FALDIC-α Fuji AC Servo System

RYS-V Type

User's Manual

Fuji Electric Co.,Ltd.

MHT258a (Engl.)

SAFETY INSTRUCTIONS

In all stages of the basic planning of this equipment, its transport, installation, operation, maintenance and check, reference must be made to this manual and other related documents. The correct understanding of the equipment, information about safety and other related instructions are essential for this system.

Cautionary indications DANGER and CAUTION are used in this manual to point out particular hazards and to highlight some unusual information which must be specially noted.

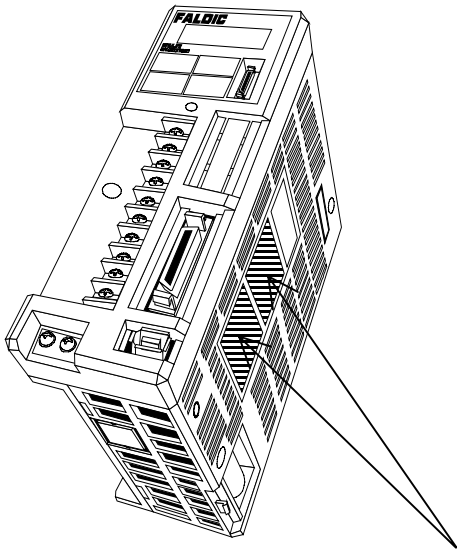
Cautionary indications	Description
DANGER	**Indicates that death or severe personal injury will result if proper precautions are not taken.**
CAUTION	**Indicates that personal injury or property damage alone will result if proper precautions are not taken.**

Pictorial symbols are used as necessary.

Pictorial symbol	Description	Pictorial symbol	Description
	Do not disassemble		Electrical shock hazard warning

Warning display
The warning display in Fig. B is located at the arrows in Fig. A.

Fig. A



Warning display

Fig. B


危　険
けが・感電のおそれあり
・通電中、及び電源遮断後5分間は本体に触れないで下さい。
・確実に接地を行うこと。
・取扱説明書を熟読の上、その指示に従って下さい。
高温注意（火傷のおそれあり）
・通電中は本体に触れないで下さい。
WARNING
RISK OF INJURY AND ELECTRIC SHOCK
・Don't touch the controller while applying power and at least 5min. after disconnecting power.
・Securely ground (earth) the controller.
・See manual for detail before use.
Caution Hot Controller (MAY CAUSE BURN)
・Don't touch the controller while applying power.

Fig. B shows following contents :
There is a risk of electric shock.
Do not touch the amplifier when a commercial power is applied and for at least five minutes after de-energization.
Be sure to ground {applicable for Japan only : grounding equal to 3rd class grounding structure of Japanese standard (grounding resistance 100 [Ω] or less)} must be connected with the terminal marked "⏚".

DANGER

●**Prior to inspection, turn off power and wait for at least five minutes.**
Otherwise, there is a risk of electric shock.

●**Do not touch the amplifier when the commercial power is supplied. Otherwise, there is a risk of electric shock.**

CAUTION

●**Do not disassemble the motor. Otherwise, the operation may be abnormal, thereby damaging the coupled machine.**

●**Do not hit the motor with hammer or any other instruments. The integrated (built-in) encoder may break causing the motor to run at an excessive speed.**

●**Do not connect a commercial power supply directly to the motor. Otherwise, it may break.**

●**Supplying other than 200 [V] to the amplifier may break it.**

●**Do not turn on and off the commercial power repeatedly. Otherwise, the amplifier rectifier may break.**

●**The motor must be firmly tightened to the mounting base or the driven machine. If rapid acceleration or deceleration is attempted without this firm tightening, the motor may become dislocated.**

●**Withstand voltage and insulation test with megger must not be conducted.**

Products introduced in this manual have not been designed or manufactured for such applications in a system or equipment that will affect human bodies or lives. Customers, who want to use the products introduced in this manual for special systems or devices such as for atomic-energy control, aerospace use, medical use, and traffic control, are requested to consult the Fuji. Customers are requested to prepare safety measures when they apply the products introduced in this manual to such systems or facilities that will affect human lives or cause severe damage to property if the products become faulty.

CONTENTS

SAFETY INSTRUCTION

1. GENERAL **1-1**
1.1 Outline 1-1
1.2 System configuration 1-3
1.3 Functions 1-5
1.4 Explanation of model type 1-6

2. SPECIFICATIONS **2-1**
2.1 Motor 2-1
2.2 Amplifier 2-10
2.3 Torque-speed data 2-14

3. INSTALLATION **3-1**
3.1 Motor 3-1
3.2 Amplifier 3-3
3.3 External dimensions 3-8

4. TERMINAL DIAGRAMS AND WIRING **4-1**
4.1 Amplifier, motor and optional devices layout 4-1
4.2 Commercial power supply 4-5
4.3 Wiring between motor and encoder 4-6
4.4 Host interface (I/F) 4-10
4.5 External connection diagrams (basic) 4-15

5. CONTROL FUNCTIONS **5-1**
5.1 Summary 5-1
5.2 Run command 5-5
5.3 Speed control 5-10
5.4 Position control 5-15
5.5 Signal for safety 5-23
5.6 Torque control 5-31
5.7 Incidental functions 5-33

6. PARAMETER SETTING **6-1**
6.1 Mechanical equipment system 6-1
6.2 Peripheral device 6-10
6.3 Amplifier 6-17
6.4 Communication 6-23
6.5 List of parameter 6-24

7. KEYPAD PANEL **7-1**
7.1 Summary 7-1
7.2 Function list 7-3
7.3 Sequence mode 7-5
7.4 Monitor mode 7-10
7.5 Parameter edit mode 7-15
7.6 Positioning data edit mode 7-19
7.7 Test running mode 7-19

8. TEST (TRIAL) RUNNING OPERATION **8-1**
8.1 Preparation 8-1
8.2 Touch panel 8-4
8.3 Control input signal 8-6

9. INSPECTION AND MAINTENANCE **9-1**
9.1 Inspection 9-1
9.2 Memory backup 9-1
9.3 Fault display 9-2
9.4 Items to specify when faulty 9-15
9.5 Others informations 9-15

10. PERIPHERAL DEVICES **10-1**
10.1 Cables 10-3
10.2 Auto circuit breaker (FAB, MCCB), earth leakage circuit breaker (ELCB) and magnetic contactor (MC) 10-4
10.3 Surge suppressor (surge killer) 10-4
10.4 Power filter 10-5
10.5 AC reactor (reactor for impedance matching) 10-6
10.6 External braking resistor 10-6
10.7 DC reactor 10-7
10.8 Optional cables, connector kits, battery and external braking resistors 10-8

11. APPENDIXES **11-1**
11.1 Model type selection 11-1
11.2 Example of program 11-10
11.3 Control block diagram 11-15

1. GENERAL

1.1 Outline

The FALDIC-α series which corresponds to a host interface is an AC servo system for motion-control necessary for a driven machine.

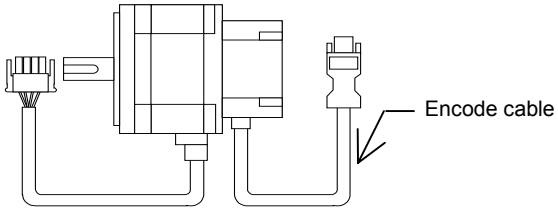
(1) Model type in this manual

(a) Amplifier (*) : RYS□□□S3-VVS
RYS□□□S3-VSS
(b) Motor (*) : GYC□□□DC1-S
GYS□□□DC1-S
(c) Gear head : GYN□□□SAG-G□□
GRN□□□SAG-G□□

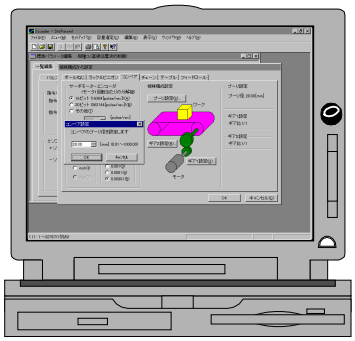
Remark : "Origin return" and "interrupt positioning" of RYS□□□S3-VVS type amplifier could not be validated depending on the shipping period of product. Check them after purchasing.

(1) Main features of product

(a) Wiring saving 16-bit serial pulse encoder (encoder) (65536 pulses/rev.)
(i) On the motor, an encoder for any of INC and ABS systems is mounted.
(ii) If a battery is mounted on the amplifier, it is usable as ABS system.
(iii) Encoder cabling consists of 2 wires for power supply and 2 for signal, of totally 4 wires. For ABS system, 2 wires for battery must be added.
(iv) A motor of a differen t output [kW] can be driven without changing the encoder setting provided that it has a rated output of frame No. (size) equal to the output to apply, one step smaller or greater. Refer to 9.3 (3) (d) .
(v) The basic resolution is 65536 pulses/rev., and the frequency dividing output is 16 to 16384 pulses/rev.



(b) Preparing a PC (*) loader



(i) Servo system support tools capable of controlling the para. (*) editing, monitoring, test running, etc. are available.
(ii) Fault diagnostic function alarm can be detected and fault cause covering the mechanical equipment system can be assumed.

(*) Amplifier : Servo-amplifier
Motor : Servo-motor
PC : Personal computer
Para. : Parameter(s)

(c) Closely mountable amplifiers

(i) Several amplifiers can be mounted sidewise spaced by less than 5 [mm] between themselves. In that case, however, the operation duty is not continuous but 80% ED. Refer to 3.2 (2) .

(ii) Control power supply input terminals are provided. Maintenance is available at a status where the main circuit power supply is trun off.

(iii) PN terminals for higher harmonics suppression are provided. A DC reactor can be mounted.

(iv) A touch panel is provided.

(v) You can select a control function from 3 types:

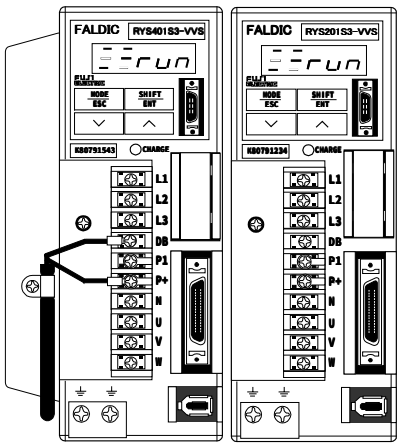
1) Pulse train input /speed control type (RYS-V type amplifier : Input frequency 500 [kHz] max.)

2) Linear positioning function (RYS-L type amplifier : Maximum command value ± 79,999,999)

A linear positioning system can be used for ball-screw or other mechanical equipment systems.

3) Rotational indexing function (RYS-R type amplifier : Maximum number of divisions 4095)

A rotational indexing system for ATC, tool magazine, etc. can be used.



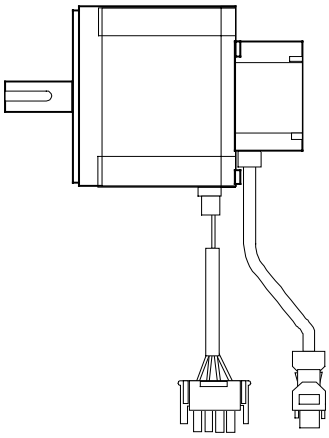
(d) Cubic/slim type motors

Cubic type of approximately half the depth of our basic type motor and slim type of flange of approximately half size are obtained.

(i) The degree of protection (motor enclosure protection) is IP55. Optionally, IP67 can be supplied.

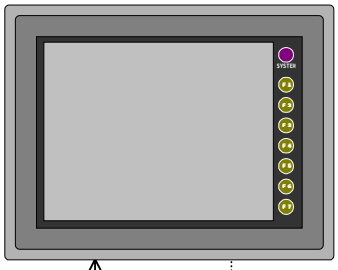
(ii) 0.03 to 5 [kW] are available.

(iii) Acceptable acceleration vibration is 4.9 [m/s^2] and the slit plate material of 16-bit serial encoder is non-glass film.



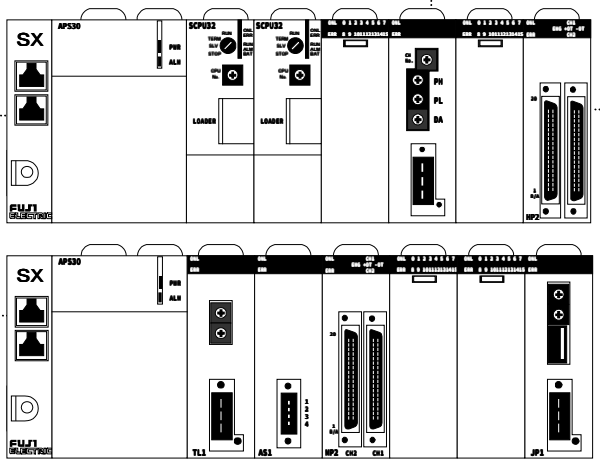
1.2 System configuration

The following illustrates related devices of FALDIC-α system.



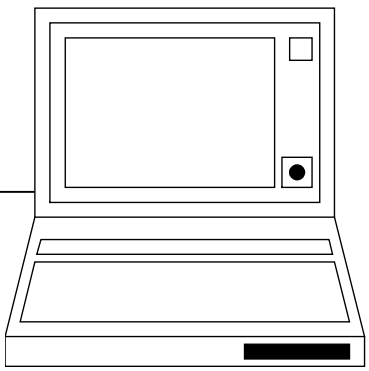
Programmable operation display (POD)
UG20

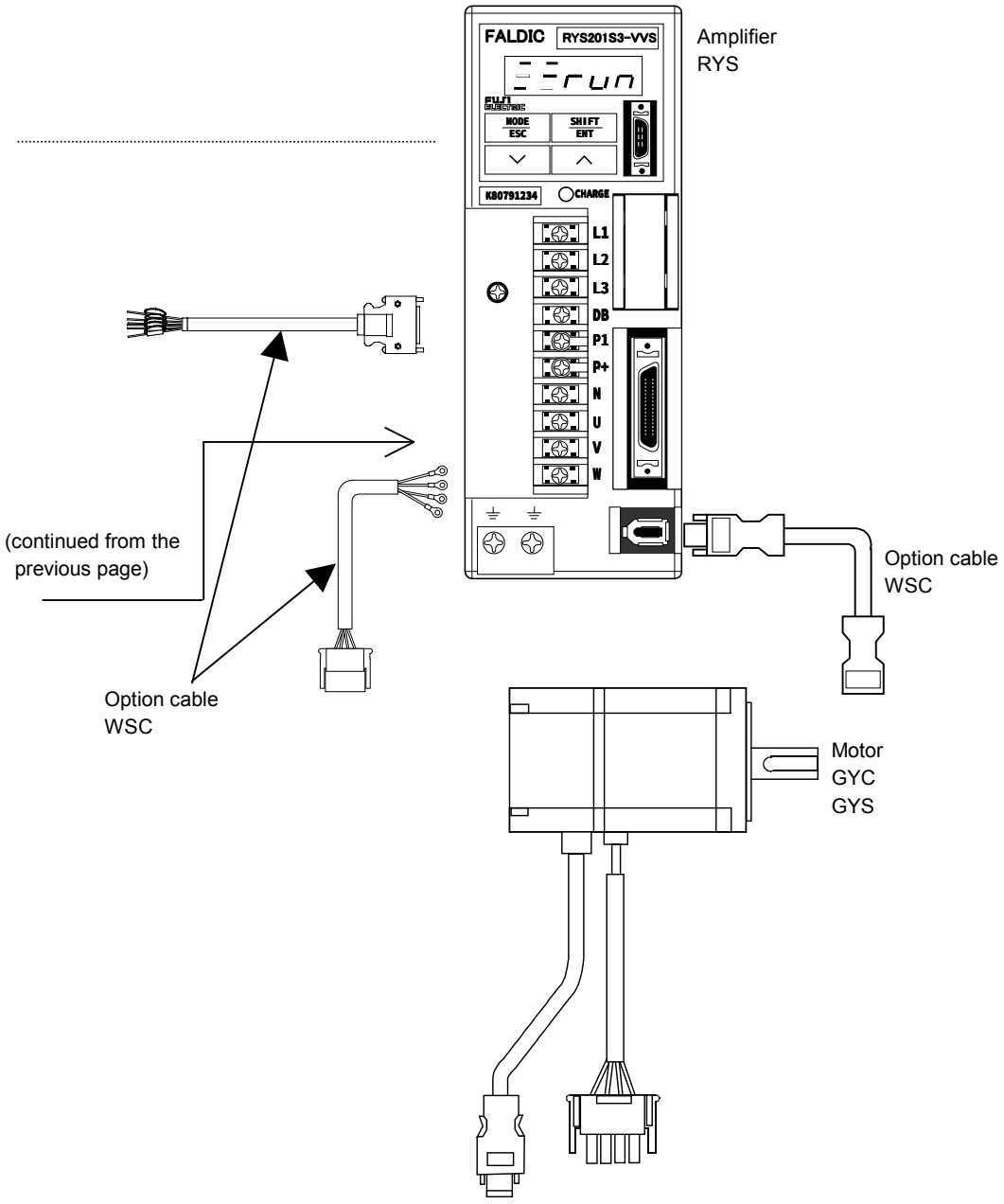
Programmable logic controller (PLC)
MICREX-SX
MICREX-F
FLEX-PC



(continue to the next page)

General-purpose PC
[Programming support tool]
- D300win (MICREX-SX)
- Screen editor (UG)
- Servo-loader (FALDIC-α)




FALDIC
RYS201S3-VVS
MODE
ESC
SHIFT
ENT
CHARGE
L1
L2
L3
DB
P1
P+
N
U
V
W
Amplifier
RYS
(continued from the
previous page)
Option cable
WSC
Option cable
WSC
Motor
GYC
GYS

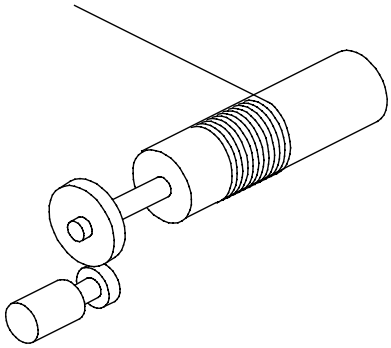
1.3 Functions

The FALDIC-α series has 3 types of control function for particular applications.

(1) RYS-V type : Pulse train/speed control (velocity)

Maximum input frequency 500[kHz]
Rotates according to pulse train from host control equipment, or speed command from encoder or variable resistor.
The host interface has :

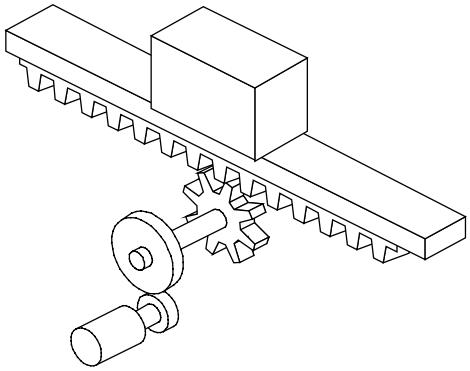
- DI/DO speed (minimum DI/DO),
- SX bus,
- Open network, etc.



(2) RYS-L type：Linear positioning function (linear motion)

Maximum command value ± 79,999,999
The amplifier incorporates a linear positioning function.
A linear positioning system can be used by ball-screw, rack and pinion or other mechanical equipment systems.
It is usable for 99-point of positioning data, current (present) position output, immediate positioning, M-code output and other functions.
The host interface has：

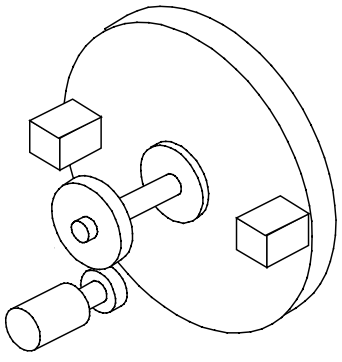
- DI/DO position (expanded DI/DO),
- SX bus,
- Open network, etc.



(3) RYS-R type：Rotational indexing function (rotation)

Maximum indexing number 4095
The amplifier incorporates a rotational indexing function.
A rotational indexing system for ATC, tool magazine, loader/unloader, etc. can be used.
The rotational indexing function is usable for shorted route control, one-point halt, single-direction infinite rotation, etc.
The host interface has：

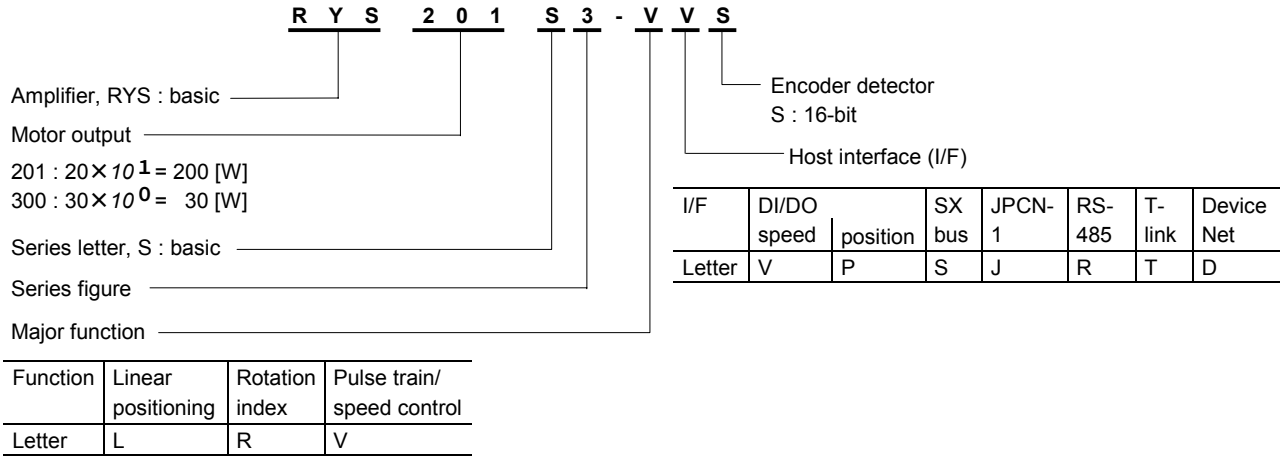
- DI/DO position (expanded DI/DO),
- SX bus,
- Open network, etc.



1.4 Explanation of model type

Model type of amplifier and motor is expressed with a combination of figures and letters :

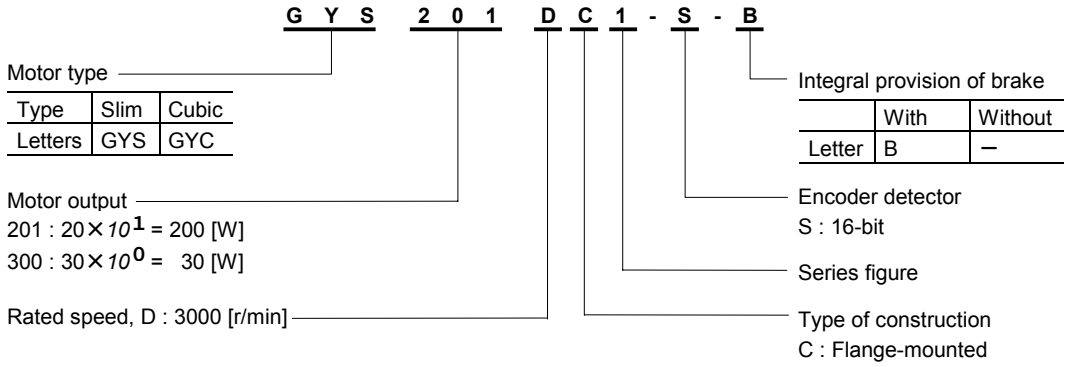
(a) Amplifier



I/F	DI/DO speed	DI/DO position	SX bus	JPCN-1	RS-485	T-link	Device Net
Letter	V	P	S	J	R	T	D

Function	Linear positioning	Rotation index	Pulse train/ speed control
Letter	L	R	V

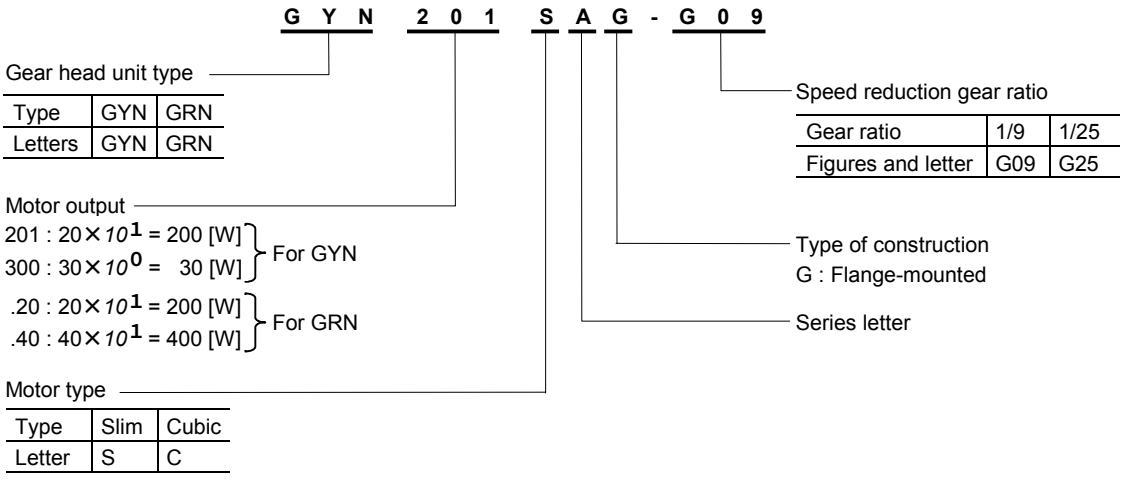
(b) GYS/GYC type motor



Type	Slim	Cubic
Letters	GYS	GYC

	With	Without
Letter	B	—

(c) Gear head unit



Type	GYN	GRN
Letters	GYN	GRN

Gear ratio	1/9	1/25
Figures and letter	G09	G25

Type	Slim	Cubic
Letter	S	C

2. SPECIFICATIONS

2.1 Motor

(1) Cubic type motor (0.1 to 5 [kW])

(a) Basic design

(i) 0.1 to 1.5 [kW]

Type GYC□□□DC1-S		101	201	401	751	102	152
Rated output [kW]		0.1	0.2	0.4	0.75	1	1.5
Rated torque (*4) [N•m]		0.318	0.637	1.27	2.39	3.18	4.78
Speed [r/min]	Rated	3000					
	Max.	5000					
Breakdown (max.) torque (*3) [N•m]		0.955/1.43	1.91/2.87	3.82/5.73	7.17/10.7	9.55/12.7	14.3/19.1
Moment of inertia of motor rotor ($\times 10^{-3}$) J[kg•m^2]		0.00538	0.0216	0.0412	0.121	0.326	0.451
Current [A]	Rated	1.0	1.5	2.6	4.8	6.7	9.6
	Max. (*3)	3/4.5	4.5/6.8	7.8/11.8	14.4/21.6	20.1/26.8	28.8/38.4
Winding insulation class		B				F	
Operation duty type		Continuous					
Degree of enclosure protection		Totally enclosed, IP55 except for shaft sealing					
Electrical connection terminals	Motor power	With 0.3 m flexible leads and connectors				With cannon connectors	
	Encoder detector						
Temp. detection		Without providing					
Type of construction (mounting)		IMB5, IMV1, IMV3, flange-mounted					
Shaft extension		Cylindrical extension with key					
Final color for external non-machined surface		Munsell N1.5					
Encoder detector		16-bit serial encoder					
Vibration level, peak to peak amplitude		5 micrometers				10 micrometers (*1)	
Install location		For indoors, 1000[m] and below of site-altitude					
Ambient climatic conditions		Temperature : −10 to +40 [°C], humidity : 90 [%] RH max. (free from condensation)					
Acceleration vibration, acceptable (max.)		49 [m/s^2]				24.5 [m/s^2]	
Mass (weight) [kg]		0.75	1.3	1.9	3.5	5.7	7

(b) Additional data for motor with providing brake

(i) 0.1 to 1.5 [kW]

Type GYC□□□DC1-S-B	101	201	401	751	102	152
Rated output [kW]	0.1	0.2	0.4	0.75	1	1.5
Rated torque [N•m]	0.318	0.637	1.27	2.39	3.18	4.78
Braking torque [N•m]	0.318	1.27	1.27	2.39	17.0	17.0
Rated voltage DC [V]	24					
Attraction time [ms]	60	80	80	50	120	120
Release time [ms]	40	40	40	80	30	30
Brake input [W]	6.5	9	9	8.5	12	12
Mass (weight) [kg]	1	1.9	2.6	4.3	8.0	9.8

(c) Additional data for motor with providing speed reduction gear, gear head unit

(i) Motor with gear ratio 1/9

1) 0.1 to 1.5 [kW]

Type	GYN□□□CAG-G09	101	201	401	751	102	152
Actual speed reduction ratio		1/9					
Speed [r/min]	Rated	333.3					
	Max.	555.5					
Rated torque	[N•m]	2.45	4.9	9.8	18.1	25.5	38.3
Breakdown (max.) torque	[N•m]	7.35	14.7	29.4	54.4	76.5	115
Direction of motor rotation (*2)		CCW					
Backlash (max.)	[min]	40	30				
Mass (weight)	[kg]	0.72	2.1	2.1	3.8	7.8	7.8

(ii) Motor with gear ratio 1/25 or 1/15

1) 0.1 to 1.5 [kW]

Type	GYN□□□CAG-G25/G15	101	201	401	751	102	152
Actual speed reduction ratio		1/25				1/15	
Speed [r/min]	Rated	120				200	
	Max.	200				333.3	
Rated torque	[N•m]	6.37	12.7	25.5	48	39.2	57.8
Breakdown (max.) torque	[N•m]	19.1	38.2	76.4	144	117.6	173.4
Direction of motor rotation (*2)		CCW					
Backlash (max.)	[min]	40	30			30	30
Mass (weight)	[kg]	0.72	2.1	2.1	3.8	7.8	7.8

(*1) 15 micrometers for over the rated speed.

(*2) Direction of gear-output-shaft rotation is CCW (counter-clockwise), when motor shaft rotates forward(*).
The direction is viewed from a point facing the drive-end of motor.

(*3) Breakdown (max.) torque and maximum current values are selected in accordance with the following paired combination of amplifier and motor types.
Lower value/higher value：
When the same output [kW] rating of amplifier and motor/when amplifier size is one step larger than the motor frame No. size corresponding with amplifier.
Refer to 2.3.

(*4) Rated torque are continuous operating torque , on condition that motors are mounted heat sink which size are bellow table.

Motor type	Heat sink size [mm]
GYC101DC1-S	250 × 250 × 6
GYC201DC1-S	300 × 300 × 6
GYC401DC1-S	300 × 300 × 6
GYC751DC1-S	350 × 350 × 6
GYC102DC1-S	400 × 400 × 10
GYC152DC1-S	400 × 400 × 10

Note : (*) The direction of motor rotation (when viewed from a point facing the drive-end of motor) is designed according to Japanese standards:
- Forward direction : Counter-clockwise rotation (CCW)
- Reverse direction: Clockwise rotation (CW)

(1) Cubic type motor (0.1 to 5 [kW]) (cont'd)

(a) Basic design

(ii) 2 to 5 [kW]

Type GYC□□□DC1-S		202	302	402	502
Rated output [kW]		2	3	4	5
Rated torque (*4) [N•m]		6.37	—	—	—
Speed [r/min]	Rated	3000			
	Max.	5000			
Breakdown (max.) torque (*3) [N•m]		19.1	—	—	—
Moment of inertia of motor rotor ($\times 10^{-3}$) J[kg•m^2]		0.575	—	—	—
Current [A]	Rated	12.6	—	—	—
	Max. (*3)	37.8	—	—	—
Winding insulation class		F	—	—	—
Operation duty type		Continuous			
Degree of enclosure protection		Totally enclosed, IP55 except for shaft sealing			
Electrical connection terminals	Motor power	With cannon connectors			
	Encoder detector				
Temp. detection		Without providing			
Type of construction (mounting)		IMB5, IMV1, IMV3, flange-mounted			
Shaft extension		Cylindrical extension with key			
Final color for external non-machined surface		Munsell N1.5			
Encoder detector		16-bit serial encoder			
Vibration level, peak to peak amplitude		10 micrometers (*1)			
Install location		For indoors, 1000[m] and below of site-altitude			
Ambient climatic conditions		Temperature : −10 to +40 [**℃**], humidity : 90 [%] RH max. (free from condensation)			
Acceleration vibration, acceptable (max.)		24.5 [m/s^2]	—	—	—
Mass (weight) [kg]		8.2	—	—	—

(b) Additional data for motor with providing brake

(ii) 2 to 5 [kW]

Type GYC□□□DC1-S-B	202	302	402	502
Rated output [kW]	2	3	4	5
Rated torque [N•m]	6.37	—	—	—
Braking torque [N•m]	17.0	—	—	—
Rated voltage DC [V]	24			
Attraction time [ms]	120	—	—	—
Release time [ms]	30	—	—	—
Brake input [W]	12	—	—	—
Mass (weight) [kg]	11.0	—	—	—

(c) Additional data for motor with providing speed reduction gear, gear head unit

(i) Motor with gear ratio 1/9

2) 2 to 5 [kW]

Type GYN□□□CAG-G09		202	302	402	502
Actual speed reduction ratio		1/9			
Speed [r/min]	Rated	333.3			
	Max.	555.5			
Rated torque [N•m]		50.9	–	–	–
Breakdown (max.) torque [N•m]		152.0	–	–	–
Direction of motor rotation (*2)		CCW			
Backlash (max.) [min]		30	–	–	–
Mass (weight) [kg]		12.2	–	–	–

(ii) Motor with gear ratio 1/15

2) 2 to 5 [kW]

Type GYN□□□CAG-G15		202	302	402	502
Actual speed reduction ratio		1/15			
Speed [r/min]	Rated	200			
	Max.	333.3			
Rated torque [N•m]		77.4	–	–	–
Breakdown (max.) torque [N•m]		232.0	–	–	–
Direction of motor rotation (*2)		CCW			
Backlash (max.) [min]		30	–	–	–
Mass (weight) [kg]		12.2	–	–	–

(*1) 15 micrometers for over the rated speed.

