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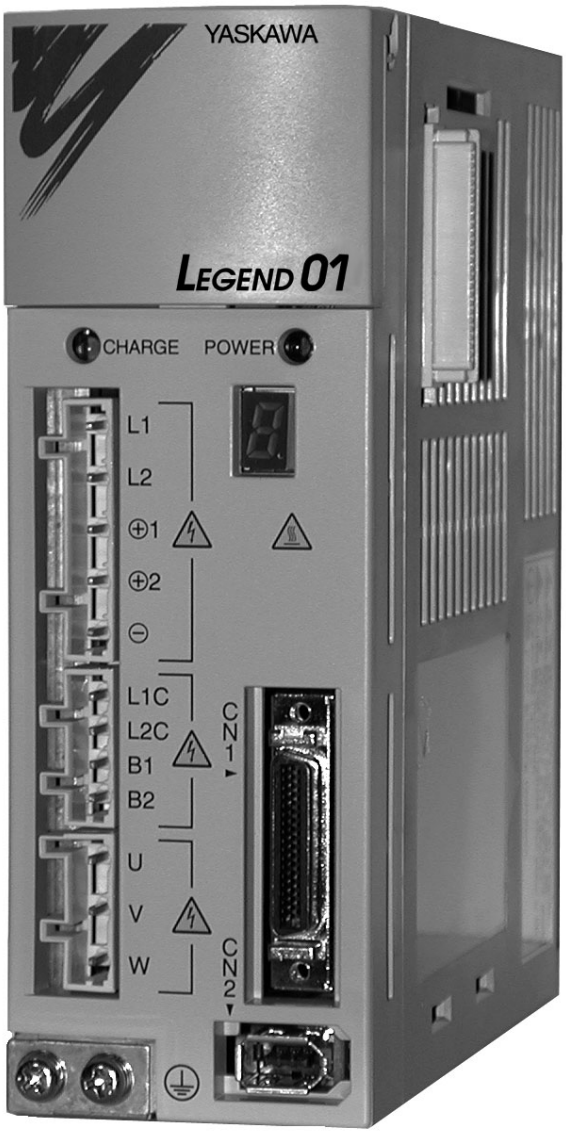
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LEGEND Digital Torque Amplifier SGDG User's Manual

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

Safety-Related Symbols

The following symbols are used in this manual according to the safety-related content. Be sure to observe text annotated with these safety symbols as their content is important.

WARNING Mis-operation may result in a hazardous condition with the possibility of death or serious injury.

CAUTION Mis-operation may result in a hazardous condition with the possibility of serious or light injury as well as material damage.

Furthermore, the items annotated with a **CAUTION** may result in serious consequences depending on the situation. Be sure to observe these as they highlight important content.

WARNING

YASKAWA manufactures component parts that can be used in a wide variety of industrial applications. The selection and application of YASKAWA products remain the responsibility of the equipment designer or end user. YASKAWA accepts no responsibility for the way its products are incorporated into the final system design.

Under no circumstances should any YASKAWA product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically under all circumstances. All products designed to incorporate a component part manufactured by YASKAWA must be supplied to the end user with appropriate warnings and instructions as to that part's safe use and operation. Any warnings provided by YASKAWA must be promptly provided to the end user.

YASKAWA offers an express warranty only as to the quality of its products in conforming to standards and specifications published in YASKAWA's manual. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED. YASKAWA assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

Icon Display

The following icons were designed so as to aid in understanding the type of descriptive content. The icons are displayed where needed to aid in comprehension.



Major items which should be memorized. In addition、this can be a minor item which does not reach the level of damage to the machine, such as the generation of an alarm display.



This shows programming, operation examples, etc.



This shows supplemental information and convenient functions to remember.

Terminology?? This explains difficult-to-understand technical terminology and technical terms which have not been previously explained.

Outline of Manual

- Thank you for purchasing the LEGEND Digital torque amplifier.
- Use this product with a full understanding of conditions such as product specifications, usage limits, etc.
- This manual explains the following areas for users of the LEGEND Digital torque amplifier.
    - Methods for mounting and wiring servomotor and amplifiers
    - How to use the various functions
    - Ratings and specifications for standard device types
    - Maintenance and Inspection
- For additional information on Sigma II servomotor,please refer to the following documents:
    - Sigma II Servo System Product Catalog Supplement (Doc.# G-MI#99001x-Sigma II)
    - Sigma II Series Servo System User's Manual (Doc.# YEA-S800-32.2x)
    - Linear Servomotor Product Catalog (Doc.#KAE-S800-39.10)

Safety Notes

In this manual, we will describe important cautionary items which should always be observed regarding usage, inspection upon receipt of product, mounting, wiring, operation, and maintenance/inspection.

■ Inspection Upon Receipt of Product

CAUTION

- Use the servomotors and amplifiers in the designated combinations. (See "3.5 Combinations" on page 39.)

  Failure to do so may result in fire or unit failure.

■ Mounting

CAUTION

- Never use this product in an area where water may splash, in a corrosive or flammable atmosphere, or next to flammable items.

  Doing so may result in electric shock or fire.

■ Wiring

WARNING

- Be sure to connect the ground terminal of the digital torque amplifier to a grounding electrode (100Ω or less).

  Failure to do so may result in electric shock or fire.

CAUTION

Wiring Precautions

- Do not bundle or run power and signal lines together in the same duct.

  Keep power and signal lines at least 11.81" (30cm) apart.
- Use twisted pair or shielded multi-core twisted pair wires for signal and encoder (PG) feedback lines.
- The maximum lengths for signal lines are as follows:
  - Maximum of 9.84ft (300cm) for reference input lines.
  - Maximum of 65.6ft (20m) for PG feedback lines.
  - Use a cable type UL20276-SB for distances over 65.6ft (20m).

⚠ CAUTION

- Do not connect a three-phase power supply to the digital torque amplifier output terminals U, V, and W.

  Doing so may result in injury or fire.
- Securely fasten the screws for the power terminals and motor terminals.

  Failure to do say may result in fire.

■ Operation

⚠ WARNING

- To prevent unexpected accidents, test the motor with the motor shaft not connected to a machine or load.
- To prevent unexpected accidents, run with limit switches or stoppers attached to both ends of the magnet track.

  Failure to do so may result in injury.
- Set parameters before operating the motor in connection with a machine..

  Operating without making these settings may result in machine runaway and damage.
- After mounting on the machine, prior to the start of operation, make sure the emergency stop can be applied at any time.

  Failure to do so may result in injury.
- Do not touch the heat sink while the unit is running.

  The high temperature may result in burns.

■ Maintenance/Inspection

⚠ WARNING

- Never touch the inside of the digital torque amplifier.

  Doing so may result in electrical shock.
- Be sure no wiring is exposed when power is turned ON.

  Failure to do so may result in electrical shock.
- Do not touch the terminals for five minutes following power OFF.

  Electrical shock may result due to residual voltage.

⚠ CAUTION

- Do not change the wiring while power is ON.

  Doing so may result in electrical shock or injury.

■ General Cautionary Items

Cautionary Items Regarding Usage
• The figures contained in this manual may, for purposes of detailed explanation, be drawn with covers and safety shields removed. When operating this product, be sure to return all standard covers and shields to their original locations, and operate the product in accordance with this manual. • The figures contained in this manual are representative examples, and may differ from the product recieved. • Appropriate modifications may be made to this manual due to improvements or specification changes in the product, or to improve the ease of use of the manual itself. In the event of such changes, the document number of the manual will be updated, and issued as a revision. • To order additional copies of this manual, contact your Yasakwa representative, or the nearest Yaskawa sales office printed on the back of this manual with the document number written on the cover. • Yaskawa assumes no responsibility for products modified by the customer as they fall outside the warranty.

■ Warning Label

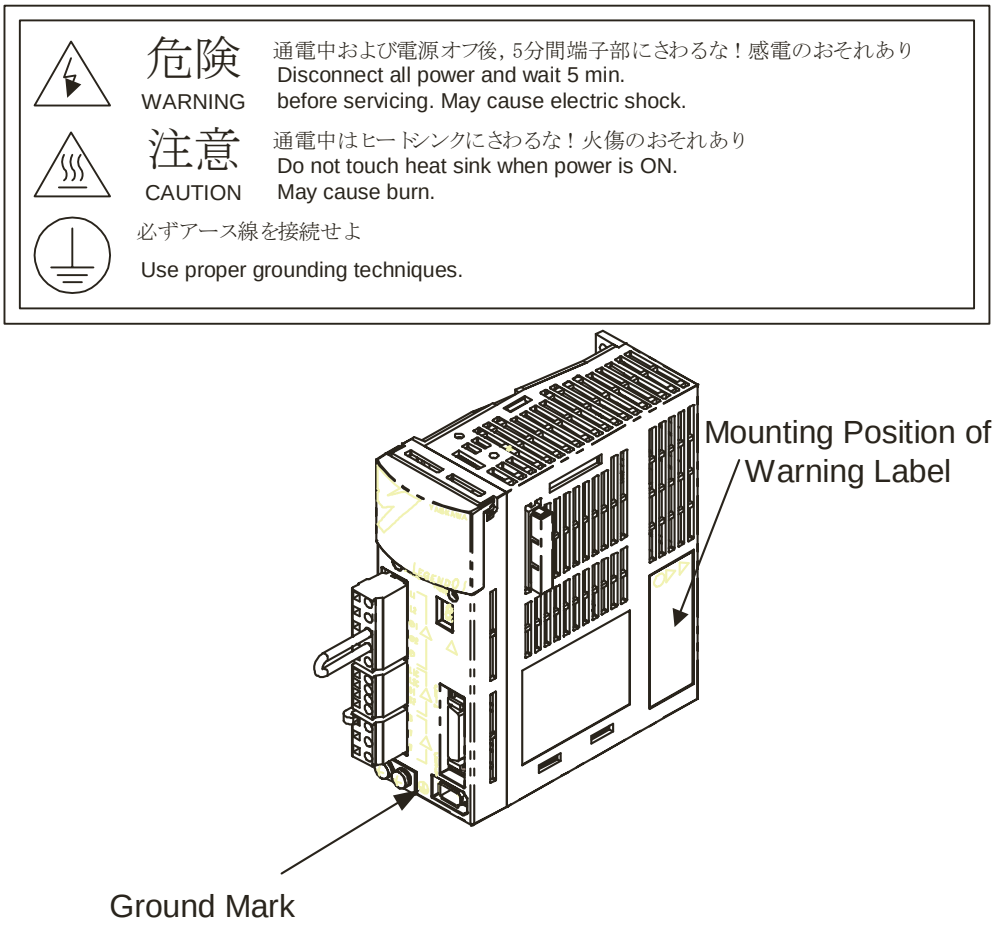


Figure A: Attachment Position of Warning Label and Ground Mark

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1. Interpretation of Model Number

1.1 Rotary Motor Type

SGMPH - 01 A A A 2 S D

Σ-II Series
Servo Motor
Series Name

SGMAH
SGMPH
SGMGH
SGMSH

SGMPH only

⑧ Brake/Oil Seal Specifications

1	w/o brake or oil seal
S	w/ oil seal
C	w/ 24V brake
E	S+C

⑦ Shaft Specification

2	Straight, no key
4	Sraight, w/ key
6	Straight, w/ key and tap
8	Straight, w/ tap

② Voltage

A	200V
B	100V *1

① Motor Capacity (kW)

No.	SGMAH	SGMPH	SGMGH	SGMSH
	3000 r / min	3000 r / min	1500 r / min	3000 r / min
A3	0.03			
A5	0.05			
01	0.1	0.1		
02	0.2	0.2		
03				
04	0.4	0.4		
05			0.45	
06				
08	0.75	0.75		
09			0.85	
10				1.0
12				
13			1.3	
15		1.5		1.5

④ Design Revision Order

A	SGMAH SGMPH SGMGH(1500 r/min) SGMSH
C	SGMGH(1500 r/min) For high-precision machine tools
E	SGMPH (Waterproof Spec. IP67)

③ Serial Encoder Specifications

No.		SGMAH	SGMPH	SGMGH	SGMSH
A	13-bit Incremental	◎	◎		
C	17-bit Incremental			◎	◎

◎: Standard ○: Option

*1. 100V is only for use with SGMAH, SGMPH servo motors of 0.2kW or less.

1.2 Linear Motor Type

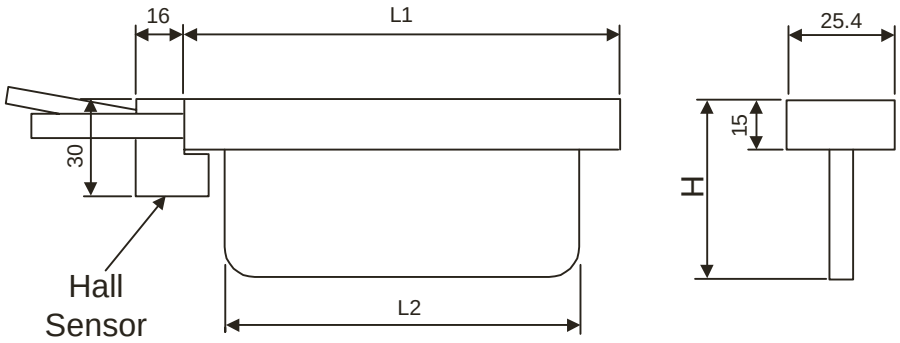
■ Motor Coils

SGL G W – 40 A 140 A W

- SGL: Linear Σ Series Motor
- G: Motor Type — G: Core-less, T: T-type iron core, F: F-type iron core
- W: Type — W: Motor Coil
- 40: Height of Magnets
- A: Voltage — A: 200V
- 140: Magnet Track Length
- A: Design Revision Order
- W: Option Specifications — P: w/ Hall sensor only. W: w/ Hall sensor and Serial Converter. The Serial Converter is required for operation with LEGEND Digital Torque Amplifiers.

1.3 Core-less Type

■ Motor Coil

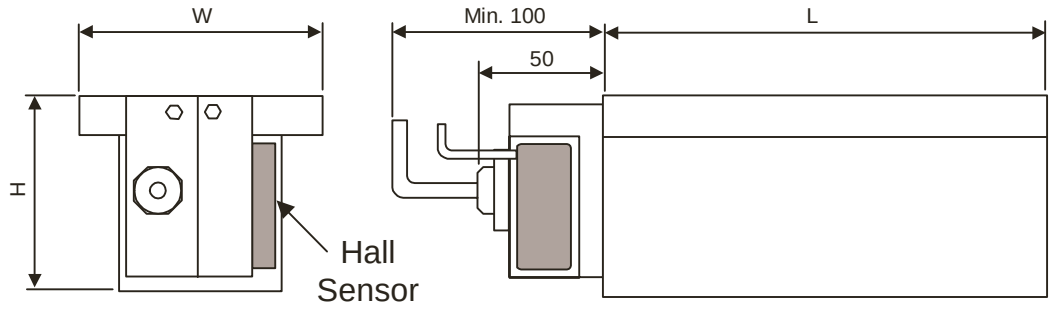


Model SGLGW-	Max. Thrust (N)	Cont. Thrust (N)	External Dimensions (mm)			Mass (kg)
			L1	L2	H	
40A140A(P)	140	47	140	125	63	0.39
40A253A(P)	280	93	252.5	237.5	63	0.65
40A365A(P)	420	140	365	350	63	0.91
60A140A(P)	220	73	140	125	83	0.47
60A253A(P)	440	147	252.5	237.5	83	0.80
60A365A(P)	660	220	365	350	83	1.13

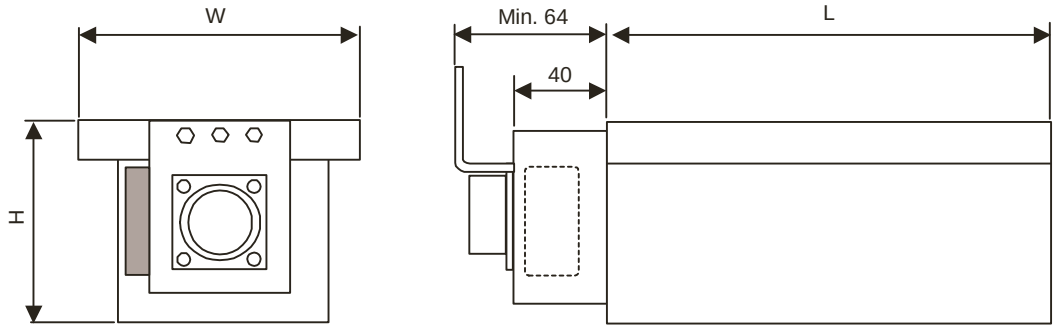
1.4 T-Type Iron Core

■ Motor Coil

Type: SGLTW-20A ☐☐☐ A(P), SGLTW -35A ☐☐☐ A(P)



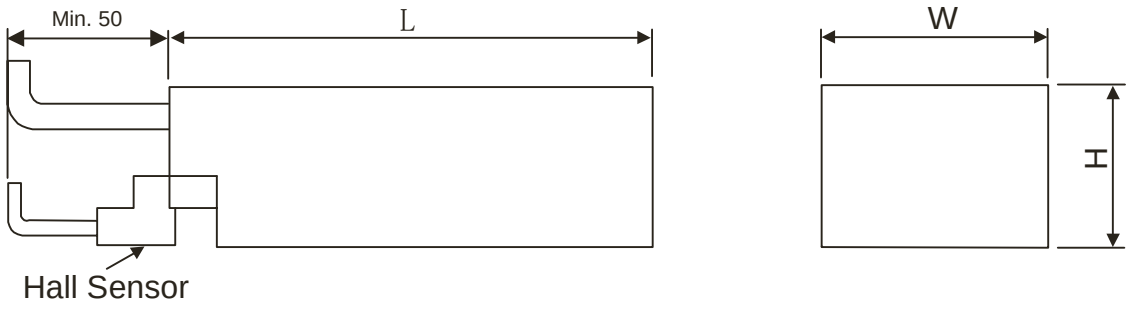
Type: SGLTW-40A ☐☐☐ A(P), SGLTW -80A ☐☐☐ A(P)



