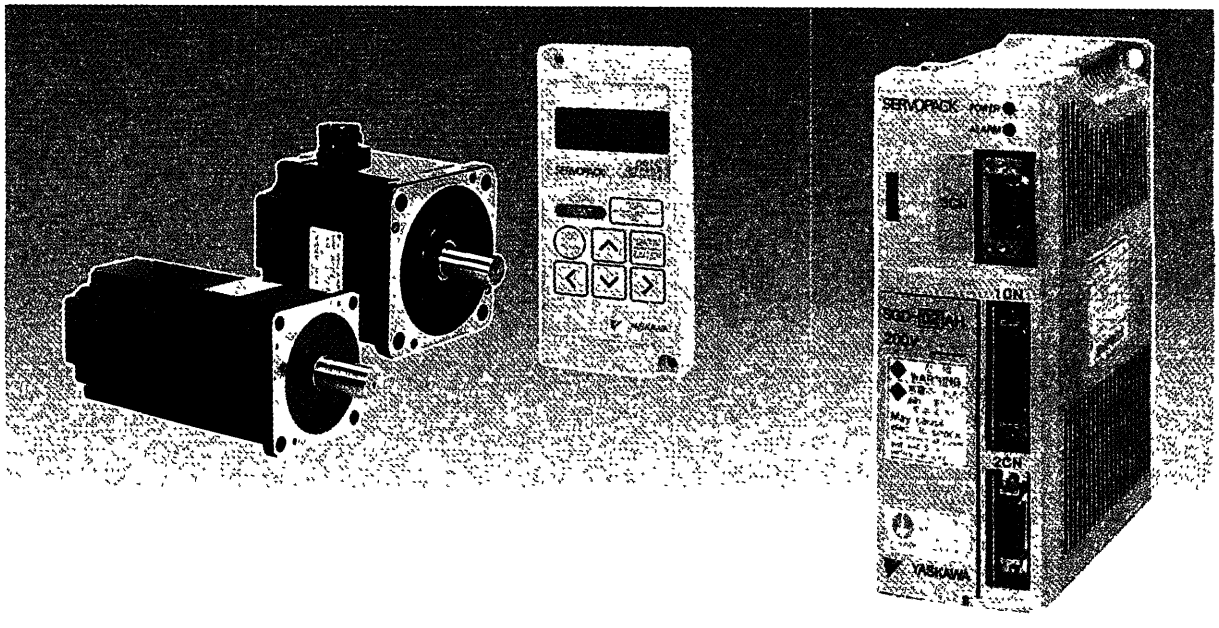
Σ Series SGM/SGMP/SGD
USER'S MANUAL

AC Servodrives

SGM/SGMP Servomotors
SGD-□H Servopack



YASKAWA

TSE-S800-15.7

Preface

Based on Yaskawa servo manufacturing technology and servo application technology accumulated over the last half a century, Yaskawa has launched the AC Servo Series that, together with its rich line of products, meets the needs of the modern needs of FA and FMS in their application to machining tools and robots.

AC Servos not only provide stable, highly accurate, and high-speed response control even under adverse environments, but also provide such features as easy application, flexibility, and easy maintain. The new Yasakawa AC Servos can be used in various servo fields, including machining tools and robots.

Features

- The highest available power rates and response in this class of servo.
- Compared with conventional products, these servomotors are approximately 1/3 both in volume and weight and Servopacks are approximately 1/4 in volume.
- The book-shape Servopacks can be used with either incremental encoders or absolute encoders.
- Positioning by the serial communications
- Electronic gear function provided.
- For incremental encoders, there are now only 9 lines to wire between the motor and encoder (previously: 15 lines).
- Improved environmental resistance by using varnish coating.

General Precautions

- The diagrams in this manual may be indicated without covers or safety shields to show details. Be sure to restore covers or shields before operating the Units and run the Units according to the instructions described in this manual.
- Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual. A new version of the manual will be released under a revised manual number when any changes are made.
- When ordering a new copy of the manual due to damage or loss, contact your Yaskawa dealer or the nearest Yaskawa sales office and provide the manual number shown on the front cover.
- Yaskawa assumes no responsibilities for products that are modified by users.

Safety Notices

The following conventions are used to indicate precautions in this manual. Failure to heed precautions provided in this manual can result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.

⚠ **WARNING** Indicates precautions that, if not heeded, are likely to result in loss of life or serious injury.

⚠ **Caution** Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

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5 Application

8 Using the Digital Operator

9 Installation and Wiring

10 Σ-Series Dimensional Drawings

Safety Precautions

■ Checking Products upon Delivery

⚠ Caution

- Always use the Servomotor and Servopack in one of the specified combinations.
  Not doing so may cause fire or malfunction.

■ Installation

⚠ Caution

- Never use the products in an environment subject to water, corrosive gases, inflammable gases, or combustibles.
  Doing so may result in electric shock or fire.

■ Wiring

⚠ WARNING

- Connect the ground terminal to a class-3 ground (100 Ω or less).
  Improper grounding may result in electric shock or fire.

⚠ Caution

- Do not connect a three-phase power supply to the U, V, or W output terminals.
  Doing so may result in injury or fire.
- Securely fasten the power supply terminal screws and motor output terminal screws.
  Not doing so may result in fire.

■ Operation

⚠ WARNING

- Never touch any rotating motor parts while the motor is running.
  Doing so may result in injury.

⚠ Caution

- Conduct trial operation on the Servomotor alone with the motor shaft disconnected from machine to avoid any unexpected accidents.
  Not doing so may result in injury.
- Before starting operation with a machine connected, change the settings to match the user's constants of the machine.
  Starting operation without matching the proper settings may cause the machine to run out of control or malfunction.
- Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.
  Not doing so may result in injury.
- Do not touch the heat sinks during operation.
  Doing so may result in burns due to high temperatures.

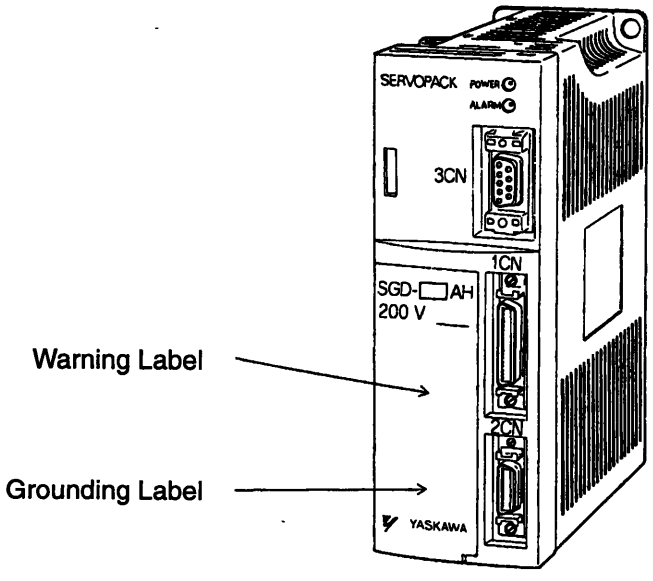
■ Maintenance and Inspection

⚠ WARNING

- Never touch the inside of the Servopacks.
  Doing so may result in electric shock.
- Do not remove the panel cover while the power is ON
  Doing so may result in electric shock.
- Do not touch terminals for five minutes after the power is turned OFF.
  Residual voltage may cause electric shock.

⚠ Caution

- Do not disassemble the Servomotor.
  Doing so may result in electric shock or injury.
- Do not attempt to change wiring while the power is ON.
  Doing so may result in electric shock or injury.



Warning Label

危 険
WARNING
感電の恐れあり
通電中及び電源オフ後5分間、端子部に触るな！
May cause electric shock.
Disconnect all power and wait 5 min. before servicing.

Grounding Label

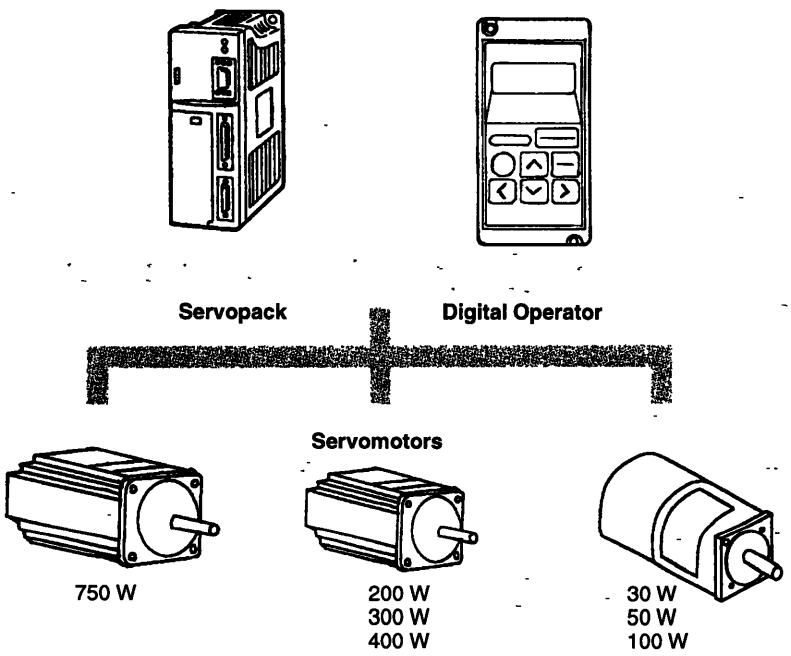
必ずアース線を接続せよ
Use proper grounding techniques.

Warning Label and Grounding Label Sticker Attachment Positions (Servopack)

1

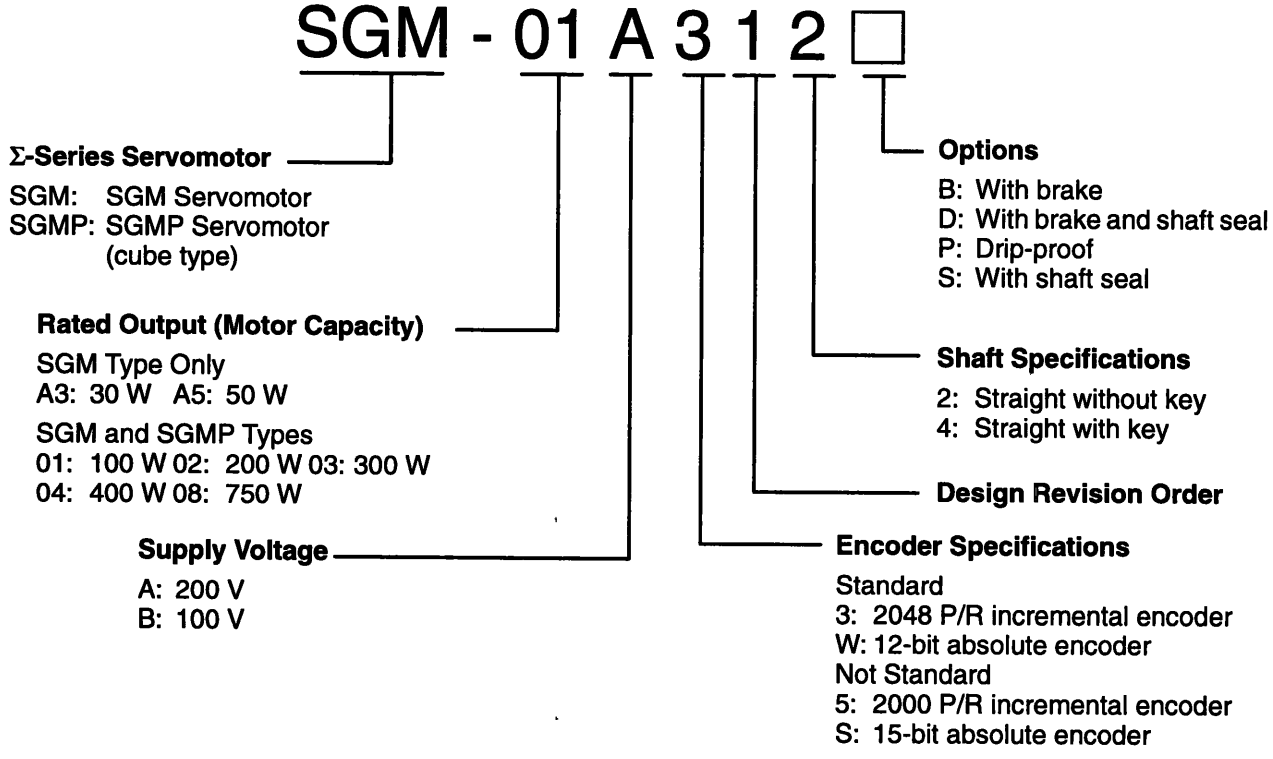
Configuration and Model Numbers

1.1 Configuration

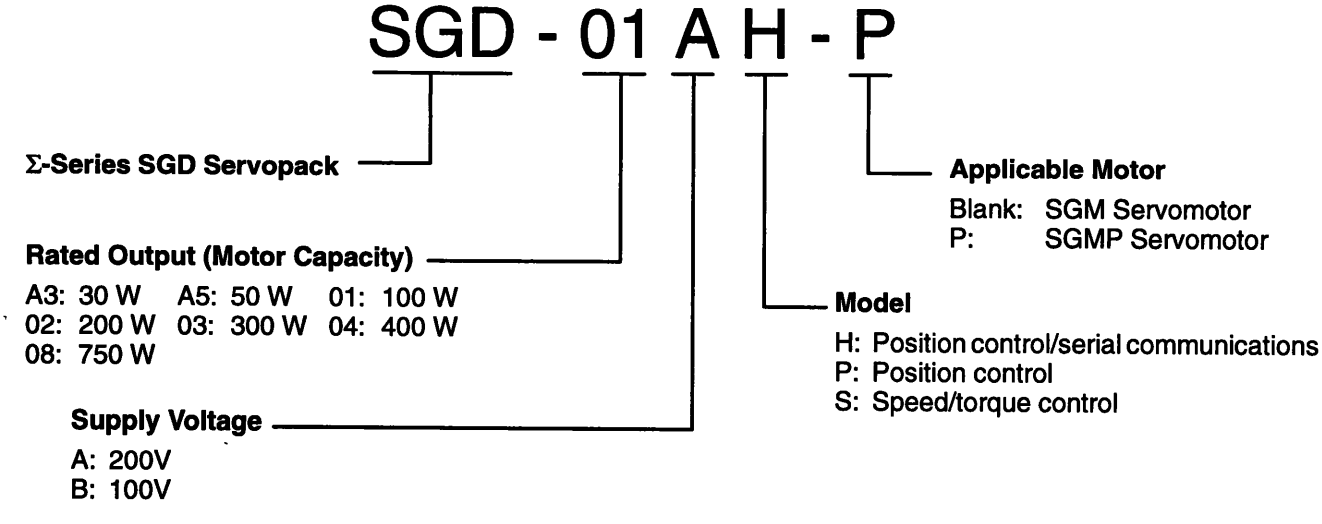


1.2 Model Numbers

1.2.1 Servomotor Model Numbers



1.2.2 Servopack Model Numbers



2

Ratings and Specifications

This chapter provides Servomotor ratings, specifications, and torque-speed characteristics, as well as Servopack ratings and specifications.

2.1 Ratings/Specifications for 200-VAC SGM Servomotors

2.1.1 Ratings and Specifications

Time Rating:	Continuous
Enclosure:	Totally enclosed, self cooled
Excitation:	Permanent magnet
Insulation Class:	Class B
Ambient Temperature	0 to 40°C
Drive Method:	Direct drive
Vibration Class:	15 μm or below
Ambient Humidity:	20% to 80% (with no condensation)
Mounting:	Flange method
Withstand Voltage:	1500 VAC
Insulation Resistance:	500 VDC, 10 MΩ min.

Table 2.1 200-VAC SGM Servomotor Ratings and Specifications

SGM Servomotor Type: SGM-			A3A	A5A	01A	02A	04A	08A
Rated Output*1		W	30	50	100	200	400	750
Rated Torque*1*2		N·m	0.095	0.159	0.318	0.637	1.27	2.39
		oz·in	13.5	22.6	45.1	90.1	181	338
Instantaneous Peak Torque*1		N·m	0.29	0.48	0.96	1.91	3.82	7.1
		oz·in	40.5	67.7	135	270	542	1010
Rated Current*1		A (rms)	0.42	0.6	0.87	2.0	2.6	4.4
Instantaneous Max Current*1		A (rms)	1.3	1.9	2.8	6.0	8.0	13.9
Rated Speed*1		r/min	3000					
Instantaneous Max Speed*1		r/min	4500					
Torque Constant*1		N·m/A (rms)	0.255	0.286	0.408	0.355	0.533	0.590
		kgf·cm/A (rms)	2.60	2.92	4.16	3.62	5.44	6.01
Moment of Inertia [J_M]	Incremental encorder, no brake	$(=GD^2_M/4)$kg·m^2	0.021 $\times10^{-4}$	0.026 $\times10^{-4}$	0.040 $\times10^{-4}$	0.123 $\times10^{-4}$	0.191 $\times10^{-4}$	0.671 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.288	0.368	0.576	1.74	2.70	9.52
	Incremental encorder, with brake	$(=GD^2_M/4)$kg·m^2	0.030 $\times10^{-4}$	0.035 $\times10^{-4}$	0.049 $\times10^{-4}$	0.181 $\times10^{-4}$	0.249 $\times10^{-4}$	0.811 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.408	0.488	0.696	2.56	3.52	11.5
	Absolute encorder, no brake	$(=GD^2_M/4)$kg·m^2	0.046 $\times10^{-4}$	0.051 $\times10^{-4}$	0.065 $\times10^{-4}$	0.148 $\times10^{-4}$	0.216 $\times10^{-4}$	0.696 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.640	0.720	0.928	2.09	3.05	9.87
	Absolute encorder, with brake	$(=GD^2_M/4)$kg·m^2	0.055 $\times10^{-4}$	0.060 $\times10^{-4}$	0.074 $\times10^{-4}$	0.206 $\times10^{-4}$	0.274 $\times10^{-4}$	0.836 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.760	0.840	1.048	2.91	3.87	11.9
Rated Power Rate*1		kW/s	4.36	9.63	25.4	32.8	84.6	85.1
Rated Angular Acceleration*1		rad/s^2	45200	61200	79500	51800	66600	35600
Inertia Time Constant		ms	1.5	0.9	0.5	0.4	0.3	0.3
Inductive Time Constant		ms	1.5	1.8	1.9	5.4	6.4	13

Note 1. These items and torque-motor speed characteristics quoted in combination with a Servopack are at an armature winding temperature of 100°C Other values quoted at 20°C. All values are typical

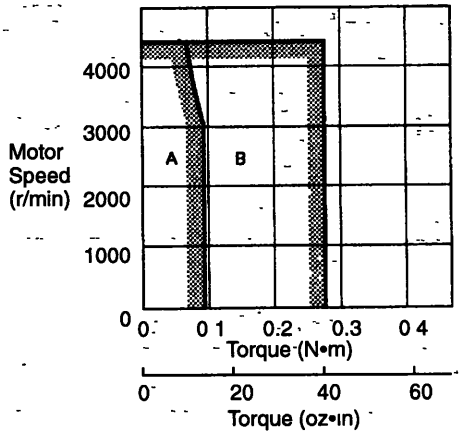
2. Rated torques are continuous allowable torque values at 40°C with a 250 x 250 x 6 (mm) (9.84 x 9.84 x 0.24 (in.)) heat sink attached.

3. When a motor is fitted with a shaft seal, use the following reduction ratings because of the higher friction torque.

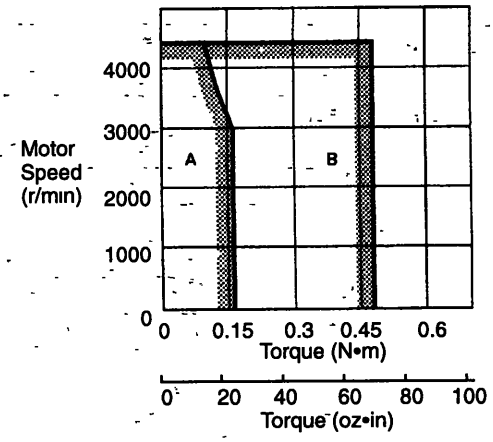
SGM-	A3A	A5A	01A	02A	04A	08A
Reduction Rating (%)	70	80	90	90	95	95

■ 200-VAC SGM Servomotor Torque-Motor Speed Characteristics

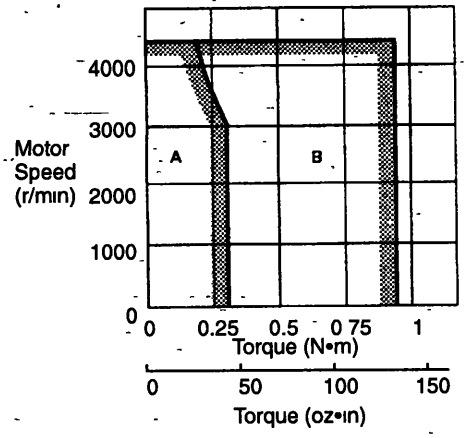
SGM-A3A



SGM-A5A



SGM-01A



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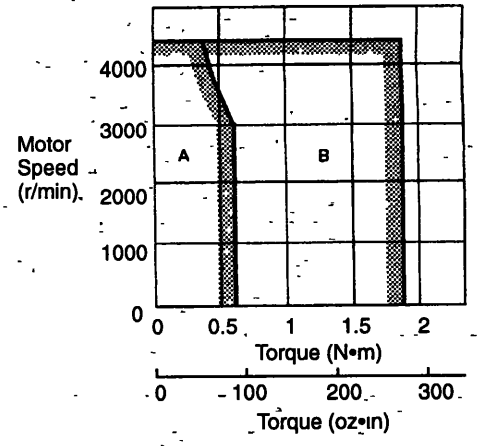

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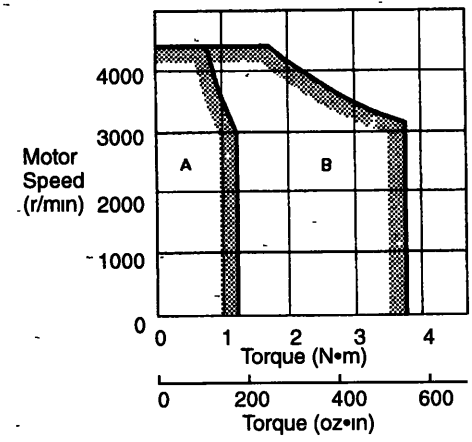
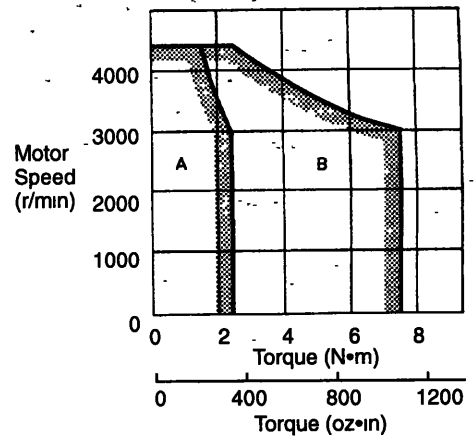


SGM-08A



A: Continuous Duty Zone
B: Intermittent Duty Zone

2.2 Ratings/Specifications for 100-VAC SGM Servomotors

2.2.1 Ratings and Specifications

Time Rating:	Continuous
Enclosure:	Totally enclosed, self cooled
Excitation:	Permanent magnet
Insulation Class:	Class B
Ambient Temperature:	0 to 40°C
Drive Method:	Direct drive
Vibration Class:	15 μm or below
Ambient Humidity:	20% to 80% (with no condensation)
Mounting:	Flange method
Withstand Voltage:	1500 VAC
Insulation Resistance:	500 VDC, 10 MΩ min.

Table 2.2 100-VAC SGM Servomotor Ratings and Specifications

SGM Servomotor Type: SGM-			A3B	A5B	01B	02B	03B
Rated Output *1		W	30	50	100	200	300
Rated Torque *1 *2		N·m	0.095	0.159	0.318	0.637	0.95
		oz·in	13.5	22.6	45.1	90.1	135
Instantaneous Peak Torque *1		N·m	0.29	0.48	0.96	1.91	3.72
		oz·in	40.5	67.7	135	270	528
Rated Current *1		A (rms)	0.63	0.9	2.2	2.7	3.7
Instantaneous Peak Current *1		A (rms)	2.0	2.9	7.1	8.4	14.8
Rated Rotation Speed *1		r/min	3000				
Max. Rotation Speed *1		r/min	4500				
Torque Constant *1		N·m/A (rms)	0.168	0.194	0.156	0.255	0.279
		kgf·cm/A (rms)	1.72	1.98	1.59	2.60	2.85
Moment of Inertia [J_M]	Incremental encorder, no brake	(=GD ^2_M/4) kg·m^2	0.021 $\times10^{-4}$	0.026 $\times10^{-4}$	0.040 $\times10^{-4}$	0.123 $\times10^{-4}$	0.191 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.288	0.368	0.576	1.74	2.71
	Incremental encorder, with brake	(=GD ^2_M/4) kg·m^2	0.030 $\times10^{-4}$	0.035 $\times10^{-4}$	0.049 $\times10^{-4}$	0.181 $\times10^{-4}$	0.249 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.408	0.488	0.696	2.56	3.53
	Absolute encorder, no brake	(=GD ^2_M/4) kg m^2	0.046 $\times10^{-4}$	0.051 $\times10^{-4}$	0.065 $\times10^{-4}$	0.148 $\times10^{-4}$	0.216 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.640	0.720	0.928	2.09	3.07
	Absolute encorder, with brake	(=GD ^2_M/4) kg m^2	0.055 $\times10^{-4}$	0.060 $\times10^{-4}$	0.074 $\times10^{-4}$	0.206 $\times10^{-4}$	0.274 $\times10^{-4}$
		oz·in·s$^2\times10^{-3}$	0.760	0.840	1.048	2.91	3.89
Rated Power Rating *1		kW/S	4.36	9.63	25.4	32.8	47.3
Rated Angular Acceleration *1		rad/s^2	45200	61200	79500	51800	49700
Inertia Time Constant		ms	1.6	0.9	0.6	0.4	0.3
Inductive Time Constant		ms	1.3	1.6	1.6	5.7	5.3

Note 1 These items and torque-motor speed characteristics quoted in combination with a Servopack are at an armature winding temperature of 100°C. Other values quoted at 20°C. All values are typical.

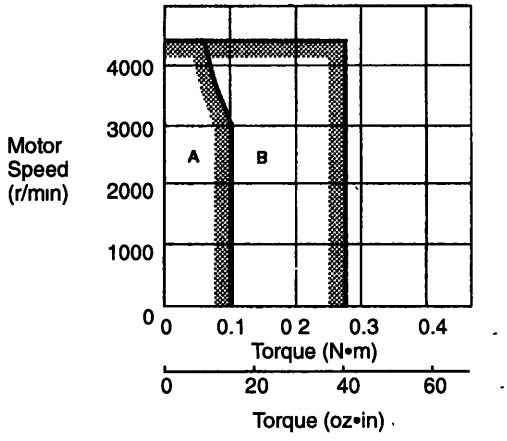
2. Rated torques are continuous allowable torque values at 40°C with a 250 x 250 x 6 (mm) (9.84 x 9.84 x 0.24 (in.)) heat sink attached.

3. When a motor is fitted with a shaft seal, use the following reduction ratings because of the higher friction torque.

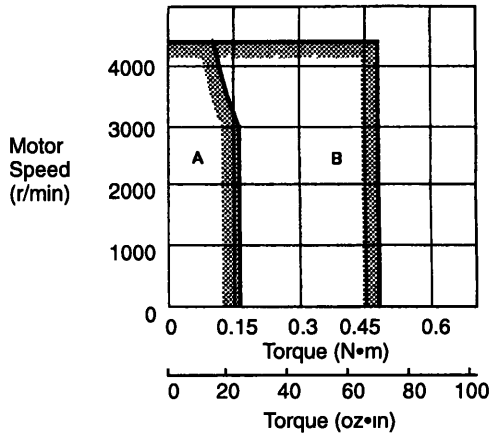
SGM-	A3B	A5B	01B	02B	03B
Reduction Rating (%)	70	80	90	90	90

■ 100-VAC SGM Servomotor Torque-Motor Speed Characteristics

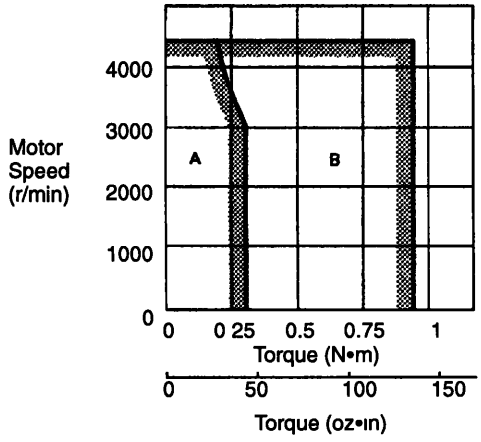
SGM-A3B



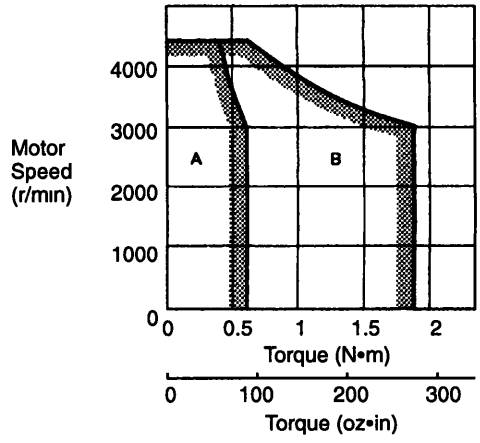
SGM-A5B



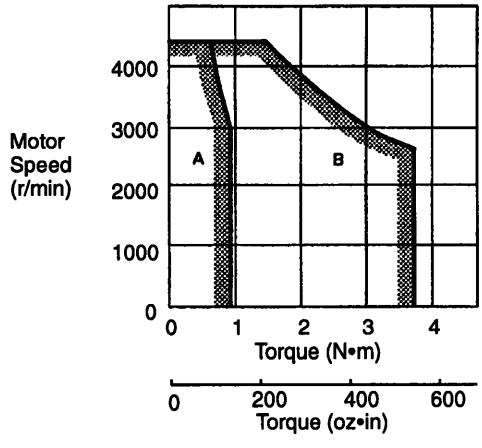
SGM-01B



SGM-02B



SGM-03B



A: Continuous Duty Zone
B: Intermittent Duty Zone

2.3 Ratings/Specifications for 200-VAC SGMP Servomotors

2.3.1 Ratings and Specifications

Time Rating:	Continuous
Enclosure:	Totally enclosed, self cooled
Excitation:	Permanent magnet
Insulation Class:	Class B
Ambient Temperature	0 to 40°C
Drive Method:	Direct drive
Vibration Class:	15 μm or below
Ambient Humidity:	20% to 80% (with no condensation)
Mounting:	Flange method
Withstand Voltage:	1500 VAC
Insulation Resistance:	500 VDC, 10 MΩ min.

Table 2.3 200-VAC SGMP Servomotor Ratings and Specifications

SGMP Servomotor Type: SGMP-			01A	02A	04A	08A
Rated Output *1		W	100	200	400	750
Rated Torque *1 *2		N·m	0.318	0.637	1.27	2.39
		oz·in	45.1	90.1	181	338
Instantaneous Peak Torque *1		N·m	0.96	1.91	3.82	7.1
		oz·in	135	270	542	1010
Rated Current *1		A (rms)	0.89	2.0	2.6	4.1
Instantaneous Peak Current *1		A (rms)	2.8	6.0	8.0	13.9
Rated Rotation Speed *1		r/min	3000			
Max. Rotation Speed *1		r/min	4500			
Torque Constant *1		N·m/A (rms)	0.392	0.349	0.535	0.641
		kgf·cm/A (rms)	4.00	3.56	5.46	6.55
Moment of Inertia	Incremental encoder, no brake	($=GD^2_M/4$) kg·m^2	0.065 $\times10^{-4}$	0.209 $\times10^{-4}$	0.347 $\times10^{-4}$	2.11 $\times10^{-4}$
		oz·in·s^{2}x10^{-3}	0.917	2.96	4.92	29.9
	Incremental encoder, with brake	($=GD^2_M/4$) kg·m^2	0.103 $\times10^{-4}$	0.307 $\times10^{-4}$	0.445 $\times10^{-4}$	2.52 $\times10^{-4}$
		oz·in·s^{2}x10^{-3}	1.46	4.35	6.31	35.7
	Absolute encoder, no brake	($=GD^2_M/4$) kg·m^2	0.090 $\times10^{-4}$	0.234 $\times10^{-4}$	0.372 $\times10^{-4}$	2.14 $\times10^{-4}$
		oz·in·s^{2}x10^{-3}	1.27	3.31	5.27	30.3
	Absolute encoder, with brake	($=GD^2_M/4$) kg·m^2	0.128 $\times10^{-4}$	0.332 $\times10^{-4}$	0.470 $\times10^{-4}$	2.55 $\times10^{-4}$
		oz·in·s^{2}x10^{-3}	1.81	4.70	6.66	36.1
Rated Power Rate *1		kW/s	15.7	19.4	46.8	26.9
Rated Angular Acceleration *1		rad/s	49200	30500	36700	11300
Inertia Time Constant		ms	0.7	0.6	0.4	0.7
Inductive Time Constant		ms	3.7	7.4	8.5	18

Note 1. These items and torque-motor speed characteristics quoted in combination with a Servopack are at an armature winding temperature of 100°C. Other values quoted at 20°C. All values are typical.

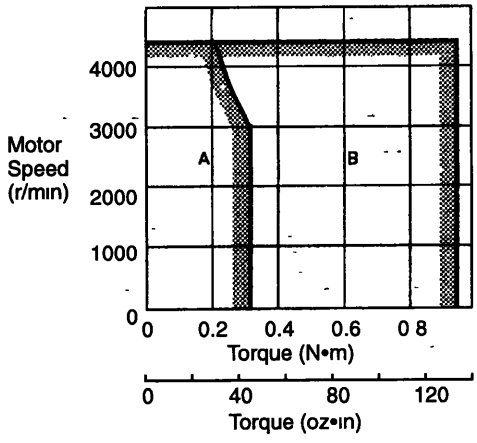
2. Rated torques are continuous allowable torque values at 40°C with the specified heat sink attached.
Heat sink dimensions 01A, 02A, 04A: 250 x 250 x 6 (mm) (9.84 x 9.84 x 0.24 (in))
08A. ..... 300 x 300 x 12 (mm) (11.81 x 11.81 x 0.47 (in))

3. When a motor is fitted with a shaft seal, use the following reduction ratings because of the higher friction torque.

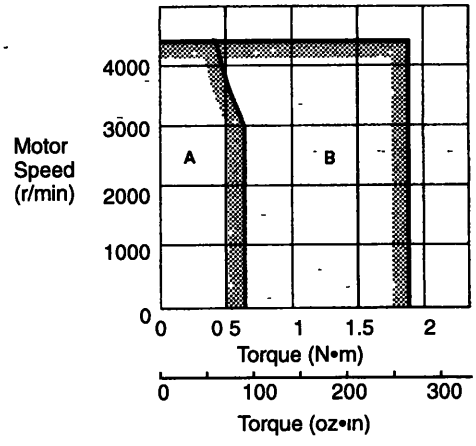
SGMP-	01A	02A	04A	08A
Reduction Rating (%)	90	90	95	95

■ 200-VAC SGMP Servomotor Torque-Motor Speed Characteristics

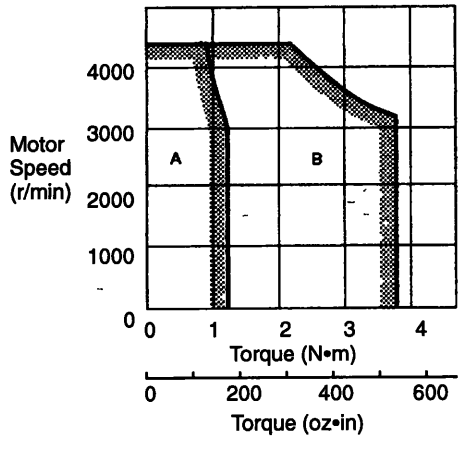
SGMP-01A



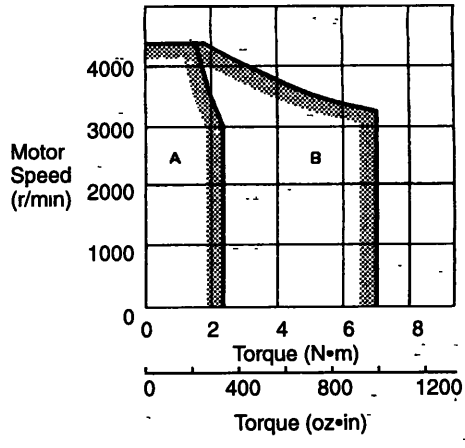
SGMP-02A



SGMP-04A



SGMP-08A



A: Continuous Duty Zone
B: Intermittent Duty Zone

2.4 Ratings/Specifications for 100-VAC SGMP Servomotors

2.4.1 Ratings and Specifications

Time Rating:	Continuous
Enclosure:	Totally enclosed, self cooled
Excitation:	Permanent magnet
Insulation Class:	Class B
Ambient Temperature	0 to 40°C
Drive Method:	Direct drive
Vibration Class:	15 μm or below
Ambient Humidity:	20% to 80% (with no condensation)
Mounting:	Flange method
Withstand Voltage:	1500 VAC
Insulation Resistance:	500 VDC, 10 MΩ min.

Table 2.4 100-VAC SGMP Servomotor Ratings and Specifications

SGMP Servomotor Type: SGMP-			01B	02B	03B
Rated Output*1		W	100	200	300
Rated Torque*1*2		N·m	0.318	0.637	0.955
		oz·in	45.1	90.1	135
Instantaneous Peak Torque*1		N·m	0.96	1.91	2.86
		oz in	135	270	406
Rated Current*1		A (rms)	2.2	2.7	4.3
Instantaneous Peak Current*1		A (rms)	7.1	8.4	13.9
Rated Rotation Speed*1		r/min	3000		
Max. Rotation Speed*1		r/min	4500		
Torque Constant*1		N m/A (rms)	0.160	0.258	0.246
		kgf·cm/A (rms)	1.64	2.63	2.51
Moment of Inertia	Incremental encoder, no brake	(=GD ^2_M/4) kg·m^2	0.065 ×10^{-4}	0.209 ×10^{-4}	0.347 ×10^{-4}
		oz·in·s^2×10^{-3}	0.917	2.96	4.92
	Incremental encoder, with brake	(=GD ^2_M/4) kg m^2	0.103 ×10^{-4}	0.307 ×10^{-4}	0.445 ×10^{-4}
		oz·in·s^2×10^{-3}	1.46	4.35	6.31
	Absolute encoder, no brake	(=GD ^2_M/4) kg·m^2	0.090 ×10^{-4}	0.234 ×10^{-4}	0.372 ×10^{-4}
		oz·in·s^2×10^{-3}	1.27	3.31	5.27
	Absolute encoder, with brake	(=GD ^2_M/4) kg·m^2	0.128 ×10^{-4}	0.332 ×10^{-4}	0.470 ×10^{-4}
		oz in·s^2×10^{-3}	1.81	4.70	6.66
Rated Power Rate*1		kW/s	15.7	19.4	26.3
Rated Angular Acceleration*1		rad/s	49200	30500	27500
Inertia Time Constant		ms	0.8	0.7	0.4
Inductive Time Constant		ms	3.6	6.3	8.5

Note 1. These items and torque-motor speed characteristics quoted in combination with a Servopack are at an armature winding temperature of 100°C. Other values quoted at 20°C. All values are typical.

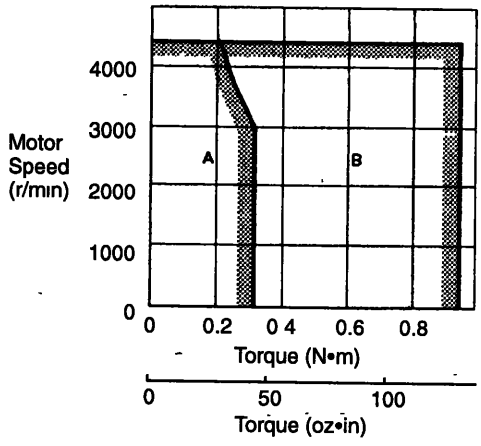
2. Rated torques are continuous allowable torque values at 40°C with a 250 x 250 x 6 (mm) (9.84 x 9 84 x 0.24 (in)) heat sink attached.

3. When a motor is fitted with a shaft seal, use the following reduction ratings because of the higher friction torque.

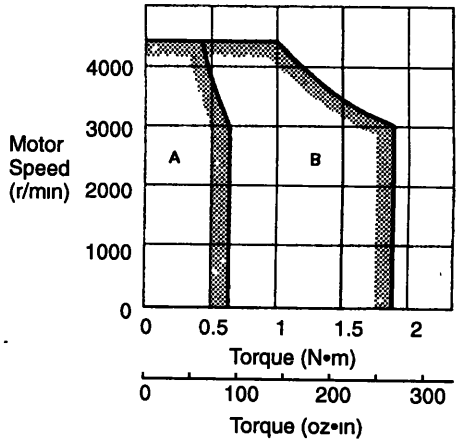
SGMP-	01B	02B	03B
Reduction Rating (%)	90	90	95

■ 100-VAC SGMP Servomotor Torque-Motor Speed Characteristics

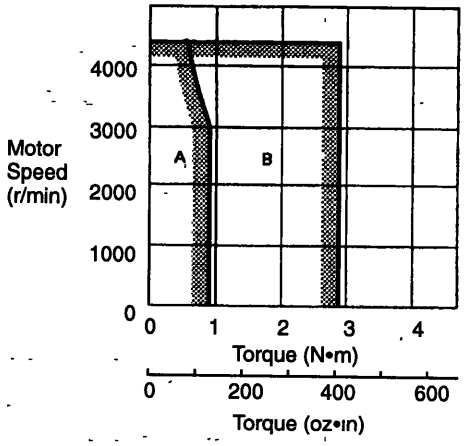
SGMP-01B



SGMP-02B



SGMP-03B



A: Continuous Duty Zone
B: Intermittent Duty Zone

2.5 Servopack Ratings and Specifications

The ratings and specifications for the SGD Servopack are shown below. Refer to them as required when selecting a Servopack. Refer to the specifications listed in the table for combination with the appropriate type of Servomotor.

Table 2.5 Servopack and Applicable Servomotors

Voltage			200 VAC						100 VAC				
SGD Servopack			A3AH	A5AH	01AH	02AH	04AH	08AH	A3BH	A5BH	01BH	02BH	03BH
Max. Applicable Motor Capacity W (HP)			30 (0.04)	50 (0 07)	100 (0.13)	200 (0 27)	400 (0 53)	750 (1.01)	30 (0:04)	50 (0.07)	100 (0.13)	200 (0.27)	300 (0.40)
Combined Specifications	Motor	Type: SGM-	A3A□	A5A□	01A□	02A□	04A□	08A□	A3B□	A5B□	01B□	02B□	03B□
		Motor Capacity W (HP)	30 (0.04)	50 (0.07)	100 (0 13)	200 (0.27)	400 (0 53)	750 (1.01)	30 (0.04)	50 (0.07)	100 (0.13)	200 (0 27)	300 (0.40)
		Rated/ Max. Motor Speed	3000/4500 r/min						3000/4500 r/min				
		Applicable encoder	Incremental encoder 2048 P/R or 2000 P/R, absolute encoder 1024 P/R										
		Allowable Load Inertia*1 $J_L \times 10^{-4}$ kg m^2 (oz·in s^2 × 10^{-3})	0 63 (8.80)	0.78 (11.0)	1 20 (17.0)	3.69 (52.2)	3.82 (54 1)	13.4 (189)	0.63 (8 80)	0.78 (11.0)	1.20 (17.0)	3.69 (52.2)	3.82 (54.1)
	Continuous Output Current		0.42	0.6	0.87	2.0	2 6	4.4	0.63	0 90	2.2	2.7	3.7
	Max. Output Current		1.3	1 9	2.8	6.0	8 0	13.9	2.0	2.9	7.1	8.4	14.8
Basic Specifications	Power Supply		Single-phase 200 to 230 VAC, +10% to −15%, 50/60 Hz*2						Single-phase 100 to 115 VAC*2, +10% to −15%, 50/60 Hz				
	Control Method		Single-phase, full-wave rectification IGBT-PWM (sine-wave driven)										
	Feedback		Incremental encoder 2048 P/R or 2000 P/R, absolute encoder 1024 P/R										
	Location	Ambient Temp.	0 to 55°C*3										
		Storage Temp.	−20 to +85°C										
		Ambient/ Storage Humidity	90% or less (with no condensation)										
		Vibration/ Shock Resistance	4.9/19.6 m/s^2 (0 5/2G)										
	Structure		Book (Base-mounted)										
	Approx. Mass kg (lb)		0.9 (1.98)				1.2 (2 65)	1.5 (3.31)	0 9 (1.98)			1.2 (2.65)	1.5 (3.31)
Performance	Bias Setting		0 to 450 r/min. (Setting resolution: 1 r/min.)										
	Feed Forward Compensation		0 to 100% (Setting resolution: 1%)										
	Position Complete Width Setting		0 to 100 reference units Reference unit: Minimum unit of position data which moves the load										

Voltage		200 VAC	100 VAC
I/O Signals	Serial Communications	Function: Position reference input, user constant setting input, confirmation output, output for all monitors Type of Communications: RS-422, asynchronous, 9600 baud communications speed, multi-drop for a maximum of 16 axes enabled	
	Sequence Input	Servo ON, P drive (or external speed setting selection), forward run stop (P-OT), reverse run stop (N-OT), origin return deceleration LS (alarm reset when using an absolute encoder), current limit + selection (or JOG forward instruction), current limit – selection (or JOG reverse instruction)	
	Sequence Output	During current limit detection, positioning complete, brake interlock, servo alarm, 3-bit alarm codes	
Dynamic Brake		Operated automatically with main power OFF or a servo alarm	
External Regenerative Resistor Unit		Required when exceeding the allowable load inertia*1	
Overtravel		Dynamic brake stop at P-OT, N-OT or deceleration stop	
Protective Functions		Overcurrent, overload, overvoltage, overspeed, overrun prevention, origin error, CPU error, encoder error, overflow	
Indicators		Alarm and power indicators (LEDs)	
		Digital Operator standard with options	
Others		Brake interlock signal output, JOG run, electronic gear	

Note 1. Allowable load inertia ranges require no optional External Regenerative Resistor Unit. Values are 30 times the moment of inertia for 30-W to 200-W Servomotors, and 20 times for 300-W, 400-W and 750-W Servomotors.

2. Supply voltage should not exceed 230 V + 10% (253 V) or 115 V + 10% (127 V). A step-down transformer is required if the voltage should exceed these values.

3. Use within the specified ambient temperature range. When enclosed in a box, the internal temperature must not exceed the ambient temperature range.

2.6 Standard Servodrives

The rated current for the external terminal of the SGD Servopack, applicable power supply size, and peripheral equipment are listed in the following table.

Table 2.6 SGM Servomotor, SGD Servopack, and Peripheral Device Combinations

Type	Servopack Model SGD-		Applicable Servomotor Model	Power Supply Capacity per Servopack*1 (kVA)	MCCB or Fuse Power Supply Capacity*2 (A)	Applicable Noise Filter (Reference Diagram)	Recommended Noise Filter*3		Power ON/OFF Contactor
							Model	Spec.	
200 VAC	30 W	SGD-A3AH	SGM-A3A□	0.25	5	(Applicable)	LF-205A	Single-phase 200 VAC-class, 5 A	Yaskawa HI-15E5 (30 A), or the equivalent
	50 W	SGD-A5AH	SGM-A5A□	0.3					
	100 W	SGD-01AH	SGM-01A□	0.5					
	200 W	SGD-02AH	SGM-02A□	0.75					
	400 W	SGD-04AH	SGM-04A□	1.2	9		LF-210	Single-phase 200 VAC-class, 10 A	
	750 W	SGD-08AH	SGM-08A□	2.2	16	(Not applicable)	LF-220	Single-phase 200 VAC-class, 20 A	
100 VAC	30 W	SGD-A3BH	SGM-A3B□	0.25	5		LF-205A	Single-phase 200 VAC-class, 5 A	
	50 W	SGD-A5BH	SGM-A5B□	0.3					
	100 W	SGD-01BH	SGM-01B□	0.5					
	200 W	SGD-02BH	SGM-02B□	0.75	8		LF-210	Single-phase 200 VAC-class, 10 A	
	300 W	SGD-03BH	SGM-03B□	1.4	15		LF-220	Single-phase 200 VAC-class, 20 A	

Note 1. Values for the rated load

2. Shut off characteristics (at 25°C): 200%: 2 s min., 700%: 0.01 s min.

3. A Tokin Corp. noise filter available from Yaskawa Control Co., Ltd. is recommended.

3

Servodrive Characteristics

This chapter provides characteristics of Servopacks and Servomotors.

3.1 Overload Characteristics

The Servopack has a built-in overload protective function to protect the Servopack and Servomotor from overload. Allowable power for the Servopack is therefore limited by the overload protective function as shown below.

The overload detection level quoted under hot start conditions at a motor ambient temperature of 40°C cannot be modified.

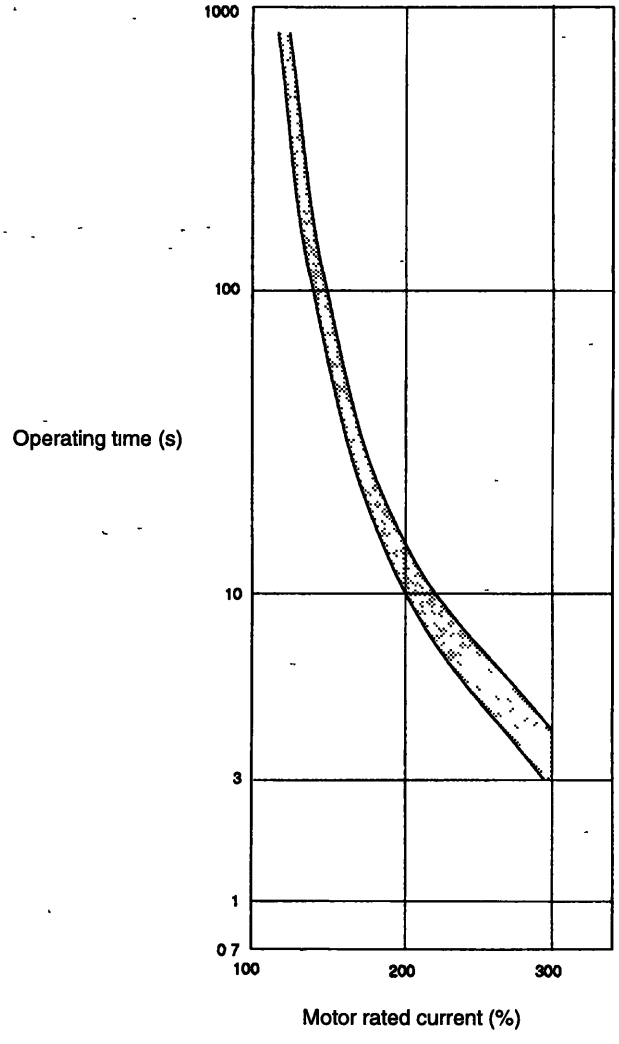


Figure 3.1 Overload Characteristics

3.2 Starting and Stopping Time

The motor starting (tr) and stopping time (tf) with a constant load are calculated using the following equations. Motor viscous torque and friction torque have been ignored.

$$\text{Starting time: } tr = 104.7 \times \frac{N_R(J_M + J_L)}{Kt \cdot I_R(\alpha-\beta)}[ms]$$

$$\text{Stopping time: } tf = 104.7 \times \frac{N_R(J_M + J_L)}{Kt \cdot I_R(\alpha + \beta)}[ms]$$

N_R: Rated motor speed (r/min)

J_M: Motor moment of inertia (kg•m^2...($GD^2_M/4$)

J_L: Load converted to shaft moment of inertia (kg•m^2)...($GD^2_L/4$)

K_t: Motor torque constant (N•m/A)

I_R: Rated motor current (A)

$\alpha = I_P/I_R$: Acceleration/deceleration current coefficient

[Where I_P is accel/decel current (accel/decel current is α times the rated motor current) (A)]

$\beta = I_L/I_R$: Load current coefficient

[Where I_L is the load torque equivalent current (load current is β times the rated motor current) (A)]

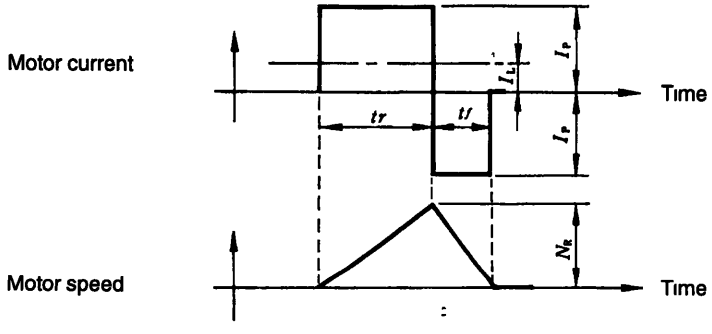


Figure 3.2 Motor Current – Motor Speed Timing Chart

3.3 Allowable Repeatability

Running and stopping repeatability are limited by the Servomotor.

3.3.1 Allowable Repeatability as Limited by the Servomotor

Running and stopping repeatability vary with motor conditions, such as the load conditions and running time. A typical example is given below (See *3.2 Starting and Stopping Time* details on symbols.).

■ With Motor Idling or Stopped

The most common example is the operating cycle shown in Fig. 3.3 where rms frequency for motor armature current is lower than the rated motor current. If we assume that T is the operating cycle, then the range for T will satisfy the following equation.

$$T \geq \frac{I^2_P(tr + tf) + I^2_L ts}{I^2_R}[s]$$

Find I_P, tr, and tf that satisfy the equation above when cycle time (T) is already known.