(*2) Direction of gear-output-shaft rotation is CCW (counter-clockwise), when motor shaft rotates forward(*).
The direction is viewed from a point facing the drive-end of motor.

(*3) Breakdown (max.) torque and maximum current values are selected in accordance with the following paired combination of amplifier and motor types.
Lower value/higher value：
When the same output [kW] rating of amplifier and motor/when amplifier size is one step larger than the motor frame No. size corresponding with amplifier.
Refer to 2.3.

Refer to 2.3.

(*4) Rated torque are continuous operating torque , on condition that motors are mounted heat sink which size are bellow table.

Motor type	Heat sink size [mm]
GYC202DC1-S	400 × 400 × 10

(2) Slim type motor (0.03 to 5 [kW]) for 200 [V] class input voltage of amplifier

(a) Basic design

(i) 0.03 to 0.75 [kW]

Type GYS□□□DC1-S		300	500	101	201	401	751
Rated output [kW]		0.03	0.05	0.1	0.2	0.4	0.75
Rated torque (*4) [N•m]		0.095	0.159	0.318	0.637	1.27	2.39
Speed [r/min]	Rated	3000					
	Max.	5000					
Breakdown (max.) torque (*3) [N•m]		−	0.478	0.955	1.91/2.87	3.82/5.73	7.17/10.7
Moment of inertia of motor rotor ($\times 10^{-3}$) J[kg•m^2]		−	0.0034	0.00517	0.0137	0.0249	0.0861
Current [A]	Rated	−	0.93	0.9	1.5	2.6	4.8
	Max. (*3)	−	2.8	2.7	4.5/6.8	7.8/11.8	14.4/21.6
Winding insulation class		B					
Operation duty type		Continuous					
Degree of enclosure protection		Totally enclosed, IP55 except for shaft sealing					
Electrical connection terminals	Motor power	With 0.3 m flexible leads and connectors					
	Encoder detector						
Temp. detection		Without providing					
Type of construction (mounting)		IMB5, IMV1, IMV3, flange-mounted					
Shaft extension		Cylindrical extension with key					
Final color for external non-machined surface		Munsell N1.5					
Encoder detector		16-bit serial encoder					
Vibration level, peak to peak amplitude		5 micrometers					
Install location		For indoors, 1000[m] and below of site-altitude					
Ambient climatic conditions		Temperature : −10 to +40 [°C], humidity : 90 [%] RH max. (free from condensation)					
Acceleration vibration, acceptable (max.)		4.9 [m/s^2]					
Mass (weight) [kg]		−	0.45	0.55	1.2	1.8	3.4

(b) Additional data for motor with providing brake

(i) 0.03 to 0.75 [kW]

Type GYS□□□DC1-S-B	300	500	101	201	401	751
Rated output [kW]	0.03	0.05	0.1	0.2	0.4	0.75
Rated torque [N•m]	0.095	0.159	0.318	0.637	1.27	2.39
Braking torque [N•m]	0.34	0.34	0.34	1.27	1.27	2.45
Rated voltage DC [V]	24					
Attraction time [ms]	−	35	35	40	40	60
Release time [ms]	−	10	10	20	20	25
Brake input [W]	−	6.1	6.1	7.3	7.3	8.5
Mass (weight) [kg]	−	0.62	0.72	1.7	2.3	4.2

(c) Additional data for motor with providing speed reduction gear, gear head unit

(i) Motor with gear ratio 1/9

1) 0.03 to 0.75 [kW]

Type	□□□□□□SAG-G09	GYN			GRN.		GYN
		300	500	101	20	40	751
Actual speed reduction ratio		–	1/9				
Speed [r/min]	Rated	–	333.3				
	Max.	–	555.5				
Rated torque [N•m]		–	1.23	2.54	4.9	9.8	18.1
Breakdown (max.) torque [N•m]		–	3.68	7.36	14.7	29.4	54.3
Direction of motor rotation (*2)		–	CCW				
Backlash (max.) [min]		–	40		30		
Mass (weight) [kg]		–	0.7		2.1		3.8

(ii) Motor with gear ratio 1/25

1) 0.03 to 0.75 [kW]

Type	□□□□□□SAG-G25	GYN			GRN.		GYN
		300	500	101	20	40	751
Actual speed reduction ratio		–	1/25				
Speed [r/min]	Rated	–	120				
	Max.	–	200				
Rated torque [N•m]		–	3.19	6.37	12.7	25.5	48
Breakdown (max.) torque [N•m]		–	9.56	19.1	38.2	76.4	144
Direction of motor rotation (*2)		–	CCW				
Backlash (max.) [min]		–	40		30		
Mass (weight) [kg]		–	0.7		2.1		3.8

(*1) 15 micrometers for over the rated speed.

(*2) Direction of gear-output-shaft rotation is CCW (counter-clockwise), when motor shaft rotates forward(*).
The direction is viewed from a point facing the drive-end of motor.

(*3) Breakdown (max.) torque and maximum current values are selected in accordance with the following paired combination of amplifier and motor types.
Lower value/higher value：
When the same output [kW] rating of amplifier and motor/when amplifier size is one step larger than the motor frame No. size corresponding with amplifier.
Refer to 2.3.

(*4) Rated torque are continuous operating torque , on condition that motors are mounted heat sink which size are bellow table.

Motor type	Heat sink size [mm]
GYS500DC1-S8	200 × 200 × 6
GYS101DC1-S	200 × 200 × 6
GYS201DC1-S	250 × 250 × 6
GYS401DC1-S	250 × 250 × 6
GYS751DC1-S	300 × 300 × 6

(2) Slim type motor (0.03 to 5 [kW]) for 200 [V] class input voltage of amplifier (cont'd)

(a) Basic design

(ii) 1 to 5 [kW]

Type GYS□□□DC1-S		102	152	202	302	402	502
Rated output [kW]		1	1.5	2	3	4	5
Rated torque (*4) [N•m]		3.18	4.78	6.37	9.55	12.7	15.9
Speed [r/min]	Rated	3000					
	Max.	5000					
Breakdown (max.) torque (*3) [N•m]		9.55/12.7	14.3/19.1	19.1	28.7	38.2	47.8
Moment of inertia of motor rotor ($\times 10^{-3}$) J[kg•m^2]		0.174	0.238	0.302	0.873	1.12	1.37
Current [A]	Rated	7.1	9.6	12.6	18.5	24.5	30
	Max. (*3)	21.3/28.4	28.8/38.4	37.8	55.5	73.5	90
Winding insulation class		F					
Operation duty type		Continuous					
Degree of enclosure protection		Totally enclosed, IP55 except for shaft sealing					
Electrical connection terminals	Motor power	With cannon connectors					
	Encoder detector						
Temp. detection		Without providing					
Type of construction (mounting)		IMB5, IMV1, IMV3, flange-mounted					
Shaft extension		Cylindrical extension with key					
Final color for external non-machined surface		Munsell N1.5					
Encoder detector		16-bit serial encoder					
Vibration level, peak to peak amplitude		10 micrometers (*1)					
Install location		For indoors, 1000[m] and below of site-altitude					
Ambient climatic conditions		Temperature : −10 to +40 [°C], humidity : 90 [%] RH max. (free from condensation)					
Acceleration vibration, acceptable (max.)		24.5 [m/s^2]					
Mass (weight) [kg]		4.4	5.2	6.3	11	13.5	16

(b) Additional data for motor with providing brake

(ii) 1 to 5 [kW]

Type GYS□□□DC1-S-B	102	152	202	302	402	502
Rated output [kW]	1	1.5	2	3	4	5
Rated torque [N•m]	3.18	4.78	6.37	9.55	12.7	15.9
Braking torque [N•m]	6.86	6.86	17	17	17	17
Rated voltage DC [V]	24					
Attraction time [ms]	60		120			
Release time [ms]	10		30			
Brake input [W]	17		12			
Mass (weight) [kg]	5.9	6.8	7.9	13.0	15.5	18.0

(c) Additional data for motor with providing speed reduction gear, gear head unit

(ii) Motor with gear ratio 1/9

2) 1 to 5 [kW]

Type	GYN□□□SAG-G09	102	152	202	302	402	502
Actual speed reduction ratio		1/9					
Speed [r/min]	Rated	333.3					
	Max.	555.5					
Rated torque	[N•m]	25.4	38.2	50.9	–	–	–
Breakdown (max.) torque	[N•m]	74.4	114	152	–	–	–
Direction of motor rotation (*2)		CCW					
Backlash (max.)	[min]	30			–	–	–
Mass (weight)	[kg]	7.8			–	–	–

(ii) Motor with gear ratio 1/15

2) 1 to 5 [kW]

Type	GYN□□□SAG-G15	102	152	202	302	402	502
Actual speed reduction ratio		1/15					
Speed [r/min]	Rated	200.0					
	Max.	333.3					
Rated torque	[N•m]	39.2	57.8	77.4	–	–	–
Breakdown (max.) torque	[N•m]	117	173	232	–	–	–
Direction of motor rotation (*2)		CCW					
Backlash (max.)	[min]	30			–	–	–
Mass (weight)	[kg]	7.8			–	–	–

(*1) 15 micrometers for over the rated speed.

(*2) Direction of gear-output-shaft rotation is CCW (counter-clockwise), when motor shaft rotates forward(*).
The direction is viewed from a point facing the drive-end of motor.

(*3) Breakdown (max.) torque and maximum current values are selected in accordance with the following paired combination of amplifier and motor types.
Lower value/higher value：
When the same output [kW] rating of amplifier and motor/when amplifier size is one step larger than the motor frame No. size corresponding with amplifier.
Refer to 2.3.

(*4) Rated torque are continuous operating torque , on condition that motors are mounted heat sink which size are bellow table.

Motor type	Heat sink size [mm]
GYS102DC1-S	350 × 350 × 6
GYS152DC1-S	350 × 350 × 6
GYS202DC1-S	350 × 350 × 6
GYS302DC1-S	400 × 400 × 10
GYS402DC1-S	400 × 400 × 10
GYS402DC1-S	400 × 400 × 10

(3) Slim type motor (0.05 to 0.2 [kW]) for 100 [V] class input voltage of amplifier

(a) Basic design

Type	GYS□□□DC1-S	500	101	201
Rated output [kW]		0.05	0.1	0.2
Rated torque (*4) [N•m]		0.159	0.318	0.637
Speed [r/min]	Rated	3000		
	Max.	5000		
Breakdown (max.) torque (*3) [N•m]		0.478	0.955	1.91/2.87
Moment of inertia of motor rotor ($\times 10^{-3}$) J[kg•m^2]		0.00341	0.00517	0.0137
Current [A]	Rated	0.85	1.5	2.7
	Max. (*3)	2.55	4.5	8.1/12.1
Winding insulation class		B		
Operation duty type		Continuous		
Degree of enclosure protection		Totally enclosed, IP55 except for shaft sealing		
Electrical connection terminals	Motor power	With 0.3 m flexible leads and connectors		
	Encoder detector			
Temp. detection		Without providing		
Type of construction (mounting)		IMB5, IMV1, IMV3, flange-mounted		
Shaft extension		Cylindrical extension with key		
Final color for external non-machined surface		Munsell N1.5		
Encoder detector		16-bit serial encoder		
Vibration level, peak to peak amplitude		5 micrometers		
Install location		For indoors, 1000[m] and below of site-altitude		
Ambient climatic conditions		Temperature : −10 to +40 [°C], humidity : 90 [%] RH max. (free from condensation)		
Acceleration vibration, acceptable (max.)		4.9 [m/s^2]		
Mass (weight) [kg]		0.45	0.55	1.2

(*1) 15 micrometers for over the rated speed.

(*2) Direction of gear-output-shaft rotation is CCW (counter-clockwise), when motor shaft rotates forward(*).
The direction is viewed from a point facing the drive-end of motor.

(*3) Breakdown (max.) torque and maximum current values are selected in accordance with the following paired combination of amplifier and motor types.
Lower value/higher value：
When the same output [kW] rating of amplifier and motor/when amplifier size is one step larger than the motor frame No. size corresponding with amplifier.
Refer to 2.3.

(*4) Rated torque are continuous operating torque , on condition that motors are mounted heat sink which size are bellow table.

Motor type	Heat sink size [mm]
GYS500DC1-S8	200 × 200 × 6
GYS101DC1-S6	200 × 200 × 6
GYS201DC1-S6	250 × 250 × 6

2.2 Amplifier

(1) Basic specification

(a) 0.03 to 0.75 [kW] for 200 [V] input voltage of amplifier

Amplifier type RYS□□□S3-VVS			300	500	101	201	401	751
Applicable motor output (*1) [kW]			0.03	0.05	0.1	0.2	0.4	0.75
Input	Phase, freq.		3-phase for power supply, single-phase for control, 50/60 [Hz]					
	Voltage		200/200-220-230 [V], +10 to −15[%]					
Control data	System		Sinusoidal PWM current control (all digital)					
	Carrier freq. [kHz]		10					
	Feedback		16-bit serial encoder (one-revolution resolution 16-bit, multi-revolution 16-bit)					
	Speed control accuracy	Loading	±1 [r/min] max.	for 0 to 100 [%] deviation				
		Supply volt.		For −10 to +10 [%] fluctuation				
		Amb. temp.	±15 [r/min] max. for −10 to +55 [°C] variation (at analog volt. input)					
	Speed range		1 : 5000 (at rated load)					
	Freq. response		500 [Hz] (at $J_L = J_M$ (*2))					
	Load inertia. max.		100 times of the motor rotor inertia, permissible					
	Overload capability		300 [%] for 3 [sec], 450 [%] for 1.5 [sec]					
Function	Braking		Regenerating, dynamic with external braking resistor					
	Protection		OC (output overcurrent), OS (overspeed), L_V (low voltage, undervoltage), H_V (high voltage, overvoltage), Et (encoder trouble), Ct (circuit trouble, amplifier trouble), dE (data error, memory error), CE (combination error), rH_2 (resistor heat 2), EC (encoder communication error), CtE (cont (control signal) error), OL (motor overload), rH (resistor heat, braking (OB) resistor overheat), OF (over flow, deviation excessive), AH (amp. heat, amplifier overheat), EH (encoder heat, encoder overheat), AL (absolute data lost), AF (absolute data over flow), SE (system error)					
	Display, setting		CHARGE (red), 7-segment LED with 5-digit and 4 operation keys					
Ambient condition	Installation place		For indoors, 1000 [m] and below of site-altitude, under clean atmosphere, no explosive hazardous gas and vapour is existing. In the case of compliance with the European standard : Pollution degree = 2, Over voltage category = **II**					
	Temp., humidity		−10 to +55 [°C], 90 [%] RH max. (free from condensation)					
	Vibration / shock		4.9 [m/s^2] / 19.6 [m/s^2] acceleration, acceptable (max.)					
Others			DC reactor terminals (P1, P+) for higher harmonics suppression. UL/cUL (compliance with UL508), European standards (compliance with EN50178)					
Mass (weight) [kg]			0.9				1.2	1.5

(*1) Use amplifier and motor as a specified pair of types given in the table of 9.3 (3) (d).
If the RYS401 (0.4 [kW]) type amplifier and GYS201 (0.2 [kW]) motor (which is a step smaller than the optimum combination) is combined as a pair, allowable breakdown (max.) torque of 0.2 [kW] motor can be obtained as 450% (in the case of the breakdown torque of the motor itself is 450% and above) of the rated torque.
Furthermore, in this case, other data are as follows :
• The moment of load inertia after conversion into motor shaft extension is at most 30 times the moment of inertia of motor rotor.
• Acceleration/deceleration time up to rated speed is 2 [ms] or more.
• The motor shaft extension is directly mechanically connected and is subjected to no external radial or thrust force.

(*2) Moment of inertia
J_L : Moment of load inertia after conversion into motor shaft extension
J_M : Moment of inertia of motor rotor

(b) 1 to 5 [kW] for 200 [V] input voltage of amplifier

Amplifier type RYS□□□S3-VVS			102	152	202	302	402	502
Applicable motor output (*1) [kW]			1	1.5	2	3	4	5
Input	Phase, freq.		3-phase for power supply, single-phase for control, 50/60 [Hz]					
	Voltage		200/200-220-230 [V], +10 to −15[%]					
Control data	System		Sinusoidal PWM current control (all digital)					
	Carrier freq. [kHz]		10		5			
	Feedback		16-bit serial encoder (one-revolution resolution 16-bit, multi-revolution 16-bit)					
	Speed control accuracy	Loading	±1 [r/min] max.	for 0 to 100 [%] deviation				
		Supply volt.		For −10 to +10 [%] fluctuation				
		Amb. temp.	±15 [r/min] max. for −10 to +55 [°C] variation (at analog volt. input)					
	Speed range		1 : 5000 (at rated load)					
	Freq. response		500 [Hz] (at $J_L = J_M$ (*2))					
	Load inertia. max.		100 times of the motor rotor inertia, permissible					
	Overload capability		300 [%] for 3 [sec], 450 [%] for 1.5 [sec]					
Function	Braking		Regenerating, dynamic with external braking resistor					
	Protection		OC (output overcurrent), OS (overspeed), L_V (low voltage, undervoltage), H_V (high voltage, overvoltage), Et (encoder trouble), Ct (circuit trouble, amplifier trouble), dE (data error, memory error), CE (combination error), rH_2 (resistor heat 2), EC (encoder communication error), CtE (cont (control signal) error), OL (motor overload), rH (resistor heat, braking (OB) resistor overheat), OF (over flow, deviation excessive), AH (amp. heat, amplifier overheat), EH (encoder heat, encoder overheat), AL (absolute data lost), AF (absolute data over flow) , SE (system error)					
	Display, setting		CHARGE (red), 7-segment LED with 5-digit and 4 operation keys					
Ambient condition	Installation place		For indoors, 1000 [m] and below of site-altitude, under clean atmosphere, no explosive hazardous gas and vapour is existing. In the case of compliance with the European standard : Pollution degree = 2, Over voltage category = **II**					
	Temp., humidity		−10 to +55 [°C], 90 [%] RH max. (free from condensation)					
	Vibration / shock		4.9 [m/s^2] / 19.6 [m/s^2] acceleration, acceptable (max.)					
Others			DC reactor terminals (P1, P+) for higher harmonics suppression. UL/cUL (compliance with UL508), European standards (compliance with EN50178)					
Mass (weight) [kg]			2		−			

(*1) (*2) } See footnote of (a).

(c) 0.05 to 0.2 [kW] for 100 [V] class input voltage of amplifier

Amplifier type RYS□□□S3-VVS6			500	101	201
Applicable motor output (*1) [kW]			0.05	0.1	0.2
Input	Phase, freq.		Single-phase for power supply, single-phase for control, 50/60 [Hz]		
	Voltage		100 to 115 [V], +10 to −15[%]		
Control data	System		Sinusoidal PWM current control (all digital)		
	Carrier freq. [kHz]		10		
	Feedback		16-bit serial encoder (one-revolution resolution 16-bit, multi-revolution 16-bit)		
	Speed control accuracy	Loading	±1 [r/min] max.	for 0 to 100 [%] deviation	
		Supply volt.		For −10 to +10 [%] fluctuation	
		Amb. temp.	±15 [r/min] max. for −10 to +55 [°C] variation (at analog volt. input)		
	Speed range		1 : 5000 (at rated load)		
	Freq. response		500 [Hz] (at $J_L = J_M$ (*2))		
	Load inertia. max.		100 times of the motor rotor inertia, permissible		
	Overload capability		300 [%] for 3 [sec], 450 [%] for 1.5 [sec]		
Function	Braking		Regenerating, dynamic with external braking resistor		
	Protection		OC (output overcurrent), OS (overspeed), L_V (low voltage, undervoltage), H_V (high voltage, overvoltage), Et (encoder trouble), Ct (circuit trouble, amplifier trouble), dE (data error, memory error), CE (combination error), rH_2 (resistor heat 2), EC (encoder communication error), CtE (cont (control signal) error), OL (motor overload), rH (resistor heat, braking (OB) resistor overheat), OF (over flow, deviation excessive), AH (amp. heat, amplifier overheat), EH (encoder heat, encoder overheat), AL (absolute data lost), AF (absolute data over flow) , SE (system error)		
	Display, setting		CHARGE (red), 7-segment LED with 5-digit and 4 operation keys		
Ambient condition	Installation place		For indoors, 1000 [m] and below of site-altitude, under clean atmosphere, no explosive hazardous gas and vapour is existing. In the case of compliance with the European standard : Pollution degree = 2, Over voltage category = **II**		
	Temp., humidity		−10 to +55 [°C], 90 [%] RH max. (free from condensation)		
	Vibration / shock		4.9 [m/s^2] / 19.6 [m/s^2] acceleration, acceptable (max.)		
Others			DC reactor terminals (P1, P+) for higher harmonics suppression. UL/cUL (compliance with UL508), European standards (compliance with EN50178)		
Mass (weight) [kg]			0.9	1.2	

(*1)
(*2) } See footnote of (a).

(2) RYS□□□S3-VVS type amplifier, basic design

Signal name		Function	Terminal symbol
Pulse train	Input	Freq. 500 [kHz] max. (differential input)	CA, *CA CB, *CB
	Form	(1) Command pulse and code, (2) Forward and reverse pulse, (3) Two 90° phase-different signal	
Freq. dividing output	Output	Freq. 500 [kHz] max. (differential output)	FA, *FA FB, *FB FZ, *FZ
	Form	Two 90° phase-different signal	
	Pulse	16 to 16384 [pulse/rev.] (in increment of 1)	
Speed command	Power supply	+10 ±0.4 [V] (output current 30 [mA] max.)	P10
	Input	±10 [V] (20 kΩ input impedance)	NREF
Torque command input			TREF
Monitor output 1/2		For analog-meter (two/one-way deflection). (1) Speed command, (2) Speed feedback, (3) Torque command, (4) Position deviation	MON1 MON2
Power supply for I/F		+24 [V] DC, 300 [mA] (supplied from external)	P24, M24
Control input		+24 [V] DC, 10 [mA] (one-point) source input External control input terminals	CONT1 to CONT8
OUT output		+30 [V] DC, 50 [mA] max. sink output External control output terminals	OUT1 to OUT5
External backup		Input terminals of backup power supply from external to encoder	BAT+, BAT−
Control function			
Control form		Position, speed and torque controls (selectable with control input signal)	
Position control		Pulse train, origin return, interrupt positioning	
Origin setting		LS (origin limit switch) and Z-phase, position preset	
Speed control		Analog voltage, multistep speed	
Torque control		Analog voltage	
Others		Override, brake timing output etc.	

(3) RYS□□□S3-VSS type amplifier, SX type design

Signal name		Function	Terminal symbol
SX bus		−	(IN, OUT)
Freq. dividing output	Output	Freq. 500 [kHz] max. (differential output)	FA, *FA FB, *FB FZ, *FZ
	Form	Two 90° phase-different signal	
	Pulse	16 to 16384 [pulse/rev.] (in increment of 1)	
Monitor output 1/2		For analog-meter (two/one-way deflection). (1) Speed command, (2) Speed feedback, (3) Torque command, (4) Position deviation	MON1 MON2
Power supply for I/F		+24 [V] DC, 300 [mA] (supplied from external)	P24, M24
Control input		+24 [V] DC, 10 [mA] (one-point) source input External control input terminals	CONT1 to CONT5
OUT output		+30 [V] DC, 50 [mA] max. sink output External control output terminals	OUT1 to OUT2
External backup		Input terminals of backup power supply from external to encoder	BAT+, BAT−
Control function		MICREX-SX FB	

(4) Optional cables, connection kits, battery and external braking resistors

Refer to 4.1 (3).

2.3 Torque-speed data

Shown below are the torque characteristic with each motor and amplifier combination.

(a) Within the range of "(A) Acceleration/deceleration area 1" and "(B) Acceleration/deceleration area 2" are used for accel./decel. (*) the motor.

(i) **(A) Acceleration/deceleration area 1** : Output torque is available at accel./decel. In case of the same output [kW] rating of the amplifier and motor combination.

(ii) **(B) Acceleration/deceleration area 2** : Output torque is available at accel./decel. When the amplifier size is one step larger than the motor frame No. size corresponding with the amplifier. Refer to 9.3 (3) (d).

(iii) In the case of (A) and (B), a torque higher than rated cannot be outputted continuously.

(b) Within the range of "**(C) Continuous operation area**", the motor can continuously be operated (at rated speed or lower). Above the rated speed, the rated torque cannot be outputted continuously.

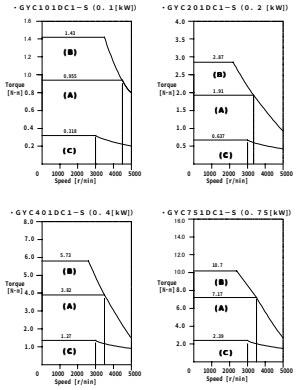
(c) The overload detecting time (guidepost) is as follows.

Output torque [%]	100 (rated torque)	125	150	200	300	450
Overload detecting time approx. [sec]	Continuous operation is acceptable.	35	18	9	3	1.5

Before tripping by overload, an early warning signal can be outputted. Refer to 5.5.6.

(*) Accel. : Accelerating or acceleration
Decel. : Decelerating or deceleration

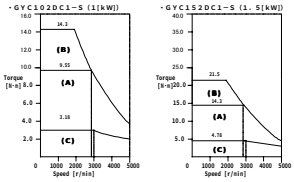
(1) GYC motor



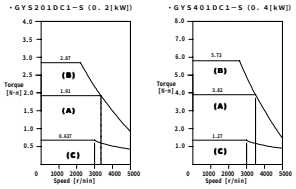
(A) Acceleration/deceleration area 1

(B) Acceleration/deceleration area 2

(C) Continuous operation area



(2) GYS motor

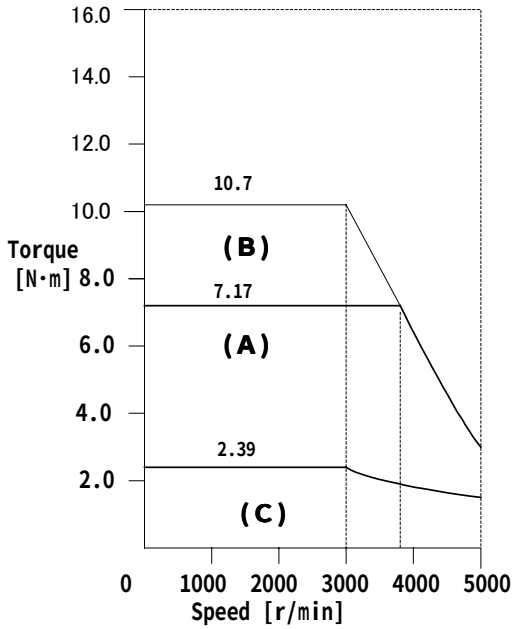


(A) Acceleration/deceleration area 1

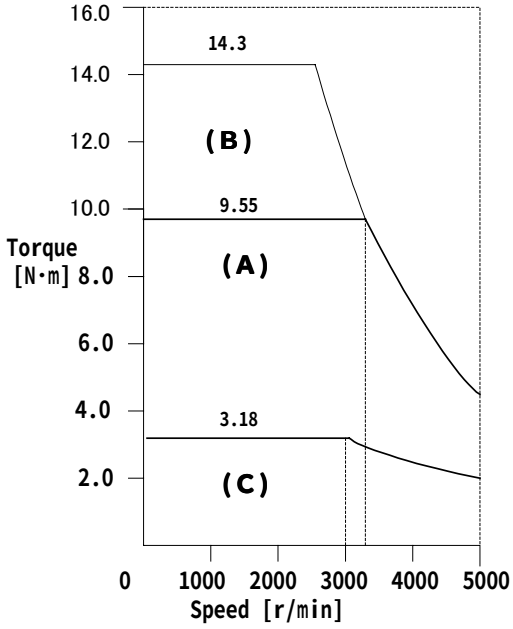
(B) Acceleration/deceleration area 2

(C) Continuous operation area

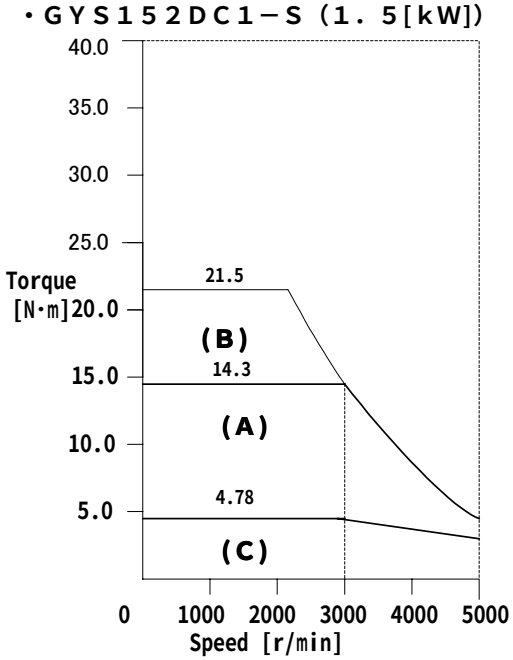
・GYS751DC1－S（0．75[kW])



・GYS102DC1－S（1[kW])



・GYS152DC1－S（1．5[kW])



(A) Acceleration/deceleration area 1
(B) Acceleration/deceleration area 2
(C) Continuous operation area

3. INSTALLATION

3.1 Motor

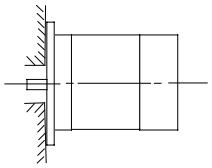
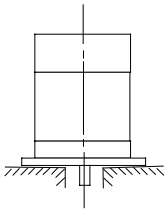
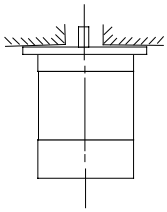
(1) Installation environment

Temperature : −10 to + 40℃

Humidity : 90%RH max. (free from condensation)

(2) Type of construction (mounting)

Each motor allows the following methods of mounting.

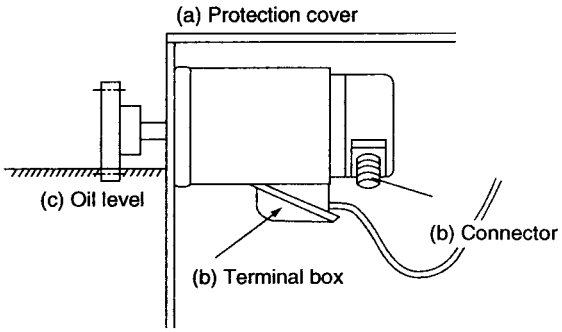
Flange-mounted		
IMB5	IMV1	IMV3
		

(3) No-oil or no-water-drop protection

In case oil or water drop splashes the motor, the motor should be protected with a suitable cover (example : “a” of figure), which will not close ventilation, and the motor should be mounted so that the terminal box, connector or connection cable should also be protected (“b” of figure).

Do not allow oil or water drop to enter the inside of motor through the shaft extension.

For mechanical connection with an oil-lubricated reduction gear unit, its oil level should always be lower than in the motor bearing-housing (“c” of figure).

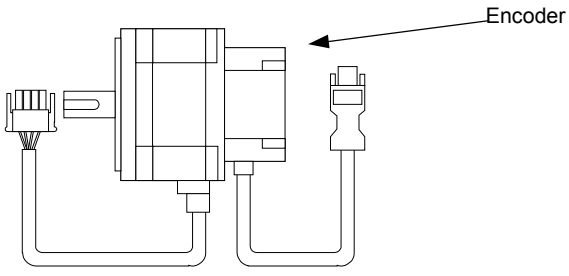


(4) Rotary encoder detector

・ An encoder is used for detecting the position, speed of motor.

・ The motor and encoder have been factory-aligned in the circumferential direction at the time of assembly.

Therefore, the mounting position of the encoder should not be changed.



DO NOT DISASSEMBLE

Do not disassemble the motor unit. There is a risk that the machine can be broken due to abnormal operation.

CAUTION

Never give shocks to the encoder, motor and shaft extension, for example by hitting them with a hammer etc. In addition, be careful not to apply a load to the encoder during installation.

(5) Mechanical coupling

(a) Motor with flexible coupling

(i) Provide a reference mark on the peripheral surface of the coupling.

(ii) Connect both halves of the coupling with a single-bolt, in order to allow them to rotate together.

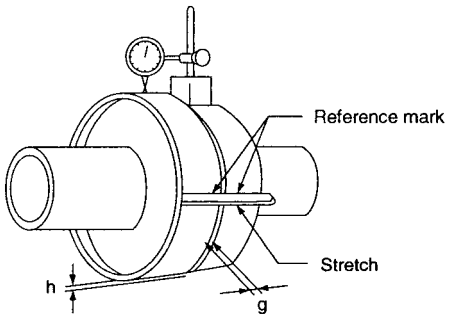
(iii) Attach a dial gauge securely to one half of the coupling so that its feeler rests lightly on the other half.

(iv) Bring the reference mark to the top of the coupling and, then, measure dimension “g” with a thickness gauge and dimension “h” with a dial gauge.

(v) Turn the coupling and carry out the measurements described in (iv) above at 90 ° intervals until the reference mark appears at the top again.

(vi) Conduct adjustments so that the difference between the maximum and the minimum measurements is held to within 0.03mm. Be sure to bolt the motor and driven machine to the base prior to marking adjustments.

If a coupling is too small to allow a dial gauge to be attached to it, attach a stretch (rectangular steel bar) to one half of the coupling and measure the clearance value of the stretch and the surface of the other half of the coupling.



(b) Motor for extemal gear drive

If a gear drive is used, the shafts of both machines should be exactly parallel, to avoid subjecting the gear teeth to an excessive load at the contact points.

