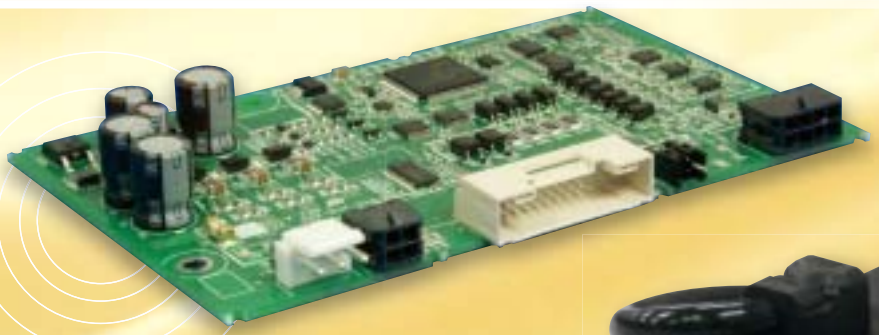
YASKAWA

AC SERVO DRIVES
Σ-S SERIES



SGPSS SERVOPACKs

Easy! Compact! and Low Price!

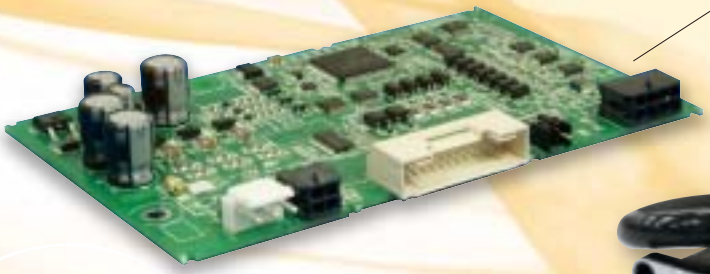
SGMSL Servomotors

Certified for
ISO9001 and
ISO14001

JQA-0422 JQA-EM0202

Σ-S-Series Servos Easily Handle Applications beyond Those of Conventional Servo Drives!

Although compact and low-priced, the Σ-S-Series Servos also provide real servo capabilities. They provide the capabilities of positioning servos that are ideal for converting pneumatic equipment to Servomotors.
If you thought a servo system could not handle your application, think again and try the Σ-S Series.



SGPSS SERVOPACKs

- DC power supply input.
- Two types of reference interfaces: Contact commands (program table method) and pulse train references.

Compact and Lightweight

SGPSS SERVOPACKs

The PCB format (80 mm × 123 mm) provides a high degree of installation freedom and helps you downsize equipment.

SGMSL Servomotors

Models are available with 25 mm × 25 mm or 40 mm × 40 mm flanges to help you downsize equipment.

Model	Rated Output	Total Length	Shaft Diameter	Square Flange Dimensions	Mass
SGMSL-A3	30 W	85 mm	$5\ ^{0}_{-0.013}$ dia.	25 mm	180 g
SGMSL-A5	50 W	92 mm	$8\ ^{0}_{-0.013}$ dia.	40 mm	350 g

SGMSL Servomotors

- Rated output of 30 W or 50 W.
- Rated Motor Speed/Maximum Motor Speed: 3,000 min^{-1}/6,000 min^{-1} (30 W) or 3,000 min^{-1}/3,000 min^{-1} (50 W)

Compliance with EU Directives

Low Prices and Greater Savings in Energy and Costs

A magnetic encoder is used and general-purpose AC Servo Drive performances and functions have been reduced to only those necessary to replace pneumatic equipment to achieve an amazingly low price.
And AC Servo Drive technology has been put to work to greatly reduce energy usage in comparison with pneumatic equipment or stepping motors to cut equipment running costs.

Easy Operation and Increased Productivity

◎ With the rated motor speed of 3,000 min^{-1} and acceleration/deceleration control, you can reduce takt time.
◎ You can use Yaskawa's SigmaWin+ Engineering Tool (free of charge) from trial operation to servo tuning and programming to easily complete setup.
◎ You can use flexible drive patterns to eliminate the need for changeovers for different workpieces.

SERVOPACK with Contact Commands (Program Table Method)

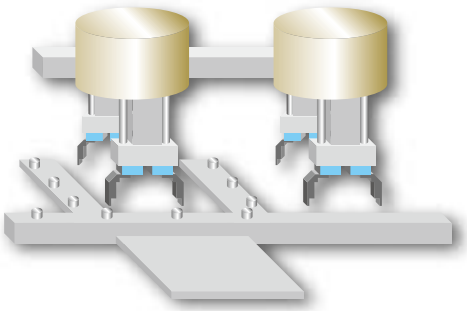
◎ Positioning functions are built in, eliminating the need for motion programming in the host controller.
◎ Just enter numeric values into the tables provided by SigmaWin+ to easily program operation.

Replacing Pneumatic Equipment with the Σ-S Series

Potential Application 1

Applications for Electric Chucks

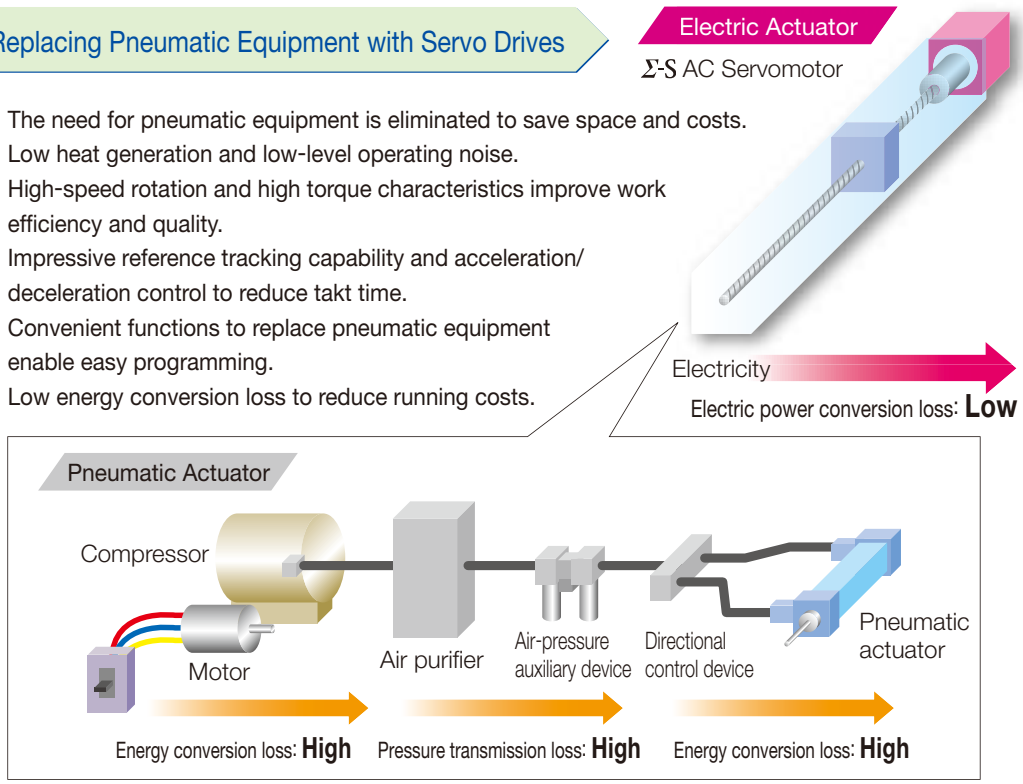
- Low heat generation and low-level operating noise.
- Impressive reference tracking capability to reduce takt time.
- Multi-point positioning for easy application to different types of workpieces.
- Torque limit settings to adjust chucking holding power.