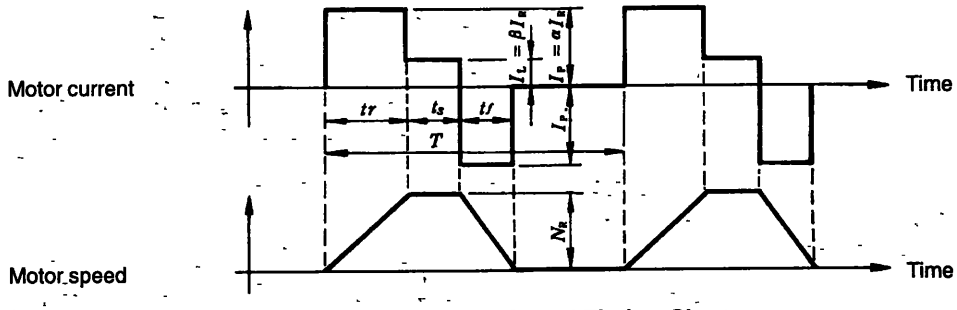


Figure 3.3 Motor Current – Motor Speed Timing Chart

■ With Motor Stopped without Idling Except during Acceleration or Deceleration

The timing chart for motor armature current and motor speed is shown in Fig. 3.4. If we assume that allowable repeatability is N (times per minute), then N can be found using the equation given below.

$$N = 286.5 \times \frac{Kt \cdot I_R}{N_R(J_M + J_L)}(1/\alpha - \beta^2/\alpha^3) \text{ [times per minute]}$$

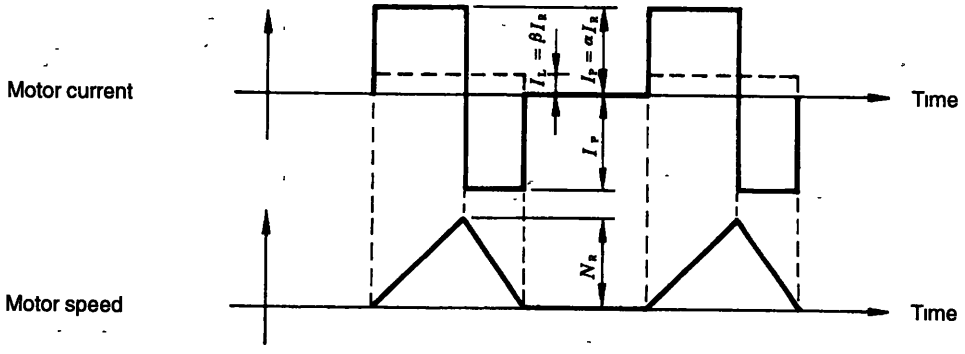


Figure 3.4 Motor Current – Motor Speed Timing Chart

■ With Motor Constantly Cycling through Acceleration, Idling, and Deceleration without Stopping

The timing chart for motor armature current and motor speed is shown in Fig. 3.5. If we assume that allowable repeatability is N (times per minute), then N can be found using the equation given below.

$$N = 286.5 \times \frac{Kt \cdot I_R}{N_R(J_M + J_L)}(1/\alpha - \beta^2/\alpha) \text{ [times per minute]}$$

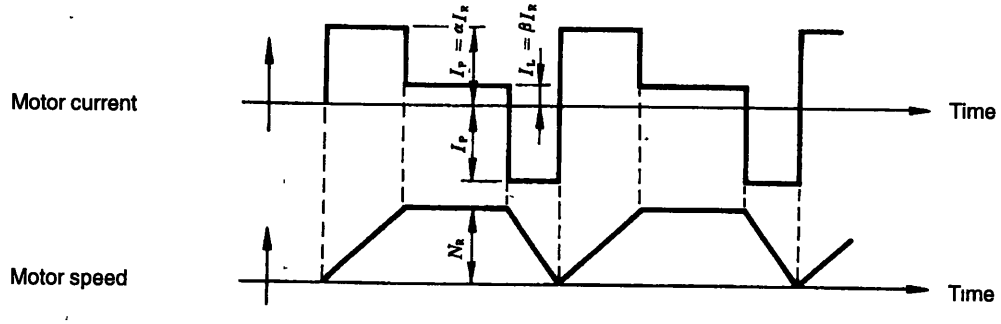


Figure 3.5 Motor Current – Motor Speed Timing Chart

3.4 Large-amplitude Frequency Characteristics

When looking at frequency characteristics with a Servopack and Motor combination, the motor speed amplitude is limited by the peak current through the Servopack. The relationship between motor speed (N) and frequency (f) is expressed using the equation given below.

$$N = 1.52 \times \frac{\alpha \cdot K_t \cdot I_R}{(J_M + J_L)f}[r/min]$$

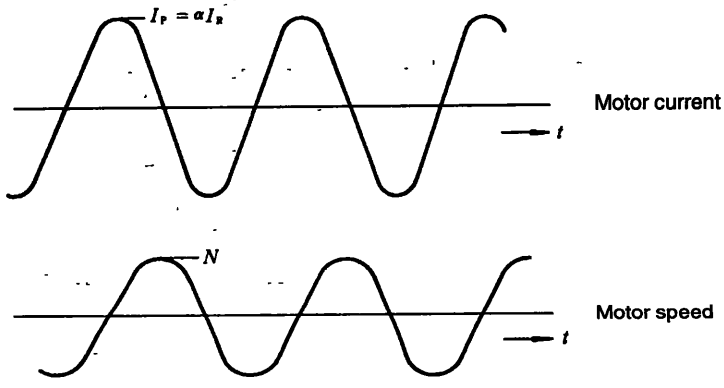


Figure 3.6 Motor Current – Motor Speed Timing Chart

3.5 Mechanical Characteristics

3.5.1 Mechanical Strength

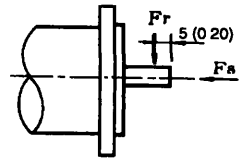
A Servomotor can withstand instantaneous peak torque on the output shaft of up to 300% of the motor rating.

3.5.2 Allowable Radial Loads and Allowable Thrust Loads

The output shaft allowable loads for SGM and SGMP Servomotors are shown below.

Use mechanical designs where thrust and radial loads do not exceed the values below during motor operation.

Table 3.1 Allowable Radial Loads and Allowable Thrust Loads for SGM and SGMP Servomotors

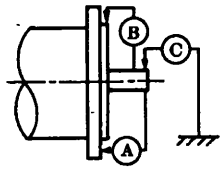
Servomotor Type	Allowable Radial Load Fr [N (kgf)]		Allowable Thrust Load Fs [N (kgf)]		Reference Diagram
	With Incremental Encoder	With Absolute Encoder	With Incremental Encoder	With Absolute Encoder	
SGM-A3	68 (7)	49 (5)	54 (5.5)	19 (2)	
SGM-A5	68 (7)	68 (7)	54 (5.5)	19 (2)	
SGM-01	78 (8)	68 (7)	54 (5.5)	19 (2)	
SGM-02	245 (25)	196 (20)	74 (7.5)	49 (5)	
SGM-03	245 (25)	196 (20)	74 (7.5)	68 (7)	
SGM-04	245 (25)	196 (20)	74 (7.5)	68 (7)	
SGM-08	392 (40)	343 (35)	147 (15)	98 (10)	
SGMP-01	78 (8)	78 (8)	49 (5)	49 (5)	
SGMP-02	245 (25)	245 (25)	68 (7)	49 (5)	
SGMP-03	245 (25)	245 (25)	68 (7)	49 (5)	
SGMP-04	245 (25)	245 (25)	68 (7)	49 (5)	
SGMP-08	392 (40)	392 (40)	147 (15)	49 (5)	

Note Radial and thrust load limit values are the sum of the loads generated by the motor torque and external loads applied to the shaft.

3.5.3 Mechanical Tolerances

Tolerances for Servomotor output shaft and installation are shown in Table 3.2.

Table 3.2 Mechanical Tolerances

Tolerance (T.I.R.) (see note)		Reference Diagram
Perpendicularity between the flange face and output shaft (A)	0.04 mm (0.0016 in)	
Mating concentricity of flange O.D. (B)	0.04 mm (0.0016 in)	
Run-out at the end of the shaft (C)	0.02 mm (0.00079 in)	

Note T.I.R. = Total Indicator Reading

3.5.4 Direction of Motor Rotation

Servomotor rotation when a forward run command is input is counterclockwise as viewed from the load end of the shaft.

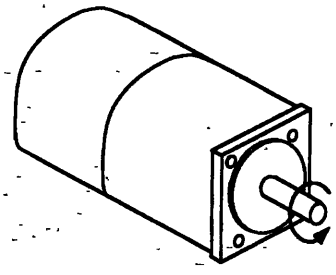
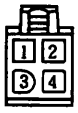


Figure 3.7 Direction of Rotation for Forward Run Command Input

■ Connector Wiring Specifications

Motor Side (Standard)

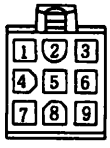


1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG (frame ground)	Green

Motor Side (with Brake)

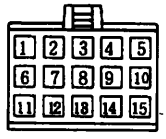
1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG (frame ground)	Green
5	Brake terminal	Black
6	Brake terminal	Black

Encoder Side (Incremental Encoder)



1	Channel A output	Blue
2	Channel $\overline{A}$ output	Blue/Black
3	Channel B output	Yellow
4	Channel $\overline{B}$ output	Yellow/Black
5	Channel C output	Green
6	Channel $\overline{C}$ output	Green/Black
7	0V (power supply)	Gray
8	+5V (power supply)	Red
9	FG (frame ground)	Orange

Encoder Side (Absolute Encoder)



1	Channel A output	Blue
2	Channel $\overline{A}$ output	White/Blue
3	Channel B output	Yellow
4	Channel $\overline{B}$ output	White/Yellow
5	Channel Z output	Green
6	Channel $\overline{Z}$ output	White/Green
7	0V (power supply)	Black
8	+5V (power supply)	Red
9	FG (frame ground)	Green/Yellow
10	Channel S output	Purple
11	Channel $\overline{S}$ output	White/Purple
* (12)	(Capacitor reset)	(Gray)
13	Reset	White/Gray
14	0 V (battery)	White/Orange
15	3 6 V (battery)	Orange

* Do not use terminal 12, it is used only to discharge the capacitor for shipment

3.5.5 Impact Resistance

The Servomotor will withstand two vertical impacts at an impact acceleration of 98 m/s^2 (10 G) (See Fig. 3.8.) when the axis of the Servomotor is mounted horizontally.
Since a precision detector is attached to the shaft at the end opposite the load end, do not subject the shaft to direct impact as this may damage the detector.

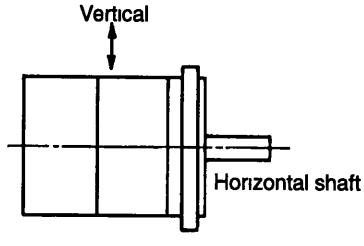


Figure 3.8 Impact Measurement

3.5.6 Vibration Resistance

The Servomotor will withstand a vibration acceleration of 24.5 m/s^2 (2.5 G) in the vertical, transverse, and longitudinal directions (See Fig. 3.9) when the axis of the Servomotor is mounted horizontally.

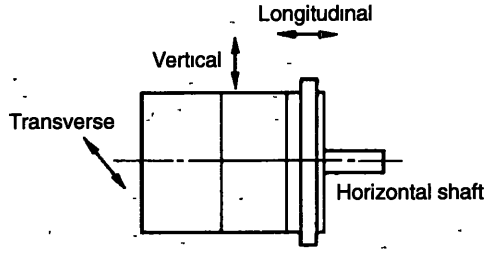


Figure 3.9 Vibration Resistance Measurement

3.5.7 Vibration Class

The vibration class of the Servomotor is 15 μm or below at the rated speed (See Fig. 3.10).

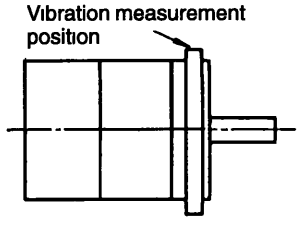


Figure 3.10 Vibration Measurement

4

Configuration and Connections

This chapter describes Servodrive configmations and connections.

4.1 Internal Connection Diagram

The internal connection diagram of the SGD-□H Servopack is given below.

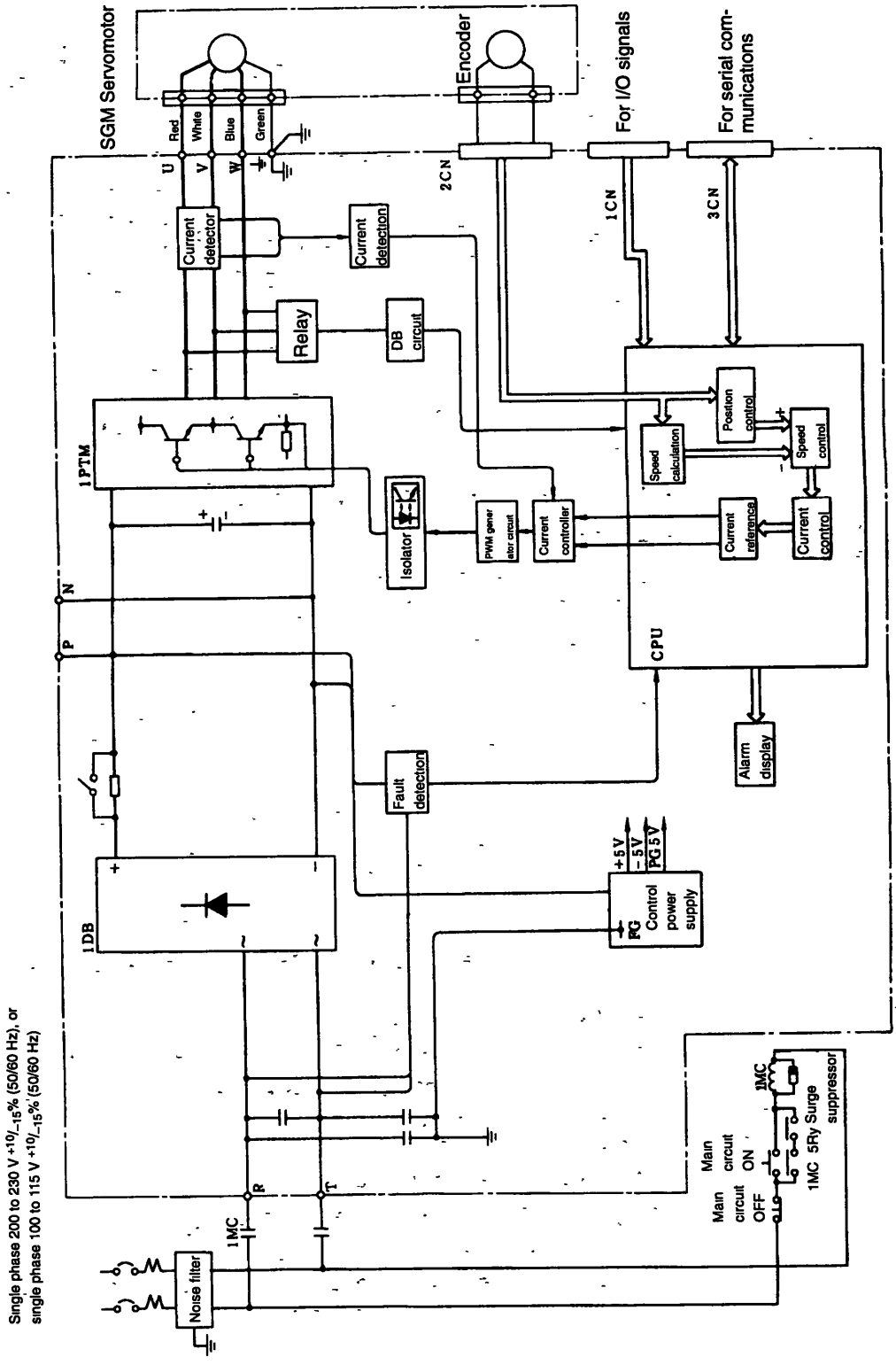


Figure 4.1 Internal Connection Diagram for the Servopack

4.2 Main Circuit Terminals

Table 4.1 Main Circuit Terminals

Terminal Signal	Name	Description
R, T	Power supply input terminal	Single-phase 200 to 230 VAC $^{+10}/_{-15}$%, 50/60 Hz*
U, V, W	Motor terminal	Connect U to the red motor terminal, V to the white motor terminal, and W to the blue motor terminal.
⏚	Ground terminal	Connect to the motor ground terminal (green) for grounding.
P, N	Regenerative Resistor Unit terminal	Connect to a Regenerative Resistor Unit (External connection is usually not needed.)

Note For 100 V power supply: Single phase 100 to 115 VAC $^{+10}/_{-15}$%, 50/60 Hz

4.3 Applicable Receptacles

4.3.1 1CN Connector for I/O Signals

Table 4.2 Specifications for Applicable Servopack I/O Signal Receptacles

Specifications for Servopack Connectors	Applicable Receptacle Model		
	Solder	Case	Manufacturer
10236-52A2JL (Manufactured by SUMITOMO 3M), 36-P right angle	10136-3000VE	10336-52A0-008	SUMITOMO 3M

4.3.2 2CN Connector for Encoder

Table 4.3 Applicable Receptacle and Cable Specifications

Specifications for Servopack Connectors	Applicable Receptacle Model			Cable Specifications (see note)
	Solder	Case	Manufacturer	
10220-52A2JL (Manufactured by SUMITOMO 3M), 20-P right angle	10120-3000VE	10320-52A0-008	SUMITOMO 3M	See *10.4.2 Cable Specifications*.

Note This cable is available from Yaskawa. Refer to *10.4.2 Cable Specifications* for more details on cables.

4.3.3 3CN Connector for Serial Communications

Table 4.4 Applicable Receptacle

Specifications for Servopack Connectors	Applicable Receptacle Model		
	Solder	Case	Manufacturer
17LE-13090-27 (Manufactured by Daiichi Denshi Kogyo Co., Ltd.), 9-pin right angle	17JE-23090-02 (D8B)	Provided with receptacle	Daiichi Denshi Kogyo Co., Ltd.

4.4 Connecting an Incremental Encoder

4.4.1 Typical Example

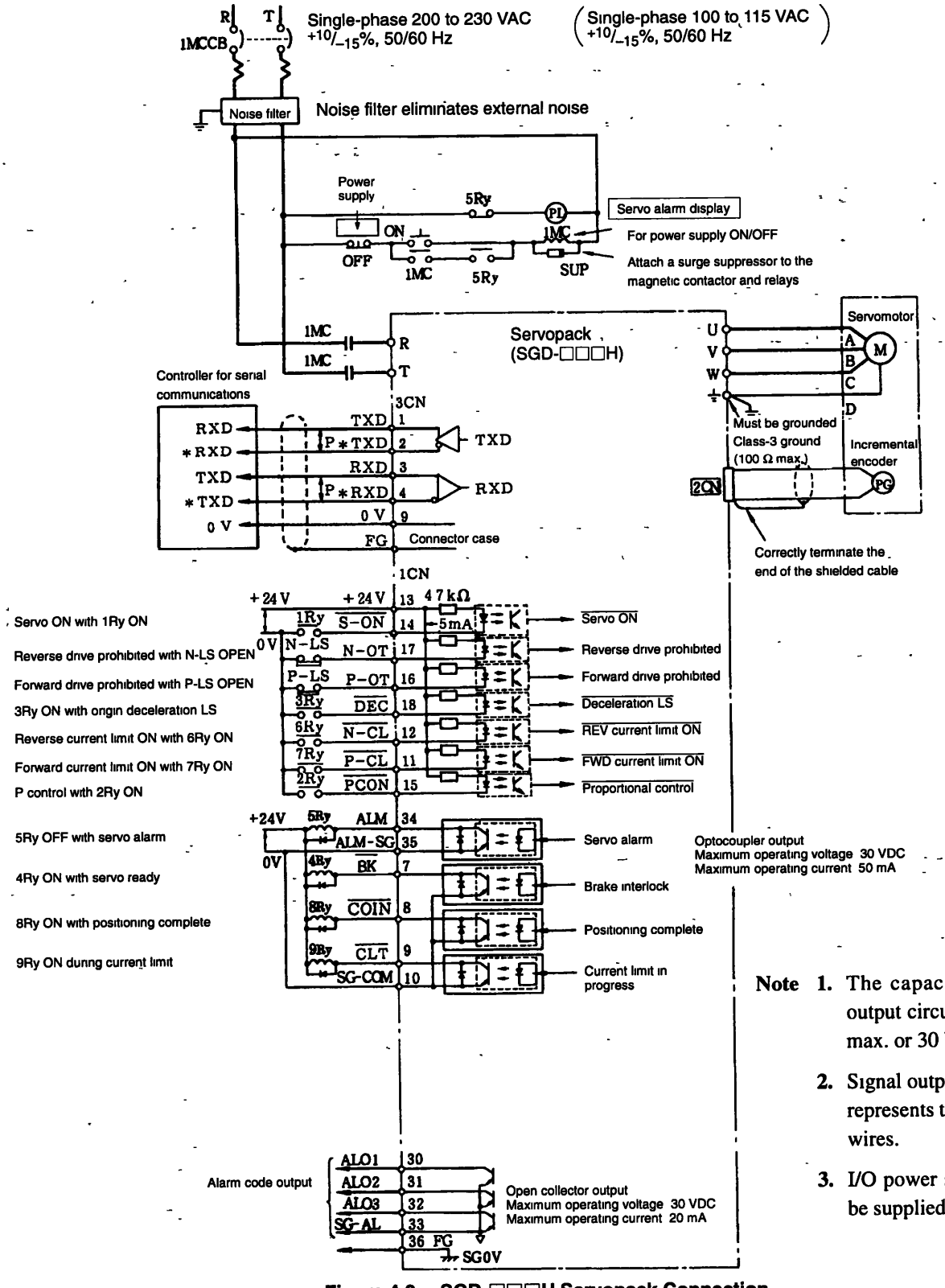


Figure 4.2 SGD-□□□H Servopack Connection

Note
1. The capacity of each output circuit is 50 mA max. or 30 VDC max.
2. Signal output line ⌶P represents twisted-pair wires.
3. I/O power supply must be supplied by the user.

4.4.2 1CN I/O Connector Terminals

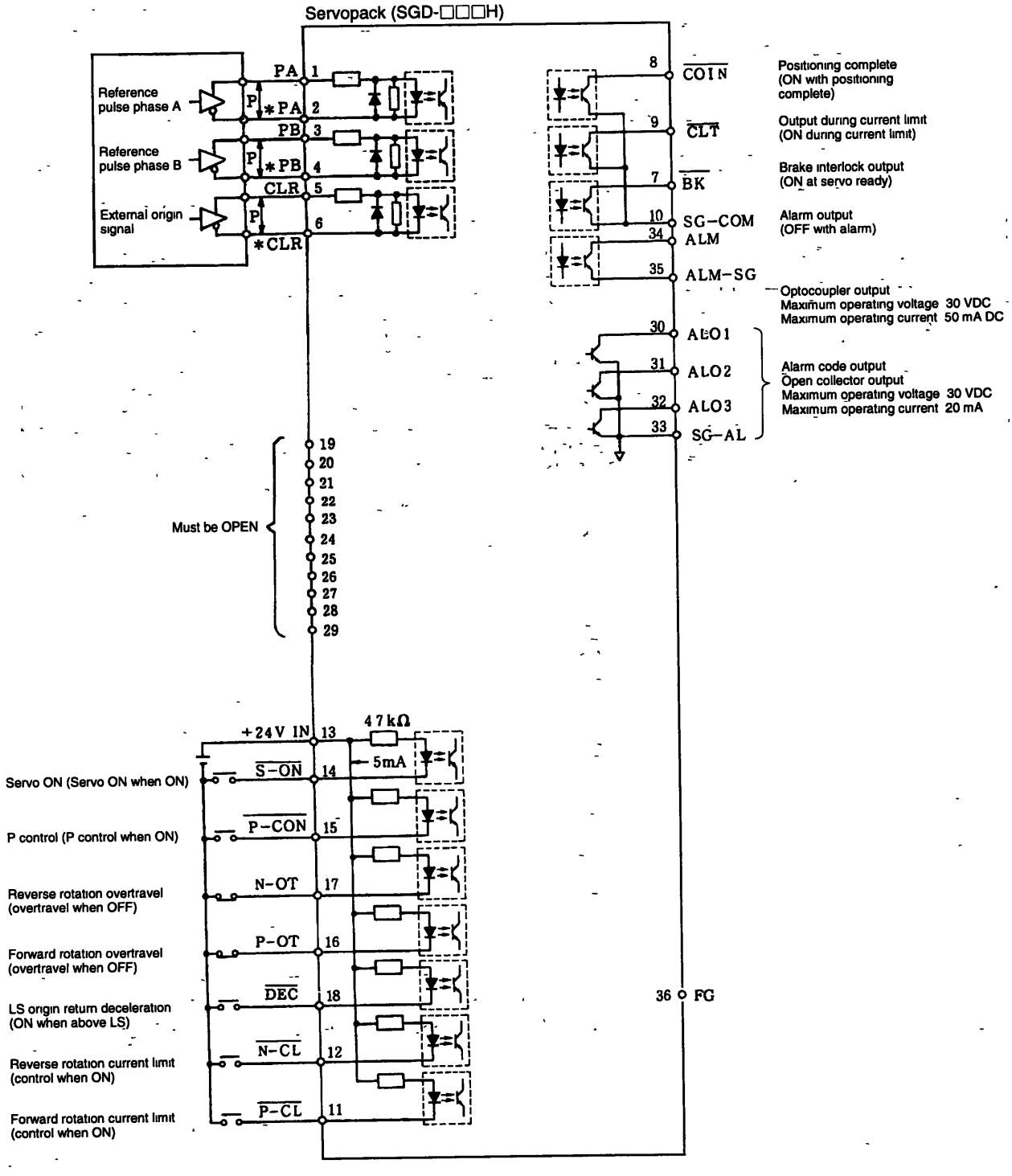
■ Terminal Layout

Table 4.5 1CN Terminal Layout

2	*PA	Reference pulse input	1	PA	Reference pulse input	20	Not used		19	Not used	
4	*PB	Reference pulse input	3	PB	Reference pulse input	22	Not used		21	Not used	
6	*CLR	External origin signal input	5	CLR	External origin signal input	24	Not used		23	Not used	
8	$\overline{\text{COIN}}$	Positioning complete signal output	7	$\overline{\text{BK}}$	Brake interlock signal output	26	Not used		25	Not used	
10	SG-COM	$\overline{\text{BK}}$/$\overline{\text{COIN}}$/CLT common 0 V	9	$\overline{\text{CLT}}$	Current limit detection signal output	28	Not used		27	Not used	
12	$\overline{\text{N-CL}}$	Reverse current limit ON input	11	$\overline{\text{P-CL}}$	Forward current limit ON input	30	ALO1	Alarm code output (open collector output)	29	Not used	
14	$\overline{\text{S-ON}}$	Servo ON input	13	+24 VIN	External power supply input	32	ALO3		31	ALO2	Alarm code output (open collector output)
16	P-OT	Forward drive prohibited input	15	$\overline{\text{P-CON}}$	P control input	34	ALM	Servo alarm output	33	SG-AL	Alarm code output common 0 V
18	$\overline{\text{DEC}}$	Deceleration LS input	17	N-OT	Reverse drive prohibited input	36	FG	Frame ground	35	ALM-SG	Servo alarm output

Note Do not use vacant pins for relay or other purposes. Set PRM36 bit 3 to 1 when using a reference pulse input (see page 7 - 7), and set PRM39 bit 7 to 1 when using an external origin signal input (see page 7 - 9).

■ I/O Signal Connections and External Signal Processing



Note 1. I/O power supply must be supplied by the user.

2. Signal output line $\exists\vdash_P$ represents twisted-pair cable.

3. See *Pulse String Input: PRM36 bit 2* for more details on reference pulses (page 7 - 7), and *Origin Pulse Selection: PRM39 bit 7* for more details on external origin signals (page 7 - 12).

Figure 4.3 1CN I/O Signal Connection and External Signal Processing

■ Input Signals and Their Application

Table 4.6 Input Signals

Signal Name	1CN Pin No.	Description	
S-ON	14	Servo ON	• When input, this signal triggers a standby status for the reference input. • Cancels the base block and dynamic brake. • The Servo ON signal can be canceled with user constant PRM37 bit 0 if not needed
P-CON	15 (Two functions can be set via user constant PRM37 bit 2.)	Proportional control reference	When input, this signal switches the speed loop control mode from PI (proportional-integral) to P (proportional) control.
		External set speed selection	When N-CL and P-CL are used as the JOG run reference, this signal is used as the reference speed selection signal.
N-OT P-OT	17 16	Reverse drive prohibited Forward drive prohibited	• Connect to the appropriate forward or reverse limit switch signal for linear or other types of drive. The signals are CLOSED during normal operation and are OPEN when the limit switch is operated. • These functions can be canceled with user constant PRM37 bit 1. Always N-OT or Always P-OT can also be set.
+24V IN	13	24 V	This signal is the external power supply input for pins 11, 12, 14, 15, 16, 17 and 18 of 1CN. The user must provide the I/O (50 mA min.) power supply.
N-CL P-CL	12 11	Reverse current limit reference (Reverse JOG run reference) Forward current limit reference (Forward JOG run reference)	This signal is the current limit reference or JOG run reference input depending on the setting of user constant PRM37 bit 2. The current limit and set speed values are set with user constant settings.
DEC	18	Origin deceleration LS	• This signal is the deceleration LS input when the motor returns to the origin. The signal is CLOSED on the LS. • Polarity can be reversed (OPEN on LS) with user constant PRM37 bit 4.

■ Input Circuits

The input signals are Servo ON, P control reference, forward/reverse overtravel prohibited, forward/reverse current limit reference, and origin deceleration LS. They comprise the input circuits that use I/O power supply (See Fig. 4.4.). See Fig. 4.2 for an example of connections.

The user must provide I/O power supply: 24 VDC ±1 V, 50 mA min. (about 5 mA per circuit).

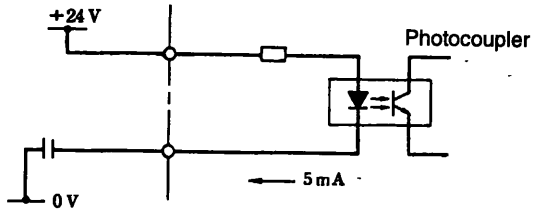


Figure 4.4 Input Circuit Configuration

$\overline{\text{P-CON}}$

The $\overline{\text{P-CON}}$ signal is used as one of the following two signals depending on the setting of user constant PRM37 bit 2.

- P Control (PRM37 bit 2 = 0)
  This signal switches the speed loop control mode between PI (proportional-integral) and P (proportional) control.
- External Set Speed Selection (PRM37 bit 2 = 1)
  This signal is used to input the speed set selection in user constants PRM26 and 27.

P-OT and N-OT: Forward and Reverse Drive Prohibited

These inputs are used to stop the forward operation of the motor (counterclockwise when viewed from the drive end of the motor) and reverse operation. When the overtravel prevention input is not used, connect 1CN 16 and 17 to the 0 V of the external 24-V power supply, or disable this function by setting bit 1 of user constant PRM37.

When an overtravel occurs, regardless of the speed reference, the internal circuit will forcibly change the speed reference to zero and immediately stop the motor. The motor will be zero-clamped after it stops.

$\overline{\text{S-ON}}$: Servo ON

Turning ON this signal activates the power drive circuit in the Servopack main circuits. The motor cannot rotate without inputting this signal (Servo OFF status).

If the Servo is turned OFF while the motor is rotating, the motor will be stopped with the dynamic brake. This signal can be automatically input by setting bit 0 of user constant PRM37.

$\overline{\text{P-CL}}$, $\overline{\text{N-CL}}$

These signals are used as one of the following two signals depending on the setting of user constant PRM37 bit 2.

- Forward and Reverse Current Limit References (PRM37 Bit 2 = 0)
  This circuit limits the peak current of the motor armature during forward (counterclockwise viewed from the load coupling side) or reverse rotation. Limits can be set individually for forward and reverse rotation with user constants PRM8 and 9. The continuous output current is set at 100%, and can be set up to the peak output current.
- JOG Run Reference (PRM37 Bit 2 = 1)
  This is the JOG run reference input.

Table 4.7 $\overline{\text{P-CL}}$ and $\overline{\text{N-CL}}$

$\overline{\text{N-CL}}$	Reverse JOG run reference
$\overline{\text{P-CL}}$	Forward JOG run reference

Table 4.8 $\overline{\text{P-CON}}$

$\overline{\text{P-CON}}$	Speed reference
OFF	Speed 1
ON	Speed 2

LS $\overline{\text{DEC}}$: Origin Deceleration

When the motor returns to the origin, it decelerates from the origin return speed (PRM18) to creep speed (PRM19) when this signal changes from H to L. After the signal changes from L to H, the motor moves from the first C-pulse position until it reaches the position set for PRM20 (final travel distance) where it stops.

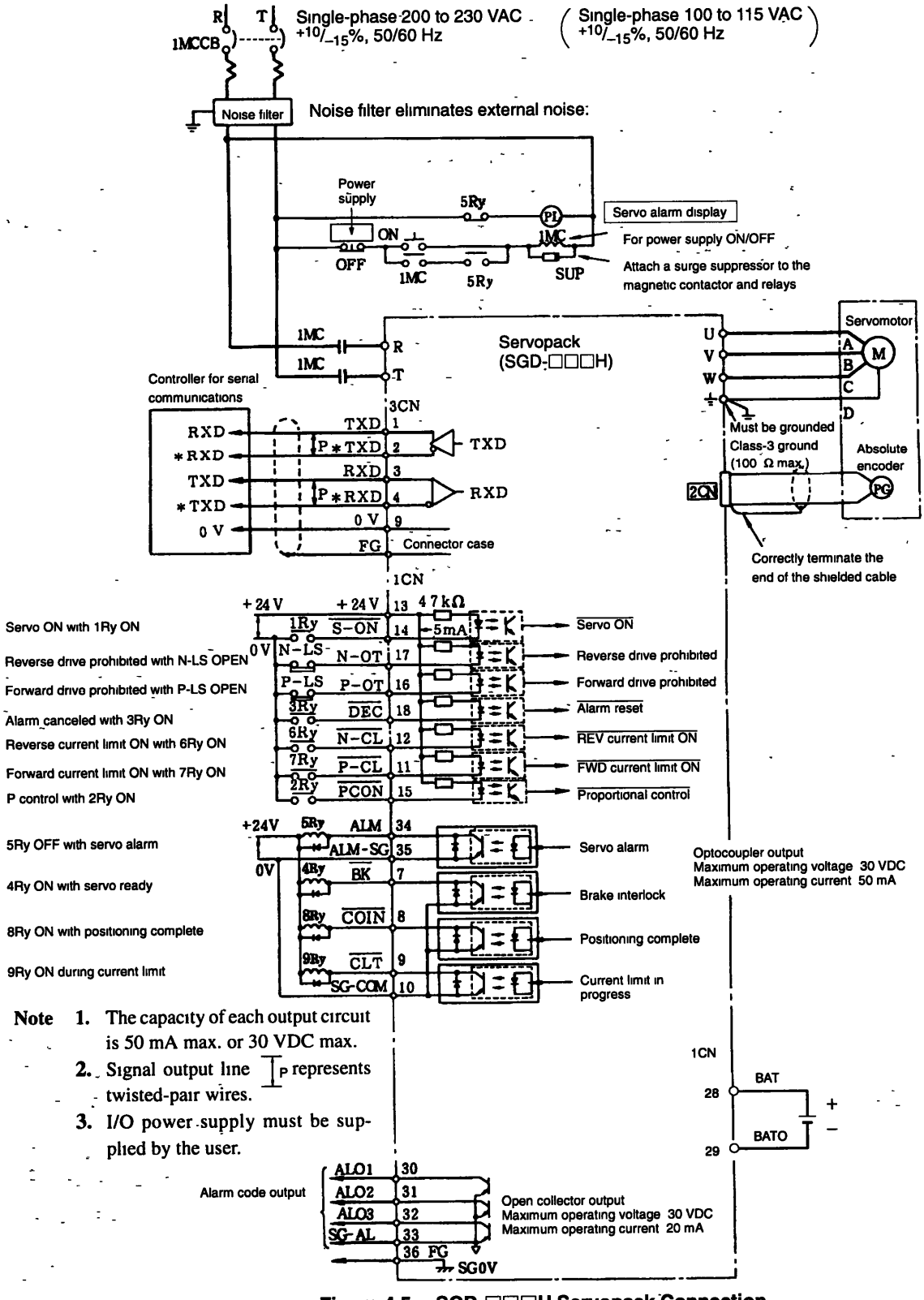
■ Output Signals and Their Application

Table 4.9 Output Signals

Signal Name	1CN pin No.	Description	
ALM	34 (35)	Servo Alarm	Turns OFF when an error is detected. See *5.4.2 Error Detection Function* for further details.
$\overline{\text{CLT}}$	9 (10)	Current Limit Detection	• When $\overline{\text{N-CL}}$ or $\overline{\text{P-CL}}$ is ON, this signal turns ON when the torque reaches the lower level value either limited by Cn-18 and Cn-19 or set in Cn-08 and Cn-09 • Turns ON when the torque set for PRM28 and 29 is applied while $\overline{\text{N-CL}}$ and $\overline{\text{P-CL}}$ are OFF.
$\overline{\text{BK}}$	7 (10)	Brake Interlock Output	Outputs the timing signal for the external brake signal.
$\overline{\text{COIN}}$	8 (10)	Positioning Complete	Output when the pulses remaining in the error counter fall within the positioning complete range set for PRM6
ALO1 ALO2 ALO3	30 (33) 31 (33) 32 (33)	Alarm Code Output	Open collector output Maximum operating voltage. 30 VDC Maximum operating current. 20 mA

4.5 Connecting an Absolute Encoder

4.5.1 Typical Example



Note
1. The capacity of each output circuit is 50 mA max. or 30 VDC max.
2. Signal output line ⌶ represents twisted-pair wires.
3. I/O power supply must be supplied by the user.

Figure 4.5 SGD-□□□H Servopack Connection

4.5.2 1CN I/O Connector Terminals

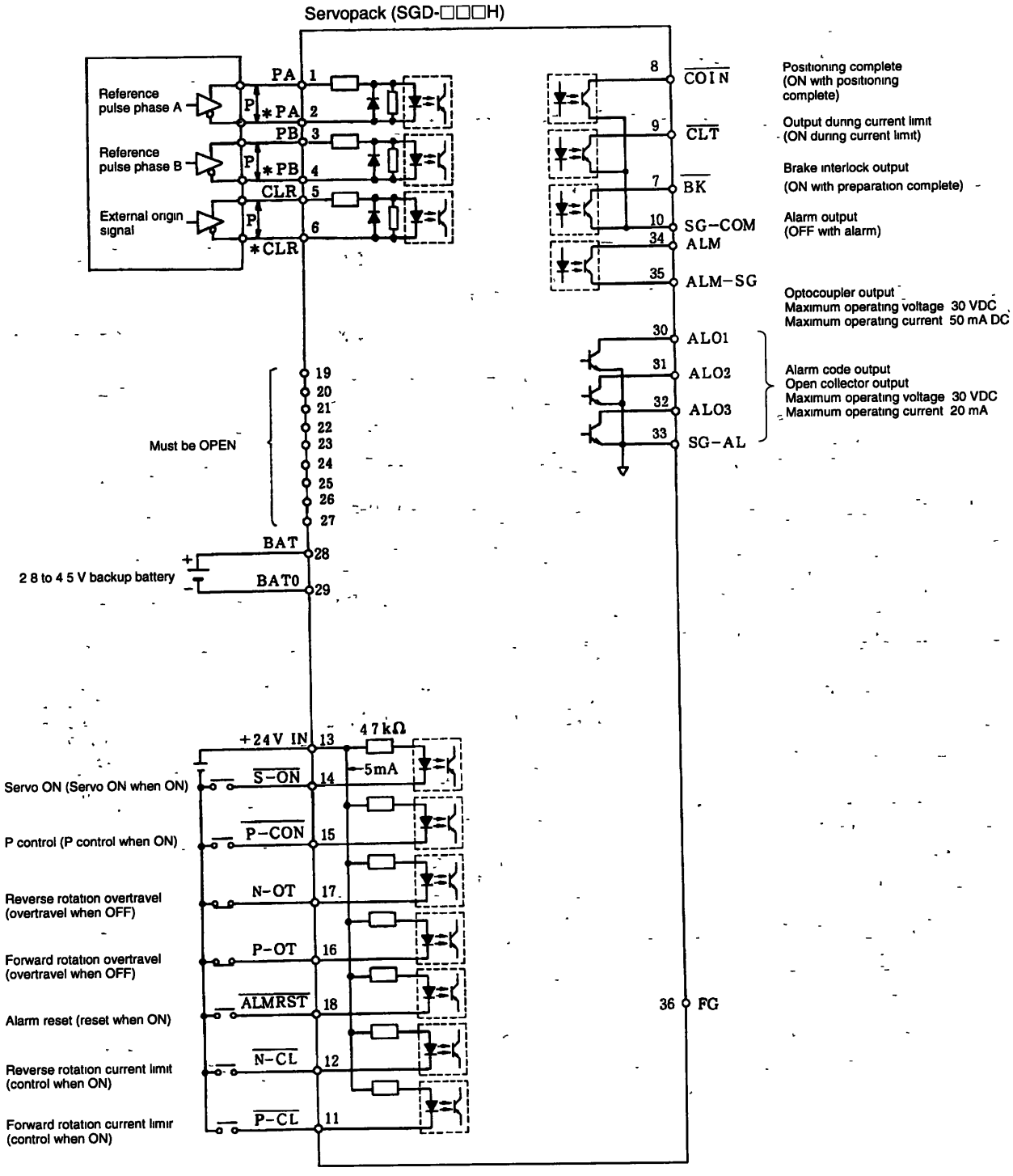
■ Terminal Layout

Table 4.10 1CN Terminal Layout

2	*PA	Reference pulse input	1	PA	Reference pulse input	20	Not used		19	Not used	
4	*PB	Reference pulse input	3	PB	Reference pulse input	22	Not used		21	Not used	
6	*CLR	External origin signal input	5	CLR	External origin signal input	24	Not used		23	Not used	
8	$\overline{\text{COIN}}$	Positioning complete signal output	7	$\overline{\text{BK}}$	Brake interlock signal output	26	Not used		25	Not used	
10	SG-COM	$\overline{\text{BK}}$/$\overline{\text{COIN}}$/CLT common 0 V	9	$\overline{\text{CLT}}$	Current limit detection signal output	28	BAT	Battery (+)	27	Not used	
12	$\overline{\text{N-CL}}$	Reverse current limit ON input	11	$\overline{\text{P-CL}}$	Forward current limit ON input	30	ALO1	Alarm code output (open collector output)	29	BAT0	Battery (–)
14	$\overline{\text{S-ON}}$	Servo ON input	13	+24 VIN	External power supply input	32	ALO3		31	ALO2	Alarm code output (open collector output)
16	P-OT	Forward drive prohibited input	15	$\overline{\text{P-CON}}$	P control input	34	ALM	Servo alarm output	33	SG-AL	Alarm code output common 0 V
18	$\overline{\text{ALMRST}}$	Alarm reset input	17	N-OT	Reverse drive prohibited input	36	FG	Frame ground	35	ALM-SG	Servo alarm output

Note Do not use vacant pins for relay or other purposes. Set PRM36 bit 3 to 1 when using a reference pulse input (see page 7 - 7), and set PRM39 bit 7 to 1 when using an external origin signal input (see page 7 - 9).

■ I/O Signal Connections and External Signal Processing



Note 1. I/O power supply must be supplied by the user.

2. Signal output line I_{P} represents twisted-pair wires.

3. See *Pulse String Input: PRM36 Bit 2* for more details on reference pulses (page 7 - 7), and *Origin Pulse Selection: PRM39 Bit 7* for more details on external origin signals (page 7 - 12).

Figure 4.6 1CN I/O Signal Connection and External Signal Processing

■ Input Signals and Their Application

Table 4.11 Input Signals

Signal Name	1CN Pin No.	Description	
S-ON	14	Servo ON	• When input, this signal triggers standby status for a reference input. • Cancels the base block and dynamic brake. • The Servo ON signal can be canceled with user constant PRM37 bit 0 if not needed
P-CON	15 (Two functions can be set via user constant PRM37 bit 2.)	Proportional control reference	When input, this signal switches the speed loop control mode from PI (proportional-integral) to P (proportional) control
		External set speed selection	When N-CL and P-CL are used as the JOG run reference, this signal is used as the reference speed selection signal.
N-OT P-OT	17 16	Reverse drive prohibited Forward drive prohibited	• Connect to the appropriate forward or reverse limit switch signal for linear or other types of drive. The signals are CLOSED during normal operation and are OPEN when the limit switch is operated. • This function can be canceled with user constant PRM37 bit 1. Always N-OT or Always P-OT can also be set.
+24V IN	13	24 V	This signal is the external power supply input for pins 11, 12, 14, 15, 16, 17 and 18 of 1CN. The user must provide the I/O (50 mA min.) power supply.
N-CL P-CL	12 11	Reverse current limit reference (Reverse JOG run reference) Forward current limit reference (Forward JOG run reference)	• This signal is the current limit reference or JOG run reference input depending on the setting of user constant PRM37 bit 2. • The current limit and set speed values are set with user constants.
ALMRST	18	Alarm reset	This signal resets the servo alarm status.
BAT BAT0	28 29	+ Backup battery input – Backup battery input	This terminal connects to the backup battery used when power to the absolute encoder is OFF. The voltage is 2 8 to 4.5 V (The user must supply the battery.)

■ Input Circuits

The input signals are the same as those for the incremental encoder (See page 4 - 7 *Input Circuits* under *5.4.2 1CN I/O Connector Terminals*) except that the DEC signal is the alarm reset (ALMRST) signal.

■ Output Signals and Their Application

Table 4.12 Output Signals

Signal Name	1CN Pin No.	Description	
ALM+ (ALM–)	34 (35)	Servo Alarm	Turns OFF when an error is detected. See *5.4.2 Error Detection Function* for further details.
$\overline{\text{CLT}}$	9 (10)	Current Limit Detection	• When $\overline{\text{N-CL}}$ or $\overline{\text{P-CL}}$ is ON, this signal turns ON when the torque reaches the lower level value either limited by Cn-18 and Cn-19 or set in Cn-08 and Cn-09. • Turns ON when torque set for PRM28 and 29 is applied while $\overline{\text{N-CL}}$ and $\overline{\text{P-CL}}$ are OFF.
$\overline{\text{BK}}$	7 (10)	Brake Interlock Output	Outputs the timing signal for the external brake signal
$\overline{\text{COIN}}$	8 (10)	Positioning Complete	Output when the pulses remaining in the error counter falls within the positioning complete range set for PRM6.
ALO1 ALO2 ALO3	30 (33) 31 (33) 32 (33)	Alarm Code Output (BCD code)	Open collector output Maximum operating voltage: 30 VDC Maximum operating current: 20 mA

4.6 Output Circuits

The output signals are the current limit detection, brake interlock, servo alarm, and positioning complete signals that comprise the non-contact transistor circuits, as well as the three open collector output alarm codes. The voltage and current specifications for all signals are as follows:

Applied Voltage (V max.) ≤ 30 V
Conduction Current (Ip) ≤ 50 mA (20 mA for ALO1 to 3)

Output circuits require a power supply (open collector output ≤ 20 mA) that must be provided by the user. We recommend the same I/O power supply as that used for the input circuits (See Fig. 4.7.).

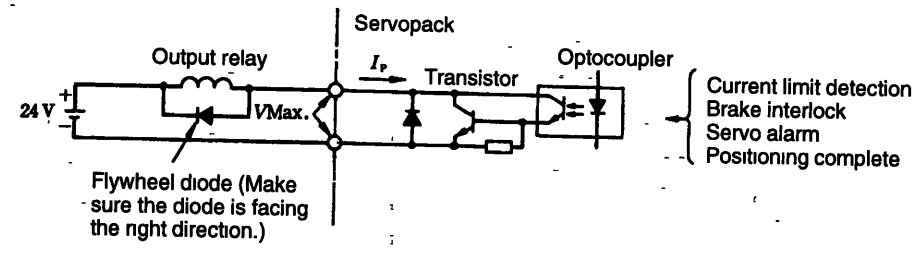
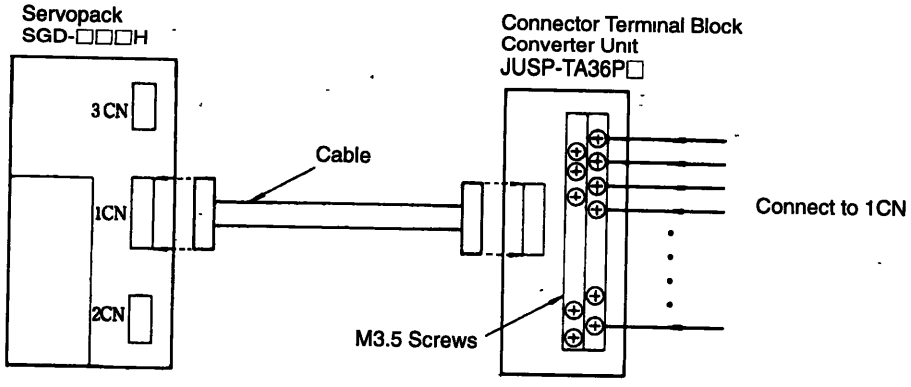


Figure 4.7 Output Circuits

4.7 Connector Terminal Block Converter Unit for 1CN

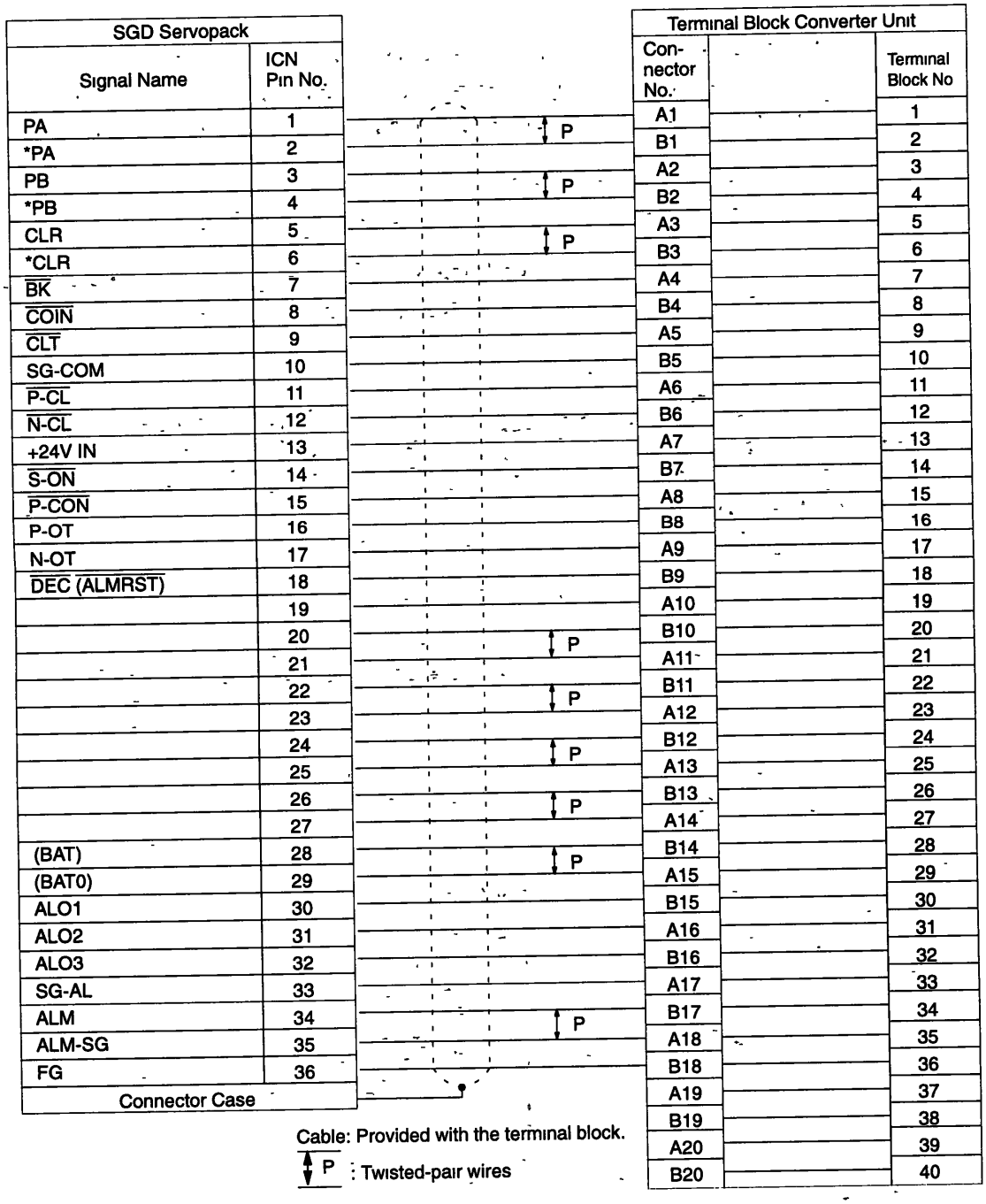
4

4.7.1 Application



Note There is no connector Terminal Block Converter Unit for the 2CN. Separate encoder cables are provided for the 2CN connector. Obtain a cable of suitable length (See *10.4.2 Cable Specifications*.)

4.7.2 Connection Specifications



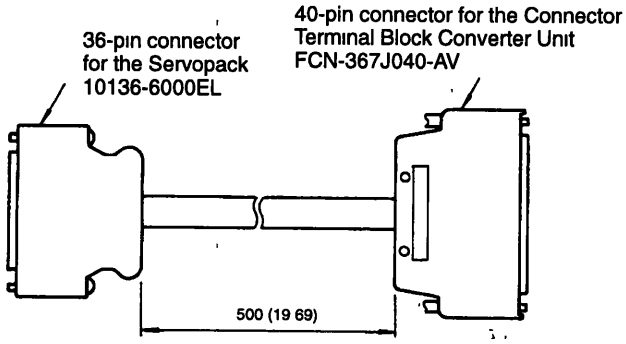
SGD Servopack			Terminal Block Converter Unit		
Signal Name	ICN Pin No.		Connector No.		Terminal Block No
PA	1	P	A1		1
*PA	2		B1		2
PB	3	P	A2		3
*PB	4		B2		4
CLR	5	P	A3		5
*CLR	6		B3		6
$\overline{BK}$	7		A4		7
$\overline{COIN}$	8		B4		8
$\overline{CLT}$	9		A5		9
SG-COM	10		B5		10
$\overline{P\text{-}CL}$	11		A6		11
$\overline{N\text{-}CL}$	12		B6		12
+24V IN	13		A7		13
$\overline{S\text{-}ON}$	14		B7		14
$\overline{P\text{-}CON}$	15		A8		15
P-OT	16		B8		16
N-OT	17		A9		17
$\overline{DEC}$ ($\overline{ALMRST}$)	18		B9		18
	19		A10		19
	20	P	B10		20
	21		A11		21
	22	P	B11		22
	23		A12		23
	24	P	B12		24
	25		A13		25
	26	P	B13		26
	27		A14		27
(BAT)	28	P	B14		28
(BAT0)	29		A15		29
ALO1	30		B15		30
ALO2	31		A16		31
ALO3	32		B16		32
SG-AL	33		A17		33
ALM	34		B17		34
ALM-SG	35	P	A18		35
FG	36		B18		36
Connector Case			A19		37
			B19		38
			A20		39
			B20		40

Cable: Provided with the terminal block.

P : Twisted-pair wires

Note Do not use vacant pins.

4.7.3 Cable Specifications (Accessory for Connector Terminal Block Converter Unit)



4.8 2CN Encoder Connector Terminals

4.8.1 2CN Terminal Layout

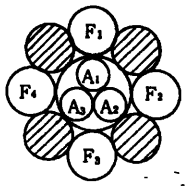
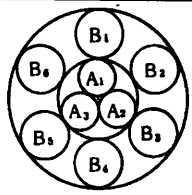
Table 4.13 2CN Terminal Layout

2	PG0V	PG power supply 0 V	1	PG0V	PG power supply 0 V	12	BAT+	Battery (+) (for absolute encoder only)	11		
			3	PG0V					13	BAT–	Battery (–) (for absolute encoder only)
4	PG5V	PG power supply +5 V	5	PG5V	PG power supply +5 V	14	PC	PG input phase C	15	*PC	PG input phase C
6	PG5V		7			16	PA	PG input phase A	17	*PA	PG input phase A
8	PS	PG input phase S (for absolute encoder only)	9	*PS	PG input phase S (for absolute encoder only)	18	PB	PG input phase B	19	*PB	PG input phase B
10						20	FG	Frame ground			

4.8.2 Applicable Cables

Yaskawa provides cables with the following specifications. Cables are not provided with the Servopack or motor. Order cables in the standard specifications (lengths) as required.

Table 4.14 Applicable Cables

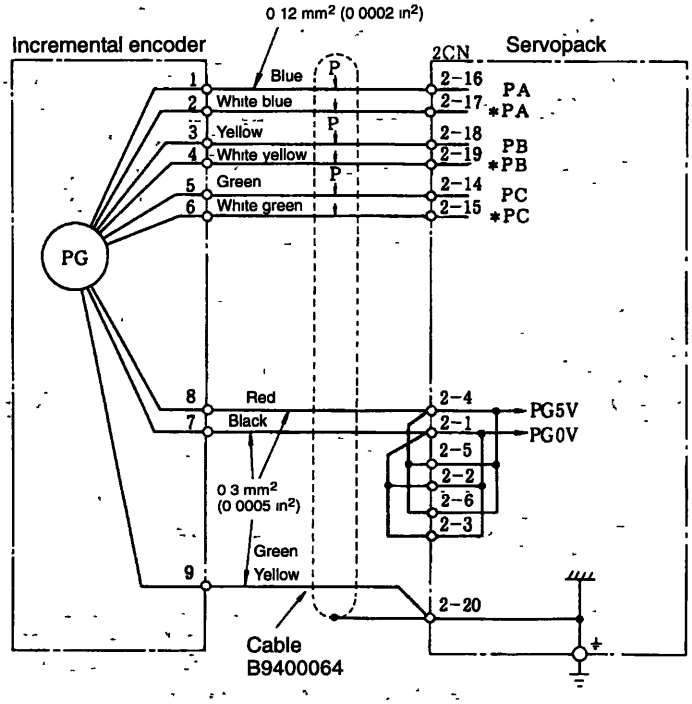
	Incremental Encoder (Yaskawa Dwg. #B9400064)	Absolute Encoder (Yaskawa Dwg. #DP8409123)
Basic Specifications	Compound KQVV-SW AWG22 x 3C, AWG26 x 4P	Compound KQVV-SW AWG22 x 3C, AWG26 x 6P
Finished Dimension	ϕ7.5 mm (ϕ0.30 in)	ϕ8.0 mm (ϕ0.31 in)
Internal Structure and Lead Colors (DP8409123 standard)	 A_1 Red A_2 Black A_3 Green yellow F_1 Blue/White blue Twisted pair F_2 Yellow/White yellow Twisted pair F_3 Green/White green Twisted pair F_4 Orange/White orange Twisted pair	 A_1 Red A_2 Black A_3 Green yellow B_1 Blue/White blue Twisted pair B_2 Yellow/White yellow Twisted pair B_3 Green/White green Twisted pair B_4 Orange/White orange Twisted pair B_5 Purple/White purple Twisted pair B_6 Gray/White gray Twisted pair
Yaskawa Standard Specifications	Standard lengths: 3 m (9.9 ft), 5 m (16.4 ft), 10 m (32.8 ft), 15 m (49.2 ft), 20 m (65.6 ft) (see note 2)	

Note 1. The maximum allowable wiring distance for applicable cables between the Servopack and the Servomotor (PG) is 20 m (65.6 ft).