(c) Motor for timing belt connection

When using a timing belt, obtain necessary data from the belt supplier, and contact Fuji.

(6) Power supply to motor

CAUTION

Do not connect commercial power supply to the motor terminals.

(7) Dimensional tolerances

Tolerances of motor at the time of shipment from the factory are as follows.

The maximum and minimum values throgh one slow revolution of the shaft are then read on the indicator.

The difference between the readings will not exceed the values given in the following table.

(a) Shaft extension run-out

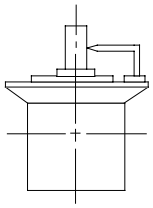
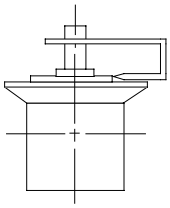
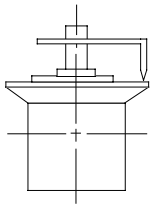
The probe of the indicator is attached to the shaft midway along its length.

(b) Concentricity of spigot and the shaft for flange-mounted motor

The indicator is fitted rigidly on the shaft extension.

(c) Perpendicularity of mounting face of flange to shaft for flange-mounted motor
The indicator is fitted rigidly on the shaft extension.

[unit : mm]

(a)	(b)	(c)
Flange-mounted	Flange-mounted	Flange-mounted
		
0.02	0.06	0.08

(7) Stress of Cable
Strain relief and mechanical protection for the connection cables and connector has to be provide in final installation.

3.2 Amplifier
(1) Installation environment
(a) Ambient climatic conditions

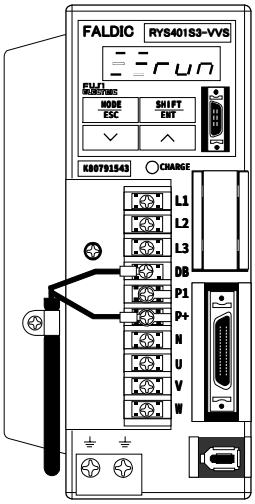
Ambient conditions		Amplifier	Motor
In transportation and storage (*1)	Temperature	−20 to +80[℃]	−10 to +70[℃]
	Humidity	90[%] RH max.	
	Air pressure	86 to 106 [kPa]	
Control rooms and equipment rooms (*1)	Temperature	−10 to +55[℃]	−10 to +40[℃]
	Humidity	90[%] RH max.	
	Air pressure	86 to 106 [kPa]	
Install location (*2)		For indoors	

(*1) Free from condensation, no condensation, no formation of ice
(*2) Site-altitude should be 1000[m] and below.

(b) Avoid use under the following conditions.
(i) Location near oil, steam or corrosive gas
(ii) Location where strong electric or magnetic field exists
(iii) Accommodation in the same panel together with high voltage (2[kV] or higher) equipment
(iv) Sharing of the same power supply with the equipment which generates large noise.
(v) In vacuum
(vi) In explosive atmosphere
(vii) Under acceleration vibration

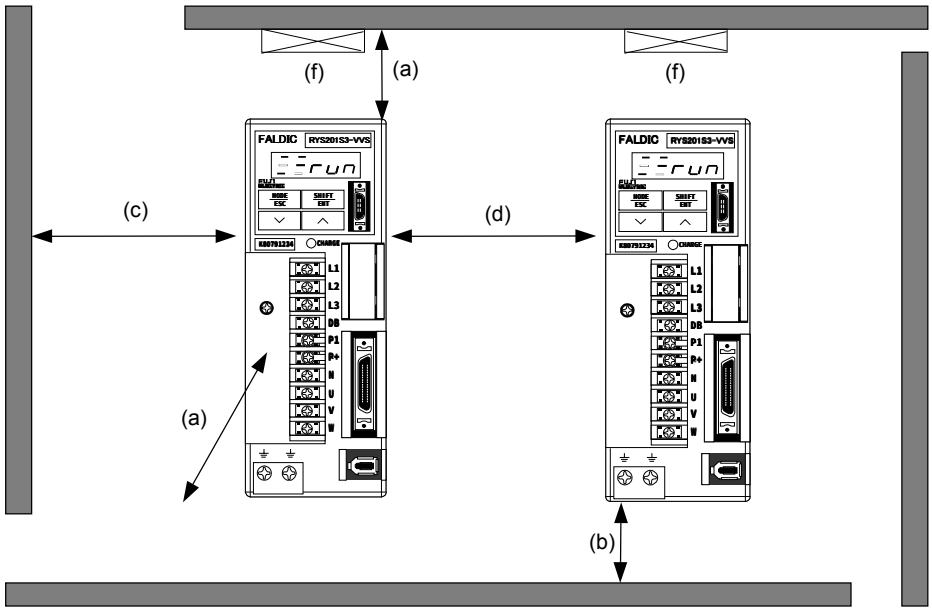
(2) Mounting

(a) Amplifier should be mounted upright so that character "FALDIC" on the front panel can be seen horizontal.



(b) Avoid overheating of the amplifier

When accommodating multiple amplifiers in the same panel, they should be installed side by side with the sufficient clearance distances below secured.



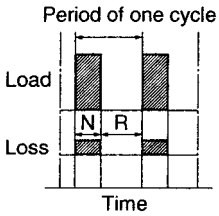
[unit : mm (min.)]

(a) Upper and front	(b) Lower	(c) Left and right	(d) Between amplifiers
50	40	10	(i) 5 (ii) If the clearance is 4.9 [mm] and below, operation duty type of amplifier is reduced to 80%ED (✳), instead of continuous duty.

(f) Fan mounting

(∗) 80%ED : Cyclic duration factor operating duty is 80% : Intermittent periodic duty
The factor is difined as

$$\frac{\text{N (operation under rated conditions)}}{\text{N (operation under rated conditions) + R(at rest and de-energized)}} \times 100\ [\%]$$



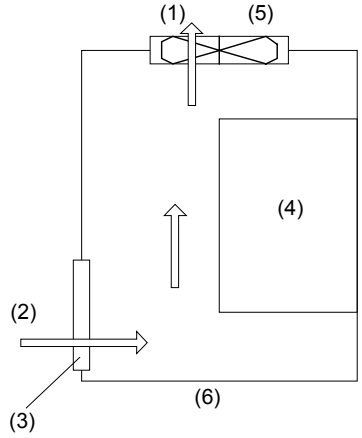
Intermittent periodic duty involve alternating operating and loading times and pauses during which a motor (or amplifier) is at a standstill (or de-energized).
The loading and standstill times of one cycle, which has a duration of 10 minutes, are so short that the steady-state temperature cannot be attained. The cycle duration factor is the ratio between the operating or loading time and cycle duration.

An ambient temperature of the amplifier must be kept at 55 [**℃**] maximum, at different points around the amplifier, at a distance of 50[mm] maximum from the amplifier.
To keep the above mentioned ambient temperature of amplifier, the amplifier should be mounted in a forced-fan-ventilated panel or equivalent cooling conditions.
Avoid the excessive temperature rise due to heat losses by the regenerating braking resistor etc. in the panel.

(c) Forced-fan-ventilated panel
Provide an exhaust port and an air intake (suction) port in the panel, and mount a fan to the exhaust port to forced ventilate the internal air. Also, mount an air filter to the air intake port in order to maintain an environment better than IEC664 pollution degree 2 (*) in the panel. For the air volume and the opening size of the air intake, refer to the following table.
Refer to technical document No. MHT221f (Engl.), chapter 2.2
(*) Pollution degree 2: An environment in which only non-conductive pollution is generated, except for occasional occurrence of temporary conductivity due to condensation.

Amplifier output	[kW]	0.05, 0.1	0.2	0.4	0.75	1
Air volume of forced-ventilation-fan	[m^3/min]	0.06	0.11	0.23	0.43	0.57
Opening size of air intake (suction air)	[m^2]	0.0009	0.0019	0.0038	0.0071	0.0095

Amplifier output	[kW]	1.5	2	3	4	5
Air volume of forced-ventilation-fan	[m^3/min]	0.85	1.14	1.7	2.27	2.84
Opening size of air intake (suction air)	[m^2]	0.0142	0.0189	0.0284	0.0378	0.0473

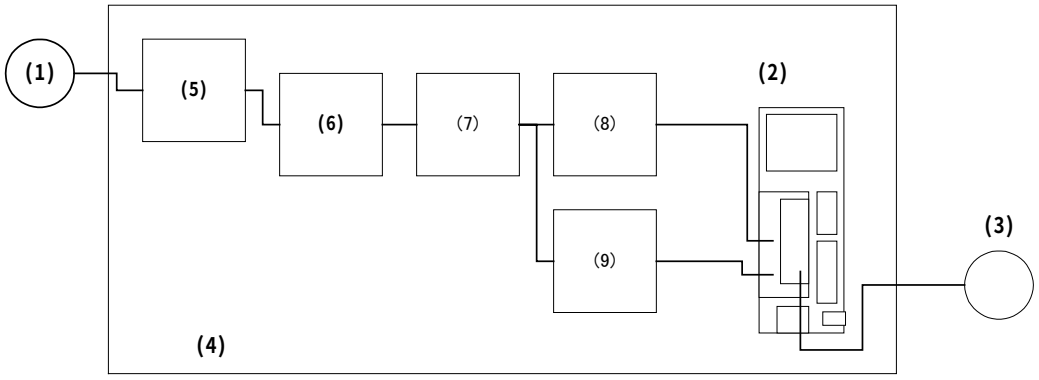


(1) Exhaust air
(2) Air intake, suction air
(3) Air filter
(4) Amplifier
(5) Fan
(6) Forced-fan-ventilated panel

Compliance with EC directives

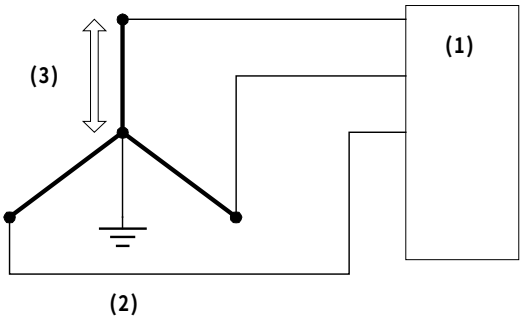
• This product should be installed in the electrical cabinet.
• Servo driver is used under the "pollution degree 2" environment as specified in IEC664.

(3) Peripheral equipment



(1) Power supply source
(2) Amplifier
(3) Motor
(4) Control panel
(5) Reinforced isolation transformer
(6) Earth leakage circuit breaker
(7) Auto circuit breaker
(8) Power filter
(9) 24[V] DC power source

(a) Power supply
The amplifier is used under the "over voltage category II" environment as specified in IEC 664.
The power input unit uses a reinforced isolation transformer based on IEC/EN standards.
A 3-phase, star-connected transformer should be used without regard to single-phase and 3-phase models. The transformer should be grounded at the neutral point. The phase (line to earth) voltage must not exceed 120[V].



(1) Amplifier
(2) Reinforced isolation transformer
(3) 230[V] / $\sqrt{3}$ = 133[V]

For the interface power source, use a 24[V] DC power source with reinforced isolation type input and output.

(b) Power filter
Regarding the EMI terminal disturbance voltage, a power filter is required.

Input voltage class [V]	100	200					
Amplifier output [kW]	0.05 to 0.2	0.05 to 0.4	0.75 to 1	1.5	2	3	4	5
Power filter type HF□□□□A-TM	3005		3010	3015	3020	3030	3040	3050
Current [A]	5		10	15	20	30	40	50
Voltage	250[V] AC							
Leakage current	1.5[mA] max. at 250[V] AC, 60[Hz]							

(c) Earthing (grounding)
To prevent electric shocks, the amplifier protection earth terminal and the control panel protection earth terminal should be connected to the ground.
When connecting earth cables to the protection earth terminal, do not tighten the cable terminals together.
The amplifier has two protection earth terminals. Do not connect copper cables directly to the amplifier terminals.
For the earth connection avoid direct contact between aluminum and copper.
Tin-plated cable lugs can be used if the plating does not contain zinc.
When tightening the screws take care not to damage the thread in the aluminum frame.
(d) Auto circuit breaker
Connect EN/IEC-approved auto circuit breaker between the power supply source and the power filter. Refer to 10.2.
(e) Residual-current-operated protective device (RCD)
Where residual-current-operated protective device (RCD) is used for protection in case of direct or indirect contact, only RCD of type B is allowed on the supply side of this electric equipment (EE). Otherwise another protective measure should be applied such as separation of the EE from the environment by double or reinforced insulation or isolation of EE and supply system by a transformer.
(f) Conformity to EMC requirements
When the amplifier and motor have been finally installed with a driven machine and devices, they may not conform to the EMC requirements because the installation, wiring, etc. are different according to the final conditions. The driven machine and devices must therefore be measured for conformity to the EMC requirements under the final conditions with the amplifier and motor installed.

Compliance with UL standards

(a) Auto circuit breaker
For compliance with UL standards, connect UL-approved (with LISTED UL mark) auto circuit breaker between the power supply source and the power filter.

Input voltage class [V]		100		200					
Amplifier output [kW]		0.05, 0.1	0.2	0.03 to 0.2	0.4	0.75, 1	1.5	2, 3	4, 5
Amplifier type	RYS□□□S3-	VVS6		VVS					
		500, 101	201	300 to 201	401	751, 102	152	202, 302	402, 502
Auto circuit	type BU-ECA	3005	3010	3005	3010	3015	3020	3030	3050
breaker	current [A]	5	10	5	10	15	20	30	50

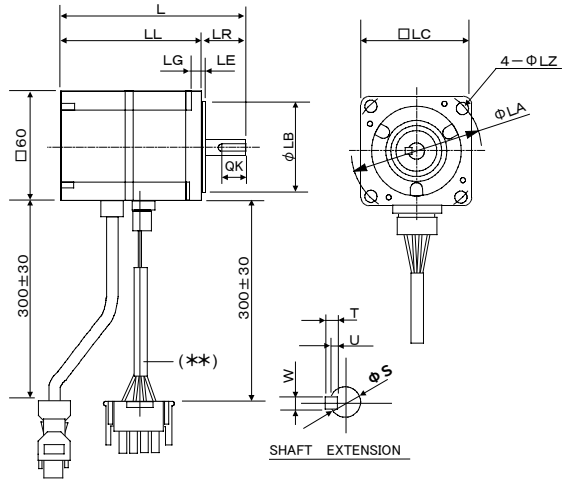
3.3 External dimensions [unit : mm]

(1) Motor, flange-mounted

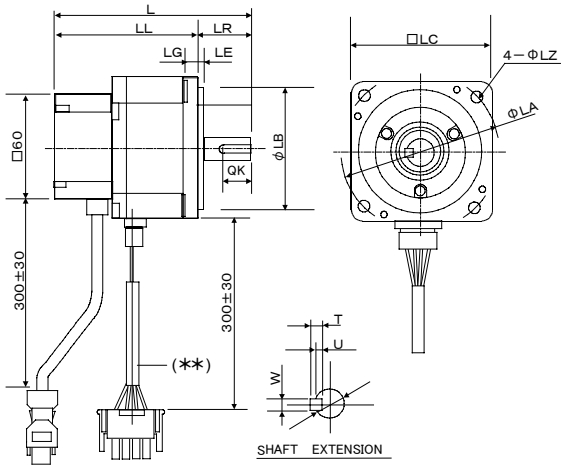
(a) Basic design, GYC type

GYC101 to 502DC1-S type, 0.1 to 5 [kW]

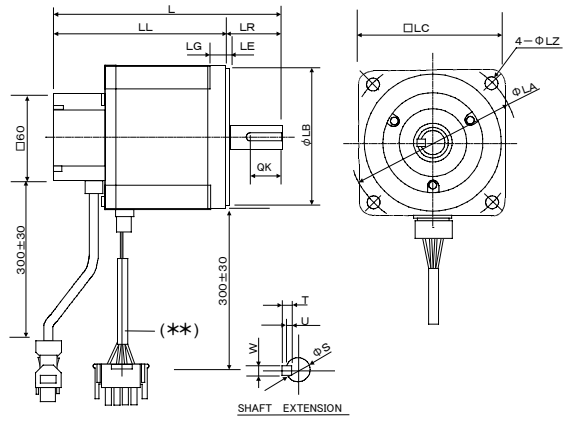
CA



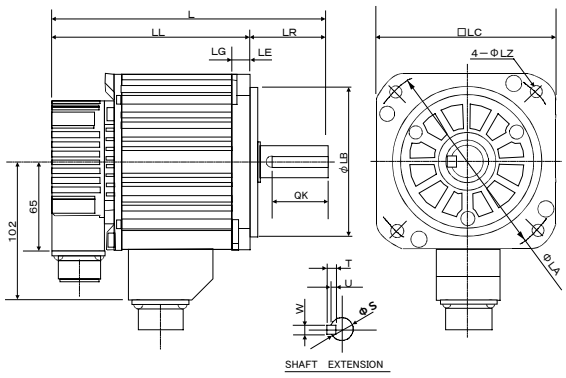
CB



CC



CD



Type GYC	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB
101DC1-S	CA	-	14	-	8h6	3	1.8	3	-	100	75	25	6	3	70	50h7
201DC1-S	CB	-	16	-	14h6	5	3	5	-	112	82	30	8	3	90	70h7
401DC1-S	CB	-	16	-	14h6	5	3	5	-	127	97	30	8	3	90	70h7
751DC1-S	CC	-	22	-	16h6	5	3	5	-	156.5	116.5	40	10	3	115	95h7
102DC1-S	CD	-	41	-	24h6	7	4	8	-	201.5	143.5	58	12	6	145	110h7
152DC1-S	CD	-	41	-	24h6	7	4	8	-	216.5	158.5	58	12	6	145	110h7
202DC1-S																
302DC1-S																
402DC1-S																
502DC1-S																

(∗) Screw hole of shaft extension

(∗∗) Insulating protection tube

(1) Motor, flange-mounted

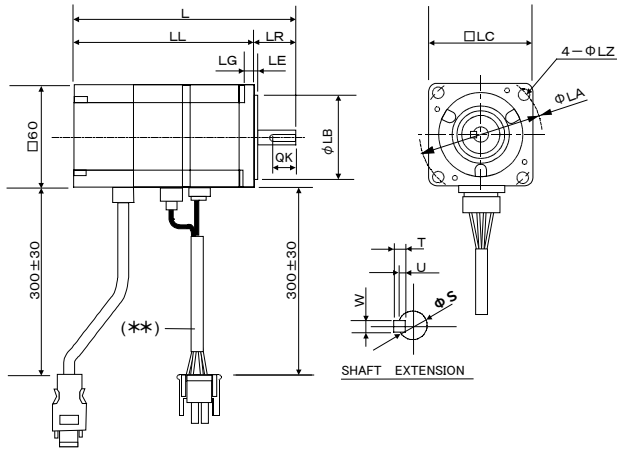
(a) Basic design

GYC101 to 502DC1-S type, 0.1 to 5 [kW]

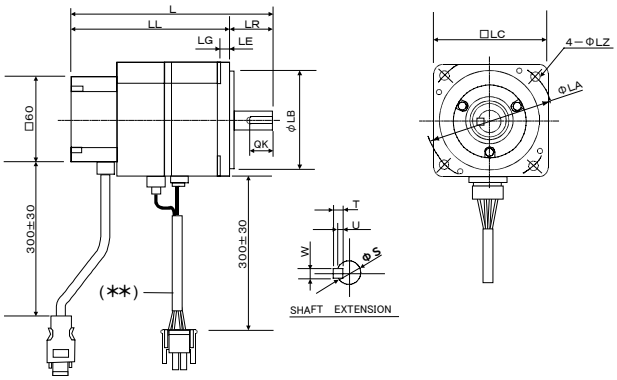
	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	60	-	-	-	5.5	-	-	-	-	-	-	0.75
	80	-	-	-	7	-	-	-	-	-	-	1.3
	80	-	-	-	7	-	-	-	-	-	-	1.9
	100	-	-	-	9	-	-	-	-	-	-	3.5
	130	-	-	-	9	-	-	-	-	-	-	5.5
	130	-	-	-	9	-	-	-	-	-	-	7.5

(b) With providing brake
GYC101 to 502DC1-S-B type, 0.1 to 5 [kW]

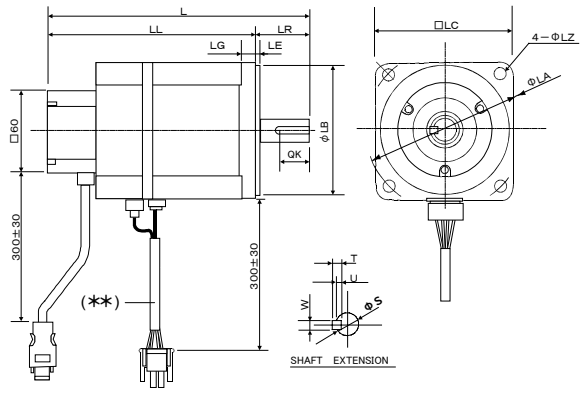
CJ



CK



CL



Type GYC	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB
101DC1-S-B	CJ	-	14	-	8h6	3	1.8	3	-	128	103	25	6	3	70	50h7
201DC1-S-B	CK	-	16	-	14h6	5	3	5	-	143.5	113.5	30	8	3	90	70h7
401DC1-S-B	CK	-	16	-	14h6	5	3	5	-	158.5	128.5	30	8	3	90	70h7
751DC1-S-B	CL	-	22	-	16h6	5	3	5	-	189	149	40	10	3	115	95h7
102DC1-S-B																
152DC1-S-B																
202DC1-S-B																
302DC1-S-B																
402DC1-S-B																
502DC1-S-B																

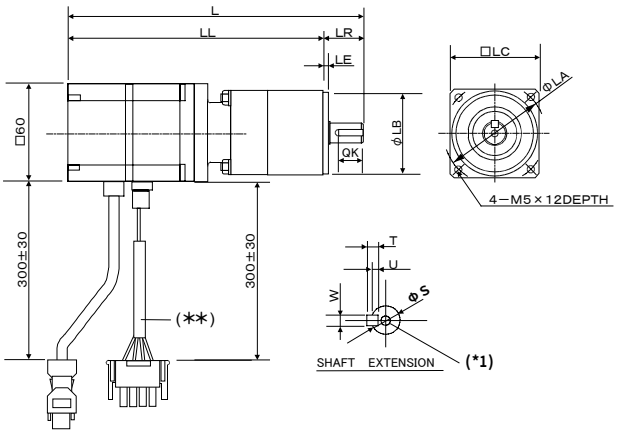
(∗) Screw hole of shaft extension
(∗∗) Insulating protection tube

(b) With providing brake
GYC101 to 502DC1-S -B type, 0.1 to 5 [kW]

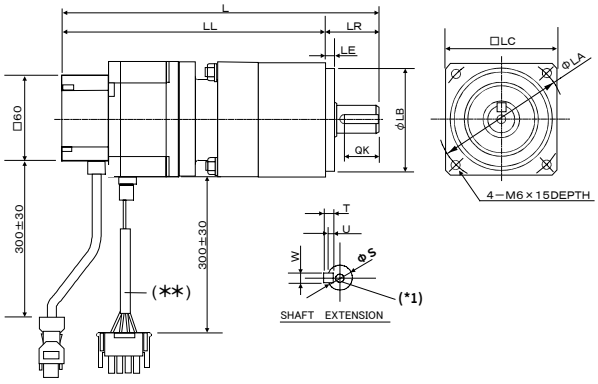
	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	60	-	-	-	5.5	-	-	-	-	-	-	1.0
	80	-	-	-	7	-	-	-	-	-	-	1.9
	80	-	-	-	7	-	-	-	-	-	-	2.6
	100	-	-	-	9	-	-	-	-	-	-	4.3

(c) With providing speed reduction gear unit, gear ratio 1/9
GYC101 to 502DC1-S type, and gear head, 0.1 to 5 [kW]

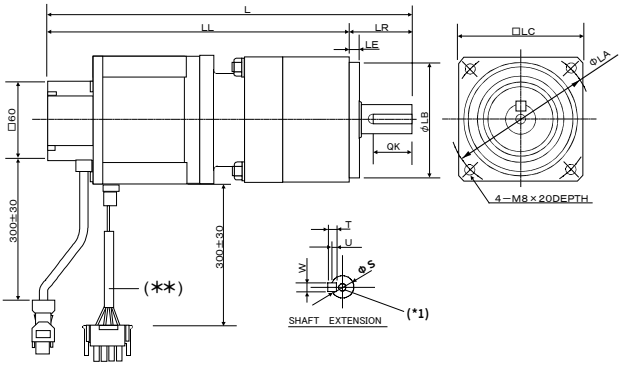
CR



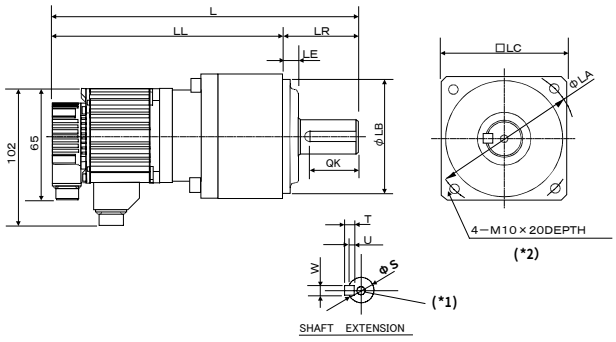
CS



CT



CU



Type GYC	Fig	Q	QK	QR	ϕS	T	U	W	(∗1)	L	LL	LR	LG	LE	ϕLA	ϕLB
101DC1-S	CR	-	15	-	$12^{+0}_{-0.011}$	4	2.5	4	M4x8	178	153	25	-	4	60	$50^{+0}_{-0.025}$
201DC1-S	CS	-	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M5x13	218	181	37	-	6	90	$70^{+0}_{-0.03}$
401DC1-S	CS	-	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M5x13	233	196	37	-	6	90	$70^{+0}_{-0.03}$
751DC1-S	CT	-	30	-	$24^{+0}_{-0.013}$	7	4	8	M6x15	282.5	233.5	49	-	8	115	$90^{+0}_{-0.035}$
102DC1-S	CU	-	45	-	$32^{+0}_{-0.016}$	8	5	10	M6x15	362.5	298.5	64	-	8	135	$110^{+0}_{-0.035}$
152DC1-S	CU	-	45	-	$32^{+0}_{-0.016}$	8	5	10	M6x15	416.5	339.5	77	-	20	160	$130^{+0}_{-0.04}$
202DC1-S																
302DC1-S																
402DC1-S																
502DC1-S																

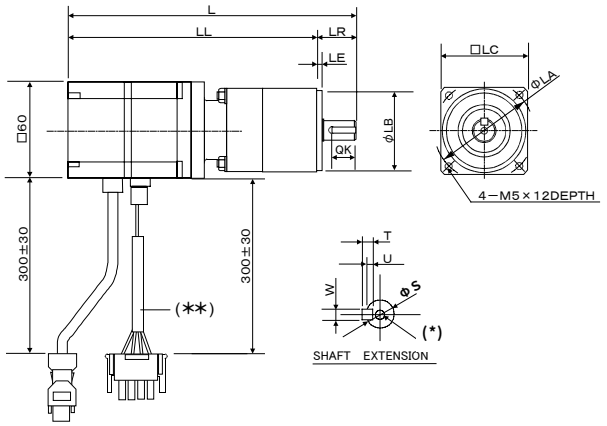
(∗1) Screw hole of shaft extension
(∗2) For 152 type, 1.5 [kW] : 4 - M12 × 24 DEPTH
(∗∗) Insulating protection tube

(c) With providing speed reduction gear unit, gear ratio 1/9
GYC101 to 502DC1-S type, and gear head, 0.1 to 5 [kW]

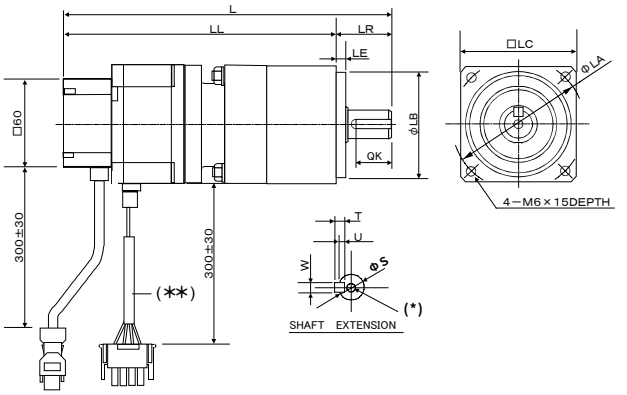
	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	52	-	-	-	M5	-	-	-	-	-	-	1.47
	78	-	-	-	M6	-	-	-	-	-	-	3.4
	78	-	-	-	M6	-	-	-	-	-	-	4.0
	98	-	-	-	M8	-	-	-	-	-	-	7.3
	120	-	-	-	M10	-	-	-	-	-	-	13.3
	140	-	-	-	M12	-	-	-	-	-	-	19.7

(d) With providing speed reduction gear unit, gear ratio 1/25
GYC101 to 502DC1-S type, and gear head, 0.1 to 5 [kW]

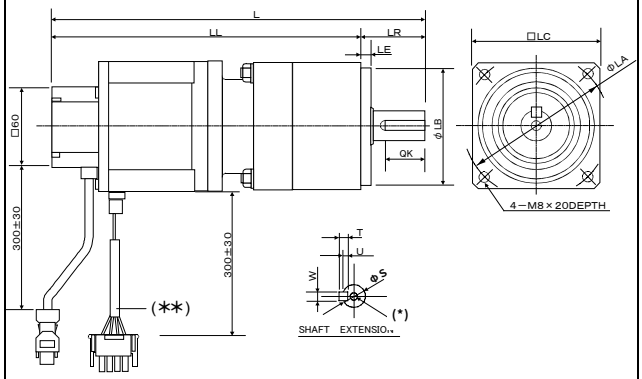
DA



DB



DC



Type GYC	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕ LA	ϕLB
101DC1-S	DA	-	15	-	$12^{+0}_{-0.011}$	4	2.5	4	M4x18	178	153	25	-	4	60	$50^{+0}_{-0.025}$
201DC1-S	DB	-	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M5x13	218	181	37	-	6	90	$70^{+0}_{-0.03}$
401DC1-S	DB	-	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M5x13	233	196	37	-	6	90	$70^{+0}_{-0.03}$
751DC1-S	DC	-	30	-	$24^{+0}_{-0.013}$	7	4	8	M6x15	282.5	233.5	49	-	8	115	$90^{+0}_{-0.035}$
102DC1-S																
152DC1-S																
202DC1-S																
302DC1-S																
402DC1-S																
502DC1-S																

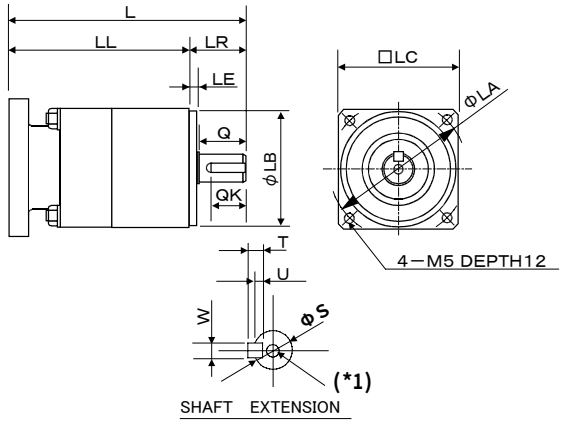
(∗) Screw hole of shaft extension
(∗∗) Insulating protection tube

(d) With providing speed reduction gear unit, gear ratio 1/25
GYC101 to 502DC1-S type, and gear head, 0.1 to 5 [kW]

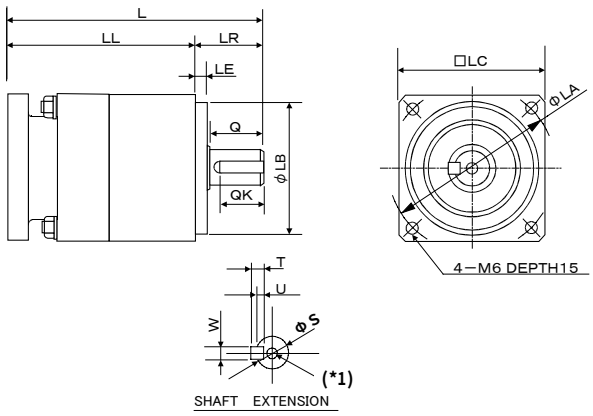
	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	52	-	-	-	M5	-	-	-	-	-	-	1.47
	78	-	-	-	M6	-	-	-	-	-	-	3.4
	78	-	-	-	M6	-	-	-	-	-	-	4.0
	98	-	-	-	M8	-	-	-	-	-	-	7.3

(e) Gear head unit for GYC motor, gear ratio 1/9
GYN101 to 502CAG - G09 type, 0.1 to 5 [kW]

