, numbers in the "Individual connectors" table)		
		⓱ X1	⓲ X2	⓴ X3, X4
Signal connector set A1 (STO not used)	AL-01136300-01	✓	– Use the short-circuiting connector included with the servo amplifier	✓
Signal connector set A2 (STO used)	AL-01136301-01	✓	✓	✓

Power/Signal connector set
For semi closed-loop control. When using fully closed-loop control or using a hall sensor with a linear servo motor, prepare another ⓴ encoder connector.

Name	Built-in regenerative resistor	STO function	Model no.	Connectors included in the set (see above, numbers in the "Individual connectors" table)							
				⓬ XA	⓭ XB	⓮ XC	⓯ XC with shorting bar	⓰ OT	⓱ X1	⓲ X2	⓴ X3, X4
Power/Signal connector set A	✓	–	AL-01134646-01	✓	✓	–	✓	✓	✓	–	✓
	–	–	AL-01134645-01	✓	✓	✓	–	✓	✓	–	✓
	✓	✓	AL-01134648-01	✓	✓	–	✓	✓	✓	✓	✓
	–	✓	AL-01134647-01	✓	✓	✓	–	✓	✓	✓	✓

General Specifications

CE UKCA c UL US KC TÜV SÜD RoHS

Model no.			GADS□01□□	GADS□02□□	GADS□03□□	GADS□05□□
Capacity			10 A	20 A	30 A	50 A
Maximum compatible motor output			200 W	400 W	1.5 kW	2.5 kW
Continuous output current			1.2 Arms	3.1 Arms	5.2 Arms	12.0 Arms
Peak output current			4.3 Arms	12.0 Arms	16.3 Arms	26.5 Arms
Control function			Position/speed/torque control (switched with parameters)			
Control system			IGBT-based, sinusoidal PWM control			
Main circuit power supply	Input voltage range		3-phase: 200 to 240 VAC (+10, -15%), 50/60 Hz (±3 Hz) Single-phase: 200 to 240 VAC (+10, -15%), 50/60 Hz (±3 Hz)[1] Single-phase: 100 to 120 VAC (+10, -15%), 50/60 Hz (±3 Hz)[2]			
	Input current (3-/single-phase)		1.2/2.0 Arms	2.2/3.9 Arms	6.9/7.0 Arms	11.0/11.6 Arms
	Power supply capacity		0.4 kVA	0.8 kVA	2.4 kVA	3.8 kVA
Control circuit power supply	Input voltage range		Single-phase: 200 to 240 VAC (+10, -15%), 50/60 Hz (±3 Hz) Single-phase: 100 to 120 VAC (+10, -15%), 50/60 Hz (±3 Hz)[2]			
	Input current		0.5 Arms			0.3 Arms
Regenerative resistor	Built-in regenerative resistor	Resistance	25 Ω			17 Ω
		Max. power consumption	5 W			20 W
	Min. allowable external resistance		25 Ω			17 Ω
Environment	Operating ambient temperature		0 to +60°C[3]			
	Storage temperature		-20 to +65°C			
	Operating and storage humidity		95% RH max. (non-condensing)			
	Operating altitude		2000 m max.[3]			
	Vibration resistance		6 m/s²			
	Shock resistance		20 m/s²			
	Overvoltage category		III			
Structure			Built-in tray-type power supply			

(1) 200 VAC single-phase input is compatible only with GADSA□□. When using single-phase input, parameter settings will be necessary.
(2) 100 VAC single-phase input is compatible only with GADSE□□. When using single-phase input, parameter settings will be necessary.
(3) When used in environments with an ambient temperature of +55 to +60°C or an altitude of 1000 to 2000 m, motor performance undergoes derating.
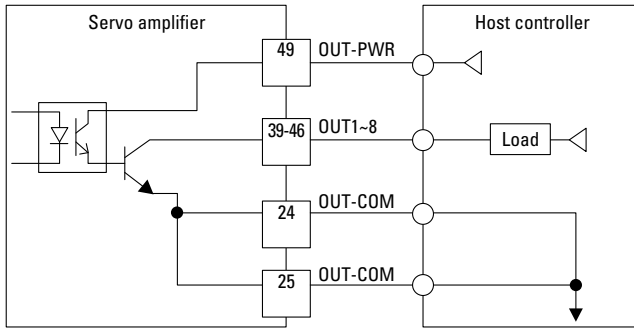
■ Performance

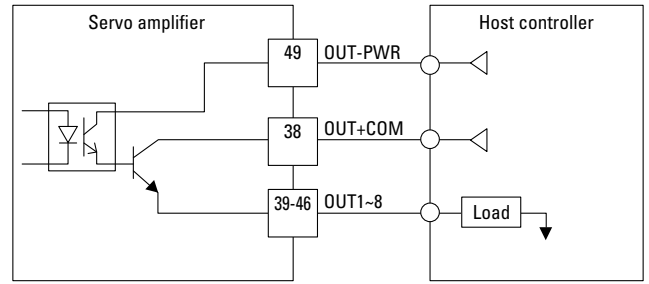| Velocity control range	1:5000 (Internal velocity command)
Frequency characteristics	3500 Hz (With 400 W or lower motors in high-speed command mode)
Allowable range of load inertia	10 times the motor rotor inertia

■ Built-in functions

Protection functions	Output power device error (overcurrent), current detection error, STO error, cooling fan error, overload, regenerative error, magnetic pole position estimation error, continuous overspeed, overheating error, external error, servo amplifier temperature error, overvoltage, main circuit power supply undervoltage, main circuit power supply open phase, main circuit power supply voltage detection error, inrush current protection time error, control circuit power supply undervoltage, encoder error, over-speed, speed control error, speed feedback error, model-following vibration control error, excessive position deviation, positioning command error, excessive inter-axis synchronization deviation, excessive dual positioning deviation, dual positioning feedback error, inter-aplifier communication error, memory error, CPU error, parameter error, control circuit error, task process error
Digital operator	Status display, parameter setting, adjustment mode, test run, alarm log, monitoring, motor code setting
Dynamic brake circuit	Built-in
Regenerative circuit	Built-in
Analog monitor	Ch 1: Velocity monitoring (VMON) 2.0 V ±10% (at 1000 min⁻¹), Ch 2: Torque command monitoring (TCMON) 2.0 V ±10% (at 100%)

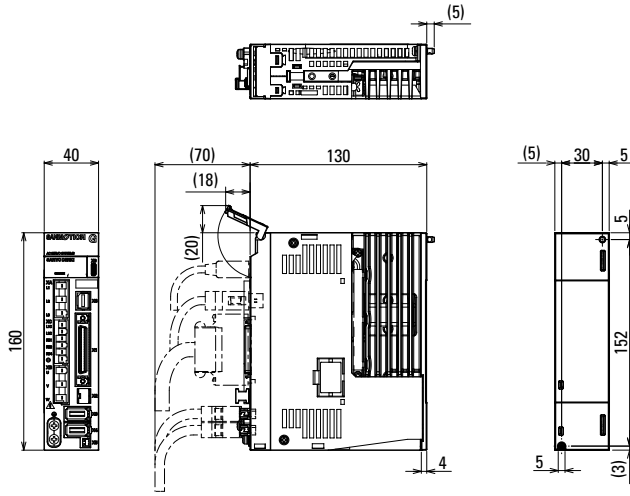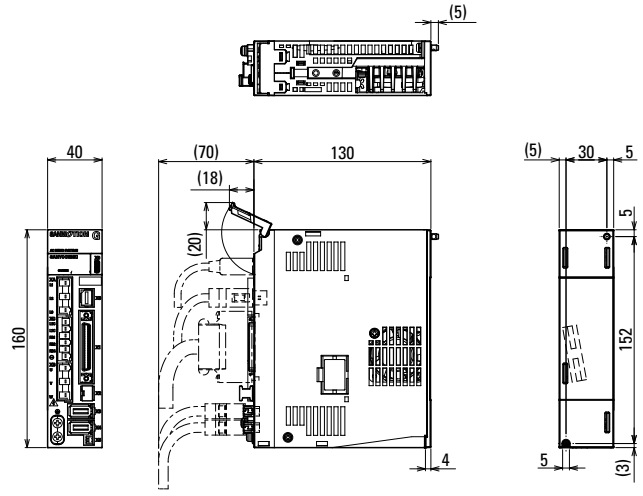# ■ General-purpose output (GPO) specifications

Sinking type

Servo amplifier		Host controller
49	OUT-PWR	
39-46	OUT1~8	Load
24	OUT-COM	
25	OUT-COM	

Sourcing type

Servo amplifier		Host controller
49	OUT-PWR	
38	OUT+COM	
39-46	OUT1~8	Load

Features

Lineup

Standard Model
Number List

Servo Motors

Linear Servo Motors

Servo Amplifiers Analog/Pulse

Servo Amplifiers EtherCAT

Options

Selection Guide

Dimensions [Unit: mm]

《10 A》

Mass：0.80 kg

《20 A》

Mass：0.80 kg

《30 A》

Mass：0.90 kg
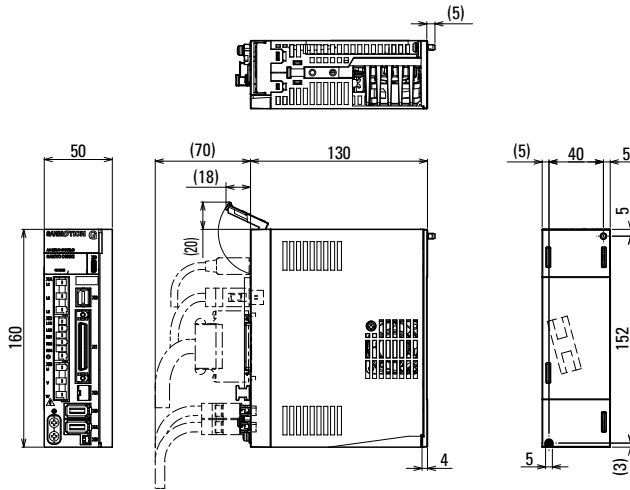
《50 A》

Mass：1.50 kg
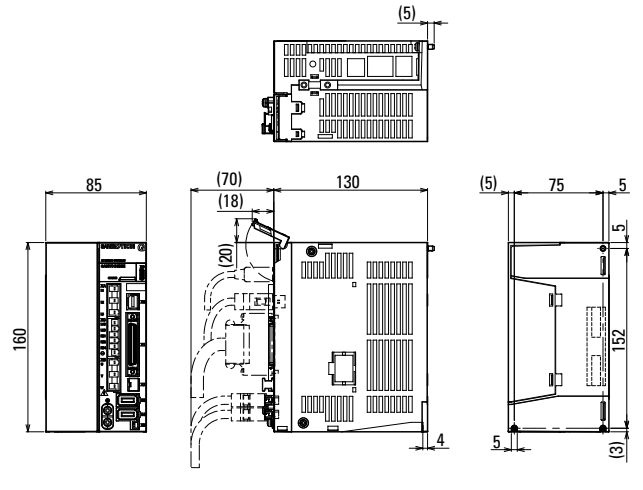
External Wiring Diagram

Sinking output

Connector no.	Name	Housing, plug, shell
XA	Main circuit power input connector	03JFAT-SAXGDK-KT10
XB	Servo motor power connector	03JFAT-SAYGDK-KT10
XC	Control power supply / regenerative resistor connector	06JFAT-SAXGDK-K5.0
X1	Controller connector	Plug: 10150-3000PE Shell: 10350-52A0-008
X2	Safety device connector	For short-circuiting: 1971153-2 For wiring: 2013595-3
X3, X4	Motor encoder connector	I/O connector : 54599-1019

(1) ⎓ Use shielded twisted pair (STP) cables.

(2) When using the built-in regenerative resistor, jumper between RB1 and RB4 terminals. When using an external regenerative resistor, remove the shorting jumper connected to RB1 and RB4 terminals, and then connect the external regenerative resistor between RB1 and RB2 terminals.

(3) The ⊖ terminal is a maintenance terminal (high-voltage circuit). Do not connect wires to this terminal.

(4) Motor side connections vary depending on motor specifications.

(5) Refer to the encoder connection diagram for the wiring of encoder connectors.

(6) L1, L2, L3, L1C, L2C, RB1, RB2, RB4, ⊖, U, V, and W are high-voltage circuits. All other signal lines are low-voltage circuits. When wiring, provide sufficient clearance between high-voltage and low-voltage circuits.

(7) For differential line drivers, use one with a differential voltage (VT) within 2.5 to 3.8 V. If the differential voltage is below 2.5 V or above 3.8 V, it may cause malfunction due to missing pulses.

(8) X2 is a safety device connector. Turning Servo ON (motor in operation) requires to connect a safety device to X2 and get safety functions enabled. When not using safety functions, insert an optional short-circuit connector to X2.

(9) Do not connect anything to the X2-1 or X2-2 pins.

(10) When using a differential input signal, be sure to connect the signal ground (SG) between the servo amplifier and equipment.

(11) Use of a UL or IEC/EN compliant leakage circuit breaker is recommended.

(12) When using single-phase 100/200 VAC or VDC input, connect the main circuit power supply to L1 and L2, and do not use L3.

(13) When using a single-phase power supply, please check our User's Manual or Product Specification for accompanying limitations.

(14) Use of a UL or IEC/EN compliant leakage circuit breaker is recommended on the primary side of the DC power supply.

(15) When using a DC power supply, please check our User's Manual or Product Specification for accompanying limitations.

(16) An external power supply is to be prepared by the customer.

(17) Use an input voltage that meets the product specifications.

Features

Lineup

Standard Model Number List

Servo Motors

Linear Servo Motors

Servo Amplifiers Analog/Pulse

Servo Amplifiers EtherCAT

Options

Selection Guide

External Wiring Diagram

Sourcing output

Connector no.	Name	Housing, plug, shell
XA	Main circuit power input connector	03JFAT-SAXGDK-KT10
XB	Servo motor power connector	03JFAT-SAYGDK-KT10
XC	Control power supply / regenerative resistor connector	06JFAT-SAXGDK-K5.0
X1	Controller connector	Plug: 10150-3000PE Shell: 10350-52A0-008
X2	Safety device connector	For short-circuiting: 1971153-2 For wiring: 2013595-3
X3, X4	Motor encoder connector	I/O connector: 54599-1019

(1) ⊣⊢ Use shielded twisted pair (STP) cables.