2. See *10.4.2 Cable Specifications* for details on cables.

4.8.3 2CN Connection Method

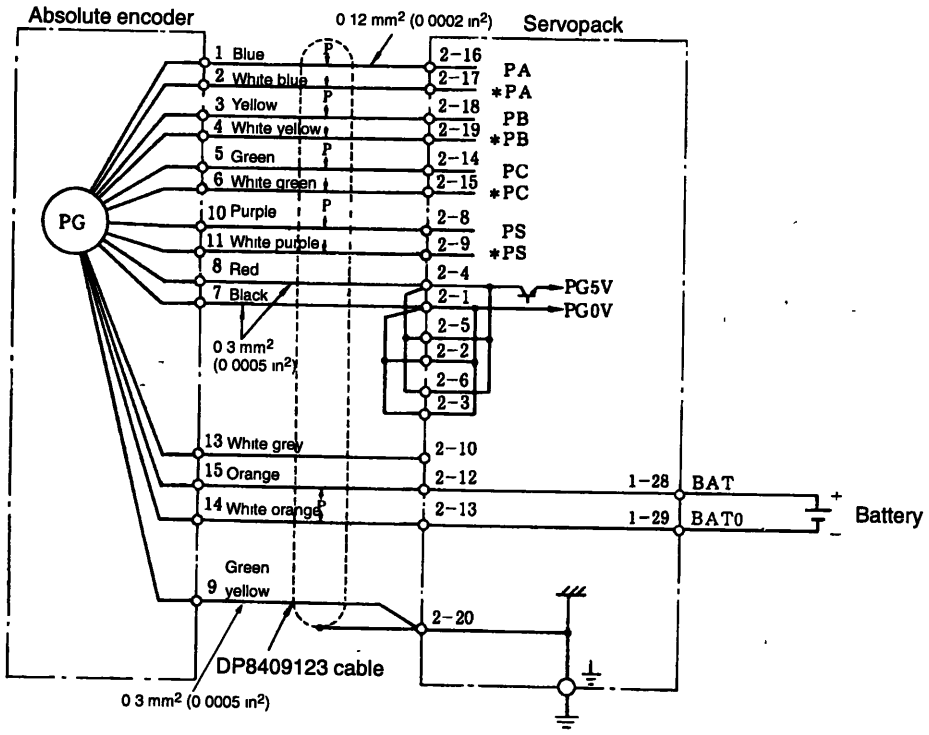
■ Incremental Encoder



Note P represents twisted-pair wires.

Figure 4.8 Using a B9400064 Cable for an Incremental Encoder

■ Absolute Encoder



Note P represents twisted-pair wires.

Figure 4.9 Using a DP8409123 Cable for an Absolute Encoder

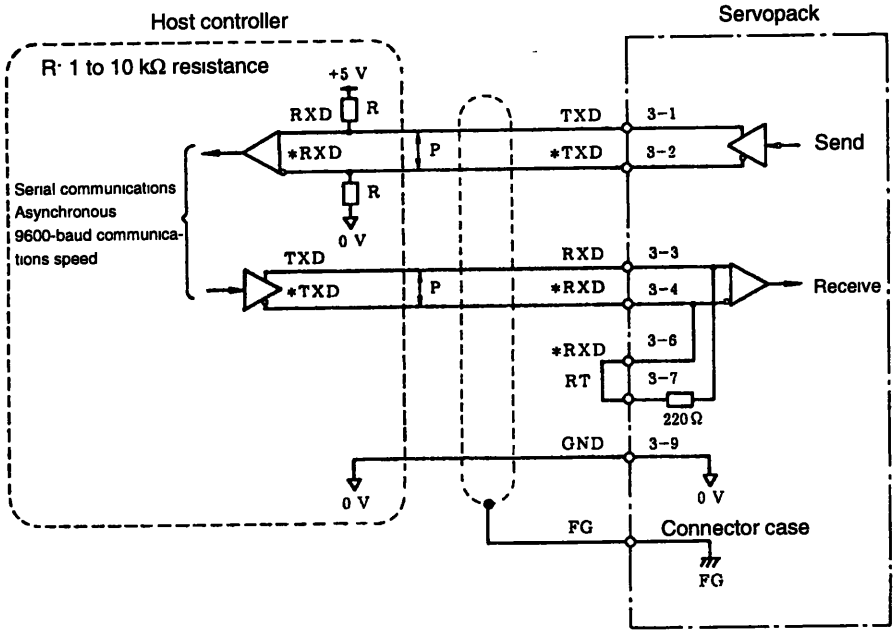
4.9 3CN Serial Communications Connectors

4.9.1 3CN Terminal Layout

Table 4.15 3CN Terminal Layout

1	TXD	Serial communications: Normal line driver output
2	*TXD	Serial communications. Inverted line driver output
3	RXD	Serial communications: Normal line receiver input
4	*RXD	Serial communications. Inverted line receiver input
5	OPH	Digital Operator signal
6	*RXD	Serial communications: Inverted line receiver input
7	RT	Terminating resistance
8	5VPP	Digital Operator power supply (+5 v)
9	GND	Signal ground 0 V

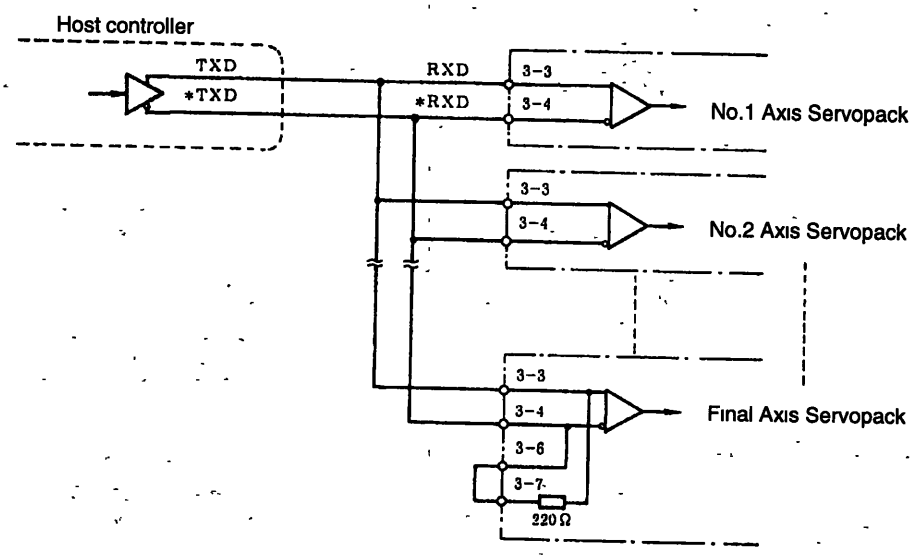
4.9.2 3CN Connection Method and External Signal Processing



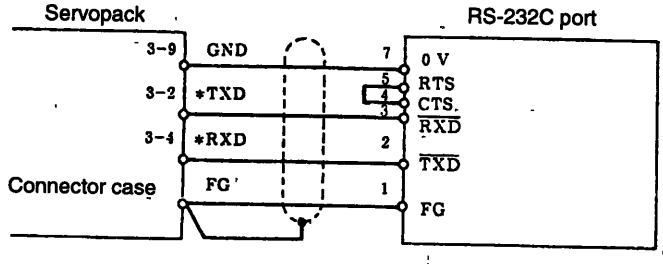
Note ⌶ represents twisted-pair wires.

■ Multiple Axis Connections

Short 3CN pins 6 and 7 to insert a terminating resistor only at the Servopack for the last axis on the line.



■ Using an RS-232C Port, such as One on a Personal Computer

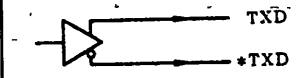
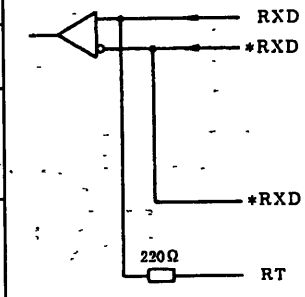
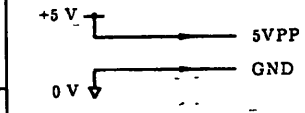


Note 1. This type of connection is only for short distances (2 m (6.56 ft) max.). Use RS-422 specifications for longer distances.

2. These 2-m (6.56-ft) cables are available from Yaskawa. Refer to *10.4.2 Cables* for details on cables and connections.
   For PC98 (25-pin D-sub): DE9405258
   For PC98 (half-pitch connector): DE9408564
   For IBM PC (9-pin D-sub): DE9408565

4.9.3 3CN I/O Signals and Their Application

Table 4.16 3CN Output Signals

Signal Name	Pin No.	Name		Circuit Structure	Description
TXD	1	Data send signal	Normal output	(Line driver) 	This is the data send signal from the Servopack in RS-422 serial communications. The signal line goes to high impedance when data is not being sent.
*TXD	2		Inverted output		
RXD	3	Data receive signal	Normal input	(Line receiver) 	This is the data receive signal from the host controller (personal computer, etc.) in RS-422 serial communications
*RXD	4		Inverted input		
OPH	5	–			This signal is only for the Digital Operator. Do not connect anything else to this pin.
*RXD	6	Terminating resistor			Short pins 6 and 7 to insert a terminating resistor in the serial input circuit of the Servopack. When using multiple axes connections, short only the last axis on the line.
RT	7				
5VPP	8	+5-V output			This +5-V power supply output is only for the Digital Operator. Do not connect anything else to these pins
GND	9	Signal ground 0 V			Signal ground 0 V for TXD (*TXD) and RXD (*RXD)

Note 1. Connect the shield on the serial communications cable to the connector case.

2. Serial data send signal: The signal line goes to high impedance when data is not being sent, so attach pull-up and pull-down resistors to the data receive section of the host controller.

3. The allowable wiring distance is a maximum of 20 m (65.6 ft) with RS-422 cables

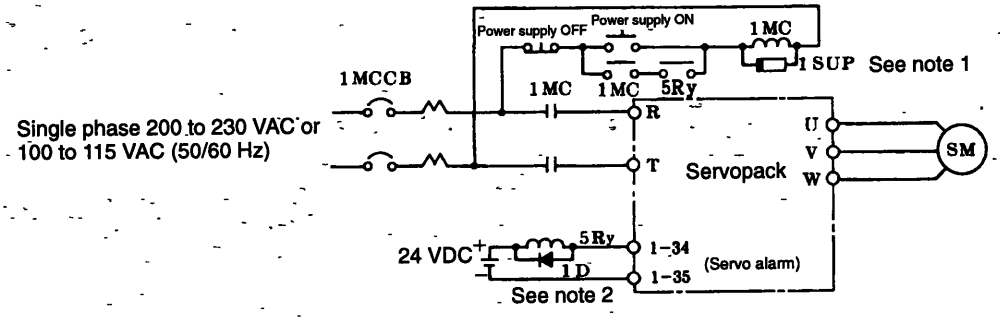
5

Application

This chapter describes how to use Servodrives.

5.1 Turning Power ON/OFF

The figure below shows a typical example of the power ON/OFF sequence.



Note 1. CR50500BA surge suppressor (OKAYA Electric Industries Co , Ltd) or the equivalent
2. Flywheel diode (to prevent spikes in 5Ry)

Figure 5.1 Example of Power ON/OFF Sequence

IMPORTANT

1. Construct a power ON sequence so the power is turned OFF if a servo alarm signal is output. See *5.4.4 Handling Protection Circuit Operation* for more details on handling the alarm signal output.
2. During the power ON/OFF sequence shown in Fig. 5.1, it takes up to two seconds until the normal signal is valid once power is turned ON. The Servopack outputs a servo alarm signal for up to two seconds when power is turned ON in order to give time to initialize the Servopack.
3. The Servopack has a capacitor in the power supply. A high charging current will thus flow for 0.2 seconds when the power is turned ON. Frequently turning the power ON and OFF will cause the main power devices (such as capacitors and fuses) to deteriorate and can result in unexpected problems. Start and stop the Servomotor with Start and Stop commands rather than turning the power supply ON and OFF.
4. A power loss alarm may occur if the Servopack is turned ON immediately after being turned OFF. To prevent this, always wait for the time shown in the table below before turning the power ON again.

Servopack Type SGD-	A3AH A5AH	01AH 02AH 04AH	08AH	200-VAC input
	A3BH	A5BH 01BH 02BH	03BH	100-VAC input
Power Holding Time	6 s	10 s	15 s	Maximum values

5. After turning the power OFF, do not touch the power terminals for at least five minutes because high voltage may remain in the Servopack

5.2 Position Control

5.2.1 Electronic Gear Function

The electronic gear function enables the motor travel distance per input reference pulse to be set to any value. More specifically, the value is set based on the number of encoder pulses, reference unit (minimum unit of position data for moving the load), and machine gear ratio. An input of one pulse moves the load by one reference unit.

■ Setting the Electronic Gear Ratio (B/A)

Determining the Reference Unit

The reference unit is the minimum unit of position data for moving the load, e.g., 0.01 mm, 0.1°, or 0.01 inches.

A 1-pulse input moves the load by 1 reference unit.

Example: Reference Unit = 0.1 μm
If a reference of 50000 pulses is input, the load will move 5 mm
(50000 x 0.1 = 5000 μm = 5 mm).

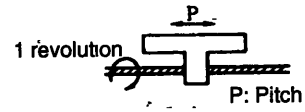
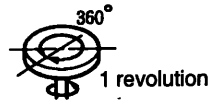
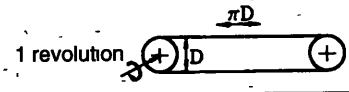
Determine the reference unit based on factors like equipment specifications and positioning precision.

Determining the Load Travel Distance per Load Shaft Revolution in Reference Units

$$\text{Load travel distance per load shaft revolution} = \frac{\text{Load travel distance per load shaft revolution}}{\text{Reference unit}}$$

Table 5.1 shows an example of the load travel distance per load shaft revolution.

Table 5.1 Example of the Load Travel Distance per Load Shaft Revolution

Load Travel Distance per Load Shaft Revolution	Example of the Load Structure	
P	Ball screw	
360°	Disc table	
πD	Belt and pulley	

Example: Load Travel Distance per Load Shaft Revolution= 12 mm (0.47 in), Reference Unit = 0.01 mm (0.0004 in)

Load travel distance per load shaft revolution = 12/0.01 = 1200 (reference units)

Determining the Electronic Gear Ratio (B/A)

B = [(PRM34) x 4] x (motor shaft revolution speed)

A = [Load travel distance per load shaft revolution (reference units)] x (load shaft speed)

Reduce the electronic gear ratio (B/A) to the lowest terms so that both A and B are less than 30000, and then set A and B in PRM33 and PRM32.

Motor Shaft and Load Shaft Revolution Speed

The motor shaft and load shaft speeds form the gear ratio for the mechanical system. If the mechanical system is structured so that load shaft makes "l" revolutions when the motor shaft makes "m" revolutions, the gear ratio for the motor shaft and the load shaft is m/l, as shown below.

Motor shaft speed m (revolutions)

Load shaft speed l (revolutions)

Fig. 5.2 shows a block diagram of the electronic gear function.

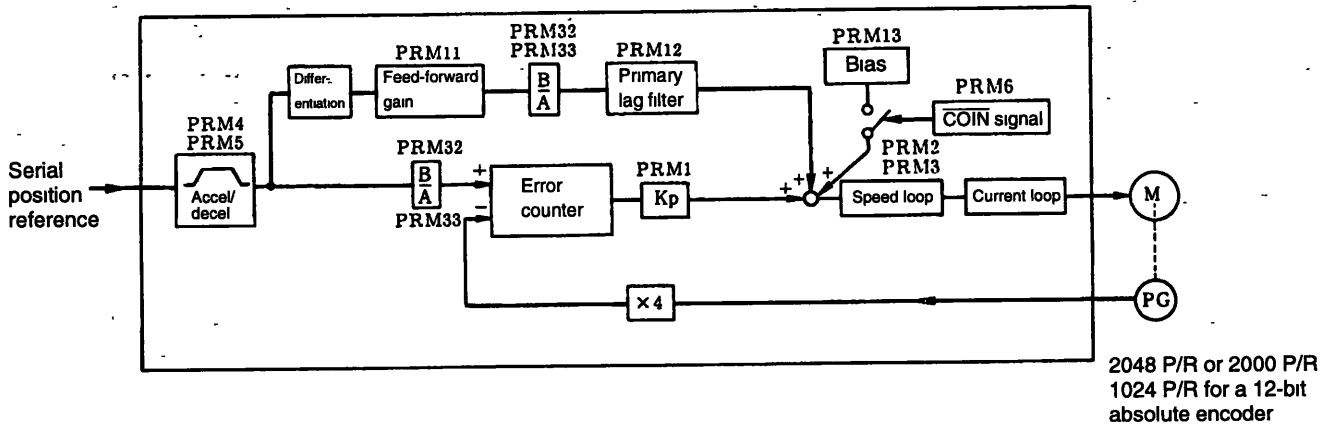


Figure 5.2 Block Diagram of the Electronic Gear Function

5.2.2 Feed-forward Function

The feed-forward control function performs reference pulse differentiation and add it to speed reference in order to shorten positioning time. Set the amount of feed-forward control (0% to 100%) in PRM11, but do not set the level too high, because this may cause overshooting with light loads.

A primary lag filter can be added for the feed-forward reference. If it is added, set the time constant for the primary lag filter in user constant PRM12.

5.3 Setting Up a 12-bit Absolute Encoder

5.3.1 Battery

An absolute encoder requires a battery in order to save position data in the event of a power interruptions.

- We recommend the following battery.
  One lithium battery: ER6VC 3.6 V battery made by Toshiba Battery Co., Ltd.
- Make sure the battery is installed securely so that environmental changes or changes over time will not cause a loss of contact.
- The battery voltage is not monitored inside the Servopack. Provide a battery voltage monitor circuit if necessary. The minimum voltage is 2.8 V.

5.3.2 Setup Procedure

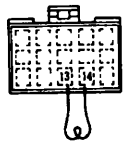
The encoder needs to be set up to clear the cumulative rotation number to zero to set up the motor, or when the absolute encoder has been left disconnected from a battery for more than two days.

Internal circuit elements may not function properly if the capacitor in the encoder is not fully charged. Use the setup procedure described below in the following cases.

- To set the data for the amount of motor rotation to zero when test running the motor.
- When the Servopack is left for more than two days without connecting the absolute encoder to a battery.

Note Failure to follow the procedure exactly as written may result in problems.

1. Turning ON Servopack Power
   - Wire the Servopack, motor, and encoder together correctly.
   - Connect the battery and turn ON the Servopack. Leave the Servopack turned ON for at least three minutes to sufficiently charge the backup capacitor. The encoder will be in alarm status at this time.
2. Resetting Data
   - Turn OFF the Servopack, and disconnect the encoder connector.
   - Short encoder terminals 13 and 14 together for 1 to 2 seconds.



3. Wiring

   Restore the wiring to the normal status.

4. Turning ON Power

   The setup is complete if there are no errors when the Servopack is turned ON. If serial data ALM00.ABS is sent from the Servopack, then repeat the procedure starting from the beginning.

5.4 Protection Functions

The Servopack is equipped with various functions to protect the drive and motor from damage.

5.4.1 Dynamic Brake Function

The Servopack is equipped with a dynamic brake for emergency stops. The brake is operated for any of the following conditions.

- When an alarm occurs (error detection).
- When the servo ON signal is turned OFF (When the servo receives the SVOFF command.)
- When power is turned OFF

5.4.2 Error Detection Function

Table 5.2 shows the error detection function for the Servopack. Alarm details can be checked in two output forms other than serial communications.

Table 5.2 Error Detection Function

Serial Communications Send Data	Output Signals				Error Detection Function	Description
	Alarm Output Code			SVALM Output		
	ALO1	ALO2	ALO3			
ALM00, ABS ALM02, PRM ALM04, PRM	OFF	OFF	OFF	OFF	Parameter error	An absolute or parameter (user constant) error.
ALM10, OC	ON	OFF	OFF	OFF	Overcurrent detection	• Overcurrent flowed through the main circuit • The Servopack heat sink overheated.
ALM31, OF	ON	ON	OFF	OFF	Overflow detection	The number of pulses remaining in the error counter exceeded the range of setting by user constant.
ALM40, OV	OFF	OFF	ON	OFF	Overvoltage detection	The main circuit DC voltage exceeded 420 V.
ALM51, OS	ON	OFF	ON	OFF	Overspeed detection	Motor speed exceeded the maximum speed
ALM71, OL ALM72, OL	ON	ON	ON	OFF	Overload detection	The rated torque for the motor and Servopack was exceeded.
ALMC2, PG ALMC3, PG ALMC4, PG	ON	OFF	ON	OFF	Phase error detection, overrun detection, broken PG signal line	• An overrun was caused by the motor or the PG wiring incorrect. • Noise in encoder wiring.
ALM8□, POS	OFF	OFF	OFF	OFF	Encoder alarm	Absolute encoder alarm.
ALMF3, SRC	OFF	ON	OFF	OFF	Momentary power loss detection	Power was turned back ON within the allotted power retention time after it was turned OFF

ON: Output transistor is ON.
OFF: Output transistor is OFF.

5.4.3 ALM, ALM-SG: Servo Alarm Output

The power drive circuit in the Servopack will turn OFF and the alarm status will be displayed if any error detection function operates. Details of the alarm will be sent via serial communications, the red indicator on the Servopack will light, and the alarm output (ALM, ALM-SG) will go OFF. At the same time, the alarm code will be output externally through the open collector output circuits of ALO1 to ALO3. See *Table 5.2* for details on alarm codes.

5.4.4 Handling Protection Circuit Operation

An alarm signal output indicates some kind of error. Determine the cause, take appropriate action, and then resume operation.

■ Error Troubleshooting

Check the error data for past occurrences through serial communications or using the error traceback mode of the Digital Operator (JUSP-OP02A-1), and implement the remedy listed in *Table 13.6*, page 13 - 5.

5.4.5 Servo Alarm Reset

Use one of the methods given below to reset a servo alarm.

- Enter ARES via serial communications.
- Enter the alarm reset signal (if using an absolute encoder).
- Turn the power OFF and then back ON again.

5.4.6 Indications

The following indications are made on the front panel of the Servopack.

- Power ON: Green LED indicator lights
- Alarm occurred: Red LED indicator lights

5.5 Precautions

5.5.1 Overhanging Loads

Do not allow the motor to be continuously rotated by the load while the regenerative brake is being applied.

Example: Tension Control Drive
Do not use the motor for lowering objects without a counterweight.

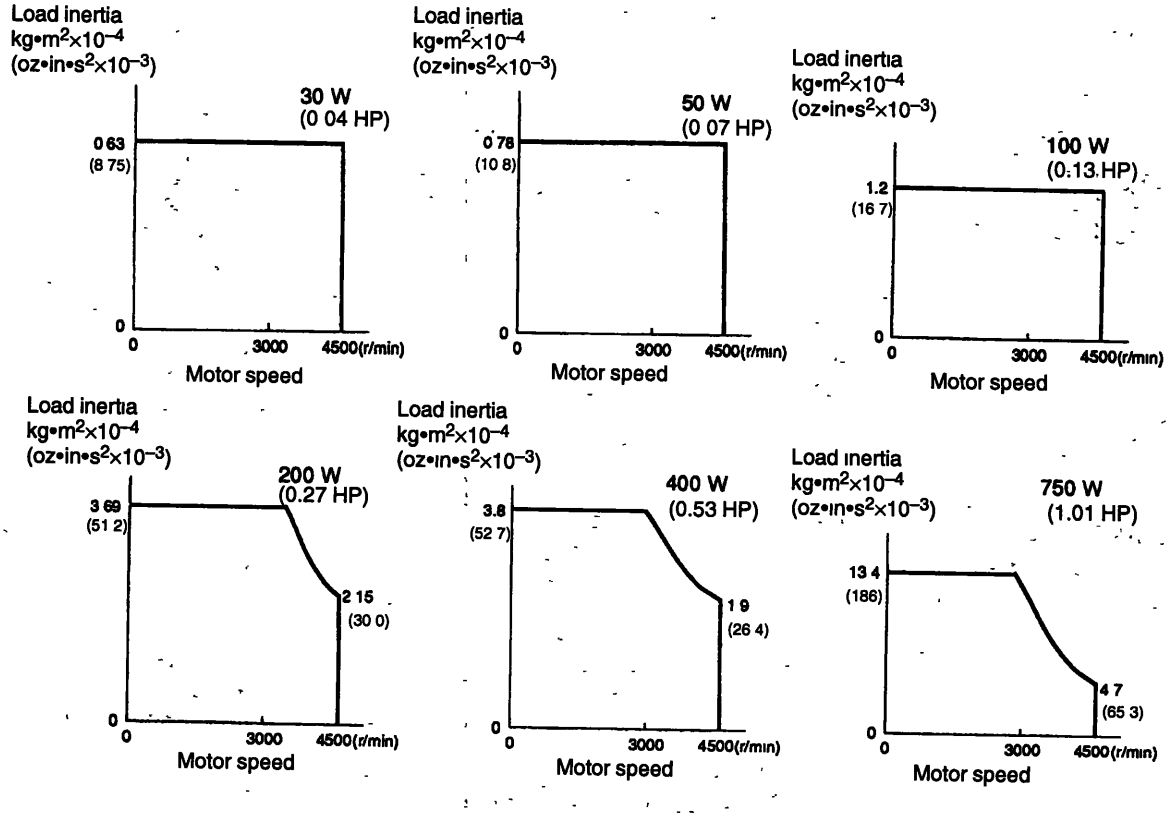
Rated specifications for the regenerative braking capacity of the Servopack is only for brief periods while the motor is stopped. Contact your Yaskawa representative about applications with overhanging loads.

5.5.2 Load Inertia J_L

Make sure the allowable load inertia J_L calculated for the motor shaft falls within the range given in *Fig. 5.3*. An overvoltage alarm will occur during deceleration if the load inertia exceeds the values in the figure. If this occurs, take one of the following actions.

- Reduce the torque limit.
- Reduce the deceleration rate.
- Reduce the maximum rotation speed.
- Add a Regenerative Resistor Unit.

■ SGM Servomotors 200-VAC Servomotors with Incremental Encoders



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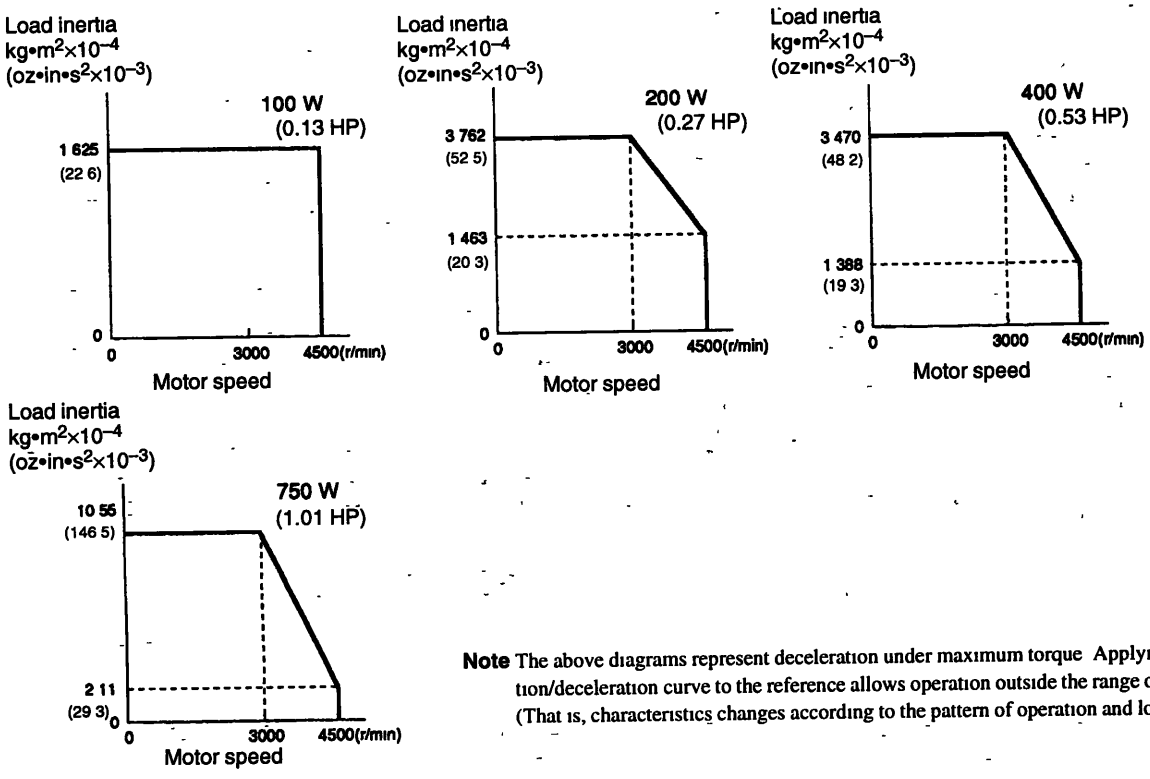
■ SGMP Servomotors 200-VAC Servomotors with Incremental Encoders



Note The above diagrams represent deceleration under maximum torque Applying an acceleration/deceleration curve to the reference allows operation outside the range of the diagrams (That is, characteristics changes according to the pattern of operation and load conditions)

Figure 5.3 Allowable Load Inertias

5

5.5.3 Regenerative Unit

A Regenerative Unit is used as an SGD Servopack Peripheral Device.

■ Specifications and Ratings

Specifications for the Regenerative Unit are given below.

Type	JUSP-RG08C	Comments
Applicable Servopack	SGD-□□□□	—
Regenerative Working Voltage	380 VDC	—
Regenerative Process Current	8 A, DC	Regenerative resistance: 50 Ω, 60 W
Error Detection Functions	Regenerative resistance failure, regenerative transistor failure, overvoltage	—
Alarm Output	Normally closed contact (OPEN when protective function operates)	200-V operation OK
Dimensions in mm (inches)	55 × 160 × 130 mm (2.17 × 6.30 × 5 31 in) W×H×D	—

■ Connecting a Regenerative Unit

The connections of the Regenerative Unit are shown below.

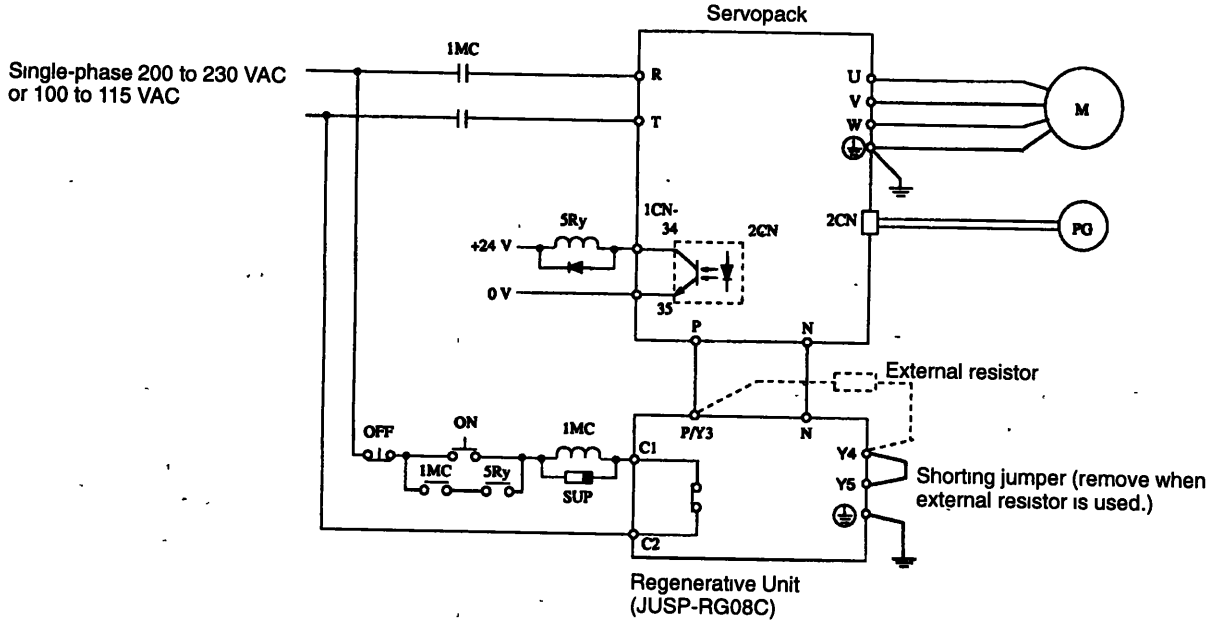


Figure 5.4 Regenerative Unit Connection Diagram

- A Regenerative Unit is equipped with the following fault detection functions:
  - Detecting disconnection in the regenerative resistor.
  - Detecting faults in the regenerative transistor.
  - Detecting overvoltage.
- When one of these fault detection functions operates, the internal alarm relay is actuated, and the circuit between output terminals C1 and C2 is opened.
- Form a sequence so that Servopack power turns OFF when the alarm relay is actuated.
- Once the alarm relay is actuated, it takes two or three seconds until the system returns to a normal state. This time is required for the main capacitor inside the Servopack to discharge.
- When using an external resistor, remove the shorting jumper between Y4 and Y5 and then connect the resistor between P/Y3 and Y4.
- The resistance value of the external resistor must be 50 Ω min.

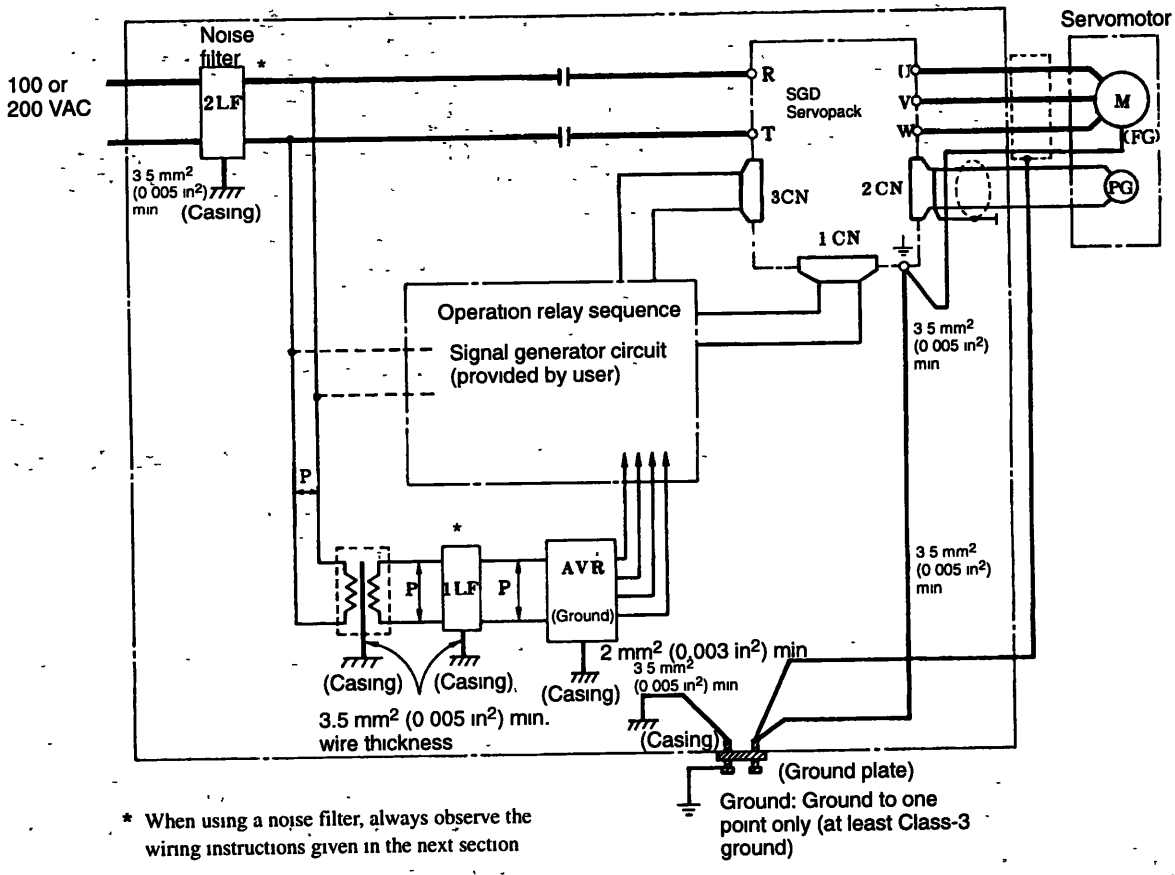
5.5.4 Noise Control

■ Example of Wiring for Noise Control

The Servopack uses high-speed switching elements in the main circuit. "Switching noise" may be generated by these high-speed switching elements if wiring or grounding around the Servopack is not appropriate. To prevent this, always wire and ground the Servopack correctly.

The Servopack also has a built-in microprocessor (CPU). Therefore, install a noise filter to protect the microprocessor from external noise.

The diagram below shows an example of wiring for noise control.



* When using a noise filter, always observe the wiring instructions given in the next section

Note 1. Use a wire (preferably a plain stitch copper wire) at least 3.5 mm² (0.005 in²) thick to ground the casing.

2. Use twisted-pair wires whenever possible for wires indicated by P.

Figure 5.5 Grounding

■ Correct Grounding

Motor Frame Grounding

If the Servomotor is grounded via the machine, switching noise current (Cf dv/dt) will flow from the Servopack power unit (PWM) through motor stray capacitance. Always connect the Servomotor ground terminal 4 (green) to the Servopack ground terminal to prevent adverse effects from switching noise. Be sure to ground the ground terminal.

Servopack SG 0 V

If the reference input line receives noise, ground the SG 0 V line. If the main circuit wiring for the motor is accommodated in a metal conduit, ground the conduit as well as the junction box. Always ground using ground to one point only.

■ Using a Noise Filter

Use an inhibit-type noise filter to block noise from the power supply line. *Table 5.3* lists recommended noise filters for each Servopack. Also install a noise filter on the power supply line for peripheral equipment if needed.

Note Always observe the installation and wiring instructions shown in *Figs. 5.6* to *5.9*. Incorrect use of a noise filter reduces its benefits.

Table 5.3 Noise Filter Types

Power Voltage	Servopack Type		Noise Filter Connection	Recommended Noise Filter*	
				Model	Specifications
200 V	30 W (0.04 HP)	SGD-A3AH	(Correct) 	LF-205A	Single-phase 200 VAC, 5 A
	50 W (0.07 HP)	SGD-A5AH			
	100 W (0 13 HP)	SGD-01AH			
	200 W (0.27 HP)	SGD-02AH			
	400 W (0.53 HP)	SGD-04AH		LF-210	Single-phase 200 VAC, 10 A
	750 W (1.01 HP)	SGD-08AH		LF-220	Single-phase 200 VAC, 20 A
100 V	30 W (0.04 HP)	SGD-A3BH	(Incorrect) 	LF-205A	Single-phase 200 VAC, 5 A
	50 W (0.07 HP)	SGD-A5BH			
	100 W (0.13 HP)	SGD-01BH			
	200 W (0.27 HP)	SGD-02BH		LF-210	Single-phase 200 VAC, 10 A
	300 W (0.39 HP)	SGD-03BH		LF-220	Single-phase 200 VAC, 20 A

Note These noise filters made by Tokin Corp. are available from Yaskawa. Contact your nearest Yaskawa sales representative for noise filters.

- Separate input lines from output lines.
  Do not run input and output lines in the same duct or bundle them together.

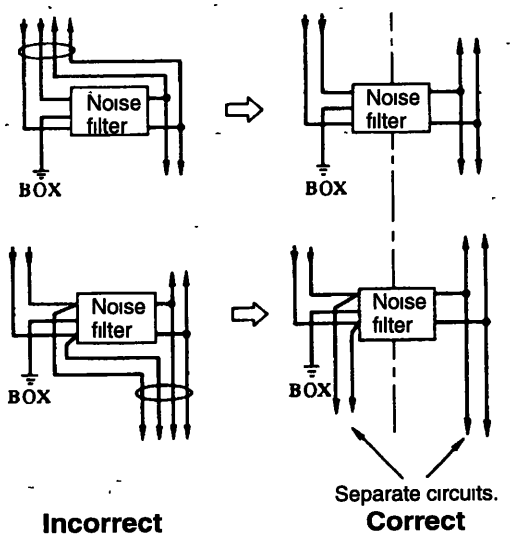


Figure 5.6

- Separate ground wires from noise filter output lines.
  Do not run ground wires, noise filter output lines, and other signal lines in the same duct or bundle them together.

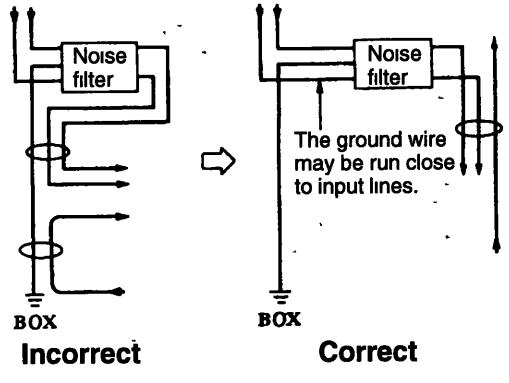


Figure 5.7

- Connect the ground wire directly to the junction box or the ground plate.

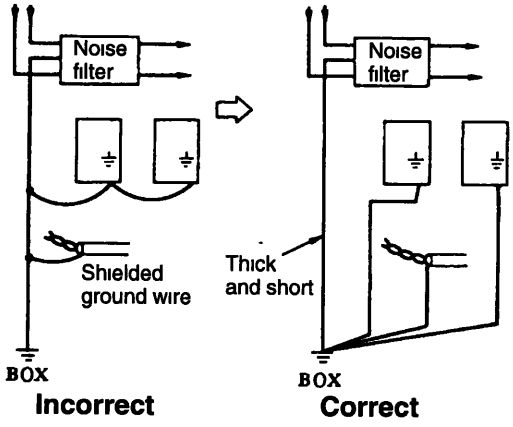


Figure 5.8

- When grounding a noise filter inside a unit, connect the noise filter ground wire and the ground wires for other devices inside the unit to the ground plate of the unit first, and then ground these wires.

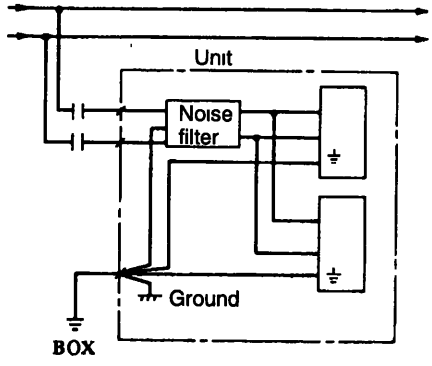


Figure 5.9

5.5.5 High Voltage Lines

A transformer that will step down three-phase 400/440 V to single-phase 200 V or single-phase 100 V is required when using a 400 V-class (400 V, 440 V) power supply. Select an appropriate power transformer according to *Table 5.5 Power Supply Capacity per Servopack.*

When using a 400 V-class supply voltage, power must be turned ON and OFF on the primary side of the power transformer.

5.5.6 Power Supply Line Protection

The Servopack is connected directly to a commercial power supply (200 or 100 V). Therefore, always use an appropriate molded-case circuit breaker (MCCB) or fuse for each Servopack. A fast-operating fuse cannot be used because the Servopack power supply is a capacitor input type, and a fast-operating fuses may blow out when power is turned ON.

Table 5.4 MCCB or Fuse for the Power Capacity

Supply Voltage	Servopack Type	Power Capacity per Servopack (kVA) (See Note 1)	Power Capacity per MCCB or Fuse (A) (See Note 2)
200 V	SGD-A3AH	0.25	5
	SGD-A5AH	0.3	
	SGD-01AH	0.5	
	SGD-02AH	0.75	
	SGD-04AH	1.2	9
	SGD-08AH	2.2	16
100 V	SGD-A3BH	0.2	5
	SGD-A5BH	0 3	
	SGD-01BH	0.5	
	SGD-02BH	0.75	8
	SGD-03BH	1 4	15

Note 1. Power capacity at the rated load

2. Operating characteristics (25°C): 2 s or more at 200%, 0.01 s or more at 700%

5

5.6 Appropriate Applications

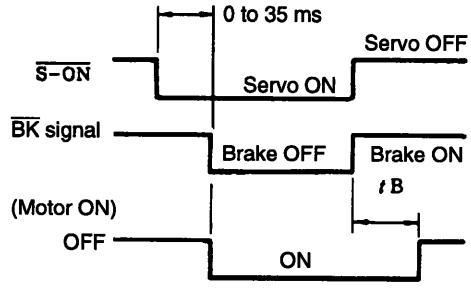
5.6.1 Holding Brake Interlock Signal

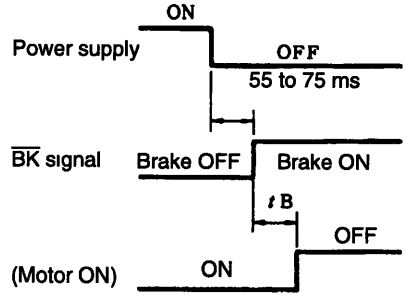
This output signal can be output for interlocking motor circuit power status, motor rotation speed, and the interlock.

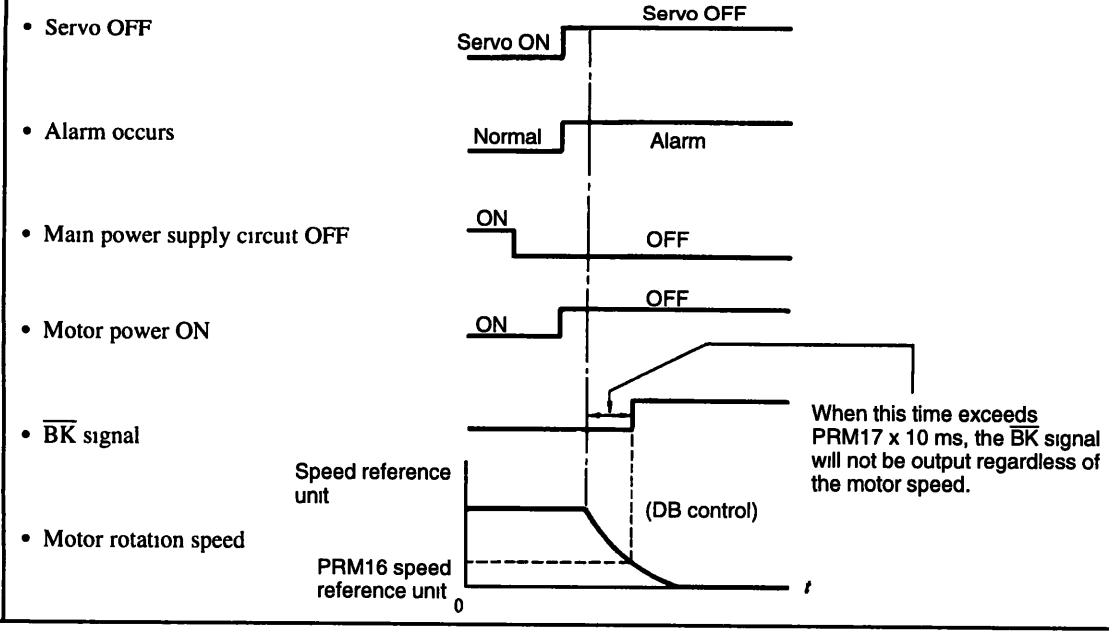
■ Setup Procedure

The brake signal is output from 1CN-7(10). Delay time tB (× 10 ms) from the brake turns ON until the Servomotor turns OFF can be adjusted in user constant PRM15. The following shows the Servo ON signal and power supply timing.

Table 5.5 Servo ON Signal and Power Supply Timing

<table>
<tr><td>Motor Stopped</td><td>Servo ON Signal Timing</td><td>Power Supply Timing</td></tr>
<tr><td></td><td> 

tB: Brake Time (set from 0 to 50 ms in PRM15)</td><td> 

tB: Brake Time (set from 0 to 50 ms in PRM15)</td></tr>
<tr><td>Motor Running</td><td colspan="2">Timing with the Servo OFF, main power supply circuit OFF, and an alarm

</td></tr>
</table>

5.7 Adjustments

5.7.1 Servo System Adjustments

The following user constants (parameters) are provided for the user to adjust the servo system.

- PRM2: Speed Loop Gain
- PRM3: Speed Loop Integration Time Constant
- PRM10:Torque Reference Filter Time Constant
- PRM1: Position Loop Gain

A simple block diagram of the servo system is shown below.

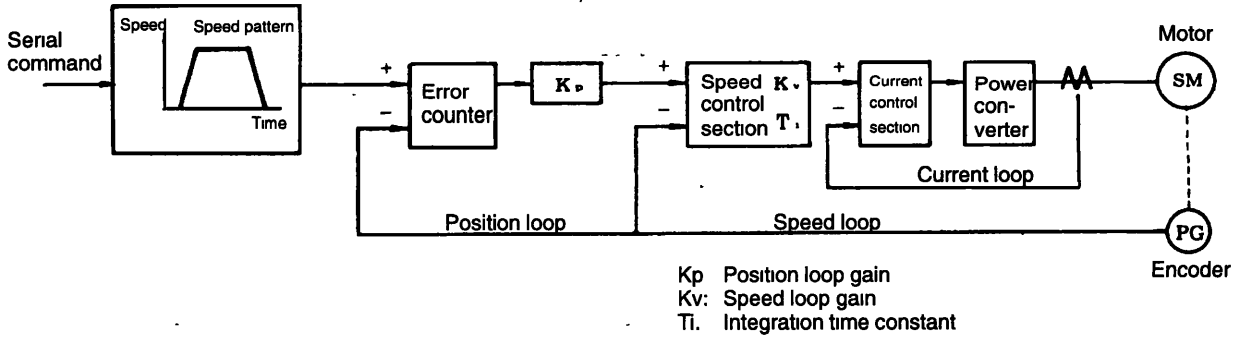


Figure 5.10 Servo System Block Diagram

■ Basic Rules for Gain Adjustment: Three Feedback Systems

The servo system is equipped with the following feedback systems.

- Position loop
- Speed loop
- Current loop

The interior loops require better response. Failure to follow this principle will result in poor response and vibration.

Position and Speed Loop

- Can be adjusted by the customer.
- Make sure the response is balanced.

Current Loop

- Can not be adjusted by the customer.
- Maintain an adequate response.

Increasing position gain alone to improve response will result in a speed reference vibration in the Servopack that will cause vibration or slow positioning time. If the position loop gain is increased, the speed loop gain must be similary increased.

The mechanical system will start to vibrate at the upper limits for the position and speed loop gain. Can not exceed these limits. Generally position loop gain cannot be increased beyond the natural frequency of the mechanical system.

Example: Articulated Robots
Using harmonic gears produces a mechanism with extremely low rigidity.
Natural frequency: 10 to 20 Hz
Position loop gain: 10 to 20 (1/s)

Example: Chip Mounter, IC Bonder, Precision Machine Tools
Natural frequency: 70 Hz min.
Position loop gain: 70 (1/s) min.

The response of the servo system (Controller, Servodriver, Servomotor, detector, etc.) is crucial to the response requirements, but a highly rigid system is also needed as well.

5.7.2 User Constants

■ PRM2: Speed Loop Gain

The Speed Loop Gain sets the speed loop response. The response is improved by setting this user constant to the maximum value in a range that does not cause vibrations in the mechanical system. The equation below shows the relationship between the speed loop gain and the load inertia.

$$\text{Speed loop gain Kv (Hz)} = \frac{2}{\frac{GD^2_L}{GD^2_M} + 1} \times \text{(PRM2 value)}$$

GD^2_L: Motor axis converted load inertia
GD^2_M:Motor moment of inertia

■ PRM3: Speed Loop Integration Time Constant

The speed loop has an integration element that enables response to micro-inputs. Because this integration element can produce a delay in the servo system, positioning settling time increases and response slows as the time constants increase. The integration time constant must be increased, however, to prevent machine vibration if the load inertia is large or the mechanical system includes an element prone to vibration. The following equation can be used to calculate a guideline value.

$$T_i \geq 2.3 \times \frac{1}{2\pi \times K_v}$$

Ti: Integration time constant (s)

Kv: Speed loop gain (Hz) (calculated above)

■ PRM10: Torque Reference Filter Time Constant

When a ball screw is used, torsional resonance may occur that increases the pitch of the vibrating noise. This vibration can sometimes be overcome by increasing the torque reference filter time constant. The filter, however, will produce a delay in the servo system, just like the integration time constant, and its value should not be increased any more than necessary.

■ PRM1: Position Loop Gain

The position loop gain determines the response of the servo system. The higher it is set, the higher the response and the less time it takes for positioning. As such, the equipment must have higher rigidity and a higher characteristic frequency.

The entire servo system is more susceptible to vibration if position loop gain alone is increased to improve response, and the speed reference output from the position loop will cause vibration. Always increase speed loop gain while checking the response.

Position loop gain K_P is calculated as shown below.

$$K_P = \frac{V_S}{\epsilon}$$

K (1/s): Position loop gain

V (PPS): Steady speed reference

ε (Pulse): Steady error (The number of pulses in the error counter at constant speed)

■ Adjustment Procedure

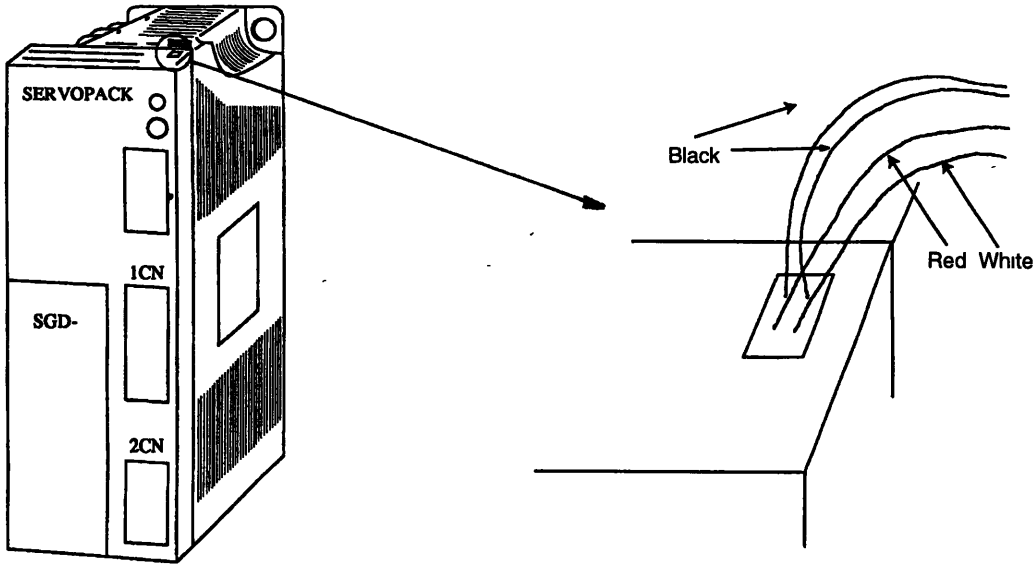
1. Set the loop gain to a low value and increase speed loop gain within a range that does not cause noise or vibration to occur.
2. Slightly reduce the speed loop gain from the value in step 1, and increase position loop gain within a range that does not cause overshooting or vibration to occur.
3. Determine the speed loop integration time constant by observing the positioning settling time and vibration in the mechanical system. Positioning time may be increased if the speed loop integration time constant is too large.
4. It is not necessary to change the torque reference filter time constant unless torsional resonance occurs in the equipment shafts. Torsion resonance may be present if there high-frequency vibration noise. In this case, adjust the torque reference filter time constant to reduce the noise.
5. Finally, the position and speed loop gain as well as the integration time constant must be finely adjusted to determine the optimum point for step response.

■ Analog Monitoring

Motor speed and torque can be monitored via an analog signal while adjusting the gain. The cable connections and output signals needed for this are outlined below.

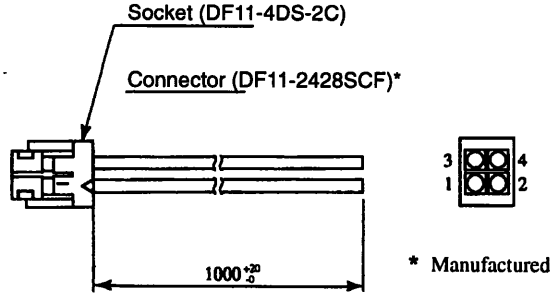
Note The cable is only loosely attached to the SGD connector, and an external force applied to it may cause it to disconnect. Do not connect meters or other devices to the cable in applications.