Potential Application 2

Replacing Pneumatic Equipment with Servo Drives

- The need for pneumatic equipment is eliminated to save space and costs.
- Low heat generation and low-level operating noise.
- High-speed rotation and high torque characteristics improve work efficiency and quality.
- Impressive reference tracking capability and acceleration/deceleration control to reduce takt time.
- Convenient functions to replace pneumatic equipment enable easy programming.
- Low energy conversion loss to reduce running costs.



Model Designations

SERVOPACKs

SGPSS — 3R1 C H1 A

- SGPSS: Σ-S-Series SERVOPACK
- 3R1: Maximum applicable motor capacity 3R1: 50 W
- C: Voltage: 24 VDC
- H1: Interface — H1: Contact commands, rotary; P1: Pulse train references, rotary
- A: Design revision order

Servomotors

SGMSL — A3 C K A A 1

- SGMSL: Σ-S-Series Servomotor
- A3: Rated output A3: 30 W, A5: 50 W
- C: Voltage: 24 VDC
- K: Encoder specifications: 10-bit magnetic incremental encoder
- A: Design revision order
- A: Shaft end 2: Straight, A: Straight with flat seat
- 1: No options

Compliance with EU Directives

SERVOPACKs: SGPSS-3R1C

European Directive	Harmonized Standards
EMC Directive 2014/30/EU	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second Environment)
Low Voltage Directive 2014/35/EU	EN 61800-5-1
RoHS Directive 2011/65/EU	EN 50581

Servomotors: SGMSL

European Directive	Harmonized Standards
EMC Directive 2004/108/EC	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second Environment)
Low Voltage Directive 2006/95/EC	EN 60034-1 EN 60034-5
RoHS Directive 2011/65/EU	EN 50581

Control Performance

By using the Σ-S Series in equipment, you can use the superior performance of an AC Servo Drive to increase equipment value.

● Pressing Operation

The workpiece can be pressed or held in place at any force (torque). Workpiece damage and omissions are reduced because even fragile workpieces can be held or workpieces can be held securely, which increases work quality.

● Multi-point Positioning

You can perform positioning to different target positions. You can set the target positions required for the workpieces to eliminate the need for machine changeover operations to match workpiece size. This allows you to easily handle different types of workpieces.

● Zone Outputs

Workpieces are detected in realtime when they reach a specified zone and a digital signal is output. For example, with pneumatic equipment, there is no way to tell when the workpiece has reached the target zone, and waiting time becomes necessary to allow for time differences that result from changes in load mass and friction. You can use the zone outputs of the Σ-S Series to time starting the next operation, eliminating waiting time and increasing manufacturing throughput.

● Acceleration/Deceleration Control

Acceleration at startup and deceleration when stopping can be controlled to the required values. With pneumatic equipment, rapid changes in speed when starting and stopping can have adverse effects on workpieces, which can fly out of control. By using the acceleration/deceleration control of the Σ-S Series, impact is reduced when starting and stopping to prevent that type of problem.

Program Table Operation (for SERVOPACKs with Contact Commands only)

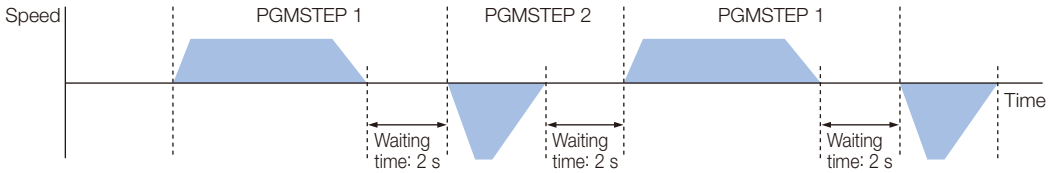
You can set (program) positioning operation patterns in tables in advance and then use input signals from the host controller to specify the operation patterns to achieve automatic operation. Two types of programmed operations are provided: positioning and pressing operation.

Example of Positioning Operation

◎ Program Table

PGMSTEP	POS	SPD	ACC	DEC	TLIMT	PTLIMT	CLLV	PSPD	INPOS	AREA1	AREA2	EVENT	NEXT
1	I+300000	15000	:	:	:	0	:	:	10	0	0	IT2000	2
2	I−300000	30000	:	:	:	0	:	:	10	0	0	IT2000	1

◎ Operation Pattern



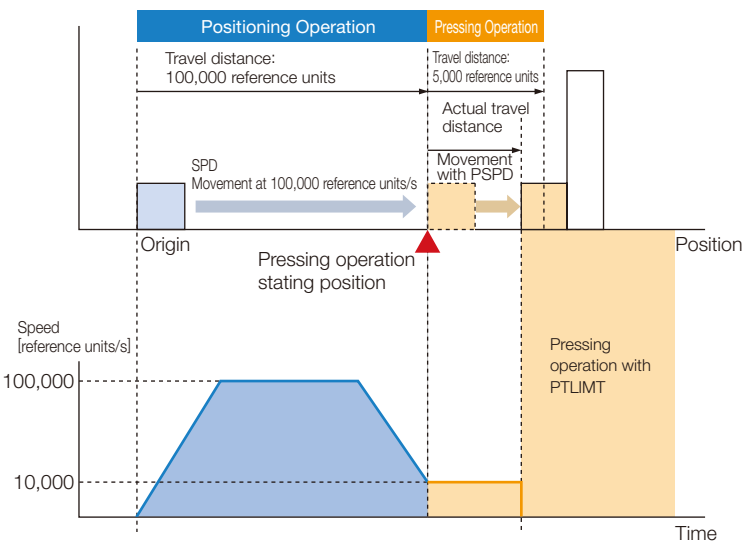
Example of Pressing Operation

After a movement to the target position with positioning operation, actuator pressing operation is performed at the specified torque.