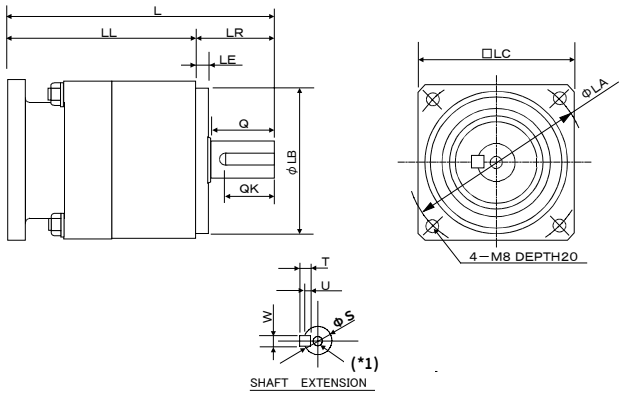
DJ



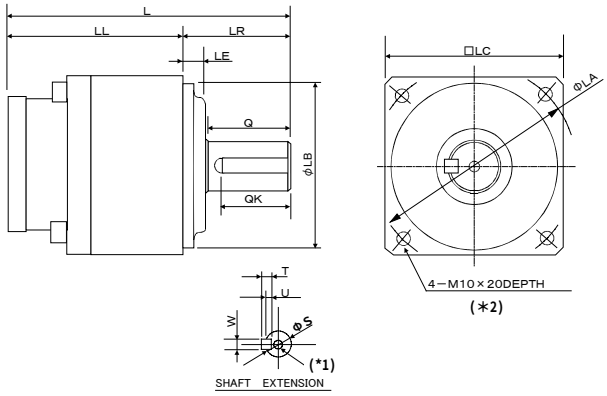
DK



DL



DM

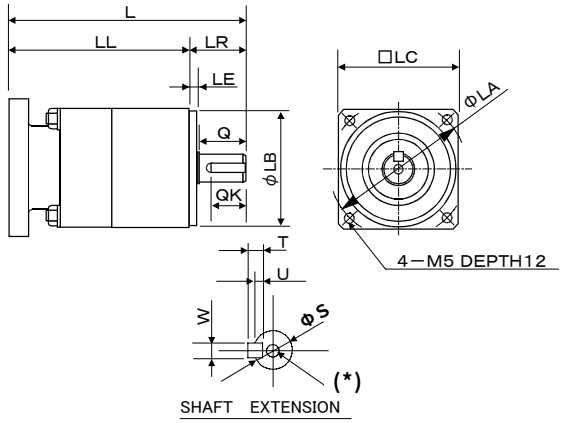


Type GYN	Fig	Q	QK	QR	ϕS	T	U	W	(∗1)	L	LL	LR	LG	LE	ϕLA	ϕLB	□LC	[kg]
101CAG-G09	DJ	20	15	-	$12^{+0}_{-0.011}$	4	2.5	4	M4x8	103	78	25	-	4	60	$50^{+0}_{-0.025}$	52	0.72
201CAG-G09	DK	30	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M5x13	136	99	37	-	6	90	$70^{+0}_{-0.03}$	78	2.1
401CAG-G09	DK	30	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M5x13	136	99	37	-	6	90	$70^{+0}_{-0.03}$	78	2.1
751CAG-G09	DL	40	30	-	$24^{+0}_{-0.013}$	7	4	8	M6x15	166	117	49	-	8	115	$90^{+0}_{-0.035}$	98	3.8
102CAG-G09	DM	55	45	-	$32^{+0}_{-0.016}$	8	5	10	M6x15	219	155	64	-	8	135	$110^{+0}_{-0.035}$	120	7.8
152CAG-G09	DM	55	45	-	$32^{+0}_{-0.016}$	8	5	10	M6x15	258	181	77	-	20	160	$130^{+0}_{-0.04}$	140	12.2
202CAG-G09																		
302CAG-G09																		
402CAG-G09																		
502CAG-G09																		

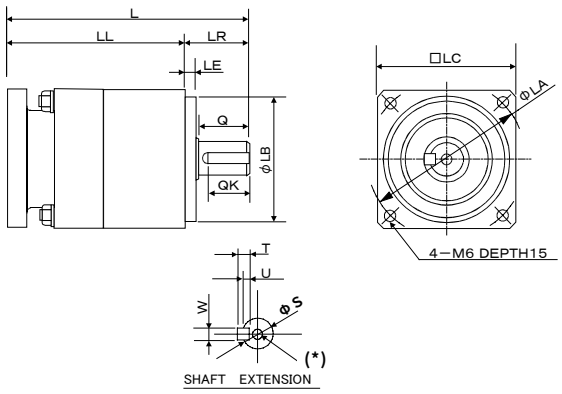
(∗1) Screw hole of shaft extension
(∗2) For 152 type, 1.5 [kW] : 4 - M12 × 24 DEPTH

(f) Gear head unit for GYC motor, gear ratio 1/25
GYN101 to 502CAG - G25, 0.1 to 5 [kW]

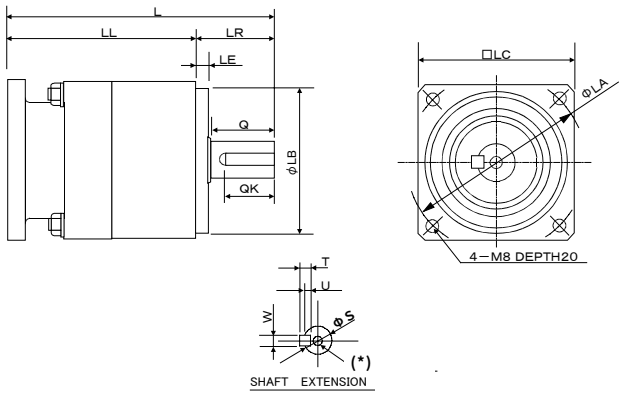
DR



DS



DT

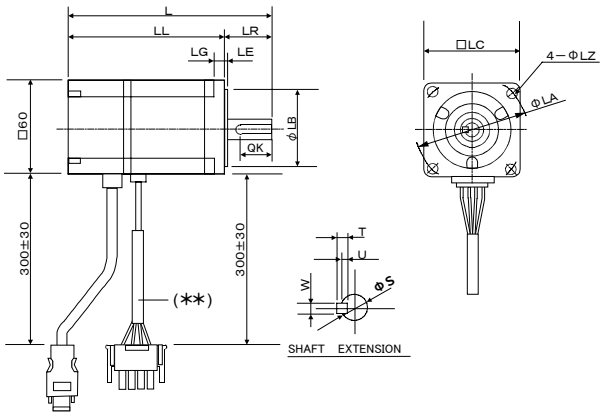


Type GYN	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB	□LC	[kg]
101CAG-G25	DR	20	15	-	$12^{+0}_{-0.011}$	4	2.5	4	M4x8	103	78	25	-	4	60	$50^{+0}_{-0.025}$	52	0.72
201CAG-G25	DS	30	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M4x8	136	99	37	-	6	90	$70^{+0}_{-0.03}$	78	2.1
401CAG-G25	DS	30	23	-	$19^{+0}_{-0.013}$	6	3.5	6	M4x8	136	99	37	-	6	90	$70^{+0}_{-0.03}$	78	2.1
751CAG-G25	DT	40	30	-	$24^{+0}_{-0.013}$	7	4	8	M6x15	166	117	49	-	8	115	$90^{+0}_{-0.035}$	98	3.8
102CAG-G25																		
152CAG-G25																		
202CAG-G25																		
302CAG-G25																		
402CAG-G25																		
502CAG-G25																		

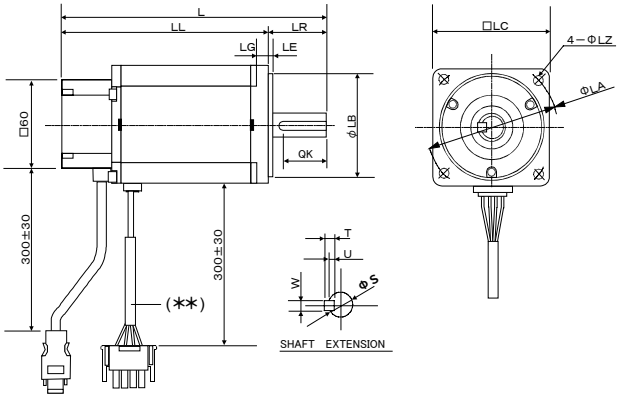
(∗) Screw hole of shaft extension

(g) Basic design, GYS type
GYS300 to 502DC1-S type, 0.03 to 5 [kW]

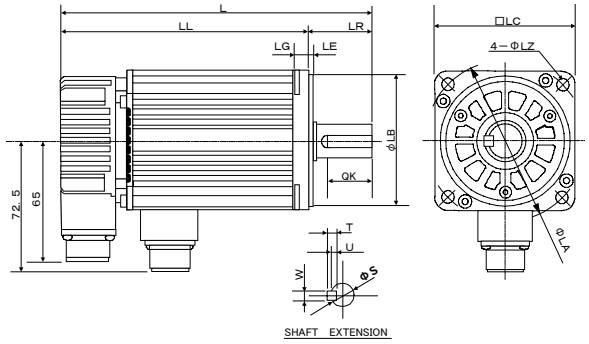
EC



ED



EE



Type GYS	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB
300DC1-S																
500DC1-S																
101DC1-S																
201DC1-S	EC	-	20	-	14h6	5	3	5	-	126.5	96.5	30	6	3	70	50h7
401DC1-S	EC	-	20	-	14h6	5	3	5	-	154.5	124.5	30	6	3	70	50h7
751DC1-S	ED	-	30	-	16h6	5	3	5	-	180	140	40	8	3	90	70h7
102DC1-S	EE	-	32	-	24h6	7	4	8	-	198	153	45	10	3	115	95h7
152DC1-S	EE	-	32	-	24h6	7	4	8	-	220.5	175.5	45	10	3	115	95h7
202DC1-S																
302DC1-S																
402DC1-S																
502DC1-S																

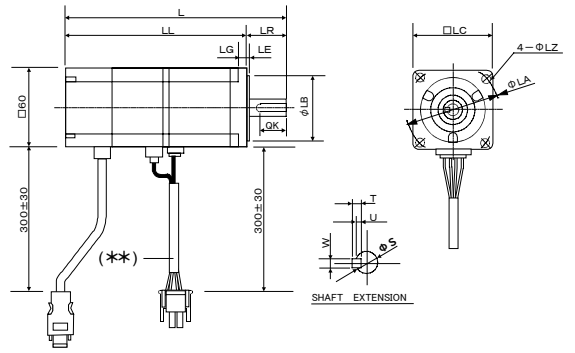
(∗) Screw hole of shaft extension
(∗∗) Insulating protection tube

(g) Basic design
GYS300 to 502DC1-S type, 0.03 to 5 [kW]

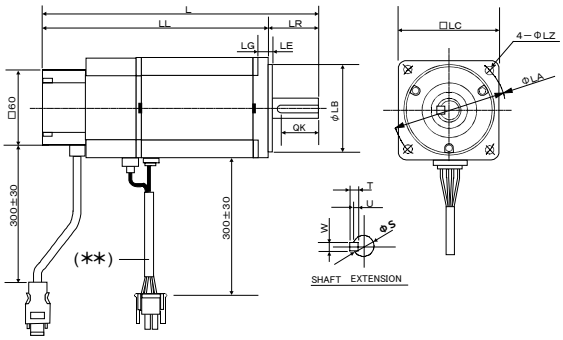
	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	60	-	-	-	5.5	-	-	-	-	-	-	1.2
	60	-	-	-	5.5	-	-	-	-	-	-	1.8
	80	-	-	-	7	-	-	-	-	-	-	3.4
	100	-	-	-	9	-	-	-	-	-	-	4.6
	100	-	-	-	9	-	-	-	-	-	-	5.5

(h) With providing brake
GYS300 to 502DC1-S-B type, 0.03 to 5 [kW]

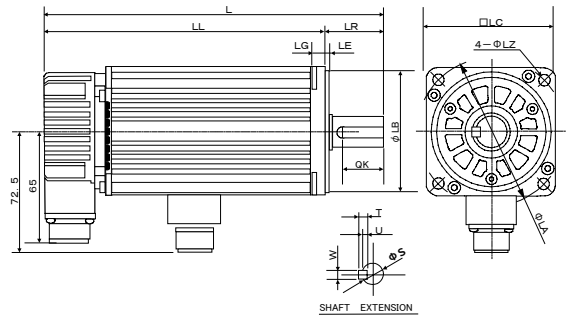
EL



EM



EN



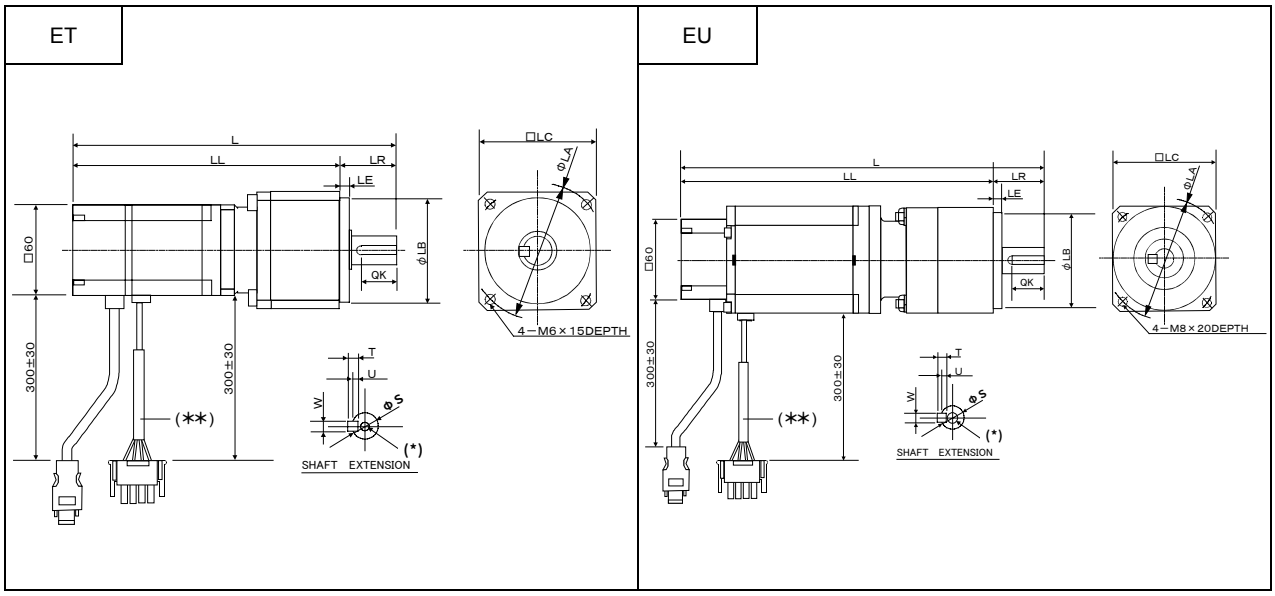
Type GYS	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB
300DC1-S-B																
500DC1-S-B																
101DC1-S-B																
201DC1-S-B	EL	-	20	-	14h6	5	3	5	-	165	135	30	6	3	70	50h7
401DC1-S-B	EL	-	20	-	14h6	5	3	5	-	193	163	30	6	3	70	50h7
751DC1-S-B	EM	-	30	-	16h6	5	3	5	-	216.5	176.5	40	8	3	90	70h7
102DC1-S-B	EN	-	32	-	24h6	7	4	8	-	249	204	45	10	3	115	95h7
152DC1-S-B	EN	-	32	-	24h6	7	4	8	-	271.5	226.5	45	10	3	115	95h7
202DC1-S-B																
302DC1-S-B																
402DC1-S-B																
502DC1-S-B																

(∗) Screw hole of shaft extension
(∗∗) Insulating protection tube

(h) With providing brake
GYS300 to 502DC1-S-B type, 0.03 to 5 [kW]

	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	60	-	-	-	5.5	-	-	-	-	-	-	1.7
	60	-	-	-	5.5	-	-	-	-	-	-	2.3
	80	-	-	-	7	-	-	-	-	-	-	4.2
	100	-	-	-	9	-	-	-	-	-	-	6.6
	100	-	-	-	9	-	-	-	-	-	-	7.5

(i) With providing speed reduction gear unit, gear ratio 1/9
GYS300 to 502DC1-S type, and gear head, 0.03 to 5 [kW]



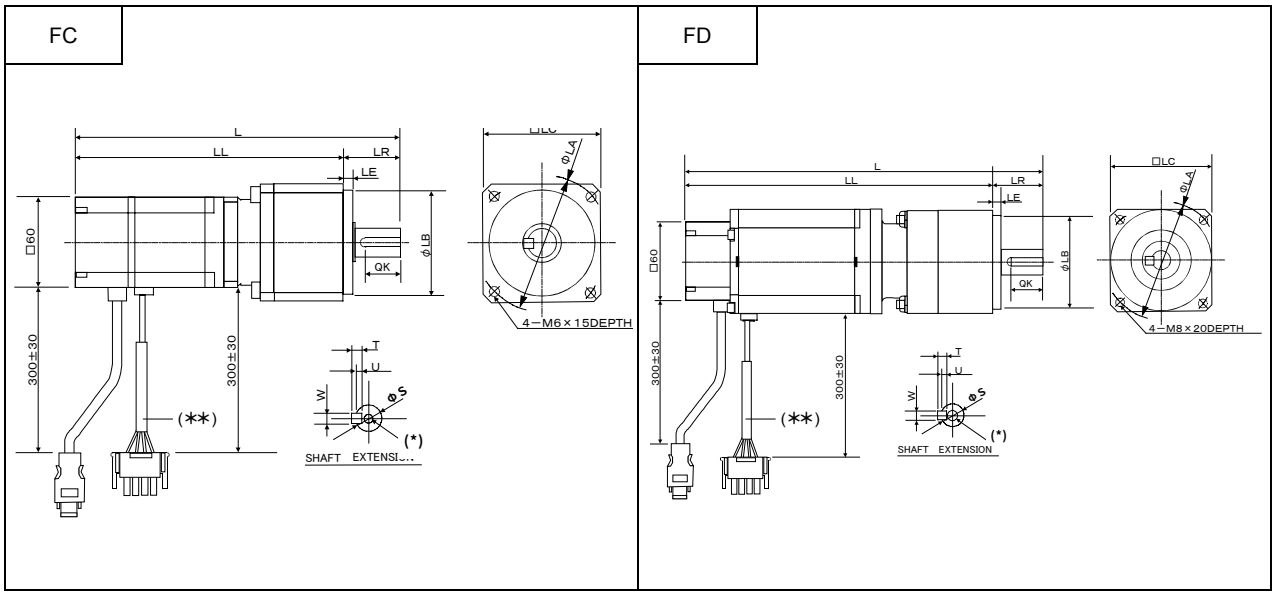
Type GYS	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB
300DC1-S																
500DC1-S																
101DC1-S																
201DC1-S	ET	-	23	-	19h6	6	3.5	6	M4x8	232.5	195.5	37	-	6	90	70h7
401DC1-S	ET	-	23	-	19h6	6	3.5	6	M6x15	260.5	223.5	37	-	6	90	70h7
751DC1-S	EU	-	40	-	24h6	7	4	8	M6x15	306	257	49	-	8	115	90h7
102DC1-S																
152DC1-S																
202DC1-S																
302DC1-S																
402DC1-S																
502DC1-S																

(∗) Screw hole of shaft extension
(∗∗) Insulating protection tube

(i) With providing speed reduction gear unit, gear ratio 1/9
GYS300 to 502DC1-S type, and gear head, 0.03 to 5 [kW]

	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	78	-	-	-	-	-	-	-	-	-	-	3.3
	78	-	-	-	-	-	-	-	-	-	-	3.9
	98	-	-	-	-	-	-	-	-	-	-	7.3

(j) With providing speed reduction gear unit, gear ratio 1/25
GYS300 to 502DC1-S type, and gear head, 0.03 to 5 [kW]



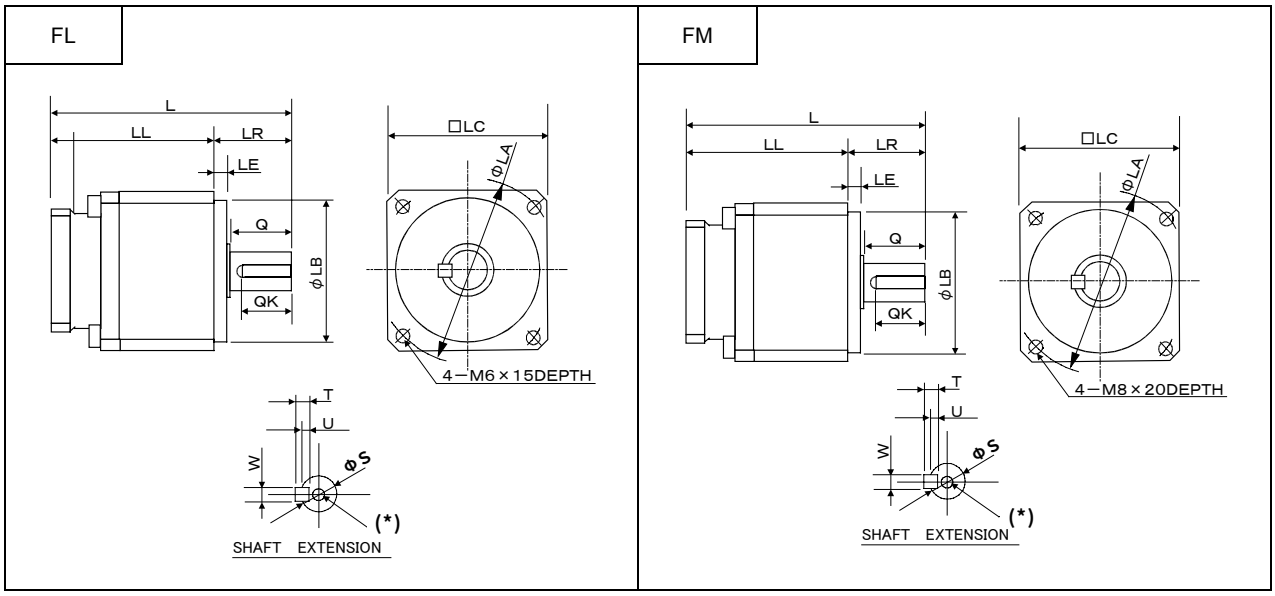
Type GYS	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB
300DC1-S																
500DC1-S																
101DC1-S																
201DC1-S	FC	-	23	-	19h6	6	3.5	6	M4x8	232.5	195.5	37	-	6	90	70h7
401DC1-S	FC	-	23	-	19h6	6	3.5	6	M4x8	260.5	223.5	37	-	6	90	70h7
751DC1-S	FD	-	40	-	24h6	7	4	8	M6x15	306	257	49	-	8	115	90h7
102DC1-S																
152DC1-S																
202DC1-S																
302DC1-S																
402DC1-S																
502DC1-S																

(∗) Screw hole of shaft extension
(∗∗) Insulating protection tube

(j) With providing speed reduction gear unit, gear ratio 1/25
GYS300 to 502DC1-S type, and gear head, 0.03 to 5 [kW]

	□LC	L1	L2	L3	ϕLZ	IE	IL	C	LL	LR	LG	Mass [kg]
	78	-	-	-	-	-	-	-	-	-	-	3.3
	78	-	-	-	-	-	-	-	-	-	-	3.9
	98	-	-	-	-	-	-	-	-	-	-	7.3

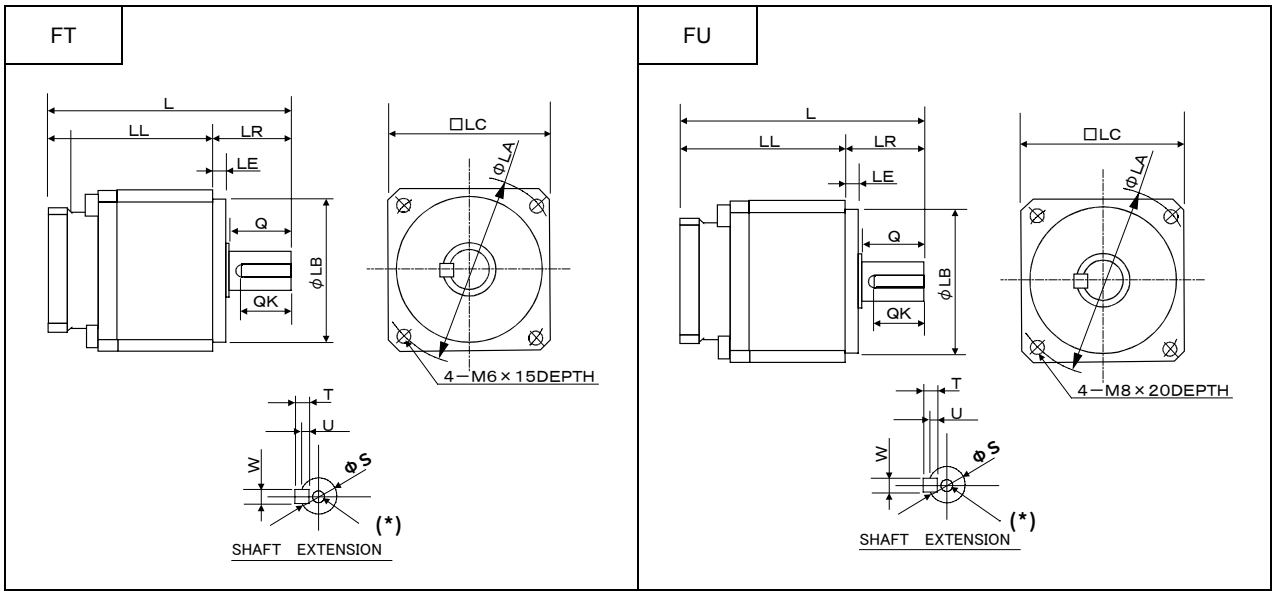
(k) Gear head unit for GYS motor, gear ratio 1/9
GYN300 to 502, GRN.20 to .40 SAG-G09, 0.03 to 5 [kW]



Type G09	Fig	Q	QK	QR	φS	T	U	W	(∗)	L	LL	LR	LG	LE	φLA	φLB	□LC	Mass [kg]
GYN300SAG-																		
GYN500SAG-																		
GYN101SAG-																		
GRN.20SAG-	FL	30	23	-	19h6	6	3.5	6	M4x8	136	99	37	-	6	90	70h7	78	2.1
GRN.40SAG-	FL	30	23	-	19h6	6	3.5	6	M4x8	136	99	37	-	6	90	70h7	78	2.1
GYN751SAG-	FM	40	31	-	24h6	7	4	8	M6x15	166	117	49	-	8	115	90h7	98	3.9
GYN102SAG-																		
GYN152SAG-																		
GYN202SAG-																		
GYN302SAG-																		
GYN402SAG-																		
GYN502SAG-																		

(∗) Screw hole of shaft extension

(l) Gear head unit for GYS motor, gear ratio 1/25
GYN300 to 502, GRN.20 to .40 SAG-G25, 0.03 to 5 [kW]

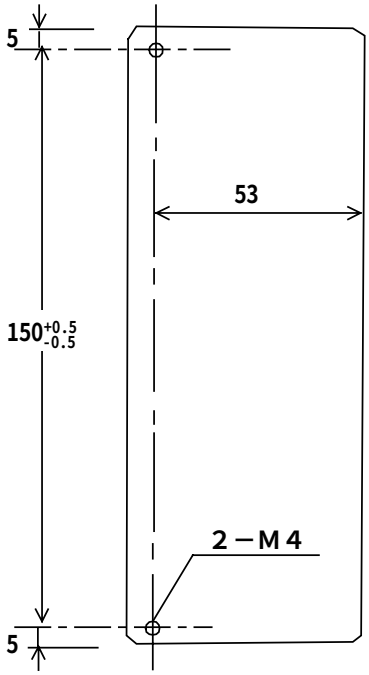


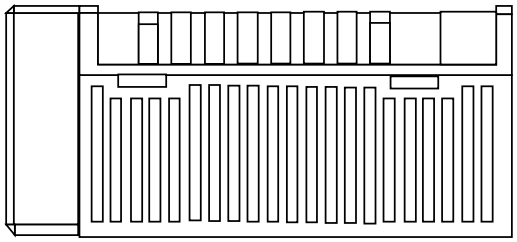
Type G25	Fig	Q	QK	QR	ϕS	T	U	W	(∗)	L	LL	LR	LG	LE	ϕLA	ϕLB	□LC	Mass [kg]
GYN300SAG-																		
GYN500SAG-																		
GYN101SAG-																		
GRN.20SAG-	FT	30	23	-	19h6	6	3.5	6	M4x8	136	99	37	-	6	90	70h7	78	2.1
GRN.40SAG-	FT	30	23	-	19h6	6	3.5	6	M4x8	136	99	37	-	6	90	70h7	78	2.1
GYN751SAG-	FU	40	31	-	24h6	7	4	8	M6x15	166	117	49	-	8	115	90h7	98	3.9
GYN102SAG-																		
GYN152SAG-																		
GYN202SAG-																		
GYN302SAG-																		
GYN402SAG-																		
GYN502SAG-																		

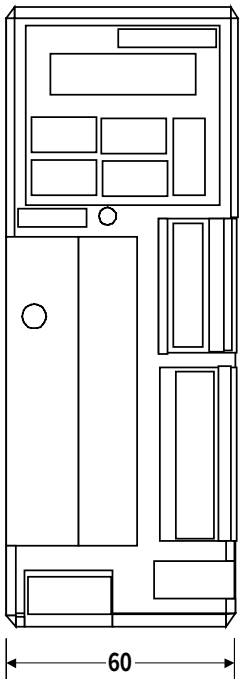
(∗) Screw hole of shaft extension

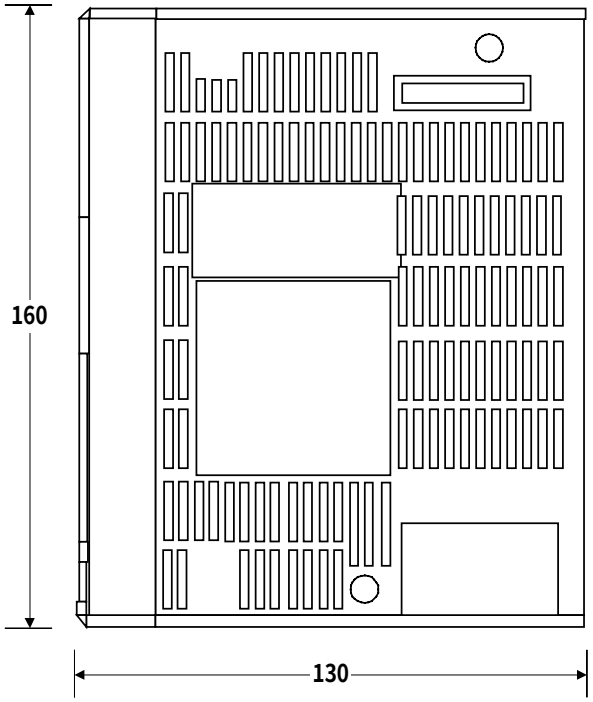
(2) RYS amplifier

(a) 0.03 to 0.2 [kW]

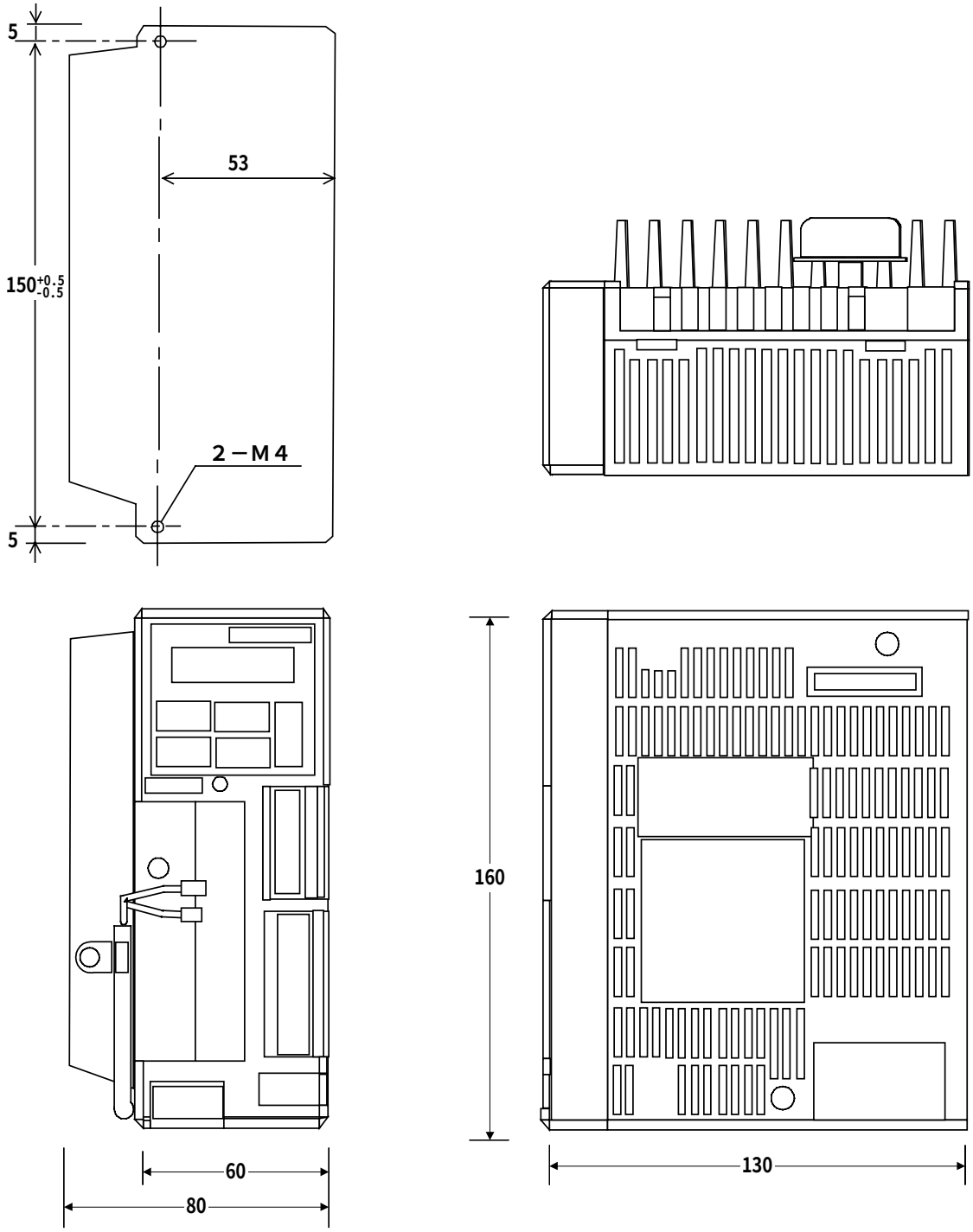




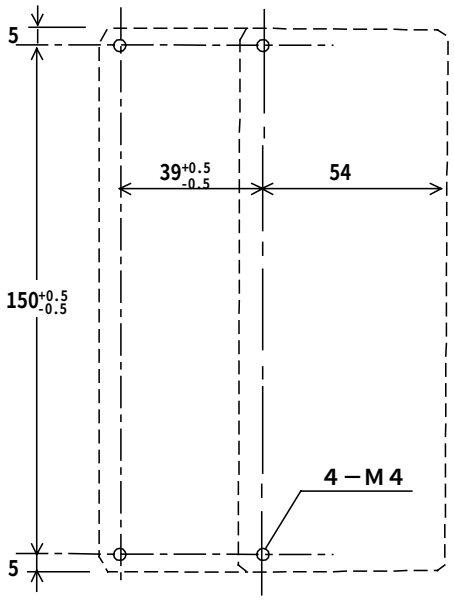


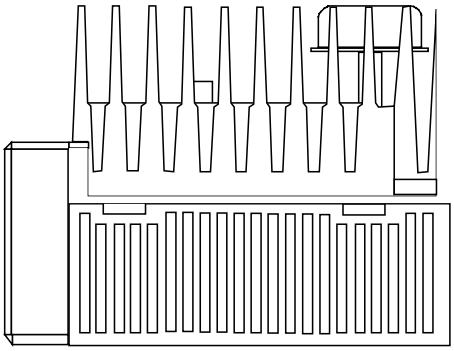


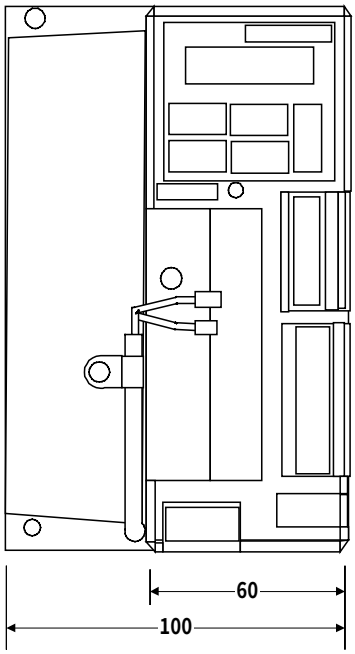
(b) 0.4 [kW]