Connecting Monitoring Cables to an SGD Servopack



Insert the cables that will be used for monitoring through the location marked with a circle in the figure above. Make sure the red and white cables reach the front panel of the Servopack.

Dimension Diagram of the Monitoring Cable (Dwg. #DE9404559)



* Manufactured by Hirose Electric Co , Ltd

Cable Colors and Monitor Signals

Cable Color	Signal Name	Description
Red	VTG-M	Speed monitor (0.5 V, 1000 r/min.)
White	TRQ-M	Torque monitor (0.5 V, 100% torque)
Black (2 wires)	GND	GND

5.7.3 Functions that Improve Response

The following functions are provided to improve response.

- Mode switching
- Feed-forward function
- Bias function

These functions will not necessarily improve characteristics, and they can even have the opposite effect. Be sure to observe the precautions given below, and monitor the actual response of the characteristics while making adjustments.

■ Mode Switching

Mode switching is used to improve transient characteristics if the torque reference saturates during acceleration and deceleration. In other words, mode switching is a function that automatically switches the speed control mode inside the Servopack from PI (proportional/integral) to P (proportional) control above a certain setting.

■ Feed-forward Function

Feed-forward function generally shortens positioning time, but has no effect on systems where the position loop gain is at its maximum. Adjust the feed-forward amount (PRM11) as outlined below.

- Adjust the speed and position loop.
- Gradually increase the amount of feed-forward amount (PRM11) until the positioning complete signal ($\overline{\text{COIN}}$) is output as quickly possible.

A primary delay filter can be applied to the feed-forward to improve characteristics when the positioning complete signal is intermittent or when speed overshooting occurs due to excessive feed-forward.

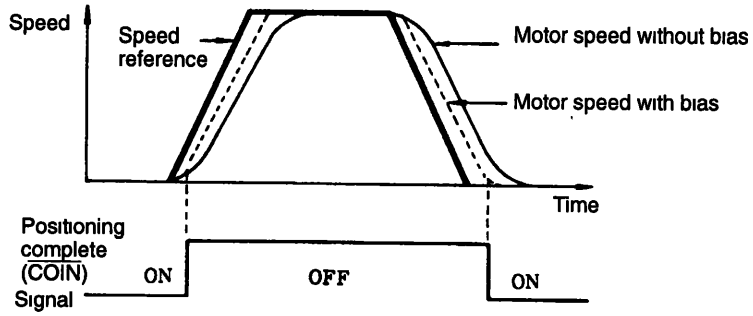
Note Make sure that the position complete signal ($\overline{\text{COIN}}$) breaks up (repeatedly turning ON/OFF) and that the speed is not overshoot. Setting the amount of feed-forward too high will cause a intermittent positioning complete signal as well as speed overshooting.

■ Bias Function

When the number of lag pulses in the error counter exceeds the width of the positioning complete signal (PRM6), bias amount (PRM13) is added to the error counter output (speed reference) until the speed reference falls within the width of the positioning complete signal. This shortens the positioning time by reducing the number of lag pulses in the error counter.

Motor rotation will become unstable if the bias amount is set too large. Adjust the bias while monitoring the response because the optimum value will vary with the gain and the positioning complete width.

Set PRM13 to 0 if bias is not used.



5.7.4 Guidelines for Gain Settings According to the Load Inertia Ratio

Adjustment guidelines are given below based on the rigidity and load inertia of the mechanical system. These values are given as guidelines only, and vibration or poor response may occur within the given ranges. Monitor the response (waveform) to optimize the adjustment. Higher gain is possible with highly rigid machines.

■ Machines with High Rigidity

Machines with high rigidity include ball screws and direct-drive machines.

Examples: Chip mounters, IC bonders, precision machine tools

Load Inertia Ratio (GD^2_L/GD^2_M)	Position Loop Gain (PRM1) [1/s]	Speed Loop Gain (PRM2) [Hz]	Speed Loop Integration Time Constant (PRM3) [ms]
×1	50 to 70	50 to 70	5 to 20
×3		100 to 140	
×5		150 to 200	
×10		270 to 380	
×15		400 to 560	
×20		500 to 730	
×30		700 to 1100	

Note 1. For an inertia ratio of ×10 or higher, slightly reduce the position loop gain and speed loop gain below the values shown, and set the integration time constant to a higher value before starting the adjustment.

2. Slightly increase the speed loop integration time constant for an inertia ratio of ×20 or higher.
3. As the inertia ratio increases, set the position loop gain and speed loop gain to the lower limit of the range of values specified and increase the speed loop integration time constant.

■ Machines with Medium Rigidity

Machines with medium rigidity include machines driven by ball screws through reduction gears. or machines driven directly by long ball screws.

Examples: General machine tools, orthogonal robots, conveyors

Load Inertia Ratio (GD^2_L/GD^2_M)	Position Loop Gain (PRM1) [1/s]	Speed Loop Gain (PRM2) [Hz]	Speed Loop Integration Time Constant (PRM3) [ms]
×1	30 to 50	30 to 50	10 to 40
×3		60 to 100	
×5		90 to 150	
×10		160 to 270	
×15		240 to 400	
×20		310 to 520	
×30		450 to 770	

Note 1. For an inertia ratio of ×10 or higher, slightly reduce the position loop gain and speed loop gain below the values shown, and set the integration time constant to a higher value before starting the adjustment.

2. Slightly increase the speed loop integration time constant for an inertia ratio of ×20 or higher

3. As the inertia ratio increases, set the position loop gain and speed loop gain to the lower limit of the range of values specified, and increase the speed loop integration time constant

■ Machines with Low Rigidity

Machines with low rigidity include machines driven by timing belts, chains, or wave reduction gears (Product name: Harmonic drive).

Example: Conveyors, articulated robots

Load Inertia Ratio (GD^2_L/GD^2_M)	Position Loop Gain (PRM1) [1/s]	Speed Loop Gain (PRM2) [Hz]	Speed Loop Integration Time Constant (PRM3) [ms]
×1	10 to 20	10 to 20	50 to 120
×3		20 to 40	
×5		30 to 60	
×10		50 to 110	
×15		80 to 160	
×20		100 to 210	
×30		150 to 310	

Note 1. For an inertia ratio of ×10 or higher, slightly reduce the position loop gain and speed loop gain below the values shown, and set the integration time constant to a higher value before starting the adjustment.

2. Slightly increase the speed loop integration time constant for an inertia ratio of ×20 or higher.

3. As the inertia ratio increases, set the position loop gain and speed loop gain to the lower limit of the range of values specified, and increase the speed loop integration time constant.

6

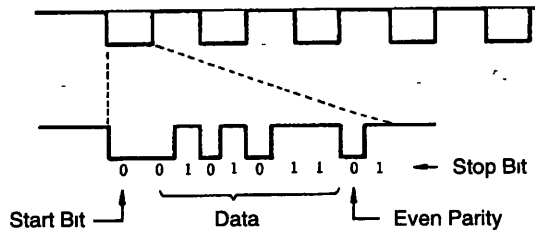
Serial Communications

This chapter describes serial communications specifications and commands.

6.1 Specifications

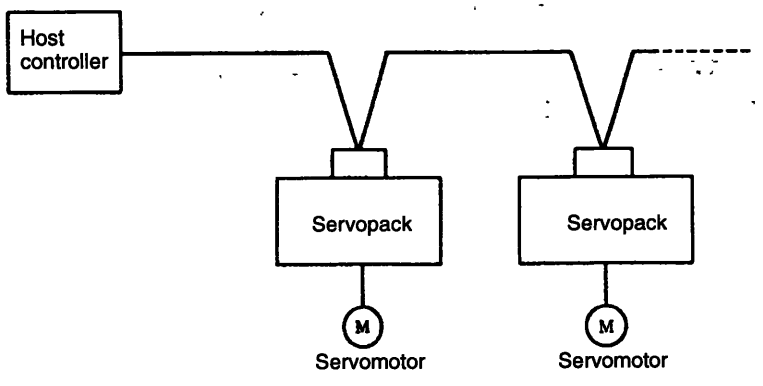
The specifications and one-character structure are given below.

Item	Specifications
Standard	RS-422
Communications Method	Asynchronous (ASYNCH)
Baud Rate	9600 baud
Start Bits	1 bit
Data	7-bit JIS, 7 bits (JIS X0201, formerly C6220)
Parity	1-bit even
Stop Bits	1 bit



6.2 Control Structure

A host controller and Servopack can control up to 16 axes.



6

6.3 Sending Commands from Controller to Servopack

Commands are sent from the Controller to the Servopack as outlined below.

Item	Single Axis	Multiple Axes
Commands	*command_string* C_R	Axis-specific commands *axis_No.(00 to 98) command_string* C_R
		All-axis commands *command_string* C_R When PRM36 bit 8 (ignore with no axis number) is set to 1, set the axis number to 99 to send commands for all axes simultaneously.
Examples	• SPD12345 C_R • NOV1234 C_R • ST C_R	• 11SPD123 C_R • 12SPD456 C_R • 11MOV123 C_R • 12MOV456 C_R • ST C_R

Note C_R = Carriage Return

6.3.1 Confirmation Return Signal

An OK C_R is returned each time a command is received if PRM36 bit 10 is set to 1.

■ PRM36 Bit 9 Set to 1

If an unacceptable command is received, the Servopack for the designated axis will return ERR_SN C_R. No signal will be returned from axes that were not specified or if the command was received normally

■ PRM36 Bit 9 and 10 Set to 1

The specified axis will return either an OK or ERR_SN each time it receives a command.

6.3.2 Typical Send Examples

The following shows typical send examples.

■ Sending a Run Command to the Servopack

○ SVON C_R
● OK C_R
○ SVONN C_R
● ERR_SN C_R

○: From Controller to Servopack
●: From Servopack to Controller

There is a maximum 5-ms delay between receiving and executing a command.

■ Requesting Data from the Servopack

○ ALM C_R
● ALM_ _RUN C_R
○ MON1 C_R
● PUN = -12345678 C_R

○. From Controller to Servopack
●: From Servopack to Controller

6.4 Serial Commands

6.4.1 List of Serial Commands

The following table lists serial commands.

Operation	Command	Description
Run	SV ON	Supplies power to the motor.
	SV OFF	Stops power to the motor.
	ARES	Resets an alarm.
	ZEROSET (±) nnnnnnn	Overwrites the origin so the current position becomes (±) nnnnnnn.
	RES	Operates the same as turning power ON and OFF.

Operation	Command	Description
Move Reference	POS (±) nnnnnn	Positions the motor at (±) nnnnnnn (absolute value) using linear acceleration and deceleration.
	POSI (±) nnnnnn	Positions the motor at (±) nnnnnnn (incremental value) using linear acceleration and deceleration
	MOV (±) nnnnnn	Sets an absolute position reference.
	MOVI (±) nnnnnn	Sets an incremental position reference.
	SPD nnnnn	Sets a speed reference
	RP	Repeats an incremental move following a POSI or MOVI command.
	ST	Starts automatic operation.
	ZRN	Starts a return to origin.
	PCON	Switches the speed loop to P control.
	PCOFF	Cancels P control for the speed loop.
	HOLD	Places the feed on hold (retains the remaining distance).
	SKIP	Decelerates to a stop
User Constant	PRMpp	Sends the user constant at pp (user constant number).
	PRMpp = (±) nnnnn	Overwrites the user constant at pp (user constant number) with (±) nnnnnnn.
Monitoring	MONp	Sends monitor data.
	IN	Sends the input signal status.
	OUT	Sends the output signal status.
	ALM (p)	Sends an alarm code Nothing for p: Current alarm p = 1 to 9: Alarm p times earlier.
Output Setting	OUT = bbbb	Turns ON and OFF masked output.

6.4.2 Command Functions

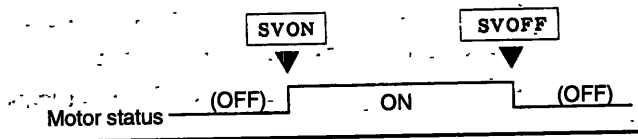
■ User Constant Commands

User constant commands are used to access or overwrite the contents of user constants. User constants will not be lost if the power goes out because they are stored on EEPROM. See *roman 7 User Constants* for more details on these constants.

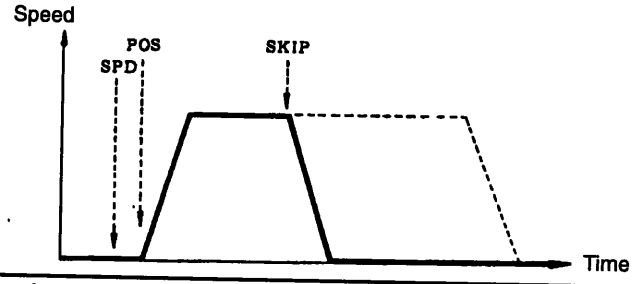
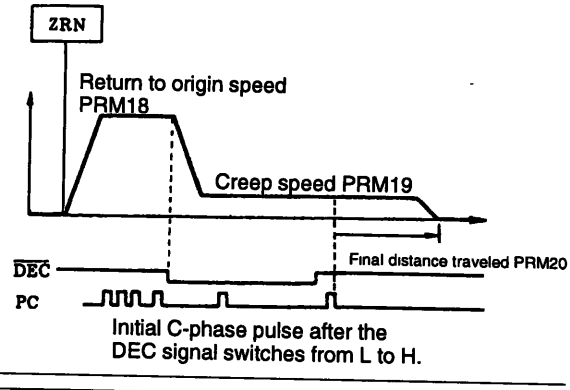
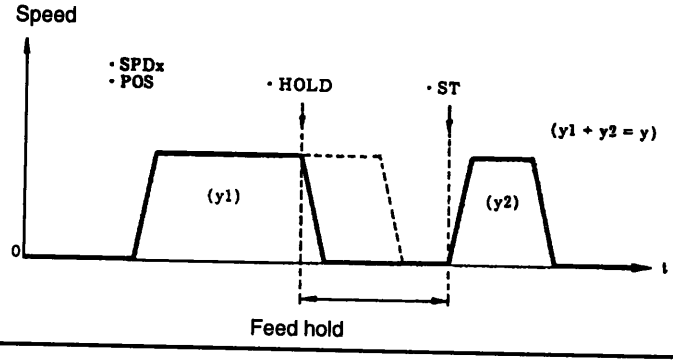
Command	Description
PRMpp (pp = user constant No.)	This command sends the contents of user constant pp from the Servopack in order to check the contents. **Note** User constants are output in hexadecimal for pp 36 to 39. Example Command: `PRM30` →_ `RPM30 = XX.....X` (Sent from the Servopack)
PRMpp = (±) n...n using up to 5 digits (pp = user constant No., n = 0 to 9)	This command overwrites the user constant at pp with [(±) n...n]. The plus sign (+) can be omitted. The power must be turned OFF and back ON or the RES command must be sent after executing this command or user constants starting from PRM32 may not operate properly. **Note** Be sure to convert bits 15 to 0 for pp 36 to 39 to hexadecimal prior to sending them. Thus, n = 0 to 9 A, B, C, D, E and F. Example Commands: `PRM32 = 2048` `PRM33 = 1000` Turn the power OFF and then back ON.

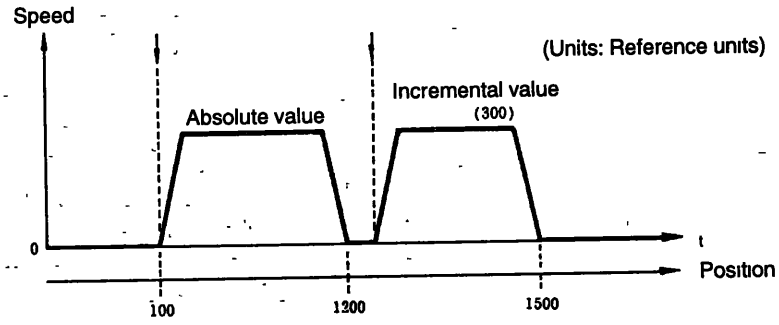
■ Basic Operating Commands

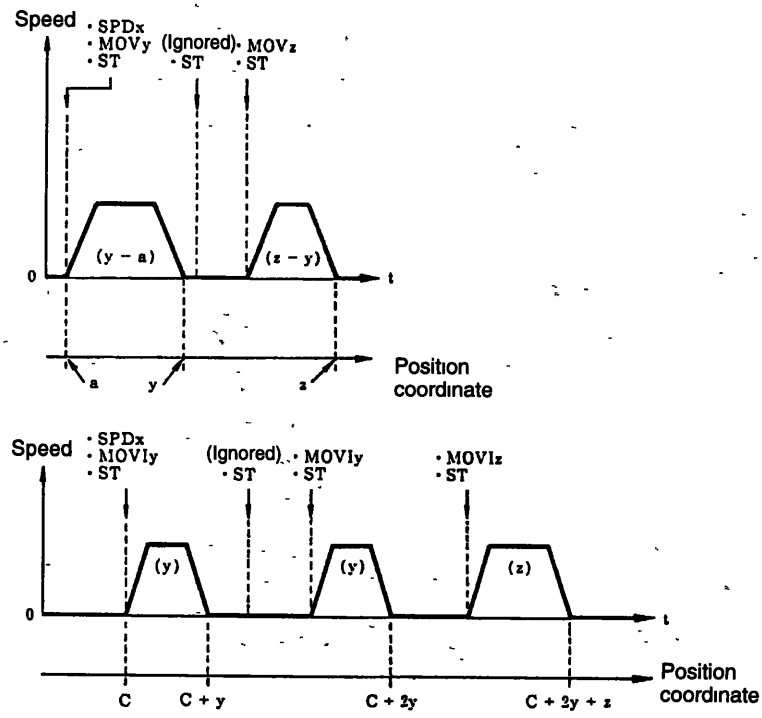
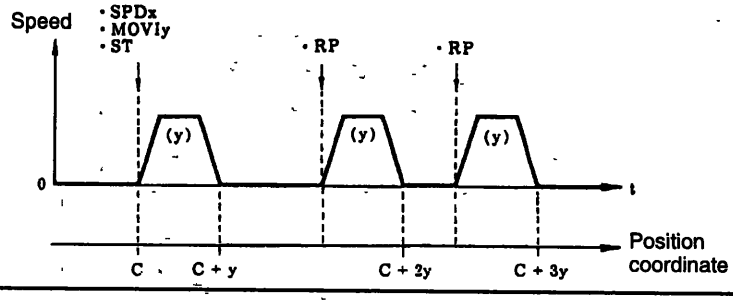
The following table describes basic operating commands.

Command	Description
RES	This command operates the same as turning power ON and OFF, i.e., it resets the digital control section of the Servopack. It is used when user constants starting from PRM32 are overwritten.
ARES	This command operates the same as the alarm reset signal/ALMRST to reset alarms that occur in the Servopack.
ZEROSET (±) n...n Maximum ±3000000 (The plus sign (+) can be omitted.)	This command sets (±) n...n as the standard origin position. (Units: Reference units) ZEROSET ± n.. ..n The current position will be set at (±) n...n, and is displayed as monitor data PUN = (±) nnnnnnn.
SVON SVOFF	The SVON command operates the power drive circuits of the main Servopack circuits to turn the motor ON. The SVOFF command turns the motor OFF. (Both signals operate the same as the Servo ON signal S-ON.) **Note** The S-ON signal must be masked (PRM37 bit 0 = 1) if the SVON/SVOFF commands are used without the S-ON signal. 
SPD n...n Maximum 50000	This command sets the speed reference. The units for (nn.....n) is [× 1,000 reference units/min]. When power is turned ON or the RES command is executed, the speed reference value becomes all zeroes. An ERR_SN signal will be returned if a POS or POSI command is executed prior to executing an SPD command when power is turned ON or the RES command is executed.
ST	This command starts automatic operation after a MOV or MOVI command is executed, restarts following a HOLD, and moves the remaining distance when ST is sent. The ST command is ignored during positioning.

6

<table>
<tr><th>Command</th><th>Description</th></tr>
<tr><td>SKIP</td><td>This command stops operation and stops the motor at a specified rate of deceleration.
 
</td></tr>
<tr><td>ZRN</td><td>This command starts the return to origin operation as shown below.
<table>
<tr><th>Return to Origin Method</th><th>Operating Pattern</th></tr>
<tr><td>Two-speed method using the C-phase pulse signal (in the Servopack) of the DEC signal (LS deceleration) PG.</td><td> 
</td></tr>
</table>
<table>
<tr><th>User Constant No.</th><th>Name</th><th>Setting Range</th><th>Units</th></tr>
<tr><td>36 (bit 0)</td><td>Origin return direction</td><td colspan="2">0: Forward, 1. Reverse</td></tr>
<tr><td>18</td><td>Origin return speed</td><td>0 to 50000</td><td rowspan="2">× 1000 reference units/min</td></tr>
<tr><td>19</td><td>Origin return creep speed</td><td>0 to 50000</td></tr>
<tr><td rowspan="2">20</td><td rowspan="2">Origin return final travel distance</td><td>0 to 10000</td><td rowspan="2">Reference units</td></tr>
<tr><td>0 to −10000</td></tr>
</table></td></tr>
<tr><td>HOLD</td><td>This command stops the motor at the specified deceleration rate and retains the distance remaining if it is entered during positioning using the POS or POSI commands (Feed hold function)
 
</td></tr>
</table>

Command	Description
POS (±) n...n Maximum 4000000 POSI (±) n...n Maximum 4000000 (The plus sign (+) can be omitted.)	These commands position the motor using linear acceleration. POS: Moves to the absolute position (±) n...n POSI. Moves incrementally (±) n...n (Speed is set using the SPD command.) 
PCON PCOFF	These commands switch the speed loop mode of the Servopack from PI (proportional/integral) control to P (proportional) control. PCON sets P control while PCOFF returns to PI control.

Command	Description
MOV (±) n...n (The plus sign (+) can be omitted.) Maximum 4000000 MOVI (±) n...n (The plus sign (+) can be omitted.) Maximum 4000000	These commands set the position reference using reference units for (±) n...n units. (+ n...n: Forward motor rotation, – n...n: Reverse motor rotation) The position reference becomes all zeroes when power is turned ON or the RES command is executed 
RP	This command operates the same as the incremental command (POSI or MOVI) that was just executed. RP will be ignored if any other command is sent between the POSI or MOVI command and the RP command. 

■ Monitoring Commands

Monitoring commands return monitor data from the Servopack when they are executed.

"C_R" (carriage return) is added to the text string rather than "L_F" (line feed).

Monitor Commands

Command	Data sent from Servopack		Unit, Misc.
	Name	Display	
MON1	Current position	PUN = ± n ...n (see note) — 7 digits max.	Reference units
MON2	Position error	PER = ± n. ...n (see note) — 7 digits max.	Converted pulse 4 times the absolute encoder pulse
MON3	Current speed (motor rotation speed)	VFB = ± n.....n (see note) — 4 digits max.	r/min
MON4	Reference speed	VRF = ± n.....n (see note) — 5 digits max.	× 1000 reference units/min
MON5	Torque reference	TRQ = ± nnn (see note) — 3 digits max.	%
MON6	Servopack status	STS = n n n n n 1 2 3 4 5 n is 0 or 1. n is "1" for the following conditions 1: RDY, Ready 2: COIN, Positioning completed 3: RUN, Moving 4: TLIM, Current limit in progress 5: ALM, Alarm	

Note A plus sign (+) is not output if data sent from MON1 to MON5 Servopacks is positive or 0, but a negative sign (–) is output if the data is negative.

Input Signal Status: IN Command

Data sent from a Servopack: IN = n^6 n^5 n^4 n^3 n^2 n^1 n^0

The monitor data indicates the input signal status as follows (with contacts):

Open: 0, Closed: 1

Each data digit corresponds to a connector pin number and signal name as shown below.

Command	Data sent from a Servopack						
	n^6	n^5	n^4	n^3	n^2	n^1	n^0
IN	12	11	17	16	18	15	14
	$\overline{\text{N-CL}}$	$\overline{\text{P-CL}}$	N-OT	P-OT	$\overline{\text{DEC}}$ (ALMRST)	$\overline{\text{P-CON}}$	$\overline{\text{S-ON}}$

Output Signal Status: OUT Command

Data sent from the Servopack: OUT = n^6 n^5 n^4 n^3 n^2 n^1 n^0

Monitor data represents output signal status. The output relay is turned OFF when set to 0 and is ON when set to 1.

Each data digit corresponds to a connector pin number and signal name as shown below.

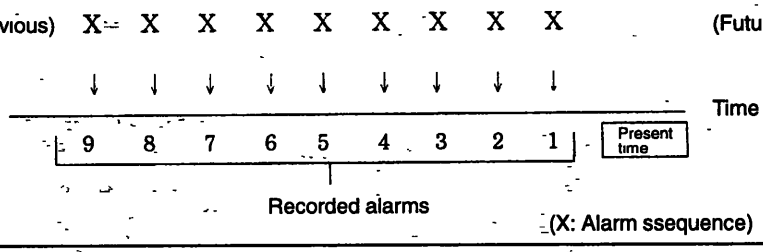
Command	Data sent from a Servopack						
	n^6	n^5	n^4	n^3	n^2	n^1	n^0
OUT	32	31	30	11	8	7	34
	ALO3	ALO2	ALO1	CLT	$\overline{\text{COIN}}$	$\overline{\text{BK}}$	ALM

Setting Output Signals

Command	Description
OUT = bbbb	This command can output CLT (1CN-9), $\overline{\text{COIN}}$ (1CN-8), $\overline{\text{BK}}$ (1CN-7) and ALM (1CN-34) when these signals are masked. OUT = b b b b ALM signal $\overline{\text{BK}}$ signal $\overline{\text{COIN}}$ signal CLT signal All signals are turned OFF when b = 0 and are turned ON when b = 1. Example: `OUT 0101` Here the CLT signal is turned OFF, the $\overline{\text{COIN}}$ signal is turned ON, the $\overline{\text{BK}}$ signal is turned OFF and the ALM signal is turned ON if the signals are masked. See User Constant PRM37 bits 11 to 8 for more details on masking output signals.

ALM (ALMp) Command

The Servopack sends status data just once with the ALM (ALMp) command. See *Servopack Status and Data Sent from the Servopack* on the next page for details on alarm codes and alarm abbreviations.

<table>
<tr><th rowspan="2">Command</th><th colspan="3">Data Sent from the Servopack</th></tr>
<tr><th colspan="2">Servopack Status</th><th>Data Display</th></tr>
<tr><td rowspan="4">ALM</td><td rowspan="4">Operating condition</td><td>Motor OFF (base block status)</td><td>ALM_ _BB</td></tr>
<tr><td>Motor ON</td><td>ALM_ _RDY</td></tr>
<tr><td>Motor running</td><td>ALM_ _RUN</td></tr>
<tr><td>Positioning complete</td><td>ALM_ _COIN</td></tr>
<tr><td colspan="2">Alarm occurred
(Including overtraveling, software limit switch)</td><td>ALM_nn.nnnn
Alarm code — Alarm abbreviation</td></tr>
<tr><td>ALMp
(p = 1 to 9)</td><td colspan="2">Previous alarm p times earlier</td><td>ALMp = nn.nnnn
Alarm code — Alarm abbreviation</td></tr>
<tr><td colspan="3">The Servopack stores up to 9 previous alarms, and ALM1 to ALM9 commands can be used to see details of these previous alarms. ALM3, for example, is the command used to view the third alarm before the last alarm.
 
</td></tr>
</table>

Servopack Status and Data Sent from the Servopack

Servopack Status			Data Sent
Description			
Status Display	Normal	Motor OFF (base block status)	ALM_ _BB
		Motor ON	ALM_ _RDY
		Motor running	ALM_ _RUN
		Positioning completed	ALM_ _$\overline{\text{COIN}}$
	Positive overtravel		ALM_P P-OT
	Beyond positive software limit switch		ALM_P. P-LS
	Negative overtravel		ALM_N. N-OT
	Beyond negative software limit switch		ALM_N. N-LS
Alarm Display	Absolute data error		ALM 00. ABS
	Parameter corrupted		ALM 02. PRM
	Parameter setting error		ALM 04. PRM
	Overcurrent detection (or overheated heat sink detection)		ALM 10. OC
	Overflow		ALM 31. OF
	Overvoltage detection		ALM 40. OV
	Acceleration calculation		ALM 51. OS
	Overload detection (instantaneous peak load)		ALM 71. OL
	Overload detection (continuous peak load)		ALM 72. OL
	Encoder error		ALM 80. POS
	Encoder backup error		ALM 81. POS
	Encoder checksum error		ALM 82. POS
	Encoder battery error		ALM 83. POS
	Encoder absolute data error		ALM 84. POS
	Encoder overspeed		ALM 85. POS
	Overrun detection		ALM C1. RWY
	Phase error detection		ALM C2. PG
	Broken PA, PB phase wire		ALM C3. PG
	Broken PC phase wire		ALM C4, PG
	Power loss alarm		ALM F3. SRC
	CPU error		See note

Note Serial data that is sent will be erratic when a CPU error has occurred.

7

User Constants

This chapter describes the contents and settings of user constants, including details on memory switches.

7.1 Setting User Constants

The Servopack has the following user constants that can be set or modified to fit the system. It is important to understand what the constants mean before using them.

User constants are set and modified through serial communications or through a Digital Operator when serial communications are not available. See *Chapter 6 Serial Communications* or *Chapter 8 Digital Operator (JUSP-OP02A-1)* for more details.

7.1.1 Gain-related Constants

■ PRM1: Position Loop Gain

- Set the proportional gain for the position controller.
- Allowable adjustment range: 1 to 500 [1/s]

■ PRM2: Speed Loop Gain

- Set the proportional gain for the speed controller.
- Allowable adjustment range: 1 to 2000 [Hz] (With equivalent inertia)
- Set PRM 2 at 40 Hz maximum when the motor is running under no-load conditions.

■ PRM3: Speed Loop Integration Time Constant

- Set the time constant for the speed controller.
- Allowable adjustment range: 2 to 10000 [ms]

■ PRM7: Mode Switch

- Set the mode switching level. PRM7 switches between PI and P control in order to improve transient characteristics when the speed controller output saturates during acceleration and deceleration. The mode switch can be used to select any one of the following detection points and to set their levels.

Torque reference (speed controller output):	%
Speed reference:	Speed reference value
Motor acceleration and deceleration detection:	Reference units/100 ms
Error pulse:	Reference units

- The detection point is selected using PRM36 bits 12 and 13.

■ PRM10: Torque Reference Filter Time Constant

- Set the primary lag filter to add to the reference torque line for speed error and speed loop gain.

- PRM10 is used to prevent vibration due to mechanical resonance.
- Allowable setting range: 0 to 250 [× 100 µs]

■ PRM11: Feed Forward Compensation

- Set the feed forward compensation for the position controller.
- Allowable adjustment range: 0 to 100 [%]

■ PRM12: Feed Forward Reference Filter

- Set the primary lag filter to add to the feed-forward compensation line.
- PRM12 can be used to reduce the impact of feed forward control.
- Allowable setting range: 0 to 500 [× 100 µs]

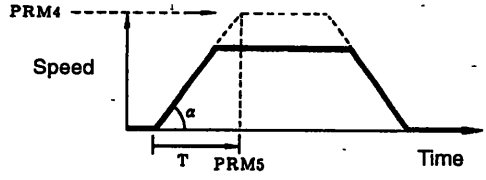
■ PRM13: Bias

- Set the position control bias. PRM13 is used depending on load conditions to shorten positioning time.
- Allowable adjustment range: 0 to 450 [r/min]

7.1.2 Positioning Unit Related Constants

■ PRM4: Maximum Speed

- Set the maximum speed using speed reference units (position reference units x 1000/min)
- Allowable adjustment range: 0 to 50000 [reference units], but the speed cannot be set higher than the maximum rotation speed of the motor.



■ PRM5: Acceleration/Deceleration Time

- Set the acceleration based on the time required for the motor to go from a stop to the maximum speed (PRM4).
- Acceleration remains constant even if the feed speed varies.

■ PRM32 (B) and PRM33 (A): Electronic Gear Ratio

- The electronic gear ratio B/A (PRM32/PRM33) represents the number of encoder pulses per reference unit.

  For example, consider a system where the reference unit is micrometers in equipment that drives a ball screw with a 5-mm (0.20-in) pitch using a Servomotor with an incremental en-

coder (2048 pulses). Since 2048 encoder pulses are generated 4 times (unconditionally 4 times) in one motor revolution, the number of pulses generated is 2048 × 4 or 8192 pulses. Here, the Servomotor moves 5 mm (0.20 in) above the 5-mm (0.20-in) pitch ball screw, and this distance expressed as micrometers is 5000 µm. Therefore, set PRM32 to 8192 and PRM33 to 5000.

- Make sure that the electronic gear ratio falls within the range $1 \leqq B/A \leqq 10$.
- Always execute RES or turn power OFF and back ON when the electronic gear ratio is changed.
- Be sure to recalculate and correct user constants set in reference and speed reference units.

■ PRM34: Number of Encoder Pulses

- Set the number of pulses per encoder rotation.
- For a 12-bit absolute encoder: Set 1024 [P/R].
- For an incremental encoder:
  Set 2048 [P/R] (SGM-□□□312) or 2000 [P/R] (SGM-□□□512).

7.1.3 Torque Related Constants

■ PRM8: Forward External Current Limit

- Set the forward current limit. PRM8 is valid when contact input $\overline{\text{P-CL}}$ (1CN-11) is ON.
- Allowable setting range: 0 to maximum torque [%]

■ PRM9: Reverse External Current Limit

- Sets the reverse current limit. PRM9 is valid when contact input $\overline{\text{N-CL}}$ (1CN-12) is ON.
- Allowable setting range: 0 to maximum torque [%]

■ PRM28: Forward Torque Limit

- Set the forward torque limit.
- Allowable setting range: 0 to maximum torque [%]

■ PRM29: Reverse Torque Limit

- Set the reverse torque limit.
- Allowable setting range: 0 to maximum torque [%]

7.1.4 Sequence Related Constants

■ PRM6: Positioning Completed Width

- Set the range for the positioning complete signal output ($\overline{\text{COIN}}$).
- Allowable setting range: 0 to 100 [reference units]

■ PRM15: Delay Time from Brake Reference Output to Servo OFF Operation

- Sets the time delay from the brake reference output to Servo OFF when using a Servomotor with a brake.
- Allowable setting range: 0 to 50 [× 10 ms]

■ PRM16: Mechanical Brake ON Enabled Speed with Servo OFF

- Set the motor rotation speed that turns the mechanical brake ON (signal open) with the Servo OFF.
- PRM16 holds the mechanical brake open when motor rotation speed exceeds this setting.
- Allowable setting range: 0 to maximum speed [speed reference units]

■ PRM17: Delay Time from Servo OFF to Forced Brake ON During Motor Rotation

PRM17 prevents the mechanical brake from being applied immediately when motor rotation exceeds the mechanical brake ON enabled speed with the Servo OFF. PRM17 designates brake ON (signal OPEN) regardless of motor rotation speed after this specified time elapses.

- Allowable setting range: 0 to 1000 [× 10 ms]

■ PRM25: Command Distribution Completed Signal Width

- PRM25 is valid only when the CLT signal (1CN-9) is converted to command distribution completed signal (PRM39 bit 10 = 1).
- PRM25 sets the number of pulses left until command distribution completed signal is output.
- Allowable adjustment range: 0 to 30000 (reference units)
- The unit for PRM25 is (× 100 reference units) when PRM39 bit 11 is set to 1.

7.1.5 Other Constants

■ PRM14: Overflow

- Set the overflow detection level.

- Allowable setting range: 1 to 65535 [× 100 reference units]

PRM18: Origin Return Speed

- Set the initial speed for origin return.
- PRM18 is set in speed reference units. The direction is determined by PRM36 bit 0.

PRM19: Origin Return Creep Speed

- Set the speed for locating the origin after the deceleration limit switch signal turns ON during a origin return.
- PRM19 is set in speed reference units.

PRM20: Origin Return Final Travel Distance

- Set the distance from the origin return (encoder C-phase pulse) to the origin.
- PRM20 is set in position reference units and requires a sign.
- If the direction of the setting is opposite of the origin return direction, the Servomotor will decelerate to a stop after detecting the origin, and reverse directions.

PRM21: Origin Return Strike Time and Strike Torque

- Set the strike time and strike torque when the method used to origin return (PRM39 bits 4 to 6) is set to 5 or 6.
- Last two digits (00 to 99): Strike torque (% units) <5 decimal digits>
- First three digits (0 to 300): Strike time (10-ms units)

  Example: `PRM21 = 5070` ..... Strike continuously for 500 ms at 70% torque.

PRM26 and PRM27: JOG Speed

- Set the JOG-mode speed for running forward or reverse depending on $\overline{\text{P-CL}}$ or $\overline{\text{N-CL}}$ contact input.
- The Servomotor runs at the first JOG speed set in PRM26 when the $\overline{\text{P-CON}}$ signal is OFF, and runs at the second JOG speed set in PRM27 when the P-CON signal is ON.
- Allowable setting range: 0 to maximum speed (PRM4)
- Speed reference units: Position reference units × 1000/min

PRM30: Forward Software Limit/PRM31: Reverse Software Limit

- Set the limits to the range of motion. A Servomotor with an absolute encoder or an incremental encoder that returns to origin cannot move beyond these limits.
- They are used to check the range when a run start command is received via serial communications. The Servomotor does not start moving if the reference position is outside the range.
- The Servomotor moves up to the software limit and then stops when an external JOG signal is received.

- Set PRM30 and PRM31 to 0 in systems that do not use software limits.

■ PRM35: Axis Number

- Be sure to give each Servopack a unique number when multiple Servopacks are connected in parallel on a single transmission line. Add an axis designation number in front of all communications commands to send commands only to the required axes. Axis numbers range from 01 to 98.
- Setting this parameter enables communications for the relevant Servopack only.
- PRM36 to PRM39 are bit parameters. Convert bits 15 (MSB) to 0 (LSB) to hexadecimal in PRM command settings.

7.1.6 Memory Switches

■ PRM 36 Bit 0: Origin Return Direction

- When using an absolute encoder, PRM36 is valid only if PRM36 bit 1 is set to 1.
- Set the origin return direction to 0 for a positive direction (+) and to 1 for a negative direction (–).

■ PRM36 Bit 1: Change the Origin Return Method

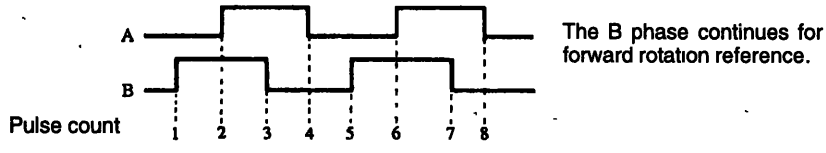
- When PRM36 bit 1 is set to 0 with an incremental encoder, the ZRN command will return the Servomotor to the origin the same way as setting PRM39 bits 6 to 4 to 0. With an absolute encoder, the ZRN command positions the Servomotor at the position set in PRM20.
- When PRM36 bit 1 is set to 1, the Servomotor will return to the origin the same way as setting PRM39 bits 6 to 4 to 1 for both absolute and incremental encoders.

■ PRM36 Bit 2: Encoder Selection

- Set PRM36 bit 2 to 0 for an incremental encoder and to 1 for an absolute encoder.

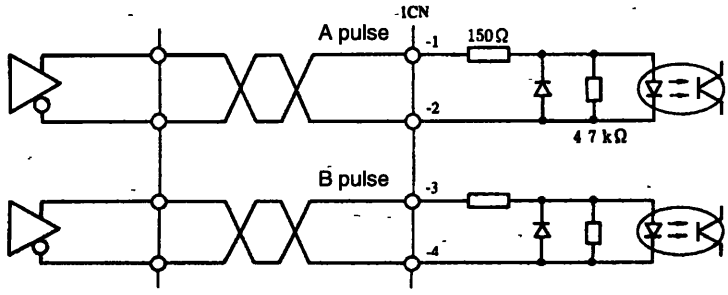
■ PRM36 Bit 3: Pulse Train Input

- The Servomotor moves by pulse train reference when PRM36 bit 3 is set to 1.
- The reference pulse is a two-phase pulse 90° phase difference, and is counted using a multiplier of 4. A reference of one reference unit is given one count.
- The pulse form and multiplier cannot be changed.



Note 1. Pulse inputs are ignored during serial commands as well as during JOG operations and cannot be cleared from the error counter.

2. Be sure to input pulses equivalent to 5-V line driver signals.



■ PRM36 Bits 7 to 4: Pulse Count Check for Absolute Encoder Cycle

- This settings is valid only when using an absolute encoder.
- PRM36 bits 7 to 4 are used to check whether the number of PG pulses (A and B phase) between origin pulses (C phase) match the number of pulses per encoder rotation when an absolute encoder is used. Set the allowable errors.
  Units: Encoder pulse units
- An encoder alarm (ALM80.POS) occurs when the error exceeds this setting, but the check is not performed if the bits are set to 0.

■ PRM36 Bit 8: Ignore with No Axis Number

- When this bit is set to 0, serial commands with no axis number are valid for all axes. Set this bit to 0 if there is only one axis.
- When this bit is set to 1, serial commands with no axis number are ignored. Add axis number 99 to make commands valid for all axes.

■ PRM36 Bit 9: Error Signal Return

- An ERR SN will be returned when a serial command receive error occurs when PRM36 bit 9 is set to 1. Only the designated axis will return a signal.
- The receive errors given below both return ERR SN.
  Illegal text and numbers
  The received command cannot be executed.
  (An ST command when the Servo is OFF or the reference is outside the software limits.)

■ PRM36 Bit 10: OK Signal Return

- When this bit is set to 1, OK is returned when a serial command is received normally. An OK may be returned even if the serial command is not valid as when SVOFF is received while the Servo is OFF or when ARES is received when there is no alarm.

Note OK is not returned when a RES command is received because status is initialized the same as turning power OFF and ON.

■ PRM36 Bit 11: Received Text Return

- When this bit is set to 1, received text is returned after an OK (receive normal) or ER (receive error), but only from the designated axis. The text is returned without the axis number, and is returned one space after OK or ER.

  Example: `02SPD5000` — Command (Host controller to Servopack)
  `OK SPD5000` — Returned (Servopack to host controller)

■ PRM36 Bits 12 and 13: Mode Switch Selection

- Set the mode switch switching conditions. See *5.7.3 Functions that Improve Response* for more details on mode switching.

  Bits 13 and 12 = 0, 0: Torque
  Bits 13 and 12 = 0, 1: Speed
  Bits 13 and 12 = 1, 0: Acceleration
  Bits 13 and 12 = 1, 1: Error pulse

- Set the mode switching level in PRM7.

Note When changing switching conditions, be sure to change PRM7 to suit the new conditions.

■ PRM36 Bit 14: Starting Point Change

- When this bit is set to 0, the reference position (target position for the previous reference) is set as the starting point for an incremental reference (MOVI, POSI) during current limit.
- When this bit is set to 1, the current position (position where the Servomotor stopped) is set as the starting point for an incremental reference (MOVI, POSI) during current limit.

■ PRM37 Bit 0: S-ON Signal Mask

- When this bit is set to 1, the S-ON signal (1CN-14) is disabled.

■ PRM37 Bit 1 OT Signal Mask

- When this bit is set to 1, the P-OT signal (1CN-16) and the N-OT signal (1CN-17) are disabled so the Servomotor cannot run even when these signals are OPEN.

■ PRM37 Bit 2: External JOG Signal

- When this bit is set to 1, the P-CL signal (1CN-11), N-CL signal (1CN-12), and P-CON signal (1CN-15) are set as external JOG run reference signals.

  P-CL → JOG+ (JOG forward reference, forward when ON and stopped when OFF)
  N-CL → JOG– (JOG reverse reference, reverse when ON and stopped when OFF)
  P-CON → SP2ND (2nd JOG speed selection, PRM26 speed when ON and PRM27 speed when OFF)

PRM37 Bit 3: ALMRST Signal Mask

- When this bit is set to 1, the ALMRST signal (1CN-18) is disabled.

PRM37 Bit 4: Inverted DEC Signal

- When this bit is set to 1, the logic of the deceleration signal (DEC, 1CN-18) when the Servomotor origin return is reversed. The Servomotor starts decelerating when the DEC turns OFF, and searches for an origin pulse when the signal turns back ON.

PRM37 Bits 7 and 6: Special Input Signal

- Enable input signals to execute serial commands and other functions. Set bits 7 and 6 to 0 and 1, respectively, to enable the special input signals. Be sure to mask the input signals at PRM37 bit 3 and bits 1 to 0, or both functions will be executed.
- When using this function, specify the function allotted to signals at PRM38 and PRM39 bits 3 to 0.

PRM37 Bit 8: ALM Signal Mask

- When this bit is set to 1, the ALM signal (1CN-34) is removed from the servo status output. Here, the ALM signal changes with the serial command `OUT = b3 b2 b1 b0`, where b0 = 0 turns the mask OFF and b0 = 1 turns the mask ON.

PRM37 Bit 9: $\overline{\text{BK}}$ Signal Mask

- When this bit is set to 1, the $\overline{\text{BK}}$ signal (1CN-7) is removed from the servo status output. Here, the $\overline{\text{BK}}$ signal changes with serial command `OUT = b3 b2 b1 b0`, where b1 = 0 turns the mask OFF and b1 = 1 turns the mask ON.

PRM37 Bit 10: $\overline{\text{COIN}}$ Signal Mask

- When this bit is set to 1, the $\overline{\text{COIN}}$ signal (1CN-8) is removed from the servo status output. Here, the $\overline{\text{COIN}}$ signal changes with serial command `OUT = b3 b2 b1 b0`, where b2 = 0 turns the mask OFF and b2 = 1 turns the mask ON.

PRM37 Bit 11: CLT Signal Mask

- When this bit is set to 1, the CLT signal (1CN-9) is removed from the servo status output. Here, the CLT signal changes with serial command `OUT = b3 b2 b1 b0`, where b3 = 0 turns the mask OFF and b3 = 1 turns the mask ON.

PRM37 Bit 12: Inverted ALM Signal Output

- When this bit is set to 1, the logic of the ALM signal (1CN-34) is reversed. Here, the ALM signal is OFF during normal operation and is ON when an alarm occurs.

PRM37 Bit 13: Inverted $\overline{BK}$ Signal Output

- When this bit is set to 1, the logic of the $\overline{BK}$ signal (1CN-7) is reversed. Here, the $\overline{BK}$ signal is OFF when the motor is ON and is ON during base block.

PRM37 Bit 14: Inverted $\overline{COIN}$ Signal Output

- When this bit is set to 1, the logic of the $\overline{COIN}$ signal (1CN-8) is reversed. Here, the $\overline{COIN}$ signal is OFF when positioning is completed and is ON for all other cases.

PRM37 Bit 15: Inverted CLT Signal Output

- When this bit is set to 1, the logic of the CLT signal (1CN-9) is reversed. Here, the CLT signal is OFF during current limit and is ON when current limit is OFF.

PRM38 and PRM39 Bit 3 to 0: Input Signal Allocation

- Set the input signal allocation when PRM37 bits 7 and 6 are 0 and 1.

PRM38 bits 15 to 12:	Allocated to the N-CL signal (1CN-12)
PRM38 bits 11 to 8:	Allocated to the P-CL signal (1CN-11)
PRM38 bits 7 to 4:	Allocated to the P-CON signal (1CN-15)
PRM38 bits 3 to 0:	Allocated to the S-ON signal (1CN-14)
PRM39 bits 3 to 0:	Allocated to the ALMRST signal (1CN-18)

- The settings are as follows:

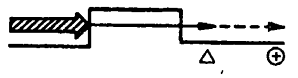
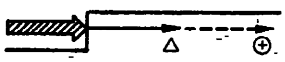
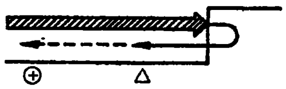
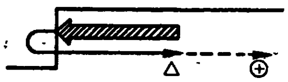
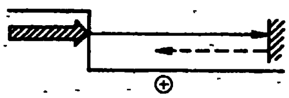
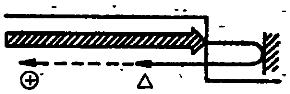
0:	No special operation. Always set unmasked signals at 0.
1:	SVON command
2:	PCON command
3:	ST command
4:	HOLD command (HOLD when OFF, run enabled when ON)
5:	RP command
6:	SKIP command
7:	ZRN command
8:	ARES command

PRM39 Bits 6 to 4: Selection of Origin Return Method

- Select the method used to origin return when PRM36 bit 1 is set to 1.
- The parameters used in origin return are listed below.

PRM18:	Origin return speed
PRM19:	Origin return creep speed
PRM20:	Origin return final travel distance
PRM21:	Origin return strike time and torque (PRM39 bits 6 to 4 must be 5 or 6)
PRM36 bit 0:	Origin return direction
PRM36 bit 1:	Change the origin return method
PRM37 bit 4:	Inverted DEC signal
PRM39 bits 6 to 4:	Selection of origin return method
PRM39 bit 7:	Origin pulse selection

- The settings values are described in the following table.

Setting	Move Status	Description
0		Moves the equipment the distance to the origin based on the initial C-phase pulse position after exceeding deceleration limit switch in order to set the origin just as with returning to the origin using standard settings.
1		Moves the equipment the distance to the origin based on the initial C-phase pulse when deceleration limit switch turns ON in order to set the origin.
2		Moves the equipment in reverse when deceleration limit switch turns ON and moves it the distance to the origin based on the initial C-phase pulse when deceleration limit switch turns OFF in order to set the origin.
3	 (When deceleration limit switch turns ON)	Functions the same as 1, above, when returning the equipment to the origin from the deceleration-limit switch OFF position. When returning to the origin from the deceleration limit switch ON position, the equipment moves in reverse and then reverses direction when the deceleration limit switch signal turns OFF. After that, it again functions the same as 1, above.
5		After the equipment strikes the movement limit, it moves the distance to the origin in the reverse direction in order to set the origin
6		After the equipment strikes the movement limit, it moves in the reverse direction and moves the distance to the origin based on the initial C-phase pulse when deceleration limit switch turns ON in order to set the origin

Note 1. Symbols in the figure indicate the following:

⇒ Origin return speed (PRM18)

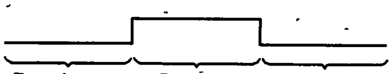
→ Origin return creep speed (PRM19)

--→ Move the return to origin distance (PRM20)

△ Origin pulse (C-phase pulse) position

⊕ Return to origin complete position

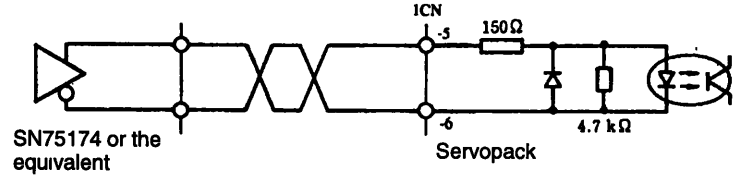
2. ⎍ indicates deceleration limit switch status.



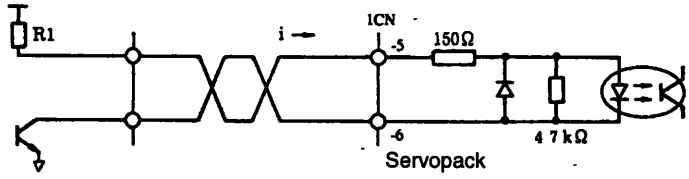
3. Codes can be used to set the direction of movement for distance to origin (PRM20). Care must be taken with this setting, however, because the direction of movement is limited using return to origin by striking when PRM39 bits 4 to 6 are set to 5.

■ PRM39 Bit 7: Origin Pulse Selection

- When this bit is set to 0, the encoder origin pulse (C phase) is set as the reference position for returning to the origin.
- When this bit is set to 1, the leading edge of the CLR signal (1CN-5 and 6) is set as the reference position for returning to the origin. Be careful here because the voltage level of the CLR signal varies with other I/O signals.



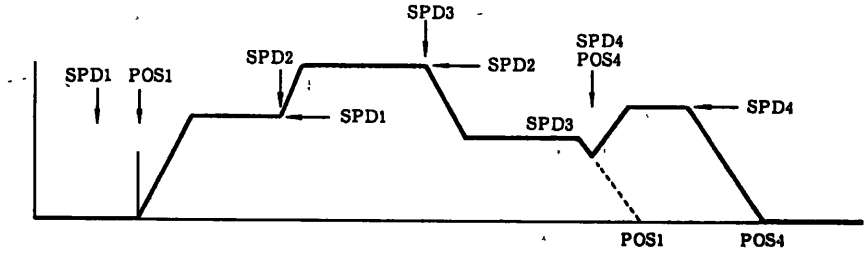
or

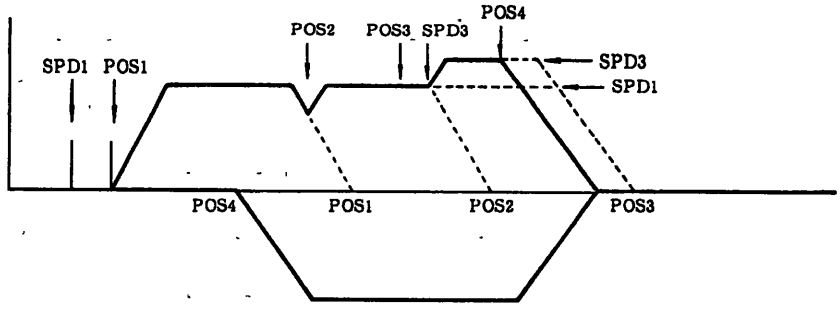


i = 6.6 to 15.3 mA
R1 examples: 1 kΩ when the VCC is 12 V
180 Ω when the VCC is 5 V

■ PRM39 Bit 8: Overwrite Method

- When this bit is set to 0, the position and speed reference commands are ignored while the equipment is moving.
- When this bit is set to 1, position and speed reference commands entered while the equipment is moving are enabled immediately.

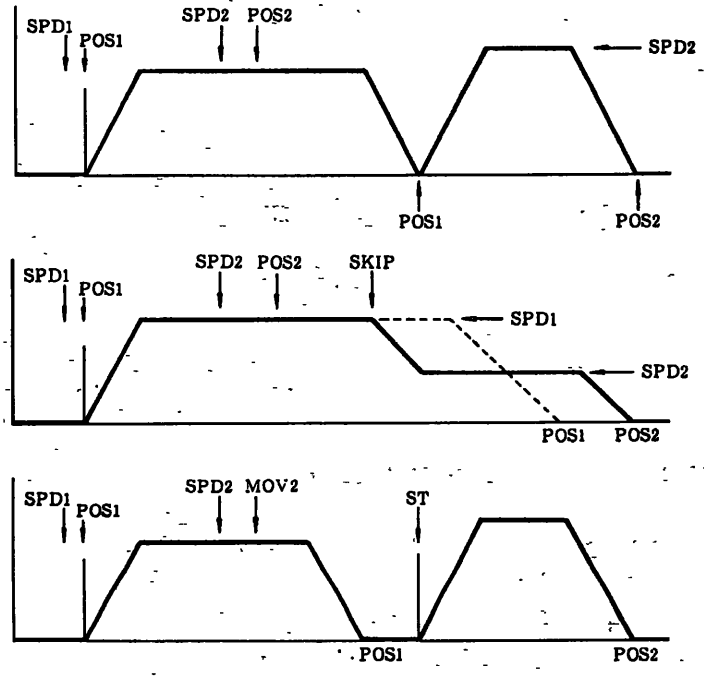




■ PRM39 Bit 9: Reference Buffer Method

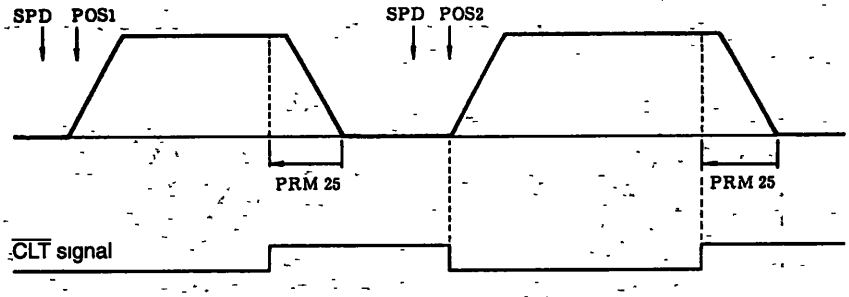
- When this bit is set to 0, the position and speed reference commands are ignored while the equipment is moving.
- When this bit is set to 1, the position and speed reference commands entered while the equipment is moving are held as a single group and enabled when operation ends or when operation is aborted by a SKIP command.

Note The Servomotor will not stop even if a SKIP command is sent when the reference commands given below are received.



■ PRM39 Bit 10: Pulse Distribution Completed Signal

- When this bit is set to 1, the CLT signal output (1CN-9) is switched to the pulse distribution completed signal after current limit is detected. The number of pulses remaining before outputting the pulse distribution completed signal is set to PRM25 in reference units.