◎ Program Table

PGMSTEP	POS	SPD	ACC	DEC	TLIMT	PTLIMT	CLLV	PSPD	INPOS	AREA1	AREA2	EVENT	NEXT
3	A+100000	100000	:	:	:	50	40	10000	5000	0	0	IT0	END

◎ Operation Pattern



◎ Program Settings

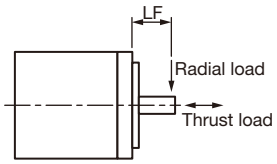
PGMSTEP	Program step
POS	Target position
SPD	Positioning speed specification
ACC	Acceleration specification
DEC	Deceleration specification
TLIMT	Torque limit specification for positioning
PLIMT	Torque limit specification for pressing operation
CLLV	Torque threshold (INPOS output level during pressing operation)
PSPD	Movement speed during pressing operation
INPOS	Positioning completed width
AREA1	Reverse area boundary position
AREA2	Forward area boundary position
EVENT	End criteria
NEXT	Program step to execute next (PGMSTEP)

Ratings and Specifications

● Ratings

Voltage			24 VDC	
Model SGMSL-			A3C	A5C
Rated Output*1		W	30	50
Rated Torque*1, *2		N·m	0.0955	0.159
Instantaneous Maximum Torque*1		N·m	0.286	0.477
Rated Current*1		Arms	2.9	3.1
Instantaneous Maximum Current*1		Arms	8.6	9.2
Rated Motor Speed*1		min^{-1}	3000	
Maximum Motor Speed*1		min^{-1}	6000	3000
Torque Constant		N·m/Arms	0.0358	0.0579
Motor Moment of Inertia		$\times10^{-4}$ kg·m^2	0.00629	0.0414
Rated Power Rate*1		kW/s	14.5	6.11
Rated Angular Acceleration Rate*1		rad/s^2	152000	38400
Heat Sink Size (Aluminum)		mm	250 × 250 × 6	200 × 200 × 6
Protective Structure*3			Totally enclosed, self-cooled, IP40	
Allowable Load Moment of Inertia (Motor Moment of Inertia Ratio)			30 Times	
Allowable Shaft Loads*4	LF	mm	16	20
	Allowable Radial Load	N	44	78
	Allowable Thrust Load	N	14.5	54

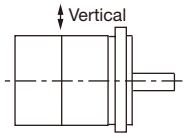
*1. These values are for operation in combination with a SERVOPACK when the temperature of the armature winding is 100°C. The values for other items are at 20°C. These are typical values.
*2. The rated torques are the continuous allowable torque values at 40°C with an aluminum heat sink of the dimensions given in the table.
*3. This does not apply to the connectors or shaft opening. Protective structure specifications apply only when the special cable is used.
*4. The allowable shaft loads are illustrated in the following figure. Design the mechanical system so that the thrust and radial loads applied to the Servomotor shaft end during operation do not exceed the values given in the table.



● Specifications

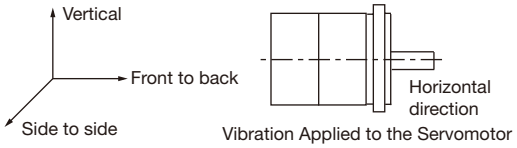
Voltage		24 VDC
Model SGMSL-		A3C, A5C
Time Rating		Continuous
Thermal Class		B
Insulation Resistance		500 VDC, 10 MΩ min.
Withstand Voltage		550 VAC for 1 minute
Excitation		Permanent magnet
Mounting		Flange-mounted
Drive Method		Direct drive
Rotation Direction		Counterclockwise (CCW) for forward reference when viewed from the load side
Environmental Conditions	Surrounding Air Temperature	0°C to 40°C
	Surrounding Air Humidity	20% to 80% relative humidity (with no condensation)
	Installation Site	• Must be indoors and free of corrosive and explosive gases. • Must be well-ventilated and free of dust and moisture. • Must facilitate inspection and cleaning. • Must have an altitude of 1,000 m or less. • Must be free of strong magnetic fields.
	Storage Environment	Store the Servomotor in the following environment if you store it with the power cable disconnected. Storage Temperature: -20°C to 60°C (with no freezing) Storage Humidity: 20% to 80% relative humidity (with no condensation)
	Allowable external magnetic field	10 mT max. (near encoder cover)
Shock Resistance*1	Impact Acceleration Rate at Flange	245 m/s^2
	Number of Impacts	2 times
Vibration Resistance*2	Vibration Acceleration Rate at Flange	24.5 m/s^2
Applicable Standards		Refer to *Compliance with EU Directives* (page 3) for details.

*1. The shock resistance for shock in the vertical direction when the Servomotor is mounted with the shaft in a horizontal position is given in the left table.



Shock Applied to the Servomotor

*2. The vertical, side-to-side, and front-to-back vibration resistance for vibration in three directions when the Servomotor is mounted with the shaft in a horizontal position is given in the left table. The strength of the vibration that the Servomotor can withstand depends on the application. Always check the vibration acceleration rate that is applied to the Servomotor with the actual equipment.

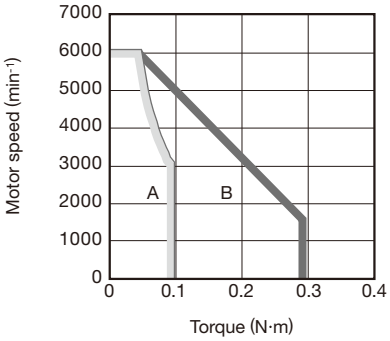


Vibration Applied to the Servomotor

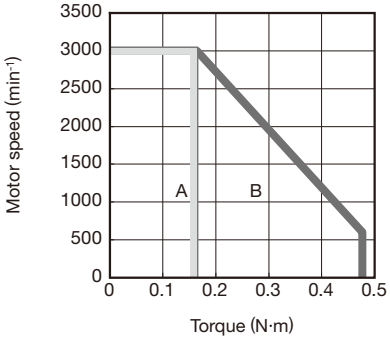
● Torque-Motor Speed Characteristics

A : Continuous duty zone
B : Intermittent duty zone

SGMSL-A3C



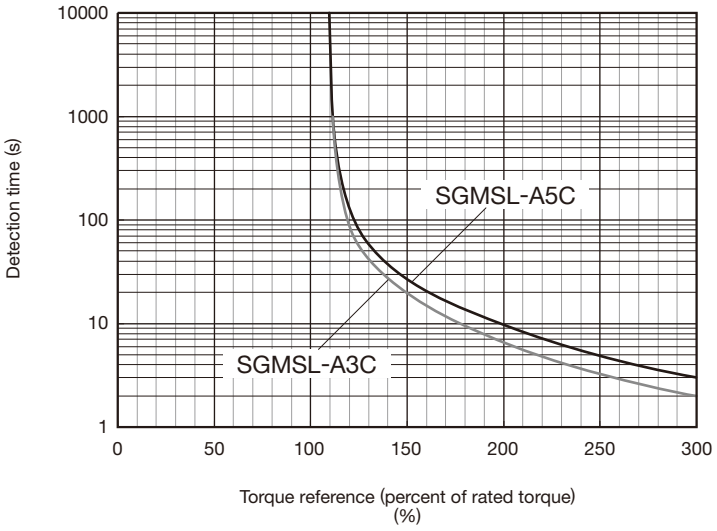
SGMSL-A5C



Note: 1. These values are for operation in combination with a SERVOPACK when the temperature of the armature winding is 100˚C. These are typical values.
2. The characteristics in the intermittent duty zone depend on the power supply voltage.
3. If the effective torque is within the allowable range for the rated torque, the Servomotor can be used within the intermittent duty zone.
4. The Servomotor Main Circuit Cable may cause a voltage drop, which may reduce the intermittent duty zone of the torque-motor speed characteristics.