Model SGLTW-	Max. Thrust (N)	Cont. Thrust (N)	External Dimensions (mm)			Mass (kg)
			L	W	H	
20A170A(P)	380	130	170	100	51	2.6
20A320A(P)	760	250	315	100	51	4.8
20A460A(P)	1140	380	460	100	51	7
35A170A(P)	660	220	170	100	66	3.7
35A320A(P)	1320	440	315	100	66	6.8
35A460A(P)	2000	670	460	100	66	10
40A400A(P)	2000	670	395	150	78	20
40A600A(P)	3000	1000	585	150	78	30
80A400A(P)	4000	1300	395	150	115	30
80A600A(P)	6000	2000	585	150	115	43

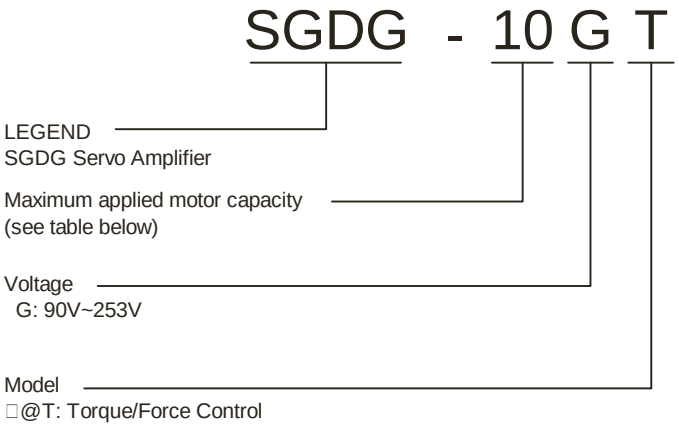
1.5 F-Type Iron Core

■ Motor Coil



Model SGLFW-	Max. Thrust (N)	Cont. Thrust (N)	External Dimensions (mm)			Mass (kg)
			L	W	H	
20A090A(P)	86	25	91	40	34	0.7
20A120A(P)	125	40	127	40	34	0.9
35A120A(P)	220	80	127	55	34	1.3
35A230A(P)	440	160	235	55	34	2.3
50A200A(P)	600	200	215	71.5	43	3.7
50A380A(P)	1200	400	395	71.5	43	6.9
1ZA200A(P)	1200	400	215	119	43	6.4
1ZA380A(P)	2400	800	395	119	43	12.2

1.6 Digital Torque Amplifier



Maximum Capacity of Applied Motor

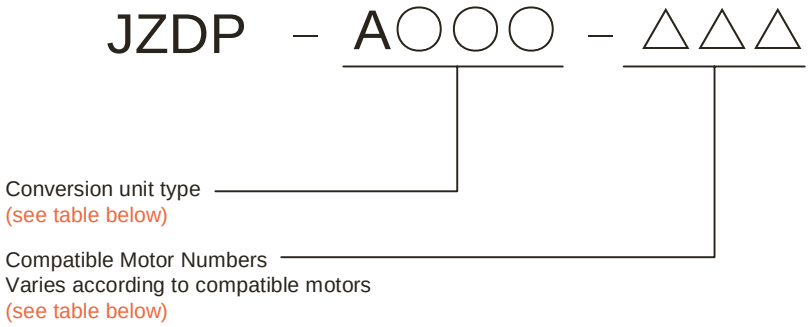
Applied Motor Maximum Capacity Symbol	Capacity (kW)
01	0.1
04	0.4
10	1.0
15	1.5

Note: Keep the following in mind in SGDG digital torque amplifier and SGDG/SGL□W servomotor combinations:
The SGDG-01GT can drive motors of 30~200W rated output.
The SGDG-04GT can drive motors of 100~750W rated output.
The SGDG-10GT can drive motors of 300W~2kW rated output.
The SGDG-15GT can drive motors of 750W~3kW rated output.

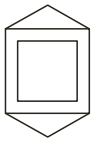
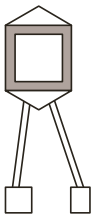
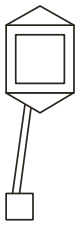
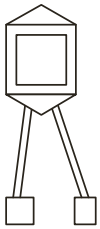
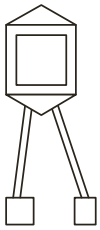
Since LEGEND servo drives are applicable to a wider range motor and driver combinations, the output power of the drive will dictate the available maximum motor power even if the maximum output power of the motor is larger than that of the connected drive.

Specific speed/torque performance will vary depending on such power supply conditions as voltage, number of available phases, etc.

1.7 Serial Converter Unit



Serial Converter Unit Type Model Classifications

Model	Model	Usage Scale	Hall Sensor (Y/N?)
JZDP-A003		By Haidenhain	N
JZDP-A004 (Note) US Market-dedicated		By Renishaw	Y
JZDP-A005		By Renishaw	N
JZDP-A006		By Haidenhain	Y
JZDP-A008		By Renishaw	Y

Serial Converter Units and Applied Motors

Serial Converter Unit Model JZDP-A00 □ - □□□	Applied Motor	Serial Converter Unit Model JZDP-A00 □ - □□□	Applied Motor
001	SGLGW-40A140A(P)	013	SGLTW-20A460A(P)
002	SGLGW-40A253A(P)	014	SGLTW-35A170A(P)
003	SGLGW-40A365A(P)	015	SGLTW-35A320A(P)
004	SGLGW-60A140A(P)	016	SGLTW-35A460A(P)
005	SGLGW-60A253A(P)	017	SGLFW-20A090A(P)
006	SGLGW-60A365A(P)	018	SGLFW-20A120A(P)
007	SGLTW-40A400A(P)	019	SGLFW-35A120A(P)
008	SGLTW-40A600A(P)	020	SGLFW-35A230A(P)
009	SGLTW-80A400A(P)	021	SGLFW-50A200A(P)
010	SGLTW-80A600A(P)	022	SGLFW-50A380A(P)
011	SGLTW-20A170A(P)	023	SGLFW-1ZA200A(P)
012	SGLTW-20A320A(P)	024	SGLFW-1ZA380A(P)

Notes:

2. Wiring

2.1 Main Circuit Wiring

Here we will show representative examples of main circuit wiring, the functions of the main circuit terminals, as well as the power input sequence, etc. Observe the following cautionary items when wiring.

⚠ CAUTION

- Do not pass the power line and signal lines through the same duct or bundle them together. Keep the power line and signal lines at least 30cm apart when wiring.
- Use a twist pair wire or multi-core twisted-pair bundled shield wire for the signal and encoder lines.

  The maximum wiring length is 3m for the command input line, and 20m for the encoder feedback line.
- Do not touch the power terminal for 5 min. after power OFF as a high voltage may remain even after power OFF.

  Perform inspection work after checking that the CHARGE lamp has gone out.
- Do not turn the power ON/OFF frequently. Limit ON/OFF repetition to one time per minute.

  Because the digital torque amplifier has a capacitor in its power unit, a large charging current (charging time: 0.2sec.) will be fed at power ON. For this reason, frequent power ON/OFF switching degrades the main circuit element within the digital torque amplifier.

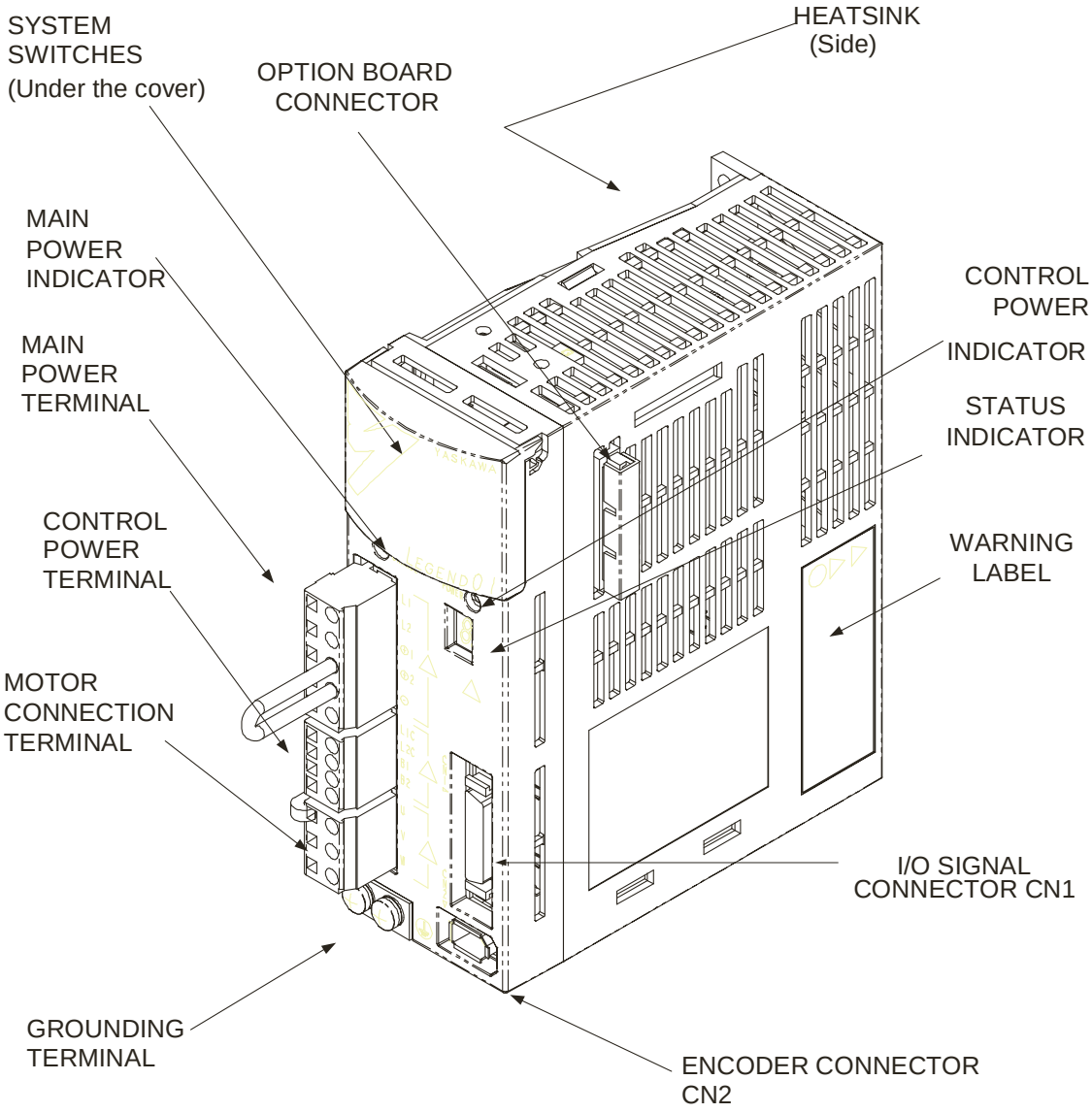
■ Main Circuit Terminal Names and Functions

Table 2.1: Main Circuit Terminal Names and their Functions

Terminal Code	Name	Function
L1, L2 or L1, L2, L3	Main Circuit Power Input Terminal	100W/400W Single Phase 90~253 V 1.0kW~1.5kW Three Phase 90~253 V
U, V, W	Motor Connection Terminal	Connected to motor.
L1C, L2C	Control Power Input Terminal	Single Phase 90~253 V
⏚(2 places)	Ground Terminal	Perform “Ground Processing “ by connecting with the power grounding terminal and the motor grounding terminal.

Table 2.1: Main Circuit Terminal Names and their Functions (Continued)

Terminal Code	Name	Function	
B1, B2 or B1, B2, B3	External Regen Resistor Connection Terminal	100W/400W	Connection not normally needed. Connect an external regen resistor (provided by customer) between B1-B2 if regen capability is insufficient. (Note) There is no B3 terminal.
		1.0kW/1.5kW	B2-B3 is normally shorted (using the integrated regen resistor) If the capacity of the internal regen resistor is insufficient, connect an external regen resistor (provided by customer) between B1-B2 with B2-B3 open (wiring removed).
⊕1, ⊕2	High-Frequency Harmonic Suppressing DC Reactor Connection Terminal	This is normally shorted between ⊕1-⊕2. If harmonic frequency suppression is needed, connect a DC reactor between ⊕1-⊕2.	
⊖	Main Circuit Load Terminal	Connection is normally not needed.	


SYSTEM
SWITCHES
(Under the cover)
OPTION BOARD
CONNECTOR
HEATSINK
(Side)
MAIN
POWER
INDICATOR
MAIN
POWER
TERMINAL
CONTROL
POWER
TERMINAL
MOTOR
CONNECTION
TERMINAL
GROUNDING
TERMINAL
CONTROL
POWER
INDICATOR
STATUS
INDICATOR
WARNING
LABEL
I/O SIGNAL
CONNECTOR CN1
ENCODER CONNECTOR
CN2

■ Example of Typical Main Circuit Wiring

A typical wiring example is shown in the figure below.

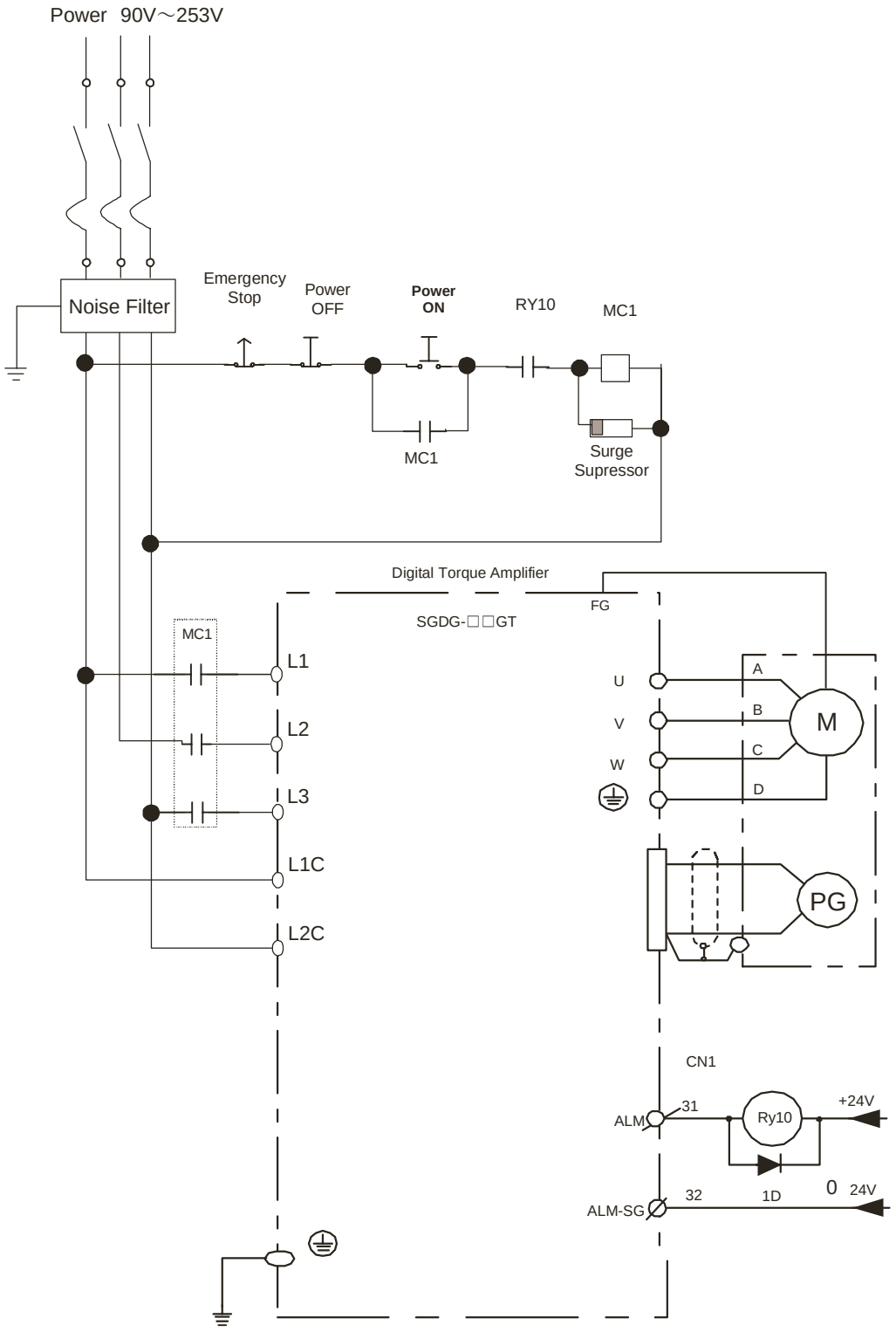
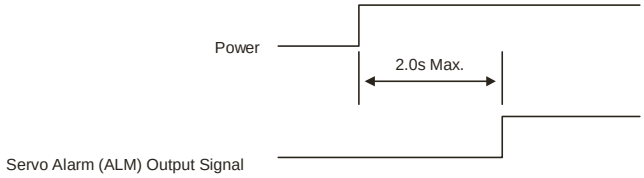


Figure A Main Circuit Wiring Example

■ Power ON Sequence Design

Keep the following in mind when designing a Power ON Sequence.