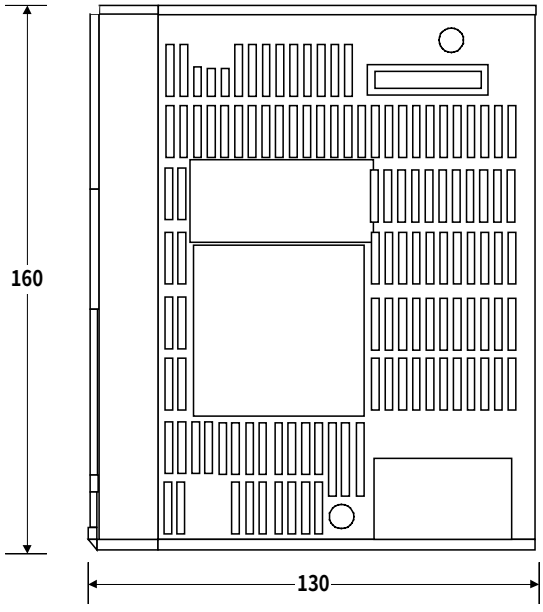


(c) 0.75 [kW]

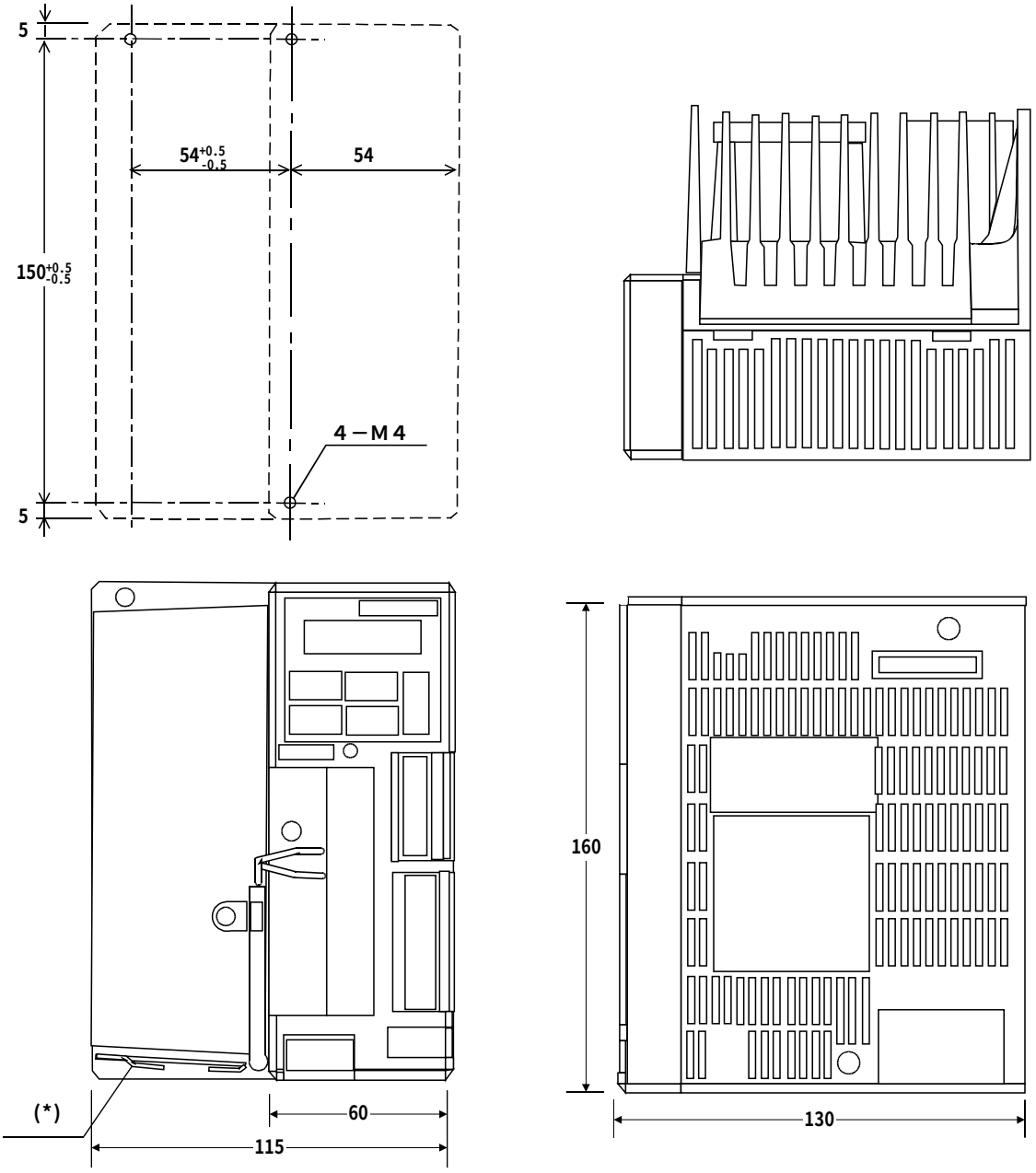








(d) 1 to 1.5 [kW]

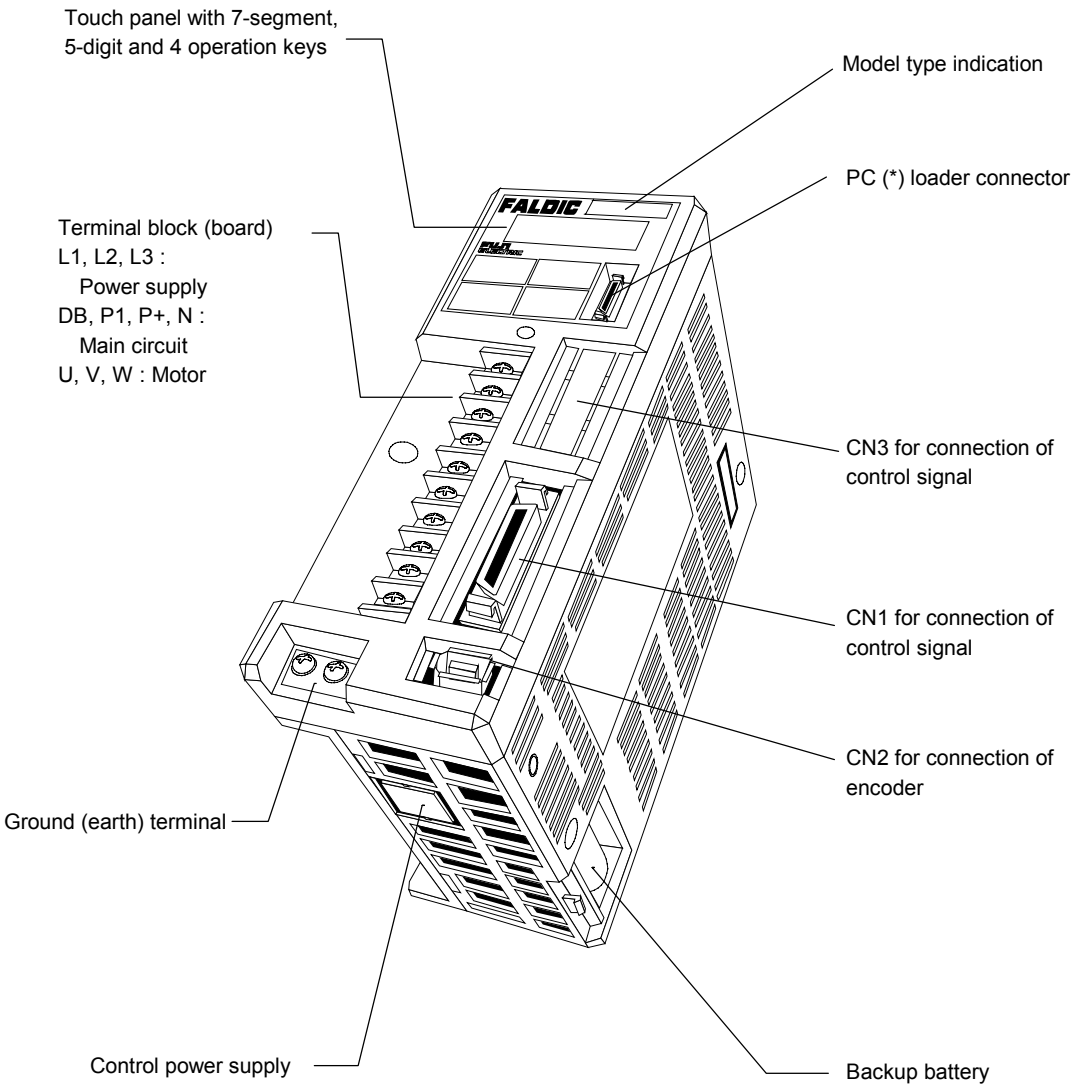


(∗) Cooling - fan

4. TERMINAL DIAGRAMS AND WIRING

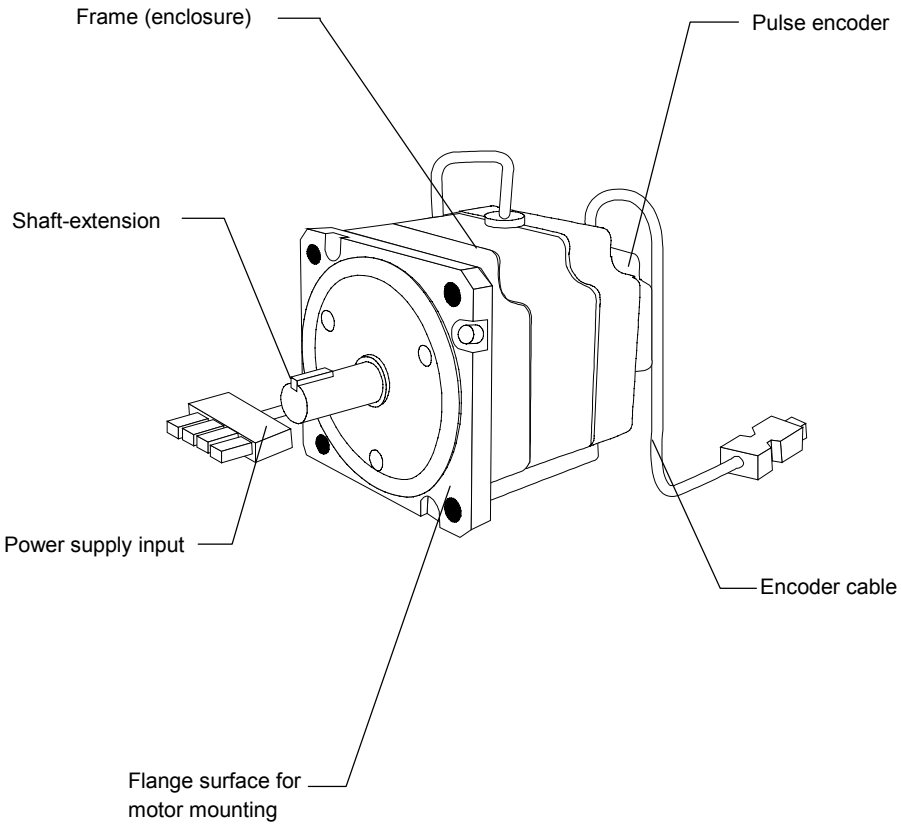
4.1 Amplifier, motor and optional devices layout

(1) Amplifier

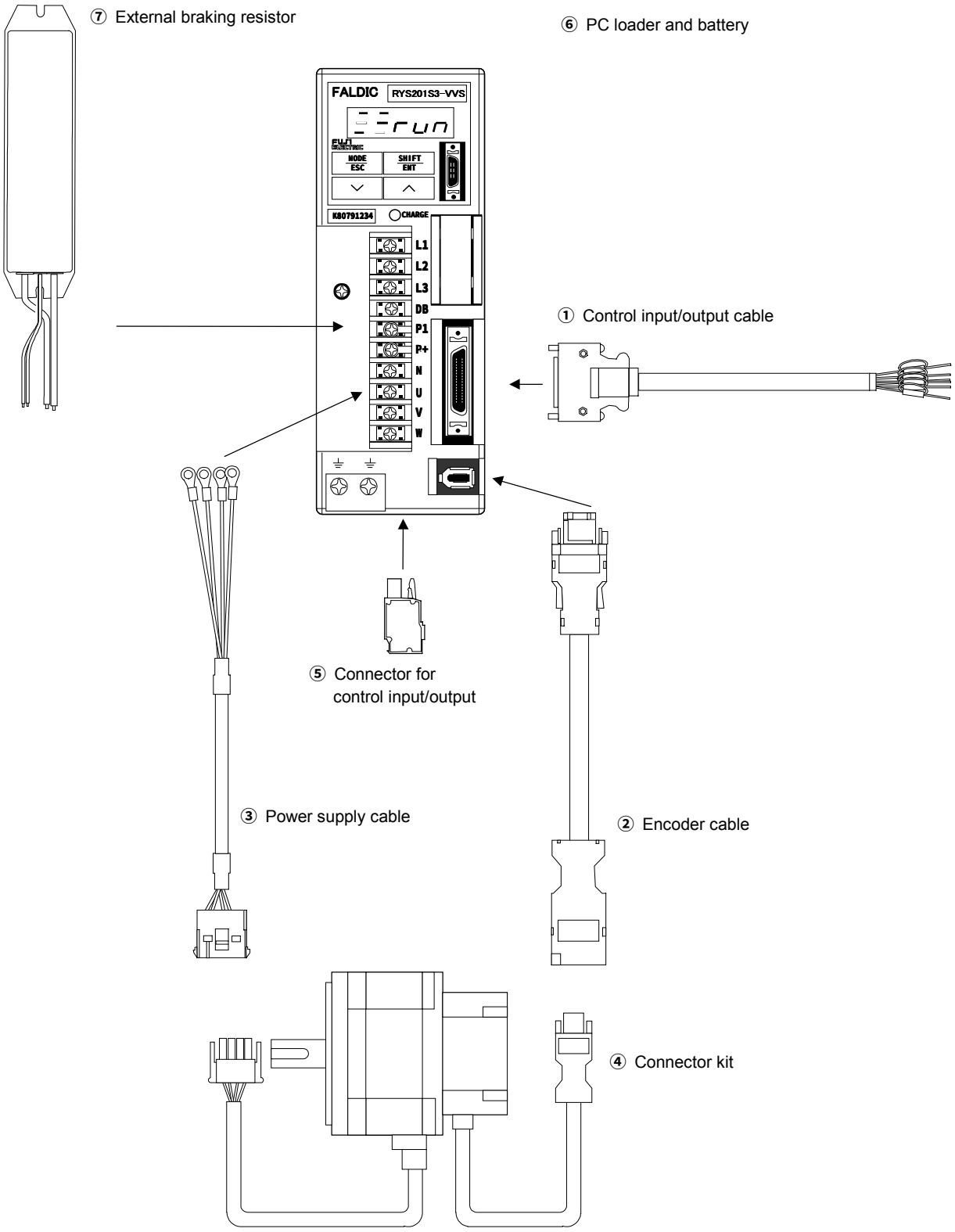


(*) PC : Personal computer

(2) Motor


Frame (enclosure)
Pulse encoder
Shaft-extension
Power supply input
Encoder cable
Flange surface for
motor mounting

(3) Optional devices : Refer to the next page.



■ **Optional cables, connector kits, battery and external braking resistors** : Refer to 10.8

Reference letter or figure : See previous page	10.8		Description (*)				Type	
①	(1)	a	Cable	Control	Expanded	3 [m] lg.	WSC -	D20P03
		b			S/X bus			D26P03
		c			V type			D36P03
②		d		Encoder	Molex-Molex	5 [m] lg.		P06P05
						10 [m] lg.		P06P10
						20 [m] lg.		P06P20
		e			Molex-Canon	5 [m] lg.		P06P05-C
						10 [m] lg.		P06P10-C
						20 [m] lg.		P06P20-C
		f			Molex	5 [m] lg.		P06P05-W
						10 [m] lg.		P06P10-W
						20 [m] lg.		P06P20-W
③		g		Motor without brake	AMP	5 [m] lg.		M04P05
						10 [m] lg.		M04P10
						20 [m] lg.		M04P20
		h		Motor with brake	AMP	5 [m] lg.		M06P05
						10 [m] lg.		M06P10
						20 [m] lg.		M06P20
④	(2)	a	Connector kit	Control (CN1)	Expanded		WSK -	D20P
		b			SX bus			D26P
		c			V type			D36P
		d		Encoder (CN2)	Molex (amp. side)			P06P-M
		e			Molex (motor side)			P06P-F
		f			Canon			P06P-C
		g		Motor without brake	AMP	0.75 [kW] and below		M04P
		h			Canon	GYS, 1, 1.5 [kW]		M04P-CA
		i				GYC, 1 [kW] and above		M04P-CB
		j		Motor with brake	AMP	0.75 [kW] and below		M06P
		k			Canon	GYS, 1, 1.5 [kW]		M06P-CA
		l				GYC, 1 [kW] and above		M06P-CB
⑤		m		Control		0.75 [kW] and below		L02P
⑥		n	Battery				WSB -	S
		—	PC loader				WSL -	PC
⑦	(3)	a	External braking resistor			0.4 [kW] and below	WSR -	401
		b				0.75 [kW]		751
		c				1, 1.5 [kW]		152

(*) Amp. : Amplifier lg. : Cable length
Molex, Canon, AMP : Supplier's product name of connector and terminal

4.2 Commercial power supply

Supply commercial power supply shown in 2 to the amplifier.

(1) Power supply

Supply 200 [V] commercial power to the amplifier.
Connect it to terminals L1, L2 and L3.

- Voltage : 200/200-220-230 [V]+10%/－15%. Supply voltage unbalance 3% max.
- Frequency : 50/60 [Hz]
- Phase : 3-phase (main circuit power supply) / single-phase (control power supply)

(2) Power supply capacity

The power supply capacity required for each amplifier is as follows.
The power supply capacity is applied for cabling with specified cable and 20 [m] max. wiring length. If the power capacity is 500[kVA] or more, AC reactor for impedance matching should be provided. See 10.5.

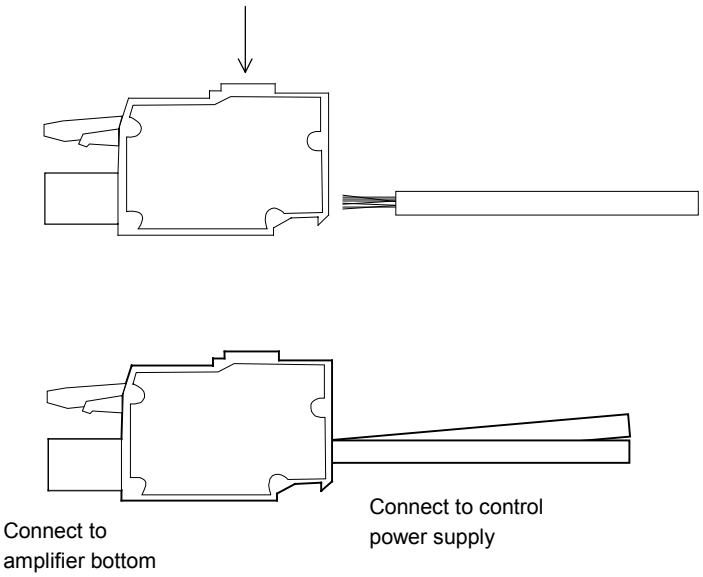
Amplifier type	RYS□□□S3	101	201	401	751	102	152	202	302	402	502
Motor type (example)	GYC□□□										
Motor output	[kW]	0.1	0.2	0.4	0.75	1	1.5	2	3	4	5
Power capacity	[kVA]	0.15	0.6	1.2	1.8	3	4.5	6	9	10	15

(3) Higher harmonics suppression

If a (harmonics suppressing) reactor is connected to RYS type amplifier of 3.7 [kW] max., use a “DC reactor”. Refer to 10.7.

(4) Control power supply input

The wiring procedure for control power supply is as follows.
(a) Connector
Use a connector of WSK-L02P type. Refer to 4.1(3) and 10.8 (2)m.
(b) Wiring
Remove the insulation covering of wire by approx. 13[mm] long and, while strongly pressing the arrow part in the figure by the operation lever furnished with the connector or flat head screwdriver, insert the wire.
After connecting 2 wires, engage the connector with the control power supply and amplifier.



4.3 Wiring between motor and encoder

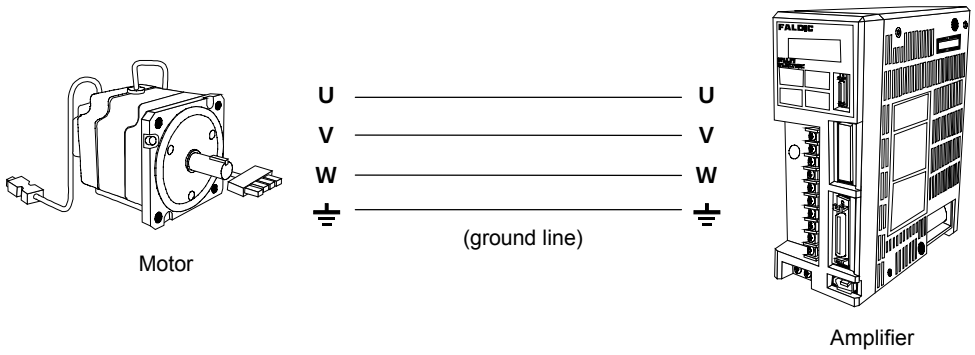
(1) Motor wiring

Connect the power line of the motor to the output U, V, W terminals of the amplifier.

Do not connect commercial power supply to the motor terminals.

The direction of rotation of the motor cannot be changed by changing the phase sequence of the motor terminals. It can be achieved by system para.

> ⚠ **CAUTION**
>
> **Do not connect commercial power supply directly to the motor. Otherwise, It may break.**



The wiring length between amplifier and motor should be within 50[m] long.

It is not permitted to perform ON/OFF of the wiring between the amplifier and motor by magnetic-contactors. It is not permitted to turning ON/OFF multiple motors with a single amplifier.

Furthermore, it is not permitted to wiring the following equipment along the wiring between amplifier and motor :

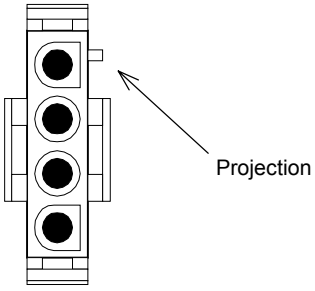
Phase advancing capacitor, reactor, power filter, surge suppressor (surge killer)

Terminal workings of motor power supply are as follows :

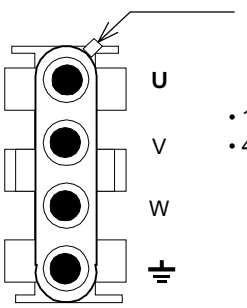
(a) GYC/GYS type motor : 0.75 [kW] and below

(i) Motor without providing brake

• View of engaging (jointing) side



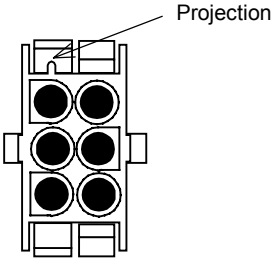
• Viewed from socket inserting side



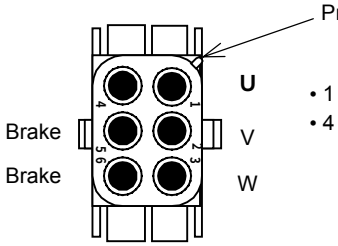
• 1 cap housing : 350780-1 type
• 4 sockets : 350750-3 or 350689-3 type

(ii) Motor with providing brake

• View of engaging (jointing) side



• Viewed from socket inserting side

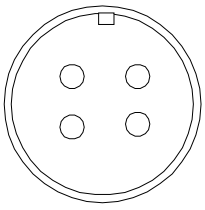


• 1 of cap housing : 350781-1 type
• 4 of sockets : 350750-3 or 350689-3

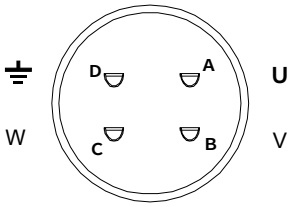
(b) GYC/GYS type motor : 1 [kW] and above

(i) Motor without providing brake

• View of engaging (jointing) side



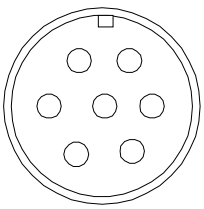
• View of plug wiring side



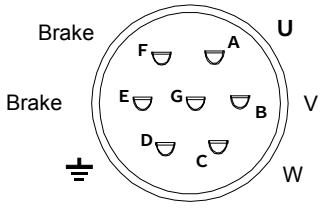
• 1 of connector : MS3108B18-10S type
• 1 of cable clamp : MS3057-10A type

(ii) Motor with providing brake

• View of engaging (jointing) side



• View of plug wiring side



G is vacant pin.

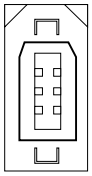
• 1 of connector (for GYC) : MS3108B20-15S type
• 1 of connector (for GYC) : MS3108B24-10S type
• 1 of cable clamp (for GYS) : MS3057-10A type
• 1 of cable clamp (for GYS) : MS3057-16A type

(2) Encoder wiring

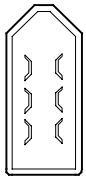
Connect the encoder wiring to CN2 of the amplifier.
The wiring length between amplifier and encoder should be within 50[m] long.

(a) With flexible leads

• View of engaging (jointing) side



• View of housing wiring side



Wiring to motor

5	SIG+	6	SIG−
3	BAT+	4	BAT−
1	P5	2	M5

Housing	: 53988-0611
Shell body clamp	: 58302-0600
Mold cover	: 53989-0605
Ditto.	: 53990-0650
Cable clamp	: 58303-0000
Clamp screw	: 53982-0009

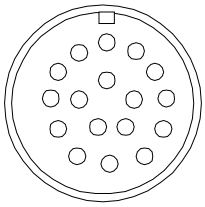
Wiring to amplifier

6	SIG−	5	SIG+
4	BAT−	3	BAT+
2	M5	1	P5

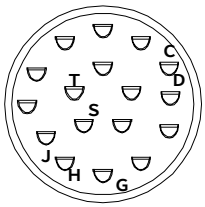
Housing	: 54180-0611
Shell body clamp	: 58299-0600
Shell body cover	: 58300-0600
Mold cover	: 54181-0615
Ditto.	: 54182-0605
Cable clamp	: 58303-0000
Clamp screw	: 59832-0009

(b) Canon connector

• View of engaging (jointing) side



• View of plug wiring side



H	PS
G	MS
C	SIG+
D	SIG−
T	BAT+
S	BAT−
J	Shield

(c) Wiring cable

If the optional encoder wiring cable is not used, use wiring with the following cable or equivalent.

• Cross-link polyethylene insulated, vinyl sheath cable :

AWG No.25 / 2P+AWG No.23/2C(*), (twisted-pair cable), RMCV-SB (UL2464) type

The wiring length should be within 10[m] long.

• Cross-link polyethylene insulated, vinyl sheath cable :

AWG No.25 / 2P+AWG No.16/2C(*), (twisted-pair cable), RMCV-SB (UL2464) type

(*) 2P (pairs), 2C (core) twisted-pair cable of different wire sizes. Use the enlarged sectional area of wires for power supply.

(d) Connection

It is not allowed to extend the wiring distance by connecting two or more cables of short wiring length.

CAUTION

Do not extend the wiring distance by connecting two or more encoder wiring cables.
A voltage drop by contact resistance of connector may stop the operation abruptly.

Remark : The wire size conversion between AWG and [mm] is as follows.

Gauge		Diameter		Sectional area	
				Circular mil	mm^2
A W G	mm G	mil	mm	CM	mm^2
	1.4	55.12	1.400	3038	1.539
16		50.82	1.291	2583	1.309
	1.2	47.24	1.200	2232	1.131
23		22.57	0.5773	509.4	0.2581
	.55	21.65	0.5500	468.7	0.2376
24		20.10	0.5106	404.0	0.2047
	.50	19.69	0.5000	387.7	0.1963
25		17.90	0.4547	320.4	0.1623
	.45	17.72	0.4500	314.0	0.1590

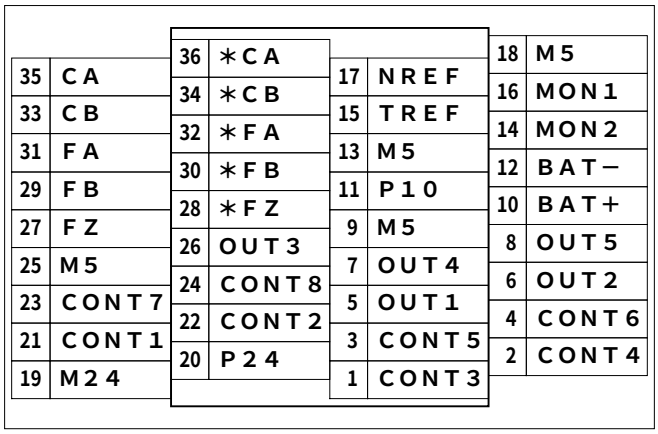
4.4 Host interface (I/F)

Connect signals to and from host controller to amplifier CN1 and CN3.

(1) RYS-V type amplifier, basic

• CN1

Connect control input/output signals.

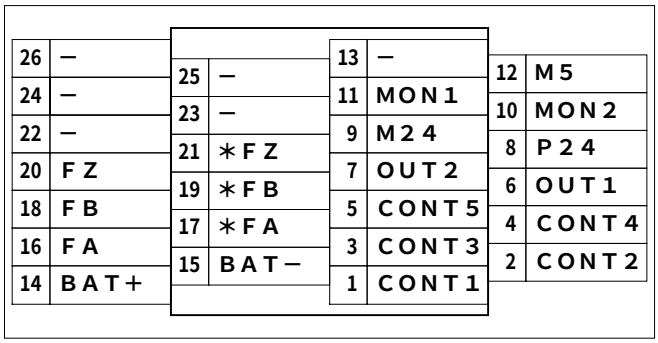


Plug : 10136-3000VE
Shell kit : 10336-52A0-008

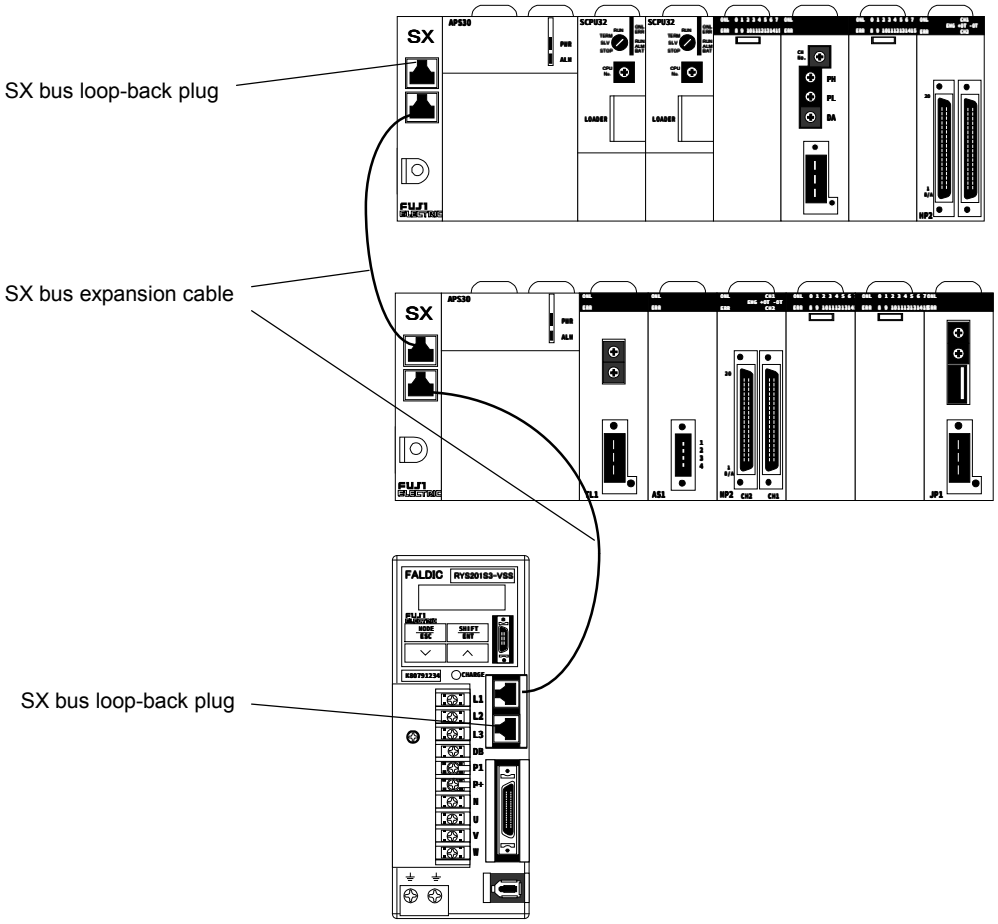
(2) RYS-V type amplifier, SX connection

(a) CN1

Connect control input/output signals.