(2) When using the built-in regenerative resistor, jumper between RB1 and RB4 terminals. When using an external regenerative resistor, remove the shorting jumper connected to RB1 and RB4 terminals, and then connect the external regenerative resistor between RB1 and RB2 terminals.

(3) The ⊖ terminal is a maintenance terminal (high-voltage circuit). Do not connect wires to this terminal.

(4) Motor side connections vary depending on motor specifications.

(5) Refer to the encoder connection diagram for the wiring of encoder connectors.

(6) L1, L2, L3, L1C, L2C, RB1, RB2, RB4, ⊖, U, V, and W are high-voltage circuits. All other signal lines are low-voltage circuits. When wiring, provide sufficient clearance between high-voltage and low-voltage circuits.

(7) For differential line drivers, use one with a differential voltage (VT) within 2.5 to 3.8 V. If the differential voltage is below 2.5 V or above 3.8 V, it may cause malfunction due to missing pulses.

(8) X2 is a safety device connector. Turning Servo ON (motor in operation) requires to connect a safety device to X2 and get safety functions enabled. When not using safety functions, insert an optional short-circuiting connector to X2.

(9) Do not connect anything to the X2-1 or X2-2 pins.

(10) When using a differential input signal, be sure to connect the signal ground (SG) between the servo amplifier and equipment.

(11) Use of a UL or IEC/EN compliant leakage circuit breaker is recommended.

(12) When using single-phase 100/200 VAC or VDC input, connect the main circuit power supply to L1 and L2, and do not use L3.

(13) When using a single-phase power supply, please check our User's Manual or Product Specification for accompanying limitations.

(14) Use of a UL or IEC/EN compliant leakage circuit breaker is recommended on the primary side of the DC power supply.

(15) When using a DC power supply, please check our User's Manual or Product Specification for accompanying limitations.

(16) An external power supply is to be prepared by the customer.

(17) Use an input voltage that meets the product specifications.

Servo Amplifiers

EtherCAT interface type

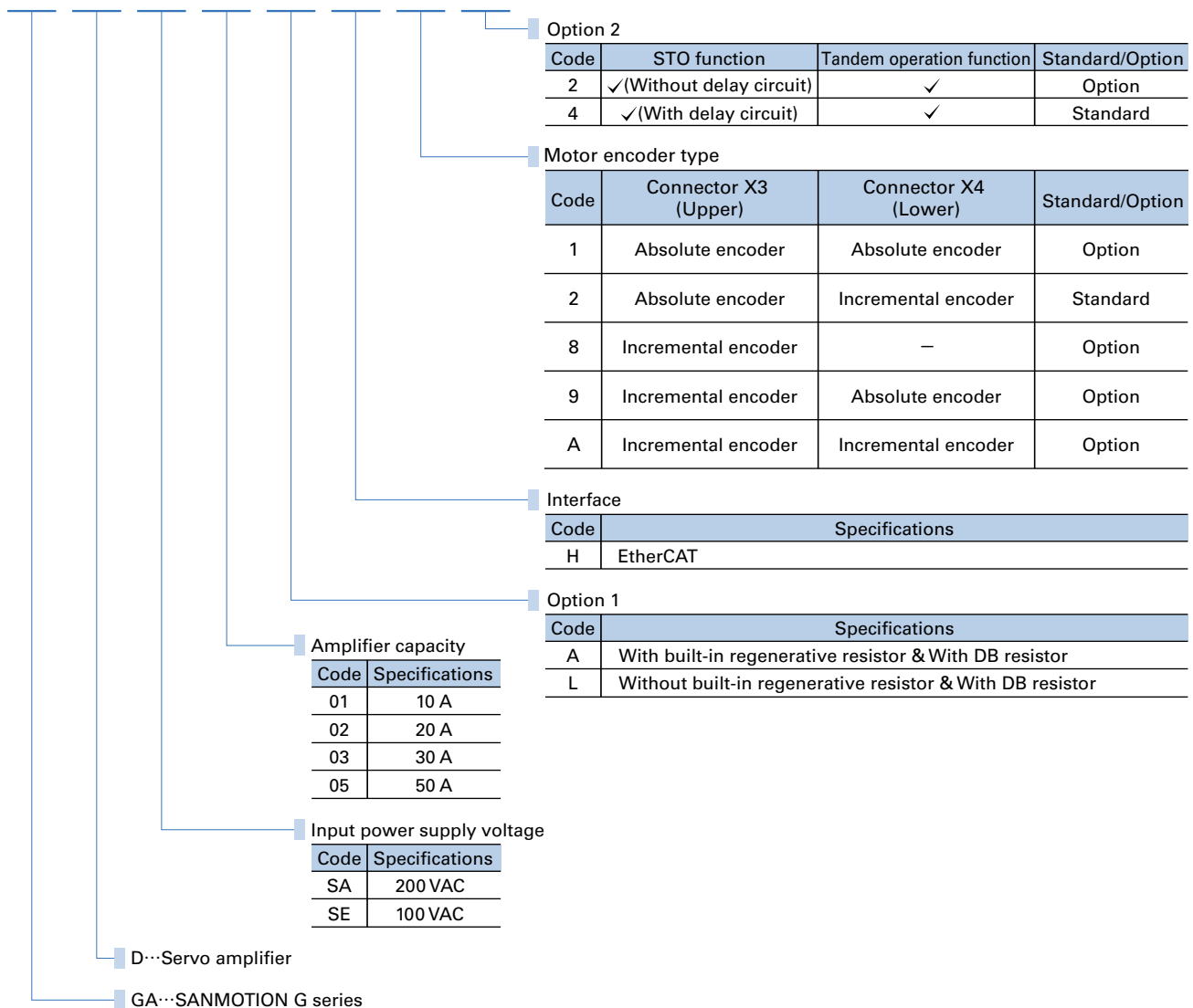Amplifier capacity: 10 to 50 A

■ How to read model numbers

Note that not all possible combinations of field values may yield valid products. Also, some of the values listed below are for options.
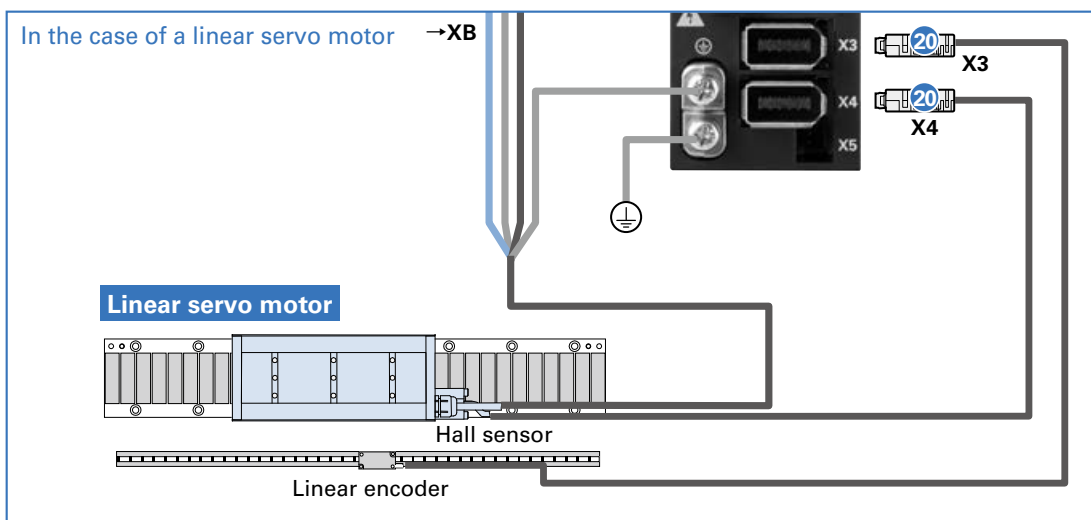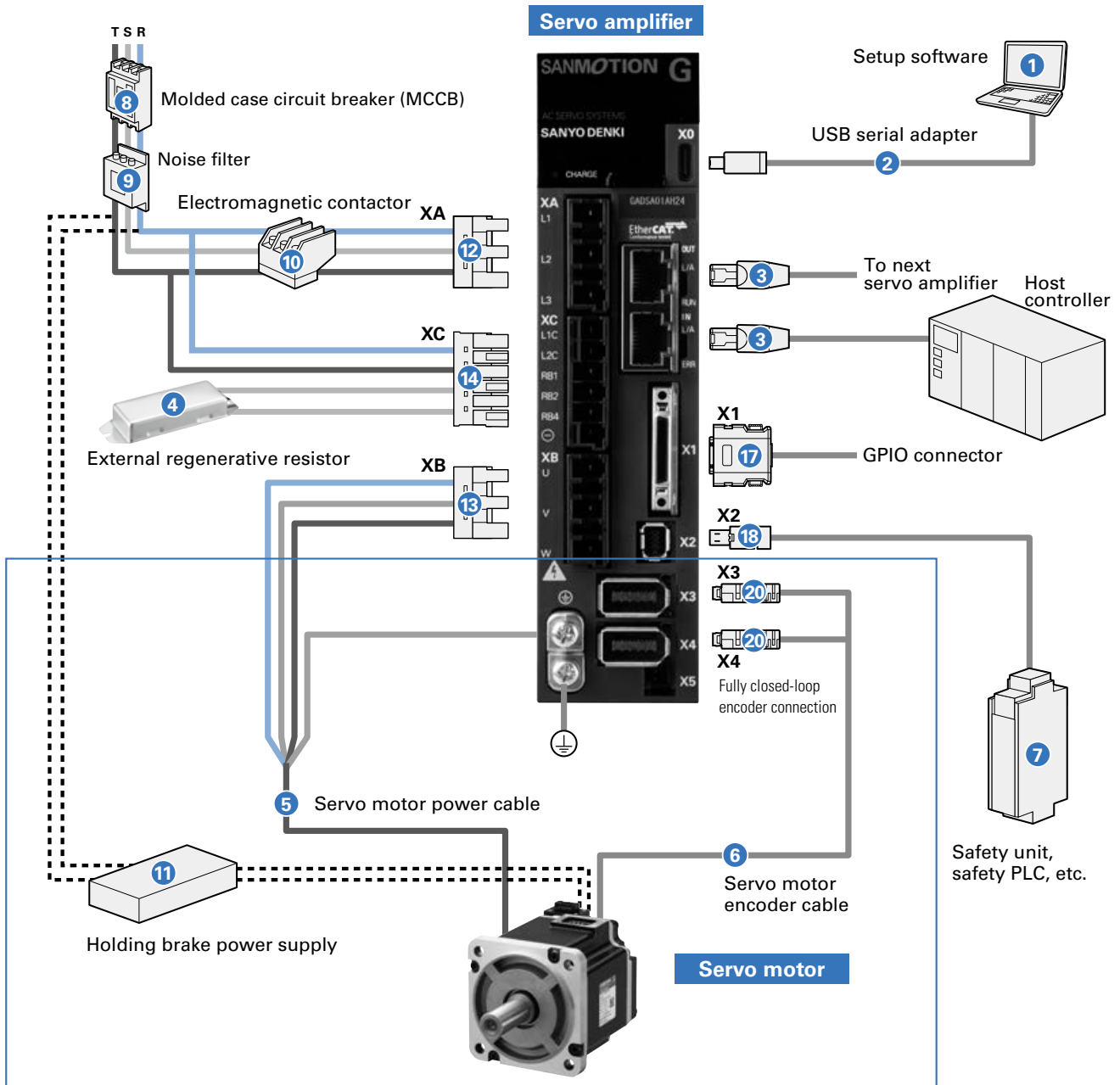
Refer to the Standard Model Number List section for standard models with valid model numbers.

GA D SA 01 A H 2 4

Option 2

Code	STO function	Tandem operation function	Standard/Option
2	✓(Without delay circuit)	✓	Option
4	✓(With delay circuit)	✓	Standard

Motor encoder type

Code	Connector X3 (Upper)	Connector X4 (Lower)	Standard/Option
1	Absolute encoder	Absolute encoder	Option
2	Absolute encoder	Incremental encoder	Standard
8	Incremental encoder	—	Option
9	Incremental encoder	Absolute encoder	Option
A	Incremental encoder	Incremental encoder	Option

Interface

Code	Specifications
H	EtherCAT

Option 1

Code	Specifications
A	With built-in regenerative resistor & With DB resistor
L	Without built-in regenerative resistor & With DB resistor

Amplifier capacity

Code	Specifications
01	10 A
02	20 A
03	30 A
05	50 A

Input power supply voltage

Code	Specifications
SA	200 VAC
SE	100 VAC

D···Servo amplifier

GA···SANMOTION G series

System Configuration

10 to 50 A   The photo shows a 10 A model.

Servo amplifier

Setup software ①

USB serial adapter ②

T S R

⑧ Molded case circuit breaker (MCCB)

⑨ Noise filter

Electromagnetic contactor **XA** ⑫

⑩

SANMOTION G

AC SERVO SYSTEMS
SANYO DENKI   X0
CHARGE

XA
L1
L2
L3
XC
L1C
L2C
RB1
RB2
RB4
⊖
XB
U
V
W

③ To next servo amplifier   Host controller

③

XC ⑭

④

External regenerative resistor

XB ⑬

X1 ⑰   GPIO connector

X2 ⑱

X3 ⑳
X4 ⑳
Fully closed-loop encoder connection

X3
X4
X5

⑤ Servo motor power cable

⑥ Servo motor encoder cable

⑦ Safety unit, safety PLC, etc.