- Design the power feed sequence so that the power goes OFF if a “Servo Alarm” is output. See “Figure A Main Circuit Wiring Example” on page 12.
- Hold down the power ON button for at least two seconds. The digital torque amplifier will output a “Servo Alarm” signal for at most two seconds at power ON. This is necessary for digital torque amplifier initial setting.



■ Power Line Size and Peripheral Devices

See the Sigma II Series Servo System User's Manual: Servo Selection and Data Sheet edition. (Document Number: YEA-SIA-S800-32.2x)

■ Digital Torque Amplifier Power Loss

The digital torque amplifier power loss at continuous output is shown in Table 2.2 below.

Table 2.2: Digital Torque Amplifier Power Loss at Continuous Output

Main Circuit	Max. Applied Motor Capacity	Digital Torque Amplifier Model	Output Current (actual) A	Main Circuit Power Loss W	Regen Resistor Power Loss W	Control Circuit Power Loss W	Total Power Loss W
Single-phase 200V	0.10	SGDG–01GT	0.91	6.7	–	13	19.7
	0.40	SGDG–04GT	2.8	20	–	13	33
3-phase 200V	1.0	SGDG–10GT	7.6	55	12	15	82
	1.5	SGDG–15GT	11.6	123	14	15	152

Note: The regen resistor power loss is the allowable power loss. Take the following measures if this value is exceeded. Remove the lead wire of the digital torque amplifier's integrated regen resistor and install an external regen resistor. Furthermore, the external regen resistor is an option. For details on regen resistors, see “4.5 Regenerative Resistor Selection”.

■ Main Circuit Terminal Block Wiring Method

Observe the following cautionary items when wiring.

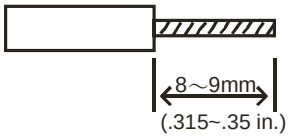
⚠ CAUTION

- Perform wiring after removing the terminal block from the digital torque amplifier unit.
- Insert one wire into each power line insertion aperture in the terminal block.
- When inserting the power lines, be sure that they do not short against the surrounding material due to exposed wire cores.
- Power lines that have been mistakenly pulled out by excessive force should be re-stripped then connected.

Servo amplifiers with capacities of 1.5kW or less consist of a connector-type terminal block for the main circuit. Wire the terminal block by the following procedure.

Connection Method

1. Strip the insulation of the power lines used.



2. Open the terminal block wiring insertion area with a tool. There are two opening methods as shown in figures A and B.
   - Figure A shows opening by prying with an accessory lever.
   - Figure B shows opening by forcibly pressing the driver insertion aperture with either a flathead screwdriver head width 3.0~3.5mm (.118~.138 in.) or a 210-120J-type driver from Wago, Inc. The work can be done using either of the methods in Figure A: or Figure B:.

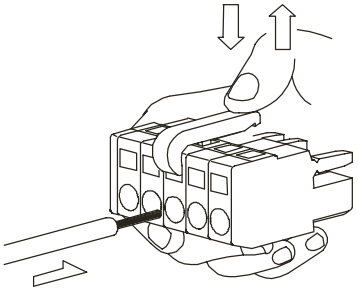


Figure A:

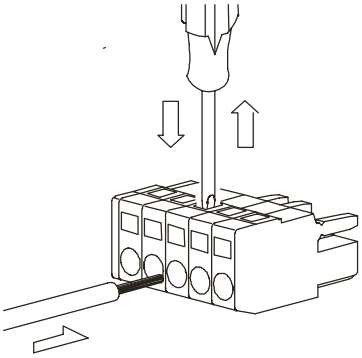


Figure B:

3. Insert the core of the power line into the opening. Release the lever or the pressure on the driver after insertion.

■ Power Terminal Processing

Strip the insulation on the power line. The useable line sizes are as follows:
- Solid Conductor .. ϕ0.5~ϕ1.6mm
- Stranded Conductor ..AWG28~AWG12

■ Peripheral Device Types and Capacities

Table 2.3 Shows Servopack device Types and capacities.

Table 2.3: Peripheral Device Types and Capacities

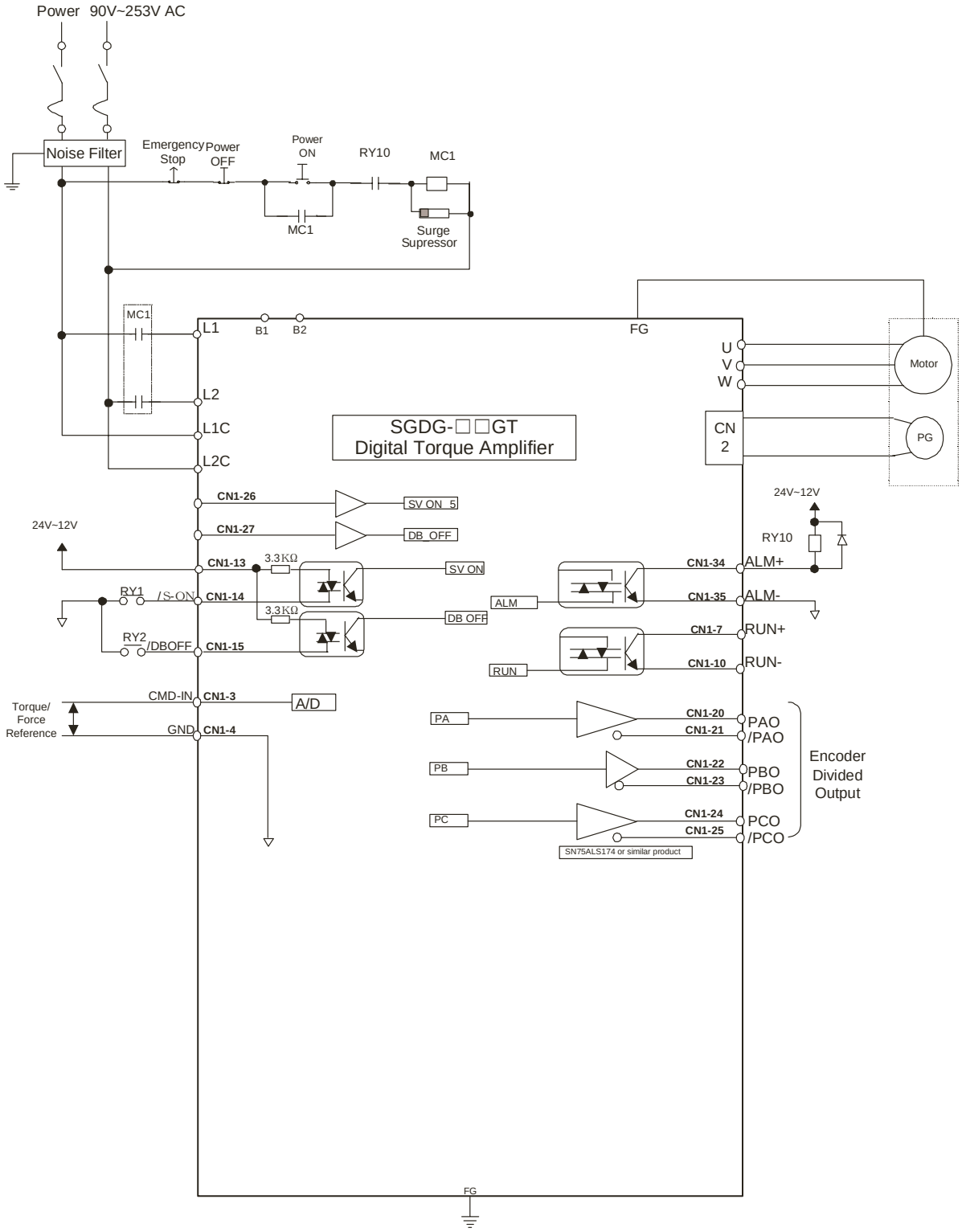
Main Circuit Power Supply	Model		Power Supply Capacity Per Amplifier (KVA)	MCCB or Fuse Capacity (Arms)	Recommended Noise Filter*		Magnetic Contactor
	Capacity (kW)	SGDG-			Model	Specifi-cations	
Single-Phase 200V	0.1	01GT	0.40	4	FN2070-6/07	Single-Phase 250VAC 6A	10A or Equivalent
	0.4	04GT	1.2	8	FN2070-10/07	Single-Phase 250VAC 10A	20A or Equivalent
Three-Phase 200V	1.0	10GT	2.3	7	FN258L-16/07	Three-Phase 480V 16A	20A or Equivalent
	1.5	15GT	3.2	10			

* The FN □□□□ noise filter is manufactured by Schaffner Corp.

2.2 Input Signals

■ Example of I/O Signal Connection

• A typical example of I/O signal connection is shown below.



■ Connector (CN1) Terminal Array List

The CN1 terminal array and its specifications are shown below.

CN1 Terminal Layout

1	---	---	2	GND	GND	19	GND	GND	20	PAO	Encoder Divided Output A phase+
3	CMD -IN	Torque/ Force Reference Input	4	GND	GND	21	*PAO	Encoder Divided Output A phase-	22	PBO	Encoder Divided Output B phase+
5	---	---	6	GND	GND	23	*PB0	Encoder Divided Output B phase-	24	PCO	Encoder Divided Output C phase+
7	RUN +	RUN Signal Output	8	---	---	25	*PCO	Encoder Divided Output C phase-	26	/S-ON5	Servo ON Input
9	---	---	10	RUN -	RUN Signal Output	27	DB OFF5	DB OFF Signal Input	28	SPD-MON	Speed Monitor 1V/1000 RPM
11	---	---	12	---	---	29	Torque Mon	Torque Monitor 5V/Max. Torque	30	---	---
13	+24V	External Power Input	14	/S-ON	Servo ON Signal Input	31	---	---	32	---	---
15	DB OFF	DB OFF Signal Input	16	---	---	33	GND	GND	34	ALM +	Servo Alarm Output
17	---	---	18	---	---	35	ALM -	Servo Alarm Output	36	---	---

Note 1 Do not use empty terminals for relays.

Note 2 Connect the I/O signal cable shield wire to the connector shell. This is connected to the frame ground on the digital torque amplifier side connector.

■ CN1 Specifications

Specification for Connector Used in Digital Torque Amplifier	Applied Receptacle Model		
	Soldering Type	Case	Manufacturer Name
10236-52A2JL-type Right Angle 36P	10136-3000VE	10336-52A0-008	Sumitomo 3M, Inc.

■ I/O Signal Names and Their Functions

The names and functions of the digital torque amplifier I/O signals are shown below.

Input Signals

Signal Name		Pin No.	Function
Common	/S-ON	14 26	Servo ON • The inverter output is enabled to provide power to the motor.
	DB ─ OFF	15	DB Release • A free run state has resulted by releasing the DB.
	+24VIN	13	Sequence signal control power input • +24V power supply provided by customer.
Torque	CMD-IN	3	Torque/Force Reference Input • -10~+10VDC 10V= Peak Motor Torque

Output Signals

Signal Name		Pin No.	Function	
Common	ALM+ ALM -	34 35	Servo Alarm : Turns OFF due to error detection.	
	PAO *PAO PBO *PBO PCO *PCO	20 21 22 23 24 25	A-phase Signal B-phase Signal C-phase Signal	2-phase pulse (A-phase, B-phase) Conversion Encoder Output Signal and origin pulse (C-phase) signal
	RUN+ RUN -	7 10	Base Block Release Signal : Output during base block release	
	SPD-MON	28	Speed Monitor (1V/1000rpm), Linear Scale 1V/1000mm/sec	
	TORQUE-MON	29	5V/Max Torque	
	FG	Shell	The frame ground in connected upon connection of the I/O signal cable shield wire to the connector shell.	

Output Signals (Continued)

Signal Name		Pin No.	Function
Reserved		1 5 8 9 11 12 16 17 18 30 31 32 36	Open Terminal (Note) Do not use empty terminals for relays, etc.

■ Interface Circuit

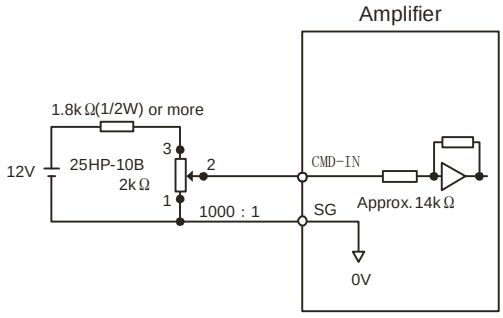
An example is given below of connection of the digital torque amplifier I/O signals to an upper level device.

■ Command Input Circuit and Interface

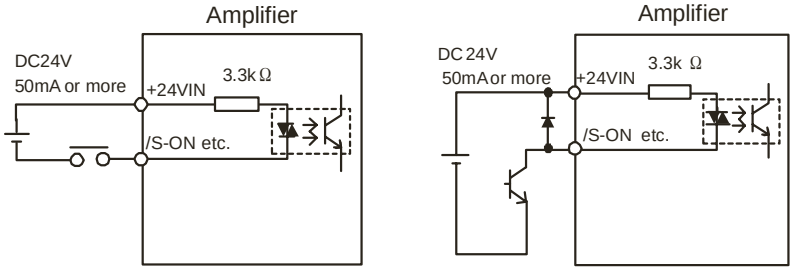
Analog Input Circuit

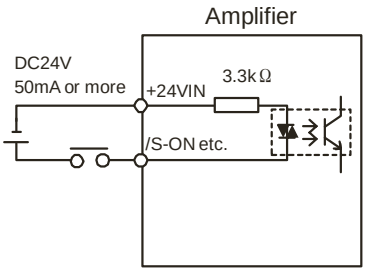
The analog signal is the torque reference signal. The input impedance is as follows.

- Command Input (CMD-IN): Approx. 14kΩ
  The maximum allowable voltage for the input signal is ±12V
- 10V= Peak Motor Torque



■ Sequence Input Circuit and Interface



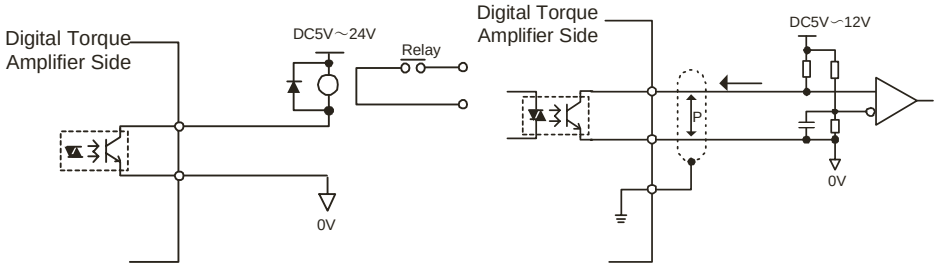


This is connected by a relay or open collector transistor circuit. Select a low current type when connecting by relay. If low current relay is not used, this may cause a connection fault.

■ Output Circuits and Interfaces

The output signal circuits of the digital torque amplifier are of the three types shown below. Configure the input circuit on the upper-level device to match each of these output circuits.

- Connection with Line Driver Output Circuits
  The output signals (PAO, *PAO, PBO, *PBO) where the encoder serial data was converter to a 2-phase (A-phase, B-phase) pulse, and the origin pulse signal (PCO, *PCO) are output by the line driver circuit. The upper-level device receives these through the line receiver circuit. See "2.3 Wiring to the Encoder" for an example of the connection circuit.
- Connection with Photocoupler Output Circuit
  Servo alarms and other output signals for sequence use are configured in the photocoupler output circuit. They are connected through the relay and line driver circuits.



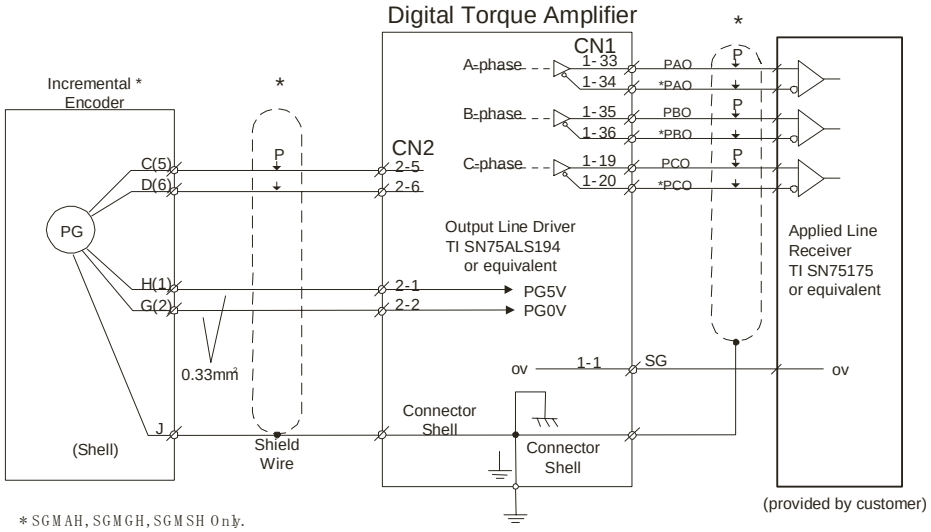
Note: The maximum allowable voltage and current capacity of the photocoupler output circuit are as follows:

- Voltage: DC30V(Max.)
- Current: DC50mA(Max.)