(b) CN3
Connect SX bus expansion cable.
Connect the cable coming from OUT to IN.
Connect the SX bus loop-back plug to vacant connector.



■ **Terminal function**

(1) RYS□□□S3-VVS (DI/DO, speed control)

Terminal symbol (*)	Connector pin No.	Terminal name	Function
P24 M24	20 19	Control power supply	+24[V] DC, 0.2[A]
CONT1 CONT2 CONT3 CONT4 CONT5 CONT6 CONT7 CONT8	21 22 1 2 3 4 23 24	Control input	+24[V] DC, 10[mA] Initially assigned at factory : CONT1 : Run command [RUN] CONT2 : Manual forward [FWD] CONT3 : Manual reverse [REV] CONT4 : Alarm reset [RST] CONT5 : Multistep speed 1[X1] CONT6 : Ditto. 2 [X2] CONT7 : Pulse train ratio 1 CONT8 : Position control
OUT1 OUT2 OUT3 OUT4 OUT5	5 6 26 7 8	Control output	+30[V] DC, 50[mA] max. Initially assigned at factory : OUT1 : Ready [RDY] OUT2 : CPU ready [CPURDY] OUT3 : Speed zero [NZERO] OUT4 : － OUT5 : －
NREF TREF	17 15	Speed Torque	Terminal of speed command voltage Terminal of torque command voltage
P10 M5	11 13	Analog input	Power supply (+10[V] DC) for variable resistor of speed and torque command input
MON1 MON2 M5	16 14 9	Monitor 1 Monitor 2 (output)	Analog voltage. Initially assigned at factory : MON1 : Speed monitor MON2 : Torque monitor
CA *CA CB *CB M5	35 36 33 34 25	Pulse train input	Input terminal for pulse train input
FA *FA FB *FB FZ *FZ	31 32 29 30 27 28	Freq. dividing output	Freq. dividing terminal. Two 90° phase-different signal in proportion with rotational quantity of motor is outputted.
BAT+ BAT－	10 12	External backup (input)	Power supply for encoder backup

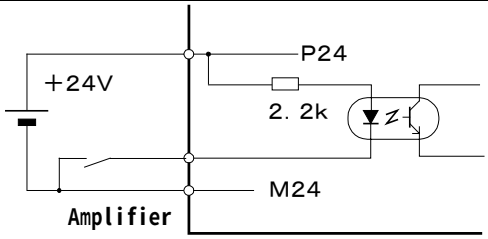
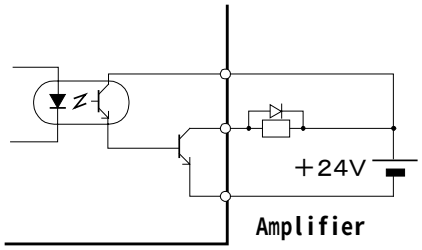
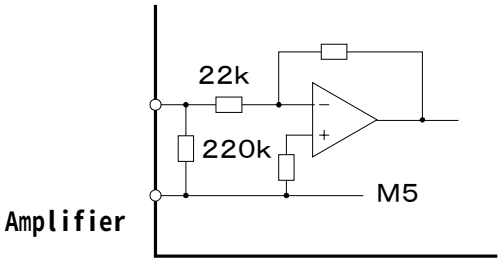
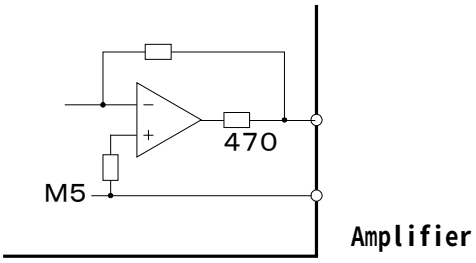
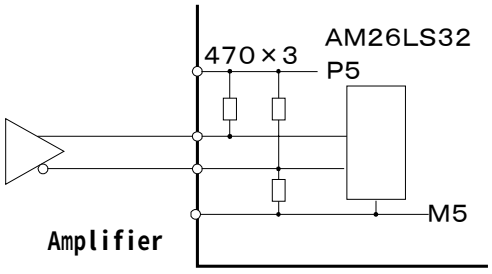
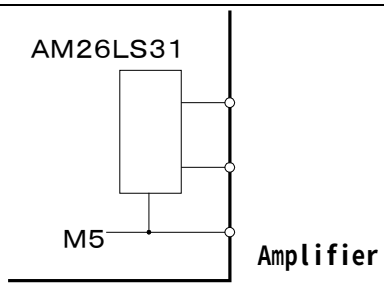
(*) Each of terminal M5 is internally connected. They are not connected with terminal M24.

(2) RYS□□□S3-VSS (SX bus, speed control)

Terminal symbol (*)	Connector pin No.	Terminal name	Function
P24 M24	8 9	Control power supply	+24[V] DC, 0.2[A]
CONT1 CONT2 CONT3 CONT4 CONT5	1 2 3 4 5	Control input	+24[V] DC, 10[mA] Initially assigned at factory : CONT1 : CONT2 : CONT3 : } 0 (not specified) CONT4 : CONT5 :
OUT1 OUT2	6 7	Control output	+30[V] DC, 50[mA] max. Initially assigned at factory : OUT1 : Brake timing OUT2 : Dynamic braking
MON1 MON2 M5	11 10 12	Monitor 1 Monitor 2 (output)	Analog voltage. Initially assigned at factory : MON1 : Speed monitor MON2 : Torque monitor
FA *FA FB *FB FZ *FZ	16 17 18 19 20 21	Freq. dividing output	Freq. dividing terminal. To 90° phase-different signal in proportion to rotational quantity of motor is outputted. The reference potential is at terminal M5.
BAT+ BAT−	14 15	External backup (input)	Power supply for encoder backup

(*) Each of terminal M5 is internally connected. They are not connected with terminal M24.

■ **Interface circuits**

Signal name	Specification	Interface circuit
Control input	+24[V] DC, 10[mA] (each one-point)	
Control output	+30[V] DC, 50[mA] (max.)	
Analog input	20[kΩ] impedance	
Analog output (monitor output)	Voltage output	
Pulse train input	Differential input	
Pulse train output	Differential output	

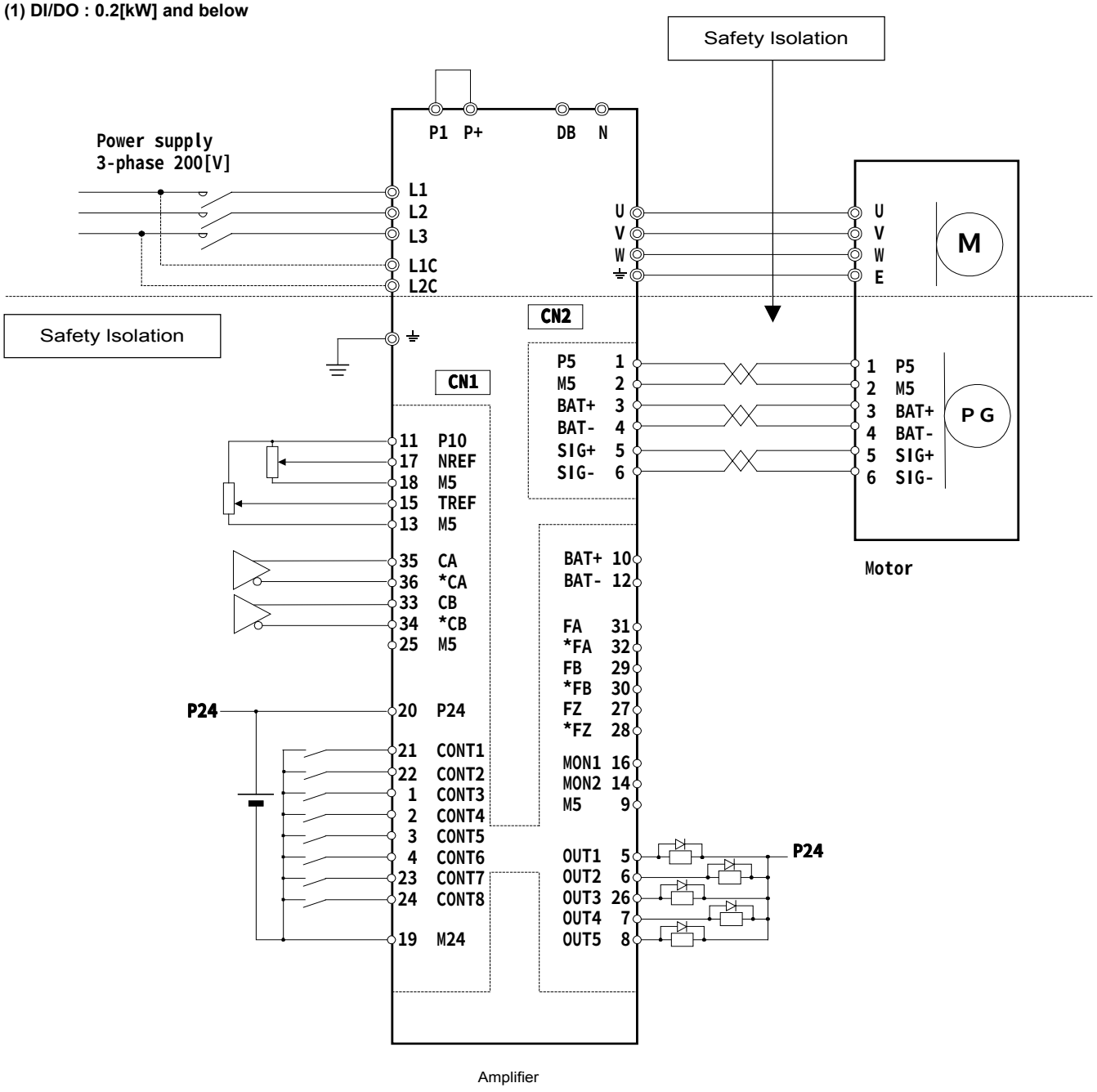
4.5 External connection diagrams (basic)

External connection diagrams of RYS-V type amplifier and GYC type motor are shown below.

	Page
(1) DI/DO : 0.2[kW] and below (*)	4-16
(2) Ditto. : 0.4[kW] and above	4-17
(3) SX bus : 0.2[kW] and below (*)	4-18
(4) Ditto. : 0.4[kW] and above	4-19
(5) Positioning module : NP1F-MP2	4-20
(6) Ditto. : NC1F-VP1	4-22
(7) Positioning unit : AD75	4-24
(8) Position control unit : C200HW-NC113	4-25

(*) For 0.2[kW] and below, braking resistor is not provided (is not built-in) with amplifier.

(1) DI/DO : 0.2[kW] and below

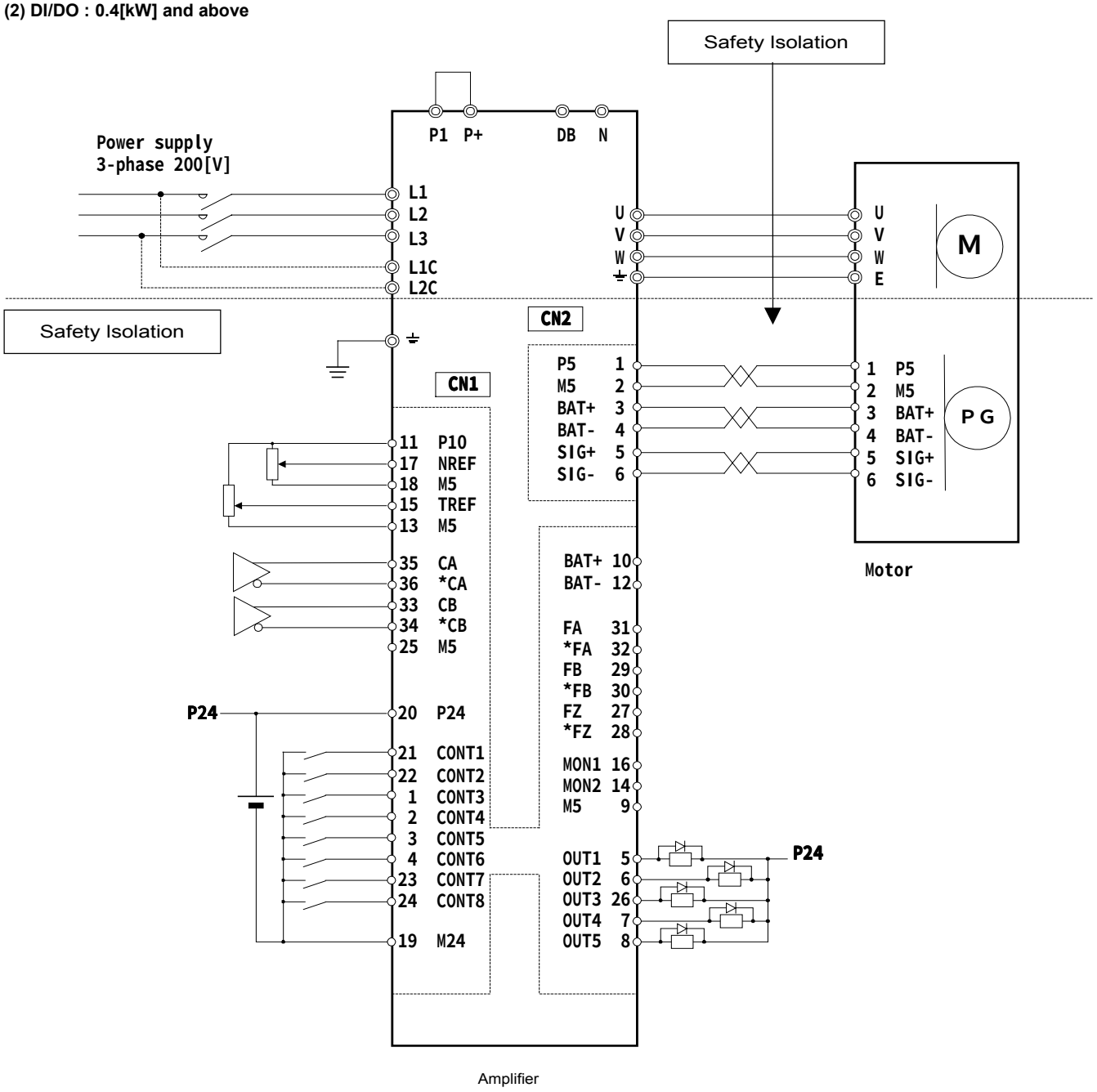


Amplifier

• CONT and OUT terminals are factory assigned : Refer to "Control function" (1) of 4.4.

• The wiring length between amplifier and motor can be extended to 20[m] long if an optional cable is applied (or to approx. 50[m] long provided that the cable sectional area is enlarged).

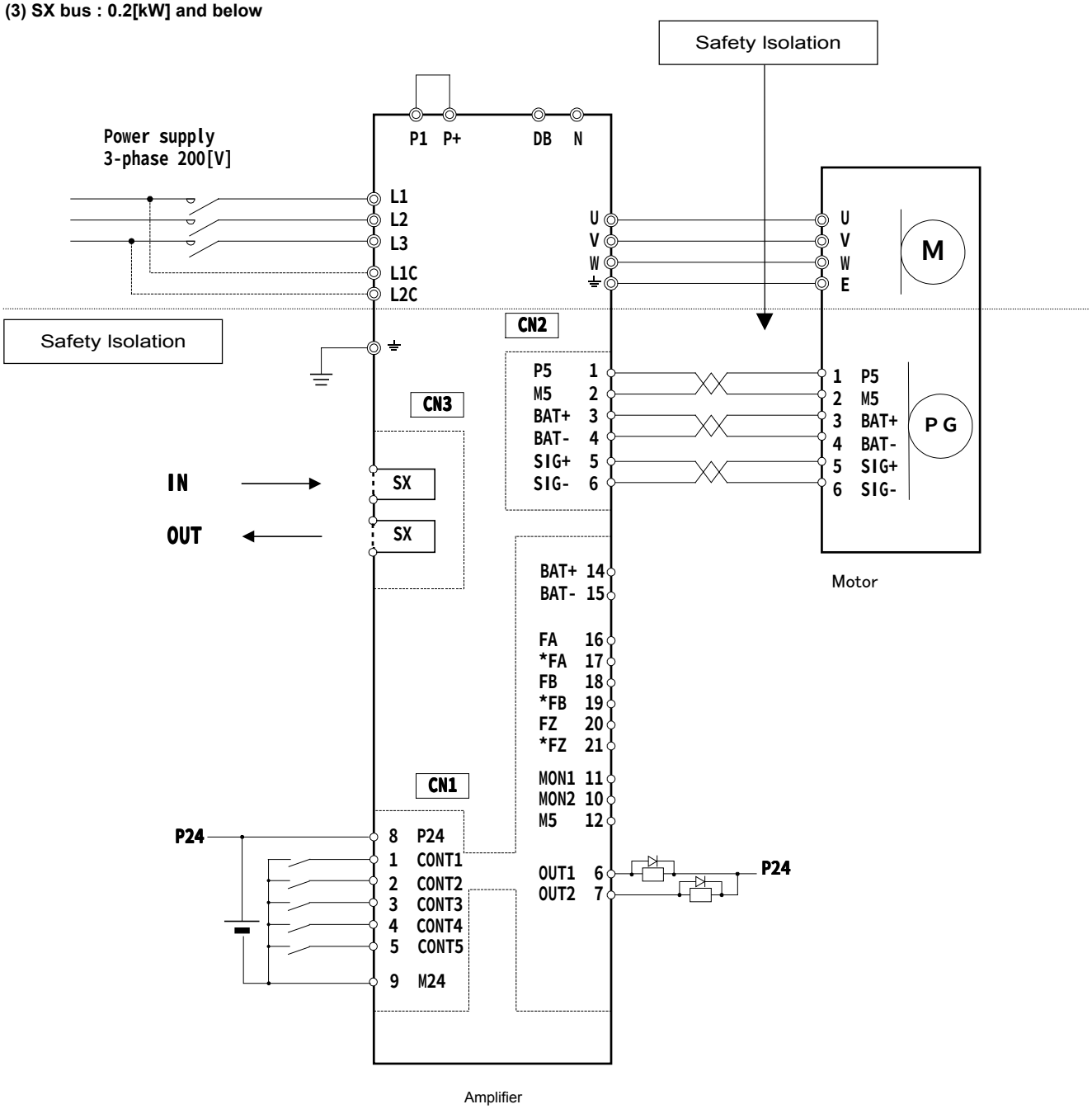
(2) DI/DO : 0.4[kW] and above



• CONT and OUT terminals are factory assigned : Refer to "Control function" (1) of 4.4.

• The wiring length between amplifier and motor can be extended to 20[m] long if an optional cable is applied (or to approx. 50[m] long provided that the cable sectional area is enlarged).

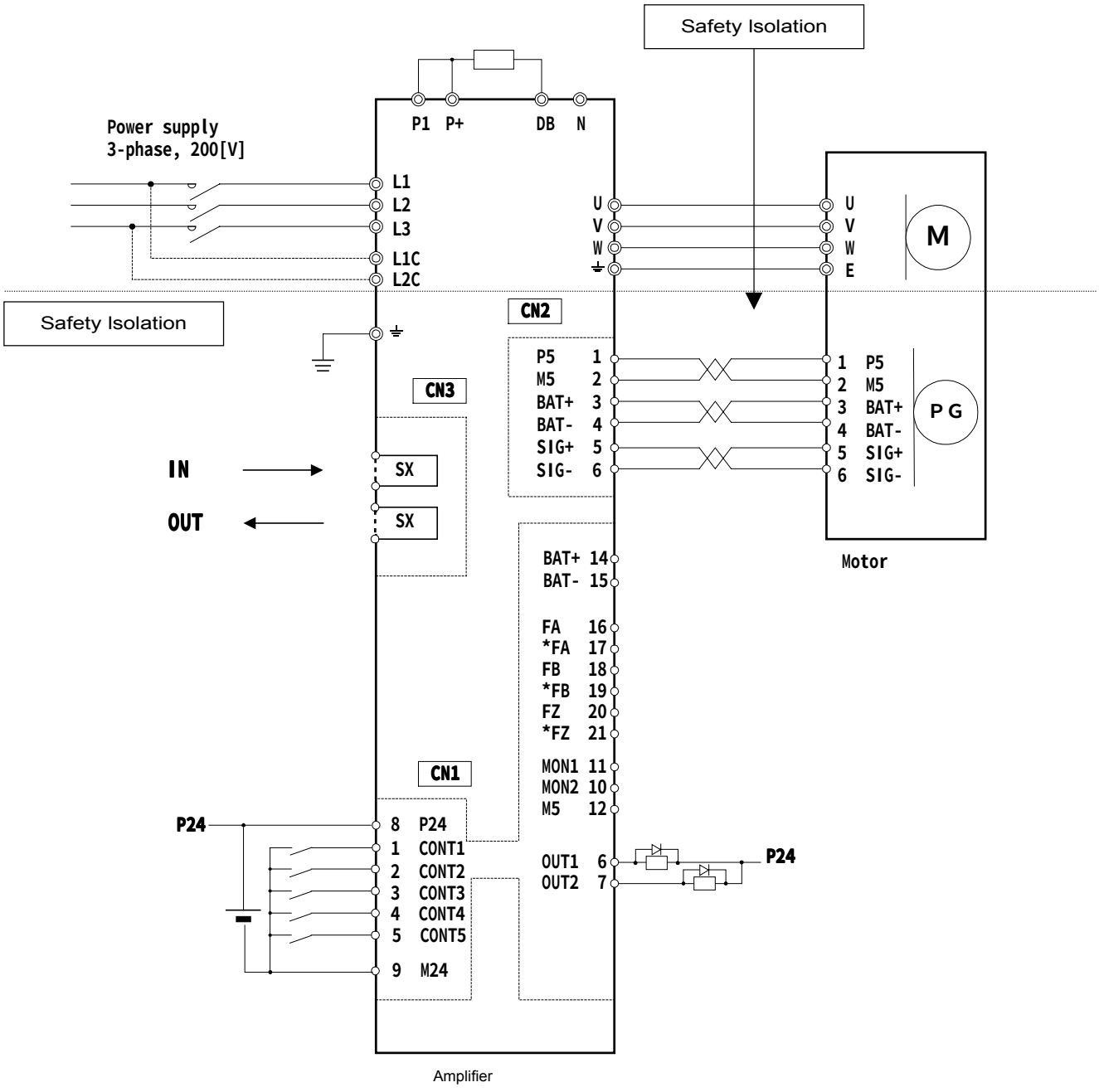
(3) SX bus : 0.2[kW] and below



• CONT and OUT terminals are factory assigned : Refer to "Control function" (2) of 4.4.

• The wiring length between amplifier and motor can be extended to 20[m] long if an optional cable is applied (or to approx. 50[m] long provided that the cable sectional area is enlarged).

(4) SX bus : 0.4[kW] and above

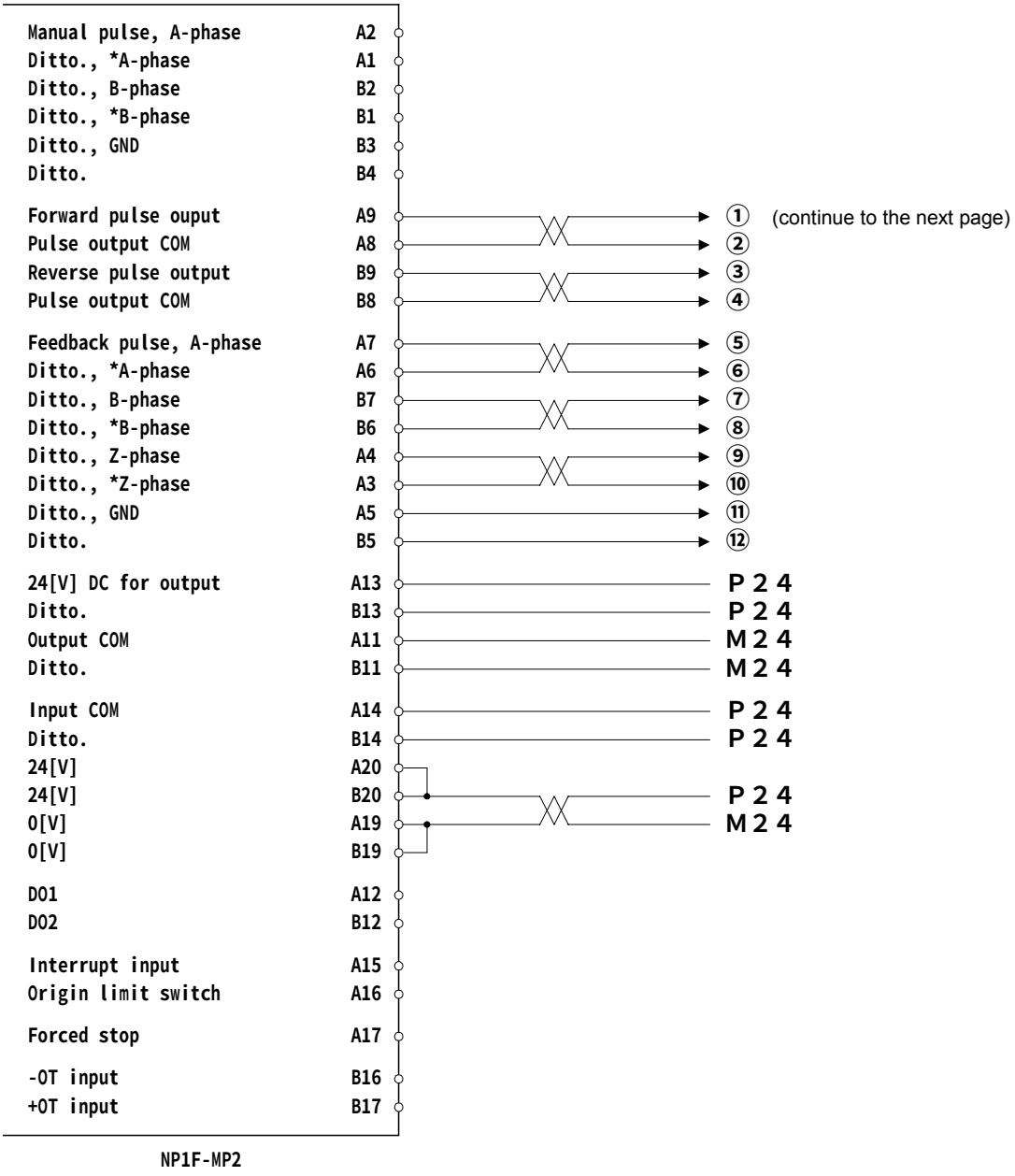


• CONT and OUT terminals are factory assigned : Refer to "Control function" (2) of 4.4.

• The wiring length between amplifier and motor can be extended to 20[m] long if an optional cable is applied (or to approx. 50[m] long provided that the cable sectional area is enlarged).

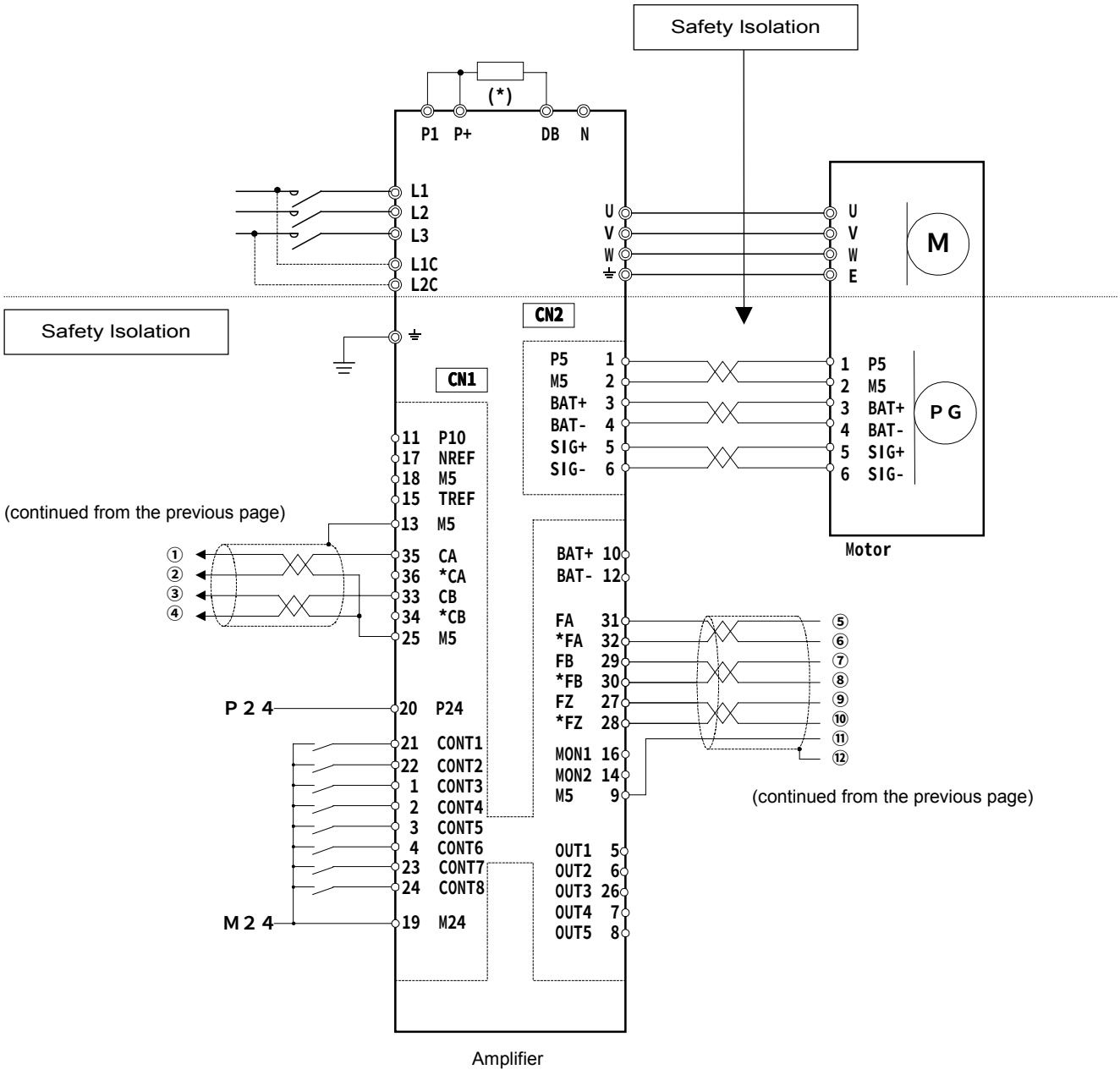
(5) Positioning module : NP1F-MP2

Typical connection with a positioning module (pulse train output two-axis) for MICREX-SX (Fuji's PLC) is shown below.
Control form is semi-closed loop and 500[kHz] input frequency (max.).