■ PRM39 Bit 11: Multiplier for Distribution Completed Signal Width

- PRM39 bit 11 is valid only when PRM39 bit 10 is set to 1.
- When this bit is set to 1, the unit for PRM25, which is used to set the range for the output completed signal above, is changed from reference units to (x 100 reference units). This parameter is useful for creating signals when passing points during operation.

■ PRM39 Bit 12: Ignore Parity

- When this bit is set to 0, the error characters are ignored during the parity check on the serial communications input.
- When this bit is set to 1, a parity check is not performed on the serial communications input.

7.2 User Constants

This following is a list of user constants.

Table 7.1 List of User Constants

No.	Digits (Bits)	Name (Description)	Units	Upper and Lower Limits	Factory Setting
1		Position loop gain	1/s	1 to 250	40
2		Speed loop gain	Hz	1 to 2000	80
3		Speed loop integration time constant	ms	2 to 10000	20
4		Maximum speed	Speed reference units	0 to 50000	37000
5		Acceleration/deceleration time	ms	0 to 1000	100
6		Positioning completed width	Reference units	1 to 250	1
7		Mode switch level Torque Speed Acceleration/deceleration Error pulse	 % Speed reference units Speed/100 ms Reference units	 0 to max. 0 to max. 0 to max. 0 to 10000	200
8		Forward external current limit	%	0 to max.	100
9		Reverse external current limit	%	0 to max.	100
10		Torque reference filter time constant	× 100 µs	0 to 250	4
11		Feed forward compensation	%	0 to 100	0
12		Feed forward reference filter	100 µs	0 o 500	0
13		Bias	Speed reference units	0 to 450	0
14		Overflow	× 100 reference units	1 to 50000	500
15		Time delay from brake ON to Servo OFF	× 10 ms	0 to 50	0
16		Mechanical brake ON enabled speed with the Servo OFF	Speed reference units	0 to max.	100
17		Time from Servo OFF to forced brake ON during motor rotation	× 10 ms	0 to 1000	0
18		Origin return speed	Speed reference units	1 to max.	1000
19		Origin return creep speed	Speed reference units	1 to max.	200
20		Origin return final travel distance	Reference units	±30000	0
21	Last two digits	Origin return strike torque	%	0 to 99	0
	First three digits	Origin return strike time	× 10 ms	0 to 300	0
22 23 24		Not used.			0 0 0
25		Pulse distribution completed signal range	Reference units	0 to 30000	0

No.	Digits (Bits)	Name (Description)	Units	Upper and Lower Limits	Factory Setting
26		1st JOG speed	Speed reference units	0 to max.	1000
27		2nd JOG speed	Speed reference units	0 to max.	200
28		Forward torque limit	%	0 to max.	Max.
29		Reverse torque limit	%	0 to max.	Max.
30		Forward software limit	× 100 reference units	±30000	0
31		Reverse software limit	× 100 reference units	±30000	0
32		Electronic gear ratio B (no. of pulses)		30000	1
33		Electronic gear ratio A (no. of units set)		30000	1
34		Number of encoder pulses	P/R	513 to 32768	2048
35		Axis number		0 to 99	99
36	b15	Not used.		0	0
	b14	Starting point change (for an incremental reference during current limit) 0: Previous reference position 1: Current position		0, 1	0
	b13 to b12	Mode switch selection 00: Torque, 01: Speed, 10. Acceleration/deceleration, 11: Error pulse		00 to 11	00
	b11	1: Received text return		0, 1	0
	b10	1: OK signal return		0, 1	0
	b9	1: Error signal return		0, 1	0
	b8	1: Ignore with no axis number		0, 1	0
	b7 to b4	Pulse count check for absolute encoder cycle	PG pulses	000 to 101	000
	b3	1: Pulse train input		0, 1	0
	b2	1: Absolute encoder		0, 1	0
	b1	1: Change the origin return method		0, 1	0
	b0	Origin return direction: 0: + direction, 1: – direction		0, 1	0

No.	Digits (Bits)	Name (Description)	Units	Upper and Lower Limits	Factory Setting
37	b15	1: Inverted CLT signal output.		0, 1	0
	b14	1: Inverted $\overline{\text{COIN}}$ signal output.		0, 1	0
	b13	1: Inverted $\overline{\text{BK}}$ signal output.		0, 1	0
	b12	1: Inverted ALM signal output.		0, 1	0
	b11	1: CLT signal mask		0, 1	0
	b10	1: $\overline{\text{COIN}}$ signal mask		0, 1	0
	b9	1: $\overline{\text{BK}}$ signal mask		0, 1	0
	b8	1: ALM signal mask		0, 1	0
	b7 to b6	Special input signals: 00: General, 01: Allocated		00, 01	00
	b5	Not used.		0	0
	b4	1: Inverted DEC signal		0, 1	0
	b3	1: ALMRST signal mask		0, 1	0
	b2	1: External JOG signal		0, 1	0
	b1	1: OT signal mask		0, 1	0
	b0	1: S-ON signal mask		0, 1	0
38	b15 to b12	N-CL signal allocation		0000 to 1000	0000
	b11 to b8	P-CL signal allocation		0000 to 1000	0000
	b7 to b4	P-CON signal allocation		0000 to 1000	0000
	b3 to b0	S-ON signal allocation		0000 to 1000	0000
39	b15	Not used.		0	0
	b14	Not used.		0	0
	b13	Not used.		0	0
	b12	1: Ignore parity		0, 1	0
	b11	1: Multiplier for pulse distribution completed signal width		0, 1	0
	b10	1: Pulse distribution completed signal		0, 1	0
	b9	1: Reference buffer method		0, 1	0
	b8	1: Overwrite method		0, 1	0
	b7	Origin pulse selection 0: C phase of PG, 1. CLR signal		0, 1	0
	b6 to b4	Selection of origin return method		000 to 110	000
	b3 to b0	ALMRST signal allocation		0000 to 1000	0000

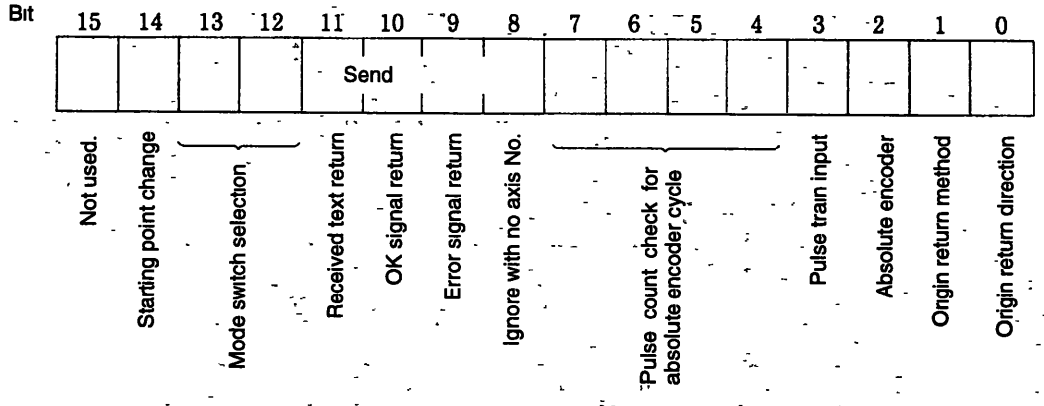
Note 1. Speed reference units are expressed as reference units × 1000/min.

2. The factory setting for PRM2 (speed loop gain) must meet the following conditions:
   Load inertia ≧ motor moment of inertia × 3
   Since vibrations will occur with these load settings with a small motor (no load inertia) or small load inertia, always set PRM2 at 40 or less prior to operation.
3. Be sure to set the electronic gear ratio (PRM32 and 33) so that 1 ≦ B (PRM32)/A (PRM33) ≦ 10.
4. To avoid possible danger, never change parameters starting at PRM28 (encoder selection, number of encoder pulses, etc.) while the Servomotor is ON (Servo ON).

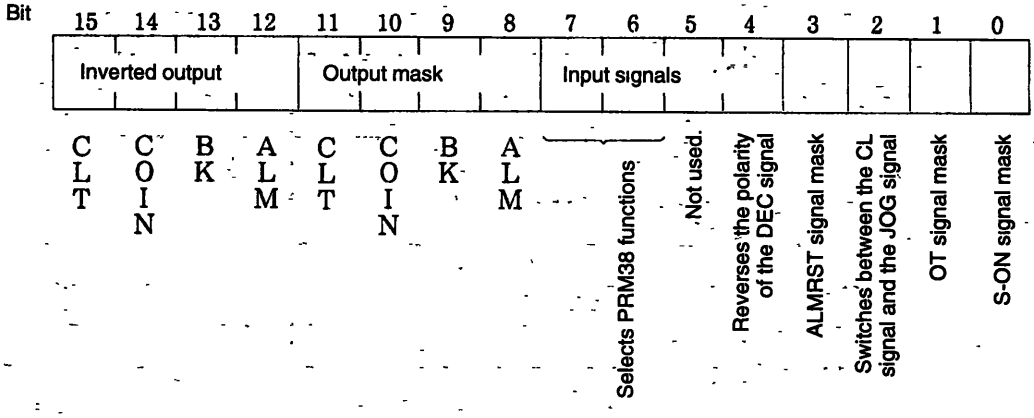
5. Changing parameters like the electronic gear ratio and number of encoder pulses may cause the Servomotor to run at a maximum speed outside the specified Servomotor speed range and may generate an A.04 alarm when power is turned ON. If this happens, check the reference units one more time.
6. Since the JOG reference is internally processed as POS±2097152, the Servomotor will stop after a set number of rotations.
7. Be sure to convert b15 (MSB) to b0 (LSB) to hexadecimal in 4-bit groups ((b15 to b12, b11 to b8, b7 to b4, b3 to b0) for parameters 36 to 39. Servopacks read and send bits in hexadecimal. The upper and lower limits as well as factory settings for parameters 36 to 39 in the table above are given in binary.

Parameter numbers PRM36, PRM37, PRM38 and PRM39 are illustrated below.

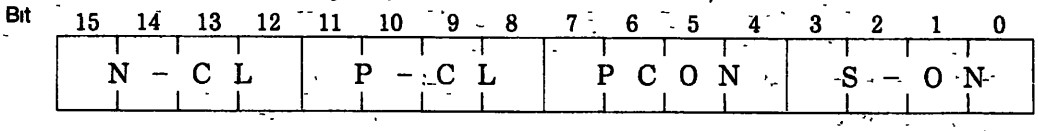
PRM36



PRM37



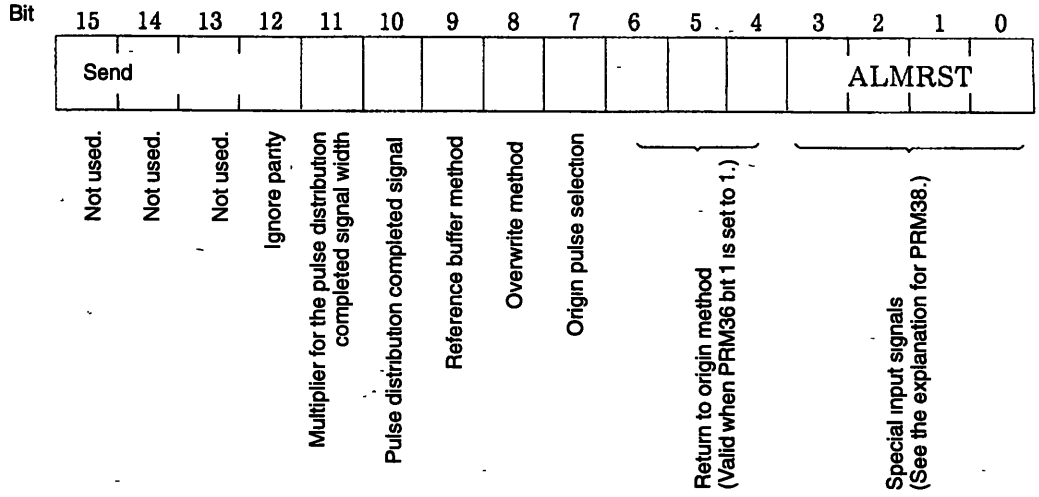
PRM38 Special input signals (Valid when PRM37 bit 6 is set to 1)



The following commands can be allocated to each signal.

0: None
1: SVON
2: PCON
3: ST
4: HOLD
5: RP
6: SKIP
7: ZRN
8: ARES

PRM39



8

Using the Digital Operator

This chapter describes the basic operation of the Digital Operator.

8.1 Switch Operation

Figure 8.1 shows the Digital Operator. The Digital Operator provides various functions, which are grouped under different Operating Modes. See *8.2 Basic Functions and Switching Modes*.

Note Use serial communications to send references, monitoring functions, and all other commands to an SGD-□□□H-series Servopack. When serial communications are not available (e.g., at system startup), functions such as monitoring and setting parameters for test operation and maintenance are possible with the SGD Digital Operator. The Digital Operator is used for maintenance work only, and not for normal operation.

When executing serial communications again after using the Digital Operator, be sure to turn OFF power before changing the connections.

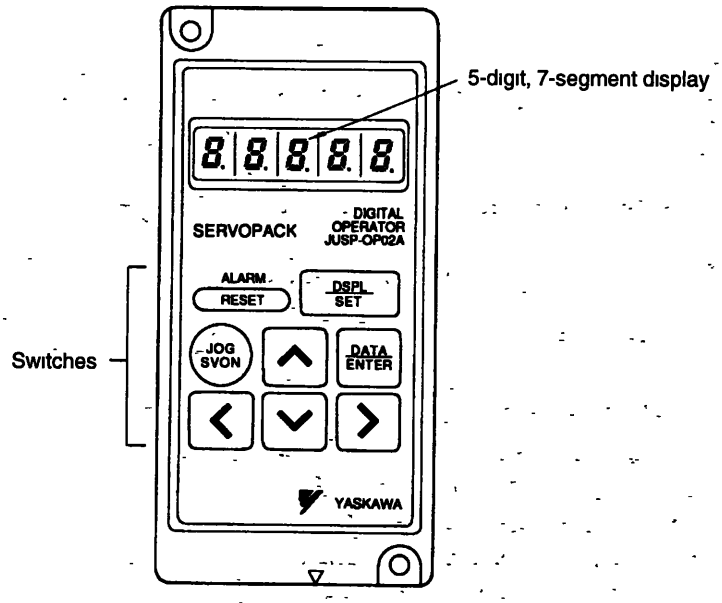


Figure 8.1 Digital Operator

8

8.2 Basic Function and Mode Selction

Table 8.1 shows the Digital Operator functions. The Status Display Mode is set when the control power supply is turned ON. Press the DSPL/SET Key as shown in *Figure 8.2* to switch modes.

Table 8.1 Digital Operator Functions

Mode	Function
Status Display	Displays status • Baseblock • Run • Alarm
Setting	Sets and displays user constants • Operating mode from Digital Operator (JOG). • Clears alarm traceback data. • Checks Servomotor parameters. • Checks the software version.
Monitor	Monitoring functions • Speeds • Torque references • No. of pulses from motor U-phase edge • Electrical angle • Internal status bits • Position error
Alarm Traceback	Displays previous alarms.

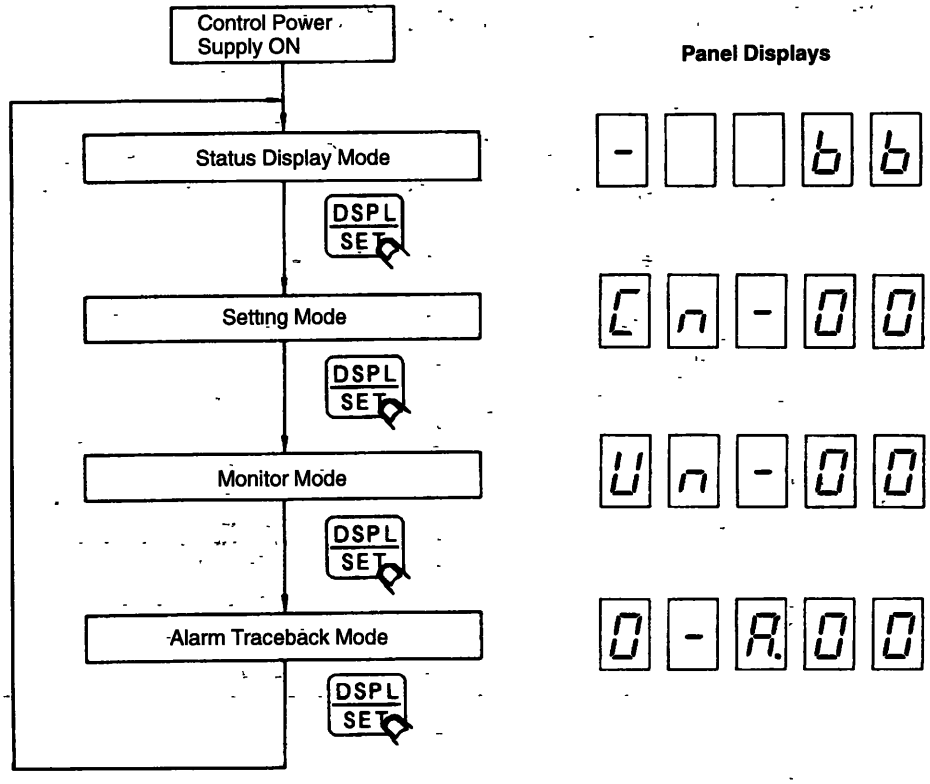


Figure 8.2 Changing Modes

8

8.3 Status Display Mode

The Status Display Mode displays Servopack status using bits and codes as shown in *Figure 8.3*. *Table 8.2* shows bit data and *Table 8.3* show the codes and status. ALARM/RESET is the reset switch for alarms, and DSPL/SET switches from Status Display Mode to Setting Mode.

The panel display is shown below.

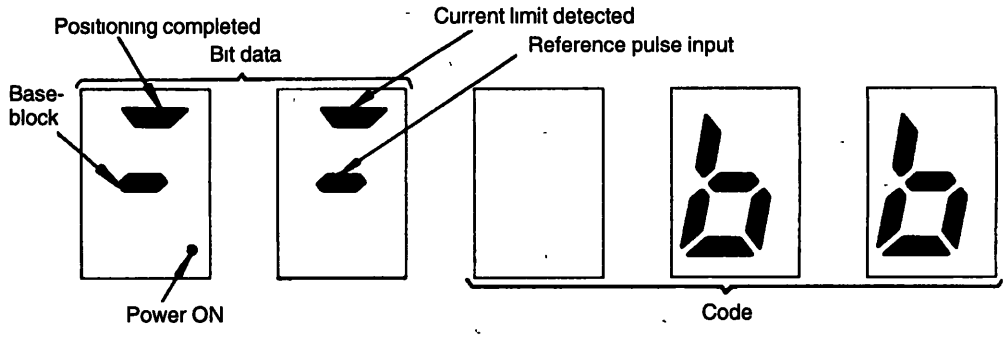


Figure 8.3 Status Display Mode

Table 8.2 Bit Data Description

Bit Data	Description
Power ON	Lit when Servopack power is ON.
Baseblock	Lit for base block, and not lit with Servo ON.
Positioning Completed	Lit when positioning has been completed.
Current Limit Detection	Lit if the torque reference is at the torque limit.

Table 8.3 Codes and Status

Code	Status
bb	Baseblock
run	Operating
Pot	Forward rotation prohibited
not	Reverse rotation prohibited
A00	Alarm status See *Table 8.7 Table of Alarms* on page 8 - 19.
A02	
⋮	

8.4 Setting Mode

The Setting Mode is used to perform the following operations.

- Set and display user constants.
- Operate the system from the Digital Operator.
- Clear alarm traceback data.
- Check Servomotor parameters.
- Check the software version.

8.4.1 User Constants

■ Setting Constants (Cn-01 to Cn-23)

The panel display is shown below.

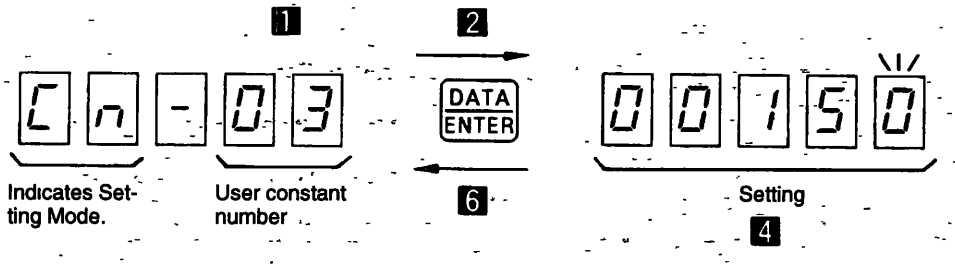


Figure 8.4 Setting User Constants

1. Set the user constant number using the Cursor Keys.
   - Select the digit that will be set using the LEFT and RIGHT Keys. The selected digit will flash.
   - Use the UP and DOWN Keys to increase or decrease the selected digit to the desired user constant number.
2. Press the DATA/ENTER Key to display the setting of the user constant.
3. Change the setting using the Cursor Keys. (The procedure here is the same described in step 1, above.)
4. Press the DSPL/SET Key to store the setting.
5. Repeat steps 1 to 4 above as many times as required.
6. Press the DATA/ENTER Key to return to the user constant number display.
7. Press the DSPL/SET Key to switch from Setting Mode to Monitor Mode.

See *Table 8.4* (p 8 - 7) for a list of user constants.

■ Setting Memory Switches (Cn-24 to Cn-27)

User constants Cn-24 to Cn-27 are used to set bits used as memory switches. The procedure used to set user constant numbers and display settings are the same as those given in steps 1. and 2. in the above procedure.

The panel display is shown below.

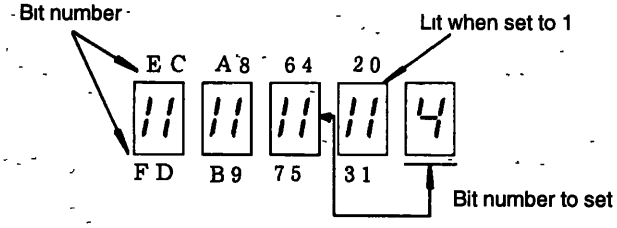


Figure 8.5 Bit Data Display

1. Use the LEFT and RIGHT Keys to set the bit number of the memory switch that will be set on the right side of the panel.
2. Use either the UP or DOWN Key to turn ON and OFF the memory switch.
3. Repeat steps 1 and 2, above, as many times as required.
4. Press the DSPL/SET Key to store the setting.
5. Press the DATA/ENTER Key to return to the user constant number display.
6. Press the DSPL/SET Key to switch from Setting Mode to Monitor Mode.

■ User Constants

The following is a list of user constants.

Table 8.4 List of User Constants

Cn No.	Parameter No.	Bits	Name (Description)	Unit	Upper and Lower Limits	Factory Setting
01	1		Position loop gain	1/s	1 to 250	40
02	2		Speed loop gain	Hz	1 to 2000	80
03	3		Speed loop integration time constant	ms	2 to 10000	20
04	4		Maximum speed	Speed reference units	0 to 50000	37000
05	5		Acceleration/deceleration time	ms	0 to 1000	100
06	6		Positioning completed width	Reference units	1 to 250	1
07	7		Mode switching level Torque Speed Acceleration/deceleration Error pulse	 % Speed reference units Speed/100 ms Reference units	 0 to max. 0 to max. 0 to max. 0 to 10000	200
08	8		Forward external current limit	%	0 to max.	100
09	9		Reverse external current limit	%	0 to max.	100

Cn No.	Parameter No.	Bits	Name (Description)	Unit	Upper and Lower Limits	Factory Setting
0A	10		Torque reference filter time constant	× 100 µs	0 to 250	4
0B	11		Feed-forward compensation	%	0 to 100	0
0C	12		Feed-forward reference filter	100 µs	0 to 500	0
0D	13		Bias	Speed reference units	0 to 450	0
0E	14		Overflow	× 100 reference units	1 to 50000	500
0F	15		Time from brake ON to Servo OFF	× 10 ms	0 to 50	0
10	16		Mechanical brake ON enabled speed with the Servo OFF	Speed reference units	0 to max.	100
11	17		Time from Servo OFF to forced brake ON during motor rotation	× 10 ms	0 to 1000	0
12	18		Origin return speed	Speed reference units	1 to max	1000
13	19		Origin return creep speed	Speed reference units	1 to max	200
14	20		Origin return final travel distance	Reference units	±30000 (see note)	0
15	21	Last two digits	Origin return strike torque	%	0 to 99	0
		First three digits	Origin return strike time	× 10 ms	0 to 300	0
16 17 18	22 23 24		Not used.			0 0 0
19	25		Pulse distribution completed signal range	Reference units	0 to 30000	0
1A	26		1st JOG speed	Speed reference units	0 to max.	1000
1B	27		2nd JOG speed	Speed reference units	0 to max.	200
1C	28		Forward torque limit	%	0 to max	max.
1D	29		Reverse torque limit	%	0 to max.	max.
1E	30		Forward software limit	× 100 reference units	±30000 (see note 3)	0
1F	31		Reverse software limit	× 100 reference units	±30000 (see note 3)	0
20	32		Electronic gear ratio B (no. of pulses)		30000	1
21	33		Electronic gear ratio A (no. of units set)		30000	1
22	34		Number of encoder pulses	P/R	513 to 32768	2048
23	35		Axis number		0 to 99	99

Cn No.	Parameter No.	Bits	Name (Description)	Unit	Upper and Lower Limits	Factory Setting
24	36	b15	Not used.		0	0
		b14	Starting point change (for an incremental reference during current limit) 0: Previous reference position 1: Current position		0, 1	0
		b13 to b12	Mode switch selection 00: Torque, 01: Speed, 10: Acceleration/deceleration, 11: Error pulse		00 to 11	00
		b11	1: Received text return		0, 1	0
		b10	1: OK return		0, 1	0
		b9	1: Error signal return		0, 1	0
		b8	1: Ignore with no axis number		0, 1	0
		b7 to b4	Pulse count check for absolute encoder cycle	PG pulses	000 to 101	000
		b3	1: Pulse train input		0, 1	0
		b2	1: Absolute encoder		0, 1	0
		b1	1: Change the origin return method		0, 1	0
		b0	Origin return direction. 0: + direction, 1. – direction		0, 1	0
25	37	b15	1: Inverted CLT signal output		0, 1	0
		b14	1: Invered $\overline{\text{COIN}}$ signal output		0, 1	0
		b13	1: Inverted $\overline{\text{BK}}$ signal output		0, 1	0
		b12	1: Inverted ALM signal output		0, 1	0
		b11	1: CLT signal mask		0, 1	0
		b10	1: $\overline{\text{COIN}}$ signal mask		0, 1	0
		b9	1: $\overline{\text{BK}}$ signal mask		0, 1	0
		b8	1: ALM signal mask		0, 1	0
		b7 to b6	Special input signals: 00. General, 01: Allocated		00, 01	00
		b5	Not used.		0	0
		b4	1: Inverted DEC signal		0, 1	0
		b3	1: ALMRST signal mask		0, 1	0
		b2	1: External JOG signal		0, 1	0
		b1	1: OT signal mask		0, 1	0
		b0	1: S-ON signal mask		0, 1	0
26	38	b15 to b12	N-CL signal allocation		0000 to 1000	0000
		b11 to b8	P-CL signal allocation		0000 to 1000	0000
		b7 to b4	P-CON signal allocation		0000 to 1000	0000
		b3 to b0	S-ON signal allocation		0000 to 1000	0000

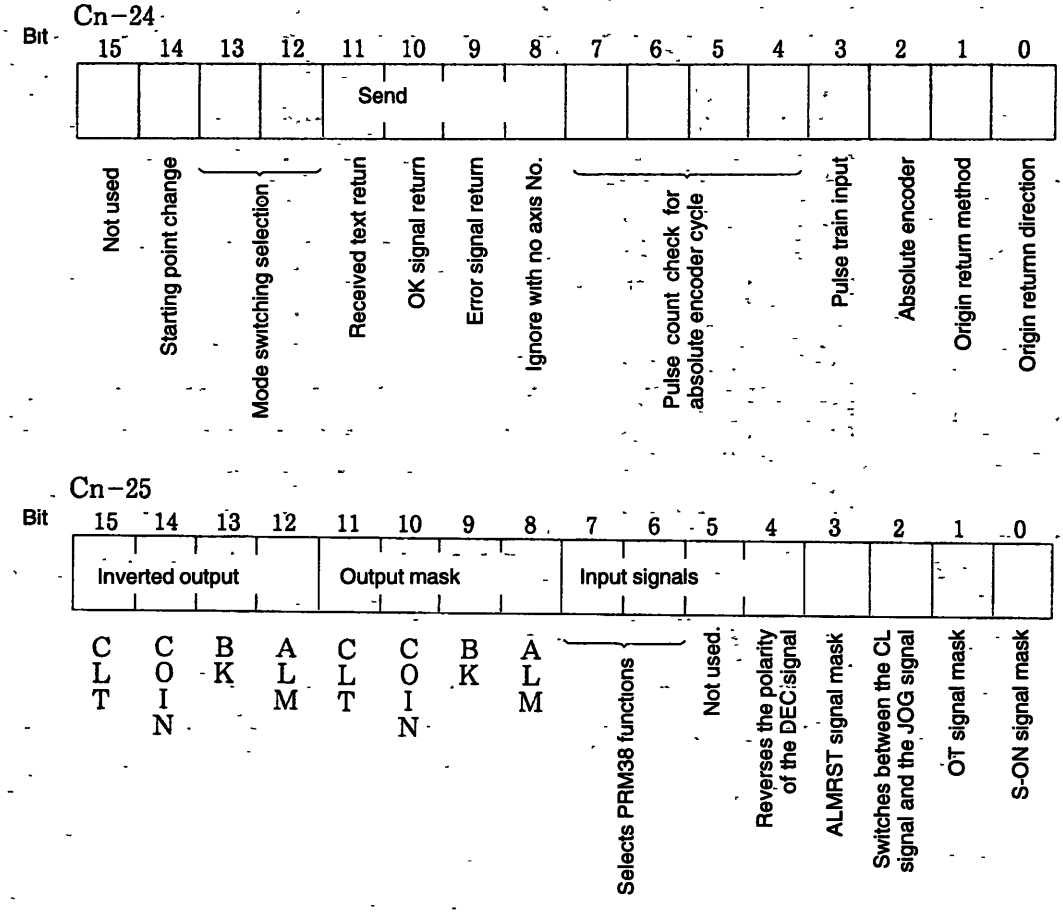
Cn No.	Parameter No.	Bits	Name (Description)	Unit	Upper and Lower Limits	Factory Setting
27	39	b15	Not used.		0	0
		b14	Not used.		0	0
		b13	Not used.		0	0
		b12	1: Ignore parity		0, 1	0
		b11	1: Multiplier for pulse distribution completed signal width		0, 1	0
		b10	1: Pulse distribution completed signal		0, 1	0
		b9	1: Reference buffer method		0, 1	0
		b8	1: Overwrite method		0, 1	0
		b7	Origin pulse selection 0: C phase of PG, 1: CLR signal		0, 1	0
		b6 to b4	Selection of origin return method		000 to 110	000
		b3 to b0	ALMRST signal allocation		0000 to 1000	0000

Note 1. Specify parameter numbers for Cn numbers in hexadecimal.

2. Use a bit pattern to set Cn-24 to Cn-27.

3. A 16-bit two's complement is used to set and display settings for Cn-14, Cn-1E, and Cn-1F. (Example: For −1000, the setting is 65536 − 1000 or 55536.)

User settings for Cn-24, Cn-25, Cn-26 and Cn-27 are illustrated below.



Cn−26 Special input signals (Valid when Cn-25 bit 6 is set to 1.)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	N − C L				P − C L				P C O N				S − O N			

The following commands can be allocated to each signal.

0: None
1: SVON
2: PCON
3: ST
4: HOLD
5: RP
6: SKIP
7: ZRN
8: ARES

Cn−27

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Send														ALMRST	

Bit 15: Not used.
Bit 14: Not used.
Bit 13: Not used.
Bit 12: Ignore parity
Bit 11: Multiplier for pulse distribution completed signal width
Bit 10: Pulse distribution completed signal
Bit 9: Reference buffer method
Bit 8: Overwrite method
Bit 7: Origin pulse selection
Bit 6 to 4: Return to origin method (Valid when PRM36 bit 1 is set to 1.)
Bit 3 to 0: Special input signals (See the explanation for PRM3)

8.4.2 Operation Using the Digital Operator

■ Setting Operation Mode

Set user constant Cn-00 to 00 to switch from the monitor panel to Operation Mode.

8

The panel display is shown below.

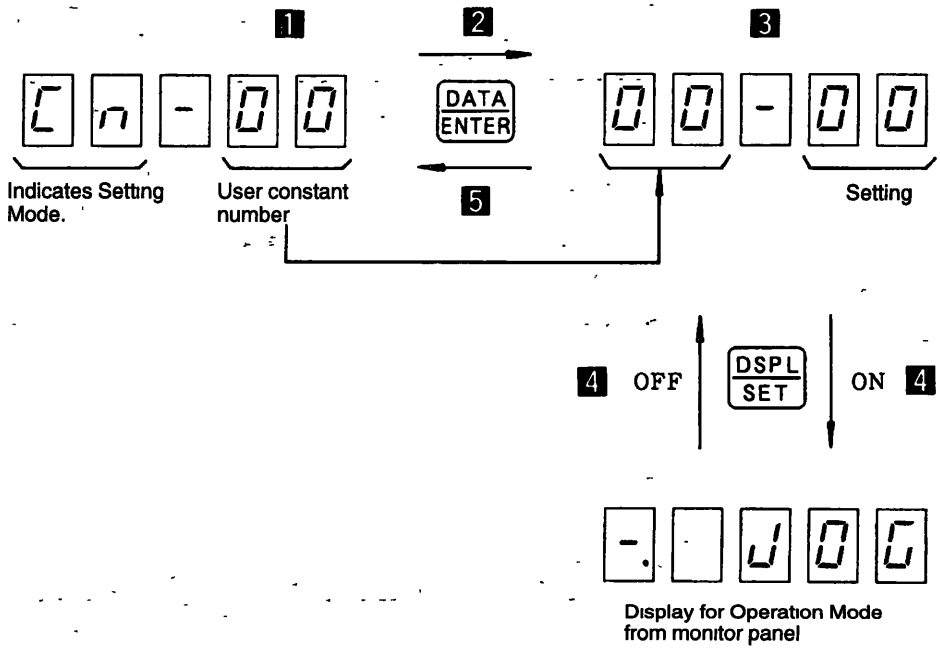


Figure 8.6 Operation Mode from the Digital Operator

1. Use the Cursor Keys to select user constant number 00.
2. Press the DATA/ENTER Key to display the setting of the user constant.
3. Use the Cursor Keys to set 00.
4. Press the DSPL/SET Key on the monitor panel to turn the Operation Mode ON and OFF.
5. Press the DATA/ENTER Key to return to the user constant number display.
6. Press the DSPL/SET Key to switch from Setting Mode to Monitor Mode.

■ Operation Using the Digital Operator

Be sure to set the size of the speed reference at user constant PRM27 (2nd JOG speed). See *7.2 User Constants* for more details on this setting.

1. Press the JOG/SVON Key to switch between SVON and SVOFF.
2. Press and hold the UP Key for reverse rotation.
3. Press and hold the DOWN Key for forward rotation.

Note The $\overline{\text{S-ON}}$ signal must be masked (Cn-25 bit 0 set to 1) if the $\overline{\text{S-ON}}$ signal is not used. Also be sure to mask the OT signal (Cn-25 bit 1 set to 1) if the N-OT and P-OT signals are not used.

8.4.3 Clearing Alarm Traceback Data

Set user constant Cn-00 to 02 to clear alarm traceback data.

The panel display is shown below.

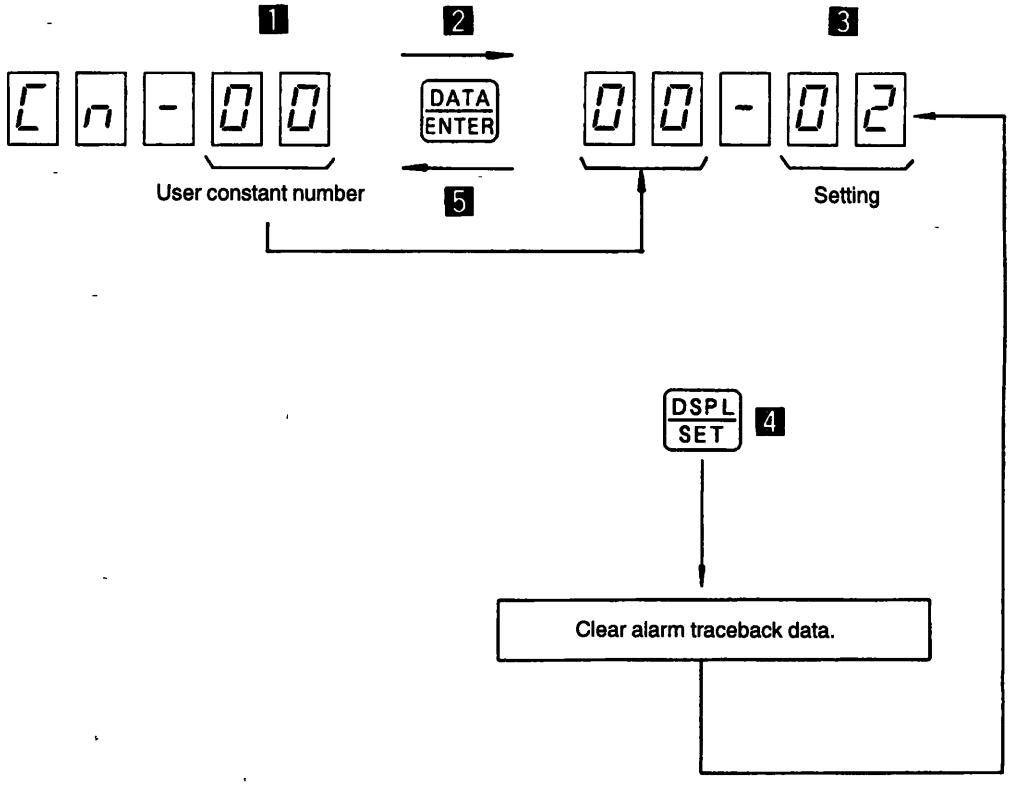


Figure 8.7 Clearing Alarm Traceback Data

1. Use the Cursor Keys to select user constant number 00.
2. Press the DATA/ENTER Key to display the setting of the user constant.
3. Use the Cursor Keys to set 02.
4. Press the DSPL/SET Key to clear alarm trace data and return to the display for user constant Cn-00.
5. Press the DATA/ENTER Key to return to the user constant number display.
6. Press the DSPL/SET Key to switch from Setting Mode to Monitor Mode.

8.4.4 Checking Servomotor Parameters

■ Checking Servomotor Parameters

Set user constant Cn-00 to 04 to switch to Servomotor parameter checking mode.

The panel display is shown below.

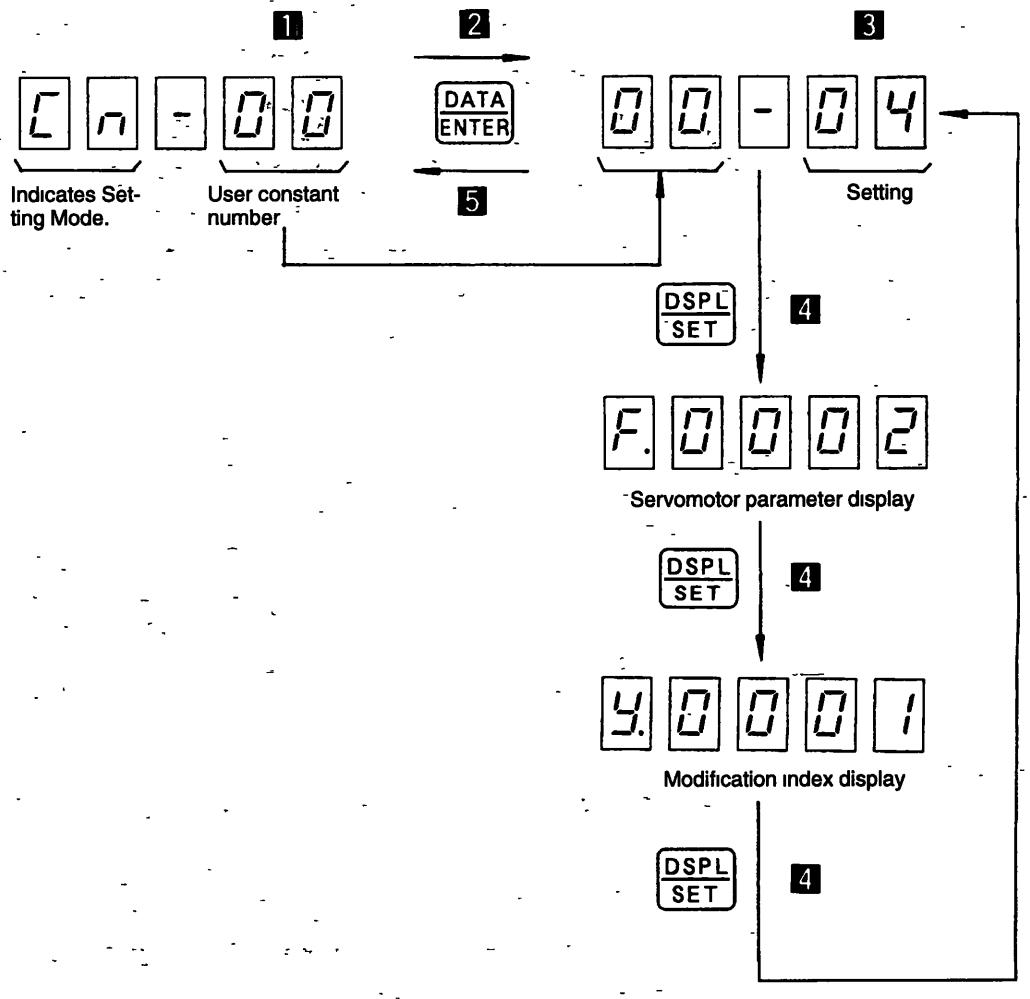


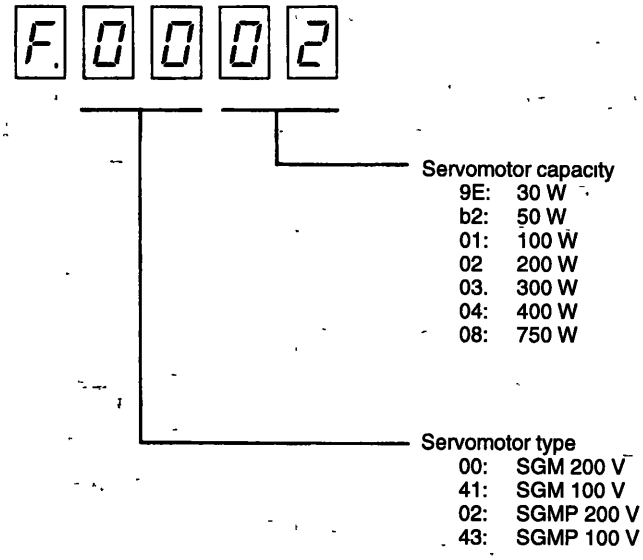
Figure 8.8 Display Changes when Checking Servomotor Parameters

1. Use the Cursor Keys to select user constant number 00.
2. Press the DATA/ENTER Key to display the setting of the user constant.
3. Use the Cursor Keys to set 04.
4. Press the DSPL/SET Key to check the Servomotor parameters.
5. Press the DATA/ENTER Key to return to the user constant number display.
6. Press the DSPL/SET Key to switch from Setting Mode to Monitor Mode.

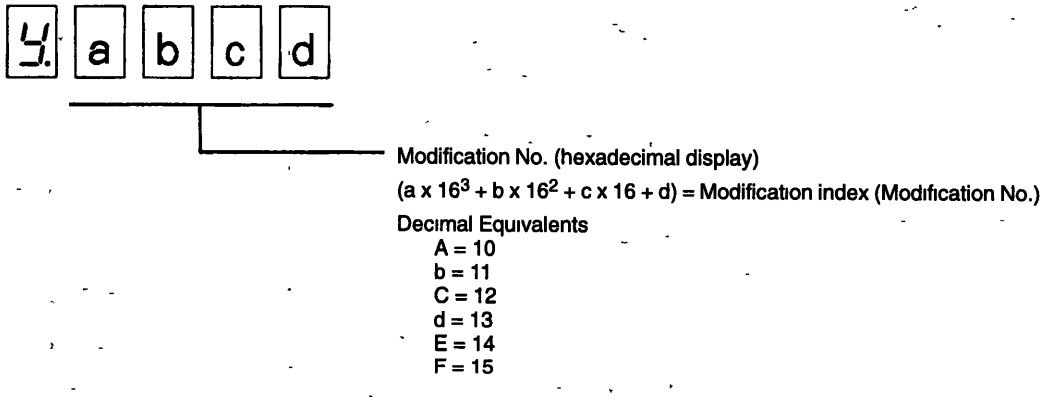
■ Parameter Display

The Servomotor type and modification index (modification No.) are displayed as shown below.

Servomotor Parameters



Modification Index (Modification No.)



8.4.5 Checking the Software Version

■ Setting the Software Version Checking Mode

Set user constant Cn-00 to 06 to switch to Software Version Checking Mode.

The panel display is shown below.

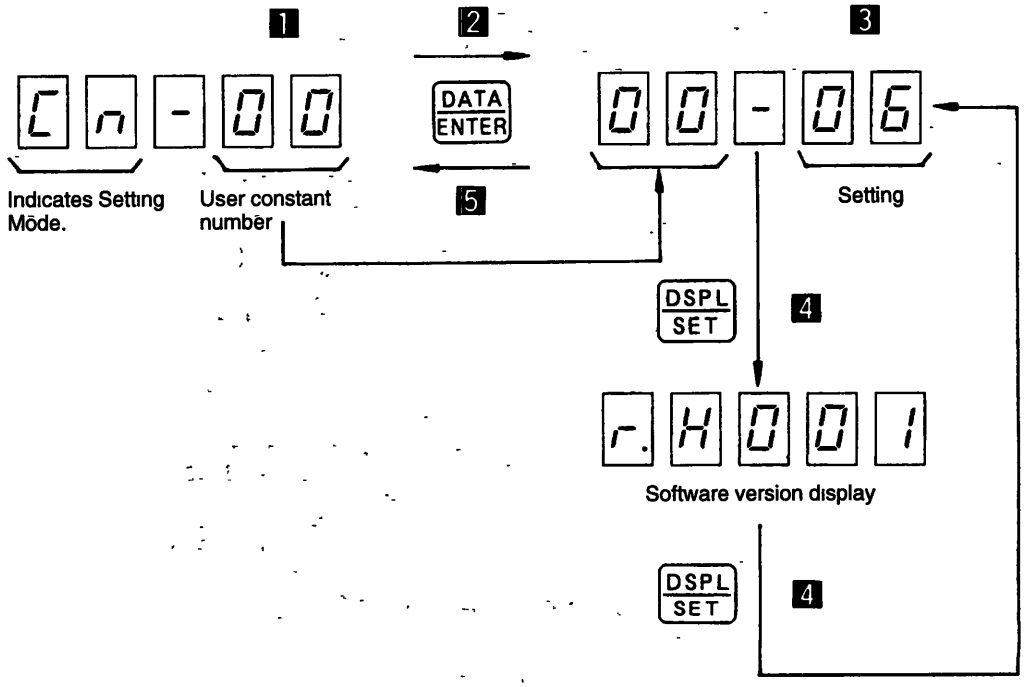
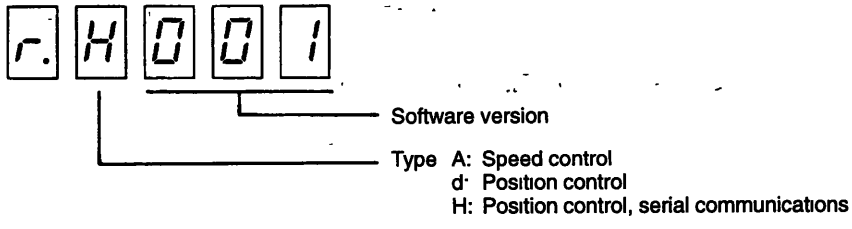


Figure 8.9 Display Changes when Checking the Software Version

1. Use the Cursor Keys to select user constant number 00.
2. Press the DATA/ENTER Key to display the setting of the user constant.
3. Use the Cursor Keys to set 06.
4. Press the DSPL/SET Key to switch to the adjustment mode.
5. Press the DATA/ENTER Key to return to the user constant number display.
6. Press the DSPL/SET Key to switch from Setting Mode to Monitor Mode.

■ Software Version Display



8.5 Monitor Mode

The Digital Operator can monitor the speed, torque and other references in Monitor Mode.

8.5.1 Monitor Display

The following table shows the types of monitoring available.

Table 8.5 Monitor Display

Monitor No.	Monitor Display
00	Feedback speed (r/min)
02	Torque reference (%)
03	No. of pulses from motor U-phase edge (pulse)
04	Electrical angle (deg)
05	Internal status bit display (See Table 8.6.)
08	Position error (reference units)

The panel display is shown below.

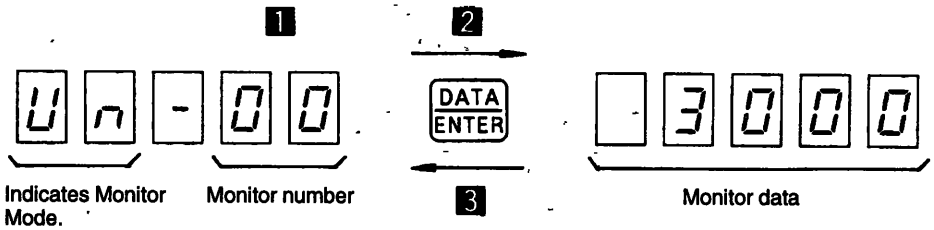


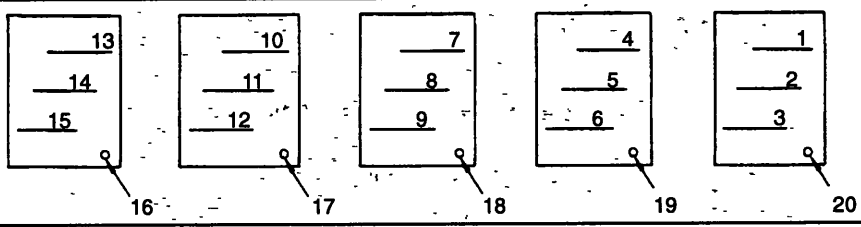
Figure 8.10 Display Changes in Monitor Mode

1. Use the UP and DOWN Keys to select monitor number to be used.
2. Press the DATA/ENTER Key to start the monitor display.
3. Press the DATA/ENTER Key to return to monitor number selection.
4. Press the DSPL/SET Key to switch from Monitor Mode to Alarm Traceback Mode.

8.5.2 Internal Status Bit Display in Monitor Mode

The following tables describes the bit displays for Un-05 internal status in Monitor Mode.

Table 8.6 Internal Status Bit Display in Monitor Mode (Un-05)



	Bit No.	Code	Description
Un-05	1	SVALM	Lit for a servo alarm.
	2	DBON	Lit when the dynamic brake is ON.
	3		Not used.
	4	CLT	Lit during current limit.
	5	$\overline{\text{COIN}}$	Lit when positioning has been completed
	6	MSON	Lit when the mode switch is ON.
	7	P-CL	Lit when forward current limit is ON.
	8	N-CL	Lit when reverse current limit is ON.
	9	B-ON	Lit when the Servomotor is ON.
	10	PA	Not lit when the A-phase encoder input signal is high.
	11	PB	Not lit when the B-phase encoder input signal is high.
	12	PC	Not lit when the C-phase encoder input signal is high.
	13	PU	Not lit when the U-phase encoder input signal is high (only for an incremental encoder).
	14	PV	Not lit when the V-phase encoder input signal is high (only for an incremental encoder).
	15	PW	Not lit when the W-phase encoder input signal is high (only for an incremental encoder).
	16	SVON	Lit when the servo is ON.
	17	P-CON	Lit for the P control input.
	18	P-OT	Lit for the forward rotation prohibited input.
	19	N-OT	Lit for the reverse rotation prohibited input.
	20		Not used.

8.6 Alarm Traceback Mode

The Alarm Traceback Mode is used to display data on previous alarms.

- The storage capacity for alarm data is up to 10 previous alarms.
- Traceback data A.99 for ten alarms is saved when the control power supply is turned ON or an alarm is reset (included in the 10 alarms).
- See *Table 8.7* for more details on traceback data and steps to be taken for alarms.

The panel display is shown below.

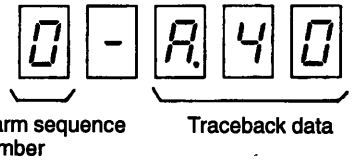


Figure 8.11 Alarm Traceback Mode

1. Press the UP and DOWN Keys to scroll through the alarm sequence numbers and display information on previous alarms. The higher the left-hand digit (alarm sequence number), the older the alarm data.)
2. Press the DSPL/SET Key to switch from Alarm Traceback Mode to Status Display Mode.

The following table lists alarm displays and traceback data provided by the Digital Operator.

Table 8.7 Alarm Displays and Traceback data Provided by the Digital Operator

Displayed Alam Code	Description
A.00	Absolute data error (only with an absolute encoder)
A.02	Parameter breakdown
A.04	Parameter setting error
A.10	Overcurrent (or overheated heat sink)
A.31	Overflow
A.40	Overvoltage
A.51	Overspeed (110% of maximum speed)
A.71	Overload (instantaneous peak load)
A.72	Overload (continuous peak load)

Displayed Alam Code	Description
A80	Absolute encoder error (only with an absolute encoder)
A81	Absolute encoder backup error (only with a 12-bit absolute encoder)
A82	Absolute encoder checksum error (only with a 12-bit absolute encoder)
A83	Absolute encoder battery error (only with a 12-bit absolute encoder)
A84	Absolute encoder absolute data error (only with a 12-bit absolute encoder)
A85	Absolute encoder overspeed (only with a 12-bit absolute encoder)
AC1	Servo overrun detected (improper Servomotor or encoder wiring)
AC2	Phase error (only with an incremental encoder)
AC3	PA or PB phase disconnection
AC4	PC phase disconnection
AF3	Power loss error (detected if power was reconnected within the power holding time)
A99	Not an alarm. Reset by resetting the alarm or turning Servopack power ON (only for traceback data).
The following are operator-related alarms that are not recorded in alarm traceback.	
CPF00	Digital Operator transmission error 1
CPF01	Digital Operator transmission error 2

9

Installation and Wiring

This chapter describes delivery item checking, installation, and wiring specifications for Servomotors and Servopacks.

9.1 Checking on Delivery

When Σ-Series products are delivered, check the following items:

Check Items	Remarks
Check if the delivered products are the ones you ordered.	Check the model numbers marked on the nameplates of Servomotor and Servopack.
Check for damage.	Check the overall appearance, and check for damage or scratches resulting from transportation.
Check if the motor shaft rotates smoothly.	If the motor shaft can be smoothly turned by hand, it is normal. If the motor has a brake, however, it cannot be turned manually.
Check loose screws.	Check for looseness by using a screwdriver as necessary.

If any of the above items are faulty or incorrect, contact the dealer from which you purchased the products or your nearest sales representative. Be sure to confirm that there are no loose screws, breakage in lead wires, or damage in insulation.

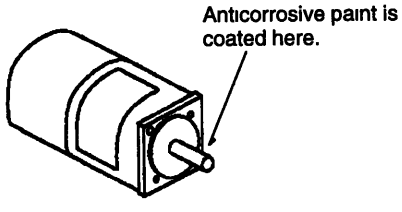
9.2 Installation

9.2.1 Installing the Servomotor

The Servomotor can be installed either horizontally or vertically. If the Servomotor is installed incorrectly or in an inappropriate location, the service life will be shortened or unexpected problems will occur. To prevent this, always observe the installation instructions provided below.

■ Before Installation

Anticorrosive paint is coated on the edge of the motor shaft to prevent corrosion during storage. Before installation, clean off the anticorrosive paint thoroughly using a cloth moistened with thinner.



IMPORTANT Avoid getting thinner on other parts of the Servomotor when cleaning the shaft.

■ Storage

Store the Servomotor in the following temperature range.