● Servomotor Overload Protection Characteristics

The overload detection level is set for hot start conditions with a Servomotor ambient temperature of 40˚C.

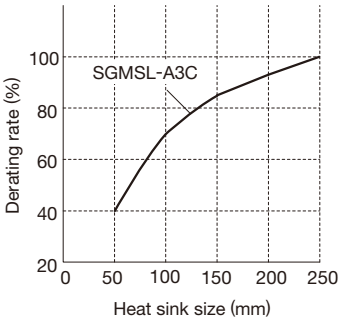


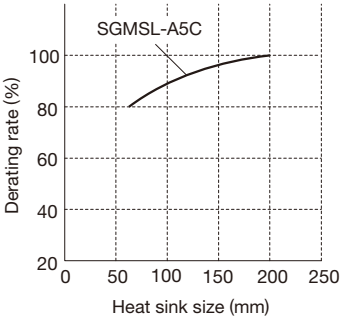
Note: The above overload protection characteristics do not mean that you can perform continuous duty operation with an output of 100% or higher. Use the Servomotor so that the effective torque remains within the continuous duty zone given in *Torque-Motor Speed Characteristics*.

● Servomotor Heat Dissipation Conditions

The Servomotor ratings are the continuous allowable values at an ambient temperature of 40˚C when a heat sink is installed on the Servomotor. If the Servomotor is mounted on a small device component, the Servomotor temperature may rise considerably because the surface for heat dissipation becomes smaller. Refer to the right graphs for the relation between the heat sink size and derating rate.

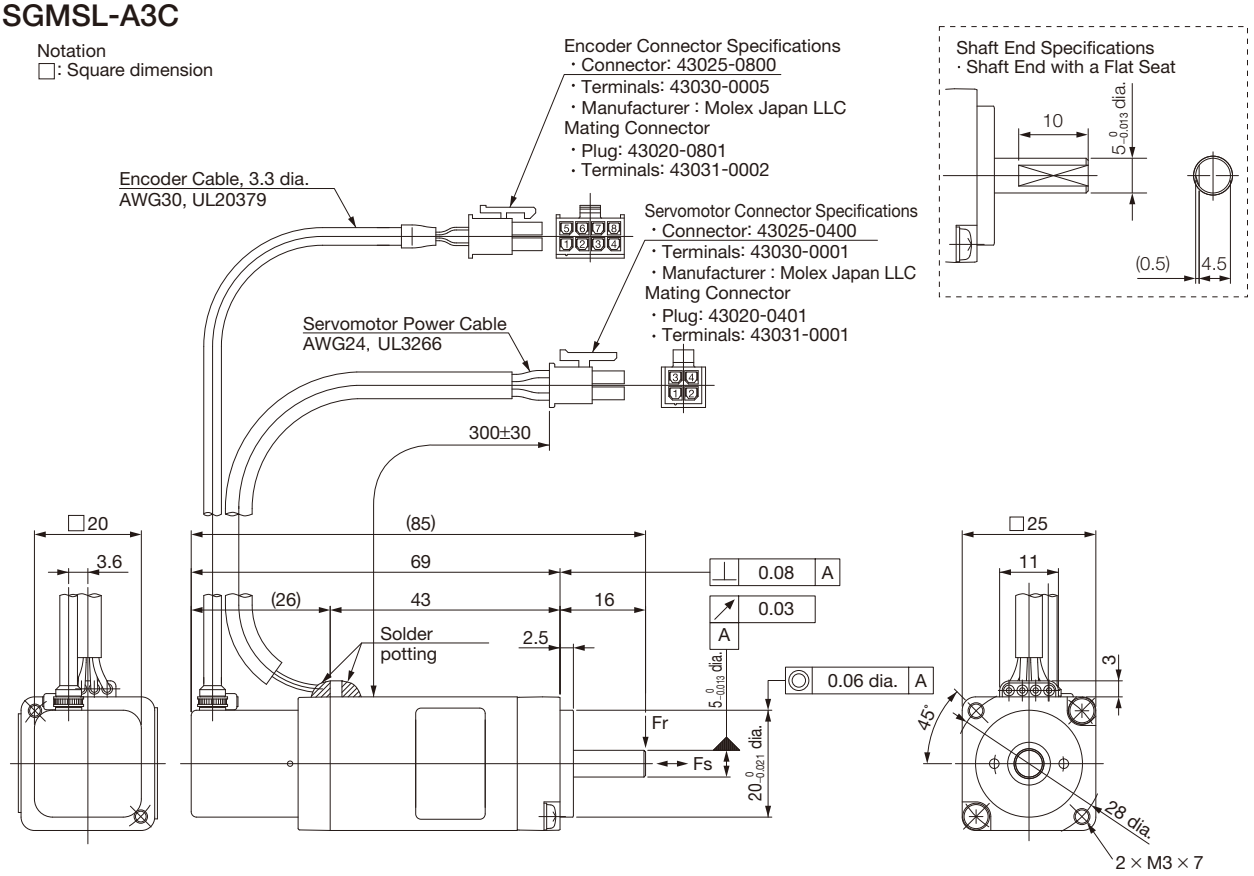
Note: The derating rates are applicable only when the average motor speed is less than or equal to the rated motor speed. If the average motor speed exceeds the rated motor speed, consult with your Yaskawa representative.