⑪ Holding brake power supply

Servo motor

In the case of a linear servo motor   →**XB**

X3 ⑳ **X3**
X4 ⑳ **X4**
X5

Linear servo motor

Hall sensor

Linear encoder

Options and Peripheral Items (10 to 50 A)

No.	Name	Model no.	Description	
❶	Setup software	Can be downloaded from Product Information on our website.	Parameters can be set and monitored via communication with a PC.	
❷	USB communication cable	AL-Y0020355-0□	PC side: Type A, amplifier side: Type C	PC communication cable for setup software
		AL-Y0021049-0□	PC side: Type C, amplifier side: Type C	
❸	EtherCAT connector	To be provided by the customer	Communication with controller or another servo amplifier	
❹	External regenerative resistor	AL-R□□□W□□B	Used when more regenerative capacity is needed, e.g., high-frequency movements	
❺	Servo motor power cable	p. 65, p. 66	For rotary motors only	
❻	Servo motor encoder cable	p. 66		
❼	Safety unit, safety PLC, etc.	To be provided by the customer	Connects I/O signals from the STO function to devices such as a safety unit and safety PLC.	
❽	Molded case circuit breaker (MCCB)	To be provided by the customer	Used to protect power lines	
❾	Noise filter	To be provided by the customer	Used to prevent external noise from power lines	
❿	Electromagnetic contactor	To be provided by the customer	Used to switch the power on and off (prepare a protective circuit)	
⓫	Holding brake	To be provided by the customer	Used for servo motors with holding brake	

Individual connectors

No.	Connector code	Details		Model no.	Mfr. part no.	Manufacturer
⓬	XA	Power connector	For main circuit power supply connection	AL-01111794-01	03JFAT-SAXGDK-KT10	J.S.T.
⓭	XB		For servo motor/linear servo motor connection	AL-01111795-01	03JFAT-SAYGDK-KT10	
⓮	XC		For control circuit power supply / external regenerative resistor connection	AL-01111793-01	06JFAT-SAXGDK-K5.0	
⓯	XC		For control circuit power supply / built-in regenerative resistor connection (with short-circuit jumper)	AL-AP000439-01	06JFAT-SAXGDK-K5.0 + Shorting bar	
⓰	OT	Connector tool for XA/XB/XC		AL-00961844-01	J-FAT-OT(N)	
⓱	X1	GPIO connector		AL-01131482-01	DH-27-CT1B, DH40-27S, DH-27-CMB(7.3)	Hirose Electric Co., Ltd.
⓲	X2	Signal connector	STO wiring connector	AL-00718252-01	2013595-3	Tyco Electronics Japan G.K.
⓳	X2		STO short-circuit connector*	AL-00849548-02	1971153-2	
⓴	X3, X4		For encoder connection (With linear servo motors, linear encoder / hall sensor connection)	AL-00530312-01	54599-1019	Molex Japan Co., Ltd.

* If not wiring X2, be sure to insert a supplied short-circuit STO connector to X2.

Power connector sets

Name	Model no.	Connectors included in the set (see above, numbers in the "Individual connectors" table)				
		⓬ XA	⓭ XB	⓮ XC	⓯ XC with shorting bar	⓰ OT
Power connector set A (With built-in regenerative resistor)	AL-01135740-01	✓	✓	–	✓	✓
Power connector set B (With external regenerative resistor)	AL-01133414-01	✓	✓	✓	–	✓

Signal connector sets

Name	Model no.	Connectors included in the set (see above, numbers in the "Individual connectors" table)		
		⓱ X1	⓲ X2	⓴ X3, X4
Signal connector set B1 (STO not used)	AL-01136298-01	✓	– Use the short-circuiting connector included with the servo amplifier	✓
Signal connector set B2 (STO used)	AL-01136299-01	✓	✓	✓

Power/Signal connector set
For semi closed-loop control. When using fully closed-loop control or using a hall sensor with a linear servo motor, prepare another ⓴ encoder connector.

Name	Built-in regenerative resistor	STO function	Model no.	Connectors included in the set (see above, numbers in the "Individual connectors" table)							
				⓬ XA	⓭ XB	⓮ XC	⓯ XC with shorting bar	⓰ OT	⓱ X1	⓲ X2	⓴ X3, X4
Power/Signal connector set B	✓	–	AL-01100889-01	✓	✓	–	✓	✓	✓	–	✓
	–	–	AL-01100888-01	✓	✓	✓	–	✓	✓	–	✓
	✓	✓	AL-01100925-01	✓	✓	–	✓	✓	✓	✓	✓
	–	✓	AL-01100893-01	✓	✓	✓	–	✓	✓	✓	✓

Features

Lineup

Standard Model Number List

Servo Motors

Linear Servo Motors

Servo Amplifiers Analog/Pulse

Servo Amplifiers EtherCAT

Options

Selection Guide

General Specifications

CE UKCA c UL us KC TÜV SÜD RoHS

Model no.			GADS☐01☐☐	GADS☐02☐☐	GADS☐03☐☐	GADS☐05☐☐
Capacity			10 A	20 A	30 A	50 A
Maximum compatible motor output			200 W	400 W	1.5 kW	2.5 kW
Continuous output current			1.2 Arms	3.1 Arms	5.2 Arms	12.0 Arms
Peak output current			4.3 Arms	12.0 Arms	16.3 Arms	26.5 Arms
Control function			Position/speed/torque control (switched with parameters)			
Control system			IGBT-based, sinusoidal PWM control			
Main circuit power supply	Input voltage range		3-phase: 200 to 240 VAC (+10, -15%), 50/60 Hz (±3 Hz) Single-phase: 200 to 240 VAC (+10, -15%), 50/60 Hz (±3 Hz)[1] Single-phase: 100 to 120 VAC (+10, -15%), 50/60 Hz (±3 Hz)[2]			
	Input current (3-/single-phase)		1.2/2.0 Arms	2.2/3.9 Arms	6.9/7.0 Arms	11.0/11.6 Arms
	Power supply capacity		0.4 kVA	0.8 kVA	2.4 kVA	3.8 kVA
Control circuit power supply	Input voltage range		Single-phase: 200 to 240 VAC (+10, -15%), 50/60 Hz (±3 Hz) Single-phase: 100 to 120 VAC (+10, -15%), 50/60 Hz (±3 Hz)[2]			
	Input current		0.5 Arms			0.3 Arms
Regenerative resistor	Built-in regenerative resistor	Resistance	25 Ω			17 Ω
		Max. power consumption	5 W			20 W
	Min. allowable external resistance		25 Ω			17 Ω
Environment	Operating ambient temperature		0 to +60°C[3]			
	Storage temperature		-20 to +65°C			
	Operating and storage humidity		95% RH max. (non-condensing)			
	Operating altitude		2000 m max.[3]			
	Vibration resistance		6 m/s^2			
	Shock resistance		20 m/s^2			
	Overvoltage category		III			
Structure			Built-in tray-type power supply			

(1) 200 VAC single-phase input is compatible only with GADSA☐☐. When using single-phase input, parameter settings will be necessary.

(2) 100 VAC single-phase input is compatible only with GADSE☐☐. When using single-phase input, parameter settings will be necessary.

(3) When used in environments with an ambient temperature of +55 to +60°C or an altitude of 1000 to 2000 m, motor performance undergoes derating.

■ Performance

Velocity control range	1:5000 (Internal velocity command)
Frequency characteristics	3500 Hz (With 400 W or lower motors in high-speed command mode)
Allowable range of load inertia	10 times the motor rotor inertia

■ Built-in functions

Protection functions	Output power device error (overcurrent), current detection error, STO error, cooling fan error, overload, regenerative error, magnetic pole position estimation error, continuous overspeed, overheating error, external error, servo amplifier temperature error, overvoltage, main circuit power supply undervoltage, main circuit power supply open phase, main circuit power supply voltage detection error, inrush current protection time error, control circuit power supply undervoltage, encoder error, over-speed, speed control error, speed feedback error, model-following vibration control error, excessive position deviation, positioning command error, excessive inter-axis synchronization deviation, excessive dual positioning deviation, dual positioning feedback error, inter-aplifier communication error, memory error, CPU error, parameter error, control circuit error, task process error
Digital operator	Status display, test run, alarm log, monitoring
Dynamic brake circuit	Built-in
Regenerative circuit	Built-in
Monitoring	Ch 1: Velocity monitoring (VMON) 2.0 V ±10% (at 1000 min^{-1}), Ch 2: Torque command monitoring (TCMON) 2.0 V ±10% (at 100%)

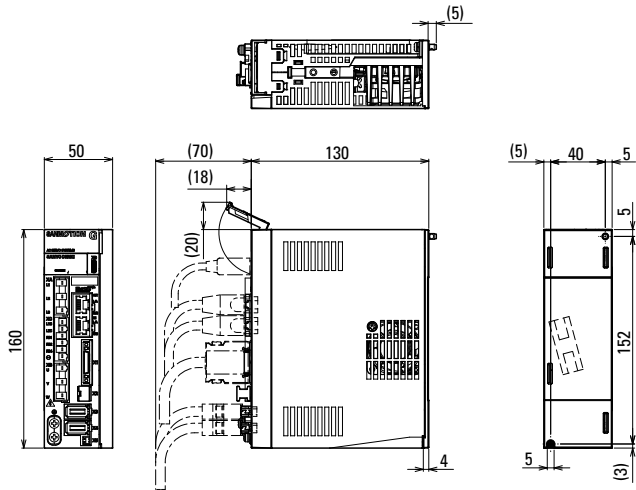# Dimensions [Unit: mm]

《10 A》
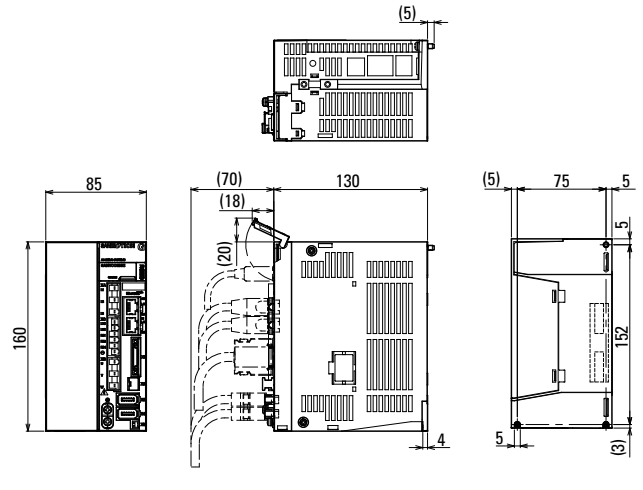
Mass：0.80 kg

《20 A》

Mass：0.80 kg

《30 A》

Mass：0.90 kg

《50 A》

Mass：1.50 kg

Features

Lineup

Standard Model Number List

Servo Motors

Linear Servo Motors

Servo Amplifiers Analog/Pulse

Servo Amplifiers EtherCAT

Options

Selection Guide

External Wiring Diagram

EtherCAT

Connector no.	Name	Housing, plug, shell
XA	Main circuit power input connector	03JFAT-SAXGDK-KT10
XB	Servo motor power connector	03JFAT-SAYGDK-KT10
XC	Control power supply / regenerative resistor connector	06JFAT-SAXGDK-K5.0
X1	Controller connector	Plug: DH40-27S Cover: DH-27-CT1B Clamp: DH-27-CMB(7.3)
X2	Safety device connector	For short-circuiting: 1971153-2 For wiring: 2013595-3
X3, X4	Motor encoder connector	I/O connector: 54599-1019

(1) Use shielded twisted pair (STP) cables.

(2) When using the built-in regenerative resistor, connect a shorting jumper between RB1 and RB4 terminals. When using an external regenerative resistor, remove the shorting jumper connected to RB1 and RB4 terminals, and then connect the external regenerative resistor between RB1 and RB2 terminals.

(3) The ⊖ terminal is a maintenance terminal (high-voltage circuit). Do not connect wires to this terminal.

(4) Motor side connections vary depending on motor specifications.

(5) Refer to the encoder connection diagram for the wiring of encoder connectors.

(6) L1, L2, L3, L1C, L2C, RB1, RB2, RB4, ⊖, U, V, and W are high-voltage circuits. All other signal lines are low-voltage circuits. When wiring, provide sufficient clearance between high-voltage and low-voltage circuits.

(7) For differential line drivers, use one with a differential voltage (VT) within 2.5 to 3.8 V. If the differential voltage is below 2.5 V or above 3.8 V, it may cause malfunction due to missing pulses.

(8) X2 is a safety device connector. Turning Servo ON (motor in operation) requires to connect a safety device to X2 and get safety functions enabled. When not using safety functions, be sure to insert the short-circuiting connector to X2.

(9) Do not connect anything to the X2-1 or X2-2 pins.

(10) Use a category 5e (TIA standards) or better shielded twisted pair cable (STP).

(11) Pins 4-5 and 7-8 of the EtherCAT IN/OUT connectors are shorted inside the amplifier. Pins 4-5 and 7-8 are connected with 75 Ω resistors as shown on the diagram It is also connected to the pulse transformer midpoint with a 75 Ω resistor.

(12) For sourcing type output, connect pin X1-14 to an external power supply; for sinking type output, connect pin X1-14 to GND.

(13) An external power supply is to be prepared by the customer.

(14) Use of a UL or IEC/EN compliant leakage circuit breaker is recommended.

(15) When using single-phase 100/200 VAC or VDC input, connect the main circuit power supply to L1 and L2, and do not use L3.

(16) When using a single-phase power supply, please check our User's Manual or Product Specification for accompanying limitations.

(17) Use of a UL or IEC/EN compliant leakage circuit breaker is recommended on the primary side of the DC power supply.

(18) When using a DC power supply, please check our User's Manual or Product Specification for accompanying limitations.

(19) Use an input voltage that meets the product specifications.

Options

Setup Software

This software allows you to set servo system parameters from a PC.
It also allows you to easily start up and run tests for the servo system.
The software can be downloaded from Product Information on our website.
https://www.sanyodenki.com/

■ Setup software name

SANMOTION MOTOR SETUP SOFTWARE

■ Main functions

Parameter settings (by group, by function)

Diagnosis (alarm indicator, warning indicator, alarm cancellation)

Test run execution (speed jog, positioning operation, motor home position search, serial encoder clearance)

Servo tuning (notch filter tuning, FF vibration control frequency tuning)

Various measurement functions (operating waveform display, machinery frequency response measurement)

Use a USB communication cable to connect the USB port on the PC and the servo amplifier.

■ Supported operating systems

Windows 10/11

See our website for details on supported OS versions.

New features of SANMOTION G series

GPIO monitoring
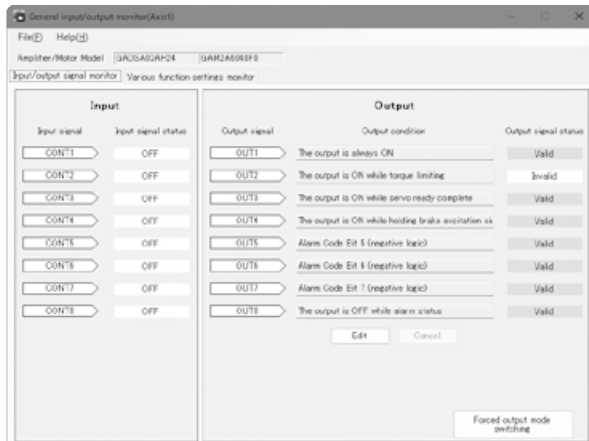
Graphically displays general-purpose I/O signal status

Advanced tuning

By setting the operating conditions of the machine, the frequency response characteristics and positioning settling characteristics are measured and automatically adjusted to the optimum control parameters.