2.3 Wiring to the Encoder

The wiring of the digital torque amplifier to the encoder is described here.

■ Connection to Encoder (CN2) and Output Signal Processing from Digital Torque Amplifier (CN1)



■ Encoder Connector (CN2) Terminal Array and Models

The CN2 terminal arrays and models are shown below.

CN2 Terminal Array

1	PG5V	Encoder Power +5V	**2**	PG0V	Encoder Power 0V
5	PS	Encoder Serial Signal Input	**6**	*PS	Encoder Serial Signal Input

CN2 Connectors

CN2 Connectors

Model of Connector Used in Digital Torque Amplifier	**Applied Plug (or socket) Model**		
	Plug, soldered type (digital torque amplifier-side connector)	**Socket, soldered type, (motor-side connector)**	**Manufacturer Name**
53460-0611	55100-0600	54280-0600	Japan Molex, Inc.

Note: The plug and socket on the digital torque amplifier side are a set product FA1394 from Japan Molex, Inc.

Note: The motor-side socket is connected to the connector for the SGMAH, SGMPH servomotor encoder.

Note: The SGMGH and SGMSH servomotor encoder connectors are shown below.

- Plug L-type: MS3108B20-29S or
- Straight: MS3106B20-29S
- Cable Clamp: MS3057-12A



Yaskawa provides a dedicated cable for the encoder. For details, see the following document.

- Sigma II Servo System Product Catalog Supplement (Doc.# G-MI#99001x-Sigma II)

2.4 Cable Specifications and Peripheral Devices

Ratings and specifications for peripheral devices, as well as cable specifications for digital torque amplifiers are summarized in the tables below.

CAUTION

Wiring Precautions

- **Do not bundle or run power and signal lines together in the same duct.**
  Keep power and signal lines at least 11.81" (30cm) apart.
- **Use twisted pair or shielded multi-core twisted pair wires for signal and encoder (PG) feedback lines.**
- **The maximum lengths for signal lines are as follows:**
  - Maximum of 9.84ft (300cm) for reference input lines.
  - Maximum of 65.6ft (20m) for PG feedback lines.
  - Use a cable with 164 ft (50m) specifications for distances over 65.6ft (20m).

■ Cable Specifications

External Terminal Name	SGDG Terminal Symbol	Wire Size AWG [in^2 (mm^2)]	
		01GT	04GT
Main circuit power input terminals	L1, L2 (Single Phase)	16 AWG [HIV 0.002 (1.25)]	14 AWG [0.003 (2.0)]
Servomotor connection terminals	U, V, W	16 AWG [HIV 0.002 (1.25)]	
Control power supply terminals	L1C, L2C		
Control I\O signal connector	CN1	Twisted pair or shielded twisted pair wires Core wire at least 28 AWG [0.0002 (0.12)], tinned, annealed copper twisted wires Finished cable dimensions: maximum Φ0.63in (16mm) for CN1 and Φ0.27in (6.8mm) for CN2.	
PG signal connector	CN2		
Ground terminal	⏚	14 AWG [HIV 0.003 (2.0)]	
Main circuit power input terminals	L1, L2, L3 (Three-phase)	14 AWG [HIV 0.003 (2.0)]	
Servomotor connection terminals	U, V, W		
Control power supply terminals	L1C, L2C	16 AWG [HIV 0.002 (1.25)]	
Control I\O signal connector	CN1	Twisted pair or shielded twisted pair wires Core wire at least 28 AWG [0.0002 (0.12)], tinned, annealed copper twisted wires Finished cable dimensions: maximum Φ0.63in (16mm) for CN1 and Φ0.27in (6.8mm) for CN2.	
PG signal connector	CN2		
Ground terminal	⏚	14 AWG [HIV 0.003 (2.0)]	

Notes:
1. Wire sizes were selected for three cables per bundle at 40°C ambient temperature with the rated current.
2. Use cables with a minimum withstand voltage of 600V for main circuits.
3. If cables are bundled in PVC or metal ducts, consider the reduction ratio of the allowable current.
4. Use heat-resistant cable under high ambient or panel temperatures where normal vinyl cable will rapidly deteriorate.

The following table shows types of cables. It is used in conjunction with the preceding tables.

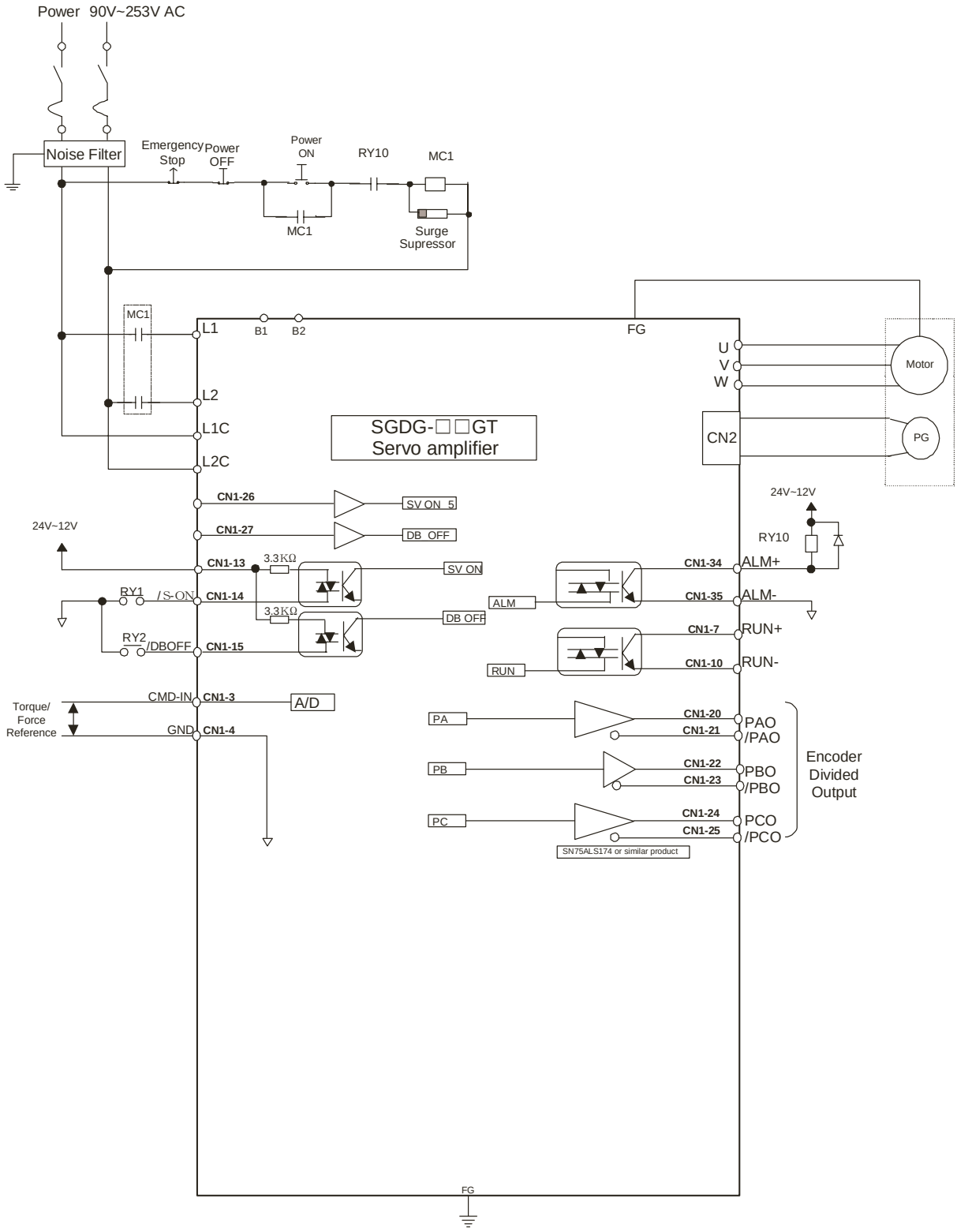
Cable Type		Temperature Rating of Conductor °C
Name	**Composition**	
PVC	Standard polyvinyl chloride cable	—
IV	600V PVC cable	60
HIV	Temperature-resistant vinyl cable	75

The following table specifies the appropriate cables for CN1 and CN2 digital torque amplifier connectors. Wire sizes were selected with the expectation of three cables per bundle, at an ambient temperature of 40°C, at the rated current level.

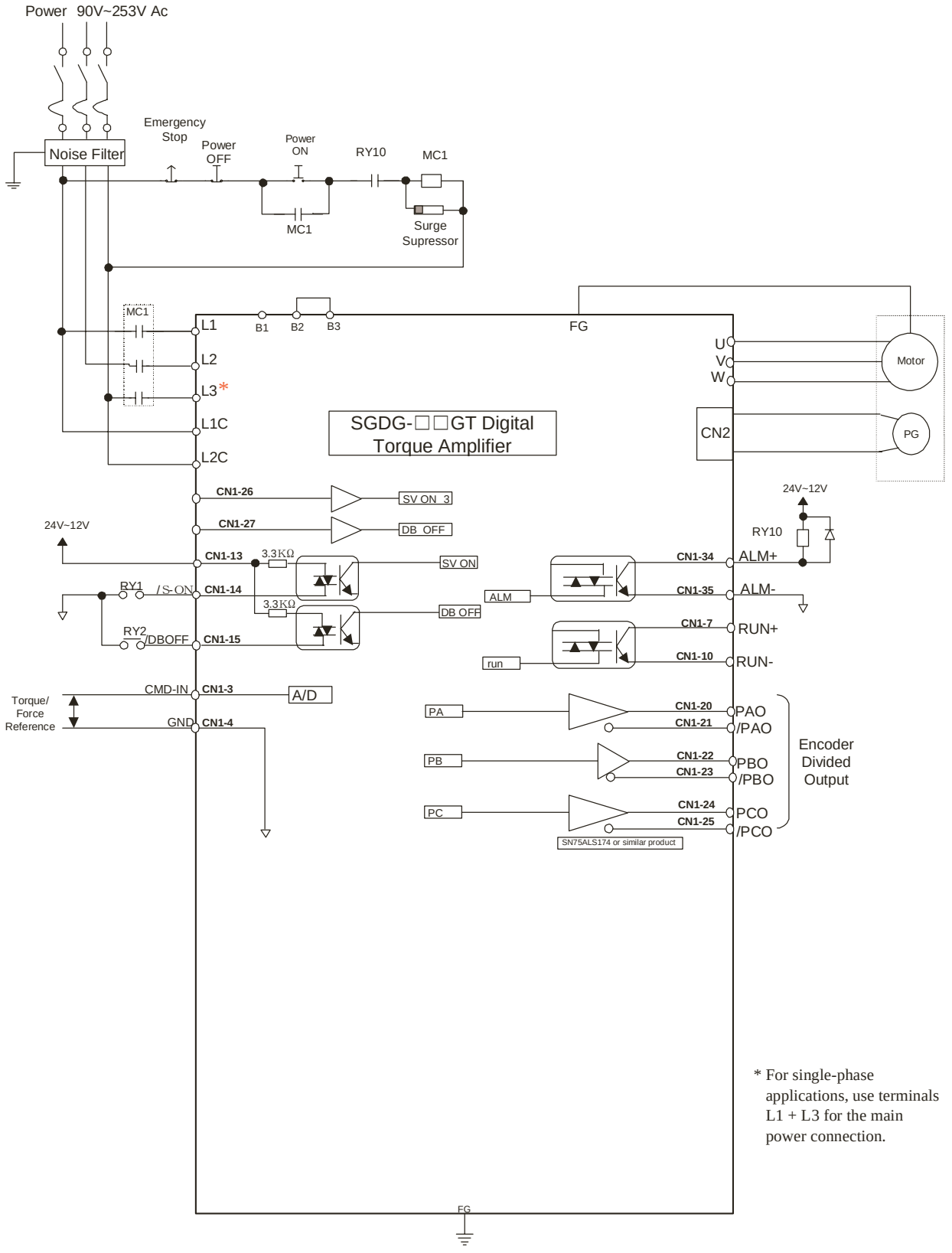
Connector Name	Signal	Description	Specification
Control I/O Signal Connector	CN1	Cable	Use twisted pair or shielded twisted pair wire.
		Applicable wire	(AWG): 24, 26, 28, 30
		Finished cable Dimension	Φ 0.63 (Φ16.0) maximum
PG Signal Connector	CN2	Cable	Use Yaskawa cable, or shielded twisted pair wire.
		Applicable wire	(AWG): 24, 26, 28, 30 Use 22 AWG [0.0005in^2 (0.34mm^2)] for the encoder power supply and 26 AWG [0.0002 in^2 (0.14mm^2)] for other signals. These conditions permit wiring distances up to 65.6ft (20m).
		Finished cable Dimension	Φ 0.27 (Φ6.8) maximum

2.5 Standard Connection Examples

■ Single-phase Power Specification (SGDG-01GT, SGDG-04GT)



■ 3-Phase Power Specification (SGDG-10GT, SGDG-15GT)



* For single-phase applications, use terminals L1 + L3 for the main power connection.

Notes:

3. Setup

3.1 Linear Motor Mounting

CAUTION

- In the case of linear motors, various changes can occur according to the direction of the motor mounting and the direction of the encoder mounting. Therefore, perform setup carefully.

  Careless setup may result in injury.

■ Motor Mounting and Encoder Mounting

Mount so that the motor forward direction matches the encoder forward direction.

■ Setting the Linear Encoder Scale Pitch

Upon completing mounting and wiring, feed control power only, input (SW2) the correct linear scale pitch used by each application. Alarm 0 (SW setting error) is output at the initial power ON because the initial value is assumed to be “0”. This ceases occurring if the correct value is set in SW2 and the power cycled.

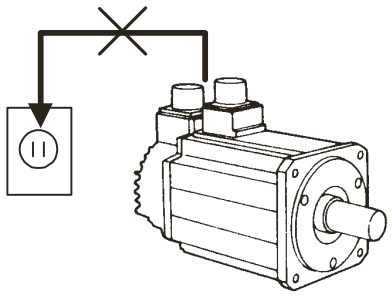
3.2 Rotary Motor Mounting

The SGM□H servomotor can be mounted in both the horizontal or vertical direction. However, mistaking the mounting direction or mounting in an inappropriate location may shorten motor life or lead to unexpected accidents. Correctly mount the motor according to the following cautionary items.

CAUTION

- Do not connect the servomotor directly to a commercial power source. This will damage the motor.

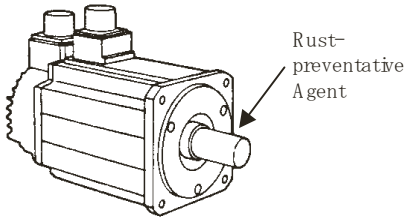
  The servomotor will not run without a dedicated digital torque amplifier.



Before Mounting

Important

The shaft end is treated with a rust-preventative agent. Before mounting the motor, wipe off this rust-preventative agent with a cloth soaked in thinner.
When removing the rust-preventative agent, be sure that the thinner does not contact any other parts of the servomotor.



■ Storage Temperature

Store the servomotor within the temperature range below when storing without electrical feed.

-20 ~ +60°C Temperature Range

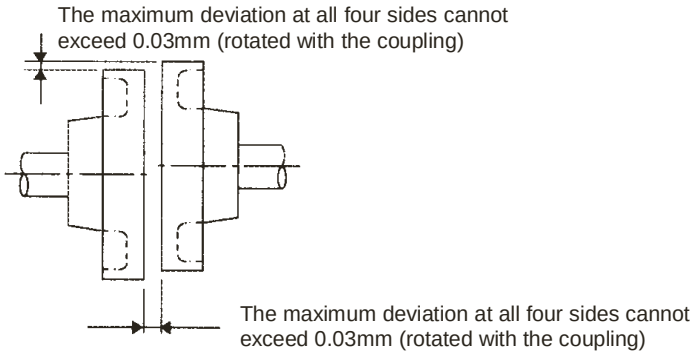
■ Mounting Location

The SGM□H servomotor is intended for use indoors. Use in an environment meeting the following conditions.

- Indoors, in a location free from corrosive or explosive gas.
- A location with good ventilation, with little dust, grime, or steam
- A location with an ambient temperature between 0~40°C
- A location with a relative humidity of 20%~80%, no condensation
- A location easy to inspect and clean

■ Alignment

Upon mating to the machine, make sure the motor shaft core and the machine shaft core are coupled in a straight line. Mount the servomotor so that it falls within the alignment accuracy in the figure below.



Important

(1) Improper alignment can lead to vibration, which risks damaging the shaft coupling.

(2) When mounting the coupling, do not apply shock directly to the shaft. This may damage the encoder mounted on the shaft end opposite the load.

■ Mounting Direction

The SGM□H servomotor can be mounted in either the horizontal or vertical directions.

■ Shaft Tolerance Ranges

Design machine systems so that the thrust loads and radial loads[1] applied to the servomotor shaft during operation fall within the tolerances in Table 3.1.
The allowable radial loads shown in the table are the maximum loads that can be applied to the end of the output shaft.

1. Thrust Load, Radial Load:
   Thrust Load (Fs): The shaft load applied parrallel to the shaft core.
   Radial Load (Fr): Shaft load applied at a right angle to the shaft core.