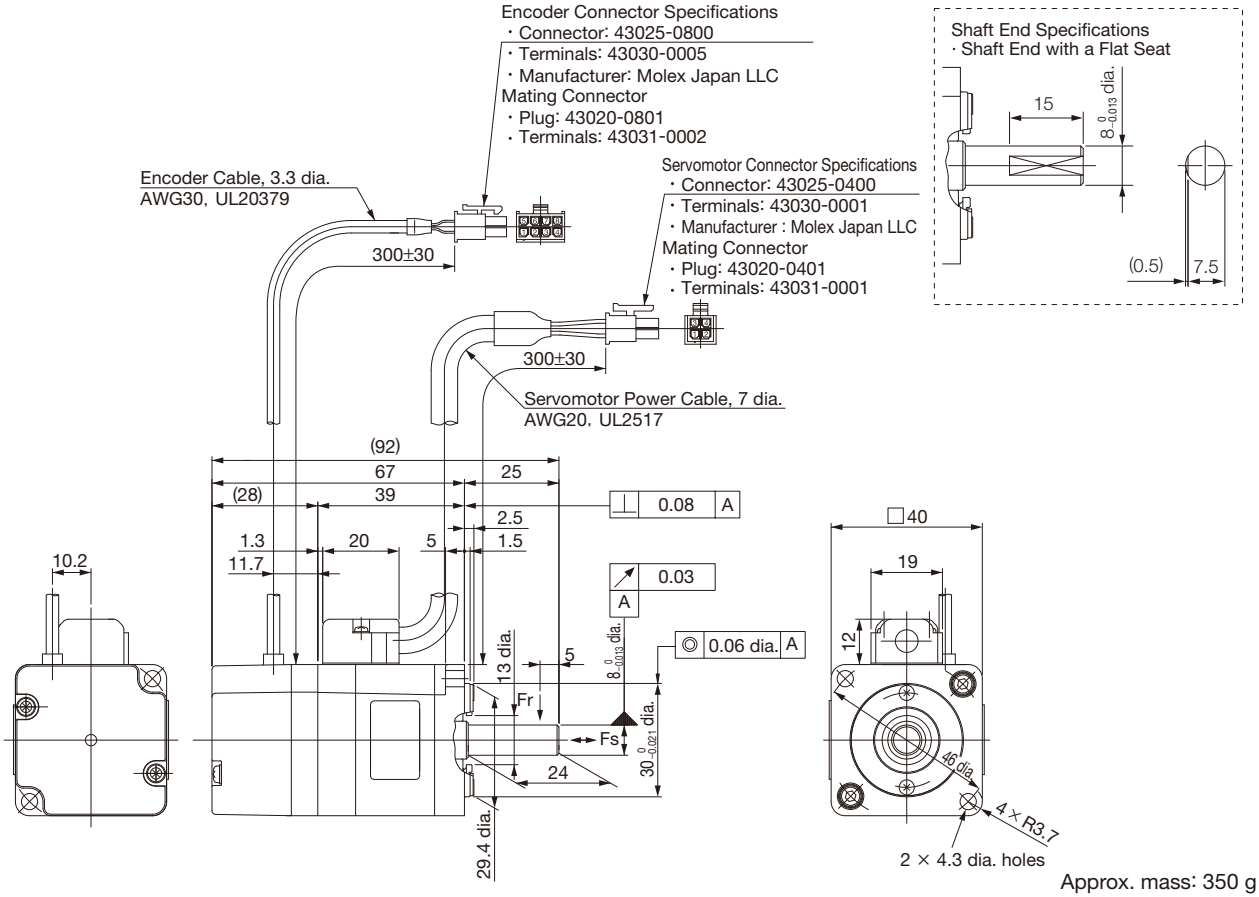
Dimensions Unit: mm

●SGMSL-A3C



Approx. mass: 180 g

●SGMSL-A5C



Approx. mass: 350 g

SERVOPACK with Contact Commands (Model SGPSS-3R1CH1A)

● Ratings

Item		Rating
Maximum Applicable Motor Capacity		50 W
Continuous Output Current		3.1 Arms
Instantaneous Maximum Output Current		9.2 Arms
Power Supply	Input Voltage	24 VDC ±15%
	Input Current*2	3.3 A
Power Supply Capacity per SERVOPACK*1		215 W
Power Loss*2		10.9 W
Overvoltage Category		I

*1: This is the value for the maximum instantaneous load.
*2: This is the net value at the rated load.

● Specifications

Item			Specification
Drive Method			PWM control, sine wave current drive
Feedback			Magnetic encoder: 10-bit (incremental encoder)
Operating Conditions	Surrounding Air Temperature		0°C to 40°C
	Storage Temperature		−20°C to 85°C
	Surrounding Air Humidity		90% relative humidity max. (with no freezing or condensation)
	Storage Humidity		90% relative humidity max. (with no freezing or condensation)
	Vibration Resistance		4.9 m/s^2
	Shock Resistance		19.6 m/s^2
	Protection Class		None
	Pollution Degree		2
	Altitude		1,000 m max.
	Others		Do not use the SERVOPACK in the following locations: Locations subject to static electricity noise, strong electromagnetic/magnetic fields, or radioactivity.
Applicable Standards			Refer to *Compliance with EU Directives* (page 3) for details.
Performances	Frequency Characteristics		250 Hz (J_L=J_M)
	Torque Control Precision*		±2%
I/O Signals	Sequence Input Signals	Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±10% Number of input points: 13
			Input method: Sink inputs or source inputs Input signals: ・Mode Switch (/MODE) ・Program Table Operation Start (/START) ・Program Table Operation Stop (/STOP) ・Origin Return (/HOME) ・Program Table Operation Reset (/PGMRES) ・Origin Return Deceleration Switch (/DEC) ・Servo ON (/S-ON) ・Alarm Reset (/ALM-RST) ・External Torque Limits (/P-CL and /N-CL) ・Emergency Stop (E-STP) ・Forward Jog (/JOGP) ・Reverse Jog (/JOGN) ・Program Step Selection (/SEL0 to /SEL5)

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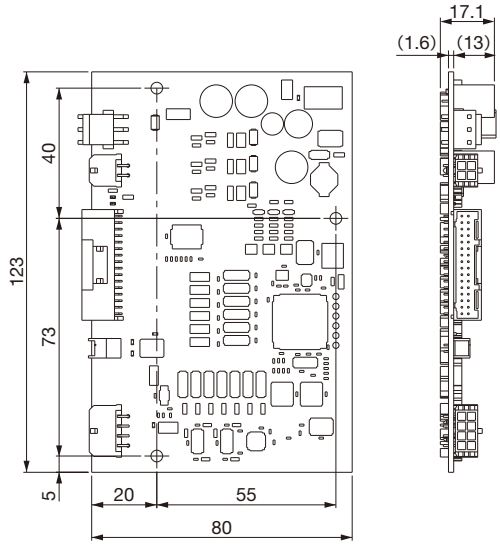
Item			Specification
I/O Signals	Sequence Output Signals	Fixed Output	Allowable voltage range: 24 VDC ±10% Number of output points: 1 Output signal: Servo Alarm (ALM)
		Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±10% Number of output points: 13
			Output method: Photocoupler (isolated) sink outputs are used. Output signals: ・Positioning Completed (/INPOSITION) ・Speed Coincidence (/V-CMP) ・Rotation Detection (/TGON) ・Servo Ready (/S-RDY) ・Torque Limit Detection (/CLT) ・Brake Control (/BK) ・Warning (/WARN) ・Near (/NEAR) ・Program Step Number (/POUT0 to /POUT5) ・Zone (/ZONE0 to /ZONE3) ・Program-Specified Area (/PAREA) ・Busy (/BUSY) ・Origin Return Completed (/POSRDY) ・Servo ON Status (/S-ONS) ・Emergency Stop Status (E-STPS) ・Encoder Origin (/PCO)
Communications	RS-232C Communications (CN5)		Computer (for SigmaWin+ Engineering Tool)
Indicators			3 LED indicators (PWR, ALM, RUN)
Dynamic Brake (DB)			None (coasting to a stop)
Regenerative Processing			None
Overtravel (OT) Prevention			None
Protective Functions			Overcurrent, overvoltage, overload, position deviation overflow, overspeed, encoder error, CPU error, parameter error, etc.
Utility Functions			Servo tuning, alarm traceback, jogging, origin search, etc.
Control Functions	Position Control	Feedforward Compensation	0% to 100%
		Positioning Completed Width Setting	0 to 99,999 reference units
	Program Table Method		Program table positioning in which steps are executed in sequence with commands from contact inputs
	Maximum Number of Steps		64
	Origin Return		5 methods
	Jogging		Constant-speed feeding with contact inputs

∗: This is the repeatability of the output current from the SERVOPACK.