System analysis (high-precision mode)
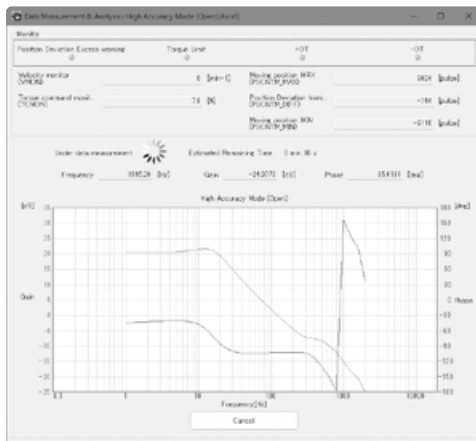
A function to measure the frequency response more precisely than the system analysis of the SANMOTION R 3E Model has been added.

Motor parameter downloader
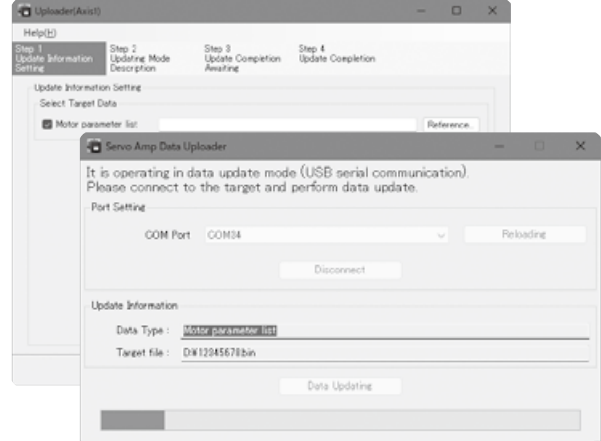
Newly added motors can be easily added with the setup software without updating the amplifier firmware.

Cables   [Unit in drawings: mm]

■ USB communication cable for setup software

Communication cable with computers for setup software use.

PC side: Type A, amplifier side: Type C

Cable length: L [m]	Model no.
1.0	AL-Y0020355-01
2.0	AL-Y0020355-02

Servo amplifier (USB Type C)   PC (USB Type A)
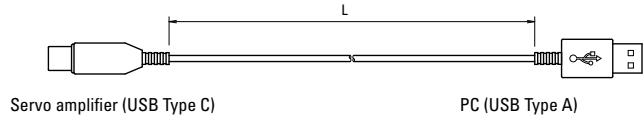
PC side: Type C, amplifier side: Type C

Cable length: L [m]	Model no.
1.0	AL-Y0021049-01
2.0	AL-Y0021049-02

Servo amplifier (USB Type C)   PC (USB Type C)
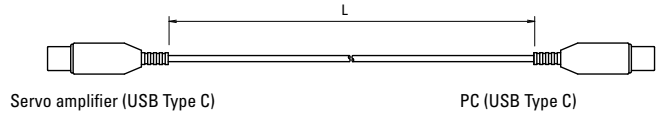
■ Amplifier-amplifier cable for tandem operation   Dedicated for analog/pulse input type

Connects between servo amplifiers for tandem operation. (X6⇔X6)

Cable length: L [m]	Model no.
0.2	AL-01134653-01
3.0	AL-01134653-02
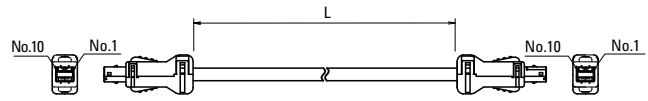
No.10 No.1   No.10 No.1

■ Servo motor power cable   The power supply for the holding brake needs to be provided by the customer

Front and rear cable exits are directed to the output shaft direction and the opposite direction, respectively.

40 mm sq.

Cable exit direction	L [m]	Model no.
Front	1	GSSF0100S
Rear	1	GSSR0100S
Front	3	GSSF0300S
Rear	3	GSSR0300S
Front	5	GSSF0500S
Rear	5	GSSR0500S
(A) Power		22 AWG
(B) Brake		24 AWG
(C) Ground		22 AWG
(D) Cable diameter		ø5.4

Connection	Lead wire color	Motor signal name	Connector pin no.
	Red	U	1
	White	V	2
	Black	W	3
	Green/Yellow	Ground	4
	Yellow	Brake	5
	Yellow	Brake	6

60 to 86 mm sq.

Cable exit direction	L [m]	Model no.
Front	1	GMSF0100S
Rear	1	GMSR0100S
Front	3	GMSF0300S
Rear	3	GMSR0300S
Front	5	GMSF0500S
Rear	5	GMSR0500S
(A) Power		19 AWG
(B) Brake		23 AWG
(C) Ground		19 AWG
(D) Cable diameter		ø6.6

Connection	Lead wire color	Motor signal name	Connector pin no.
	Red	U	1
	White	V	2
	Black	W	3
	Green/Yellow	Ground	4
	Yellow	Brake	5
	Yellow	Brake	6

Front cable exit

(50)
(5)
(24.45)
(11.9)
(D)
(A) Red, white, black
(B) Yellow, yellow
(C) Green, yellow
(ø11.9)
(3.3)
(16.5)
(26.3)

Rear cable exit

(24.45)
(11.9)
(50)
(5)
(D)
(16.5)
(3.3)
(ø11.9)
(26.3)
(A) Red, white, black
(B) Yellow, yellow
(C) Green, yellow

Front cable exit

(50)
(5)
(31)
(12.9)
(D)
(A) Red, white, black
(B) Yellow, yellow
(C) Green, yellow
(ø13.4)
(2.1)
(19.5)
(31.2)

Rear cable exit

(31)
(12.9)
(50)
(5)
(D)
(19.5)
(2.1)
(ø13.4)
(31.2)
(A) Red, white, black
(B) Yellow, yellow
(C) Green, yellow

Features

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Servo Motors

Linear Servo Motors

Servo Amplifiers Analog/Pulse

Servo Amplifiers EtherCAT

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Cables

■ Servo motor power cable The power supply for the holding brake needs to be provided by the customer

Front and rear cable exits are directed to the output shaft direction and the opposite direction, respectively.

100 mm sq.

L [m]		Model no. (w/o holding brake)			Model no. (w/ holding brake)		
1		GPPB0100S			GQPB0100SB		
3		GPPB0300S			GQPB0300SB		
5		GPPB0500S			GQPB0500SB		
(A) Power		14 AWG			14 AWG		
(B) Brake		20 AWG			20 AWG		
(C) Ground	Wire gauge	14 AWG			14 AWG		
	Terminal	N2-M4			N2-M4		
(D) Cable diameter		ø12.5			ø12.5		
Connection		Lead wire color	Motor signal name	Connector pin no.	Lead wire color	Motor signal name	Connector pin no.
		Red	U	A	Red	U	F
		White	V	B	White	V	I
		Black	W	C	Black	W	B
		Green	Ground	D	Green	Ground	E, D
		Yellow	—	—	Yellow	Brake	G, H

(A) Red, white, black
(B) Yellow, yellow
(C) Ground
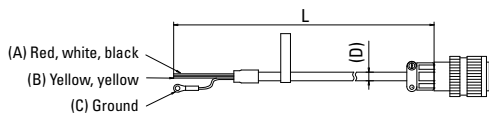
130 mm sq.

L [m]		Model no. (w/o holding brake)			Model no. (w/ holding brake)		
1		GRPB0100S			GRPB0100SB		
3		GRPB0300S			GRPB0300SB		
5		GRPB0500S			GRPB0500SB		
(A) Power		14 AWG			14 AWG		
(B) Brake		20 AWG			20 AWG		
(C) Ground	Wire gauge	14 AWG			14 AWG		
	Terminal	N2-M4			N2-M4		
(D) Cable diameter		ø12.5			ø12.5		
Connection		Lead wire color	Motor signal name	Connector pin no.	Lead wire color	Motor signal name	Connector pin no.
		Red	U	D	Red	U	D
		White	V	E	White	V	E
		Black	W	F	Black	W	F
		Green	Ground	G, H	Green	Ground	G, H
		Yellow	—	—	Yellow	Brake	A, B

(A) Red, white, black
(B) Yellow, yellow
(C) Ground
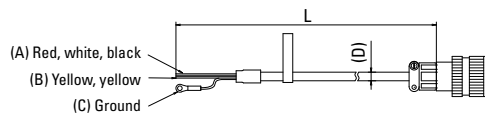
■ Servo motor encoder cable

40 to 86 mm sq.

Cable exit direction	L [m]	Model no.
Front	1	GESF0100S
Rear	1	GESR0100S
Front	3	GESF0300S
Rear	3	GESR0300S
Front	5	GESF0500S
Rear	5	GESR0500S
Size		26 AWG
(A) Cable diameter		ø5.1

Connection	Lead wire color	Motor signal name	Connector pin no.
	Shielded	Ground	1
	Red	5V	2
	Black	SG	3
	White*	—	4
	Yellow*	—	5
	Brown	ES+	6
	Blue	ES-	7
	Green*	—	8
	Purple*	—	9

* Do not connect unused lead wires (white, yellow, green, or purple) to the servo amplifier.
Note: Contact us if the cable length is to be 10 m or longer.
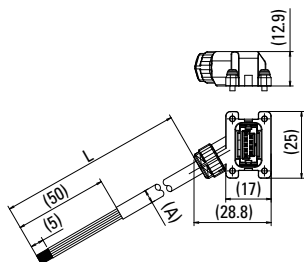
Front cable exit   Rear cable exit
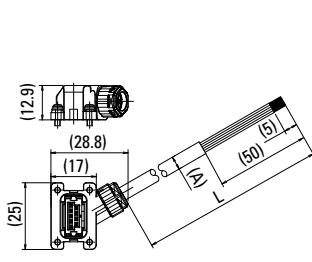
100 to 130 mm sq.

L [m]	Model no.
1	RS-CA9-01-R
3	RS-CA9-03-R
5	RS-CA9-05-R
(A) Cable diameter	ø6.7

Connection	Motor side Straight plug Mfr. part no.: JN2DS10SL2-R (JAE) Pin no.	Amplifier side I/O connector Mfr. part no.: 54599-1016 (Molex Japan Co., Ltd.) Pin no.	Signal name
	1	7	ES+
	2	8	ES-
	3	—	—
	4	10	EBAT-*
	5	—	—
	6	—	—
	7	—	Ground
	8	9	EBAT+*
	9	1	5V
	10	2	SG

* Do not supply power to batteryless encoders.
Note: Contact us if the cable length is to be 25 m or longer.


Straight plug   I/O connector
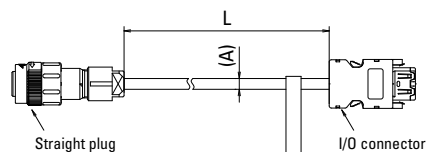
AC Reactors

It is recommended you install an AC reactor to the power supply input to suppress harmonic currents and correct the power factor.

Model no.	Compatible servo amplifier	Dimensions [Unit: mm]								Terminal Size	Mass [kg]
		W	W1	W2	H	D	D1	D2	d		
R-ACL-004	GADSA01☐ GADSA02☐ GADSE01☐ GADSE02☐ GADSE03☐	75	70	50	110	60	60	40	5	M4	0.8
R-ACL-01K	GADSA03☐	85	70	50	130	60	60	40		M4	1.2
R-ACL-02K	GADSA05☐	120	90	70	150	70	72	60		M4	1.8

Note: Connect an AC reactor to each servo amplifier.
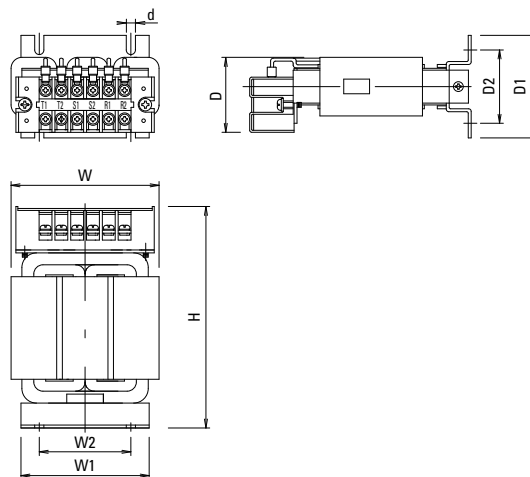
Analog Monitor   [Unit in drawings: mm]

This is an analog monitor that is capable of displaying velocity waveforms and the like on an oscilloscope for the purpose of system tuning or maintenance.

Name	Details	Model no.
Monitor box	Monitor box unit 2 pcs of dedicated cables (on the right)	Q-MON-3

Note: Power is supplied by the servo amplifier.