- –20°C to 60°C

Installation Site

The Servomotors are designed for indoor use. Install Servomotor in an environment which meets the following conditions:

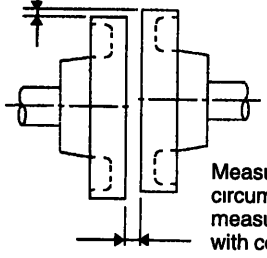
- Free from corrosive or explosive gases
- Well-ventilated and free from dust and moisture
- Ambient temperature of 0 to 40°C
- Relative humidity of 20% to 80% (with no condensation)
- Sufficient access for each inspection and cleaning

If the Servomotor is used in a location subject to water or oil mist, install a shield or cover over the Servomotor.

Alignment

Align the shaft of the Servomotor with that of the equipment to be controlled. When connecting couplings, be careful not to apply any impact to the shaft or excessive force on bearings. Install the Servomotor so that alignment accuracy falls within the range shown below.

Measure this distance at four different positions on the circumference. The difference between the maximum and minimum measurements must be 0.03 mm (0.0012 in) or less. (Turn together with couplings.)



Measure this distance at four different positions on the circumference. The difference between the maximum and minimum measurements must be 0.03 mm (0.0012 in) or less. (Turn together with couplings.)

IMPORTANT If the shafts are not aligned properly, vibration will occur, resulting in damage to the bearings.

Allowable Bearing Load

Do not apply any excessive thrust load or radial load to the AC Servomotor. When installing gears, couplings, pulleys, etc., be careful not to apply any impact to the shaft or excessive force on bearings. Mechanical shock to the shaft end must be less than 50 G (490m/s^2).

Design the mechanical system so that thrust load and radial load applied to the servomotor shaft end during operation falls within the range shown in *Table 3.1.*

9.2.2 Installing the Servopack

The SGD-□□H Servopack is a book-shaped compact servo controller.

■ Installation Site

Situation	Precautions
When installed in a control panel	Depending on the size of the panel, the temperature inside the control panel may become higher than the ambient temperature due to heat generated by internal devices. Design the control panel size, unit layout, and cooling method so that the temperature around the Servopack does not exceed 55°C.
When installed near a heating unit	Suppress radiation heat from the heating unit and temperature rise caused by convection so that the temperature around the Servopack does not exceed 55°C.
When installed near a source of vibration	Install a vibration-isolator underneath the Servopack to prevent it from receiving vibration.
When installed in a place subject to corrosive gases	Corrosive gases do not immediately affect the Servopack but will eventually cause magnetic contactors or relays in the reference circuits or main circuits to malfunction. Take appropriate action to prevent corrosive gases.
Others	Avoid installation in hot or humid places, or where excessive dust or iron powder is present in the air.

■ Orientation

Install the Servopack perpendicular to the wall as shown in the figure.

The Servopack must be orientated as shown in the figure because it is designed to be cooled by natural convection.

- Firmly secure the Servopack through the mounting holes provided.

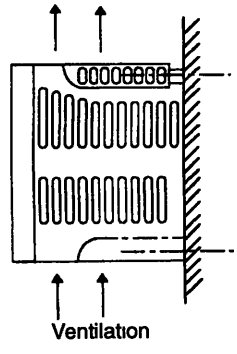
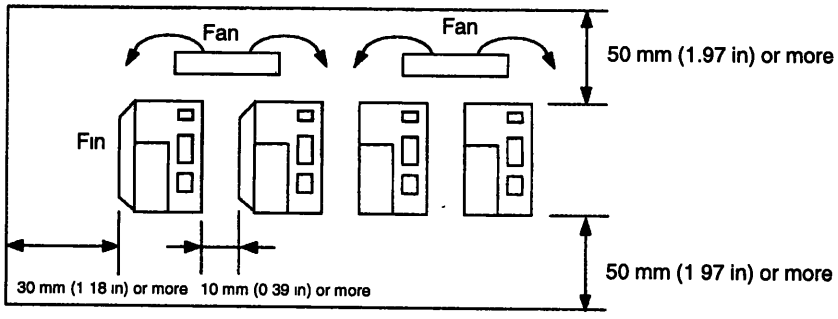


Figure 9.3 Installation Orientation

■ Installation Method



- Install the Servopack perpendicular to the wall so that the front panel faces outward.
- Provide sufficient space around each Servopack to allow cooling by natural convection.
- When installing Servopacks side by side, install cooling fans above the Servopacks to prevent the temperature around each Servopack from increasing excessively and also to maintain an even temperature inside the control panel.
- When installing multiple Servopacks side by side in a control panel, provide at least 10 mm (0.39 in) space between them and at least 50 mm (1.97 in) space above and below them as shown in the figure above and observe the following installation conditions:
  - Ambient temperature for Servopacks: 0 to 55°C
  - Humidity: 90% RH or less
  - Vibration: 0.5G (4.9 m/s^2)
  - Condensation and freezing: None
  - Ambient temperature to ensure long-term reliability: 45°C or less

9.2.3 Power Loss

The power loss of the Servopacks is as shown in the following table.

Table 9.1 Power Loss during Rated Output

Servopack Model SGD-	Supply Voltage	Capacity W	Output Current A (rms)	Power Loss W
A3AH	200 VAC	30	0.42	15
A5AH		50	0.60	18
01AH		100	0.87	20
02AH		200	2.0	35
04AH		400	2.6	45
08AH		750	4.4	60
A3BH	100 VAC	30	0.63	17
A5BH		50	0.90	20
01BH		100	2.2	30
02BH		200	2.7	47
03BH		300	3.7	70

9.3 Wiring

9.3.1 Wiring Instructions

To ensure safe and stable operation, always refer to the following wiring instructions.

IMPORTANT Always use the following cables for wiring the signal lines and PG feedback lines.

Lines	Cable Type	Yaskawa Drawing No.	Maximum Allowable Length
For reference input	Twisted-pair wires	DE9404859	3 m (9.8 ft.)
For PG feedback lines and serial communication lines	Multiconductor shielded twisted-pair wires	B9400064 (for incremental encoder) DE8400093 (for absolute encoder)	20 m (65.6 ft.)

- Cut off the excess portion of the cable to minimize the cable length.

IMPORTANT For a ground wire, use as thick a cable as possible.

- At least class-3 ground (ground to 100 Ω or less) is recommended.
- Always use one-line grounding.
- If the motor is insulated from the machine, ground the motor directly.

IMPORTANT Do not bend or apply tension to cables.

- Since the conductor of a signal cable is very thin (0.1 to 0.3 mm^2 (0.0002 to 0.0005 in^2), handle it with adequate care.

IMPORTANT To prevent malfunction due to noise, take the following actions:

- Position the input reference device and noise filter as close to the Servopack as possible.
- Always install a surge absorber circuit in the relay, solenoid and magnetic contactor coils.
- The distance between a power line (such as a power supply line or motor cable) and a signal line must be at least 30 cm (12 in). Do not put the power and signal lines in the same duct or bundle them together.
- Do not share the power supply with an electric welder or electrical discharge machine. When the Servopack is placed near a high-frequency oscillator, install a noise filter on the input side of the power supply line.

Note The Servopack uses high-speed switching elements, which may cause noise on signal lines. To prevent this, always take the above actions.

IMPORTANT Use a noise filter to prevent the radio frequency interference.

- Since the Servopacks are designed to be used for industrial use, no measures are provided against radio frequency interference. Use a noise filter in the power input line when using the Servopacks near residential areas or where they are prone to radio frequency interference.

9.3.2 Cable Specifications

The rated current of the Servopack external terminals and cable size are listed in *Tables 9.3* and *9.4*. The cable specifications and sizes must be selected according to the operating environment and current capacity. The cable specifications in these tables were selected under conditions of three cables per bundle at 40° C ambient temperature, with the rated current flowing. *Table 9.4* lists the cable types.

Table 9.2 Cable Specifications (1)

Type	Servopack Model SGD-		Main Circuit Power Input Terminal (R) (T)		Motor Connection Terminals (U) (V) (W) ⏚	
			Rated Current A (rms)	Cable Spec.	Rated Current A (rms)	Cable Specifications
For 200 V	30 W (0 04HP)	A3AH	1 3	HIV 1 25 mm	0 42	Use Yaskawa cable See *10 4 2 Cable Specifications* for details When using non-Yaskawa cables, check the cable current rating and consider the operating environment Use cable sizes AWG22 to AWG18 (0 3 to 0 89 mm^2 (0 0005 to 0 001 in^2)
	50 W (0 07HP)	A5AH	1 5		0 6	
	100 W (0 13HP)	01AH	2 5		0 87	
	200 W (0 27HP)	02AH	4 0		2 0	
	400 W (0 53HP)	04AH	6 0	HIV 2 0 min	2 6	
	750 W (1 01HP)	08AH	11 0		5 5	
For 100 V	30 W (0.04HP)	A3BH	2 0	HIV 1 25 mm	0 63	
	50 W (0 07HP)	A5BH	2 6		0 7	
	100 W (0 13HP)	01BH	4 5		2 2	
	200 W (0 27HP)	02BH	8 0	HIV 2 0 mm	2 7	
	300 W (0 40HP)	03BH	14 0		3.7	

The appropriate cables for Servopack connectors 1CN, 2CN and 3CN are shown in the following table.

Table 9.3 Cable Specifications (2)

Control I/O Signal Connector	**1CN**	Cable	Use twisted-pair cable or shielded twisted-pair wire.
		Applicable Cable	AWG24, 26, 28, 30
		Finished Cable Dimensions	Ø16.0 mm (Ø 0.63 in) max.
		Rated Current A (rms)	100 mA DC max
PG Signal Connector	**2CN**	Cable	Use Yaskawa cable. See *10.4.2 Cable Specifications* for details. Use shielded twisted-pair wire if a Yaskawa cable is not used.
		Applicable Cable	Applicable cable sizes: AWG24, 26, 28, 30. Use AWG22 for encoder power supply and FG lines. Use AWG26 for other signals. These connections permit wiring distances up to 20 m (65.6 ft.)
		Finished Cable Dimensions	Ø11.6 (Ø0.46 in.) mm max.
		Rated Current A (rms)	100 mA DC max (500 mA DC max for power supply line)
Serial Communication Connector	**3CN**	Cable	Use twisted-pair wires or shielded twisted-pair wires.
		Applicable Cable	AWG24, 26, 28, 30
		Finished Cable Dimensions	Ø7.0 mm (Ø0.28 in) max.
		Rated Current A (rms)	100 mA DC max

Note Cable selection conditions: three cables per bundle at 40 °C ambient temperature with the rated current flowing.

9.3.3 Cable Types

The types of cable are shown in the following table. Use this table in combination with the table above.

Table 9.4 Cable Types

Cable Type		Conductor Allowable Temperature °C
Symbol	**Name**	
PVC	Normal vinyl cable	–
IV	600-V vinyl cable	60
HIV	Temperature-resistant vinyl cable	75

Note 1. Use cable with 600 V min. withstand voltage for main circuits.

2. Consider allowable current reduction ratio if cables are bundled in PVC or metal ducts.

3. Use temperature-resistant cable under high ambient or panel temperatures where normal vinyl cables rapidly deteriorate.

10

Σ-Series Dimensional Drawings

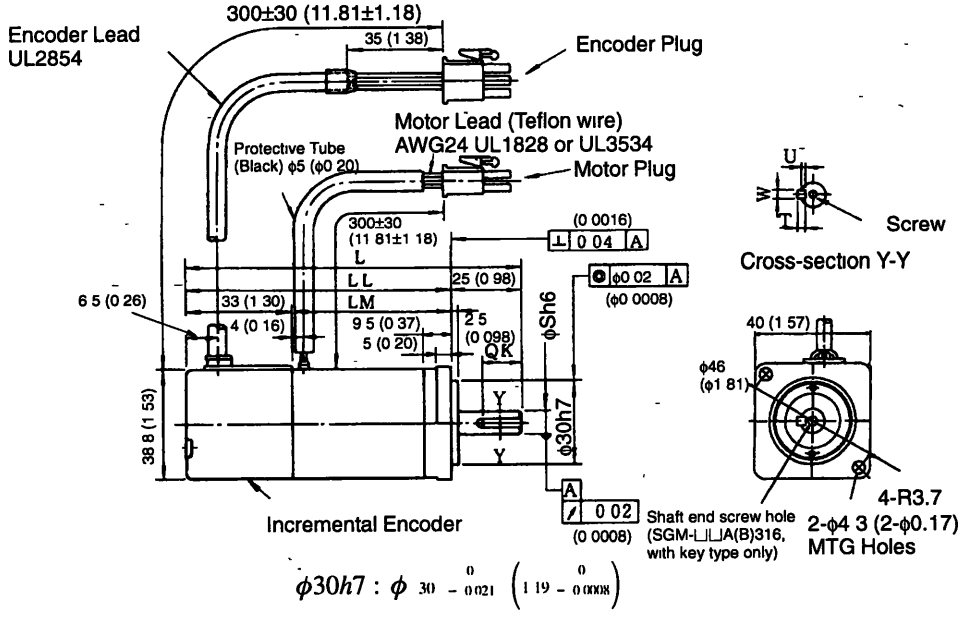
This chapter presents dimensional drawings of the Σ-series Servomotors, Servopacks, Digital Operator and Peripheral Devices.

10.1 Servomotor Dimensional Drawings

10.1.1 SGM Servomotors

■ SGM Servomotors with Incremental Encoders, No Brakes

30 W (0.04 HP), 50 W (0.07 HP), 100 W (0.13 HP)



$$\phi 30h7 : \phi\ 30\ {}^{0}_{-0.021}\ \left(1.19\ {}^{0}_{-0.0008}\right)$$

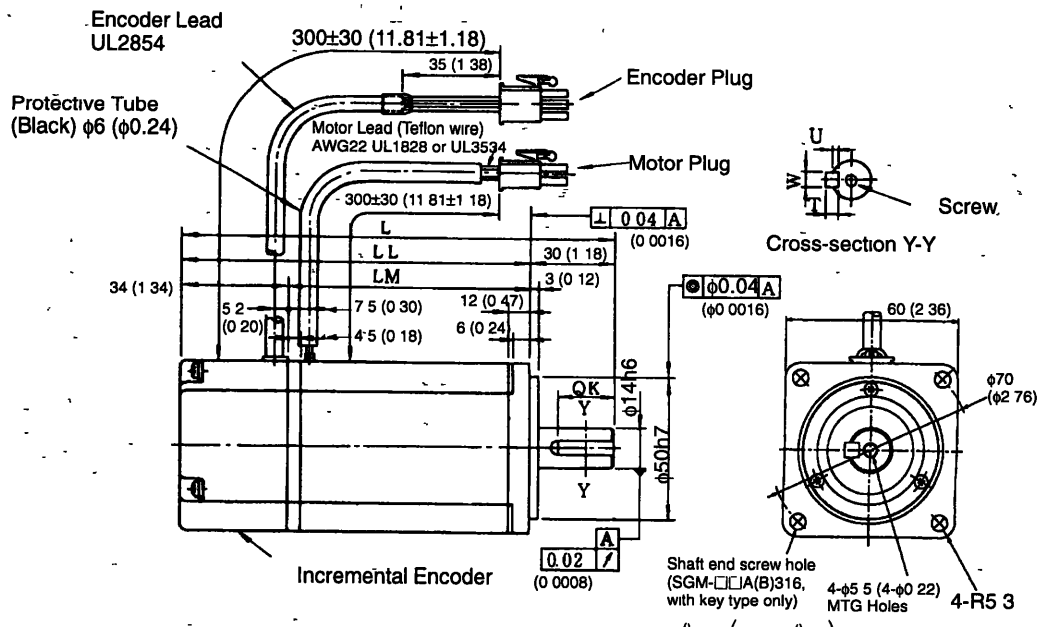
Model SGM-	L	LL	LM	S	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
A3A□12	94 5 (3 72)	69 5 (2 74)	36 5 (1 44)	6 (0 24)	No key				---	30 (0 04)	0 3 (0 66)	68 (15)	54 (12)
A3B□12													
A3A□14					14 (0 55)	1 2 (0 05)	2 (0 08)	2 (0 08)					
A3B□14													
A3A□16									M2 5, depth 5 (0 20)				
A3B□16													
A5A□12	102 0 (4 02)	77 0 (3 03)	44 0 (1 73)	6 (0 24)	No key				---	50 (0 07)	0 4 (0 88)	68 (15)	54 (12)
A5B□12													
A5A□14					14 (0 55)	1 2 (0 05)	2 (0 08)	2 (0 08)					
A5B□14													
A5A□16									M2 5, depth 5 (0 20)				
A5B□16													
01A□12	119 5 (4 70)	94 5 (3 72)	61 5 (2 42)	8 (0 31)	No key				---	100 (0 13)	0 5 (1 10)	78 (17)	54 (12)
01B□12													
01A□14					14 (0 55)	1 8 (0 07)	3 (0 12)	3 (0 12)					
01B□14													
01A□16									M3, depth 6 (0 24)				
01B□16													

Note 1. The encoder is an incremental encoder.

2. "A" in the model number indicates 200-V specifications, and "B" indicates 100-V specifications.

3. The symbol "□" in the model number indicates the number of encoder pulses (3. 2048P/R, 5: 2000P/R).

200 W (0.27 HP), 300 W (0.04 HP), 400 W (0.53 HP)



$$\phi 14h6 : \phi\ 14\ {}^{0}_{-0.011}\ \left(0.56\ {}^{0}_{-0.0004}\right)$$

$$\phi 50h7 : \phi\ 50\ {}^{0}_{-0.025}\ \left(1.98\ {}^{0}_{-0.0010}\right)$$

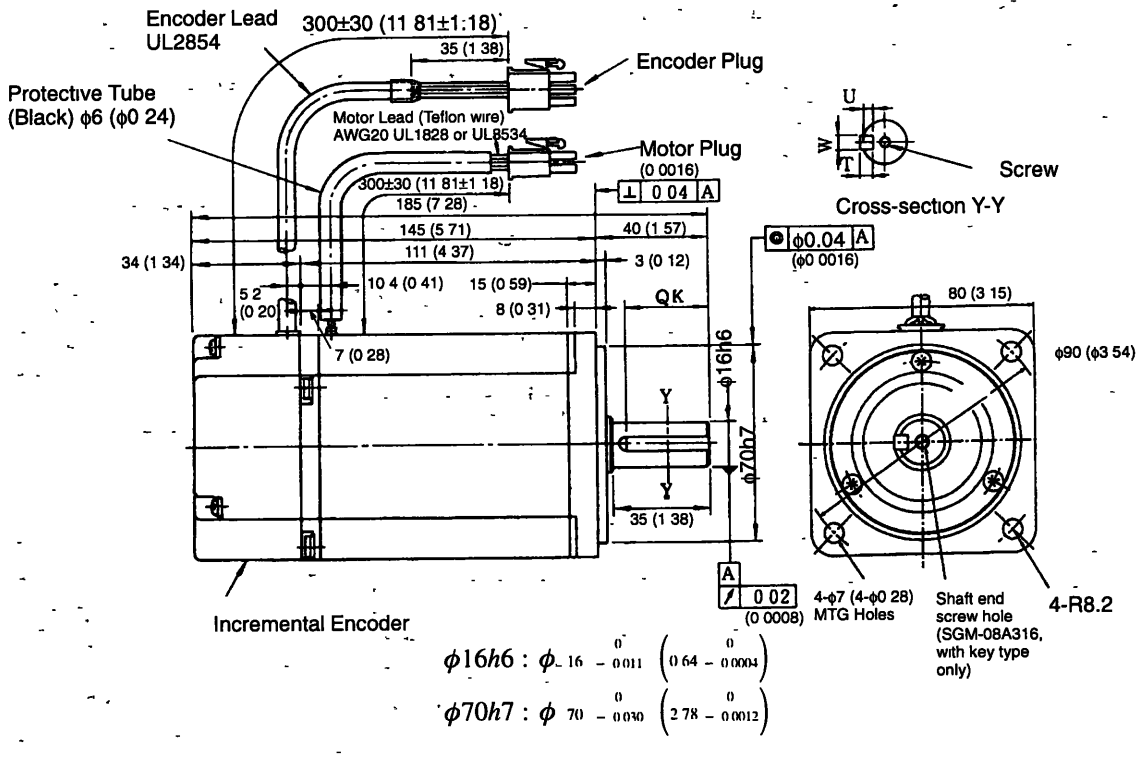
Model SGM-	L	LL	LM	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02A□12	126 5 (4 98)	96 5 (3 80)	62 5 (2 46)	No key				---	200 (0 27)	1 1 (2 43)	245 (55)	74 (16)
02B□12												
02A□14				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
02B□14												
02A□16								M5, depth 8 (0 31)				
02B□16												
03B□12	154 5 (6 08)	124 5 (4 90)	90 5 (3 56)	No key				---	300 (0 40)	1 7 (3 75)	245 (55)	74 (16)
03B□14				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
03B□16								M5, depth 8 (0 31)				
04A□12	154 5 (6 08)	124 5 (4 90)	90 5 (3 56)	No key				---	400 (0 53)	1 7 (3 75)	245 (55)	74 (16)
04A□14				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
04A□16								M5, depth 8 (0 31)				

Note 1 The encoder is an incremental encoder.

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications

3. The symbol "□" in the model number indicates the number of encoder pulses (3: 2048P/R, 5: 2000P/R)

750 W (1.01 HP)



Model SGM-	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08A□12	No key				---	750 (1 01)	3 4 (7 50)	392 (88)	147 (33)
08A□14	30 (1 18)	3 (0 12)	5 (0 20)	5 (0 20)					
08A□16					M5, depth 8 (0 31)				

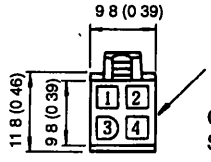
Note 1. The encoder is an incremental encoder.

2. "A" in the model number indicates 200 V-specifications

3. The symbol "□" in the model number indicates the number of encoder pulses (3: 2048P/R, 5. 2000P/R)

Motor and Encoder Plugs (For 30 W (0.04 HP) to 750 W (1.01 HP))

Motor Plug



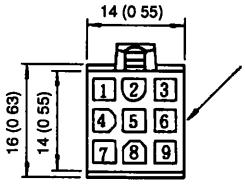
Plug 172167-1 (AMP)
Pin: 170360-1 or 170364-1

Connected to
Cap: 172159-1
Socket: 170362-1 or 170366-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green

Encoder Plug



Plug: 172169-1 (AMP)
Pin: 170359-1 or 170363-1

Connected to
Cap: 172161-1
Socket 170361-1 or 170365-1

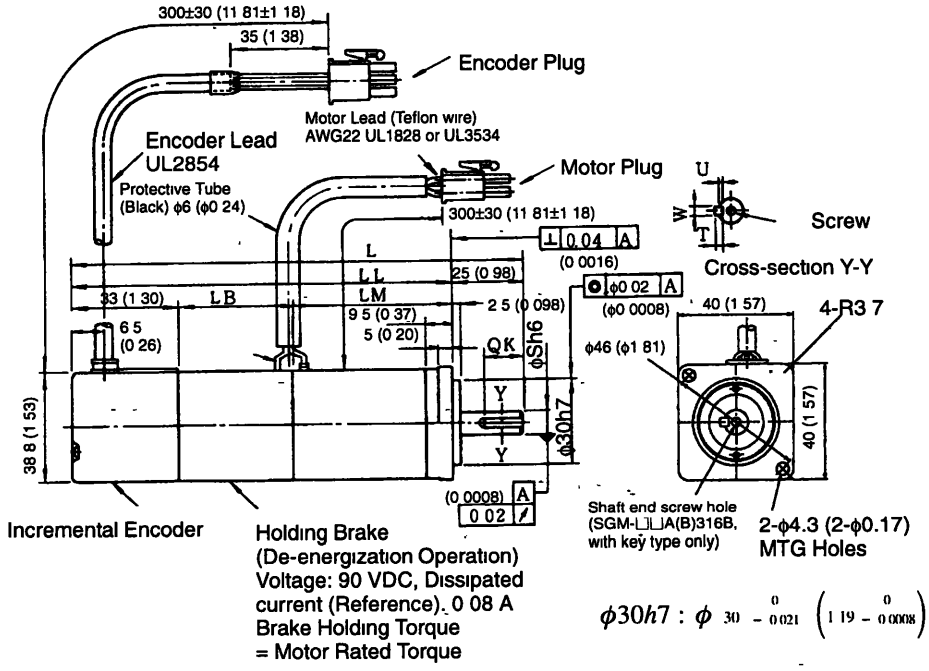
Incremental Encoder Wiring Specifications

1	A channel output	Blue
2	$\overline{A}$ channel output	Blue/Black
3	B channel output	Yellow
4	$\overline{B}$ channel output	Yellow/Black
5	C channel output	Green
6	$\overline{C}$ channel output	Green/Black
7	0 V (power supply)	Gray
8	+5 V (power supply)	Red
9	FG (Frame Ground)	Orange

10

■ SGM Servomotors with Incremental Encoders and Brakes

30 W (0.04 HP), 50 W (0.07 HP), 100 W (0.13 HP)



Model SGM-	L	LL	LM	LB	S	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
A3A□12B	126 0 (4 96)	101 0 (3 98)	36 5 (1 44)	31 5 (1 24)	6 (0 24)	No key				---	30 (0 04)	0 6 (1 32)	68 (15)	54 (12)
A3B□12B														
A3A□14B						14 (0 55)	1 2 (0 05)	2 (0 08)	2 (0 08)					
A3B□14B														
A3A□16B										M2 5, depth 5 (0 20)				
A3B□16B														
A5A□12B	133 5 (5 26)	108 5 (4 27)	44 0 (1 73)	31 5 (1 24)	6 (0 24)	No key				---	50 (0 07)	0 7 (1 54)	68 (15)	54 (12)
A5B□12B														
A5A□14B						14 (0 55)	1 2 (0 05)	2 (0 08)	2 (0 08)					
A5B□14B														
A5A□16B										M2 5, depth 5 (0 20)				
A5B□16B														
01A□12B	160 0 (6 30)	135 0 (5 31)	61 5 (2 42)	40 5 (1 59)	8 (0 31)	No key				---	100 (0 13)	0 8 (1 76)	78 (17)	54 (12)
01B□12B														
01A□14B						14 (0 55)	1 8 (0 07)	3 (0 12)	3 (0 12)					
01B□14B														
01A□16B										M3 depth 6 (0 24)				
01B□16B														

Note 1 The encoder is an incremental encoder.

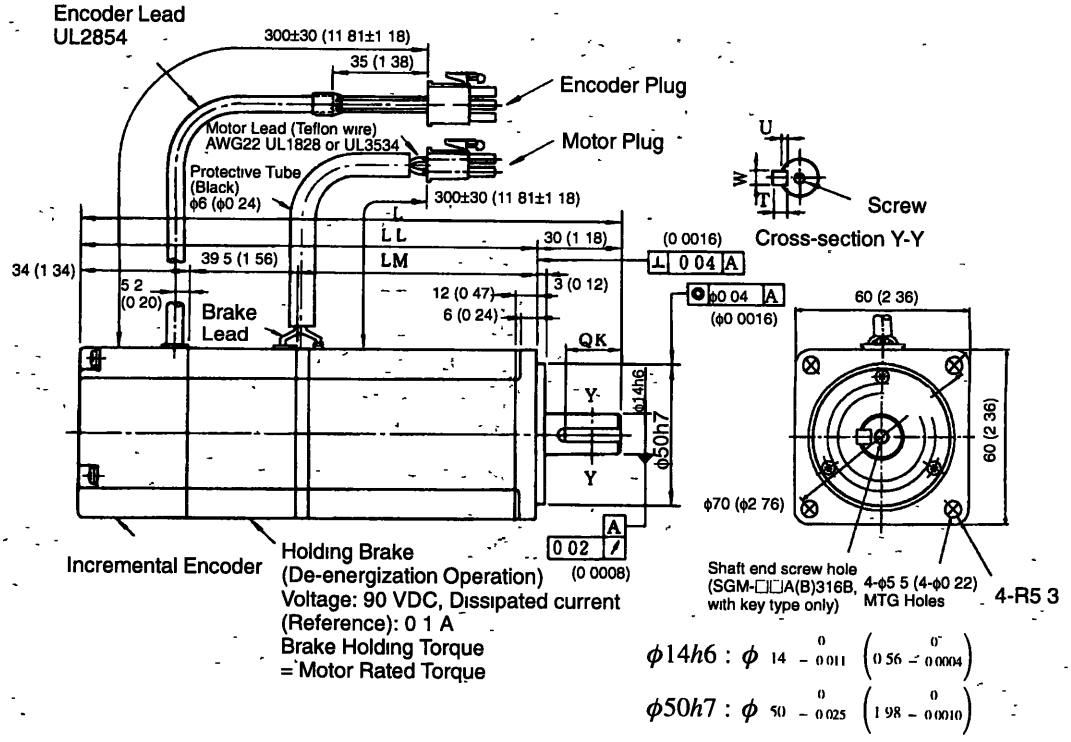
2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications.
3. The symbol "□" in the model number indicates the number of encoder pulses (3: 2048P/R, 5: 2000P/R).

Dimensional Tolerances

Model SGM-	Shaft-end Dimensions [mm (in)]
	S
A3A□12B A3B□12B A3A□14B A3B□14B	$6\ {}^{0}_{-0.008}\ \left(0.24\ {}^{0}_{-0.0003}\right)$
A5A□12B A5B□12B A5A□14B A5B□14B	$6\ {}^{0}_{-0.008}\ \left(0.24\ {}^{0}_{-0.0003}\right)$
01A□12B 01B□12B 01A□14B 01B□14B	$8\ {}^{0}_{-0.009}\ \left(0.32\ {}^{0}_{-0.0004}\right)$

10

200 W (0.53 HP), 300 W (0.40 HP), 400 W (0.27 HP)



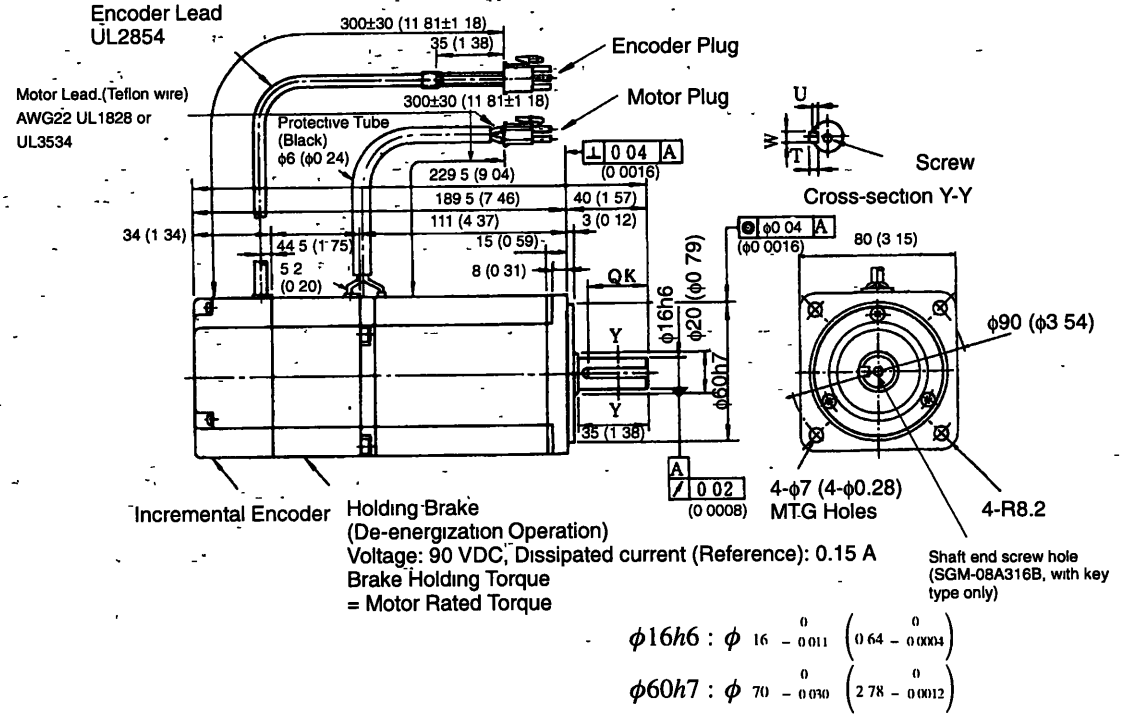
Model SGM-	L	LL	LM	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02A□12B	166 0 (6 54)	136 0 (5 35)	62 5 (2 46)	No key				---	200 (0 27)	1 6 (3 53)	245 (55)	74 (16)
02B□12B												
02A□14B				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
02A□14B												
02A□16B								M5, depth 8 (0 31)				
02A□16B												
03B□12B	194 0 (7 64)	164 0 (6 46)	90 5 (3 56)	No key				---	300 (0 40)	2 2 (4 85)	245 (55)	74 (16)
03B□14B				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
03B□16B								M5, depth 8 (0 31)				
04A□12B				No key				---	400 (0 53)	2 2 (4 85)	245 (55)	74 (16)
04A□14B				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
04A□16B								M5, depth 8 (0 31)				

Note 1 The encoder is an incremental encoder.

2. "A" in the model number indicates 200-V-specifications, and "B" indicates 100 V-specifications

3. The symbol "□" in the model number indicates the number of encoder pulses (3. 2048P/R, 5. 2000P/R).

750 W (1.01 HP)



$$\phi 16h6 : \phi\ 16\ {}^{0}_{-0.011}\ \left(0.64\ {}^{0}_{-0.0004}\right)$$

$$\phi 60h7 : \phi\ 70\ {}^{0}_{-0.030}\ \left(2.78\ {}^{0}_{-0.0012}\right)$$

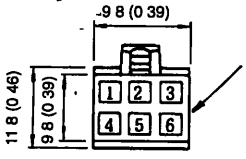
Model SGM-	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08A□12B	No key				---	750 (1 01)	4 3 (9 48)	392 (88)	147 (33)
08A□14B	30 (1 18)	3 (0 12)	5 (0 20)	5 (0 20)					
08A□16B					M5 depth 8 (0 31)				

Note 1. The encoder is an incremental encoder.

2. "A" in the model number indicates 200 V-specifications.
3. The symbol "□" in the model number indicates the number of encoder pulses (3. 2048P/R, 5 2000P/R).

Motor and Encoder Plugs (For 30 W (0.04 HP) to 750 W (1.01 HP))

Motor Plug



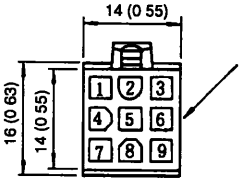
Plug. 172168-1 (AMP)
Pin 170360-1 or 170364-1

Connected to
Cap. 172160-1
Socket 170362 -1 or 170366-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green
5	Brake terminal	Red
6	Brake terminal	Black

Encoder Plug



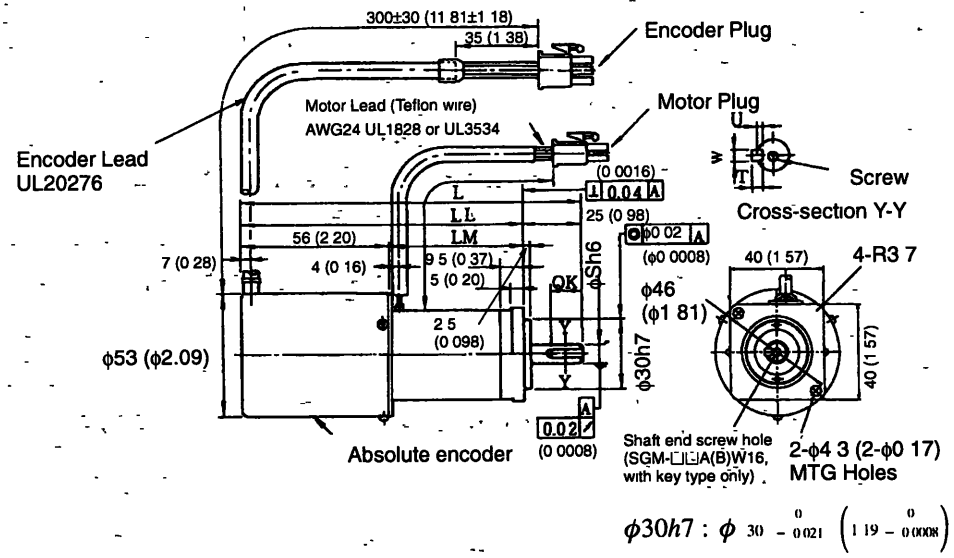
Plug: 172169-1 (AMP)
Pin: 170359-1 or 170363-1
Connected to
Cap. 172161-1
Socket. 170361-1 or 170365-1

Incremental Encoder Wiring Specifications

1	A channel output	Blue
2	$\overline{A}$ channel output	Blue/Black
3	B channel output	Yellow
4	$\overline{B}$ channel output	Yellow/Black
5	C channel output	Green
6	$\overline{C}$ channel output	Green/Black
7	0 V (power supply)	Gray
8	+5 V (power supply)	Red
9	FG (Frame Ground)	Orange

■ SGM Servomotors with Absolute Encoders, No Brakes

30 W (0.04 HP), 50 W (0.07 HP), 100 W (0.13 HP)



Model SGM-	L	LL	LM	S	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
A3AW12	117.5 (4 63)	92 5 (3 64)	36 5 (1 44)	6 (0 24)	No key				---	30 (0 04)	0 45 (0 99)	68 (15)	54 (12)
A3BW12													
A3AW14					14 (0 55)	1 2 (0.05)	2 (0 08)	2 (0 08)					
A3BW14													
A3AW16									M2.5, depth 5 (0 20)				
A3BW16													
A5AW12	125 0 (4 92)	100 0 (3 94)	44 0 (1 73)	6 (0 24)	No key				---	50 (0 07)	0 55 (1 21)	68 (15)	54 (12)
A5BW12													
A5AW14					14 (0 55)	1.2 (0 05)	2 (0 08)	2 (0 08)					
A5BW14													
A5AW16									M2 5, depth 5 (0 20)				
A5BW16													
01AW12	142 5 (5.61)	117 5 (4 63)	61 5 (2 42)	8 (0 31)	No key				---	100 (0 13)	0 65 (1.43)	78 (17)	54 (12)
01BW12													
01AW14					14 (0 55)	1 8 (0.07)	3 (0 12)	3 (0.12)					
01BW14													
01AW16									M3, depth 6 (0 24)				
01BW16													

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

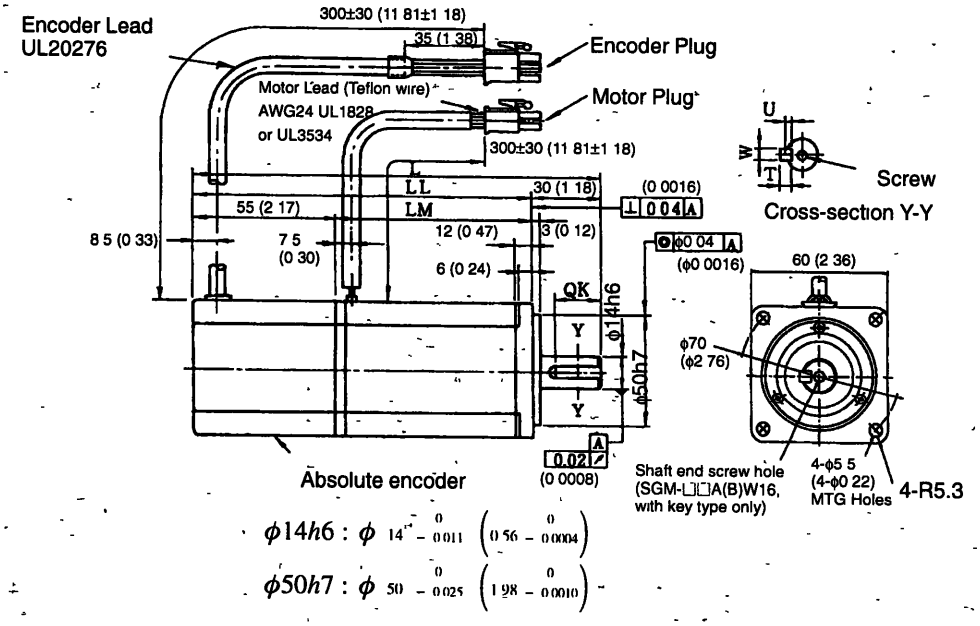
2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications.

Dimensional Tolerances

Model SGM-	Shaft-end Dimensions [mm (in)]
	S
A3AW12	$6\ {}^{0}_{-0.008}\ \left(0.24\ {}^{0}_{-0.0003}\right)$
A3BW12	
A3AW14	
A3BW14	
A5AW12	$6\ {}^{0}_{-0.008}\ \left(0.24\ {}^{0}_{-0.0003}\right)$
A5BW12	
A5AW14	
A5BW14	
01AW12	$8\ {}^{0}_{-0.009}\ \left(0.32\ {}^{0}_{-0.0004}\right)$
01BW12	
01AW14	
01BW14	

10

200 W (0.27 HP), 300 W (0.40 HP) (100 V Only), 400 W (0.53 HP) (200 V Only)



$\phi 14h6 : \phi\ {}^{0}_{-0.011}\ \left(0.56\ {}^{0}_{-0.0004}\right)$

$\phi 50h7 : \phi\ {}^{0}_{-0.025}\ \left(1.98\ {}^{0}_{-0.0010}\right)$

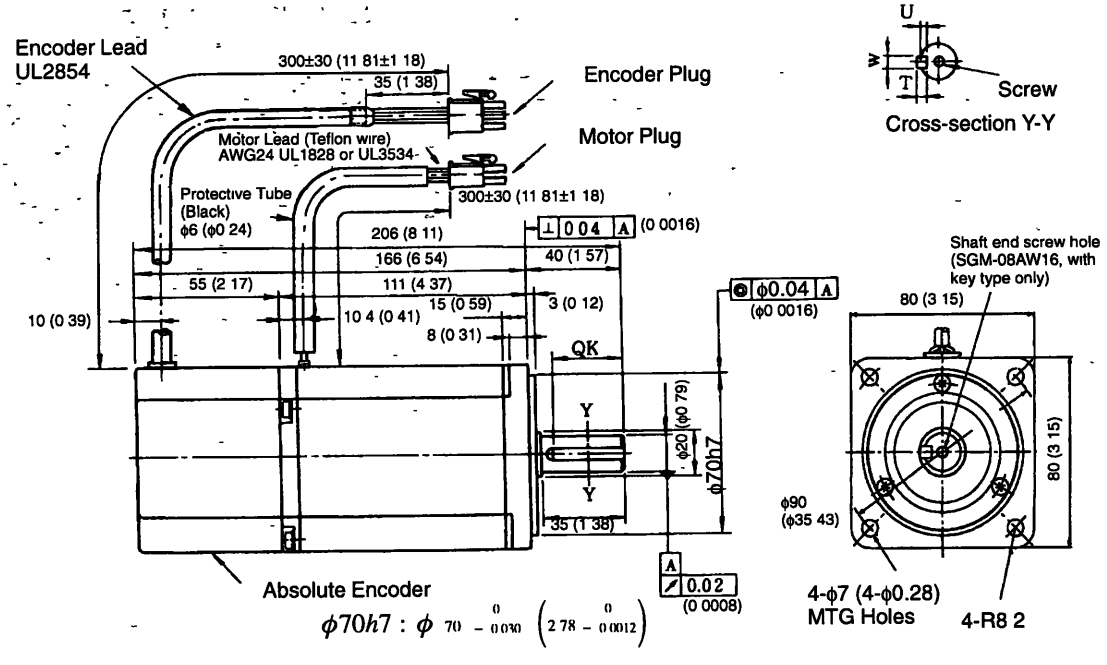
Model SGM-	L	LL	LM	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02AW12	147 5 (5 81)	117 5 (4 63)	62 5 (2 46)	No key				---	200 (0 27)	1 2 (2 65)	245 (55 1)	74 (17)
02BW12												
02AW14				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
02BW14												
02AW16								M5, depth 8 (0 31)				
02BW16												
03AW12	175 5 (6 91)	145 5 (5 73)	90 5 (3 56)	No key				---	300 (0 40)	1 8 (3 97)	245 (55 1)	74 (17)
03BW12												
03AW14				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
03BW14												
03AW16								M5, depth 8 (0 31)				
03BW16												
04AW12	175 5 (6 91)	145 5 (5 73)	90 5 (3 56)	No key				---	400 (0 53)	1 8 (3 97)	245 (55 1)	74 (17)
04AW14				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
04AW16								M5, depth 8 (0 31)				

10

Note 1 The encoder is a 12-bit absolute encoder 1024 P/R.

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications

750 W (1.01 HP)



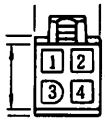
Model SGM-	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08AW12	No key				---	750 (1 01)	3 5 (7 72)	392 (88)	147 (33)
08AW14	30 (1 18)	3 (0 12)	5 (0 20)	5 (0 20)					
08AW16					M5, depth 8 (0 31)				

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R

2. "A" in the model number indicates 200 V-specifications.

Motor and Encoder Plugs (For 30 W (0.04 HP) to 750 W (1.01 HP))

Motor Plug

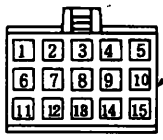


Plug 172167-1 (AMP)

Pin. 170360-1 or 170364-1

Connected to
Cap 172159-1
Socket: 170362 -1 or 170366-1

Encoder Plug



Plug: 172171-1 (AMP)
Pin: 170359-1 or 170363-1
Connected to
Cap: 172163-1
Socket. 170361-1 or 170365-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green

Absolute Encoder Wiring Specifications

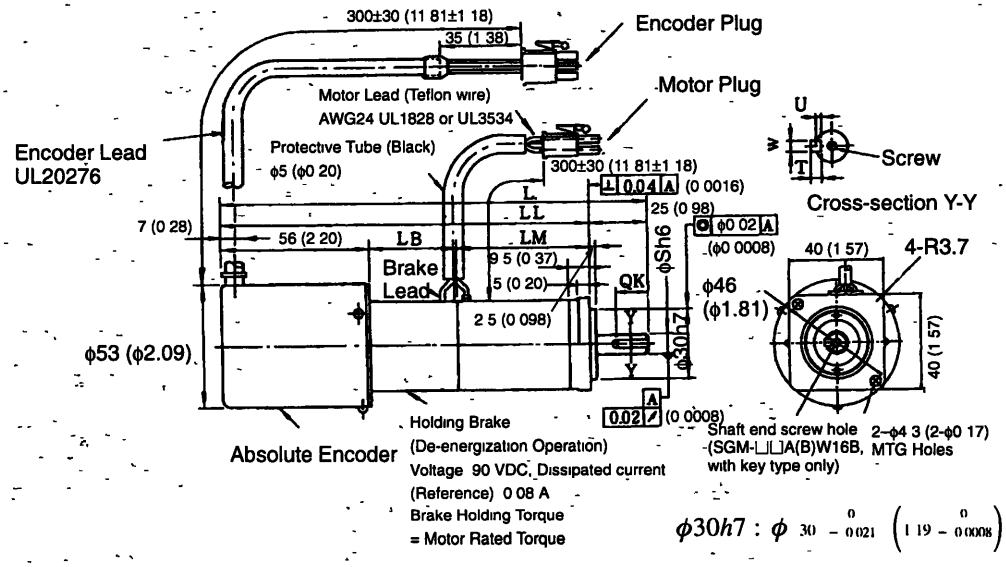
1	A channel output	Blue
2	$\overline{A}$ channel output	White/Blue
3	B channel output	Yellow
4	$\overline{B}$ channel output	White/Yellow
5	Z channel output	Green
6	$\overline{Z}$ channel output	White/Green
7	0 V (power supply)	Black
8	+5 V (power supply)	Red
9	FG (Frame Ground)	Green/Yellow
10	S channel output	Purple
11	$\overline{S}$ channel output	White/Purple
(12)	(Capacitor reset)	(Gray)
13	Reset	White/Gray
14	0 V (battery)	White/Orange
15	3 6 V (battery)	Orange

* Terminal to discharge capacitor before shipment Do not use

10

■ SGM Servomotors with Absolute Encoders and Brakes

30 W (0.04 HP), 50 W (0.07 HP), 100 W (0.13 HP)



Model SGM-	L	LL	LM	LB	S	QK	U	W	T	Screw Dimensions	Output W (HP)	Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
A3AW12B	149.0 (5.87)	124.0 (4.88)	36.5 (1.44)	31.5 (1.24)	6 (0.24)	No key				---	30 (0.04)	0.75 (1.65)	68 (15)	54 (12)
A3BW12B														
A3AW14B						14 (0.55)	1.2 (0.05)	2 (0.08)	2 (0.08)					
A3BW14B														
A3AW16B										M2.5, depth 5 (0.20)				
A3BW16B														
A5AW12B	156.5 (6.16)	131.5 (5.18)	44.0 (1.73)	31.5 (1.24)	6 (0.24)	No key				---	50 (0.07)	0.85 (1.87)	68 (15)	54 (12)
A5BW12B														
A5AW14B						14 (0.55)	1.2 (0.05)	2 (0.08)	2 (0.08)					
A5BW14B														
A5AW16B										M2.5, depth 5 (0.20)				
A5BW16B														
01AW12B	183.0 (7.20)	158.0 (6.22)	61.5 (2.42)	40.5 (1.59)	8 (0.31)	No key				---	100 (0.13)	0.95 (2.09)	78 (17)	54 (12)
01BW12B														
01AW14B						14 (0.55)	1.8 (0.07)	3 (0.12)	3 (0.12)					
01BW14B														
01AW16B										M3, depth 6 (0.24)				
01BW16B														

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

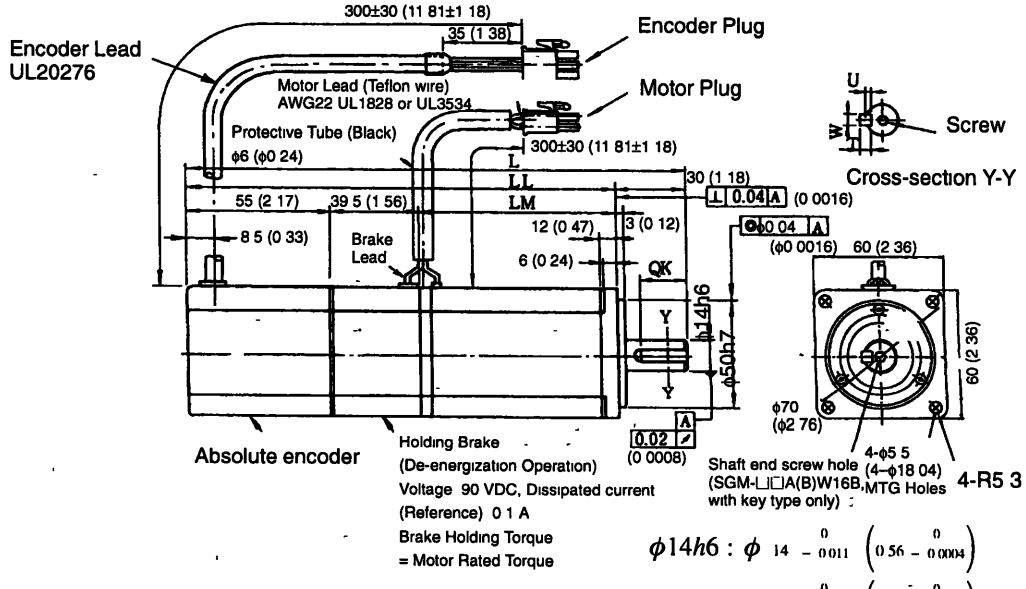
2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications.

Dimensional Tolerances

Model SGM-	Shaft-end Dimensions [mm (in)]
	S
A3AW12B	$6\ {}^{0}_{-0.008}\ \left(0.24\ {}^{0}_{-0.0003}\right)$
A3BW12B	
A3AW14B	
A3BW14B	
A5AW12B	$6\ {}^{0}_{-0.008}\ \left(0.24\ {}^{0}_{-0.0003}\right)$
A5BW12B	
A5AW14B	
A5BW14B	
01AW12B	$8\ {}^{0}_{-0.009}\ \left(0.32\ {}^{0}_{-0.0004}\right)$
01BW12B	
01AW14B	
01BW14B	

10

200 W (0.27 HP), 300 W (0.40 HP) (100 V Only), 400 W (0.53 HP) (200 V Only)

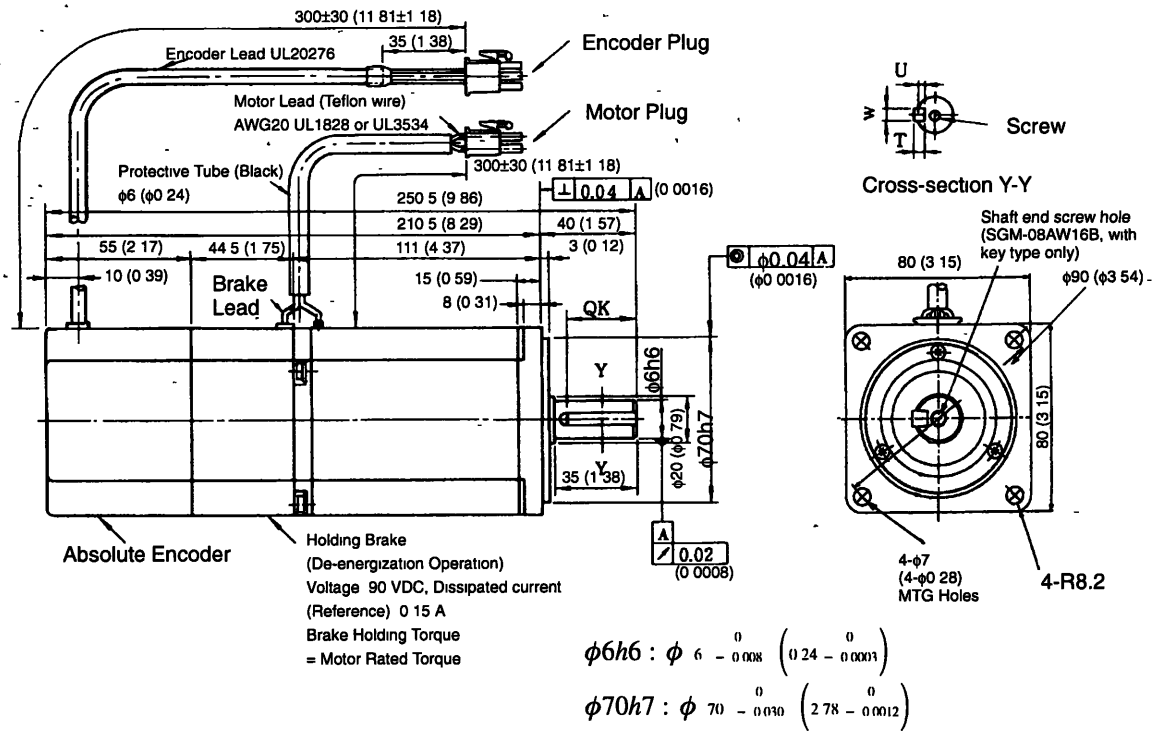


Model SGM-	L	LL	LM	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02AW12B	187 0 (7 36)	157 0 (6 18)	62 5 (2 46)	No key				---	200 (0 27)	1 7 (3 75)	245 (55 1)	74 (17)
02BW12B												
02AW14B				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
02BW14B												
02AW16B								M5, depth 8 (0 31)				
02BW16B												
03BW12B	215 0 (8 46)	185 0 (7 28)	90 5 (3 56)	No key				---	300 (0 40)	2 3 (5 07)	245 (55 1)	74 (17)
03BW14B				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)					
03BW16B								M5, depth 8 (0 31)				
04AW12B				No key				---	400 (0 53)	2 3 (5 07)	245 (55 1)	74 (17)
04AW14B				20 (0 79)	3 (0 12)	5 (0 20)	5 (0 20)	M5, depth 8 (0 31)				
04AW16B												

Note 1 The encoder is a 12-bit absolute encoder 1024 P/R.