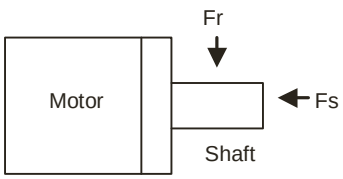
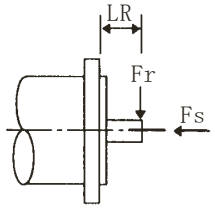
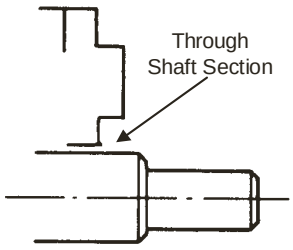


Table 3.1: Allowable Radial Load/Allowable Thrust Load for Servomotors

Motor Model		Allowable Radial Load Fr [N(kgf)]	Allowable Thrust Load Fs [N(kgf)]	LR [mm]	Reference Diagram
SGMAH-	A3	68(7)	54(5.5)	20	
	A5	68(7)	54(5.5)		
	01	78(8)	54(5.5)		
	02	245(25)	74(7.5)	25	
	04	245(25)	74(7.5)		
	08	392(40)	147(7.5)	35	
SGMPH-	01	78(8)	49(5)	20	
	02	245(25)	68(7)	25	
	04	245(25)	68(7)		
	08	392(40)	147(15)	35	
	15	490(50)	147(15)		
SGMGH-	05A □ A	490(50)	98(10)	58	
	09A □ A	490(50)	98(10)		
	13A □ A	686 (70)	343(35)		
SGMSH-	10A	686(70)	196(20)	45	
	15A	686(70)	196(20)		

■ Oil and Water Countermeasures

It is possible to take protective measures for motor operation in areas where water or oil may drip. However, use a motor with an oil seal attached when needed to set through to the shaft section[1] . In addition, mount the motor with the connectors facing downward.



■ Cable Stress

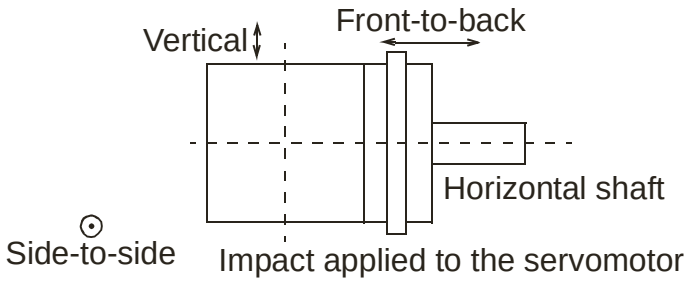
Do not bend or stretch the power line.
In particular, be careful to wire the signal cable so that they are not subject to stress because its core is very thin (0.2, 0.3mm).

1. Through Shaft Section
   This refers to the gap where the shaft protrudes from the end of the motor.

■ Vibration Resistance

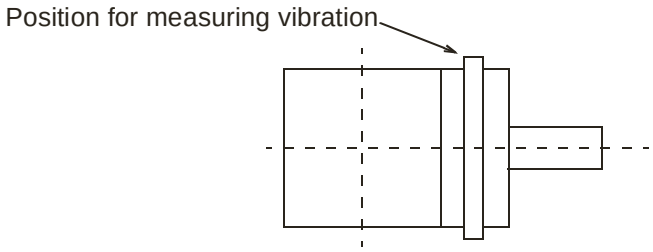
Mount the servomotor with the shaft positioned horizontally. The servomotor will withstand the following levels of vibration on all three axes: front-to-back (X), vertical (Y), and side-to-side (Z).

- SGMAH, SGMPH: 49m/s^2 (5G)
- SGMSH, SGMGH, SGMDH, and SGMUH: 24.5m/s^2 (2.5G)



3.2.1 Vibration Class

The vibration class for SGM□H servomotors operating at rated speed is 15μm (maximum).



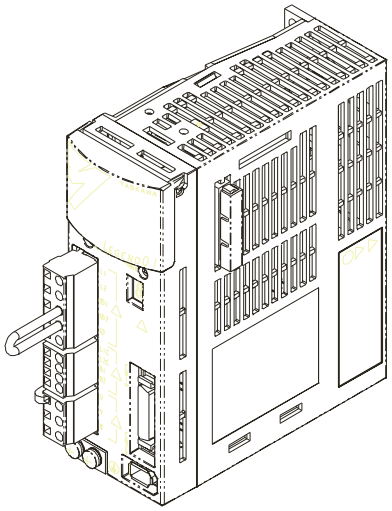
3.3 Digital Torque Amplifier Installation

The SGDG digital torque amplifier is a base-mounted digital torque amplifier. Mount it properly according to the following cautionary items as mistakes in the mounting method can lead to failure of the unit.

■ Storage Conditions

Store the digital torque amplifier within the temperature range below when storing without electrical feed.

Temperature Range: -20~ +85°C



LEGEND SGDG Digital Torque Amplifier

■ Mounting Conditions

Location

The following points should be kept in mind with regard to the mounting location.

Installation Conditions	Cautions on Mounting
Mounted in a Control Panel	Design the control panel size, digital torque amplifier installation, and cooling method so that the ambient temperature of the digital torque amplifier does not exceed 55°C.
Mounted Near a Heat-Generating Object	Suppress the temperature rise due to radiated heat and convection from the heat-generating object so that the ambient temperature of the digital torque amplifier does not exceed 55°C.
Mounted Near a Vibration Source	Attach vibration-preventative brackets to the digital torque amplifier mounting surface so that the vibrations are not communicated to the digital torque amplifier.

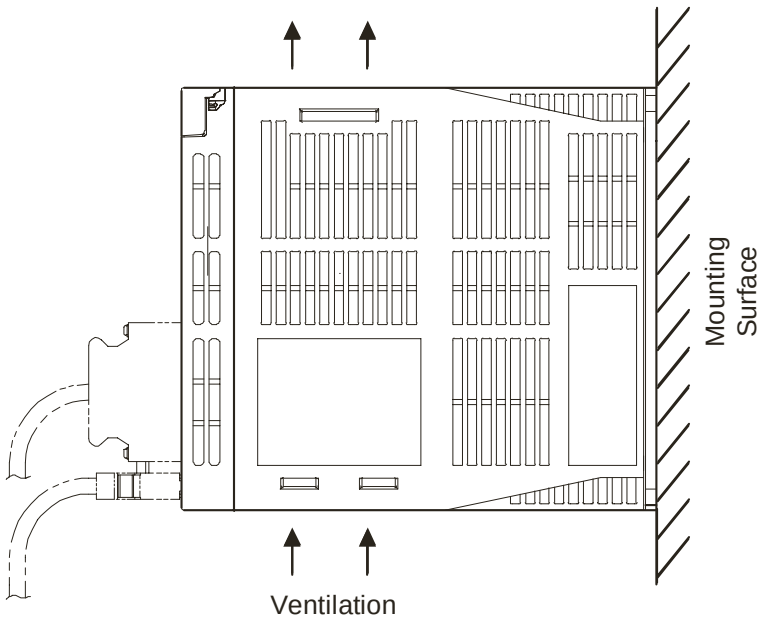
Installation Conditions	Cautions on Mounting
Mounted in a Location Exposed to Corrosive Gas	Take measures to prevent the influx of corrosive gas. The gas will have no immediate effect, but will lead to device failures in the electronic components and contact-related devices.
Others	Do not install in areas with high temperature or humidity, or where the atmosphere contains dust or iron particles.

Control Panel Environmental Conditions

- Digital Torque Amplifier Ambient Temperature: 0~55°C
- Humidity: 90% RH or less
- Vibration: 0.5G (4.9m/s^2)
- Do not allow freezing or condensation to occur.
- Use an ambient temperature of 45°C or less to maintain long-term reliability.

Mounting Direction

Mount in a vertical direction on a wall as shown in the figure below. Cool the digital torque amplifier either with natural convection or a fan. Be sure to maintain this direction. Securely fix the digital torque amplifier to the mounting surface by using the mounting holes at 2~4 locations (the number of holes will differ depending on capacity).

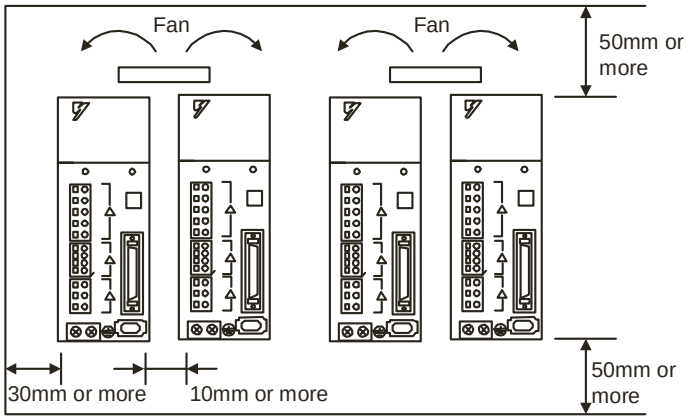


Cooling

Mount the amplifier with sufficient peripheral space around the digital torque amplifier consideration of the above figure so as to achieve sufficient cooling by either a fan or natural convection.

Digital Torque Amplifier Mounting Standards

Observe the standards for mounting into a control panel shown in the figure below, including those cases where multiple digital torque amplifiers are installed in parallel within a control panel (hereafter referred to as a “parallel platform”).



Mount the digital torque amplifier so that the front side faces the operator.

Side-by-side Installation

When installing digital torque amplifier side by side as shown in the figure above, allow at least 0.39in (10mm) between and at least 1.97in (50mm) above and below each digital torque amplifier. Install cooling fans above the digital torque amplifiers to avoid excessive temperature rise and to maintain even temperature inside the control panel.

3.4 Switch Settings

■ SW1 Function Selection Switch (dip switches)

Switch No.	Function	At OFF	At ON	Default Setting
1	Status After DB Stop During Base Block	Release DB after motor stop	Continue DB after motor stop	ON
2	Torque Reference Filter	No	Yes	ON
3	Input Power Selection	DC-Power Input Compatible	AC-Power Input Compatible	ON
4	Linear Scale Polarity Reversal	B-phase progression: U, V, W direction	A-phase progression: U, V, W direction	ON (enabled only when linear motor is used)
5	Regen Overload Alarm or Warning	No	Yes	ON
6	Feedback Pulse B-phase Reversal	Reversed	Not reversed	ON
7	Command Direction Reversal	Reversed	Not reversed	ON
8	Not used			ON

■ SW2 Linear Scale Pitch Setting (rotary switch)

Setting	Linear Scale Pitch Setting	Setting	Linear Scale Pitch Setting
0*	0 μ m	8	Not used
1	2 μ m	9	Not used
2	4 μ m	A	Not used
3	20 μ m	B	Not used
4	40 μ m	C	Not used
5	800 μ m	D	Not used
6	1000 μ m	E	Not used
7	Not used	F	Not used

* The default setting is 0 (0 μ m).

■ SW3 PG Divider Setting (rotary switch)

For a 13-bit Rotary Motor

Setting	PG Divider Setting**	Setting	PG Divider Setting**
0*	8192 P/R	8	3000 P/R
1	8000 P/R	9	2500 P/R
2	7200 P/R	A	2048 P/R
3	6000 P/R	B	2000 P/R
4	5000 P/R	C	1800 P/R
5	4096 P/R	D	1600 P/R
6	4000 P/R	E	1000 P/R
7	3600 P/R	F	Not used

＊ The default setting is 0 (2048×4). ＊＊ 4× at host controller

For a 17-bit Rotary Motor

Setting	PG Divider Setting**	Setting	PG Divider Setting**
0*	65,536 P/R	8	30000 P/R
1	64,000 P/R	9	24000 P/R
2	60,000 P/R	A	16000 P/R
3	50,000 P/R	B	131,072 P/R***
4	40,000 P/R	C	120,000 P/R***
5	36,000 P/R	D	100,000 P/R***
6	32,768 P/R	E	80,000 P/R***
7	32,000 P/R	F	Not used

＊ The default setting is 0 (16384×4). ＊＊ 4× at host controller

＊＊＊ Overspeed alarm will activate at motor speeds of 2500rpm or higher.

For Linear Motors

Setting	PG Divider Setting	Setting	PG Divider Setting
0*	1/20	8	1/32
1	1/256	9	1/16
2	1/250	A	1/10
3	1/200	B	1/8
4	1/128	C	1/5
5	1/100	D	1/4
6	1/64	E	1/2
7	1/40	F	Not used

＊ The default setting is 0 (1/20).

3.5 Combinations

Digital Torque amplifier and motor combinations are shown below.

■ Combinations with Rotary Motors

SGMAH

Digital Torque Amplifier Model	Compatible Motor Models
SGDG-01GT	SGMAH-A3B SGMAH-A5B SGMAH-A3A SGMAH-A5A SGMAH-01A
SGDG-04GT	SGMAH-01B SGMAH-02B SGMAH-02A SGMAH-04A
SGDG-10GT	SGMAH-08A

SGMPH

Digital Torque Amplifier Model	Compatible Motor Models
SGDG-01GT	SGMPH-01A
SGDG-04GT	SGMPH-01B SGMPH-02B SGMPH-02A SGMPH-04A
SGDG-10GT	SGMPH-08A
SGDG-15GT	SGMPH-15A

SGMGH

Digital Torque Amplifier Model	Compatible Motor Models
SGDG-10GT	SGMGH-05 □ A SGMGH-09 □ A
SGDG-15GT	SGMGH-13 □ A

SGMSH

Digital Torque Amplifier Model	Compatible Motor Models
SGDG-10GT	SGMSH-10 □ A
SGDG-15GT	SGMSH-15 □ A

■ Linear Motor Combinations

Digital Torque Amplifier Model	Linear Motor Models
SGDG-01GT	SGLGW-40A140A
SGDG-04GT	SGLGW-40A253A SGLGW-40A365A SGLGW-60A140A SGLGW-60A253A SGLFW-20A090A SGLFW-20A120A SGLFW-35A120A
SGDG-10GT	SGLTW-20A320A SGLTW-35A170A SGLTW-35A320A SGLFW-35A230A SGLFW-50A200A SGLGW-60A365A SGLTW-20A170A
SGDG-15GT	SGLFW-50A380A SGLFW-1ZA200A

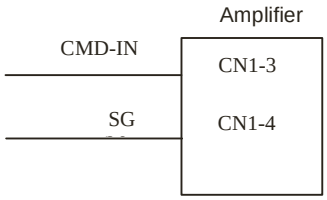
■ Serial Conversion Unit and Applicable Motors

Serial Conversion Unit Model JZDP-A00 □ - □□□	Applicable Motors	Serial Conversion Unit Model JZDP-A00 □ - □□□	Applicable Motors
001	SGLGW-40A140A(P)	013	SGLTW-20A460A(P)
002	SGLGW-40A253A(P)	014	SGLTW-35A170A(P)
003	SGLGW-40A365A(P)	015	SGLTW-35A320A(P)
004	SGLGW-60A140A(P)	016	SGLTW-35A460A(P)
005	SGLGW-60A253A(P)	017	SGLFW-20A090A(P)
006	SGLGW-60A365A(P)	018	SGLFW-20A120A(P)
007	SGLTW-40A400A(P)	019	SGLFW-35A120A(P)
008	SGLTW-40A600A(P)	020	SGLFW-35A230A(P)
009	SGLTW-80A400A(P)	021	SGLFW-50A200A(P)
010	SGLTW-80A600A(P)	022	SGLFW-50A380A(P)
011	SGLTW-20A170A(P)	023	SGLFW-1ZA200A(P)
012	SGLTW-20A320A(P)	024	SGLFW-1ZA380A(P)

4. Description of Functions

4.1 Torque/Force Control

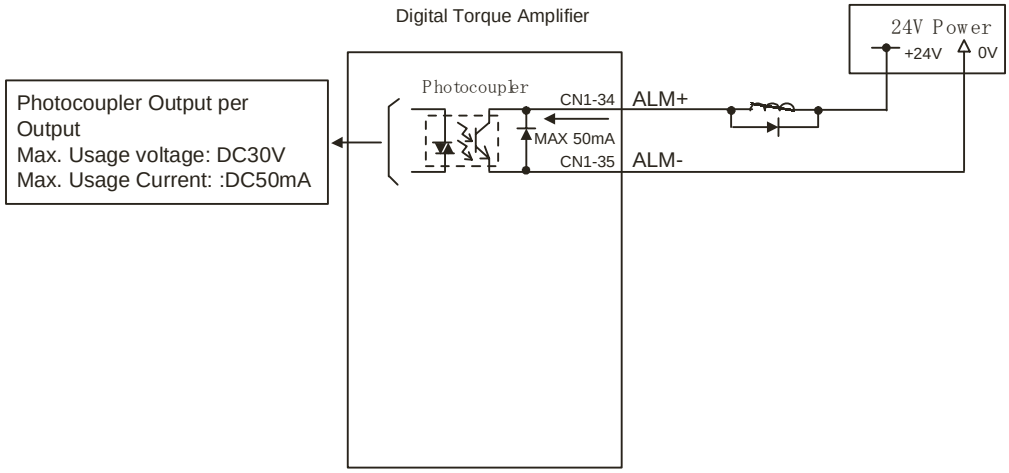
This is the torque/force control-dedicated mode.
This control mode inputs the torque/force reference from CMD-IN (CN1-3 & CN1-4).



4.2 Protection Sequence Design

This section describes the methods for integrating a protective sequence for safety purposes using I/O signals from the digital torque amplifier.