Name	Model no.
Dedicated cable	AL-00690525-01

Options
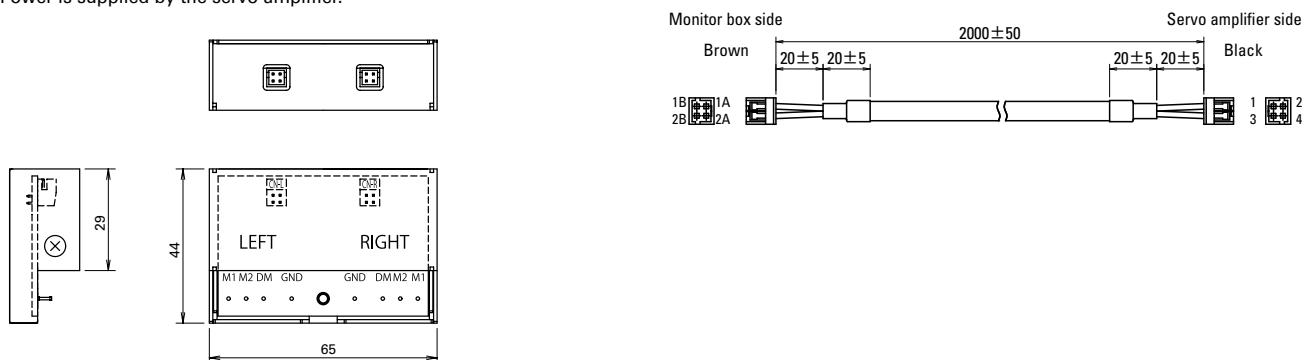
External Regenerative Resistor   [Unit in drawings: mm]

Fiberglass braided silicone rubber wire
20 AWG 0.5 mm² White (Thermostat)

Fiberglass braided silicone rubber wire
18 AWG 0.75 mm² Black
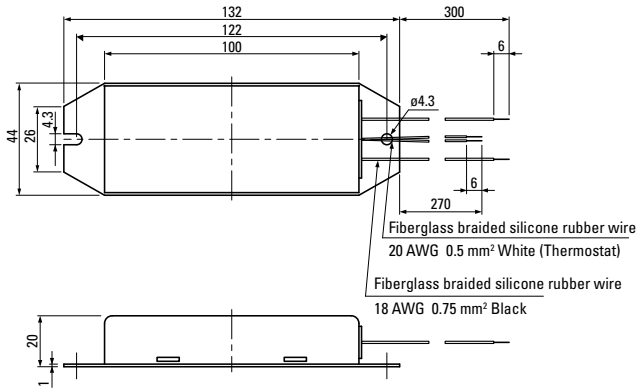
Model no.	Rated power [P_R]	Resistance	Mass
AL-R080W25B	80 W	25 Ω	0.19 kg

Thermostat detection temperature: 135 ±7°C (Normally-closed contact)

Fiberglass braided silicone rubber wire
20 AWG 0.5 mm² White (Thermostat)
Fiberglass braided silicone rubber wire
18 AWG 0.75 mm² Black
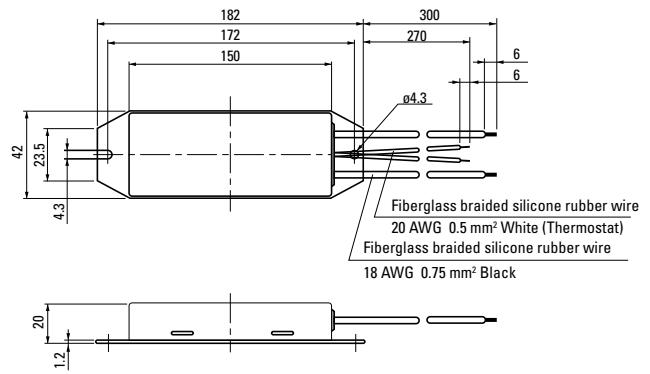
Model no.	Rated power [P_R]	Resistance	Mass
AL-R120W25B	120 W	25 Ω	0.24 kg

Thermostat detection temperature: 135 ±7°C (Normally-closed contact)

Fiberglass braided silicone rubber wire
20 AWG 0.5 mm² White (Thermostat)
Fiberglass braided silicone rubber wire
18 AWG 0.75 mm² Black
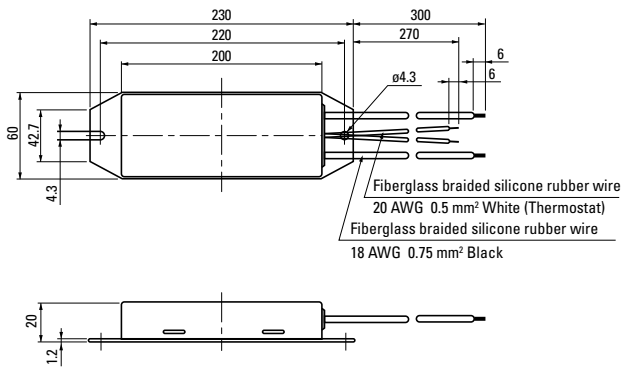
Model no.	Rated power [P_R]	Resistance	Mass
AL-R220W20B	220 W	20 Ω	0.44 kg
AL-R220W25B	220 W	25 Ω	0.44 kg
AL-R220W50B	220 W	50 Ω	0.44 kg

Thermostat detection temperature: 135 ±7°C (Normally-closed contact)

Ground
2×M3
Thermostat
Lead 24 AWG 0.2mm² White
Crimp terminal (M5)
Lead 14 AWG 2mm² White
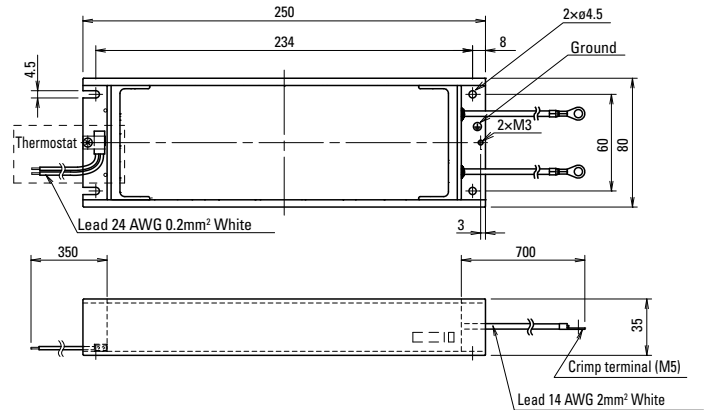
Model no.	Rated power [P_R]	Resistance	Mass
AL-R500W10B	500 W	10 Ω	1.4 kg
AL-R500W20B	500 W	20 Ω	1.4 kg
AL-R500W25B	500 W	25 Ω	1.4 kg

Thermostat detection temperature: 100 ±5°C (Normally-closed contact)

Front Mounting Brackets [Unit in drawings: mm]

Brackets for mounting the servo amplifier on the front (connector side).

Compatible servo amplifier	Model no.	Set items
10 A, 20 A, 30 A (GADS□01, 02, 03)	AL-01133484-01	Upper and lower mounting brackets: 1 each Mounting screws × 4 (M4 flat head, 8 mm)
50 A (GADSA05)	AL-00880391-01	Upper and lower mounting brackets: 1 each Mounting screws × 4 (M4 flat head, 8 mm)

Note 1: Trivalent chrome plating is used. (Surface color is silver-blue, and different from body color.)
Note 2: Cannot be used with battery box. (10 to 50 A)

AL-01133484-01
Upper bracket
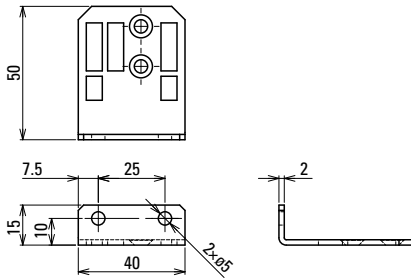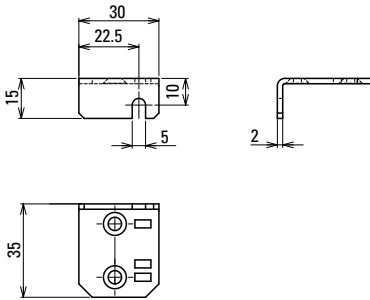
AL-00880391-01
Upper bracket
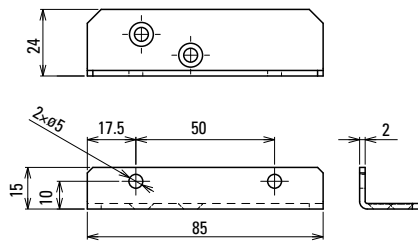
Lower bracket

Lower bracket
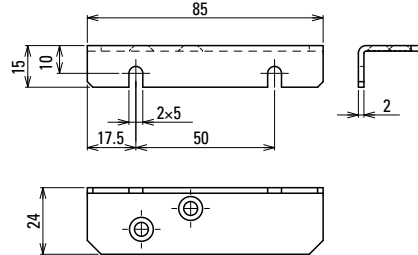
Mounting example
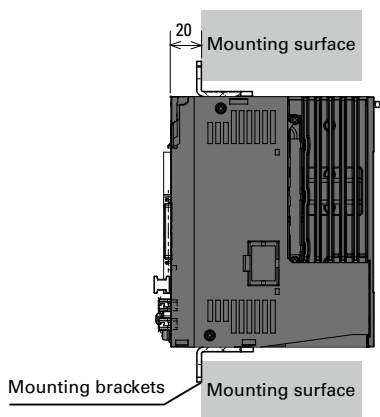
Mounting board dimensions example

10 A, 20 A

30 A

50 A

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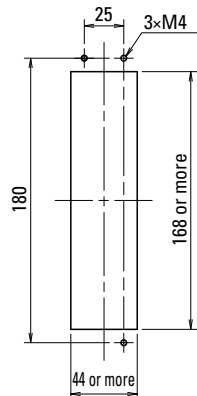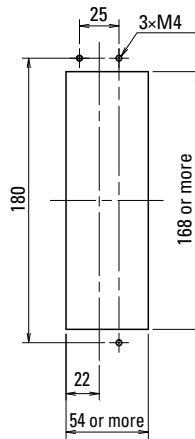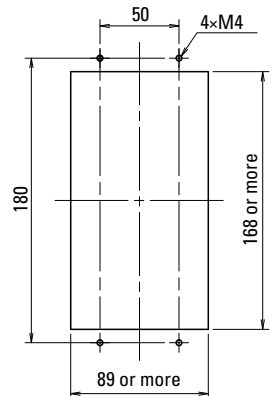
Replacement Models of Conventional Products

Servo motor

■ 200 V Low-inertia servo motors

Motor flange size	Holding brake (24 VDC)	Rated output	Conventional SANMOTION R model no.	Rated output	SANMOTION G model no.
40 mm sq.	—	50 W	R1AA04005FX☐03M	50 W	GAM1A4005F0X☐☐
	✓	50 W	R1AA04005FC☐03M	50 W	GAM1A4005F0C☐☐
	—	100 W	R1AA04010FX☐03M	100 W	GAM1A4010F0X☐☐
	✓	100 W	R1AA04010FC☐03M	100 W	GAM1A4010F0C☐☐
60 mm sq.	—	200 W	R1AA06020FX☐03M	200 W	GAM1A6020F0X☐☐
	✓	200 W	R1AA06020FC☐03M	200 W	GAM1A6020F0C☐☐
	—	400 W	R1AA06040FX☐03M	400 W	GAM1A6040F0X☐☐
	✓	400 W	R1AA06040FC☐03M	400 W	GAM1A6040F0C☐☐
80 mm sq.	—	750 W	R1AA08075VX☐03M	750 W	GAM1A8075V0X☐☐
	✓	750 W	R1AA08075VC☐03M	750 W	GAM1A8075V0C☐☐
	—	750 W	R1AA08075FX☐03M	750 W	GAM1A8075F0X☐☐
	✓	750 W	R1AA08075FC☐03M	750 W	GAM1A8075F0C☐☐
100 mm sq.	–	1 kW	R1AA10100FX☐00M	1 kW	GAM1AA100F0X☐☐
	✓	1 kW	R1AA10100FC☐00M	1 kW	GAM1AA100F0C☐☐
	–	1 kW	R1AA10100HX☐00M	1 kW	GAM1AA100H0X☐☐
	✓	1 kW	R1AA10100HC☐00M	1 kW	GAM1AA100H0C☐☐
	–	1.5 kW	R1AA10150FX☐00M	1.5 kW	GAM1AA150F0X☐☐
	✓	1.5 kW	R1AA10150FC☐00M	1.5 kW	GAM1AA150F0C☐☐
	–	1.5 kW	R1AA10150HX☐00M	1.5 kW	GAM1AA150H0X☐☐
	✓	1.5 kW	R1AA10150HC☐00M	1.5 kW	GAM1AA150H0C☐☐

■ 100 V Low-inertia servo motors

Motor flange size	Holding brake (24 VDC)	Rated output	Conventional SANMOTION R model no.	Rated output	SANMOTION G model no.
40 mm sq.	—	50 W	R1EA04005FX☐03M	50 W	GAM1E4005F0X☐☐
	✓	50 W	R1EA04005FC☐03M	50 W	GAM1E4005F0C☐☐
	—	100 W	R1EA04010FX☐03M	100 W	GAM1E4010F0X☐☐
	✓	100 W	R1EA04010FC☐03M	100 W	GAM1E4010F0C☐☐
60 mm sq.	—	200 W	R1EA06020FX☐03M	200 W	GAM1E6020F0X☐☐
	✓	200 W	R1EA06020FC☐03M	200 W	GAM1E6020F0C☐☐

■ 100 V Medium-inertia servo motors

Motor flange size	Holding brake (24 VDC)	Rated output	Conventional SANMOTION R model no.	Rated output	SANMOTION G model no.
40 mm sq.	—	30 W	R2EA04003FX☐03M	30 W	GAM2E4003F0X☐☐
	✓	30 W	R2EA04003FC☐03M	30 W	GAM2E4003F0C☐☐
	—	50 W	R2EA04005FX☐03M	50 W	GAM2E4005F0X☐☐
	✓	50 W	R2EA04005FC☐03M	50 W	GAM2E4005F0C☐☐
	—	80 W	R2EA04008FX☐03M	100 W	GAM2E4010F0X☐☐
	✓	80 W	R2EA04008FC☐03M	100 W	GAM2E4010F0C☐☐
60 mm sq.	—	100 W	R2EA06010FX☐03M	100 W	GAM2E6010F0X☐☐
	✓	100 W	R2EA06010FC☐03M	100 W	GAM2E6010F0C☐☐
	—	200 W	R2EA06020FX☐03M	200 W	GAM2E6020F0X☐☐
	✓	200 W	R2EA06020FC☐03M	200 W	GAM2E6020F0C☐☐