●Dimension Unit: mm



Approx. mass: 50 g

SERVOPACK with Pulse Train References (Model SGPSS-3R1CP1A)

● Ratings

Item		Rating
Maximum Applicable Motor Capacity		50 W
Continuous Output Current		3.1 Arms
Instantaneous Maximum Output Current		9.2 Arms
Power Supply	Input Voltage	24 VDC ±15%
	Input Current*2	3.3 A
Power Supply Capacity per SERVOPACK*1		215 W
Power Loss*2		10.9 W
Overvoltage Category		I

*1: This is the value for the maximum instantaneous load.
*2: This is the net value at the rated load.

● Specifications

Item			Specification
Drive Method			PWM control, sine wave current drive
Feedback			Magnetic encoder: 10-bit (incremental encoder)
Operating Conditions	Surrounding Air Temperature		0°C to 40°C
	Storage Temperature		−20°C to 85°C
	Surrounding Air Humidity		90% relative humidity max. (with no freezing or condensation)
	Storage Humidity		90% relative humidity max. (with no freezing or condensation)
	Vibration Resistance		4.9 m/s^2
	Shock Resistance		19.6 m/s^2
	Protection Class		None
	Pollution Degree		2
	Altitude		1,000 m max.
	Others		Do not use the SERVOPACK in the following locations: Locations subject to static electricity noise, strong electromagnetic/magnetic fields, or radioactivity.
Applicable Standards			Refer to *Compliance with EU Directives* (page 3) for details.
Performances	Frequency Characteristics		250 Hz (J_L=J_M)
	Torque Control Precision*1		±2%
I/O Signals	Sequence Input Signals	Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±10% Number of points: 8
			Input method: Sink inputs or source inputs Input signals: · Origin Return (/HOME) · Origin Return Deceleration Switch (/DEC) · Servo ON (/S-ON) · Alarm Reset (/ALM-RST) · External Torque Limits (/P-CL and /N-CL) · Position Deviation Clear (/CLR) · Operation Stop (/STOP) · Emergency Stop (E-STP)

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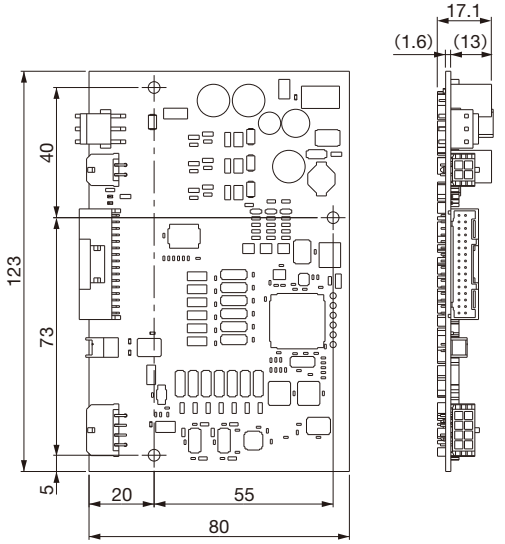
Item			Specification
I/O Signals	Sequence Output Signals	Fixed Output	Allowable voltage range: 24 VDC ±10% Number of output points: 1 Output signal: Servo Alarm (ALM)
		Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±10% Number of output points: 10
			Output method: Photocoupler (isolated) sink outputs are used. Output signals: ・Positioning Completed (/INPOSITION) ・Rotation Detection (/TGON) ・Servo Ready (/S-RDY) ・Torque Limit Detection (/CLT) ・Brake Control (/BK) ・Warning (/WARN) ・Zone (/ZONE0 to /ZONE3) ・Near (/NEAR) ・Busy (/BUSY) ・Origin Return Completed (/POSRDY) ・Servo ON Status (/S-ONS) ・Emergency Stop Status (E-STPS) ・Encoder Origin (/PCO)
Communications	RS-232C Communications (CN5)		Computer (for SigmaWin+ Engineering Tool)
Indicators			3 LED indicators (PWR, ALM, RUN)
Dynamic Brake (DB)			None (coasting to a stop)
Regenerative Processing			None
Overtravel (OT) Prevention			None
Protective Functions			Overcurrent, overvoltage, overload, position deviation overflow, overspeed, encoder error, CPU error, parameter error, etc.
Utility Functions			Servo tuning, alarm traceback, jogging, origin search, etc.
Control Functions	Position Control	Feedforward Compensation	0% to 100%
		Positioning Completed Width Setting	0 to 99,999 reference units
	Reference Pulses	Input Pulse Types	Sign + pulse train, CW + CCW pulse trains, or two-phase pulse trains with 90° phase differential
		Input Pulse Forms	Line driver or open collector
		Maximum Input Pulse Frequency	120 kpps
	Origin Return		5 methods

*: This is the repeatability of the output current from the SERVOPACK.

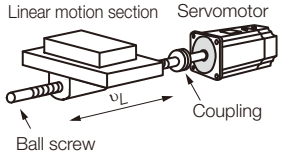
●Dimension Unit: mm



Approx. mass: 50 g

Example of Capacity Selection for Servomotors

1. Mechanical Specifications

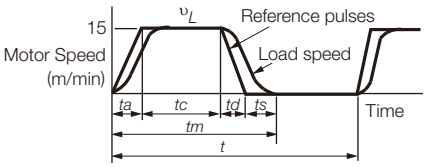


Item	Code	Value
Load Speed	υ_L	15 m/min
Linear Motion Section Mass	m	20 kg
Ball Screw Length	ℓ_B	0.3 m
Ball Screw Diameter	d_B	0.008 m
Ball Screw Lead	P_B	0.005 m
Ball Screw Material Density	ρ	7.87 × 10³ kg/m³
External Force on Linear Motion Section	F	0 N
Coupling Mass	m_C	0.3 kg

Item	Code	Value
Coupling Outer Diameter	d_C	0.03 m
Number of Feeding Operations	n	40 rotation/min
Feeding Distance	ℓ	0.25 m
Feeding Time	tm	1.2 s max.
Electrical Stopping Precision	δ	±0.02 mm
Friction Coefficient	μ	0.2
Mechanical Efficiency	η	0.9 (90%)

Note: This is the net value at the rated load.