(continue to the next page)

(5) Positioning module : NP1F-MP2 (cont'd)

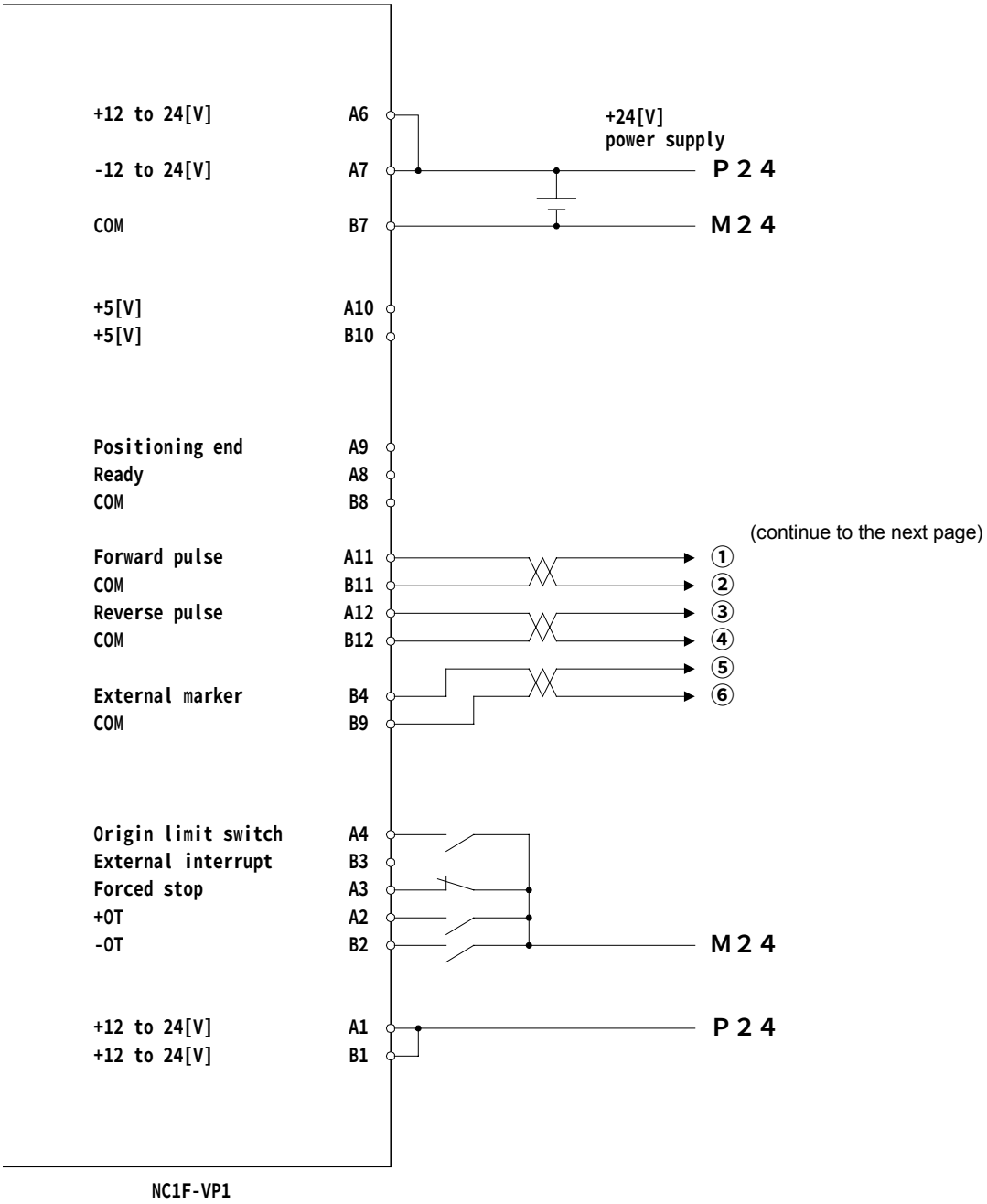


(*) For 0.2[kW] and below, braking resistor is not provided (is not built-in) with amplifier.

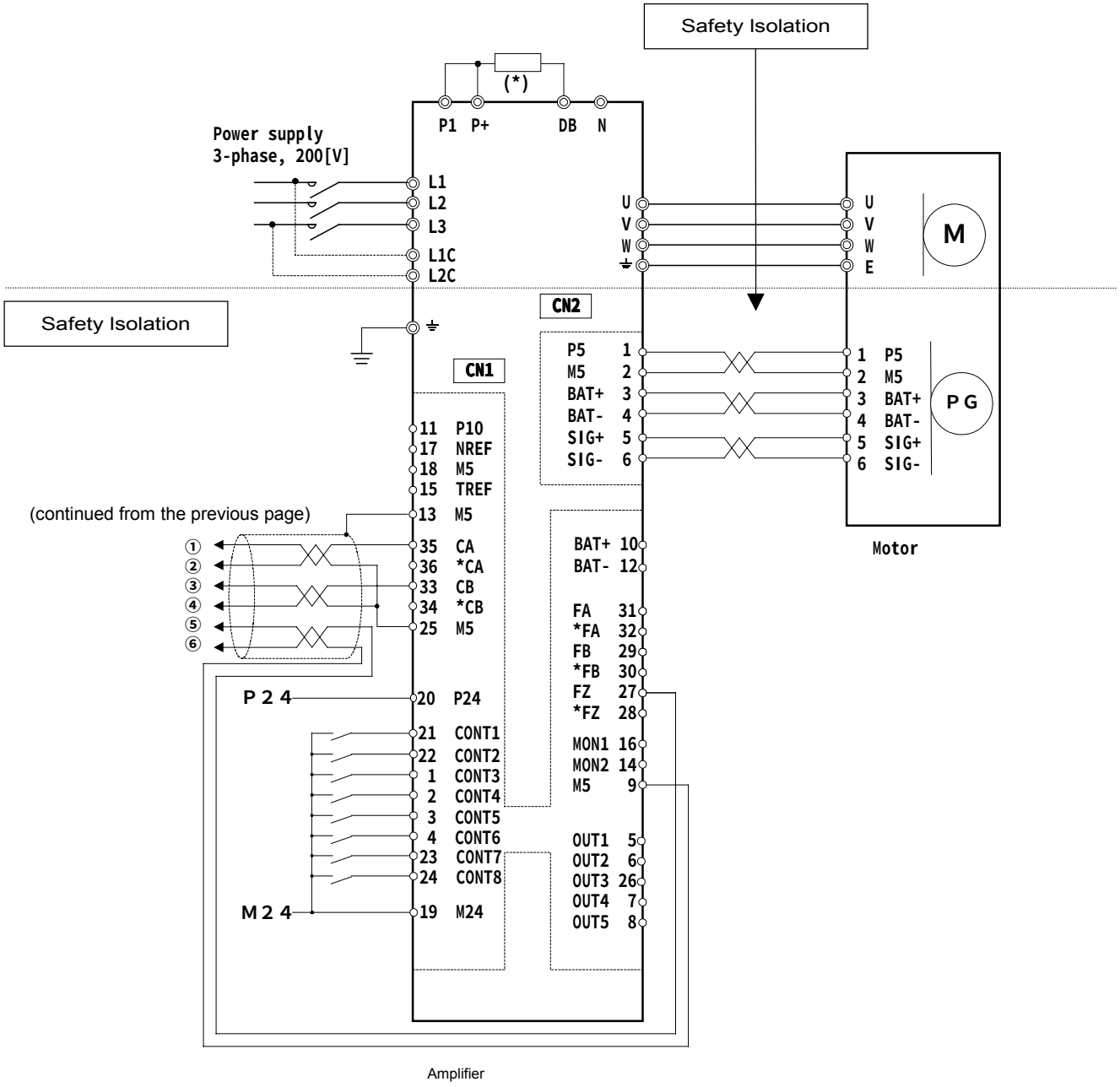
(6) Positioning module : NC1F-VP1

Typical connection with a positioning module for MICREX-F F70 (Fuji's PLC) is shown below.
Linear positioning can be applied. The pulse train of NC1F-VP1 is open collector output.
The output form setting at our shop before shipping is forward and reverse pulses.

• If MON output is on, the automatic start signal is not validated.
• MOFF at the same scan as when MON is on is not validated.



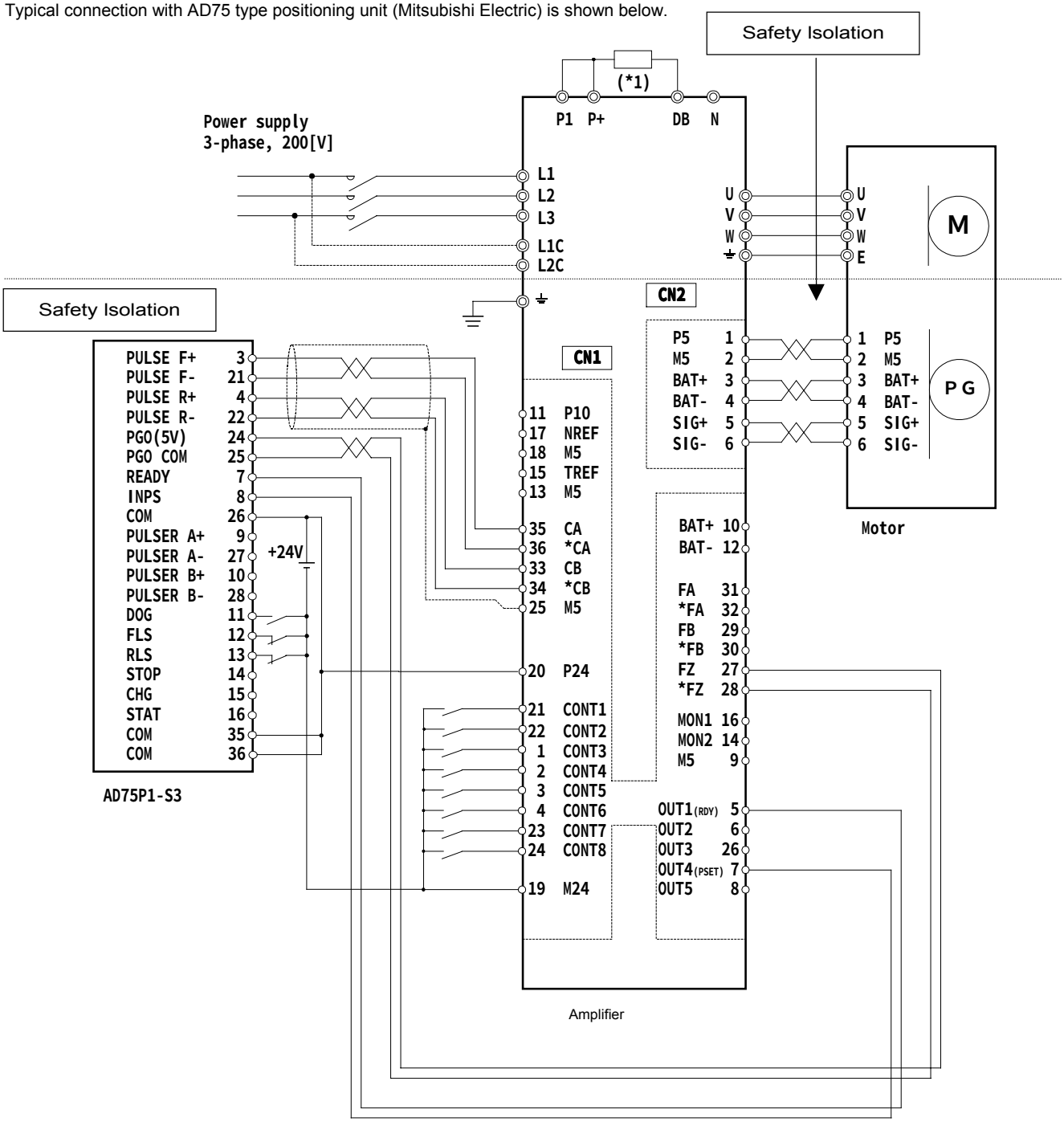
(6) Positioning module : NC1F-VP1 (cont'd)



(*) For 0.2[kW] and below, braking resistor is not provided (is not built-in) with amplifier.

(7) Positioning unit : AD75

Typical connection with AD75 type positioning unit (Mitsubishi Electric) is shown below.



(*1) For 0.2[kW] and below, braking resistor is not provided (is not built-in) with amplifier.

• The pulse output mode is used for CW/CCW (*2) pulse output.

• CONT and OUT terminals are factory assigned :

(i) System para. 1 to 8 : Refer to "Control function" (1) of 4.4

(ii) System para. 31 to 35 :

Terminal symbol	OUT1	OUT2	OUT3	OUT4 (*3)	OUT5
Function	Ready [RUN]	CPU ready [CPURDY]	Speed zero [NZERO]	Positioning end [PSET]	(not specified)

(*2) Direction of motor shaft rotation (when viewed from a point facing the drive-end of motor) is designed according to Japanese standards :

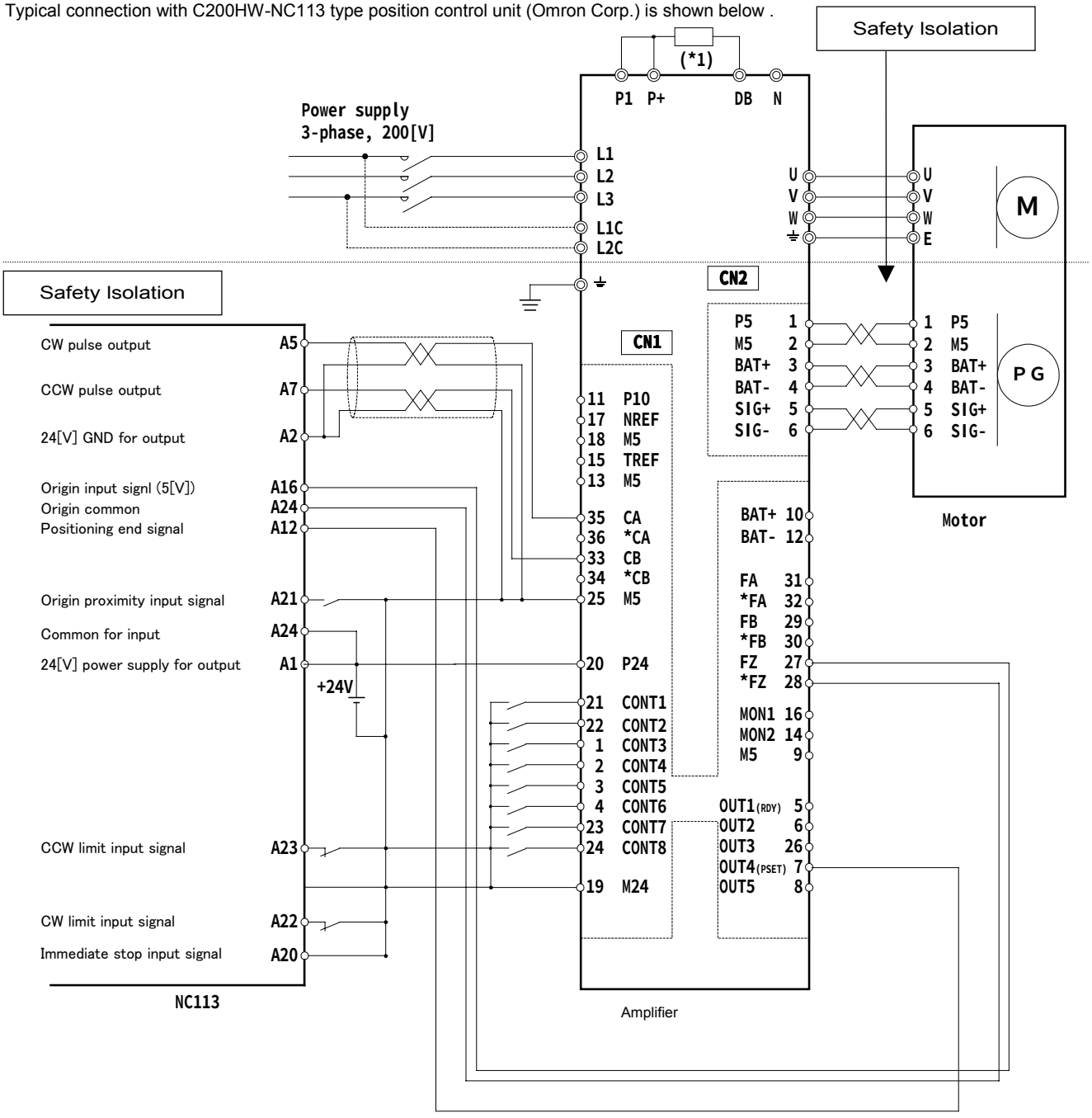
• Forward direction : Counter-clockwise (CCW) rotation • Reverse direction : Clockwise (CW) rotation

(*3) All other terminals are the same as factory assigned.

The assign number for positioning end [PSET] is "2".

(8) Position control unit : C200HW-NC113

Typical connection with C200HW-NC113 type position control unit (Omron Corp.) is shown below .



(*1) For 0.2[kW] and below, braking resistor is not provided (is not built-in) with amplifier.

• The pulse output mode is used for CW/CCW (*2) pulse output.

• CONT and OUT terminals are factory assigned :

(i) System para. 1 to 8 : Refer to "Control function" (1) of 4.4

(ii) System para. 31 to 35 :

Terminal symbol	OUT1	OUT2	OUT3	OUT4 (*2)	OUT5
Function	Ready [RUN]	CPU ready [CPURDY]	Speed zero [NZERO]	Positioning end [PSET]	(not specified)

(*2) All other terminals are the same as factory assigned.

The assign number for positioning end [PSET] is "2".

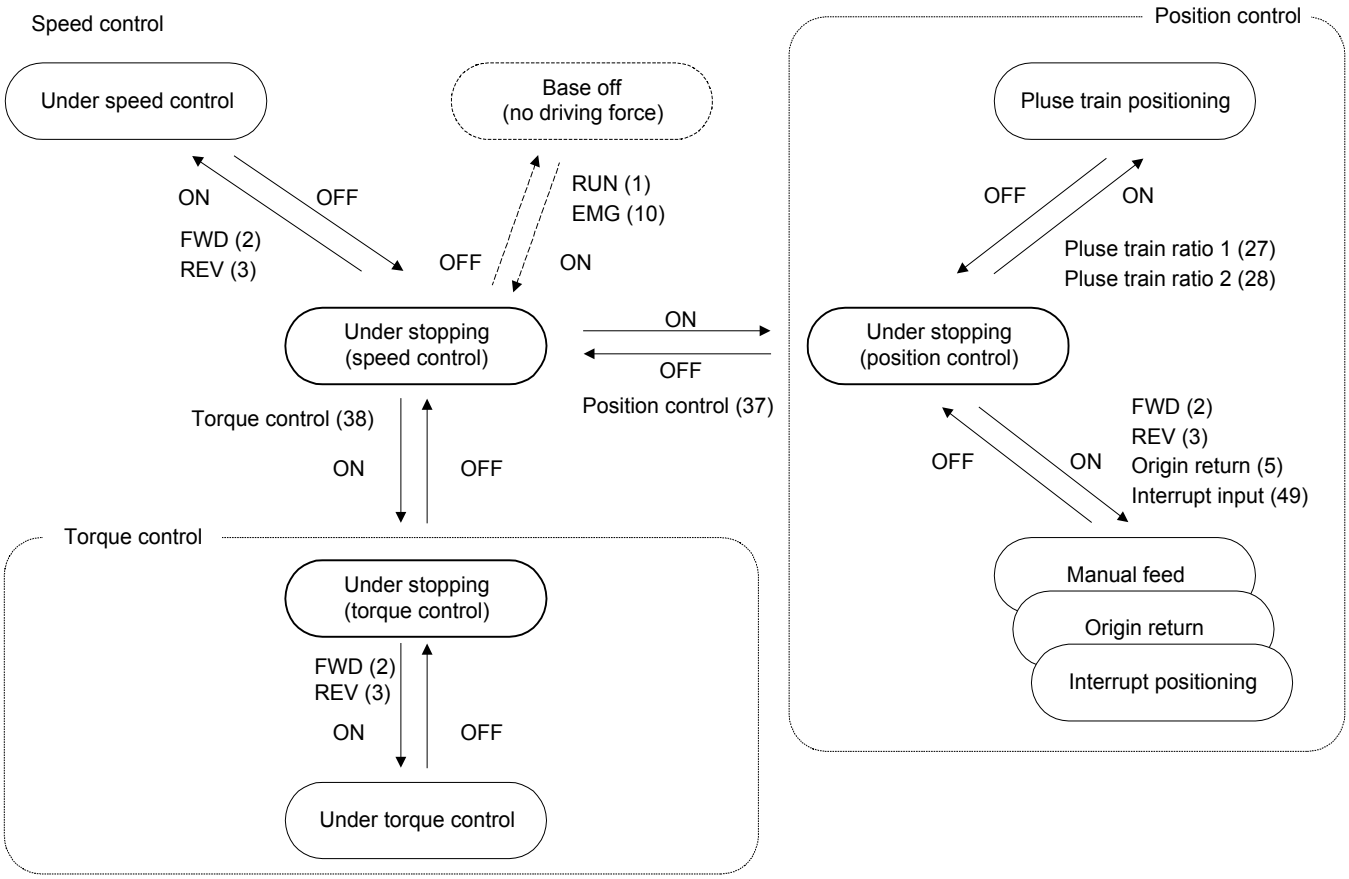
5. CONTROL FUNCTIONS

5.1 Summary

The control functions of RYS-V type are listed below.

- Speed control
  The motor speed is controlled.
- Position control
  The rotational quantity of motor's output shaft is controlled (pulse train input, origin return and interrupt positioning).
- Torque control
  The motor torque is controlled.

The speed control, position control or torque control can be selected by control input signal while the speed zero [NZERO] signal is turned on.
The ON width of speed zero signal can be changed by the basic para.(*) 52.

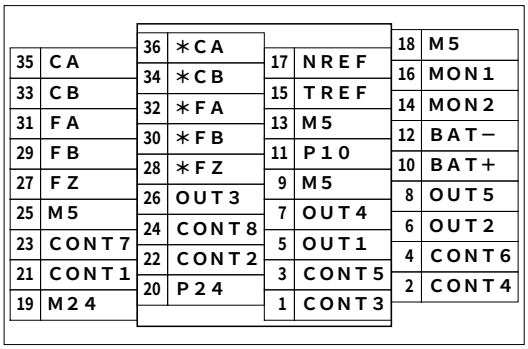


Connect the control input/output signals to the connector 1 (CN1) on the amplifier.
The shape of the connector 1 (CN1) differs from types of amplifier as follows.

Amplifier connector 1 (CN1)

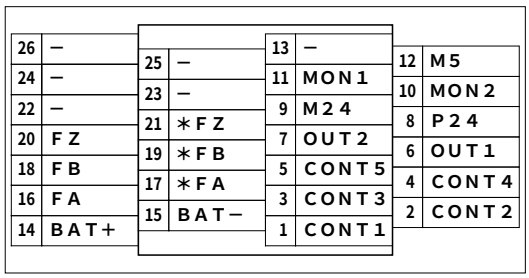
■ RYS□□□S3-VVS

① (DI/DO, speed control)



■ RYS□□□S3-VSS

② (SX bus, speed control)



Functions of terminals CONT1 to CONT8 and OUT1 to OUT5 can be changed according to the system para. setting.

Remarks:
The number in parentheses following the signal name on the previous page and hereinafter means the setting number to the system para. For example, Before performing position control using pulse train input, set "position control" (37) to "CONT assignment." Setting a number in parentheses to the system para. 87 or 88 varidates a corresponding signal at all times.

Note: (*) para.: parameter
List of the basic parameter and system parameter: See 6.5.

■ Terminal function

RYS□□□S3-VVS (DI/DO, speed control)

Terminal symbol (*)	Connector pin No.	Terminal name	Function
P24 M24	20 19	Control power supply	+24[V] DC, 0.2[A]
CONT1 CONT2 CONT3 CONT4 CONT5 CONT6 CONT7 CONT8	21 22 1 2 3 4 23 24	Control input	+24[V] DC, 10[mA] Initially assigned at factory : CONT1 : Run command [RUN] CONT2 : Manual forward [FWD] CONT3 : Manual reverse [REV] CONT4 : Alarm reset [RST] CONT5 : Multistep speed 1[X1] CONT6 : Ditto. 2 [X2] CONT7 : Pulse train ratio 1 CONT8 : Position control
OUT1 OUT2 OUT3 OUT4 OUT5	5 6 26 7 8	Control output	+30[V] DC, 50[mA] max. Initially assigned at factory : OUT1 : Ready [RDY] OUT2 : CPU ready [CPURDY] OUT3 : Speed zero [NZERO] OUT4 : － OUT5 : －
NREF TREF	17 15	Speed Torque	Terminal of speed command voltage Terminal of torque command voltage
P10 M5	11 13	Analog input	Power supply (+10[V] DC) for variable resistor of speed and torque command input
MON1 MON2 M5	16 14 9	Monitor 1 Monitor 2 (output)	Analog voltage. Initially assigned at factory : MON1 : Speed monitor MON2 : Torque monitor
CA *CA CB *CB M5	35 36 33 34 25	Pulse train input	Input terminal for pulse train input
FA *FA FB *FB FZ *FZ	31 32 29 30 27 28	Freq. dividing output	Freq. dividing terminal. Two 90° phase-different signal in proportion with rotational quantity of motor is outputted.
BAT+ BAT－	10 12	External backup (input)	Power supply for encoder backup

(*) Each of terminal M5 is internally connected. They are not connected with terminal M24.

RYS□□□S3-VSS (SX bus, speed control)

Terminal symbol (*)	Connector pin No.	Terminal name	Function
P24 M24	8 9	Control power supply	+24[V] DC, 0.2[A]
CONT1 CONT2 CONT3 CONT4 CONT5	1 2 3 4 5	Control input	+24[V] DC, 10[mA] Initially assigned at factory : CONT1 : 49 (interrupt) CONT2 : CONT3 : CONT4 : CONT5 : 0 (not specified)
OUT1 OUT2	6 7	Control output	+30[V] DC, 50[mA] max. Initially assigned at factory : OUT1 : Brake timing OUT2 : Dynamic braking
MON1 MON2 M5	11 10 12	Monitor 1 Monitor 2 (output)	Analog voltage. Initially assigned at factory : MON1 : Speed monitor MON2 : Torque monitor
FA *FA FB *FB FZ *FZ	16 17 18 19 20 21	Freq. dividing output	Freq. dividing terminal. To 90° phase-different signal in proportion to rotational quantity of motor is outputted. The reference potential is at terminal M5.
BAT+ BAT−	14 15	External backup (input)	Power supply for encoder backup

(*) Each of terminal M5 is internally connected. They are not connected with terminal M24.

5.2 Run command

This section explains the signals to run the motor and the signals to reset alarm detection.

Control input signal : Run command [RUN] (1)
Alarm reset [RST] (11)

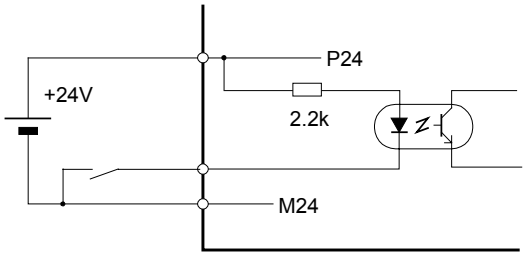
Control output signal : Ready [RDY] (1)
Alarm detection [ALM] (16)
Alarm code 0 [ALM0] (32)
Alarm code 1 [ALM1] (33)
Alarm code 2 [ALM2] (34)
Alarm code 3 [ALM3] (35)
Alarm code 4 [ALM4] (36)

5.2.1 Run command [RUN]

The signal allows the motor to rotate.
While the [RUN] signal is on, the motor is energized and can rotate.
Even if commercial power is applied to amplifier for driving motor, the motor will not start while [RUN] is off.
When turning off this [RUN] signal while motor is running, motor decelerates quickly until it stops. After the stoppage, it is not held. No holding torque is available after the motor stops.
When the [RUN] signal is turned off, all rotation commands are ignored.
Basically, motor can be operated when [RUN] is on and forced stop [EMG] signal is on.

While [RUN] signal is on and other signals are off, the motor is in stopping condition.

■ Interface



Run command [RUN] (1)
ON : Allows the motor to rotate.
OFF : Motor is in free-run status.

■ Parameter setting
To allocate the run command [RUN] signal to the control input terminal, set (1) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

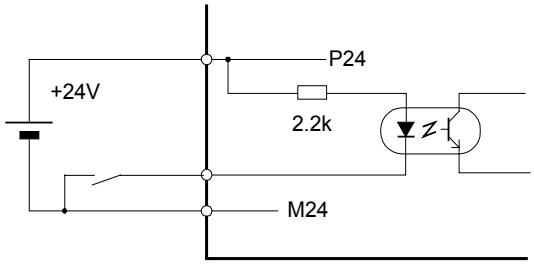
■ Related item
For the forced stop [EMG] signal, see 5.5.1.

5.2.2 Alarm reset [RST]

This signal input resets the alarm detection being issued from the amplifier.

At the ON edge of alarm reset [RST] signal of control input signals, the alarm detection is reset.
Alarm detection can also be reset in the trial operation mode [F_n004] by keypad panel.
Alarm detection can also be reset by turning on power supply again.

■ Interface



Alarm reset [RST] (11)
ON edge : Resets the alarm detection
(ON edge means at the transition from OFF level to ON level.)

■ Parameter setting

To allocate the alarm reset [RST] signal to the control input terminal, set (11) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

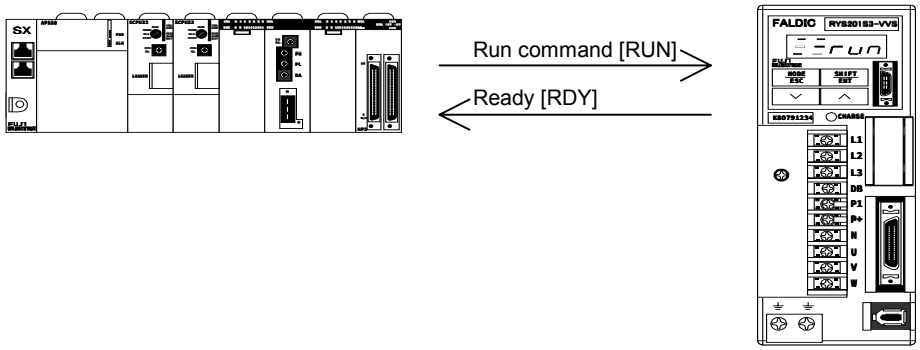
■ Related item

How to reset alarm reset is as listed below:
1) At the ON edge of [RST] signal of control input signal
2) ENT key operation in the trial operation mode [F_n004]
3) Press ∧ key and ∨ key simultaneously (longer than 1s) at alarm detection [S_n003]
4) Press ∧ key and ∨ key simultaneously (longer than 1s) at alarm history [S_n004]
5) Power shut down and turn on again
To initialize the history of alarm detection, press ENT key in the trial operation mode [F_n005].

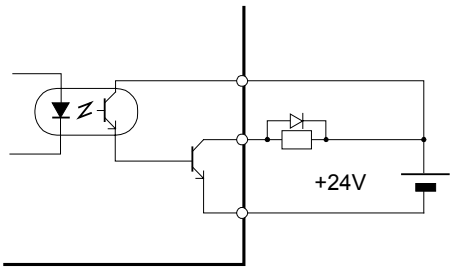
5.2.3 Ready [RDY]

This signal turns on when the motor can be rotated.

Listed below are five conditions for turning on this signal.
1) Run command [RUN] (1) signal on
2) Forced stop [EMG] (10) signal on
3) Alarm detection (16) signal off
4) External fault input (34) signal on
5) Free-run [BX] (54) signal off
When the host controller receives the on/off status of [RDY] signal, it recognizes that the motor can be rotated.



■ Interface



Ready [RDY] (1)
ON : The motor can be rotated.
OFF : Motor cannot be rotated.

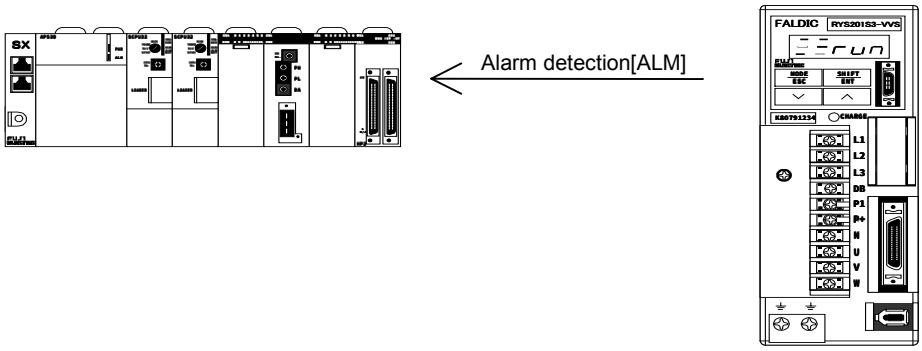
■ Parameter setting
To allocate the ready [RDY] signal to the control output terminal, set (1) to the system para.

■ Related items
The amplifier can also output “CPU ready” [CPURDY] (28) signal, which is turned on when the power is being supplied to amplifier and the internal CPU is processing normally.
For alarm detection (16) signal, see 5.2.4.
For external fault input (34) signal, see 5.5.5.
For free-run [BX] (54) signal, see 5.7.7.

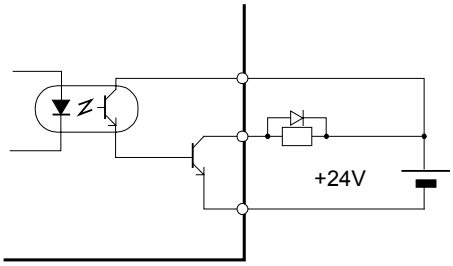
5.2.4 Alarm detection [ALM]

This signal is turned on when the amplifier protective function activates (detects an alarm).

This signal is on when amplifier detects alarm, and retained by amplifier. The signal is turned off at the ON edge of alarm reset [RST] signal after the cause of alarm is removed (Operation is enable).
Alarm or no alarm can be checked when the host control device recognizes the on/off status of the alarm detection [ALM] signal. This also can be checked whether the ready [RDY] signal is off when the running command [RUN] is on.



■ Interface



Alarm detection [ALM] (16)
ON : Amplifier is detecting alarm
OFF : Alarm is not detected.

■ Parameter setting

To allocate the alarm detection [ALM] signal to the control output terminal, set (16) to the system para.