■ 200 V Medium-inertia servo motors

Motor flange size	Holding brake (24 VDC)	Rated output	Conventional SANMOTION R model no.	Rated output	SANMOTION G model no.
40 mm sq.	—	30 W	R2AA04003FX☐03M	30 W	GAM2A4003F0X☐☐
	✓	30 W	R2AA04003FC☐03M	30 W	GAM2A4003F0C☐☐
	—	50 W	R2AA04005FX☐03M	50 W	GAM2A4005F0X☐☐
	✓	50 W	R2AA04005FC☐03M	50 W	GAM2A4005F0C☐☐
	—	100 W	R2AA04010FX☐03M	100 W	GAM2A4010F0X☐☐
	✓	90 W	R2AA04010FC☐03M6	100W	GAM2A4010F0C☐☐
60 mm sq.	—	100 W	R2AA06010FX☐03M	100 W	GAM2A6010F0X☐☐
	✓	100 W	R2AA06010FC☐03M	100 W	GAM2A6010F0C☐☐
	—	200 W	R2AA06020FX☐03M	200 W	GAM2A6020F0X☐☐
	✓	200 W	R2AA06020FC☐03M	200 W	GAM2A6020F0C☐☐
	—	400 W	R2AA06040FX☐03M	400 W	GAM2A6040F0X☐☐
	✓	360 W	R2AA06040FC☐03M6	400W	GAM2A6040F0C☐☐
	—	400 W	R2AA06040HX☐03M	400 W	GAM2A6040F0X☐☐
	✓	360 W	R2AA06040HC☐03M6	400W	GAM2A6040F0C☐☐
80 mm sq.	—	200 W	R2AA08020FX☐03M	200 W	GAM2A8020F0X☐☐
	✓	200 W	R2AA08020FC☐03M	200 W	GAM2A8020F0C☐☐
	—	400 W	R2AA08040FX☐03M	400 W	GAM2A8040F0X☐☐
	✓	400 W	R2AA08040FC☐03M	400 W	GAM2A8040F0C☐☐
	—	750 W	R2AA08075FX☐03M	750 W	GAM2A8075F0X☐☐
	✓	750 W	R2AA08075FC☐03M	750 W	GAM2A8075F0C☐☐
86 mm sq.	—	750 W	R2AAB8075FX☐03M	750 W	GAM2A9075F0X☐☐
	✓	750 W	R2AAB8075FC☐03M	750 W	GAM2A9075F0C☐☐
	—	1 kW	R2AAB8100FX☐03M	1 kW	GAM2A9100F0X☐☐
	✓	1 kW	R2AAB8100FC☐03M	1 kW	GAM2A9100F0C☐☐
	—	1 kW	R2AAB8100HX☐03M	1 kW	GAM2A9100H0X☐☐
	✓	1 kW	R2AAB8100HC☐03M	1 kW	GAM2A9100H0C☐☐
100 mm sq.	—	750 W	R2AA10075FX☐03M	750 W	GAM2AA075F0X☐☐
	✓	750 W	R2AA10075FC☐03M	750 W	GAM2AA075F0C☐☐
	—	1 kW	R2AA10100FX☐03M	1 kW	GAM2AA100F0X☐☐
	✓	1 kW	R2AA10100FC☐03M	1 kW	GAM2AA100F0C☐☐
	—	1.5 kW	R2AA10150HX☐00M	1.5 kW	GAM2AA150H0X☐☐
	✓	1.5 kW	R2AA10150HC☐00M	1.5 kW	GAM2AA150H0C☐☐
130 mm sq.	—	550 W	R2AA13050HX☐00M	550 W	GAM2AB055D0X☐☐
	✓	550 W	R2AA13050HC☐00M	550 W	GAM2AB055D0C☐☐
	—	550 W	R2AA13050DX☐00M	550 W	GAM2AB055D0X☐☐
	✓	550 W	R2AA13050DC☐00M	550 W	GAM2AB055D0C☐☐
	—	1.2 kW	R2AA13120BX☐00M	1.2 kW	GAM2AB120B0X☐☐
	✓	1.2 kW	R2AA13120BC☐00M	1.2 kW	GAM2AB120B0C☐☐
	—	1.2 kW	R2AA13120LX☐00M	1.2 kW	GAM2AB120H0X☐☐
	✓	1.2 kW	R2AA13120LC☐00M	1.2 kW	GAM2AB120H0C☐☐
	—	1.2 kW	R2AA13120DX☐00M	1.2 kW	GAM2AB120D0X☐☐
	✓	1.2 kW	R2AA13120DC☐00M	1.2 kW	GAM2AB120D0C☐☐

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Servo amplifier

■ 200 V Analog/Pulse input type

GPO	Built-in regenerative resistor	STO function*	Amplifier capacity	Conventional SANMOTION R model no.	SANMOTION G model no.
Sinking type	–	–	10 A	RS3A01A0AL0	GADSA01LA00
	–	–	20 A	RS3A02A0AL0	GADSA02LA00
	–	–	30 A	RS3A03A0AL0	GADSA03LA00
	–	–	50 A	RS3A05A0AL0	GADSA05LA00
	–	✓	10 A	RS3A01A0AL2	GADSA01LA22
	–	✓	20 A	RS3A02A0AL2	GADSA02LA22
	–	✓	30 A	RS3A03A0AL2	GADSA03LA22
	–	✓	50 A	RS3A05A0AL2	GADSA05LA22
	✓	–	10 A	RS3A01A0AA0	GADSA01AA00
	✓	–	20 A	RS3A02A0AA0	GADSA02AA00
	✓	–	30 A	RS3A03A0AA0	GADSA03AA00
	✓	–	50 A	RS3A05A0AA0	GADSA05AA00
	✓	✓	10 A	RS3A01A0AA2	GADSA01AA22
	✓	✓	20 A	RS3A02A0AA2	GADSA02AA22
	✓	✓	30 A	RS3A03A0AA2	GADSA03AA22
	✓	✓	50 A	RS3A05A0AA2	GADSA05AA22
Sourcing type	–	–	10 A	RS3A01A0BL0	GADSA01LB00
	–	–	20 A	RS3A02A0BL0	GADSA02LB00
	–	–	30 A	RS3A03A0BL0	GADSA03LB00
	–	–	50 A	RS3A05A0BL0	GADSA05LB00
	–	✓	10 A	RS3A01A0BL2	GADSA01LB22
	–	✓	20 A	RS3A02A0BL2	GADSA02LB22
	–	✓	30 A	RS3A03A0BL2	GADSA03LB22
	–	✓	50 A	RS3A05A0BL2	GADSA05LB22
	✓	–	10 A	RS3A01A0BA0	GADSA01AB00
	✓	–	20 A	RS3A02A0BA0	GADSA02AB00
	✓	–	30 A	RS3A03A0BA0	GADSA03AB00
	✓	–	50 A	RS3A05A0BA0	GADSA05AB00
	✓	✓	10 A	RS3A01A0BA2	GADSA01AB22
	✓	✓	20 A	RS3A02A0BA2	GADSA02AB22
	✓	✓	30 A	RS3A03A0BA2	GADSA03AB22
	✓	✓	50 A	RS3A05A0BA2	GADSA05AB22

■ 200 V EtherCAT interface type

Built-in regenerative resistor	STO function*	Amplifier capacity	Conventional SANMOTION R model no.	SANMOTION G model no.
–	✓	10 A	RS3A01A2HL4	GADSA01LH24
–	✓	20 A	RS3A02A2HL4	GADSA02LH24
–	✓	30 A	RS3A03A2HL4	GADSA03LH24
–	✓	50 A	RS3A05A2HL4	GADSA05LH24
✓	✓	10 A	RS3A01A2HA4	GADSA01AH24
✓	✓	20 A	RS3A02A2HA4	GADSA02AH24
✓	✓	30 A	RS3A03A2HA4	GADSA03AH24
✓	✓	50 A	RS3A05A2HA4	GADSA05AH24

■ 100 V Analog/Pulse input type

GPO	Built-in regenerative resistor	STO function*	Amplifier capacity	Conventional SANMOTION R model no.	SANMOTION G model no.
Sinking type	–	–	10 A	RS3E01A0AL0	GADSE01LA00
	–	–	20 A	RS3E02A0AL0	GADSE02LA00
	–	–	30 A	RS3E03A0AL0	GADSE03LA00
	–	✓	10 A	RS3E01A0AL2	GADSE01LA22
	–	✓	20 A	RS3E02A0AL2	GADSE02LA22
	–	✓	30 A	RS3E03A0AL2	GADSE03LA22
	✓	–	10 A	RS3E01A0AA0	GADSE01AA00
	✓	–	20 A	RS3E02A0AA0	GADSE02AA00
	✓	–	30 A	RS3E03A0AA0	GADSE03AA00
	✓	✓	10 A	RS3E01A0AA2	GADSE01AA22
	✓	✓	20 A	RS3E02A0AA2	GADSE02AA22
	✓	✓	30 A	RS3E03A0AA2	GADSE03AA22
Sourcing type	–	–	10 A	RS3E01A0BL0	GADSE01LB00
	–	–	20 A	RS3E02A0BL0	GADSE02LB00
	–	–	30 A	RS3E03A0BL0	GADSE03LB00
	–	✓	10 A	RS3E01A0BL2	GADSE01LB22
	–	✓	20 A	RS3E02A0BL2	GADSE02LB22
	–	✓	30 A	RS3E03A0BL2	GADSE03LB22
	✓	–	10 A	RS3E01A0BA0	GADSE01AB00
	✓	–	20 A	RS3E02A0BA0	GADSE02AB00
	✓	–	30 A	RS3E03A0BA0	GADSE03AB00
	✓	✓	10 A	RS3E01A0BA2	GADSE01AB22
	✓	✓	20 A	RS3E02A0BA2	GADSE02AB22
	✓	✓	30 A	RS3E03A0BA2	GADSE03AB22

■ 100 V EtherCAT interface type

Built-in regenerative resistor	STO function*	Amplifier capacity	Conventional SANMOTION R model no.	SANMOTION G model no.
–	✓	10 A	RS3E01A2HL4	GADSE01LH24
–	✓	20 A	RS3E02A2HL4	GADSE02LH24
–	✓	30 A	RS3E03A2HL4	GADSE03LH24
✓	✓	10 A	RS3E01A2HA4	GADSE01AH24
✓	✓	20 A	RS3E02A2HA4	GADSE02AH24
✓	✓	30 A	RS3E03A2HA4	GADSE03AH24

* Safe Torque Off (STO) is a safety function defined in IEC/EN 61800-5-2:2016.

Selection of Servo Motor Output (Rotary Motors)

This is a calculation method for deriving required servo motor output based on specifications of machines.
In this instance an introduction on the procedure for the selection is provided primarily for instances where ball screw (horizontal) mechanism is involved.

Selection steps

1. Determine the motion profile

Determine the mechanism to use and the motion profile.

2. Calculate the axial load moment of inertia, J_L

Calculate the load moment of inertia about the motor axis based on the mechanism.

3. Calculate the moment of inertia of the motor's load, T_L

Calculate the load torque for the mechanism to use.

4. Provisional selection of servo motor output

Provisionally select a motor that meets the following conditions: the load moment of inertia (J_L) is 10 times or below the motor's rotor moment of inertia (J_M), and the load torque (T_L) is 80% or below ($T_R \times 0.8$) the motor's rated torque (T_R).

$J_L \leq J_M \times 10$
$T_L \leq T_R \times 0.8$

5. Calculate the acceleration/deceleration torque

Calculate the total torque required to accelerate/decelerate the system (motor and load) based on the motion profile.

6. Calculate actual torque

Calculate the required actual torque using a formula and the results of the previous steps.

7. Assessment

Check if the calculated acceleration and deceleration torques (T_a and T_b) are 80% or below the selected motor's peak torque at stall ($\leq T_p \times 0.8$) and the calculated actual torque (T_{rms}) is 80% or below the motor's rated torque ($\leq T_R \times 0.8$).

$T_a \leq T_p \times 0.8$
$T_b \leq T_p \times 0.8$
$T_{rms} \leq T_R \times 0.8$

If the selected motor does not meet the conditions above, then change the servo motor output and try one with a larger output.

8. Calculate the regenerative power

Calculate the regenerative power and select an external regenerative resistor if needed.

1. Determine the motion profile

First, determine the machine mechanism and required parameters such as the dimensions of components, positioning resolution, positioning time, and gear ratio. Make a motion profile for the determined drive in a graph with speed and time axes.
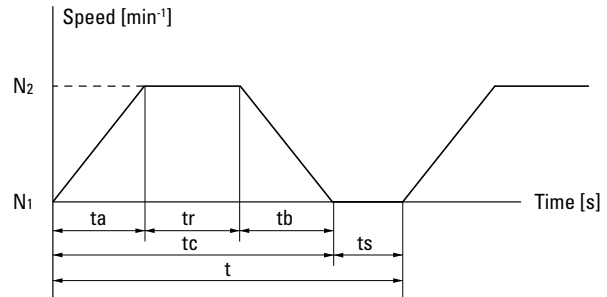
N_1: Servo motor rotational speed before acceleration [min-1]
N_2: Servo motor rotational speed after acceleration [min-1]
t_a = Time spent accelerating the load [s]
t_b = Time spent decelerating the load [s]
t_r = Time spent while motor is turning at constant speed [s]
t_s = Time spent while motor is at rest [s]
t = 1 cycle [s]

2. Calculate the axial load moment of inertia, J_L

Load moment of inertia is the quantity that expresses an object's resistance to change its state of rotational motion.
The following formula is for calculating it in the case of a (horizontal) ball screw mechanism.

■ Moment of inertia of ball screw

$$J_{L1} = \left(\frac{1}{G} \right)^2 \times \frac{\pi \times \rho \times D^4 \times L}{32} \quad [kg \cdot m^2]$$

G: Gear ratio
ρ: Ball screw density [kg/m³] (Iron: 7.8×10^3)
D: Ball screw diameter [m]
L: Ball screw length [m]

■ Moments of inertia of workpiece and table

$$J_{L2} = \left(\frac{1}{G} \right)^2 \times W \times \left(\frac{P}{2\pi} \right)^2 \quad [kg \cdot m^2]$$

G: Gear ratio
W: Workpiece mass + table mass [kg]
P: Ball screw pitch [m]

■ Axial moment of inertia of load
$J_L = J_{L1} + J_{L2}$

*The moments of inertia of the reduction gear and coupling are assumed to be small enough to be negligible.

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Servo Amplifiers EtherCAT

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3. Calculate the axial load torque, T_L

The formula for load torque converts forces exerted on the load due to friction and gravity into the rotational equivalent as reflected to the motor shaft by the lead screw. When activated, this torque always acts as the load.