2. Speed Diagram



$$t = \frac{60}{n} = \frac{60}{40} = 1.5 \text{ (s)}$$

If ta = td and *ts* = 0.1 (s),

$$ta = tm - ts - \frac{60\ell}{\upsilon_L}$$

$$= 1.2 - 0.1 - \frac{60 \times 0.25}{15} = 0.1 \text{ (s)}$$

$$tc = 1.2 - 0.1 - 0.1 \times 2 = 0.9 \text{ (s)}$$

3. Motor Speed

· Load shaft speed

$$n_L = \frac{\upsilon_L}{P_B} = \frac{15}{0.005} = 3{,}000 \text{ (min}^{-1}\text{)}$$

· Motor shaft speed

Direct coupling gear ratio 1/R = 1/1

Therefore, $n_M = n_L \cdot R = 3{,}000 \times 1 = 3{,}000 \text{ (min}^{-1}\text{)}$

4. Load Torque

$$T_L = \frac{(9.8\,\mu \cdot m + F) \cdot P_B}{2\pi R \cdot \eta} = \frac{(9.8 \times 0.2 \times 20 + 0) \times 0.005}{2\pi \times 1 \times 0.9} = 0.035 \text{ (N·m)}$$

5. Load Moment of Inertia

· Linear motion section

$$J_{L1} = m \left(\frac{P_B}{2\pi R}\right)^2 = 20 \times \left(\frac{0.005}{2\pi \times 1}\right)^2 = 0.127 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

· Ball screw

$$J_B = \frac{\pi}{32} \rho \cdot \ell_B \cdot d_B{}^4 = \frac{\pi}{32} \times 7.87 \times 10^3 \times 0.3 \times (0.08)^4 = 0.009 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

· Coupling

$$J_C = \frac{1}{8} m_C \cdot d_C{}^2 = \frac{1}{8} \times 0.3 \times (0.03)^2 = 0.338 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

· Load moment of inertia at motor shaft

$$J_L = J_{L1} + J_B + J_C = 0.474 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

6. Load Moving Power

$$P_O = \frac{2\pi n_M \cdot T_L}{60} = \frac{2\pi \times 3{,}000 \times 0.035}{60} = 11.0 \text{ (W)}$$

7. Load Acceleration Power

$$Pa = \left(\frac{2\pi}{60} n_M\right)^2 \frac{J_L}{ta} = \left(\frac{2\pi}{60} \times 3{,}000\right)^2 \times \frac{0.474 \times 10^{-4}}{0.1} = 46.78 \text{ (W)}$$

8. Servomotor Provisional Selection

① Selection Conditions

- T_L ≦ Motor rated torque
- $\frac{(Po + Pa)}{2}$ < Provisionally selected Servomotor rated output < $(Po + Pa)$
- n_M ≦ Rated motor speed
- J_L ≦ Allowable load moment of inertia

The following Servomotor meets the selection conditions.

- SGMSL-A3C Servomotor

② Specifications of the Provisionally Selected Servomotor

Item	Value
Rated Output	30 (W)
Rated Motor Speed	3,000 (min^{-1})
Rated Torque	0.0955 (N·m)
Instantaneous Maximum Torque	0.286 (N·m)
Motor Moment of Inertia	0.00629 × 10^{-4} ($kg·m^2$)
Allowable Load Moment of Inertia	0.00629 × 10^{-4} × 30 = 0.189 × 10^{-4} ($kg·m^2$)
Encoder Resolution	1,024 (pulses/rev)

9. Verification of the Provisionally Selected Servomotor

- Verification of required acceleration torque:

$$T_P = \frac{2\pi n_M (J_M + J_L)}{60ta} + T_L = \frac{2\pi \times 3{,}000 \times (0.00629 + 0.474) \times 10^{-4}}{60 \times 0.1} + 0.035$$

≈ 0.186 (N·m) <Maximum instantaneous torque...Satisfactory

- Verification of required deceleration torque:

$$T_S = \frac{2\pi n_M (J_M + J_L)}{60td} - T_L = \frac{2\pi \times 3{,}000 \times (0.00629 + 0.474) \times 10^{-4}}{60 \times 0.1} - 0.035$$

≈ 0.116 (N·m) <Maximum instantaneous torque...Satisfactory

- Verification of effective torque value:

$$Trms = \sqrt{\frac{T_P^2 \cdot ta + T_L^2 \cdot tc + Ts^2 \cdot td}{t}} = \sqrt{\frac{(0.186)^2 \times 0.1 + (0.035)^2 \times 0.9 + (0.115)^2 \times 0.1}{1.5}}$$

≈ 0.063 (N·m) < Rated torque...Satisfactory

It has been verified that the provisionally selected Servomotor is applicable in terms of capacity.
Position control is considered next.

10. Positioning Resolution

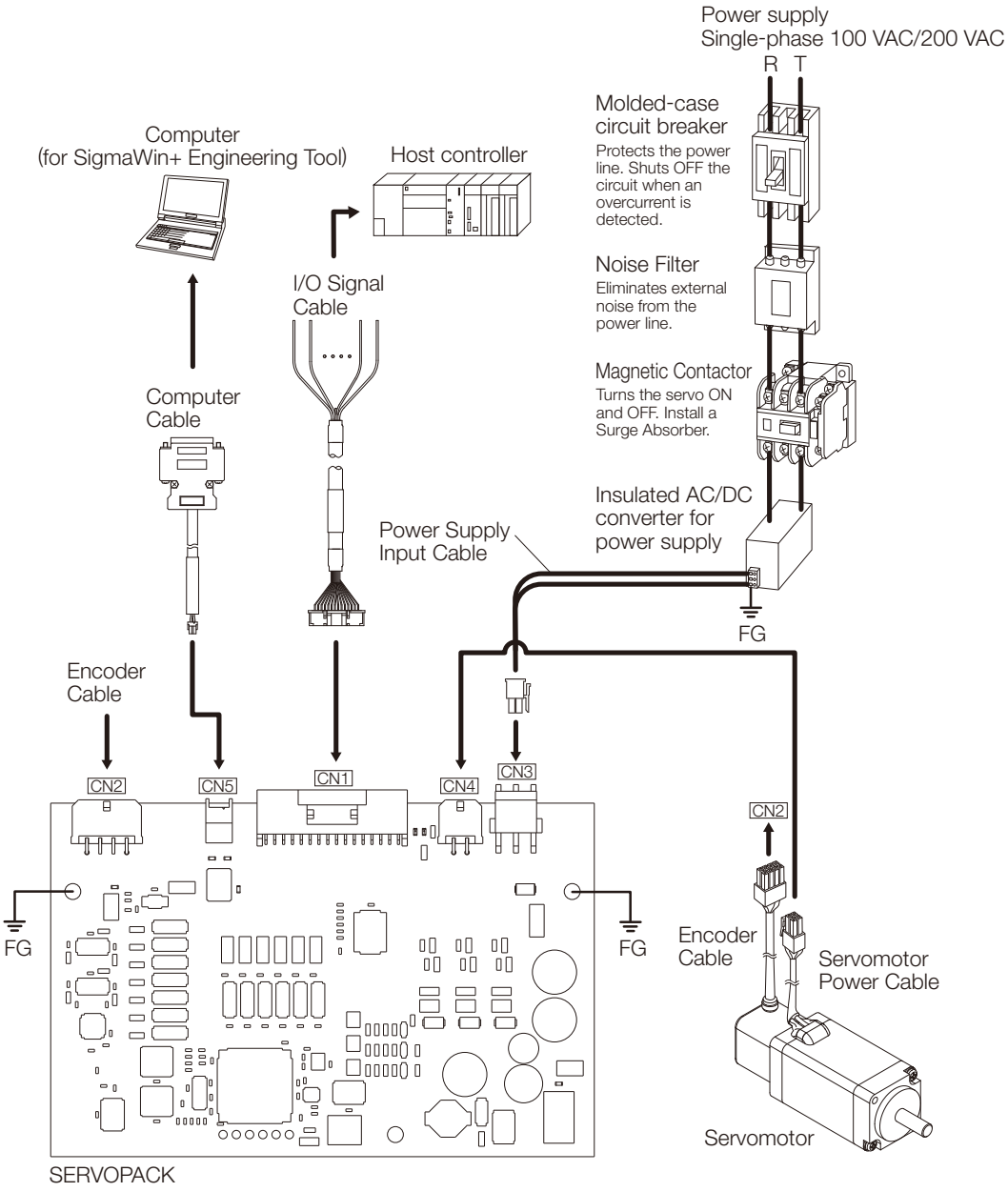
The electrical stopping precision δ is ±0.02 mm, so the position detection unit $\Delta\ell$ is 0.02 mm/pulse.
The number of pulses per motor rotation must be less than or equal to the encoder resolution (pulses/rev).
The ball screw lead P_B is 0.005 m, so the number of pulses per motor rotation is calculated with the following formula.