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications

750 W (1.01 HP)



$\phi 6h6 : \phi 6 \; {}^{0}_{-0.008} \left(0.24 \; {}^{0}_{-0.0003}\right)$

$\phi 70h7 : \phi 70 \; {}^{0}_{-0.030} \left(2.78 \; {}^{0}_{-0.0012}\right)$

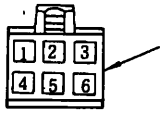
Model SGM-	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08AW12B	No key				---	750 (1 01)	4 5 (9 92)	392 (88)	147 (33)
08AW14B	30 (1 18)	3 (0 12)	5 (0 20)	5 (0 20)					
08AW16B					M5, depth 8 (0 31)				

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

2. "A" in the model number indicates 200 V-specifications

Motor and Encoder Plugs (For 30 W (0.04 HP) to 750 W (1.01 HP))

Motor Plug



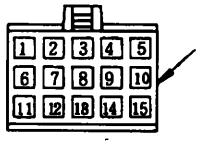
Plug: 172168-1 (AMP)
Pin 170360-1 or 170364-1

Connected to
Cap· 172160-1
Socket 170362 -1 or 170366-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green
5	Brake terminal	Red
6	Brake terminal	Black

Encoder Plug



Plug 172171-1 (AMP)
Pin: 170359-1 or 170363-1
Connected to
Cap 172163-1
Socket: 170361-1 or 170365-1

Incremental Encoder Wiring Specifications

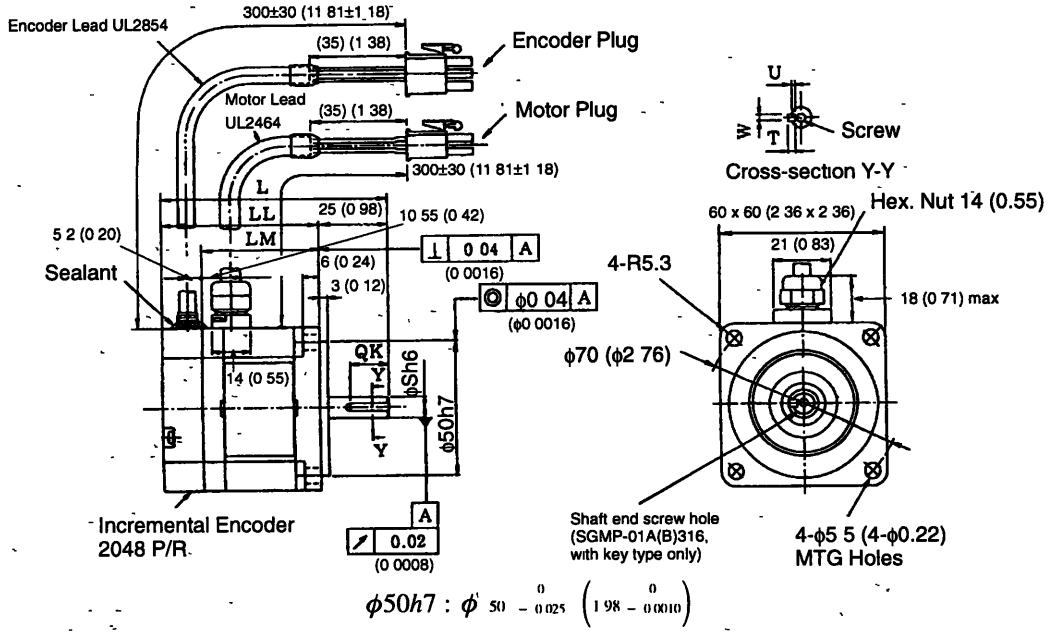
1	A channel output	Blue
2	$\overline{A}$ channel output	White/Blue
3	B channel output	Yellow
4	$\overline{B}$ channel output	White/Yellow
5	Z channel output	Green
6	$\overline{Z}$ channel output	White/Green
7	0 V (power supply)	Black
8	+5 V (power supply)	Red
9	FG (Frame Ground)	Green/Yellow
10	S channel output	Purple
11	$\overline{S}$ channel output	White/Purple
* (12)	(Capacitor reset)	(Gray)
13	Reset	White/Gray
14	0 V (battery)	White/Orange
15	3 6 V (battery)	Orange

* Terminal to discharge capacitor before shipment. Do not use.

10.1.2 SGMP Servomotors

■ SGMP Servomotors with Incremental Encoders, No Brakes

100 W (0.13 HP)



$\phi 50h7 : \phi 50\ {}^{0}_{-0.025}\ \left(1.98\ {}^{0}_{-0.0010}\right)$

Model SGMP-	L	LL	LM	S	QK	U	W	T	Screw dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
01A312	82 (3 23)	57 (2 24)	42 5 (1 67)	8 (0 31)	No key				---	100 (0 13)	0 7 (1 54)	78 (17)	49 (11)
01B312													
01A314					14 (0 55)	1 8 (0 07)	3 (0 12)	3 (0 12)					
01B314													
01A316									M3, depth 6 (0 24)				
01B316													

Note 1. The encoder is an incremental encoder 2048 P/R

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications

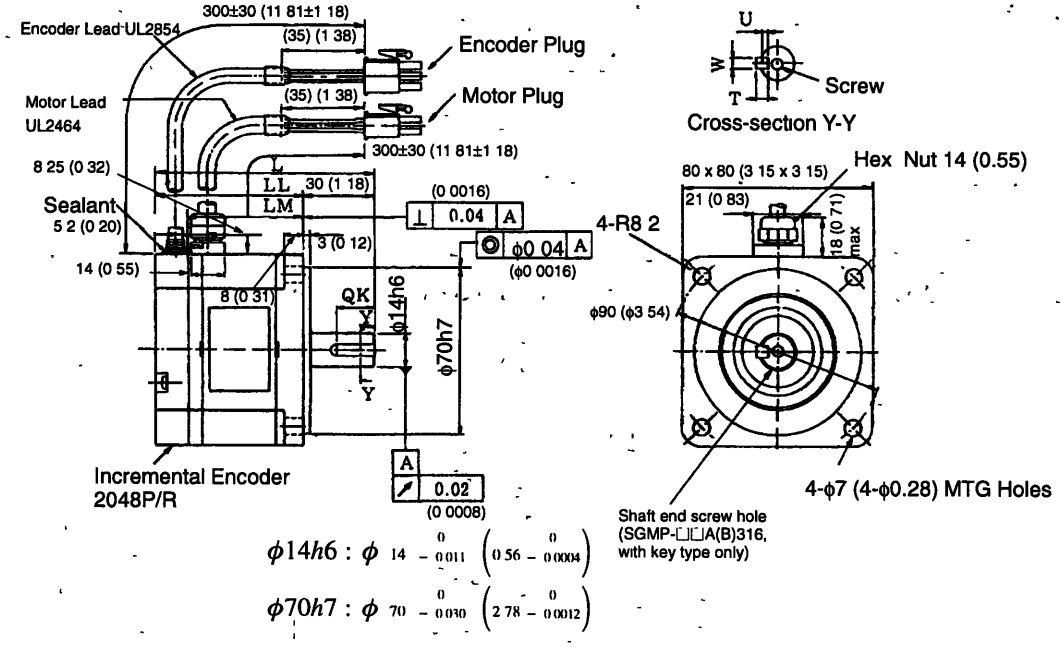
3. The quoted allowable radial load is the value at a position 20 mm (0 79 in.) from the motor mounting surface.

4. Conforms to "IP55" protective structure (except connector and output shaft faces).

Dimensional Tolerances

Model SGMP-	Shaft-end Dimensions [mm (in)]
	S
01A312	$8\ {}^{0}_{-0.009}\ \left(0.32\ {}^{0}_{-0.0004}\right)$
01B312	
01A314	
01B314	
01A316	
01B316	

200 W (0.27 HP), 300 W (0.40 HP) (100 V Only), 400 W (0.53 HP) (200 V Only)



$\phi 14h6 : \phi\ 14\ {}^{0}_{-0.011}\ \left(0.56\ {}^{0}_{-0.0004}\right)$

$\phi 70h7 : \phi\ 70\ {}^{0}_{-0.030}\ \left(2.78\ {}^{0}_{-0.0012}\right)$

Model SGMP-	L	LL	LM	QK	U	W	T	Screw dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02A312	92 (3.62)	62 (2.44)	48.1 (1.89)	No key				---	200 (0.27)	1.4 (3.09)	245 (55)	68 (15)
02B312												
02A314				16 (0.63)	3 (0.12)	5 (0.20)	5 (0.20)					
02B314												
02A316								M5, depth 8 (0.31)				
02B316												
03B312	112 (4.41)	82 (3.23)	68.1 (2.68)	No key				---	300 (0.40)	2.1 (4.63)		
03B314				16 (0.63)	3 (0.12)	5 (0.20)	5 (0.20)					
03B316								M5, depth 8 (0.31)				
04A312				No key				---	400 (0.53)			
04A314				16 (0.63)	3 (0.12)	5 (0.20)	5 (0.20)					
04A316								M5, depth 8 (0.31)				

10

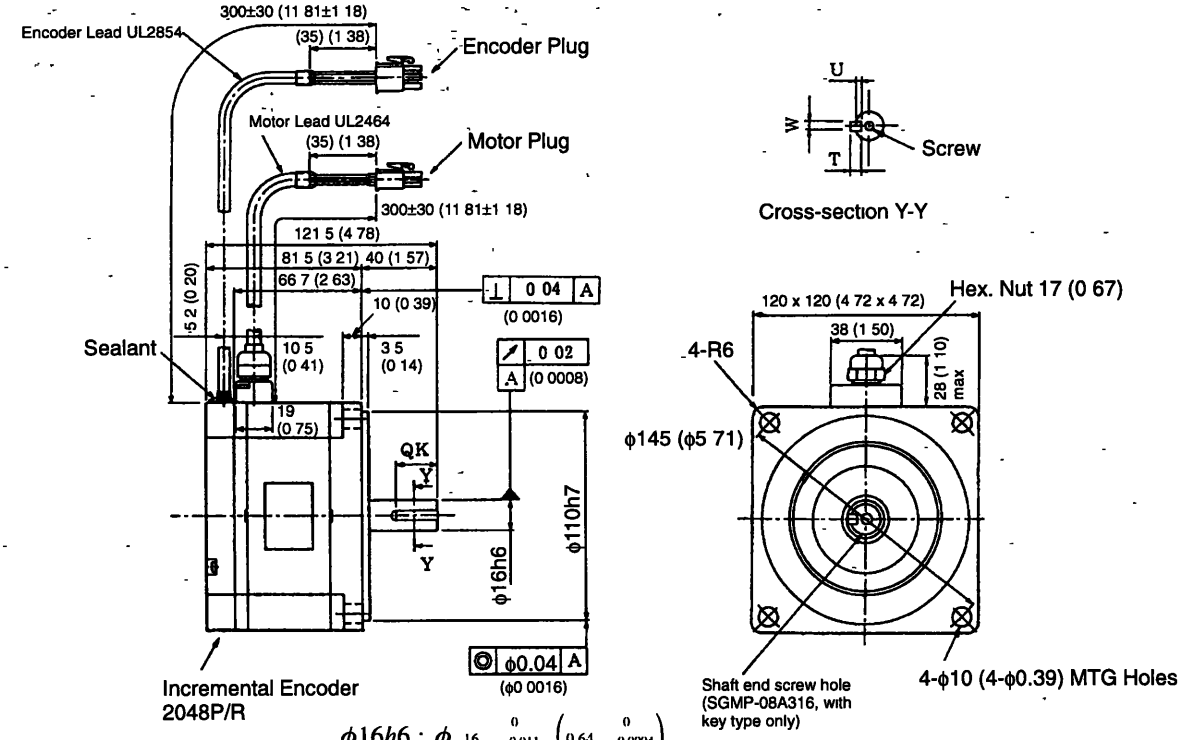
Note 1. The encoder is an incremental encoder 2048 P/R.

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications

3. The quoted allowable radial load is the value at a position 25 mm (0.98in.) from the motor mounting surface.

4. Conforms to "IP55" protective structure (except connector and output shaft faces)

750 W (1.01 HP)



$$\phi 16h6 : \phi\ 16\ {}^{0}_{-0.011}\ \left(0.64\ {}^{0}_{-0.0004}\right)$$

$$\phi 110h7 : \phi\ 110\ {}^{0}_{-0.035}\ \left(4.37\ {}^{0}_{-0.0014}\right)$$

Model SGMP-	QK	U	W	T	Screw dimensions	Output W (HP)	Approx. Mass kg(lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08A312	No key				---	750 (1.01)	4.6 (10.14)	392 (80)	147 (33)
08A314	22 (0.87)	3 (0.12)	5 (0.20)	5 (0.20)					
08A316					M5, depth 8 (0.31)				

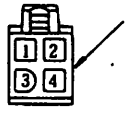
Note 1. The encoder is an incremental encoder for 2048 P/R

2. "A" in the model number indicates 200 V-specifications.
3. The quoted allowable radial load is the value at a position 35 mm (1.38 in.) from the motor mounting surface.
4. Conforms to IP55 protective structure (except connector and output shaft faces).

10

Motor and Encoder Plugs (For 100 W (0.13HP) to 750 W (1.01HP))

Motor Plug



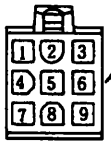
Plug: 172167-1 (AMP)
Pin: 170360-1 or 170364-1

Connected to
Cap 172159-1
Socket 170362 -1 or 170366-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green/Yellow

Encoder Plug



Plug 172169-1 (AMP)
Pin: 170359-1 or 170363-1

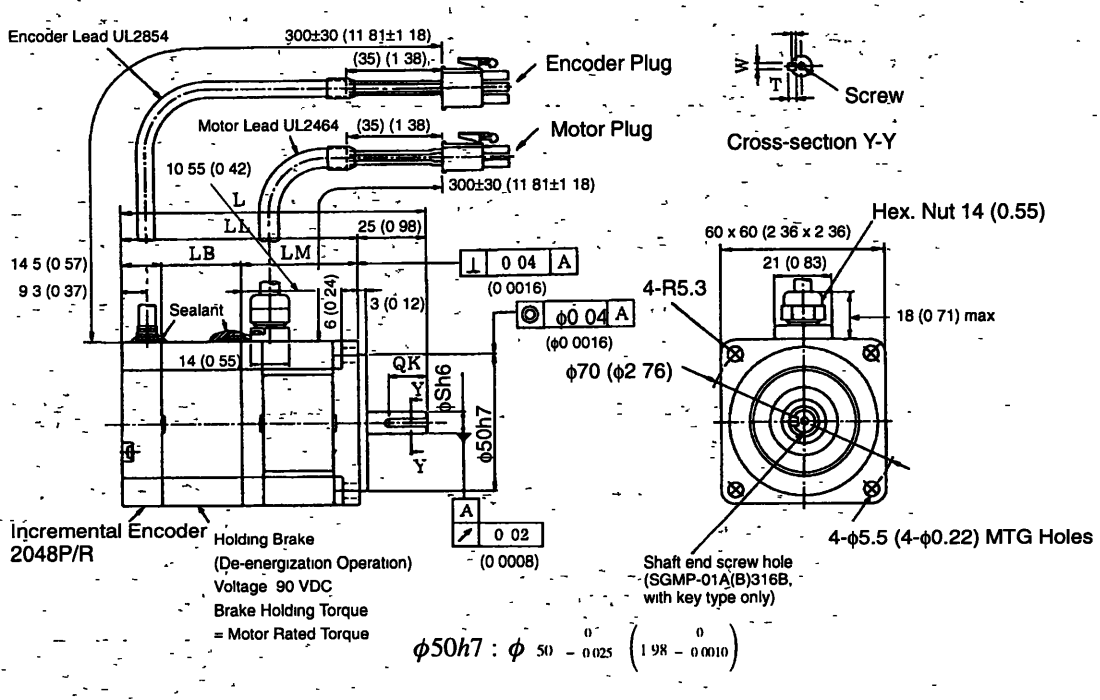
Connected to
Cap: 172161-1
Socket: 170361-1 or 170365-1

Incremental Encoder Wiring Specifications

1	A channel output	Blue
2	$\overline{A}$ channel output	Blue/Black
3	B channel output	Yellow
4	$\overline{B}$ channel output	Yellow/Black
5	C channel output	Green
6	$\overline{C}$ channel output	Green/Black
7	0 V (power supply)	Gray
8	+5 V (power supply)	Red
9	FG (Frame Ground)	Orange

■ SGMP Servomotors with Incremental Encoders and Brakes

100 W (0.13HP)



$\phi 50h7 : \phi\ 50\ {}^{0}_{-0.025}\ \left(1.98\ {}^{0}_{-0.0010}\right)$

Model SGMP-	L	LL	LM	LB	S	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
01A312B	111 (4 37)	86 (3 39)	42 5 (1 67)	29 (1 14)	8 (0 31)	No key				---	100 (0.13)	0 9 (1 98)	78 (17)	49 (11)
01A314B						14 (0.55)	1 8 (0.07)	3 (0.12)	3 (0 12)	M3, depth 6 (0 24)				
01A316B														

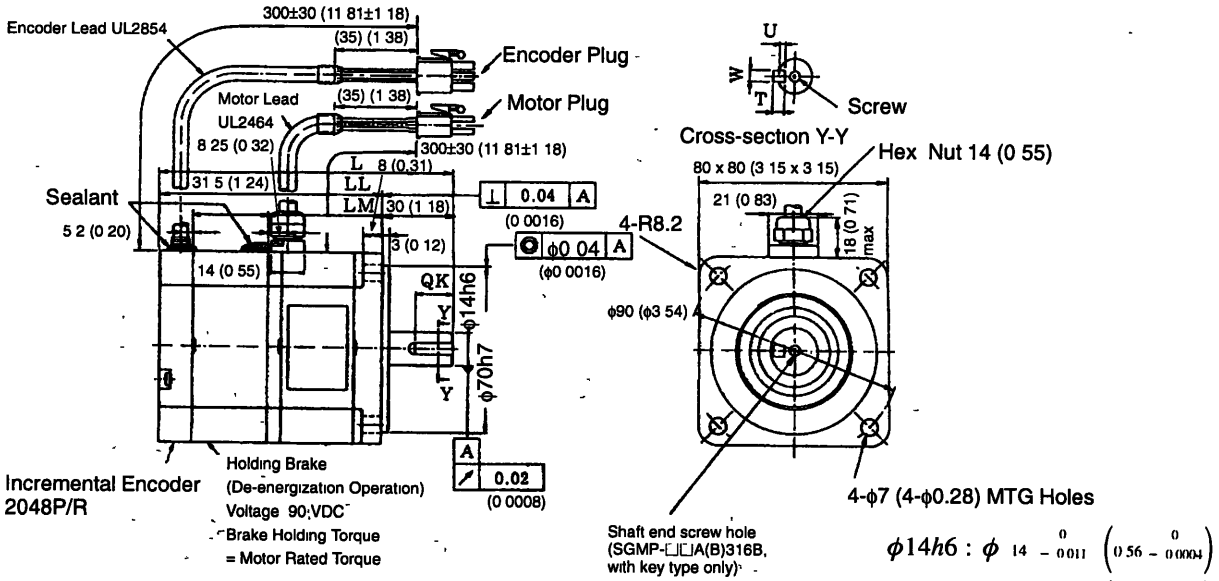
Note 1 The encoder is an incremental encoder 2048 P/R

2. "A" in the model number indicates 200 V-specifications

3. The quoted allowable radial load is the value at a position 20 mm (0 79in.) from the motor mounting surface.

4. Conforms to IP55 protective structure (except connector and output shaft faces).

200 W (0.27 HP), 300 W (0.40 HP) (100 V Only), 400 W (0.53 HP) (200 V Only)



Model SGMP-	L	LL	LM	QK	U	W	T	Screw Di-mensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02A312B	123 5 (4 86)	93 5 (3.68)	48 1 (1 89)	No key				---	200 (0 27)	1 9 (4 19)	245 (55)	68 (15)
02B312B												
02A314B				16 (0 63)	3 (0 12)	5 (0 20)	5 (0 20)					
02B314B												
02A316B								M5, depth 8 (0 31)				
02B316B												
03B312B	143 5 (5 65)	113 5 (4 47)	68 1 (2 68)	No key				---	400 (0 53)	2 6 (0 10)		
03B314B				16 (0 63)	3 (0 12)	5 (0 20)	5 (0 20)					
03B316B								M5, depth 8 (0 31)				
04A312B				No key				---				
04A314B				16 (0.63)	3 (0.12)	5 (0 20)	5 (0 20)					
04A316B								M5, depth 8 (0 31)				

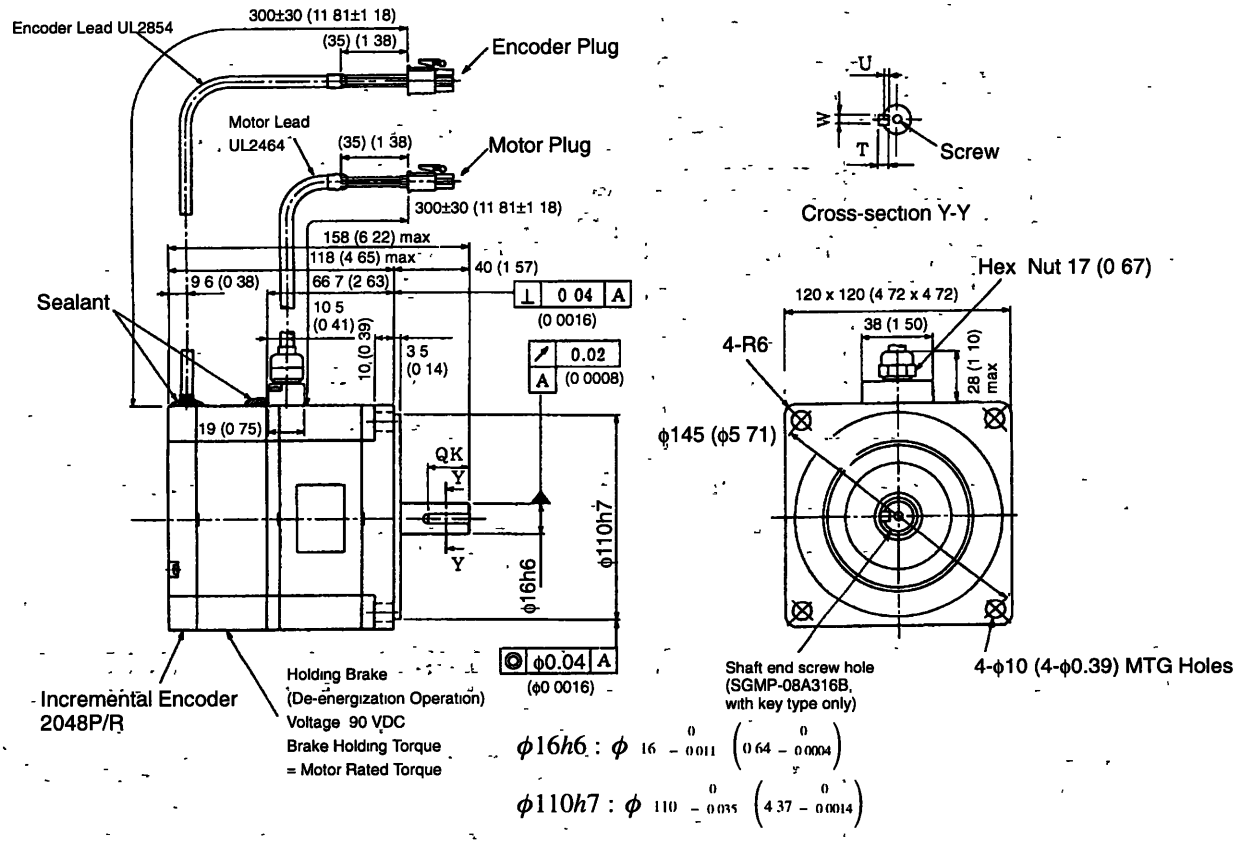
Note 1 The encoder is an incremental encoder 2048 P/R.

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications.

3. The quoted allowable radial load is the value at a position 25 mm (0 98in.) from the motor mounting surface.

4. Conforms to IP55 protective structure (except connector and output shaft faces).

750 W (1.01HP)



$\phi 16h6 : \phi 16 \, {}^{0}_{-0.011} \left(0.64 \, {}^{0}_{-0.0004} \right)$

$\phi 110h7 : \phi 110 \, {}^{0}_{-0.035} \left(4.37 \, {}^{0}_{-0.0014} \right)$

Model SGMP-	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08A312B	No key				---	750 (1 01)	5 7 (12 566)	392 (88)	147 (33)
08A314B	22 (0 87)	3 (0 12)	5 (0 20)	5 (0 20)					
08A316B					M5, depth 8 (0 31)				

Note 1. The encoder is an incremental encoder 2048 P/R.

2. "A" in the model number indicates 200 V-specifications.

3. The quoted allowable radial load is the value at a position 35 mm (1.38 in) from the motor mounting surface.

4. Conforms to IP55 protective structure (except connector and output shaft faces).

Motor and Encoder Plugs (For 100 W (0.13 HP) to 750 W (1.01 HP))

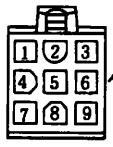
Motor Plug

Plug: 172168-1 (AMP)
Pin 170360-1 or 170364-1
Connected to
Cap: 172160-1
Socket: 170362 -1 or 170366-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green/Yellow
5	Brake	Black
6	Brake	Black

Encoder Plug



Plug: 172169-1 (AMP)
Pin 170359-1 or 170363-1
Connected to
Cap: 172161-1
Socket: 170361-1 or 170365-1

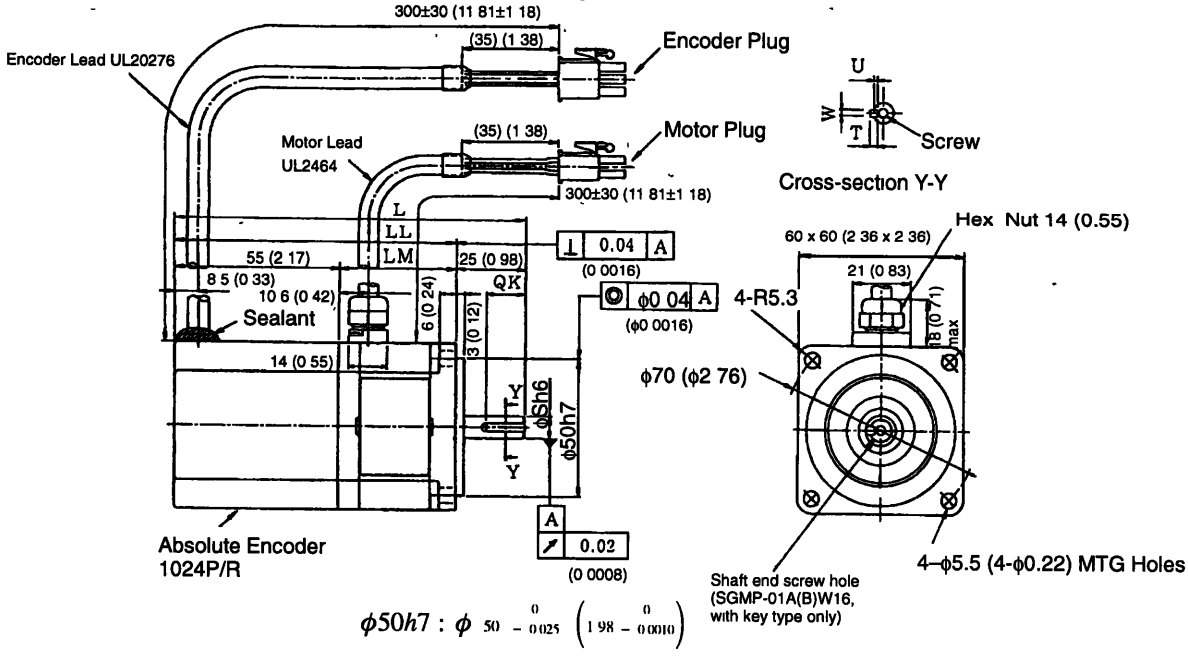
Incremental Encoder Wiring Specifications

1	A channel output	Blue
2	$\overline{A}$ channel output	Blue/Black
3	B channel output	Yellow
4	$\overline{B}$ channel output	Yellow/Black
5	C channel output	Green
6	$\overline{C}$ channel output	Green/Black
7	0 V (power supply)	Gray
8	+5 V (power supply)	Red
9	FG (Frame Ground)	Orange

10

■ SGMP Servomotors with Absolute Encoders, No Brakes

100 W (0.13HP)



$\phi 50h7 : \phi\ 50\ {}^{0}_{-0.025}\ \left(1.98\ {}^{0}_{-0.0010}\right)$

Model SGMP-	L	LL	LM	S	QK	U	W	T	Screw dimensions	Output W (HP)	Approx. Mass kg(lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
01AW12	122.5	97 5	42 5 (1.67)	8 (0 31)	No key				---	100 (0.13)	0.95 (2.094)	78 (17)	49 (11)
01BW12													
01AW14					14 (0.55)	1.8 (0 07)	3 (0.12)	3 (0.12)					
01BW14													
01AW16									M3, depth 6 (0 24)				
01BW16													

Note 1 The encoder is a 12-bit absolute encoder 1024 P/R

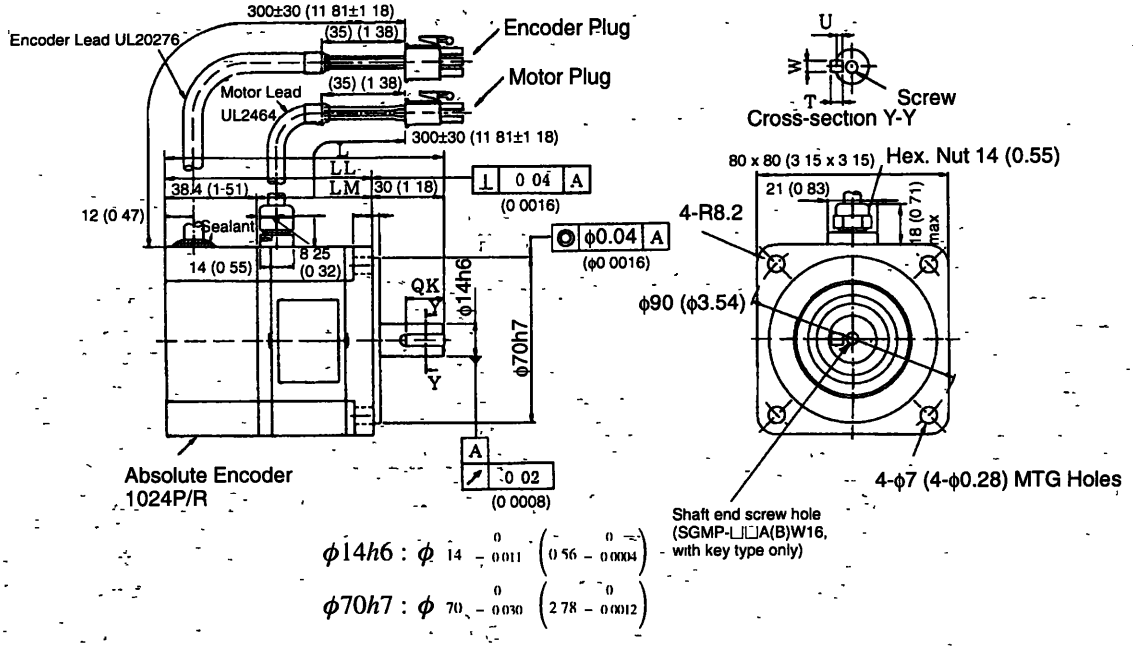
2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100-V-specifications.

3. The quoted allowable radial load is the value at a position 20 mm (0.79 in) from the motor mounting surface

4. Conforms to IP55 protective structure (except connector and output shaft faces).

10

200 W (0.27 HP), 300 W (0.40 HP) (100 V only), 400 W (0.53HP) (200 V only)



Model SGMP-	L	LL	LM	QK	U	W	T	Screw dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02AW12	116.5 (4.59)	86 5 (3.41)	48.1 (1.89)	No key				---	200 (0.27)	1 6 (3.53)	245 (55)	68 (15)
02BW12												
02AW14				16 (0.63)	3 (0.12)	5 (0.20)	5 (0 20)					
02BW14												
02AW16								M5, depth 8 (0.31)				
02BW16												
03BW12	136.5 (5.37)	106.5 (4.19)	68.1 (2.68)	No key				---	300 (0.40)	2.3 (5.07)		
03BW14				16 (0.63)	3 (0.12)	5 (0.20)	5 (0.20)					
03BW16								M5, depth 8 (0.31)				
04AW12				No key				---	400 (0.53)			
04AW14				16 (0.63)	3 (0.12)	5 (0.20)	5 (0.20)					
04AW16								M5, depth 8 (0.31)				

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

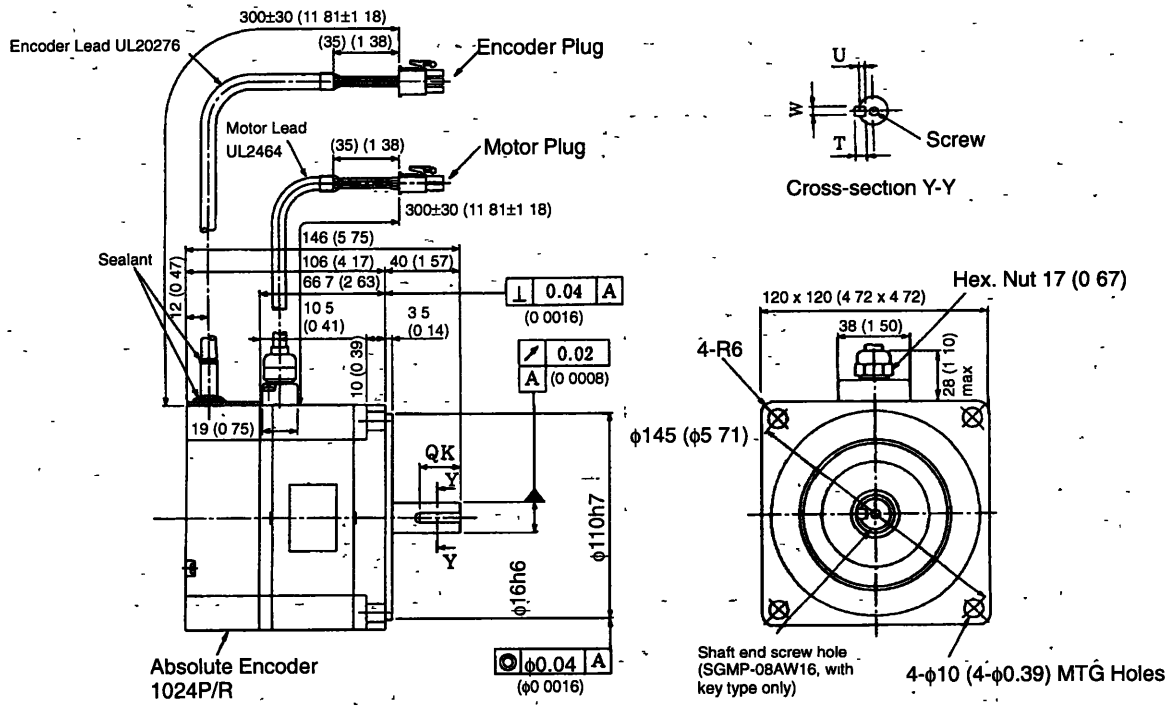
2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications.

3. The quoted allowable radial load is the value at a position 25 mm (0.98 in.) from the motor mounting surface.

4. Conforms to IP55 protective structure (except connector and output shaft faces).

10

750 W (1.01HP)



$$\phi 16h6 : \phi 16 \, {}^{0}_{-0011} \left(0\,64 \, {}^{0}_{-0\,0004} \right)$$

$$\phi 110h7 : \phi 110 \, {}^{0}_{-0035} \left(4\,37 \, {}^{0}_{-0\,0014} \right)$$

Model SGMP-	QK	U	W	T	Screw Dimen-sions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08AW12	No key				---	750 (1 01)	4 8 (10 58)	392 (88)	147 (33)
08AW14	22 (0 87)	3 (0 12)	5 (0 20)	5 (0 20)					
08AW16					M5 depth 8 (0 31)				

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

2. "A" in the model number indicates 200 V-specifications.
3. The quoted allowable radial load is the value at a position 35 mm (1.38 in) from the motor mounting surface.
4. Conforms to IP55 protective structure (except connector and output shaft faces)

Motor and Encoder Plugs (For 100 W (0.13 HP) to 750 W (1.01 HP))

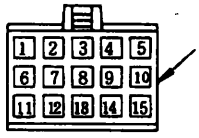
Motor Plug

Plug: 172167-1 (AMP)
Pin: 170360-1 or 170364-1
Connected to
Cap. 172159-1
Socket. 170362 -1 or 170366-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green/Yellow

Encoder Plug



Plug: 172171-1 (AMP)
Pin: 170359-1 or 170363-1
Connected to
Cap: 172163-1
Socket: 170361-1 or 170365-1

Absolute Encoder Wiring Specifications

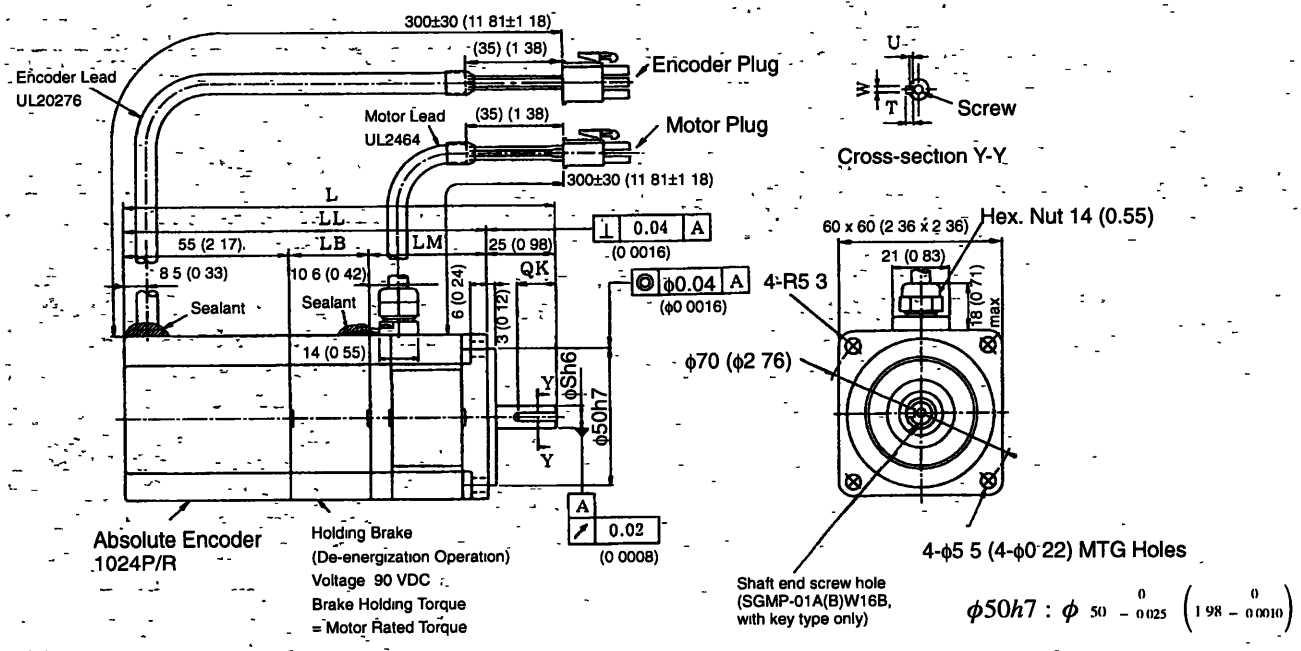
1	A channel output	Blue
2	$\overline{A}$ channel output	White/Blue
3	B channel output	Yellow
4	$\overline{B}$ channel output	White/Yellow
5	Z channel output	Green
6	$\overline{Z}$ channel output	White/Green
7	0 V (power supply)	Black
8	+5 V(power supply)	Red
9	FG (Frame Ground)	Green/Yellow
10	S channel output	Purple
11	$\overline{S}$ channel output	White/Purple
(12)	(Capacitor reset)	(Gray)
13	Reset	White/Gray
14	0 V(battery)	White/Orange
15	3 6V(battery)	Orange

* Terminal to discharge capacitor before shipment. Do not use

10

■ SGMP Servomotors with Absolute Encoders and Brakes

100 W (0.13 HP)



Model SGMP-	L	LL	LM	LB	S	QK	U	W	T	Screw dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable radial load N (lb)	Allowable thrust load N (lb)
01AW12B	151 5	126 5	42 5 (1 67)	29 (1 14)	8 (0 31)	No key				---	100 (0 13)	1 2. (2 65)	78 (17)	49 (11)
01BW12B														
01AW14B						14 (0 55)	1 8 (0 07)	3 (0 12)	3 (0 12)					
01BW14B														
01AW16B										M3, depth 6 (0 24)				
01BW16B														

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications.

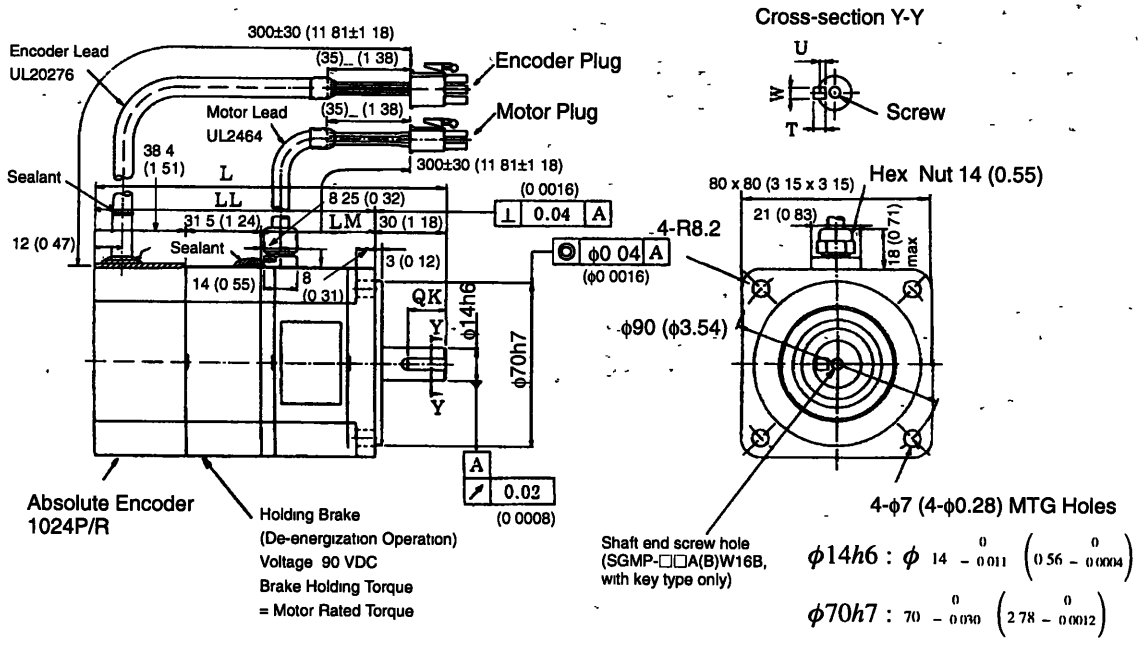
3. The quoted allowable radial load is the value at a position 20 mm (0.79 in.) from the motor mounting surface.

4. Conforms to IP55 protective structure (except connector and output shaft faces).

Dimensional Tolerances

Model SGMP-	Shaft-end Dimensions [mm (in)]
	S
01AW12B	$8\ {}^{0}_{-0.009}\ \left(0.32\ {}^{0}_{-0.0004}\right)$
01BW12B	
01AW14B	
01BW14B	
01AW16B	
01BW16B	

200 W (0.27 HP), 300 W (0.40 HP) (100 V Only), 400 W (0.53 HP) (200 V Only)



Model SGMP-	L	LL	LM	QK	U	W	T	Screw dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
02AW12B	148 (5 83)	118 (4 65)	48 1 (1.89)	No key				---	200 (0.27)	2.1 (4.63)	245 (55)	68 (15)
02BW12B												
02AW14B				16 (0.63)	3 (0.12)	5 (0.20)	5 (0.20)					
02BW14B												
02AW16B								M5, depth 8 (0.31)				
02BW16B												
03BW12B	168 (6 61)	138 (5.43)	68.1 (2.68)	No key				---	300 (0.40)	2,8 (6.17)		
03BW14B				16 (0.63)	3 (0.12)	5 (0 20)	5 (0.20)					
03BW16B								M5, depth 8 (0.31)				
04AW12B				No key				---	400 (0 53)			
04AW14B				16 (0.63)	3 (0.12)	5 (0.20)	5 (0.20)					
04AW16B								M5, depth 8 (0 31)				

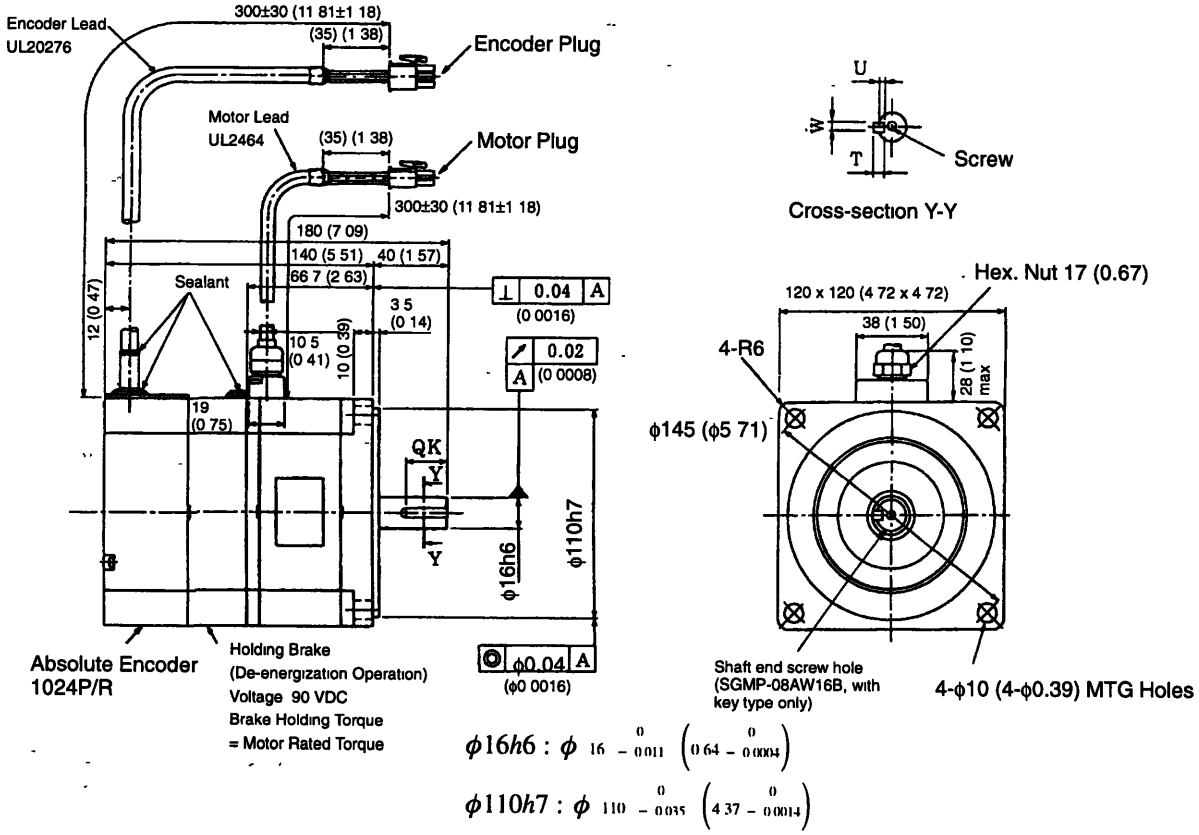
Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

2. "A" in the model number indicates 200 V-specifications, and "B" indicates 100 V-specifications.

3. The quoted allowable radial load is the value at a position 25 mm (0.98 in.) from the motor mounting surface.

4. Conforms to IP55 protective structure (except connector and output shaft faces).

750 W (1.01 HP)



$\phi 16h6 : \phi 16 \, {}^{0}_{-0.011} \left(0.64 \, {}^{0}_{-0.0004} \right)$

$\phi 110h7 : \phi 110 \, {}^{0}_{-0.035} \left(4.37 \, {}^{0}_{-0.0014} \right)$

Model SGMP-	QK	U	W	T	Screw Dimensions	Output W (HP)	Approx. Mass kg (lb)	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
08AW12B	No key				---	750 (1 01)	6 2 (13 67)	392 (88)	147 (33)
08AW14B	22 (0 87)	3 (0 12)	5 (0 20)	5 (0 20)					
08AW16B					M5, depth 8 (0 31)				

Note 1. The encoder is a 12-bit absolute encoder 1024 P/R.

2. "A" in the model number indicates 200 V-specifications.
3. The quoted allowable radial load is the value at a position 35 mm (1.38 in) from the motor mounting surface
4. Conforms to IP55 protective structure (except connector and output shaft faces)

Motor and Encoder Plugs (For 100 W (0.13 HP) to 750 W (1.01 HP))

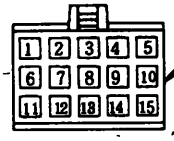
Motor Plug

Plug 172168-1 (AMP)
Pin: 170360-1 or 170364-1 (1 to 4 pins)
170359-1 or 170363-1 (5, 6 pins)
(170360-1 or 170364-1 750 W only)
Connected to
Cap: 172160-1
Socket. 170362 -1 or 170366-1

Motor Wiring Specifications

1	U phase	Red
2	V phase	White
3	W phase	Blue
4	FG	Green/Yellow
5	Brake terminal	Black
6	Brake terminal	Black

Encoder Plug



Plug: 172171-1 (AMP)
Pin: 170359-1 or 170363-1
Connected to
Cap: 172163-1.
Socket 170361-1 or 170365-1

Absolute Encoder Wiring Specifications

1	A channel output	Blue
2	$\overline{A}$ channel output	White/Blue
3	B channel output	Yellow
4	$\overline{B}$ channel output	White/Yellow
5	Z channel output	Green
6	$\overline{Z}$ channel output	White/Green
7	0 V (power supply)	Black
8	+5 V (power supply)	Red
9	FG (Frame Ground)	Green/Yellow
10	S channel output	Purple
11	$\overline{S}$ channel output	White/Purple
* (12)	(Capacitor reset)	(Gray)
13	Reset	White/Gray
14	0 V (battery)	White/Orange
15	3 6 V (battery)	Orange

* Terminal to discharge capacitor before shipment. Do not use

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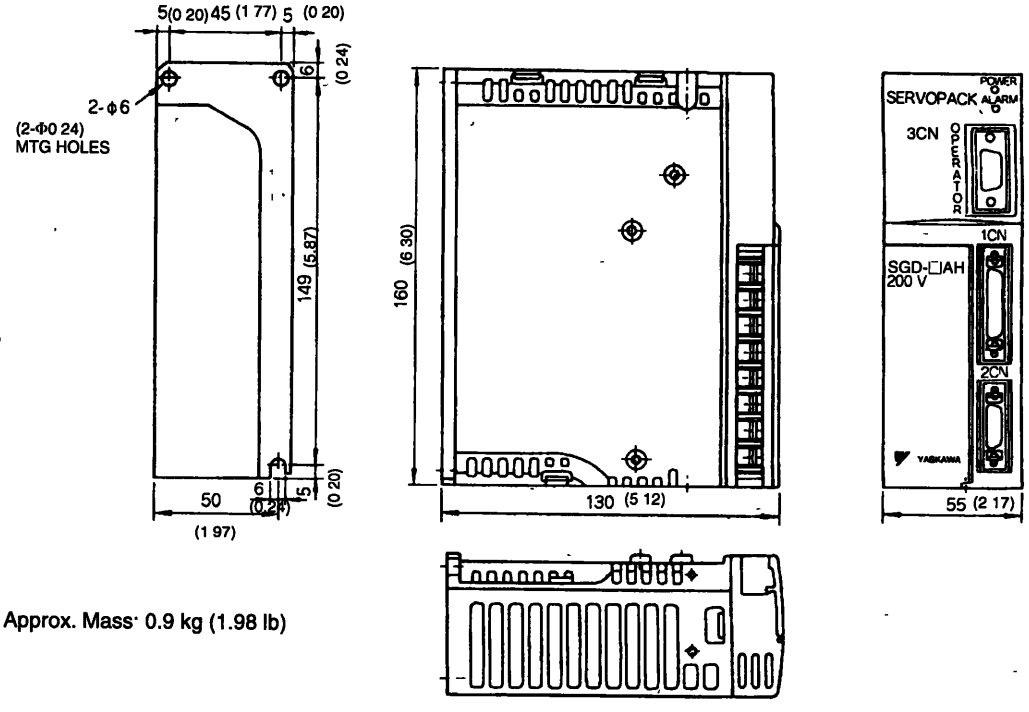
10.2 Servopack Dimensional Drawings

The dimension drawings of the SGD Servopack are broadly grouped according to capacity into the following three categories.

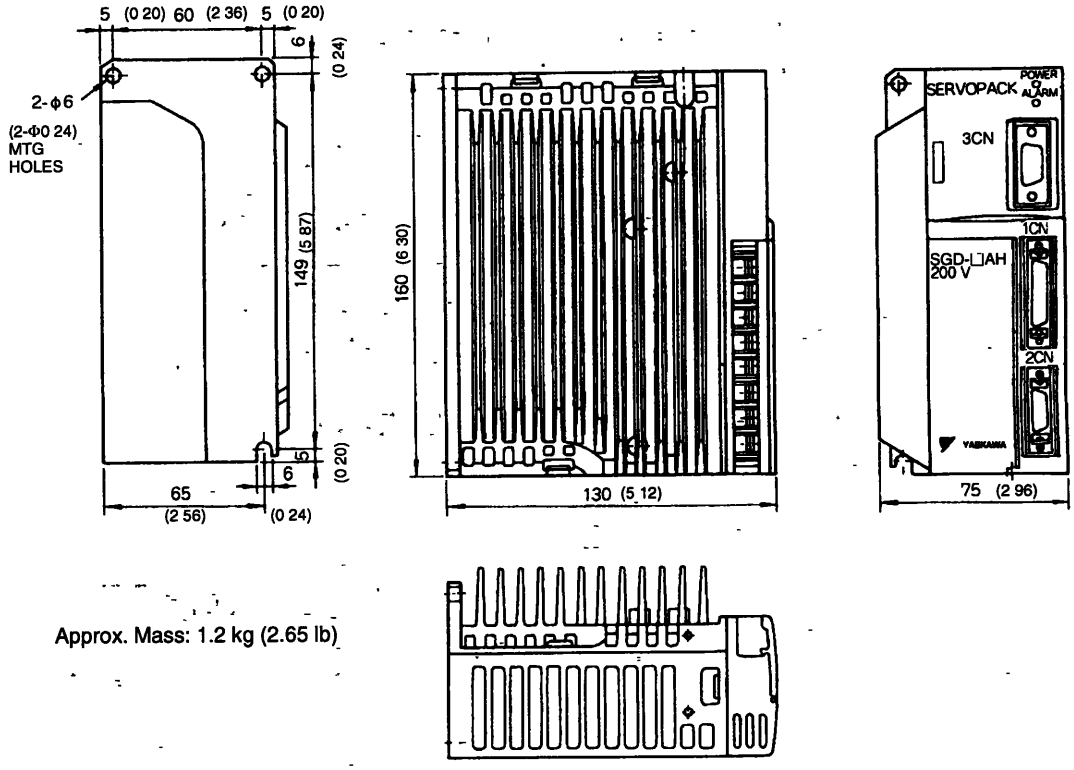
- 200 V, 30 W (0.04 HP) to 200 W (0.27 HP) (Model: SGD-A3AH to 02AH)
  100 V, 30 W (0.04 HP) to 100 W (0.13 HP) (Model: SGD-A3BH to 01BH)
- 200 V, 400 W (0.53 HP) (Model: SGD-04AH)
  100 V, 200 W (0.27 HP) (Model: SGD-02BH)
- 200 V, 750 W (1.01 HP) (Model: SGD-08AH)
  100 V, 300 W (0.40 HP) (Model: SGD-03BH)

10.2.1 SGD-A3AH to 02AH, SGD-A3BH to 01BH



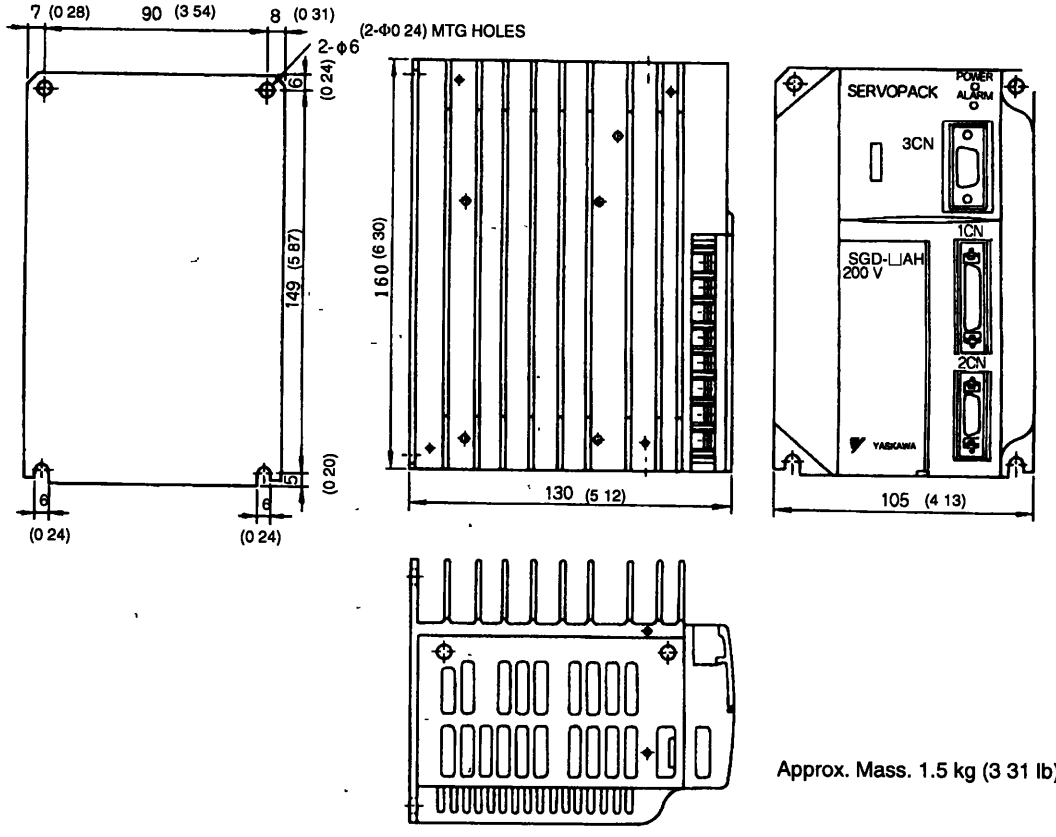
Approx. Mass: 0.9 kg (1.98 lb)

10.2.2 SGD-04AH, SGD-02BH



Approx. Mass: 1.2 kg (2.65 lb)

10.2.3 SGD-08AH, SGD-03BH



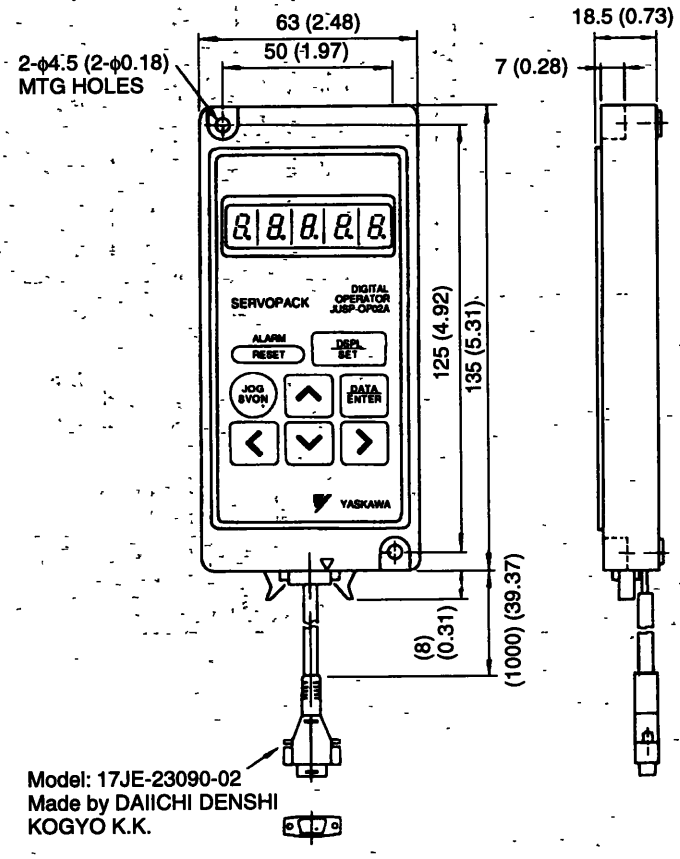
Approx. Mass. 1.5 kg (3 31 lb)

10

10.3 Digital Operator Dimensional Drawings

The dimensional drawings of the Digital Operator are as shown below.