The following formula is for calculating it in the case of a (horizontal) ball screw mechanism.

$$T_L = \frac{F + \mu W \times 9.8}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \quad [N \cdot m]$$

F: External force [N]
η: Mechanical efficiency
μ: Friction coefficient
W: Workpiece mass + table mass [kg]
P: Ball screw lead [m]
G: Gear ratio

4. Provisional selection of servo motor output

Provisionally, select motors that satisfy the following 2 conditions.
• The load moment of inertia (J_L) calculated in step 2 is 10 times or below the motor's rotor moment of inertia ($J_M \times 10$)

$$J_L \leq J_M \times 10$$

• The load torque (T_L) calculated in step 3 is 80% or below the rated torque ($T_R \times 0.8$) of the motor

$$T_L \leq T_R \times 0.8$$

5. Calculate the acceleration/deceleration torque

The acceleration/deceleration torque is the torque required to accelerate or decelerate the motor and load.

■ How to calculate acceleration torque (T_a)

$$T_a = \frac{2\pi (N_2 - N_1) \times (J_L + J_M)}{60 \times ta} + T_L \quad [N \cdot m]$$

N_2: Servo motor rotating velocity after acceleration [min^{-1}]
N_1: Servo motor rotating velocity before acceleration [min^{-1}]
J_L: Load moment of inertia about the motor axis [kg·m²]
J_M: Rotor inertial moment of servo motor [kg·m²]
T_L: Axial load torque [N·m]
t_a: Acceleration time [s]

■ Deriving deceleration torque (T_b)

$$T_b = \frac{2\pi (N_2 - N_1) \times (J_L + J_M)}{60 \times tb} - T_L \quad [N \cdot m]$$

N_2: Servo motor rotating velocity before deceleration [min^{-1}]
N_1: Servo motor rotating velocity after deceleration [min^{-1}]
J_L: Load moment of inertia about the motor axis [kg·m²]
J_M: Rotor inertial moment of servo motor [kg·m²]
T_L: Axial load torque [N·m]
t_b: Deceleration time [s]

6. Calculate actual torque

The actual torque is a root mean square of the load torque, acceleration torque, and deceleration torque.

$$Trms = \sqrt{\frac{(T_a{}^2 \times ta) + (T_L{}^2 \times tr) + (T_b{}^2 \times tb)}{t}} \quad [N \cdot m]$$

7. Assessment

We use the following conditions for assessment.
• Load torque: $T_L \leq T_R \times 0.8$
   (Load torque ≤ 80% of the rated torque)

• Acceleration torque load factor $T_a \leq T_P \times 0.8$
   (Acceleration torque ≤ 80% of the peak torque at stall)
   T_P: Peak torque at stall

• Deceleration torque load factor $T_b \leq T_P \times 0.8$
   (Deceleration torque ≤ 80% of the peak torque at stall)
   T_P: Peak torque at stall

• Actual torque: $T_{rms} \leq T_R \times 0.8$
   (Actual torque ≤ 80% of the rated torque)

• Inertia moment ratio $J_L \leq J_M \times 10$
   (Load moment of inertial ≥ 10 times or below the motor rotor moment of inertial)

Rise in motor temperature can be suppressed by keeping a large margin in torque load factor. The moment of inertia ratio can be more than 10 times, for example, for mechanisms that slowly rotate a table. We recommend that you conduct verifications using actual machines.

8. Calculate the regenerative power

Calculate the effective regenerative power (P_M) to determine the regenerative resistor to be used. The result of this calculation determines if a built-in regenerative resistor can be used or an external one is required.

■ How to calculate effective regenerative power (P_M) for horizontal drive
First, calculate the regenerative energy.

$$E_M = E_{hb} = \frac{1}{2} \times N \times 3 \times K_{e\phi} \times \frac{T_b}{K_T} \times t_b - \left(\frac{T_b}{K_T}\right)^2 \times 3 \times R_\phi \times t_b$$

E_M: Regenerative energy during horizontal driving [J]
E_{hb}: Regenerative energy during deceleration [J]
$K_{e\phi}$: Phase voltage constant [V$_{rms}$/min^{-1}] (motor constant)
K_T: Torque constant [N·m/A$_{rms}$] (motor constant)
N: Motor rotating velocity [min^{-1}]
R_ϕ: Phase resistance [Ω] (motor constant)
t_b: Deceleration time [s]
T_b: Torque from deceleration [N·m]

Calculate the regenerative power from regenerative energy.

$$P_M = \frac{E_M}{t}$$

P_M: Regenerative power [W]
E_M: Regenerative energy [J]
t: Cycle time [s]
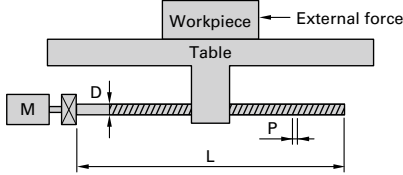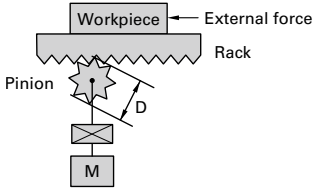
■ Selection of regenerative resistor
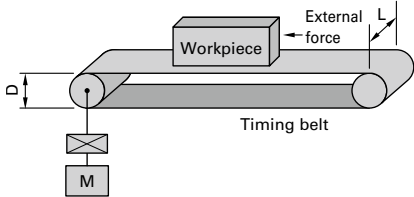Select a regenerative resistor that satisfies the following conditions.
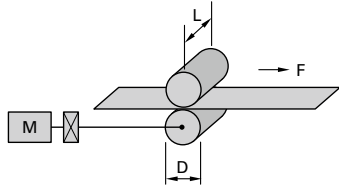• For servo amplifiers with built-in regenerative resistor
   Required regenerative power [P_M] < Maximum regenerative power that can be handled by a built-in regenerative resistor [P_R]
• External regenerative resistor
   Required regenerative power [P_M] < Maximum regenerative power that can be handled by an external regenerative resistor [P_{RO}]
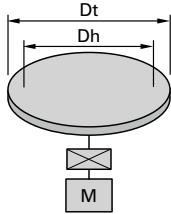
Note that our servo amplifiers either come with and without built-in regenerative resistors for absorbing regenerative power. Make a selection carefully.

Selection Materials by Mechanism

Typical mechanism examples and required selection criteria are shown below. Provide us with these information when consulting us for selection.

Ball screw		Rack & Pinion	

Ball screw			Rack & Pinion		
External force	F	N	External force	F	N
Workpiece + table mass	W	kg	Workpiece + rack mass	W	kg
Ball screw diameter	D	m	Pinion diameter	D	m
Ball screw length	L	m	Pinion thickness	L	m
Ball screw pitch	P	m	Pinion density	ρ	kg/m^3
Ball screw density	ρ	kg/m^3	Friction coefficient	μ	
Friction coefficient	μ		Gear ratio *	G	
Gear ratio *	G		Mechanical efficiency	η	
Mechanical efficiency	η				

Belt drive		Roll feed	

Belt drive			Roll feed		
External force	F	N	Sheet tension	F	N
Workpiece + belt mass	W	kg	Roll diameter	D	m
Pulley diameter	D	m	Roll width	L	m
Pulley width	L	m	Roll density	ρ	kg/m^3
Pulley density	ρ	kg/m^3	Gear ratio *	G	
Gear ratio *	G		Mechanical efficiency	η	
Mechanical efficiency	η				

Rotary indexing table

Rotary indexing table		
Table mass	W	kg
Table diameter	Dt	m
Table support diameter	Dh	m
Friction coefficient of table support	μ	
Gear ratio *	G	
Mechanical efficiency	η	

* Calculation of gear ratio (G)
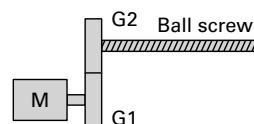
$$G = \frac{\text{Number of screw threads (G2)}}{\text{Number of motor gear teeth (G1)}}$$

Standards Conformity

■ All servo motor (rotary motor) models Contact us for linear servo motors.

Standards conformity		Standard code	Logo
Classification	**Category**		
UL/cUL standards	–	UL 1004-1, UL 1004-6 (File No. E179832)	c**UL**us
CE marking for EU Directive	Low Voltage Directive (2014/35/EU)	IEC 60034-1, EN 60034-1 IEC 60034-5, EN 60034-5	CE
	RoHS Directive (2011/65/EU as amended by (EU)2015/863)	EN IEC 63000: 2018	
UKCA marking for Great Britain (UK Conformity Assessed Marking)	Electrical Equipment (Safety) Regulations 2016	IEC 60034-1, EN 60034-1 IEC 60034-5, EN 60034-5	UKCA
	RoHS Regulations 2012	EN IEC 63000: 2018	

■ All servo amplifier models

Safety Standards		Standard code	Logo
Classification	**Category**		
UL/cUL standards	—	UL 61800-5-1 (File No. E179775)	c**UL**us
KC Mark (Korea Certification Mark)	—	KS C 9610-6-2 KS C 9610-6-4	KC
CE marking for EU Directive	Low Voltage Directive (2014/35/EU)	IEC 61800-5-1, EN 61800-5-1	CE
	Electromagnetic Compatibility Directive (2014/30/EU)	EN 61000-6-2 IEC 61800-3, EN 61800-3	
	RoHS Directive (2011/65/EU as amended by (EU)2015/863)	EN IEC 63000: 2018	
UKCA marking for Great Britain (UK Conformity Assessed Marking)	Electrical Equipment (Safety) Regulations 2016	IEC 61800-5-1, EN 61800-5-1	UKCA
	Electromagnetic Compatibility Regulations 2016	EN 61000-6-2 IEC 61800-3, EN 61800-3	
	RoHS Regulations 2012	EN IEC 63000: 2018	

■ Servo amplifier with STO Model no.: GADS□□□□□2, GADS□□□□□4

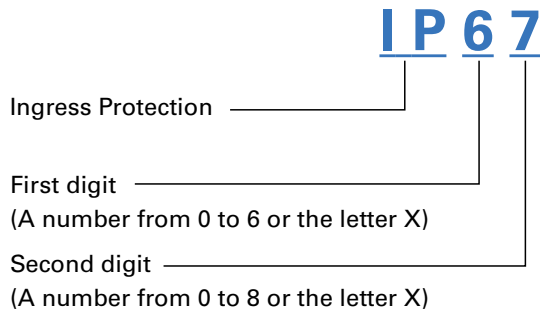(Scheduled to obtain functional safety certifications in October 2022)

Standards conformity			Standard code	Logo
Classification		**Category**		
Third party certification (TÜV SÜD)	Electrical safety	Low Voltage Directive (2014/35/EU)	IEC 61800-5-1, EN 61800-5-1	TÜV SÜD
	Functional safety	Generic Functional safety	IEC 61508, EN 61508	
		Functional safety under Machinery Directive (2006/42/EC)	IEC 62061, EN 62061 EN ISO 13849-1 / AC: 2015	
		Functional safety for PDS under Machinery Directive (2006/42/EC)	IEC 61800-5-2, EN 61800-5-2	
	EMC	Electromagnetic Compatibility Directive (2014/30/EU)	EN 61000-6-2 IEC 61800-3, EN 61800-3	
		Functional safety EMC	IEC 61326-3-1, EN 61326-3-1 EN 61000-6-7	

■ Servo amplifier without STO Model no.: GADS□□□□□0 `Options`

Standards conformity			Standard code	Logo
Classification		**Category**		
Third party certification (TÜV SÜD)	Electrical safety	Low Voltage Directive (2014/35/EU)	IEC 61800-5-1, EN 61800-5-1	TÜV SÜD
	EMC	Electromagnetic Compatibility Directive (2014/30/EU)	EN 61000-6-2 IEC 61800-3, EN 61800-3	–

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Motor Protection Rating

The protection ratings of our servo motors comply with IEC standards (IEC 60034-5).
The standard states that the liquid used for testing should be fresh (pure) water, and liquids other than water such as oil are not included in the test conditions.

IP67

Ingress Protection

First digit
(A number from 0 to 6 or the letter X)

Second digit
(A number from 0 to 8 or the letter X)

The degree of protection (IP code) is defined by IEC (International Electrotechnical Commission) 60529 "Degrees of Protection Provided by Enclosures (IP Code)" (IEC 60529)

First digit	Description	Definition
0	No protection	–
1	Protection against solid objects > 50 mm	A spherical 50 mm diameter solid probe shall not completely penetrate
2	Protection against solid objects > 12.5 mm	A spherical 12.5 mm diameter solid probe shall not completely penetrate
3	Protection against solid objects > 2.5 mm	A spherical 2.5 mm diameter solid probe shall not penetrate at all
4	Protection against solid objects > 1 mm	A spherical 1 mm diameter solid probe shall not penetrate at all
5	Protection against a level of dust that could hinder operation or impair safety	Although it is impossible to completely prevent the penetration of dust, there should be no intrusion of an amount of dust that could impede the prescribed operation and safety of the electrical equipment
6	Complete protection against dust	Completely protected against dust

Second digit	Description	Definition
0	No protection	–
1	Protected against vertically falling drops of water	Vertically dripping water shall have no harmful effect.
2	Protected against vertically falling drops of water even if inclined within 15 degrees	Vertically dripping water shall have no harmful effect when the enclosure is tilted at an angle up to 15° from the vertical.
3	Protected against spraying water	Water falling as a spray at any angle up to 60° from the vertical shall have no harmful effect.
4	Protected against splashing water	Water splashing against the enclosure from any direction shall have no harmful effect.
5	Protected against water jets	Water projected by a nozzle against enclosure from any direction shall have no harmful effects.
6	Protected against powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.
7	Protected against temporary immersion in water	Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time.
8	Protected against submersion in water	The equipment is suitable for continuous immersion in water under conditions which shall be specified by the manufacturer. The test conditions are expected to be greater than the depth requirements for IPx7, and other environmental effects may be added.

Note 1: The standard states that the liquid used for testing should be fresh (pure) water, and liquids other than water such as oil are not included in the test conditions.
　　　　Separate evaluation is necessary when used in environments subjected to non-water liquids, e.g., where machine tool cutting oil is present. Our servo motors have a proven track record of optional customization for machine tool applications, so please contact us as necessary.
Note 2: The ratings for water ingress (second digit) are not cumulative beyond IPX6. A device that is compliant with IPX7 (covering immersion in water) is not necessarily compliant with IPX5 or IPX6 (covering exposure to water jets). Select a protection rating suitable for your environment.

Safety Precautions

The products featured in this catalog are designed for use with general industrial machinery.
Pay sufficient attention to the following.