Servo Alarm Output



The basic method for continuing alarm-related “output signals” is shown below.
Prepare an external 24V usage power source. No 24V power source is integrated in the digital torque amplifier. The photocoupler output signal is handled as follows:

Output → **ALM+ CN1-34**	**Servo Alarm Output**
Output → **ALM- CN1-35**	**Signal ground for servo alarm output**

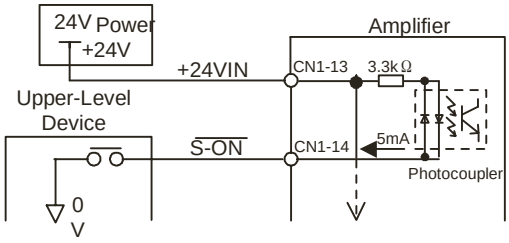
The output is “ON” when the digital torque amplifier detects an error.

Be sure to configure the external circuit so that the main power to the digital torque amplifier goes OFF at alarm output.

ON State	CN1–34, 35 is “closed”, CN1–34 is level “Low”	Normal State
OFF State	CN1–34, 35 is “open”, CN1–34 is level “High”	Alarm State

■ Servo ON Input

Serial Input Signal: The basic connection method and for Servo ON (/S-ON) is displayed below. This is used to forcibly stop the servomotor in a “non-powered” state.



→ Input/S-ON CN1-14	**Servo ON**

Switches the motor between a powered and a non-powered state.

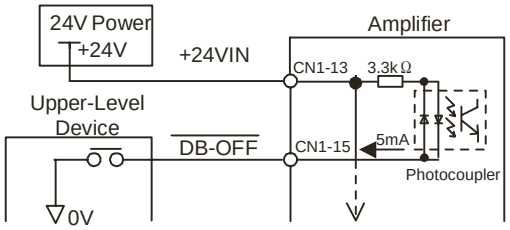
When ON **CN1-14** is “**L**” level	Sends power to the motor. This is the normal RUN state. (this is called the 4state)	Servo ON	Motor “Powered” State The motor runs according to the input signals
When OFF **CN1-14** is “**H**” level	Sets the motor to a “non-powered” state. Operation is not possible (this is the Servo OFF state). Do not perform Servo OFF while the motor is running except during an emergency stop.	Servo OFF	Motor Non-Powered State Operation is not possible

Important

Do not start/stop the motor by using the (/S-ON) signal. Always start/stop the motor with an input command.

■ DB OFF Input

Sequence Input Signal: The basic connection and handling method for the (DB OFF) signal is shown below. This is used to forcibly release the “DB stop state” during Servo OFF from the upper-level device.



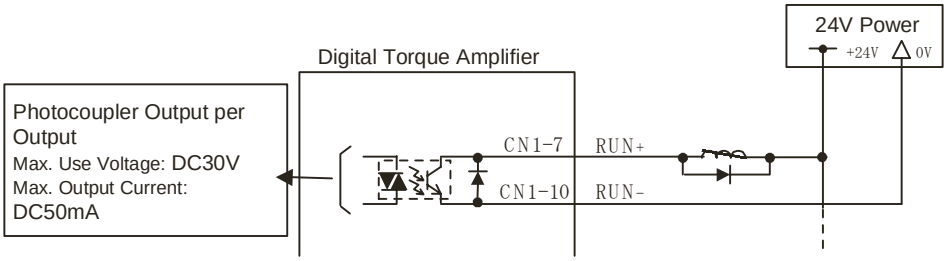
→ Input DB OFF CN1-15	DB OFF

Switches the motor between a powered and a non-powered state.

When ONCN1-15 is “L” level	DB stop at Servo OFF	**DB ON**	**DB Stop State** DB stop at Servo OFF
When OFFCN1-15 is “H” level	Releases the DB stop and goes to free run at Servo OFF	**DB OFF**	**DB Stop Release** Release DB stop according to an input signal

■ RUN Signal Output

Photocoupler Output Signal: The basic connection method and handling method for the “RUN” signal is shown below. This output signal indicates that the base block on the output inverter is released, and power is being applied to the motor.

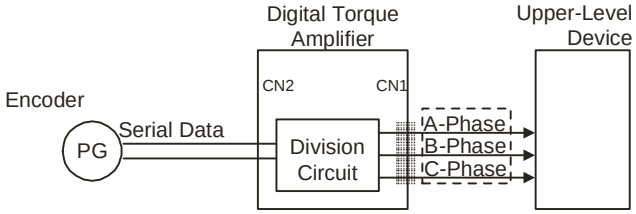


Output → RUN CN1-7	RUN Signal Output

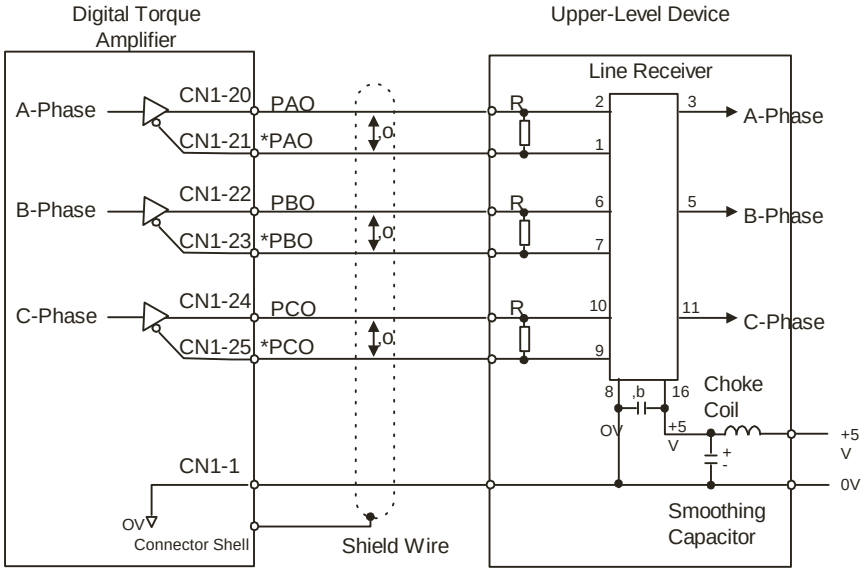
ON State	CN1–7, 10 is “closed” CN1–7 is level “L”	Base Block
OFF State	CN1–7, 10 is “open” CN1–7 is level “H”	Base Block Released

4.3 Encoder Signal Output

The output signal following division within the digital torque amplifier of the encoder output[1] can be output to an external device.



The output circuit is a line driver output. Connect in consideration of the following circuit.



,o: Shows a twisted pair wire.

Applied Line Receiver: TI SN75175 or MC3486-equivalent

R (Termination Resistance): 220~470ƒ¶
,b (Decoupling Capacitor) : 0.1ƒÊF

1. After Division: This means the output converted to the set pulse ratio based on the pulse data from the encoder mounted on the motor. The unit here is “No. of Pulses/Rotation”.

■ I/O Signals

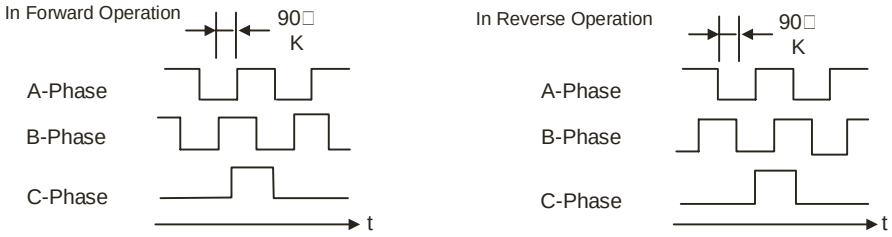
The details on the output signal are as follows:

Output → PAO CN1-20	**Encoder Output A-phase**
Output → *PAO CN1-21	**Encoder Output /A-phase**
Output → PBO CN1-22	**Encoder Output B-phase**
Output → *PBO CN1-23	**Encoder Output /B-phase**
Output → PCO CN1-24	**Encoder Output C-phase**
Output → *PCO CN1–25	**Encoder Output /C-phase**

The divided encoder signal is output.
The division ratio is set in the following switches.

Encoder Division Ratio Setting	SW3

■ Output Phase Form



Output → SG CN1–2	**Signal Ground**

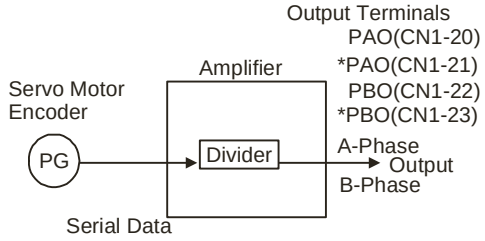
Signal Ground: Connect to “0V” on the upper-level device.

■ PG Divider Setting

Set the pulse division ratio by the following switches.

			Setting Range	Delivery Setting
SW3	PG Divider Setting	Unit P/R	16,000~131,072 (Rotary 17-bit)	65,536
			1000~8192 (Rotary 13-bit)	8192
			1/256~1/2 (Linear Motor)	1/20

Set the number of output pulses output by the encoder output signals (PAO, *PAO, PBO, *PBO).



This divides the pulses from the motor encoder (PG) by the number of pulses set there, then outputs it. The setting value is the number of output pulses per motor rotation. Set this to match the command unit of the machine controller. The setting range differs according to the encoder used.

4.4 Analog Monitor

The following signals can be monitored in the analog voltage form.

1CN Pin No.	Signal Name	Content
28	Analog Monitor 1	Motor speed : 1V/1000r/min or 1V/1000mm/sec
29	Analog Monitor 2	Torque = 5V/Max. Torque

The analog monitor output voltage is 8VDC (Max.). The output voltage will invert if it exceeds 8VDC.

4.5 Regenerative Resistor Selection

When the servomotor is operated in electrical generator mode, the servo amplfier will absorb electrical power. This is called regenerative power. Although the regenerative power is absorbed by charging the smoothing capacitor of the digital torque amplifier, the regenerative power will be further consumed by the regen resistor if the chargeable energy limit of the capacitor is exceeded. The servomotor is operated in the regen (electrical generator) mode in the following situations:

- Deceleration to stop time during acceleration/deceleration operation
- Vertical axis load
- Continuous operation where the servomotor continues rotating from the load side (overhauling load)

The capacity of the regenerative resistor integrated within the digital torque amplifier is designed for short-term operation only, such as the deceleration to stop period. Operation is not possible with an overhauling load. Install an external regen resistor if the regen power exceeds the processing capability of the digital torque amplifier. The specifications of regen resistors integrated in digital torque amplifiers and the regen power they can process (average) are shown below.

Applied Digital Torque Amplifier	Integrated Regen Resistor Specifications		Regen Power Processed by Integrated Resistor (W)	Minimum Total Resistance (Ω)
	Resistance (Ω)	Capacity (W)		
SGDG-01GT/-04GT	—	—	—	40
SGDG-10GT	50	60	12	40
SGDG-15GT	30	70	14	20

* The regen capacity (average) which can be processed is a 20% rating of the regenerative resistor capacity integrated within the digital torque amplifier.

When installing an external regen resistor, make the resistance the same as that of the resistor integrated within the digital torque amplifier. When using several resistors with small resistance combined in a group to increase the capacity (W) of the regen resistor, select resistors so that the value including the resistance error is equal to or greater than the “minimum allowable resistance” in the above table.

■ External Regen Resistors

Important

(1) If the power resistor is used at the rated load rate, resistor temperatures will reach 200°C~300°C. Be sure to derate before using. Check with the manufacturer for the load characteristics of the resistor. Use at a load rating of 20% or less when using natural cooling (natural convection cooling), and at 50% or less when forced air cooling is used.

(2) For safety reasons, we recommend the use of resistors with thermostatic switches.

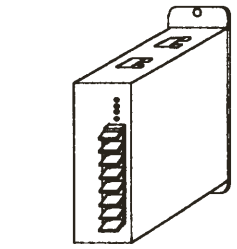
■ For Digital Torque Amplifiers of 400W Capacity or Less

SGDG-01GT

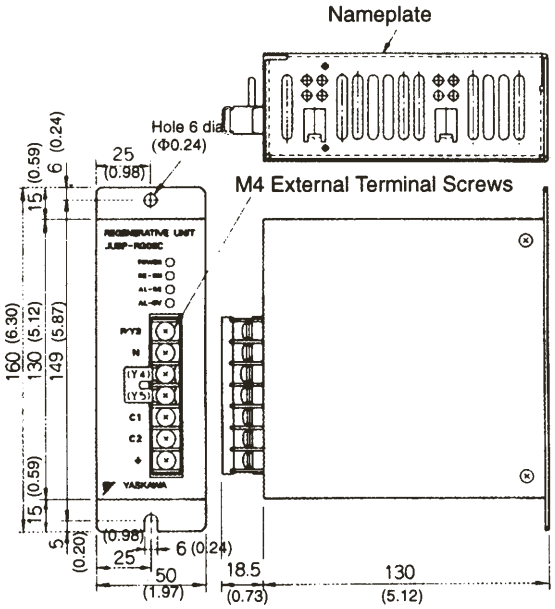
The SGDG-01GT does not have the regen transistor built-in even though there are terminals for connecting an external regen resistor. Therefore, for external regen requirement, the JUSP-RG08D external regen unit must be used. This unit connects directly across the DC bus. It is a self-contained unit consisting of bus sensing circuitry, switching IGBT, 50 ohm power resistor, and alarm relay contacts. The regen capacity of this unit is 60W before derating. The convection cool capacity is 12W. Capacity increases to 30W with forced-air cooling.
When this external regen unit is used, #5 of SW1 in the SGDG-01GT should be turned OFF to avoid erroneous alarms.

The following is the dimension and specifications of the JUSP-RG08D:

Dimensional Drawings



Approx. Mass: 1 kg (2.20 lb)



Regenerative Unit Specifications

Type	JUSP-RG08 JUSP-RG08D	Remarks
Applicable Servopack	SGDG Servopack	
Regenerative Working Voltage	380Vdc	
Regenerative Processing Current	8Adc	Regenerative resistance:50Ω 60W
Error Detection Function	Regenerative resistance disconnection, regenerative transistor fault, overvoltage	
Alarm Output	Normally closed contact (open when protective function operates)	200V operation ok
Dimensions in mm (inches)	55W x 160H x 130D (2.17W x 6.30H x 5.31D)	

SGDG-04GT

The SGDG-04GT has terminals for connecting an external regen resistor of higher capacity. However, the SGDG-04GT does not automatically recognize this external regen resistor and it doesn't activate the regen IGBT. Thus, when an external resistor is connected, the regen energy is still processed by internal regen capacity. The alarm #4 (overvoltage) will occur if the regen energy is too high. To add external regen capability to the SGDG-04GT, one of the following methods may be used:

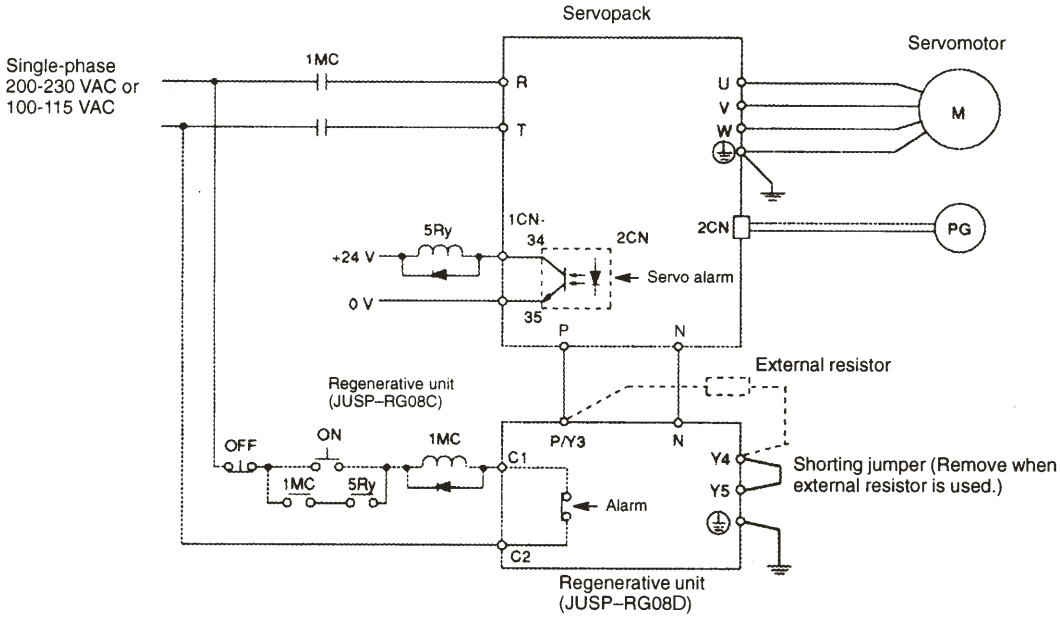
1. Use external regen unit JUSP-RG08D. Refer to the information in the table above for more details. When this external regen unit is used, #5 of SW1 in the SGDG-04GT should be turned OFF to avoid erroneous alarms.

   or

2. Use SGDG-04GTY22P for external regen application only. If the user knows that the application requires extra regen capacity, the Y-mod unit must be ordered. With Y22P-mod, two (2) external regen resistors, RH500N25_ohmK, wired in series must be connected to the SGDH-04GT at all times. These resistors should be connected across terminals B1 and B2. The convection cool capacity of these two resistors in series is 120W. The capacity increases to 300W with forced-air cooling. Therefore, the items required are:

   1 x SGDG-04GTY22P
   2 x RH500N25_ohmK

Connecting the JUSP-RG08D to the SGDG-01GT/SGDG-04GT



a) A regenerative unit has the following fault detection functions:

- Detecting disconnection in a regenerative resistor
- Detecting faults in a regenerative resistor
- Detecting overvoltage

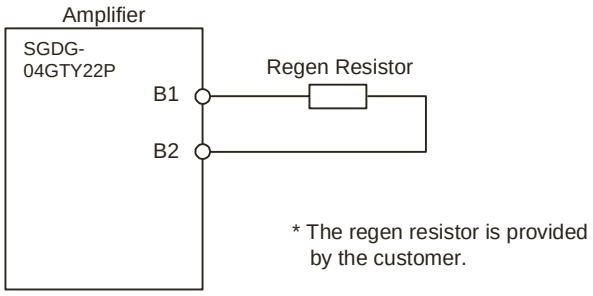
b) When one of these fault detection functions operates, the internal alarm relay is actuated. Then the circuit between output terminals C1 and C2 is opened.

c) When an external resistor is used, remove the shorting jumper between Y4 and Y5. Then, connect the resistor between P/Y3 and Y4.

d) The resistance value of the external resistor should be 50Ω min.