$$\text{Number of pulses per rotation (pulses)} = \frac{P_B}{\Delta\ell} = \frac{5 \text{ mm/rev}}{0.02 \text{ mm}} = 250 \text{ (pulses/rev)} < \text{Encoder resolution〔1,024 (pulses/rev)〕}$$

The number of pulses per motor rotation is less than the encoder resolution (pulses/rev), so the provisionally selected motor can be used.

It has been verified that the provisionally selected Servomotor is applicable for position control.

System Configuration Example



Cables

Name	Length (L)	Order Number
Power Supply Input Cables	1.5 m	JZSP-CSSG03-01P5-E
	3 m	JZSP-CSSG03-03-E
Servomotor Power Cables (relay cable)	1.5 m	JZSP-CSSM00-01P5-E
	3 m	JZSP-CSSM00-03-E
	5 m	JZSP-CSSM00-05-E
	10 m	JZSP-CSSM00-10-E
Encoder Cable (relay cable)	1.5 m	JZSP-CSSP00-01P5-E
	3 m	JZSP-CSSP00-03-E
	5 m	JZSP-CSSP00-05-E
	10 m	JZSP-CSSP00-10-E

Name	Length (L)	Order Number
I/O Signal Cables for SERVOPACK with Contact Commands	1.5 m	JZSP-CSSI203-01P5-E
	3 m	JZSP-CSSI203-03-E
I/O Signal Cables for SERVOPACK with Pulse Train References	1.5 m	JZSP-CSSI103-01P5-E
	3 m	JZSP-CSSI103-03-E
Computer Cable	2 m	JZSP-CPS00-02-E*

*: Use D-sub 9-pin connector for computer end.

Support Software

● SigmaWin+: AC Servo Drive Engineering Tool

The SigmaWin+ Engineering Tool is used to set up, optimally tune, and program Yaskawa Σ-Series Servo Drives. Contact your Yaskawa representative for information on the SigmaWin+.

System Requirements

Item	System Requirement
Supported Languages	English and Japanese
OS	Windows XP, Windows Vista, or Windows 7 (32-bit or 64-bit edition)
CPU	Pentium 200 MHz min.
Memory	64 MB min. (96 MB or greater recommended)
Available Hard Disk Space	For Standard Setup: 350 MB min. (400 MB or greater recommended for installation)

Note: Windows is a registered trademark of Microsoft Corporation. Pentium is a registered trademark of Intel Corporation.

Peripheral Devices

● Recommended AC/DC Power Supply

The same input power supply is used for both the main circuit power and control power. Use an input power supply that meets the following conditions.

- A 24-VDC power supply input must be used.
- The power supply must have double or reinforced insulation and must also be certified for safety standards.
- The power supply must not output more than 50 A.
- Protective measures must be implemented for external branch circuits according to the NEC (National Electrical Code) or other local laws or ordinances.

Recommended Power Supply

Input Power	Order Number	Manufacturer
24 VDC	HWS300-24	TDK-Lambda Corporation

● Power Supply Input, Molded-case Circuit Breakers, and Fuses

Select the molded-case circuit breaker and fuse according to the specifications of the power supply that you will use.

Power Supply Input	Maximum Applicable Motor Capacity [kW]	SERVOPACK Model	SGPSSPower Supply Capacity per SERVOPACK [W]*1	Input Power Supply Capacity		Inrush Current [A0-p]*2	Rated Voltage	
				Continuous Rating [A]	Instantaneous Maximum [A]		Fuse [V]	Molded-case Circuit Breaker [V]
24 VDC	0.05	SGPSS-3R1C	215	3.3	11.5	6	250	240

*1 : This is the value for the maximum instantaneous load.
*2 : This is the value when the recommended AC/DC Power Supply is used.
Note: Choose molded-case circuit breakers and fuses that meet the following cutoff characteristics.
Cutoff characteristics (25°C): · Power must not be shut OFF even if the instantaneous maximum current flows to the SERVOPACK for 5 s or longer.
· Does not cut off at the inrush current value of the power supply.

● Magnetic Contactors

Use a Magnetic Contactor when you configure an external AC power supply sequence.

Note: Always attach a Surge Absorber (e.g., a Surge Absorber unit) to the excitation coil of the magnetic contactor.

Recommended Magnetic Contactor

Order Number	Inquires
SC-03	Fuji Electric FA Components & Systems Co., Ltd.

● Noise Filters

Note: Some Noise Filters have large leakage currents. The grounding conditions also affect the amount of the leakage current. If necessary, select an appropriate leakage detector or leakage breaker taking into account the grounding conditions and the leakage current from the Noise Filter.

Recommended Noise Filter

AC Power Supply Voltage	Order Number	Specification	Leakage Current	Manufacturer
100 VAC/200 VAC	FN2070-6-07	Single-phase 250 V, 6A	0.734 mA, 230 VAC at 50 Hz	Schaffner EMC, Inc.

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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