- Read the included Instruction Manual carefully before installing, assembling, and using the product for proper use. The Instruction Manual is available for download from our website.
- Do not modify or alter the product in any way.
- Contact your point of sale or a properly licensed technician for installation or maintenance service of the product.
- Consult us when using the motor for the following uses, as these require special considerations for installation, operations, maintenance, and management such as redundancy and emergency power generators.
    - **Use in medical equipment or other devices that may directly affect people's lives or cause bodily injury.**
    - **Use in transportation systems or transport-related equipment such as trains or elevators, that may affect people's lives or cause bodily injury.**
    - **Systems or equipment that may have a major impact on society or on the public.**
    - **Special applications related to aviation and space, nuclear power, electric power, submarine repeaters, etc.**

For applications subject to vibration such as in vehicles or ships, please contact us in advance.
Please read and understand all of the equipment knowledge, safety information, and precautions before use.

Warning Labels on Products

Products bear the following Warning Labels to indicate the situations as below, depending on the model.

This label is attached in the vicinity of high-voltage portions such as charging or cover-protected parts, to indicate locations with risk of electric shock.

This label is attached in the vicinity of grounding terminals to indicate that grounding is required.

Safety Alert Symbols

■ Warning symbol

⚠ DANGER   Denotes immediate hazards that will cause severe bodily injury or death if not avoided.

⚠ WARNING   Denotes immediate hazards which will probably cause severe bodily injury or death if not avoided.

⚠ CAUTION   Denotes hazards which could cause bodily injury and product or property damage if not avoided.

Notice   Denotes hazards which could cause product or property damage without bodily injury if not avoided.

> Note that even items with a ⚠CAUTION symbol could potentially lead to serious outcomes, depending on the situation.
> They all indicate important situations, so be sure to observe them.

■ Prohibited/Mandatory symbol

⊘ PROHIBITED   Indicates actions that must not be taken.

❗ MANDATORY   Indicates actions that must be taken.

Storage

Notice

- Avoid storing products in environments exposed to rain or water drops or with hazardous gas or liquid. Failure to follow this may cause product failures.
- Store products where they are not exposed to direct sunlight, within the specified temperature and humidity ranges of -20 to +65℃, below 95% RH (non-condensing). Failure to follow this may cause product failures.
- When you use servo amplifiers after a long-term storage (3 years or longer), contact us. The capacitance of electrolytic capacitors can decrease through long-term storage, which may cause malfunctions.
- When you use servo motors after a long-term storage (3 years or longer), contact us. Checking on bearings and motor holding brakes will be needed.

Transportation

⚠ CAUTION

- Do not lift the motor by the cable, connector, motor output shaft, or terminal box when transporting. Failure to follow this may cause injury, product failure, or damage.
- Transport the motor with great care to avoid the risk of it falling or tipping over. Failure to follow this may cause injury.
- Follow the instructions displayed on the package box and avoid excessively stacking boxes. Failure to follow this may cause injury or product failures.
- Use the included eyebolts for transporting servo motors alone. Do not use them for transporting machines in which servo motors are used. Failure to follow this may cause product failures.

Installation

⚠ WARNING

- Do not use products in flammable or explosive environments. Failure to follow this may cause fire.
- Mount the motor to incombustible materials such as metals. Failure to follow this may cause fire.
- Use a servo motor in an environment where the motor's protection rating is sufficient. Failure to follow this may cause electric shock, fire, or product failures.
- Avoid installing the motor in locations exposed to water, cutting oil, oil mist, iron powder, or metal chips. Failure to follow this may cause electric shock, fire, or product failures.
- Make sure that oil, flammable foreign objects, cables, or metal fragments do not get inside the motor. Failure to follow this may cause fire.
- Install an emergency stop circuit to the outside of equipment to turn the power off immediately whenever needed. Failure to follow this may cause injury or fire.
- Be sure to connect a molded case circuit breaker (MCCB) or fuse between the power supply and the servo amplifier's main circuit power supply terminals for overcurrent protection. Failure to follow this may cause electric shock or fire.

⚠ CAUTION

- Install safety devices such as circuit breakers in case of short-circuiting of external wiring. Failure to follow this may cause fire.
- Unpack the box with the right side up. Failure to follow this may cause injury.
- Do not stand on the servo motor or place heavy objects on top of it. Failure to follow this may cause injury.
- Install the motor with great care to avoid the risk of it falling or tipping over. Use eyebolts if supplied. Failure to follow this may cause injury.
- Ensure that the servo motor is securely mounted to equipment. Doing otherwise may cause it to fly out while operating.
- Do not touch the servo motor output shaft (especially the keyway and gears) with your bare hand. Failure to follow this may cause injury.
- Make sure that the output shaft of the servo motor and the mating machine are well aligned. Failure to follow this may cause injury or product failures.
- The motor holding brake cannot be used as a dynamic brake to secure the safety of machinery. Install a stopping device to machinery to ensure safety. Failure to do so may result in injury.
- When using servo motors in vertical axes, install safety devices (such as an external brake) to prevent a moving part from falling in the event of an alarm. Failure to follow this may cause injury.
- Designing a safety system that uses the STO function must be done by individuals who have safety standard expertise and have sufficiently understood the descriptions of section 4.5 "Safe Torque Off" in the User's Manual Laws/Regulations Conformity Guidelines. Failure to follow this may cause injury.

Notice

- Keep the ambient temperature of the installed servo amplifier/motor within the specified operating temperature/humidity range. Failure to follow this may cause product failures.
- Make sure to install products in the specified mounting orientation. Failure to follow this may cause product failures.
- The load applied to the servo motor output shaft should be less than the allowable load. Failure to follow this may cause product failures.
- Do not strike the motor shaft with a hammer when installing or removing a coupling to the shaft. Failure to follow this may cause product failures.
- Do not drop products or subject them to excessive shock of any kind. Failure to follow this may cause product failures.
- Do not block the air inlet or outlet. Failure to follow this may cause product failures.
- Keep a specified distance between the servo amplifier and the inner surface of the control board or other devices. Failure to follow this may cause product failures.
- Prepare an external protective circuit to the amplifier to cut off the main circuit power in the event of an alarm. Failure to follow this may cause secondary damage.
- For anti-collision devices, use ones that can sufficiently withstand the maximum output of the system. Failure to follow this may cause product failures.

Wiring

⚠ WARNING

- Be sure to ground the protective grounding terminal (⏚) of a servo amplifier to the machine or control board. The grounding terminal of a servo motor must be connected to the protective grounding terminal (⏚) of the amplifier. Failure to follow this may cause electric shock or fire.
- Do not work on wiring, maintenance servicing, or inspection with power on. After turning off the power, wait at least 15 minutes and check that the CHARGE LED (red) for the main circuit power supply turns off before working. Failure to follow this may cause electric shock.
- Do not connect commercial power supply or ground to the U, V, and W terminals of servo motors. Failure to follow this may cause fire.
- Install safety devices such as circuit breakers in case of short-circuiting of external wiring. Failure to follow this may cause fire.
- Do not damage, apply excessive stresses, put heavy things on, or tuck down cables. Failure to follow this may cause electric shock or fire.
- Use the right power supply (number of phases, voltage, frequency, VAC/VDC) for the motor. Failure to follow this may cause fire.

Notice

- Use servo amplifiers and servo motors in specified combinations. Failure to follow this may cause product failures.
- Perform wiring correctly and securely. Failure to follow this may cause product failures.
- Power cables, including the main circuit power cable and motor power cable of the servo amplifier, and signal cables must not be tied together or passed through the same duct or conduit. Also, the servo motor power cable and encoder cable must not be tied together or passed through the same duct or conduit. Failure to follow this may cause faulty operation.
- When connecting an inductive load such as a relay to the control output signal of the servo amplifier, be sure to connect a surge absorber diode. Ensure that the polarity of the diode is correct. Failure to follow this may cause product failures.
- Check that the power supply for servo motor holding brake and cooling fan meet specifications (number of phases, voltage, frequency, VAC/VDC). Failure to follow this may cause product failures.

Operation

⚠ WARNING

- Never touch inside of servo amplifiers with hands. Failure to follow this may cause electric shock.
- Never touch the rotating part of servo motors during operation. Failure to follow this may cause injury.
- Test-run a servo motor with the motor position fixed and isolated from machine systems. Install the motor to the machine system only after the test is done. Failure to follow this may cause injury.
- Never touch terminals and connectors while electricity is supplied. Failure to follow this may cause electric shock.

⚠ CAUTION

- Do not apply a magnetic field to the encoder cover of the servo motor. (Do not attach magnets such as magnet stands to the encoder cover.) Failure to follow this may cause product failures.
- While power is on or for some time after power-off, the servo amplifier heatsink, regenerative resistor, external resister for dynamic brake, and servo motor may be hot. Take safety measures such as covering to prevent them from being touched accidentally, if required. If safety measures cannot be taken, attach a high-temperature caution label. Failure to follow this may cause burns.
- Do not make extreme setting changes on servo parameters as doing so may result in unstable operations. Failure to follow this may cause injury.
- Stay away from equipment when power is restored after an outage or a momentary outage because the system may restart suddenly. (Make settings on equipment to secure safety on such occasions.) Failure to follow this may cause injury.
- Stop operations immediately when an emergency occurs. When an alarm is activated, remove the cause and ensure safety before resuming operations. Failure to follow this may cause injury.

- Never plug or unplug connectors while power is on (hot swapping) as the resulting surge voltage may cause electronic component malfunctions. Failure to follow this may cause electric shock or product damage.

Notice

- The holding brake built into servo motors must not be used for dynamic braking. Failure to follow this may cause product failures.
- Do not apply static electricity or excessively high voltage to servo motor encoder cables. Failure to follow this may cause product failures.
- When inertia moment or rotational speed is high, do not use exceeding regenerative resistor cable capacity by instantaneous regenerative power. Failure to follow this may cause product failures.
- Do not drive the servo motor by external power when the dynamic brake is activated due to power shutdown or alarm. Failure to follow this may cause product failures.
- Do not turn the power on and off frequently that the frequency exceeds 30 times/day or 5 times/hour. Failure to follow this may cause product failures.
- The surge absorber for the servo motor's holding brake relay prolongs the brake delay time. Therefore, program a sequence taking the delay time into account. Failure to follow this may cause product failures. Refer to User's Manual "2. Servo Motor" for holding delay time.

Maintenance and Inspection

⚠ WARNING

- Never attempt to disassemble, repair, or alter this product in any way. Doing so might result in electric shock.

⚠ CAUTION

- Do not use servo amplifiers or servo motors that have failed, damaged, or burnt out. Failure to follow this may cause fire.

Notice

- Parts and components used in servo amplifiers (such as electrolytic capacitors, cooling fans, lithium batteries for encoders, fuses, and relays) deteriorate by aging. Considering the standard replacement period, replace these parts and components with new ones for preventive maintenance. Contact us for details. Failure to follow this may cause product failures.
- Do not perform measurements of insulation resistance or dielectric voltage of the servo amplifier or servo motor. Failure to follow this may cause product failures.

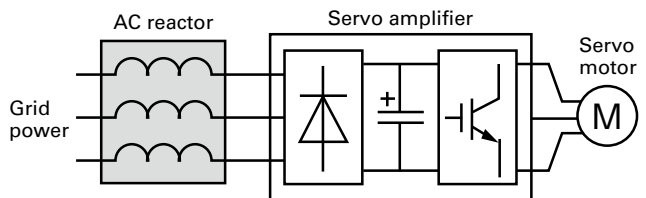### 🚫 PROHIBITED

- Do not remove the nameplate.

Disposal

❗ MANDATORY

- Dispose of servo amplifiers and servo motors as industrial waste.

Guideline for Suppressing Harmonics

Harmonic current generated by equipment such as servo amplifiers can potentially have adverse impact on other power consumers, if it flows out. Therefore, "Guideline for Suppressing Harmonics by Customers Receiving High Voltage or Special High Voltage" is published by the Ministry of International Trade and Industry (current Ministry of Economy).

Servo amplifiers used by specific power consumers fall under the category of "harmonic wave generating devices".
Consumers to whom the guideline is applied must determine if harmonic suppression measures are necessary based on the guideline and take measures for keeping harmonic emission within the limit specified by the power contract.
Even for consumers to whom the guideline is not applied, it is recommended they take harmonic suppression measures in order to avoid troubles due to the harmonics.
Our servo amplifiers fall under the circuit classification in Table 1 of the "Guideline for Suppressing Harmonics".

Refer to the following document for calculation method of harmonic currents.
"How to Calculate Harmonic Current of Servo Amplifiers for Specific Power Consumers" (JEM-TR225) by Japan Electrical Manufacturers' Association

Determine whether or not any harmonics suppression measures are required on the converter (AC-DC converter) side if the servo amplifier has a DC input power supply of DC type.

When harmonic suppression measures are necessary for the servo amplifier, connect a harmonic suppression reactor.
Contact us for the harmonic suppression reactor.

Table 1

Servo amplifier model no.	Power supply	Circuit classification	Circuit type			Conversion coefficient Ki
GADS□01□□□□ GADS□02□□□□ GADS□03□□□□ GADS□05□□□□	3-phase power supply Without AC reactor	3	3-phase bridge (Smoothing capacitor)	3-1	6-pulse converter without reactor	K31 = 3.4
	3-phase power supply With AC reactor			3-2	6-pulse converter with reactor (AC side)	K32 = 1.8
	Single-phase power supply Without AC reactor	4	Single-phase bridge (Smoothing capacitor, full-wave rectification)	4-3	Without reactor	K43 = 2.9
	Single-phase power supply With AC reactor			4-4	With reactor (AC side)	K44 = 1.3

References

- "Guideline for Suppressing Harmonics by Customers Receiving High Voltage or Special High Voltage" (September, 1994) by Ministry of International Trade and Industry (current Ministry of Economy, Trade and Industry)
- "Technical Guidelines for Suppressing Harmonics" (JEAG 9702-2018) by The Japan Electric Association
- "Measures for Suppressing Servo Amplifier and General-purpose Inverter Harmonics" (April 2022), by Japan Electrical Manufacturers' Association
- "How to Calculate Harmonic Current of Servo Amplifiers for Specific Power Consumers" (JEM-TR225) by Japan Electrical Manufacturers' Association
- "Guideline for Suppressing Servo Amplifier (input current 20 A or less) Harmonics" (JEM-TR227) by Japan Electrical Manufacturers' Association

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