Type JUSP-OP02A-1



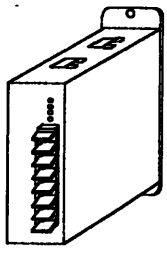
Approx. Mass: 0.18 kg (0.40 lb)

10.4 Specifications and Dimensional Drawings of Peripheral Devices

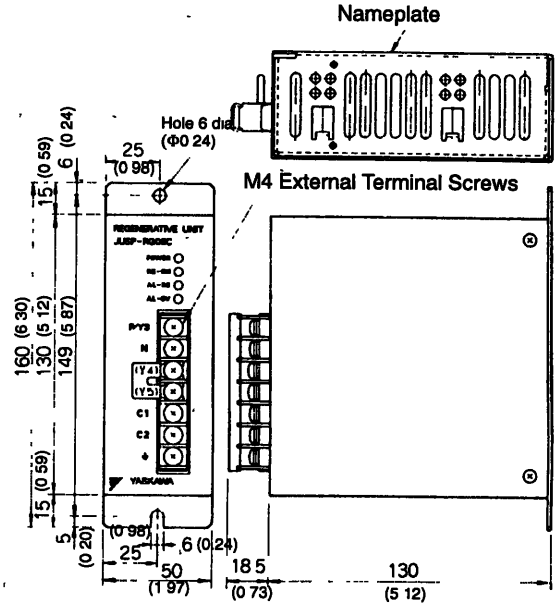
10.4.1 Regenerative Unit

The dimensional drawings of the Regenerative Unit are as shown below.

■ Type JUSP-RG08C



Approx. Mass: 1 kg (2.20 lb)

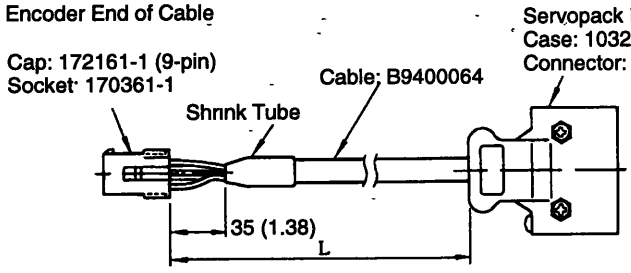


10.4.2 Cable Specifications

■ Cables from Yaskawa

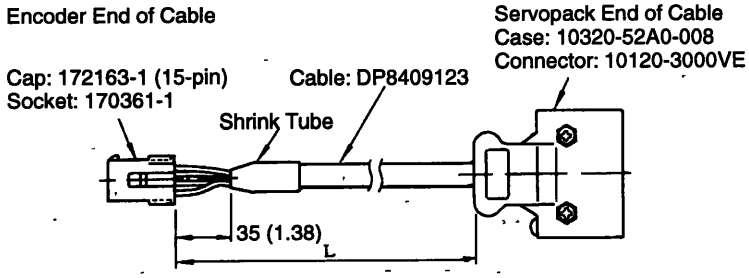
Encoder Cables

- For Incremental Encoders (Connectors at Both Ends)



Model	L in mm (feet)
DP9320089-1	$3000\,^{+100}_{0}$ $(10\,^{+0.33}_{0})$
DP9320089-2	$5000\,^{+100}_{0}$ $(16.7\,^{+0.33}_{0})$
DP9320089-3	$10000\,^{+500}_{0}$ $(33.3\,^{+1.67}_{0})$
DP9320089-4	$15000\,^{+500}_{0}$ $(50\,^{+1.67}_{0})$
DP9320089-5	$20000\,^{+500}_{0}$ $(66.7\,^{+1.67}_{0})$

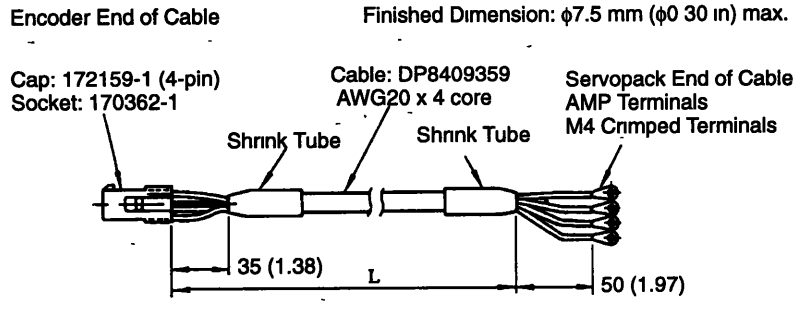
- For Absolute Encoders (Connectors at Both Ends)



Model	L in mm (feet)
DP9320088-1	$3000\,^{+100}_{0}$ $(10\,^{+0.33}_{0})$
DP9320088-2	$5000\,^{+100}_{0}$ $(16.7\,^{+0.33}_{0})$
DP9320088-3	$10000\,^{+500}_{0}$ $(33.3\,^{+1.67}_{0})$
DP9320088-4	$15000\,^{+500}_{0}$ $(50\,^{+1.67}_{0})$
DP9320088-5	$20000\,^{+500}_{0}$ $(66.7\,^{+1.67}_{0})$

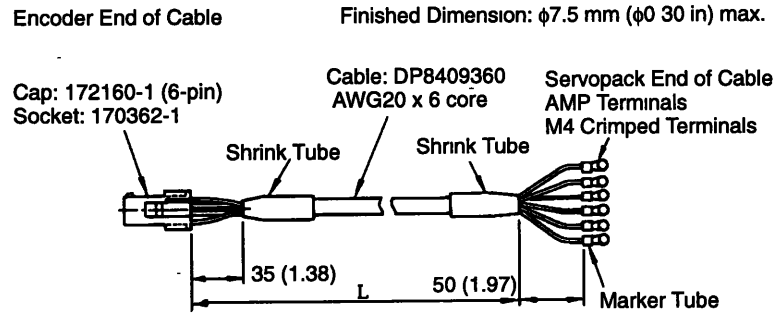
Motor Cables

- For Motors Without Brakes (with Connector and AMP Terminals)



Model	L in mm (feet)
DP9320081-1	$3000\,^{+100}_{0}$ $(10\,^{+0.33}_{0})$
DP9320081-2	$5000\,^{+100}_{0}$ $(16.7\,^{+0.33}_{0})$
DP9320081-3	$10000\,^{+500}_{0}$ $(33.3\,^{+1.67}_{0})$
DP9320081-4	$15000\,^{+500}_{0}$ $(50\,^{+1.67}_{0})$
DP9320081-5	$20000\,^{+500}_{0}$ $(66.7\,^{+1.67}_{0})$

- For Motors with Brakes (with Connector and AMP Terminals)

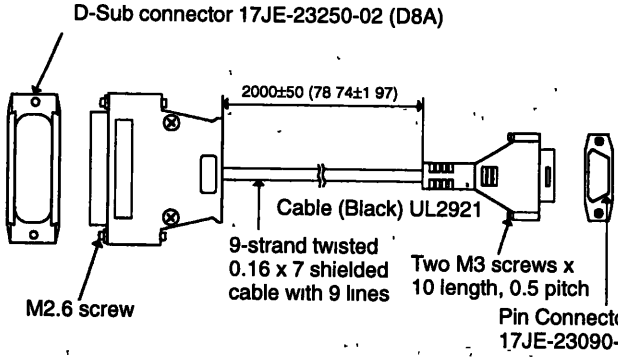


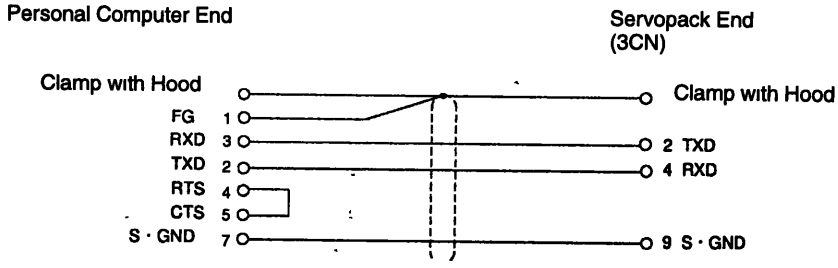
Model	L in mm (feet)
DP9320083-1	$3000\,^{+100}_{0}$ $(10\,^{+0.33}_{0})$
DP9320083-2	$5000\,^{+100}_{0}$ $(16.7\,^{+0.33}_{0})$
DP9320083-3	$10000\,^{+500}_{0}$ $(33.3\,^{+1.67}_{0})$
DP9320083-4	$15000\,^{+500}_{0}$ $(50\,^{+1.67}_{0})$
DP9320083-5	$20000\,^{+500}_{0}$ $(66.7\,^{+1.67}_{0})$

PC Connection Cables

- For NEC PC-98 Computers with D-sub Connectors 25 pin

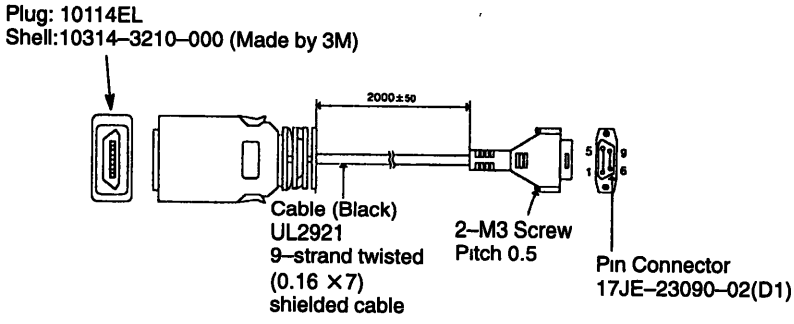
  Use Yaskawa DE9405258 cable.



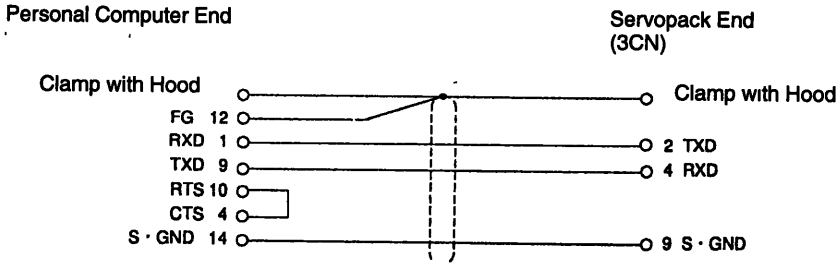


- For NEC PC-98 Half-pitch Connector

  Use Yaskawa DE9408564 cable.

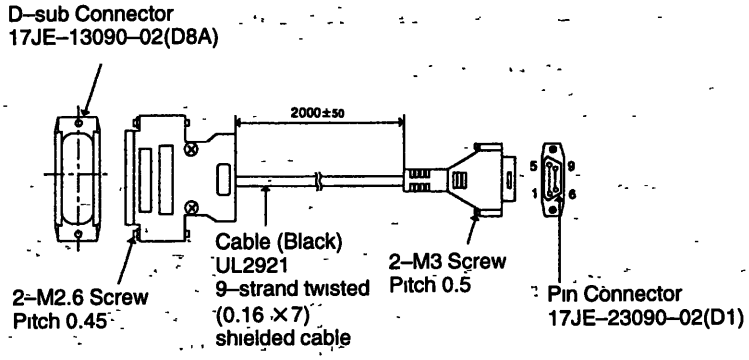


Note: Fold back the cable shielding at each end of the cable and secure it with clamp.

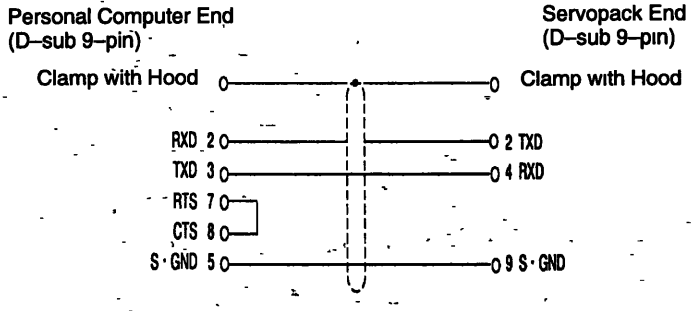


- For IBM PC (IBM-compatible PC)

  Use Yaskawa DE9408565 cable.

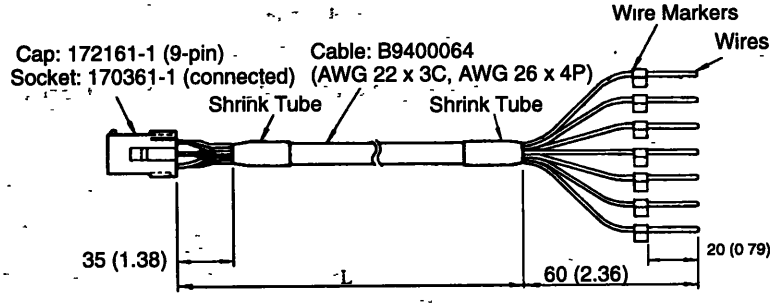


Note: Fold back the cable shielding at each end of the cable and secure it with clamp.



■ Cables without Servopack Connectors (PG Cables Only)

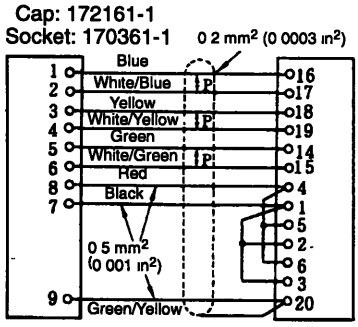
Cables for Incremental Encoders (Servopacks End without Connectors)



Lead Specifications

Wire Marker	Lead Color
1	Black
4	Red
14	Green
15	White (green)
16	Blue
17	White (blue)
18	Yellow
19	White (yellow)
20	Green (yellow)

- Connections



To be provided by user

Case: 10320-52A0-008
(Manufactured by 3M.)

Connector: 10120-3000VE
(Manufactured by 3M.)

Model	L in mm (feet)
DP9320086-1	3000 $^{+100}_{0}$ (10 $^{+0\ 33}_{0}$)
DP9320086-2	5000 $^{+100}_{0}$ (16.7 $^{+0\ 33}_{0}$)
DP9320086-3	10000 $^{+500}_{0}$ (33.3 $^{+1\ 67}_{0}$)
DP9320086-4	15000 $^{+500}_{0}$ (50 $^{+1\ 67}_{0}$)
DP9320086-5	20000 $^{+500}_{0}$ (66.7 $^{+1\ 67}_{0}$)

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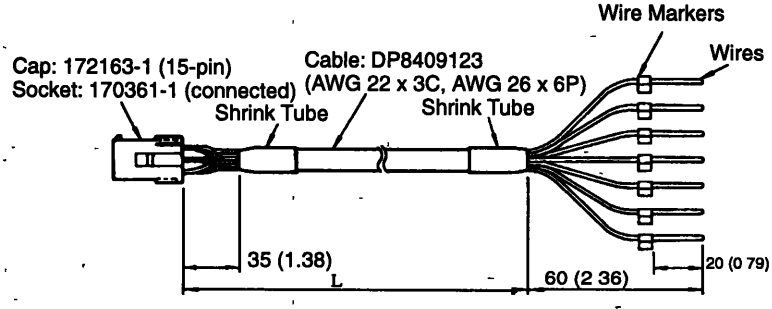
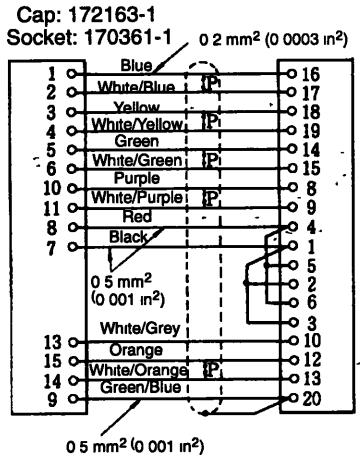
Cables for Absolute Encoders (Servopack End without Connector)



Lead Specifications

Wire Marker	Lead Color
1	Black
4	Red
8	Purple
9	White (purple)
10	White (gray)
12	Orange
13	White (orange)
14	Green
15	White (green)
16	Blue
17	White (blue)
18	Yellow
19	White (yellow)
20	Green (yellow)

- Connections



To be provided by user

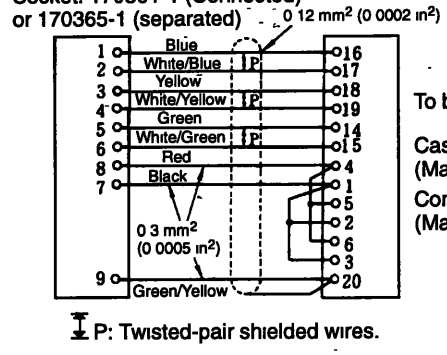
Case: 10320-52A0-008 (Manufactured by 3M)
Connector· 10120-3000VE (Manufactured by 3M.)

Model	L in mm (feet)
DP9320085-1	3000 $^{+100}_{0}$ (10 $^{+0\ 33}_{0}$)
DP9320085-2	5000 $^{+100}_{0}$ (16.7 $^{+0\ 33}_{0}$)
DP9320085-3	10000 $^{+500}_{0}$ (33.3 $^{+1\ 67}_{0}$)
DP9320085-4	15000 $^{+500}_{0}$ (50 $^{+1\ 67}_{0}$)
DP9320085-5	20000 $^{+500}_{0}$ (66.7 $^{+1\ 67}_{0}$)

■ Cables Only

Cables for Incremental Encoders

To be provided by user



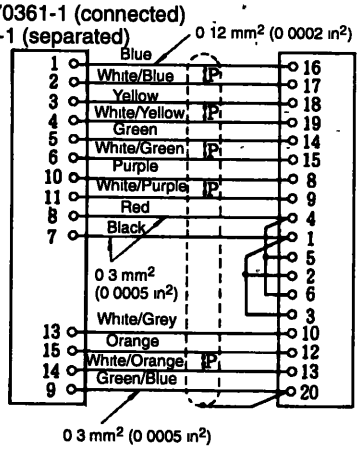
To be provided by user

Case: 10320-52A0-008 (Manufactured by 3M.)
Connector: 10120-3000VE (Manufactured by 3M.)

Model	L in mm (feet)
DP9400064-1	3000 $^{+100}_{0}$ (10 $^{+0\ 33}_{0}$)
DP9400064-2	5000 $^{+100}_{0}$ (16.7 $^{+0\ 33}_{0}$)
DP9400064-3	10000 $^{+500}_{0}$ (33.3 $^{+1\ 67}_{0}$)
DP9400064-4	15000 $^{+500}_{0}$ (50 $^{+1.67}_{0}$)
DP9400064-5	20000 $^{+500}_{0}$ (66.7 $^{+1\ 67}_{0}$)

Cables for Absolute Encoders

To be provided by user
Cap: 172163-1
Socket: 170361-1 (connected)
or 170365-1 (separated)



To be provided by user
Case: 10320-52A0-008
(Manufactured by 3M.)
Connector: 10120-3000VE
(Manufactured by 3M.)

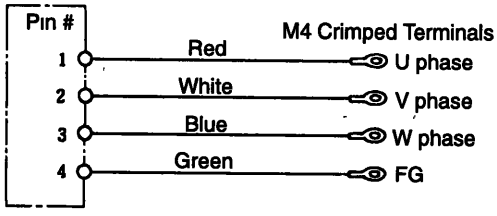
Model	L in mm (feet)
DP8409123-1	3000 $^{+100}_{0}$ ($^{+0\ 33}_{10\ 0}$)
DP8409123-2	5000 $^{+100}_{0}$ ($^{+0\ 33}_{16.7\ 0}$)
DP8409123-3	10000 $^{+500}_{0}$ ($^{+1\ 67}_{33.3\ 0}$)
DP8409123-4	15000 $^{+500}_{0}$ ($^{+1\ 67}_{50\ 0}$)
DP8409123-5	20000 $^{+500}_{0}$ ($^{+1\ 67}_{66.7\ 0}$)

10

Cables for Motors without Brakes

To be provided by user

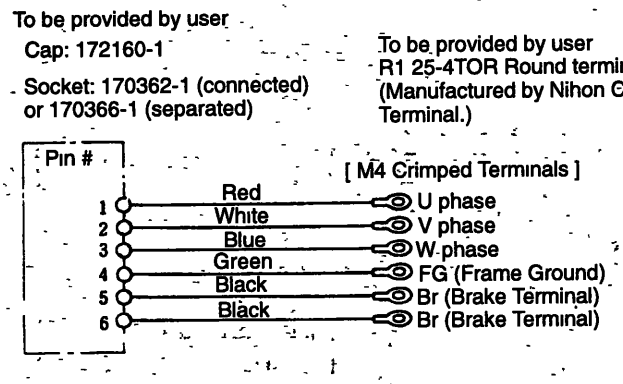
Cap: 172159-1
Socket: 170362-1 (connected)
or 170366-1 (separated)



To be provided by user
R1.25-4TOR Round terminal
(Manufactured by Nihon Crimp Terminal.)

Model	L in mm (feet)
DP8409359-1	3000 $^{+100}_{0}$ ($^{+0\ 33}_{10\ 0}$)
DP8409359-2	5000 $^{+100}_{0}$ ($^{+0\ 33}_{16.7\ 0}$)
DP8409359-3	10000 $^{+500}_{0}$ ($^{+1\ 67}_{33.3\ 0}$)
DP8409359-4	15000 $^{+500}_{0}$ ($^{+1\ 67}_{50\ 0}$)
DP8409359-5	20000 $^{+500}_{0}$ ($^{+1\ 67}_{66.7\ 0}$)

Cables for Motors with Brakes



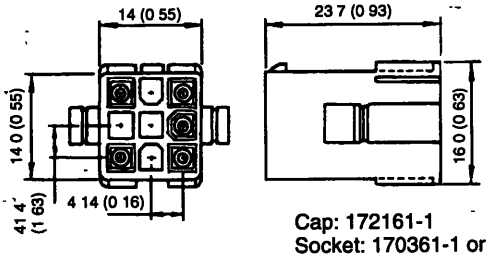
Model	L in mm (feet)
DP8409360-1	3000 $^{+100}_{0}$ (10 $^{+0.33}_{0}$)
DP8409360-2	5000 $^{+100}_{0}$ (16.7 $^{+0 33}_{0}$)
DP8409360-3	10000 $^{+500}_{0}$ (33.3 $^{+1 67}_{0}$)
DP8409360-4	15000 $^{+500}_{0}$ (50 $^{+1.67}_{0}$)
DP8409360-5	20000 $^{+500}_{0}$ (66.7 $^{+1 67}_{0}$)

Note Each connector is available as a connector kit. However, it is not an accessory of the Servopacks or motors. Refer to *10.4.3* for details on *Connector Kits*.

10.4.3 Connector Kits

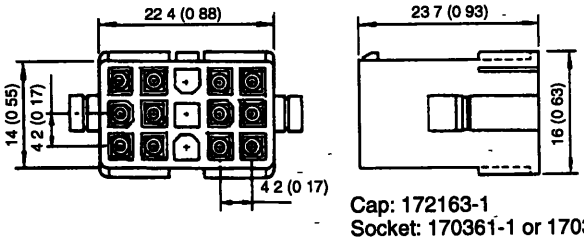
■ Encoder Cable Connectors

For Incremental Encoders



Cap: 172161-1
Socket: 170361-1 or 170365-1

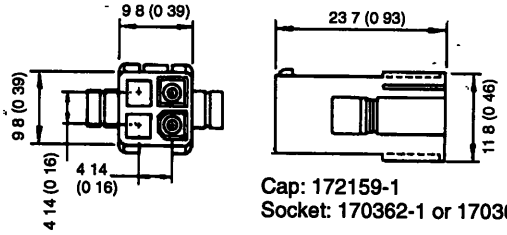
For Absolute Encoders



Cap: 172163-1
Socket: 170361-1 or 170365-1

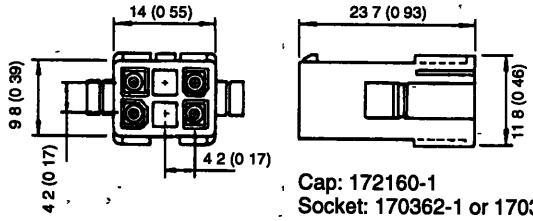
■ Motor Cable Connectors

Motors Without Brakes



Cap: 172159-1
Socket: 170362-1 or 170366-1

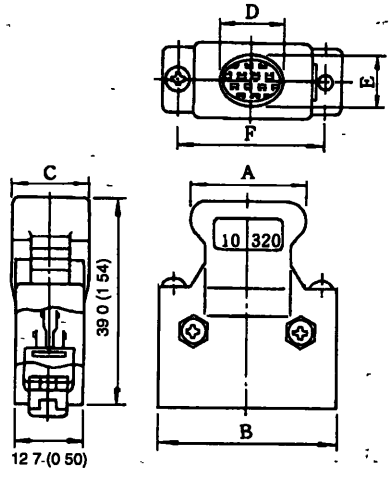
Motors with Brakes



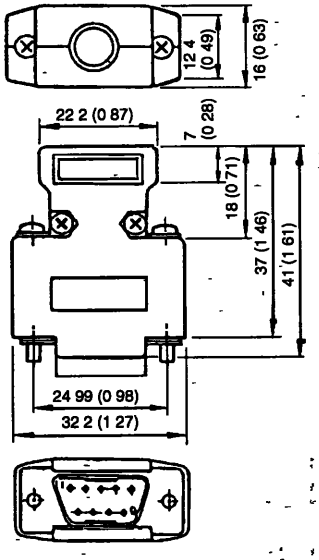
Cap: 172160-1
Socket: 170362-1 or 170366-1

■ Servopack Connectors

1CN, 2CN Connectors



3CN Connectors



Units: mm (inches)

Servopack	Connector	Case	A	B	C	D	E	F
For 1CN	10136-3000VE	10336-52A0-008	32 2 (1 27)	43 5 (1 71)	18 0 (0 71)	17 0 (0 67)	14 0 (0.55)	37 6 (1 48)
For 2CN	10120-3000VE	10320-52A0-008	22 0 (0 87)	33 3 (1 31)	14 0 (0.55)	12 0 (0 47)	10 0 (0 39)	27.4 (1 08)

The models of connector kit are shown below.

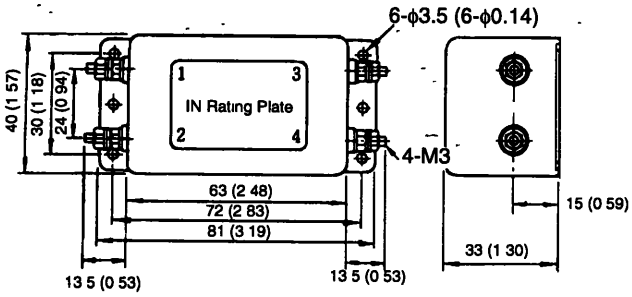
Connector Kit Model Number	Application		Connector Kit Part List											
	Encoder/Motor Cable		For Encoder Cable								For Motor Cable			
			Encoder End				Servopack End							
	Encoder Type	Motor Brake	Cap		Socket		Connector		Case		Cap		Socket	
			Model	Qty	Model	Qty	Model	Qty	Model	Qty	Model	Qty	Model	Qty
DP9420006-1	Incremental	Without	*1 172161-1	1	*1 170365-1	*3 10	*2 10120-3000VE	1	*2 10320-52A0-008	1	*1 172159-1	1	*1 170366-1	*3 5
DP9420006-2	Incremental	With									*1 172160-1	1		*3 7
DP9420006-3	Absolute	Without	*1 172163-1	1		*3 16					*1 172159-1	1		*3 5
DP9420006-4	Absolute	With									*1 172160-1	1		*3 7

Connector Model	Application	Connector Part List			
		Connector		Case	
		Model	Qty	Model	Qty
DP9420007	I/O connector for 1CN	10136-3000VE*2	1	10336-52A0-008*2	1
DE9409459	Serial communications connector for 3CN	Connector with case			
		Model			Qty
		17JE-23090-02 (D8B)			1

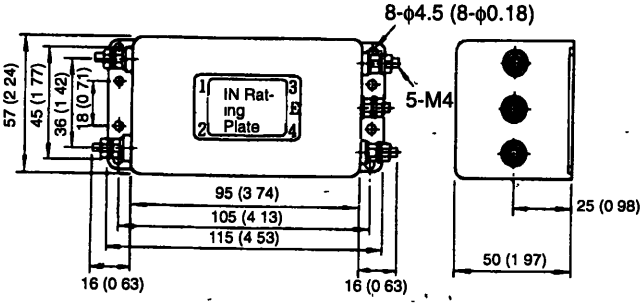
* 1. Manufactured by AMP.
* 2. Manufactured by Sumitomo 3M.
* 3. Including one spare.

10.4.4 Noise Filters

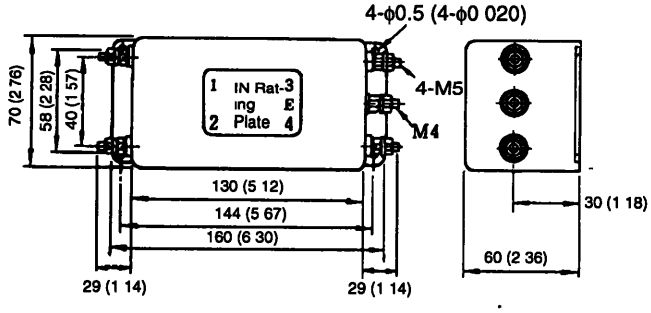
- LF-205A (Single-phase 200-VAC Class, 5 A)



- LF-210 (Single-phase 200-VAC Class, 10 A)



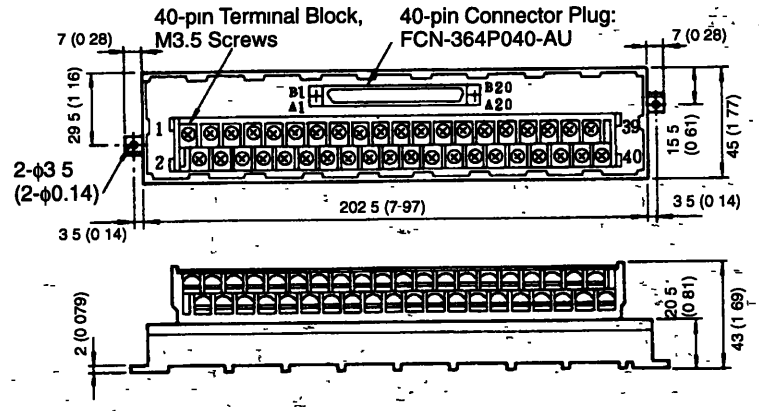
- LF-220 (Single-phase 200-VAC Class, 20 A)



Manufactured by TOKIN

10.4.5 Connector Terminal Block Converter Unit

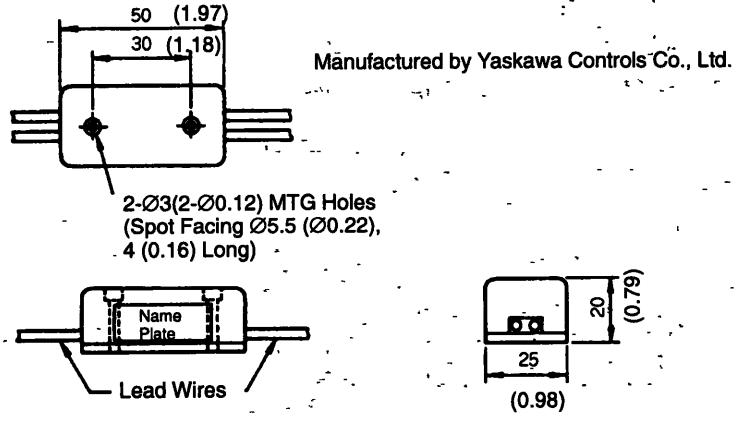
- JUSP-TA36P



10.4.6 Brake Power Supply

Brake power supplies are available for 100-V and 200-V inputs. Select an appropriate model depending on the power supply voltage.

- 200-VAC Input: 90 VDC (LPSE-2H01)
- 100-VAC Input: 90 VDC (LPDE-1H01)



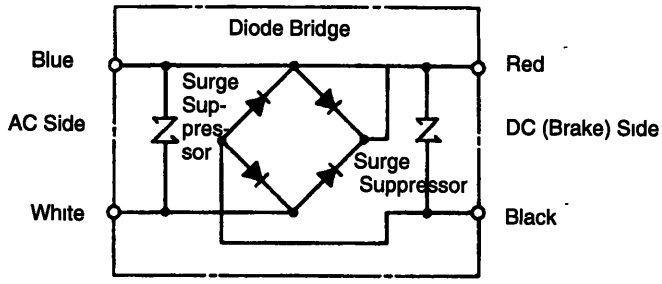
- Lead Wire Length: 500 mm each (19.69 in.)
- Max. Ambient Temperature: 60°C
- Lead Wires: Color coded

AC Input		Brake
100 V	200 V	
Blue/White	Yellow/White	Red/Black

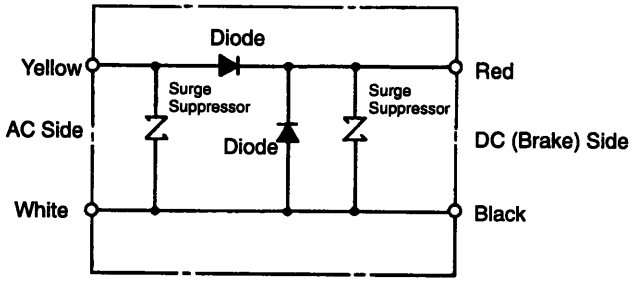
While it is possible to switch either the AC or DC side of the brake power supply, it is normally safer to switch the AC side. If the DC side is to be switched, install a surge suppressor near

the brake coil to prevent the surge voltages due to switching the DC side from damaging the brake coil.

- Internal Circuit for 200-VAC Input (LPDE-2H01)

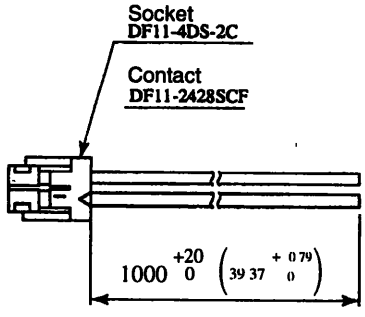


- Internal Circuit for 100-VAC Input (LPDE-1H01)



10

10.4.7 Analog Monitor Cables



Model	L in mm (feet)
DE9404559	1000 +20 0 (39 37 + 0.79 0)

11

Trial Operation

This chapter describes how to conduct a full trial operation.

11.1 Check Items before Trial Operation

Inspect the following items before conducting trial operation. Also conduct the inspections according to *Chapter 14 Maintenance and Inspection* if conducting trial operation on Servomotors that have been stored for a long period of time.

11.1.1 Servomotor

- Connection to machines or devices, wiring and grounding are correct.
- Bolts and nuts are tightened.
- For motors with shaft seals, the seals are not damaged and motor is properly lubricated.

11.1.2 Servopack

- User constants are properly set for the applicable Servomotor and specifications.
- Terminal connections and wiring leads are tightened securely. Connectors are inserted securely.
- The power supply is turned OFF if a servo alarm occurs.
- Voltage supplied to SGD Servopack is 200 to 230 V $^{+10}/_{-15}$% (100 to 115 V $^{+10}/_{-15}$%). (When using a power supply that is not 200 V (100 V), a transformer that steps down to 200 V (100 V) must be installed separately.)

Take appropriate action immediately if an alarm occurs or one of the items above is incorrect.

11.2 Trial Operation Procedure

11.2.1 Preparation for Trial Operation

To prevent accidents, initially conduct trial operation with no load connected to the Servomotor. If the trial operation must be conducted while connected to equipment, confirm that the driven system is ready for an emergency stop at any time.

■ Power ON

If the power supply ON sequence is correct as shown in *5.1*, press the ON switch to turn ON power. Press and hold the switch for about two seconds in *Figure 5.1* of *5.1*.

If the power is supplied normally, the power ON indicator LED (green) on the Digital Operator will light and the alarm LED (red) will go OFF. Send the ALM command to check Servopack status, and the Servopack will return ALM_ _BB.

The power circuit in the Servopack runs and Servomotor drive is enabled when the Servo ON signal is ON (SVON is sent by serial command or $\overline{\text{S-ON}}$ contact is turned ON). When the ALM command is sent to the Servopack, the Servopack returns ALM_ _RDY.

11.2.2 Operation

The Servomotor will only operate while the Servo ON signal is ON, and it will run at low speed.

Example Commands:
```
SVON
SPD 50
POSI 1000
```

Make sure the Servomotor is running in the proper direction according to the reference.

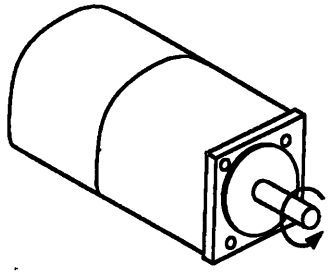


Figure 11.1 Motor Forward Operation

11.2.3 Inspection during Trial Operation

Inspect for the following items during the trial operation.

- Unusual vibration
- Abnormal noise
- Excessive temperature rise

Take actions according to *Chapter 14 Alarm Troubleshooting* if any fault is found. During trial operation, the load and machine may not fit well at first and result in an overload.

12

Settings

This chapter describes characteristics at the factory before shipping and Servo performance adjustment.

12.1 Characteristics at the Factory

The speed reference characteristics at the factory are shown below.

Speed Reference – Motor Speed Characteristics

Conditions: No load

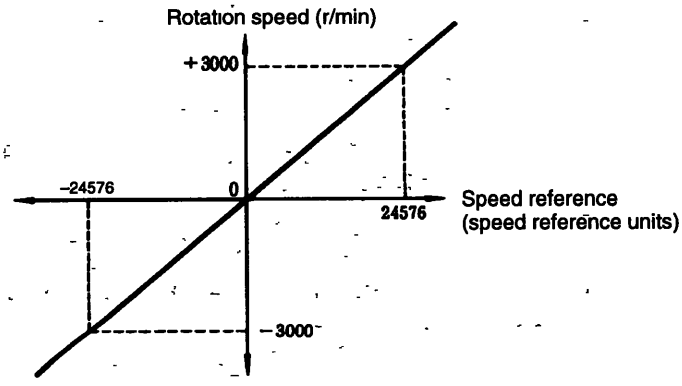


Figure 12.1 Speed Reference – Motor Speed Characteristics

12.2 Reset

If settings must be reset because of application or usage conditions, reset them in according to *Chapter 6 Serial Communications.*

12.3 Adjusting Servo Performance

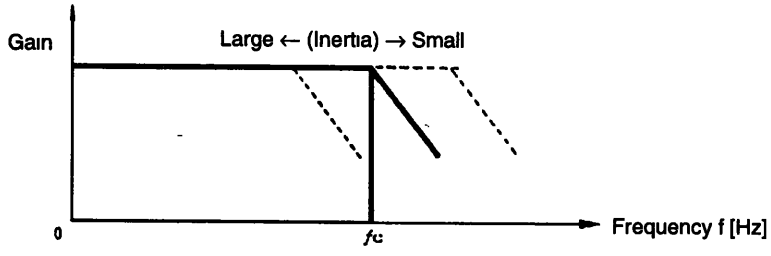
12.3.1 Setting User Constants

■ Position Loop Gain (PRM1)

Position loop gain is ideally determined by the specifications of the equipment, but initially set a level lower than the desired value. (The factory setting is 40 (1/s).)

■ Speed Loop Gain (PRM2)

The setting (Hz) of PRM 2 expresses the speed loop gain characteristics, and is the cutoff frequency "fc" for the response characteristics of a system with balanced inertia. The value fc may vary even with the same speed loop gain setting due to fluctuations in load inertia.



(J_M: Motor moment of inertia, J_L: Servomotor axis converted load inertia, $J_L/J_M = x$)

Cutoff frequency fc = PRM2 setting $\times \frac{2}{x+1}$ [Hz]

- The speed loop gain (PRM2) setting is therefore 50 (x + 1). (fc = 100 Hz with balanced inertia.)
- Since the values above may not hold for mechanical systems with low rigidity, initially set the value at 50x + 35. (The factory setting is 80 (Hz).)

Note Set PRM2 to 40 (Hz) or less if the Servomotor is running under no-load conditions.

■ Speed Loop Integration Time constant (PRM3)

Set PRM3 to 20 (ms). (Factory setting)

12.3.2 Setting Optimum Position and Speed Loop Gain

■ Speed Overshooting and Vibration

- Incrementally decrease the position loop gain (PRM1).

- Incrementally increase the speed loop gain. If the situation worsens when the speed loop gain is increased, incrementally decrease the gain.

Note A certain amount of position loop gain is necessary, so set the acceleration/deceleration time (PRM5) high if the application cannot handle overshoot.

■ When Response Tracking Worsens

- Incrementally increase the f position loop gain (PRM1).
- If the position loop gain cannot be increased any higher because of vibration, incrementally increase the speed loop gain (PRM2). If increasing the speed loop gain causes vibration, then tracking performance including that for the mechanical system is at its limit.

13

Maintenance and Inspection

This chapter describes Servodrive maintenance, inspection, and trouble-shooting.

13.1 Servodrive Maintenance and Inspection

13.1.1 Servomotor

Simple daily inspections are all that are needed to maintain the Servomotor because it is brushless. The inspection and maintenance frequencies given in the following table are only guidelines, and may be increased or decreased to suit operating conditions and environment. Do not disassemble the Servomotor during inspection and maintenance, but rather contact your Yaskawa representative if the Servomotor must be disassembled.

Table 13.1 Inspection Items

Item	Frequency	Procedure	Comments
Vibration and noise	Daily	Touch and listen.	The degree of vibration and noise must not be any higher than normal.
Appearance and cleaning	According to the degree of dirt	Clean with a cloth or compressed air.	—
Insulation resistance measurement	Yearly	Disconnect the Servopack and test insulation resistance at 500 V. Must exceed 10 MΩ.	Contact your Yaskawa representative if insulation resistance is below 10 MΩ.
Overhaul	Every 20000 hours or 5 years	Remove the Servomotor, replace consumable parts and perform any necessary repairs.	Contact your Yaskawa representative for the overhaul
Oil seal replacement (for motors equipped with oil seals)	Every 5000 hours	Remove the Servomotor and replace the oil seal.	—

13

■ Parts Replacement Schedule

The following parts are subject to mechanical wear or deterioration over time. To avoid failure, replace these parts periodically as indicated below.

Table 13.2 Parts Replacement

Part	Standard Replacement Period	Replacement Method
Bearings	20000 operating hours	Disassemble the Servomotor and replace the bearings if necessary.
Oil seal	About 5000 hours	Replace with a new oil seal.

13.1.2 Servopack

The Servopack contains highly reliable parts and does not require daily inspection. Always inspection the Servopack at least once a year. Be sure to check user settings prior to operation because we reset user constants to standard settings when we ship overhauled Servopacks.

Table 13.3 Inspection Items

Item	Frequency	Procedure	Remedy
Clean unit interior and circuit boards	Yearly	Check for dust, dirt, and oil on surfaces.	Clean with a cloth or compressed air.
Loose screws	Yearly	Check for loose terminal block and connector screws.	Tighten any loose screws.
Defective parts in unit or on circuit boards	Yearly	Check for discoloration, damage, or broken wires due to heat.	Contact your Yaskawa representative.

■ Parts Replacement Schedule

The following parts are subject to mechanical wear or deterioration over time. To avoid failure, replace these parts at the frequency indicated in the following table.

Table 13.4 Parts Replacement

Part	Standard Replacement Period	Replacement Method
Smoothing Capacitor	7 to 8 years	Test and replace with a new capacitor if necessary.
Relays	–	Test and replace if necessary.
Fuse	10 years	Replace with a new fuse.
Aluminum Electrolytic Capacitor on the Circuit Board	5 years	Test and replaced with a new circuit board if necessary

Note Operating conditions:
Ambient temperature. Annual average of 30°C
Load factor: 80% max.
Operation rate: 20 hours/day max.

13.1.3 Replacing Battery for Absolute Encoder

Replace the absolute encoder battery (purchased by the customer) as outlined below. With an ER 6-V C-type lithium battery manufactured by Toshiba Battery Co., the estimated life is about 10 years.

1. Turn ON the Servopack and wait at least 3 minutes until the encoder capacitor is charged.
2. Replace the battery. The Servopack power supply may be ON or OFF when the battery is replaced.

Encoder rotation data will not be lost if the battery is replaced following the instructions given above.

Note After completing step 1, above, the absolute encoder will function normally for up to 2 days without a battery.

13.2 Troubleshooting

13.2.1 Servomotor

Refer to the Table 13.5 for the appropriate action when a problem occurs during operation, and be sure to turn OFF the servo system power supply before commencing the procedures that are shaded. Contact your Yaskawa representative immediately if the problem cannot be resolved by using the described procedures.

Table 13.5 Causes, Inspection Areas, and Remedies

Symptom	Cause	Inspection	Remedy
Servomotor does not start	Overloaded	Try operating with no load	Reduce the load or replace with a larger capacity Servomotor.
	Loose connection	Check connector terminals (1CN, 2CN)	Tighten any loose parts.
	External connector wiring incorrect	Check external connector (1CN) wiring	Refer to the connection diagram and correct the wiring.
Unstable Servomotor rotation	Faulty connection	Check the U-, V- and W-phase lead terminals as well as feedback pulse connection.	Reconnect the wiring.
Servomotor overheated	Ambient temperature too high	Check to see if the ambient temperature is below 40°C.	Reduce the ambient temperature to below 40°C.
	Servomotor surface dirty	Check visually.	Clean dust and oil from the motor surface.
	Overloaded	Try operating with no load	Reduce the load or replace with a larger capacity Servomotor.
Abnormal noise	Mechanical mounting incorrect	• Loose Servomotor mounting screws? • Coupling not centered? • Coupling unbalanced?	• Tighten mounting screws. • Center or balance the coupling.
	Bearing defective	Check for noise and vibration near the bearing.	Contact your Yaskawa representative if defective.
	Vibration caused by the equipment	Foreign objects, damage, or deformation of sliding parts.	Contact the equipment manufacturer.

13.2.2 Servopack

■ Troubleshooting with Serial Communications Data

Table 13.6 shows examples of troubleshooting problems with serial communications data.

Table 13.6 Troubleshooting with Serial Communications Data

Serial Communications Data (Traceback Monitor)	Status When Lit	Cause	Remedy
ALM10.OC Overcurrent	Lit at power ON	Circuit board (1PWB) defective	Replace Servopack.
	Lit at power ON and servo ON	• Current feedback circuit or power transistor defective • Replace Servopack.	Replace Servopack.
	Lit during operation Lit even though power is turned OFF and ON Operation resumes after waiting and resetting.	Servopack ambient temperature exceeds 55°C.	Bring Servopack ambient temperature down to 55°C. (Heat sink overheated)
ALM40.OV Overvoltage	Lit with normal operation or deceleration	GD^2 load too large	Check Servomotor shaft converted inertia on the equipment.
		Circuit board (1PWB) defective	Replace Servopack.
ALM51.OS Overspeed	Lit with high-speed Servomotor rotation after reference input	• Servomotor wiring incorrect • Encoder wiring incorrect	• Check and correct wiring. • Check to see if the A-, B- and C-phase pulses are correct at 2CN, and repair if necessary.
ALM31.OF Overflow	No feedback pulse after reference pulse input	• Servomotor wiring incorrect • Encoder wiring incorrect	• Check and correct wiring. • Check to see if the A-, B- and C-phase pulses are correct at 2CN, and repair (disconnection, short, power supply, defective circuit board.) if necessary.
		Control board (1PWB) defective	Replace Servopack.
	Overflow during high-speed operation	• Servomotor wiring incorrect • Encoder wiring incorrect	• Check and correct wiring. • Check to see if the A-, B- and C-phase pulses are correct at 2CN, and repair (disconnection, short, power supply, defective circuit board.) if necessary.
		Control board (1PWB) defective	Replace Servopack.
	Normal operation by overflow with large reference input	Servopack adjustment incorrect	Increase speed loop gain (Cn-04).
		Load capacity too large	Review the load. (overload, load inertia)
		Speed reference too large	Decrease the speed reference.

Serial Communications Data (Traceback Monitor)	Status When Lit	Cause	Remedy
ALM71.OL Instantaneous overload	Lit during operation Operation resumes after turning power OFF and ON.	Load greatly exceeds the rated torque	Review the load. (overload)
ALM72.OL Continuous overload	Lit during operation Operation resumes after turning power OFF and ON.	Load greatly exceeds the rated torque	Review the load (overload)
ALM80.POS Absolute encoder error	Lit during operation	Faulty absolute encoder wiring or connection	Check to see if the A-, B- and C-phase pulse wiring is correct at 2CN, and repair if necessary.
		Servopack miscounted pulses	• Turn power OFF, reset and turn power ON. • Separate encoder wiring from main wiring circuits.
ALM81.POS Backup error	Lit several seconds after power ON	Absolute encoder backup voltage dropped	Follow the absolute encoder setup procedures.
ALM82.POS Checksum error	Lit several seconds after power ON	Absolute encoder memory data check failed	Follow the absolute encoder setup procedures.
ALM83.POS Battery error	Lit several seconds after power ON	Absolute encoder battery voltage dropped	Replace the battery and turn power ON twice.
ALM84.POS Absolute encoder data error	At power ON	Absolute encoder malfunctioned	Replace the Servomotor if the error occurs frequently.
ALM85.POS Overspeed	Lit several seconds after power ON	Servomotor rotated at power ON.	Turn power ON with the Servomotor stopped.
ALMC1.RWY Servo overrun	Lit soon after Servomotor started to run	Servomotor wiring incorrect or disconnected	Check wiring and connectors at the Servomotor.
		Encoder wiring incorrect or disconnected	Check wiring and connectors at the encoder.
ALMC2.PG Phase error detected	Lit 1 to 3 seconds after power ON	Faulty encoder wiring or connection	Check wiring and connectors at the encoder.
		Noise in encoder wiring	Separate encoder wiring from main wiring circuits.
		Encoder defective	Replace Servomotor.
	Lit during operation	Faulty encoder wiring or connection	Check wiring and connectors at the encoder.
		Noise in encoder wiring	Separate encoder wiring from main wiring circuits.
		Encoder defective	Replace Servomotor.
ALMC3.PG Broken encoder PA-, PB-phases	Lit soon after Servomotor started to run	Faulty encoder wiring (PA, PB) or connection	Check wiring and connectors at the encoder.
ALMC4.PG Broken encoder PC-phase	Lit soon after Servomotor started to run	Faulty encoder wiring (PC) or connection	Check wiring and connectors at the encoder.
ALMF3.SRC Power loss error	Lit at power ON	Time between turning power OFF and back ON was shorter than the power holding time	After turning power OFF, wait longer than the power holding time (6 to 15 s) before turning power back ON.

Serial Communications Data (Traceback Monitor)	Status When Lit	Cause	Remedy
ALM00.ABS Absolute data error	Lit several seconds after power ON	• Absolute encoder malfunctioned	• Turn power back ON. • Follow the absolute encoder setup procedures.
		• Absolute encoder wiring incorrect	Check and correct absolute encoder wiring.
ALM02.PRM Parameter breakdown	Lit at power ON	Circuit board (1PWB) defective	Replace Servopack.
ALM04.PRM Parameter setting error	Lit at power ON	An out-of-range parameter was previously set or loaded.	Reset all parameters within range.

Note A.00 is reset by turning power OFF.

■ Problems due to Detective Wiring or Parts

Table 13.7 Problems Caused by Detective Wiring or Parts

Symptom	Check Areas and Items	Remedy
Motor will not rotate with reference input	• Check voltage between R and T. • Make sure the alarm indicator is not lit. • Check the $\overline{\text{P-CON}}$, N-OT, P-OT, and $\overline{\text{S-ON}}$ signals. • Use the serial command ALM to check Servopack status. ALM_ _RUN should be returned.	• Check the AC power supply circuit. • Look for a cause if an indicator is lit.

■ Problems due to Setting Errors

Table 13.8 Problems due to Setting Errors

Symptom	Cause	Remedy
Poor servo tracking performance	Position loop gain too low	Increase the position loop gain (PRM1). Decrease the speed loop gain when increasing position loop gain causes hunting. **Note** Do not increase the position loop gain any higher once hunting occurs. This is the tracking performance limit.

■ Troubleshooting: No Alarm Displayed but the Motor Does Not Run

Table 13.9 Troubleshooting with no Alarm Displays

Symptom	Cause	Conditions	Remedy
Servomotor does not start	Servo ON is turned OFF	First digit of PRM37 set to 0	Turn ON the Servo ON input.
	Encoder to Servomotor wiring disconnected	—	Reconnect the wiring.
	Encoder types differs from the user constant setting	—	Select the correct encoder using the first digit of PRM36.
	P-OT and N-OT inputs are turned OFF	First digit of PRM37 set to 0	Turn ON the P-OT and N-OT inputs.

13 2.2 Servopack

Symptom	Cause	Conditions	Remedy
Servomotor moves instantaneously, then stops	Number of encoder pulses differs from the user constant setting (PRM34).	—	Set the user constant (Cn-11) to match the number of encoder pulses if necessary.
	Servomotor or encoder wiring incorrect	—	Correct the wiring.
Servomotor suddenly stops during operation and will not restart (With an absolute encoder only)	The alarm reset signal (ALMRST) is turned ON because an alarm occurred.	—	Remove the cause of the alarm and switch the alarm reset signal (ALMRST) from ON to OFF.

Σ Series SGM/SGMP/SGD
USER'S MANUAL

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