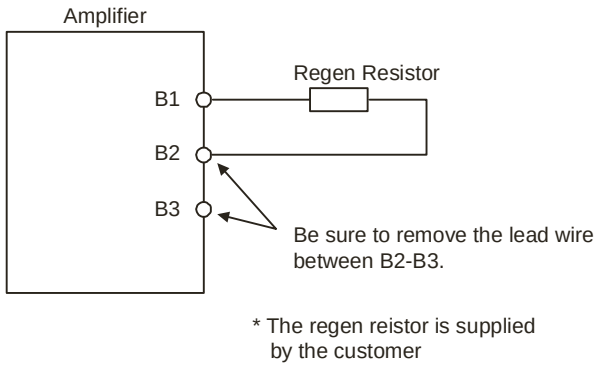
SGDG-04GTY22P

Connect the regen resistor between terminals B1-B2 on the SGDG-04GTY22P digital torque amplifier.



■ For Digital Torque Amplifiers of 500W Capacity or More

Open terminals B2-B3 on the digital torque amplifier (remove the wire), and connect the regen resistor between terminals B1-B2.



Important

The regen resistor reaches high temperatures. Use wires with high-temperature insulation, and make sure the wires do not come into contact with the regen resistor.

When an external resistor is connected, turn OFF #5 of SW1. Be sure the energy capacity of the resistor is adequate to dissipate the regen energy of the load.

■ Calculating Regen Energy

For the procedure to calculate regen resistor capacity, please refer to Chapter 5 of the Sigma II Series Servo System User's Manual (Doc.# YEA-SIA-S800-32.2x).

Notes:

5. Servo System Maintenance/ Inspection

5.1 Motor Inspection

The procedures for simple daily maintenance of the servomotor are shown in Table 5.1. Because AC servomotors are brushless, simple daily inspection is sufficient. The inspection periods in the table are standard scales. Determine the usage conditions and environment, and then decide an appropriate inspection period.



Do not disassemble the servomotor for maintenance/inspection. Contact your Yaskawa representative or sales office if the servomotor is to be disassembled.

Table 5.1: Servomotor Inspection

Inspection Item	Inspection Period	Inspection/Work Content	Notes
Check for vibration or noise	Daily	Inspect by touch or hearing.	The level should not be greater than normal.
External Inspection	According to soiling conditions	Clean with cloth or air.	—
Changing the oil seal	Once every 5,000 hours minimum	Remove from machine and replace.	Only for motors with oil seals.
Comprehensive Inspection	Every 20,000 hours or 5 years, minimum	Contact your Yaskawa service department.	The customer should not disassemble/clean the servomotor.

5.2 Digital Torque Amplifier Inspection

Digital torque amplifier inspection is summarized in the table below. Although there is no need for daily inspection, perform inspections at least once per year.

Table 5.2: Digital Torque Amplifier Inspection

Inspection Item	Inspection Period	Inspection Content	Measures Taken at Error
Unit, Board Cleaning	Once per year minimum	There should be no grime, dust, or oil on the unit.	Clean with air or cloth.
Loose Screws	Once per year minimum	There should be no looseness in the terminal block and connector mounting screws.	Tighten
Component Fault in Unit or Board	Once per year minimum	There should be no changes in coloration due to heat, damage, or wire breakage.	Consult Yaskawa.

■ Component Replacement Timeline

The components in the table below are subject to mechanical wear or degradation over time. Inspect these periodically for purposes of preventative maintenance.
Digital torque amplifiers overhauled by Yaskawa are shipped with their system switches returned to their factory default settings. Be sure to verify these switches before operating.

Table 5.3: Periodic Inspection of Components

Component Name	Standard Replacement Period	Replacement Method, Other
Cooling Fan	4 ~ 5 Years	Replace with a new item.
Smoothing Capacitor	7 ~ 8 Years	Replace with a new item. (determine by inspection)
Relays	—	Determine by inspection
Fuses	10 years	Replace with a new item.
Discharge Capacitor on Printed Circuit Board	5 years	Replace with a new board. (determine by inspection)

■ Use Conditions

- Ambient Temperature: Yearly average 30°C
- Load Ratio: 80% or less
- Operation Rate: 20 hours or less per day

5.3 Alarms

POWER ON: Green LED turns ON at control power ON.
CHARGE LED: Red LED turns ON at main circuit power ON.

■ 7-Segment LED

Normal Status	Base Block	
	Servo ON	

■ Alarm List

Alarm Display	Alarm Name	Content
	Switch Setting Error	SW2, SW3 are not set during linear motor combination
	Overcurrent	Overcurrent flowed to IGBT
	Regen Circuit Error	・Regen resistor disconnection ・Regen transistor short
		The regen energy exceeds the capacity of the regen resistor*#.
	Overvoltage	The main circuit voltage exceeds 420V*.
	Overspeed	Detected when the motor speed exceeds the maximum speed*.
	Undervoltage	The main circuit voltage is below 70V*.
	Overload	Operation for several seconds or tens of seconds at a torque/force greatly in excess of the rating*#.
		Continuous operation above the rated torque/force*.

Alarm Display	Alarm Name	Content
	Encoder Communication Error	Communication error between encoder and digital torque amplifier.
		Communication between the encoder and digital torque amplifier failed three times in succession.
	Runaway Detection	Motor runaway*.
	Encoder Failure	Checksum error in EEPROM within encoder
		Error in the number of pulses in encoder rotation
		Error in EEPROM within encoder
		Error in communication data between encoder and digital torque amplifier.
	Main Circuit Power Error	DC input with AC input settings for main circuit power or AC input with DC input settings.
		Main circuit power was frequently tuned ON/OFF*.
	Combination Error	Improper combination of motor and digital torque amplifier capacities.
		Improper motor combination.
	Digital Torque Amplifier Fault	Failure of A/D converter used in command input
		Servo amplifier system error
	Linear Motor Scale Polarity Error	Polarity setting of the linear motor scale A, B-phases is reversed.

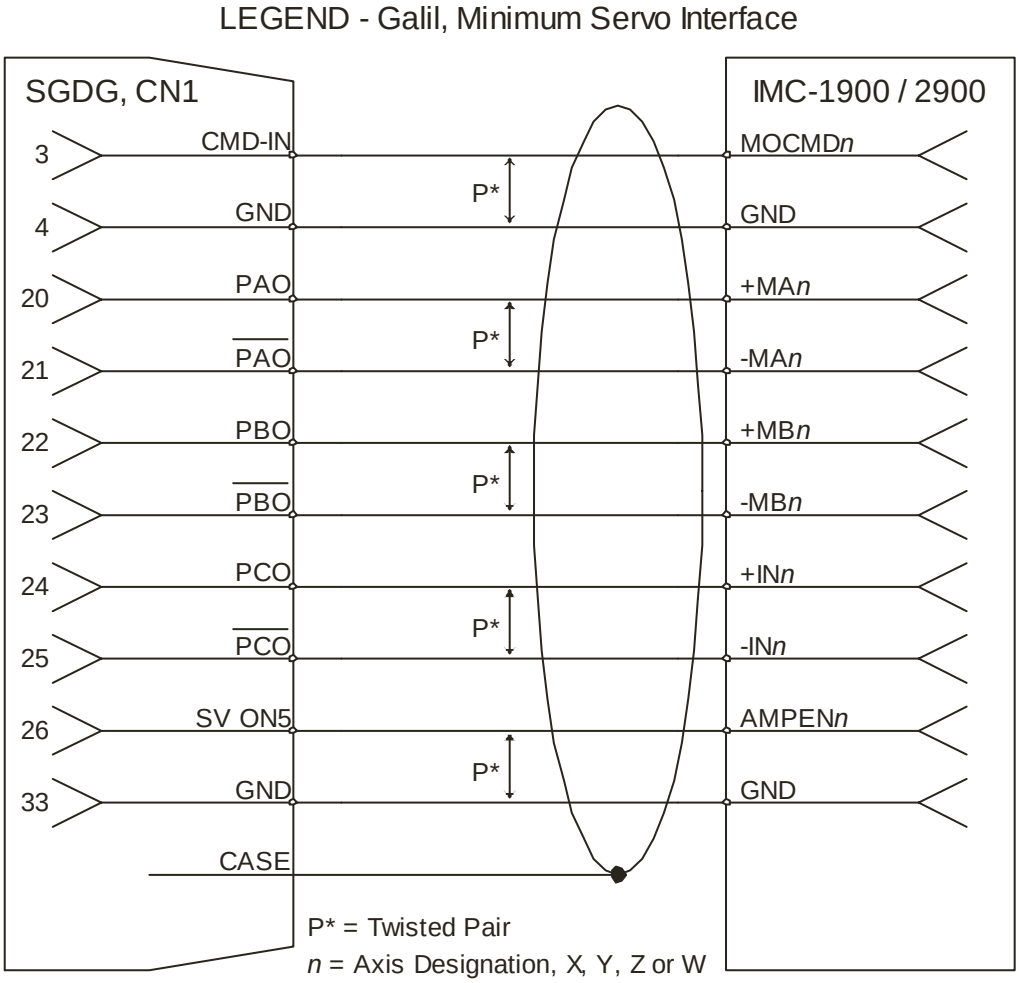
* Reset at S–ON signal ON.

LED will blink at warning before alarm.

Appendix A:Host Controller Connection Examples

This appendix provides examples of SGDG digital torque amplifier connection to typical host controllers. Please refer to the manuals of the host controllers for more details before actually connecting to them.

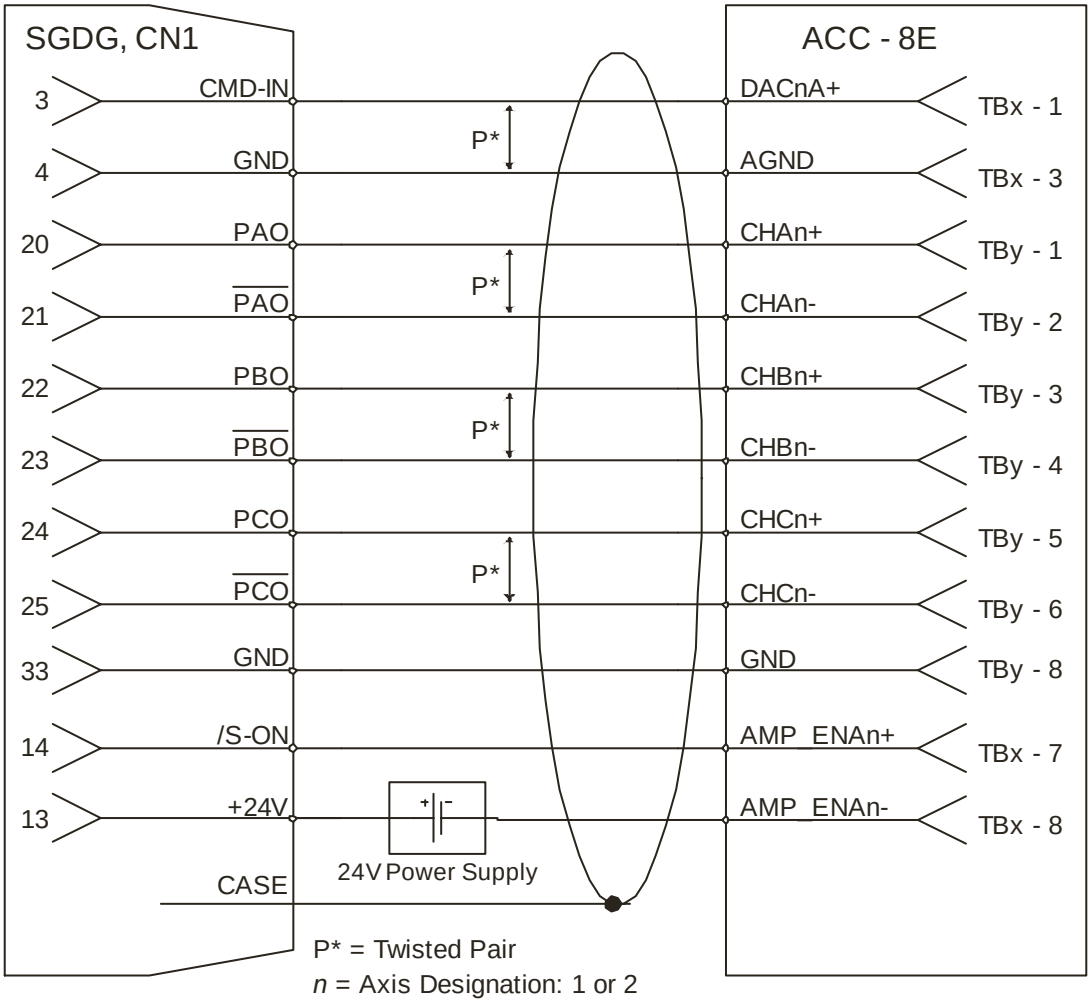
A.1 Connecting the Galil IMC-1900/2900



Caution:
Galil motion controllers allow to reverse the loop and encoder polarity with the MT and CE commands. Check applicable Galil product manuals for the appropriate procedure on proper loop and encoder phasing. ***Incorrect phasing may cause the motor to "run away!"***

A.2 Connecting the Delta Tau PMAC2

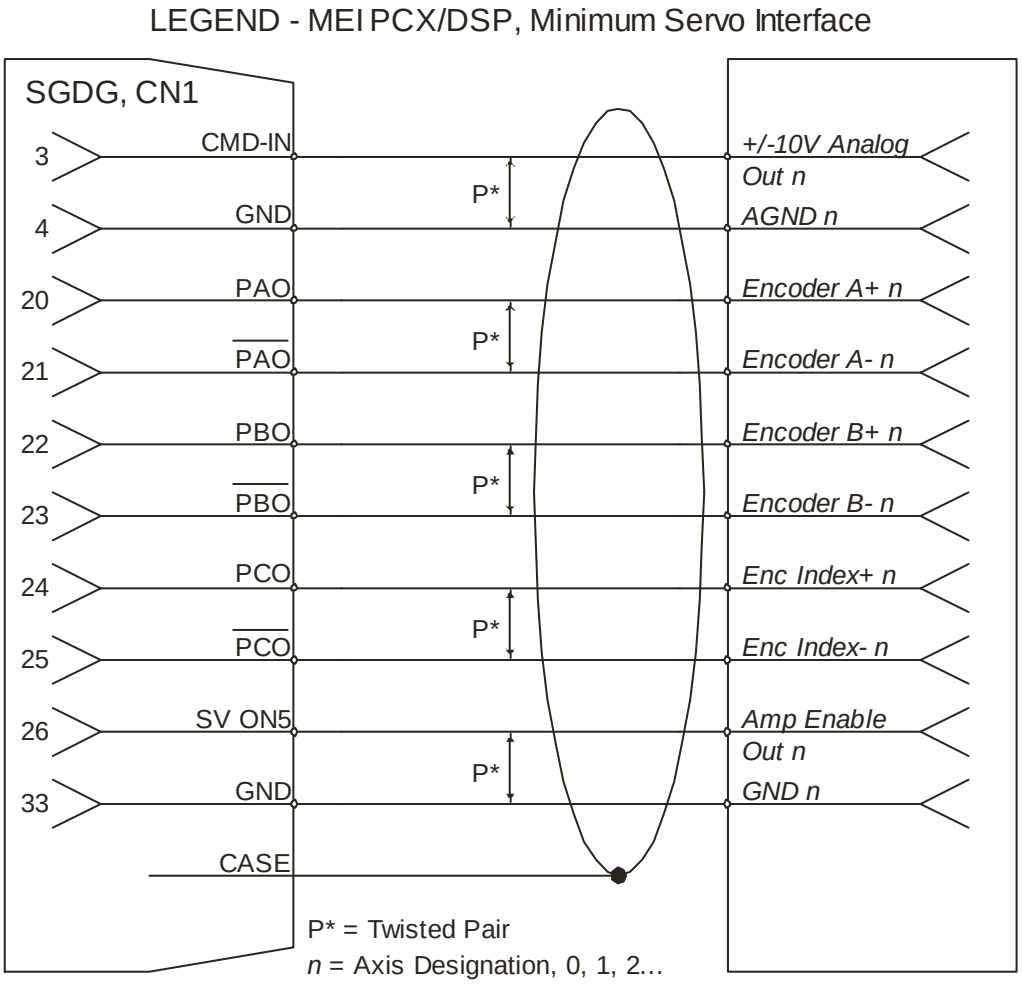
LEGEND - Delta Tau PMAC2, Minimum Servo Interface



P* = Twisted Pair
n = Axis Designation: 1 or 2
when n=1, x=5 and y=2
when n=2, x=7 and y=3

Note:
Jumper pin 1 to 2 on E1 to power ACC-8E digital 5V circuitry from PMAC2 through flat cable on JMACH port.
Jumper pin1 to 2 on E4 (axis n=1) and on E7 (axis n=2) for normally open relay contact between AMP_ENAn+ an AMP_ENAn-.

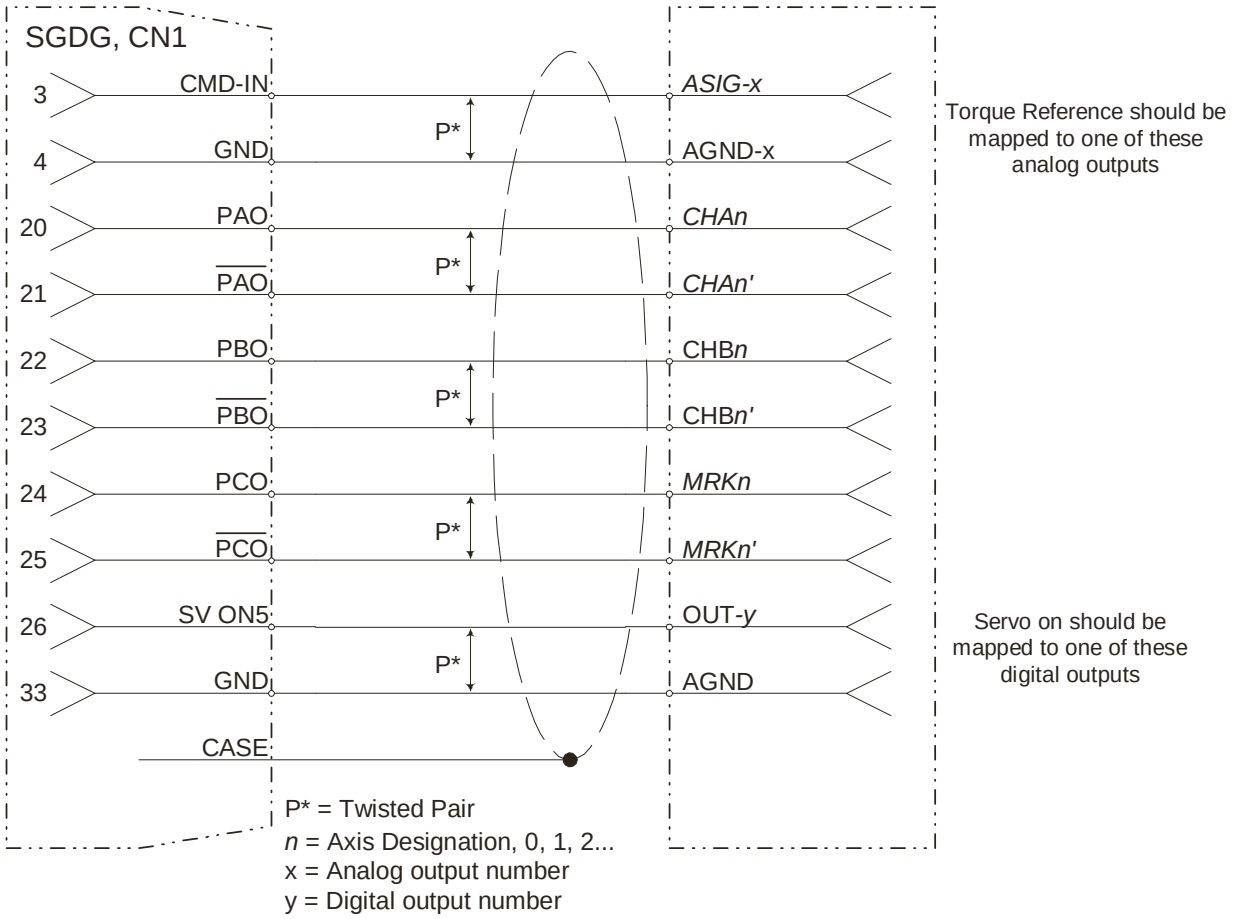
A.3 Connecting the MEI PCX/DSP



Signals may be from different connectors on MEI controller.
Consult *MEI DSP Series Motion Controller Installation Guide* for details.

A.4 Connecting the Acroloop ACR-8010

LEGEND - Acroloop (ACR-8010), Minimum Servo Interface



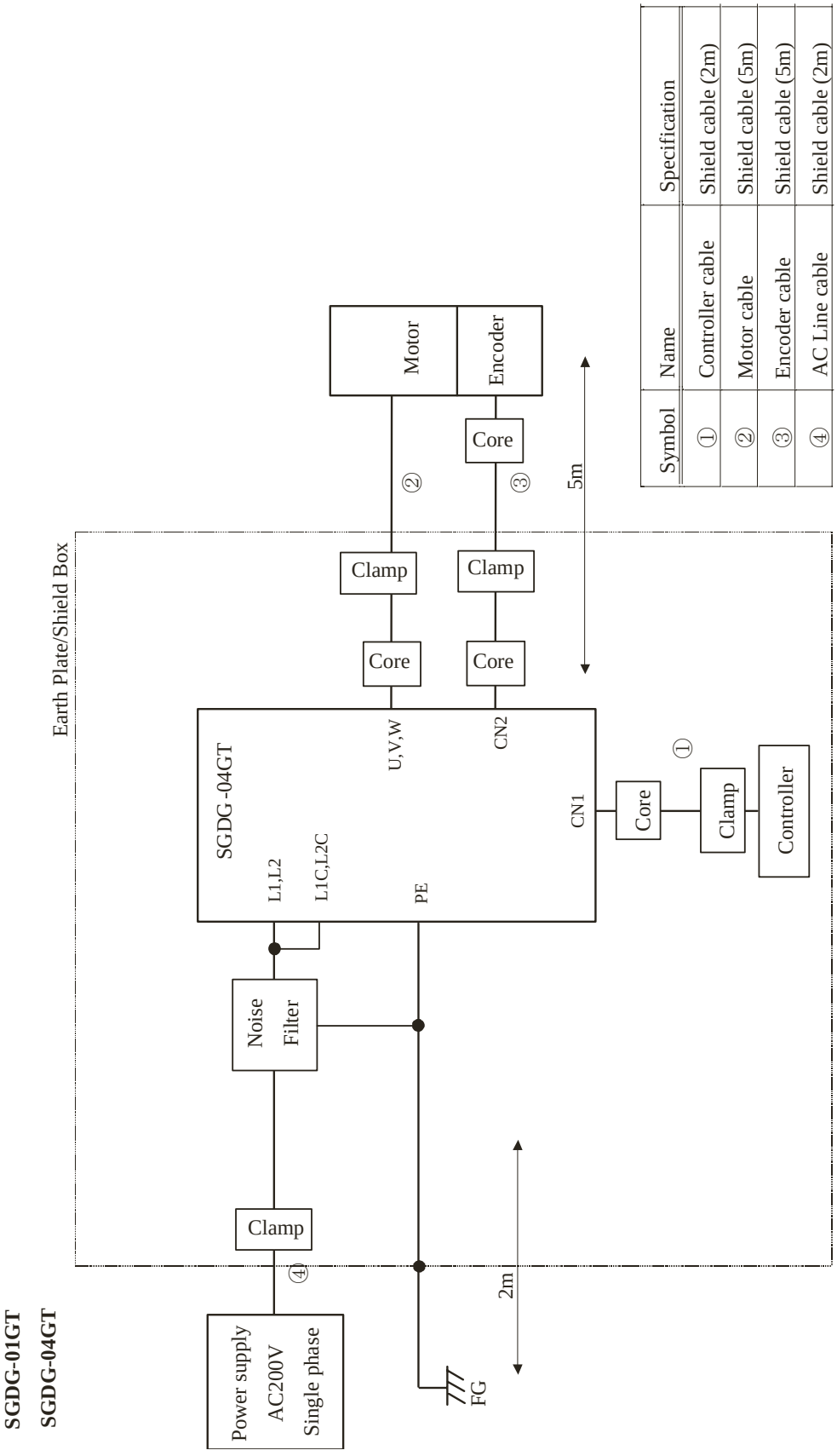
Encoder type is Differential Line Driver (+5 Volt Outputs) so Pullups should be removed
Encoders 0-3 are on P1A connector
Encoders 4-7 are on P1B connector
ASIG-0 and AGND-0 through ASIG-7 and GND-7 are on P2 connector
AGND is on P2 connector
OUT-32 through OUT-63 are on P3 connector

Appendix B: Installation Conditions for EMC Directives

The following conditions must be satisfied to adapt a combination SGM□H servomotor and an SGDG digital torque amplifier to EMC directives (EN55011-2 and EN61000-6-2).

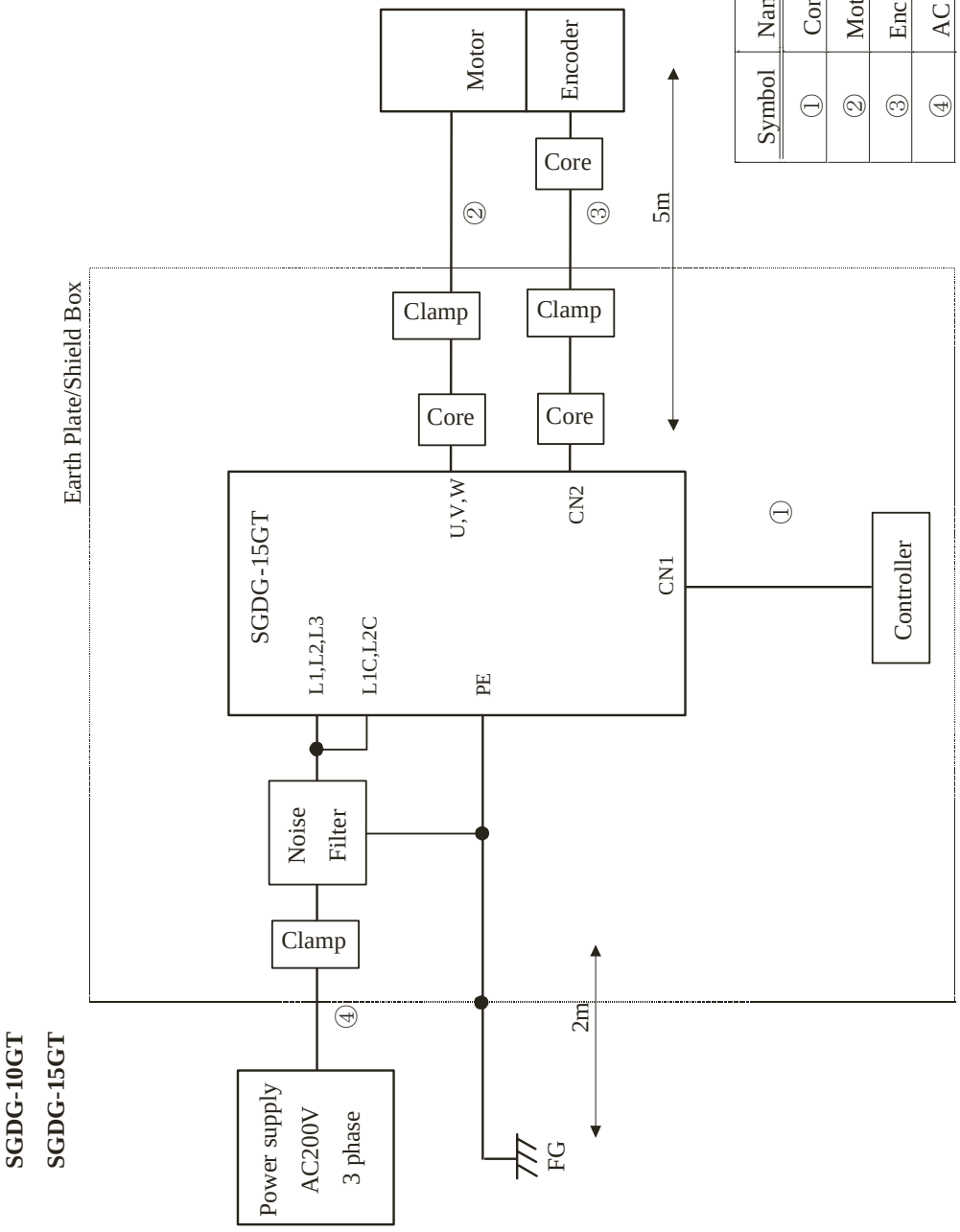
■ EMC Installation Conditions

This section describes the installation conditions that satisfy EMC guidelines for each model of the SGDG digital torque amplifier. Also, it describes the EMC installation conditions satisfied under test conditions prepared by Yaskawa. The actual EMC level may differ depending on actual system configuration, wiring, and other conditions.



Symbol	Name	Specification
①	Controller cable	Shield cable (2m)
②	Motor cable	Shield cable (5m)
③	Encoder cable	Shield cable (5m)
④	AC Line cable	Shield cable (2m)

Clamps : Fix and ground the cable shield using a piece of conductive metal.



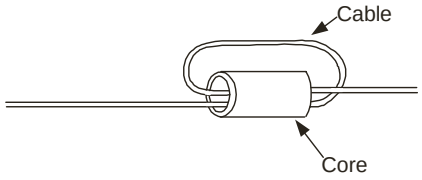
Symbol	Name	Specification
①	Controller cable	Shield cable (2m)
②	Motor cable	Shield cable (5m)
③	Encoder cable	Shield cable (5m)
④	AC Line cable	Shield cable (2m)

Clamps : Fix and ground the cable shield using a piece of conductive metal.

■ Cable Core and Cable Clamp

■ The Cable Core

Attach the core on the cable as shown below:

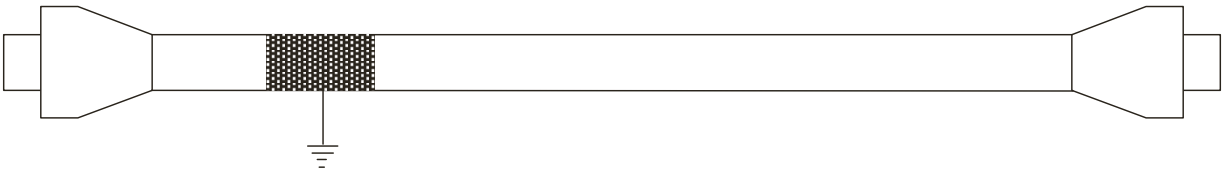
Cable Model	ESD-SR-25	Note: The diagram shows two turns of the cable
Quantity	1	
Turn	2	
Manufacturer	Tokin Corp.	

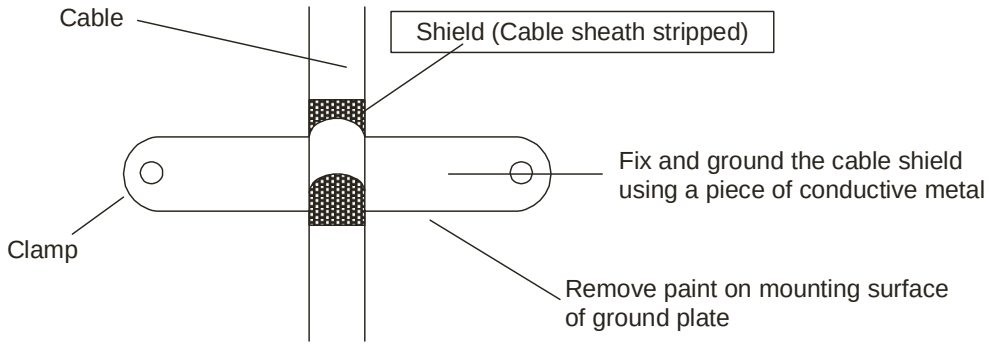
The table below shows the cable and position where the core is attached.

Cable Name	Mounting Position of the Core
Controller Cable	Near the controller and digital torque amplifier.
Servomotor Cable	Near the digital torque amplifier and the servomotor.
Encoder Cable	Near the digital torque amplifier and the servomotor.

■ Cable Clamp

The figure below shows the cable shield using a piece of conductive metal.
<Example of Cable Clamp>





■ Noise Filter for Brake Power Supply

FN2070-6/07 (Made by Schaffner) for servomotors of 0.4kW or less.

■ Cable Specifications

Shielded cables should be used for the following cables:

AC power input line cable (between the power supply and the noise filter)
Servomotor cable (between the digital torque amplifier and the servomotor)
Encoder cable (between the digital torque amplifier and the servomotor)
Controller cable (between the digital torque amplifier and the controller)

■ Recommended Ferrite Cores

Cable Name		Ferrite Cores	Manufacturer
Controller Cable		ESD-SR-25	Tokin
Encoder Cable			
Servomotor Cable	400W or lower	ESD-SR-25	Tokin
	1kW or higher	PC40T90×13.5×74	TDK

■ Shielded Box

A shielded box, a closed metallic enclosure, should be used for shielding electromagnetic interference. The structure of the box should allow the main body, door, cooling unit, etc., to be attached to the ground. The box opening should be as small as possible.

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