■ Related item

The contents of alarm detection can also be output to the control output terminals by alarm code.
Alarm code 4 [ALM4] (36) Alarm code 3 [ALM3] (35)
Alarm code 2 [ALM2] (34) Alarm code 1 [ALM1] (33)
Alarm code 0 [ALM0] (32)

*2

[ALM4]	[ALM3]	[ALM2]	[ALM1]	[ALM0]	Detection contents	Order of priority
OFF	OFF	OFF	OFF	OFF	(No detection)	21
OFF	OFF	OFF	OFF	ON	Motor overload (OL)	13
OFF	OFF	OFF	ON	OFF	-	-
OFF	OFF	OFF	ON	ON	Amplifier overheat (AH)	14
OFF	OFF	ON	OFF	OFF	Braking resistor overheat (rH)	15
OFF	OFF	ON	OFF	ON	Deviation excessive (OF)	16
OFF	OFF	ON	ON	OFF	Overcurrent (OC)	2
OFF	OFF	ON	ON	ON	Overspeed (OS)	3
OFF	ON	OFF	OFF	OFF	Overvoltage (Hv)	5
OFF	ON	OFF	OFF	ON	Undervoltage (Lv)	4
OFF	ON	OFF	ON	OFF	Encoder trouble (ET) *3)	6
OFF	ON	OFF	ON	ON	-	-
OFF	ON	ON	OFF	OFF	Control power trouble (Ct) *3)	7
OFF	ON	ON	OFF	ON	Memory error (dE) *3)	8
OFF	ON	ON	ON	OFF	-	-
OFF	ON	ON	ON	ON	-	-
ON	OFF	OFF	OFF	OFF	Encoder communication error (EC)	11
ON	OFF	OFF	OFF	ON	Motor combination error (CE) *3)	9
ON	OFF	OFF	ON	OFF	Resistor overheat 2 (rH2)	10
ON	OFF	OFF	ON	ON	CONT (control signal) error (CtE) *3)	12
ON	OFF	ON	OFF	OFF	Encoder overheat (EH)	17
ON	OFF	ON	OFF	ON	ABS (Absolute) data lost (AL) *4)	18
ON	OFF	ON	ON	OFF	Multiple rotation data overflow (AF) *4)	19
ON	OFF	ON	ON	ON	Terminal error (tE)	20
ON	ON	OFF	OFF	OFF	-	-
ON	ON	OFF	OFF	ON	-	-
ON	ON	OFF	ON	OFF	-	-
ON	ON	OFF	ON	ON	-	-
ON	ON	ON	OFF	OFF	(BCD error) *1)	-
ON	ON	ON	OFF	ON	(Out of range) *1)	-
ON	ON	ON	ON	OFF	(Negative sign specified) *1)	-
ON	ON	ON	ON	ON	System error	1

*1) BCD error, out of range, and negative sign specified are not included in the alarm detection (amplifier protective function activation).
*2) If several alarms are simultaneously detected, the output priority is as given on the table above.
*3) The alarm reset [RST] signal cannot release the alarm detection. Turn on power supply again.
*4) The alarm reset [RST] signal cannot release the alarm detection. Reset it by inputting the position preset signal

The contents of detected alarm can be output in code.
When alarm detection is released, all of the output is turned off.

5.3 Speed control

This section explains the signals to run or control the motor speed.

Control input signal : Forward command [FWD] (2)
Reverse command [REV] (3)
ACC0 [ACC0] (14)
Multistep speed 1 [X1] (51)
Multistep speed 2 [X2] (52)
Multistep speed 3 [X3] (53)
Speed command [NREF] (fixed)
Torque command [TREF] (fixed)

Control output signal : Speed zero [NZERO] (24)
Speed arrive [NARV] (25)

5.3.1 Forward command [FWD], Reverse command [REV]

These signals rotate the motor.

While the forward command [FWD] (reverse command [REV]) signal is on, the motor rotates forward (in reverse). Acceleration starts at the ON edge, deceleration starts at the OFF edge.
When the forward command and reverse command are turned on simultaneously, the motor decelerates to stop.
Operation depends, in speed control, position control, or torque control.

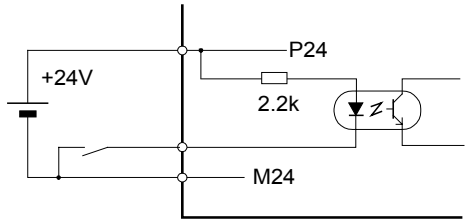
(1) Speed control
Motor rotates at the speed selected by [X1], [X2] and [X3].

[X3]	[X2]	[X1]	Speed
OFF	OFF	OFF	Speed set by speed command [NREF] terminal
OFF	OFF	ON	Speed set by basic parameter 1
OFF	ON	OFF	Speed set by basic parameter 2
OFF	ON	ON	Speed set by basic parameter 3
ON	OFF	OFF	Speed set by basic parameter 4
ON	OFF	ON	Speed set by basic parameter 5
ON	ON	OFF	Speed set by basic parameter 6
ON	ON	ON	Speed set by basic parameter 7

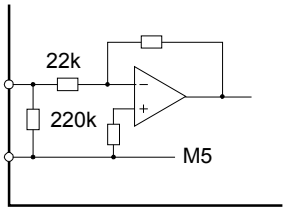
(2) Position control
Operation is same as the one by voltage of voltage of speed control. The motor starts rotation at the ON edge of forward command [FWD] (reverse command [REV]). Even when the both command signals are turned on simultaneously, the motor does not stop.
For the interrupt positioning, see 5.7.

(3) Torque control
Motor outputs its torque according to the voltage of speed command [NREF] terminal. See 5.6 for the torque control.

■ Interface



Forward command [FWD] (2)
Reverse command [REV] (3)
ON : Starts acceleration
OFF : Starts deceleration.



Speed command [NREF]
Torque command [TREF]
±10V/max. speed (±9V/max. torque)
Analog voltage input

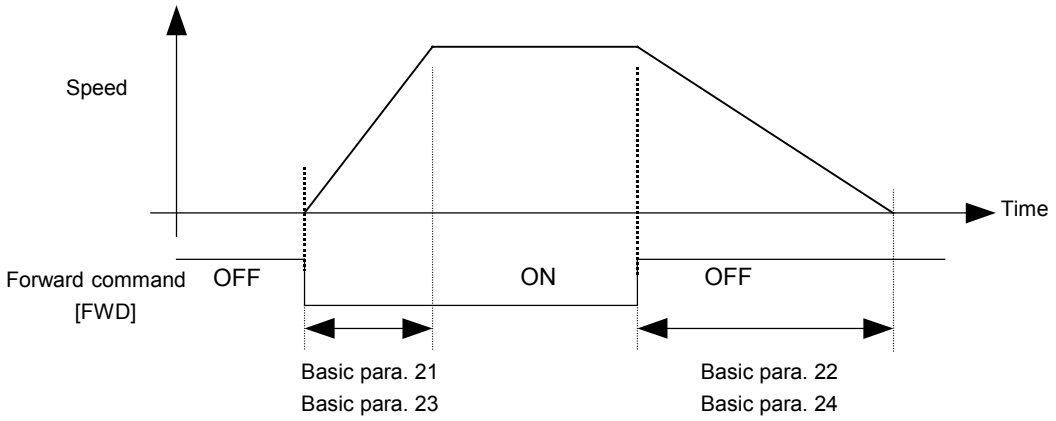
■ Parameter setting

To allocate the forward command [FWD] signal to the control input terminal, set (2) to the system para. (set (3) for Reverse command [REV])
If these signals are not allocated to the control input terminal, these signals are deemed "always off."

■ Related items

• Changeover of acceleration/deceleration time

The acceleration and deceleration time of motor can be set by basic para. 21 to 24. The acceleration time and deceleration time can be set independently.



Basic parameter 21 to 24

Para.	Name	Setting range.	Initial value	Change
21	Acceleration time 1	0.000 to 99.999s (in 0.001s steps)	0.100	Always
22	Deceleration time 1	0.000 to 99.999s (in 0.001s steps)	0.100	Always
23	Acceleration time 2	0.000 to 99.999s (in 0.001s steps)	0.100	Always
24	Deceleration time 2	0.000 to 99.999s (in 0.001s steps)	0.100	Always

The acceleration time is set by the basic para. 21 or 23, regardless of rotational direction.
Acceleration time 1 or 2 (basic para. 21 or 23) can be selected by system para. ACC0 [ACC0] setting.

[ACC0] (14)	Acceleration time	Deceleration time
OFF	Basic para. 21	Basic para. 22
ON	Basic para. 23	Basic para. 24

To allocate the ACC0 [ACC0] signal to the control input terminal, set (14) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

• Rotation speed

In speed control, seven kinds of motor speed can be set by the basic para. 1 to 7.

Basic parameter 1 to 7

Para.	Name	Setting range	Initial value	Change
1	Manual feed speed 1	0.01 to Max. speed [r/min] (in 0.01 steps)	100.00	Always
2	Manual feed speed 2	0.01 to Max. speed [r/min] (in 0.01 steps)	500.00	Always
3	Manual feed speed 3	0.01 to Max. speed [r/min] (in 0.01 steps)	1000.00	Always
4	Manual feed speed 4	0.01 to Max. speed [r/min] (in 0.01 steps)	100.00	Always
5	Manual feed speed 5	0.01 to Max. speed [r/min] (in 0.01 steps)	100.00	Always
6	Manual feed speed 6	0.01 to Max. speed [r/min] (in 0.01 steps)	100.00	Always
7	Manual feed speed 7	0.01 to Max. speed [r/min] (in 0.01 steps)	100.00	Always

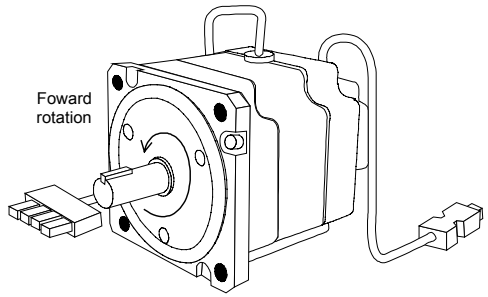
Motor speed can be changed by combining the on/off status of X1, X2 and X3 terminals.
The speed change is possible even while motor is rotating.

Selection of multistep speed

X3	X2	X1	Speed
OFF	OFF	OFF	By speed command [NREF] terminal
OFF	OFF	ON	Basic para. 1 (manual feed speed 1)
OFF	ON	OFF	Basic para. 2 (manual feed speed 2)
OFF	ON	ON	Basic para. 3 (manual feed speed 3)
ON	OFF	OFF	Basic para. 4 (manual feed speed 4)
ON	OFF	ON	Basic para. 5 (manual feed speed 5)
ON	ON	OFF	Basic para. 6 (manual feed speed 6)
ON	ON	ON	Basic para. 7 (manual feed speed 7)

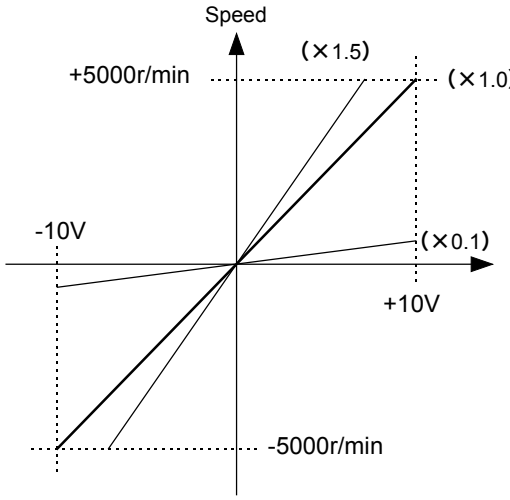
- Rotational direction

  The rotational direction of motor output shaft for the forward command [FWD] can be changed by the system para. 80. When the para. 80 is initial value, motor rotates in forward direction (counterclockwise viewed from shaft extension) for forward command. In case the motor rotates opposite to the machine movement, set 1 at the para. 80. The setting change of the system para. becomes valid after turning on power again.



- Gain for speed command [NREF] terminal

  At factory setting, the motor rotates forward at 5000[r/min] against +10V of the speed command voltage.
  By setting the system para. 63, the motor speed can be adjusted against the set speed command voltage.



Speed command voltage

*The value in ( ) is the setting value of system para. 63.

If the system para. 63 has been set at 0.1, the speed can be adjusted to 500[r/min] against +10V of the speed command voltage.

- Resolution of speed command voltage

  The speed command [NREF] terminal has a 14 bit resolution at full scale.
  The torque command [TREF] terminal has a 10 bit resolution at full scale.

- Torque limiting

  Motor output torque can be limited by using the torque limiting [TLMT] (30) signal. The torque limiting value can be selected by analog voltage at torque command [TREF] terminal and parameter setting. For details, see 5.5 Signal for safety.

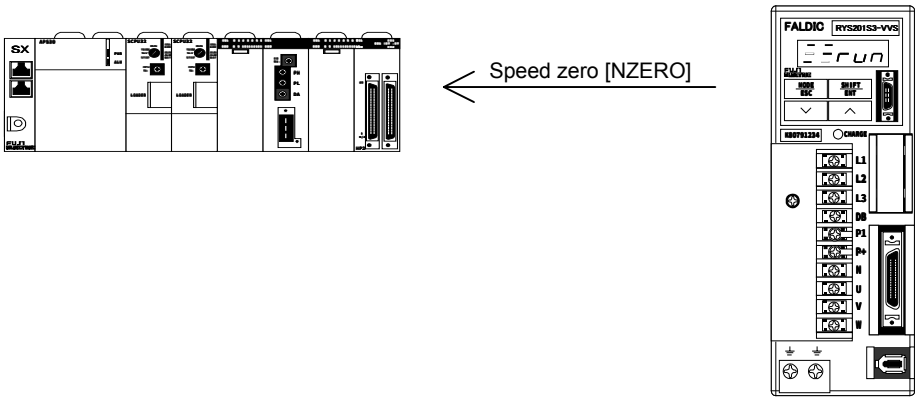
- S-curve acceleration/deceleration

  S-curve acceleration/deceleration can be carried out by basic para. 25 setting.
  The speed slowly increases by drawing an S-curve, and a shock during acceleration can be reduced.
  See 6.1.5 Non-linear (S-curve) filter coefficient.

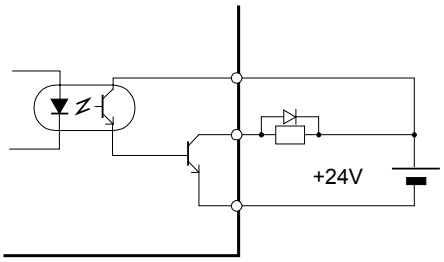
5.3.2 Speed zero [NZERO]

This signal is turned on when the motor speed is near zero.

This signal turns on when the motor speed is below the value set by basic para. 52.
Control can be changed among speed control, position control and torque control when speed zero [NZERO] signal is on.
Control is shifted to position control mode when position control (37) is on, to torque control mode when torque control (38) is on.



■ Interface



Speed zero [NZERO] (24)
ON : Control mode can be changeable.
OFF : Motor is rotating.

■ Parameter setting
To allocate the speed zero [NZERO] signal to the control output terminal, set (24) to the system para.

■ Related item
Basic parameter 52

Para.	Name	Setting range	Initial value	Change
52	Speed zero width	10 to Max. speed [r/min] (in increments of 1)	20	Always

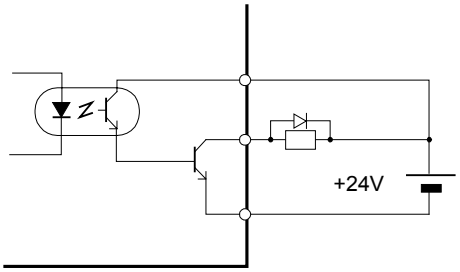
5.3.3 Speed arrive [NARV]

Check can be done that the motor rotation reaches the reference speed.

This signal turns on when motor speed reaches within setting value of basic para. 51 from the reference speed. The reference speed is the setting values of basic para. 1 to 7 and the speed command voltage. This signal is effective in speed control and position control (interrupt positioning). When control is shifted to torque control, the signal on/off status is retained at the point.

This signal will not be turned on for the following conditions:
1) [FWD] signal or [REV] signal is off.
2) Max. speed of basic para. 16 is lower than the reference speed.
3) Acceleration/deceleration time is long and the speed does not reach the reference speed.

■ Interface



Speed arrive [NARV] (25)
ON : Reaches the reference speed.
OFF : Does not reach the reference speed.

■ Parameter setting

To allocate the speed arrive [NARV] signal to the control input terminal, set (25) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

■ Related items

Basic parameter 51

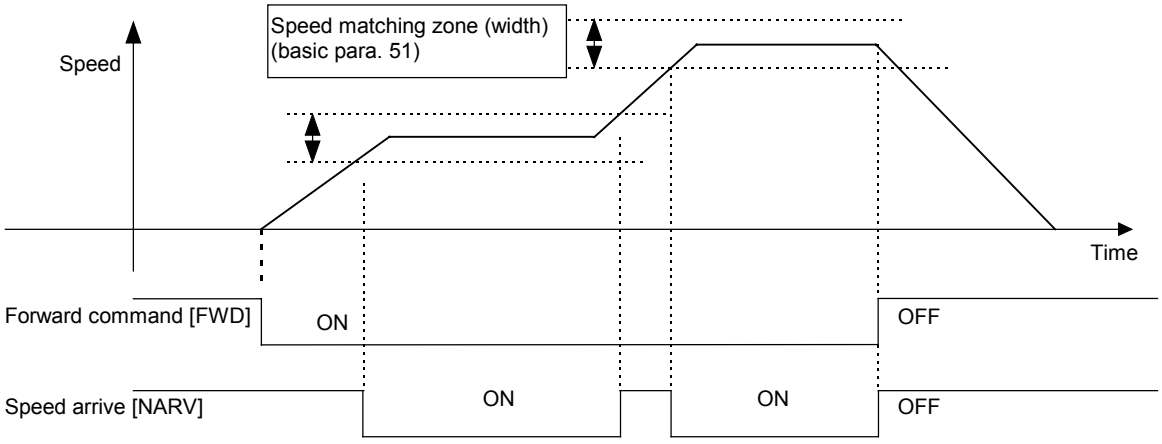
Para.	Name	Setting range	Initial value	Change
51	Speed matching zone (width)	10 to Max. speed [r/min] (in increments of 1)	50	Always

The "speed arrive" signal is turned on when the motor speed is near the reference speed (set by para.) As the initial value is 50[r/min], the "speed arrive" signal is on when the motor speed reaches the reference speed±50[r/min].
When the motor speed does not reach the reference speed due to the max. speed setting (basic. para. 16) or override setting, this signal turns off. When [FWD] or [REV] signal is off, the "speed arrive" signal does not turn on.

Basic parameter 16

Para.	Name	Setting range	Initial value	Change
16	Maximum speed	0.01 to Max. speed [r/min] (in 0.01 steps)	5000	Always

This parameter specifies the maximum value of motor speed.
If motor speed will exceed the maximum speed by "override", the motor rotates at the specified value.
In torque control, there is some 1000[r/min] difference between the setting value and the motor actual speed because speed control is not carried out.
The setting of maximum speed is not effective during position control using pulse train input.



5.4 Position control

This section explains the signals related to position control using pulse train input.

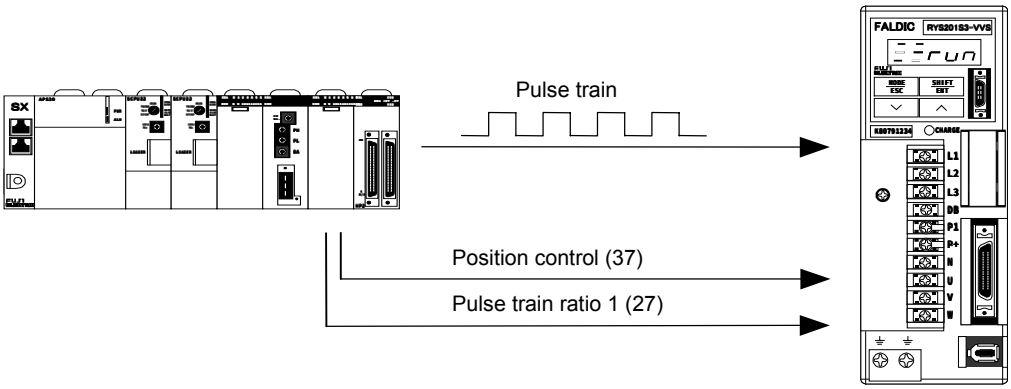
Control input signal: Position control (37)
Pulse train ratio 1 (27)
Pulse train ratio 2 (28)
Deviation clear (50)
Position preset (16)
Current position output (56)

Control output signal: Deviation zero (23)
Deviation excessive

5.4.1 Position control

When this signal turns on, the amplifier enters the position control mode.

While the position control (37) signal turns on, the amplifier is in position control. Positioning using pulse train input, origin return and interrupt positioning is available.

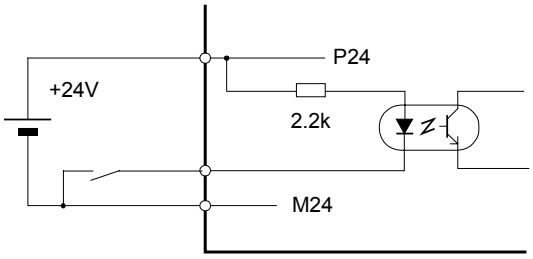


(1) Pulse train input
While pulse train ratio 1 (27) or 2 (28) is on, pulse train input is valid. (Position control (37) on is necessary.)

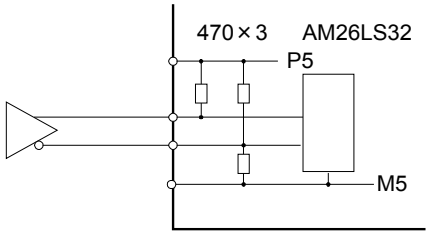
(2) Origin return
See 5.7 for origin return operation.

(3) Interrupt positioning
See 5.7 for interrupt positioning.

■ Interface



Position control
ON : In position control mode
OFF : In speed control mode
Pulse train ratio 1, 2
ON : Pulse train input is valid
OFF: Pulse train input is ignored



Pulse train input
Max. input frequency 400kHz

■ Parameter setting

To allocate the position control to the control input terminal, set (37) to the system para. Set (27) for the pulse train ratio 1, and (28) for the pulse train ratio 2. If these signals are not allocated to the control input terminals, these signals are deemed "always off."

■ Related items

- Pulse correction **α**, Pulse correction **β**

  At factory setting, the motor rotates by the move quantity per encoder one pulse in response to one pulse of pulse train input.
  In standard encoder, one rotation of motor shaft corresponds to 65536 pulses. Motor rotational quantity in response to one pulse of pulse train input can be changed.

Basic parameter 91, 92

Para.	Name	Setting range	Initial value	Change
91	Command pulse correction **α**	1 to 32767 (in increments of 1)	8	Always
92	Command pulse correction **β**	1 to 32767 (in increments of 1)	1	Always

Move amount of mechanical equipment system per 1 pulse of pulse train input can be converted to unit quantity.

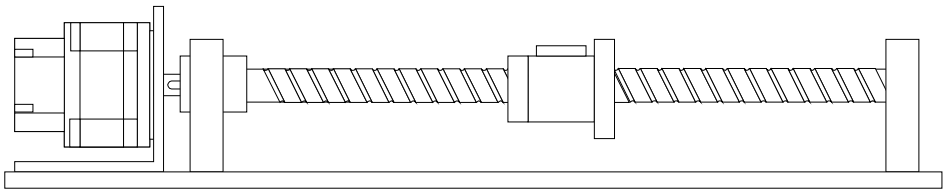
$$\frac{\text{(Move amount of mechanical equipment system per one motor rotation)}}{\text{65536 [pulses/rev]}} \times \frac{\text{Command pulse correction}}{\text{Command pulse correction } \boldsymbol{\beta}} = \text{(Unit quantity)}$$

*Unit quantity is any value of 1/1, 1/10 or 1/100.

Pulse correction value can be calculated by using move amount and unit quantity of mechanical equipment system per one rotation of motor.

【Calculation example】

Linear positioning of 10mm lead screw to incremental encoder (required unit quantity is 1/100)



$$\frac{\text{(10mm)}}{\text{65536 [pulses/rev]}} \times \frac{\text{Command pulse correction } \boldsymbol{\alpha}}{\text{Command pulse correction } \boldsymbol{\beta}} = 1/100$$

We have obtained the following values :
Command pulse correction **α** : 8192
Command pulse correction **β** : 125

With the above setting, the mechanical equipment system can now be advanced by 0.01mm per one pulse of pulse train input.

If move amount of mechanical equipment system per one rotation includes **π**, it can be replaced with 355/113.

Frequency dividing output has no relation with command pulse correction. The output is according to the system para. 79 setting.
See 5.4.5 for details.

• Pulse train ratio 1, 2

Move amount of mechanical equipment system per 1 pulse of pulse train input can be converted to unit quantity using the command pulse correction α and β.

The scale factor ratio to the move amount of mechanical equipment system can also be changed using the pulse train ratio 1 (27) and 2 (28) setting of the control input signals.

Basic parameter 93, 94

Para.	Name	Setting range	Initial value	Change
93	Pulse train ratio 1	0.01 to 100.00 (in 0.01s steps)	1.00	Always
94	Pulse train ratio 2	0.01 to 100.00 (in 0.01s steps)	10.00	Always

Decimal point can be displayed at the current position indication on the keypad panel by the basic para. 95 setting. Mechanical equipment system position can be checked by the numerical value with decimal point.

Basic parameter 95

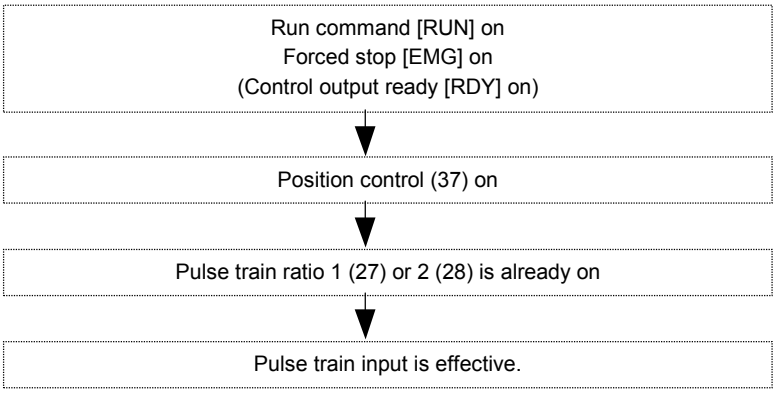
Para.	Name	Setting range	Initial value	Change
95	Decimal point at positioning data	0 : 1 1 : 0.1 2 : 0.01 3 : 0.001 4 : 0.0001 5 : 0.00001	0	Always

Manual feed (forward command, reverse command), origin return and interrupt positioning are invalid while the pulse train ratio factor 1 or 2 is on and the pulse train input is effective.

Temporary stop (pause) and positioning cancel signal are invalid when pulse train input is effective.

• Pulse train input

Position control comes to effective for the following conditions :

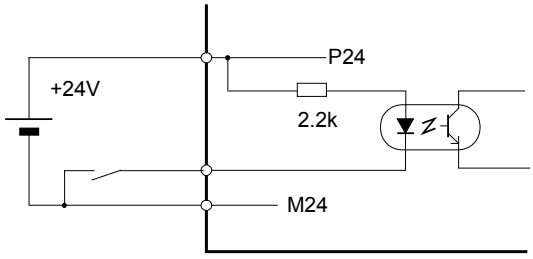


5.4.2 Deviation clear

When this signal turns on, the difference (deviation) between current command position and current feedback position is cleared to zero.

While this signal is on, the difference (deviation) is kept to zero.
The deviation clear is valid during the on period of "speed zero" [NZERO] signal.
Current command position is assigned as current feedback position.

■ Interface



ON : Clears deviation
OFF : Nothing done

■ Parameter setting
To allocate the deviation clear signal to the control input terminal, set (50) to the system para.

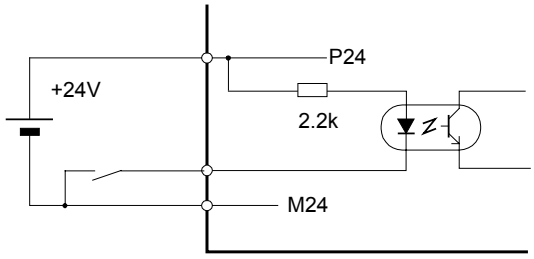
■ Related items
All of the rotation commands are ignored while the deviation clear signal is on.
Even if the deviation clear is carried out, the current feedback position does not change.
The remaining deviation due to the contact stoppage can be cleared to zero when the work is released, in order to avoid movement corresponding to the deviation quantity.
When the deviation clear is carried out, the deviation zero signal of the control output is on. See 5-4-4

5.4.3 Position preset

When this signal turns on, the current command position can be rewritten.

At the ON edge of this signal input, the current command position can be rewritten to the basic para. 80 setting. .On edge means the control input signal's transfer point from off to on.
Position preset is executable while speed zero [NZERO] signal is on. The origin return complete signal is output.
This signal will reset the following alarm detection:
1) ABS (absolute) data lost
2) Multiple rotation overflow

■ Interface



Position preset (16)
ON edge : Presets the current command position

■ Parameter setting
To allocate the position preset signal to the control input terminal, set (16) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

■ Related item
Basic parameter 80

Para.	Name	Setting range	Initial value	Change
80	Preset position	0 to ±79,999,999 (in increments of 1)	0	Always

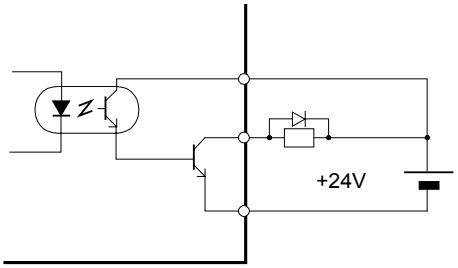
* When the basic para. 95 is set, the decimal point indication is available.
At the ON edge of position preset, the current command position can be rewritten by the basic para. 80 setting.

5.4.4 Deviation zero

Check can be done that the motor is near the reference position.

This signal turns on when the difference (deviation) between the current command position and current feedback position is within the value set by basic para.53.
Deviation zero signal is effective for the following control conditons:
1) In speed control, the stopped motor is in "servo lock" condition (system para. 81).
2) In position control
The signal on/off status is retained in other control mode such as torque contol.
The level of setting value of basic para. 53 has no relation with the positioning accuracy.

■ Interface



Deviation zero (23)
ON : Deviation amount is within the deviation zero zone (width)
OFF : Motor is rotating

■ Parameter setting
To allocate the deviation zero signal to the control output terminal, set (23) to the system para.

■ Related item
Basic parameter 53

Para.	Name	Setting range	Initial value	Change
53	Deviation zero zone (width)	10 to 10,000 pulses (in increments of 1)	200	Always

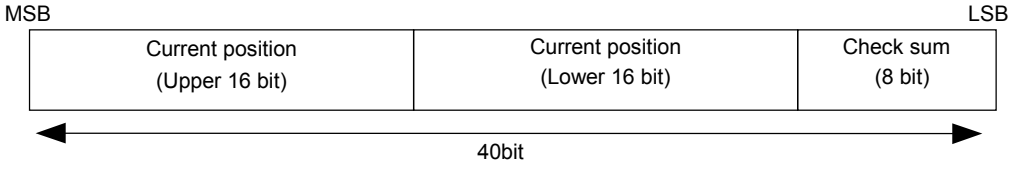
* Can be set by the motor's encoder pulse count.

5.4.5 Current position output

The current position that the amplifier is recognizing is outputted.

The current position output signal value is a signal of unit quantity set by basic para. 91 and 92. Actual move amount of mechanical equipment system is transmitted based on an origin point. When pulse correction function is not used, the current position is represented by the rotational quantity (accumulated absolute position) where one revolution of motor is divided by 16384 pulses/rev.

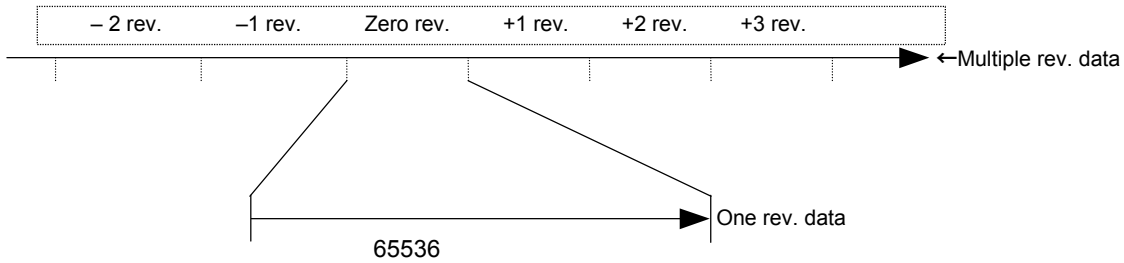
Transmission format



Current position : Transmitted in 32 bit binary data, beginning with MSB.
Check sum : Resultant lower 8 bit when 1 byte (8 bit) data is added 4 times from MSB side. Check sum is transmitted, beginning with MSB side as well. Check sum is done for the current position 32 bit length data.

Remarks :
Motor position detector (16 bit serial encoder) consists of one rotation data and multiple rotation data. This is different from the current position output data transmitted from amplifier.

1) Multiple rotation data
   Rotational quantity per one rotation based on the origin of motor (encoder)
   The data is complement of 2 in 16 bit and from –32768 to +32767.
2) One rotation data
   Absolute position within motor (encoder) one rotation
   16 bit data and 0 to 65535.



* The position of position preset or origin return complete is within this zone.

■ Related item

System parameter 79

Para.	Name	Setting range	Initial value	Change
79	Output pulse count	16 to 16384 (in increments of 1)	2048	Power

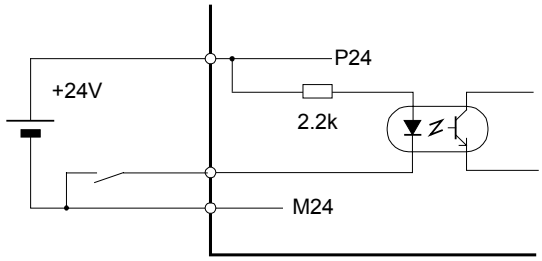
* Output pulse count from terminals such us FA /*FA.
Output pulse count from frequency dividing output terminals FA/*FA, FB/*FB is set.
The pulse count is A-phase and B-phase pulse count per one rotation of motor output shaft.
2048 pulses/rev. is set at factory shipment.

• Calculation example of output frequency
Supposing that motor output shaft speed is 5000 [r/min] and the output pulse count is 3000 [pulse/rev];

f = (5000 / 60) × 3000 [pulse] = 250000 [Hz]

Consequently, 250 [kHz] pulse will be output.

■ Interface

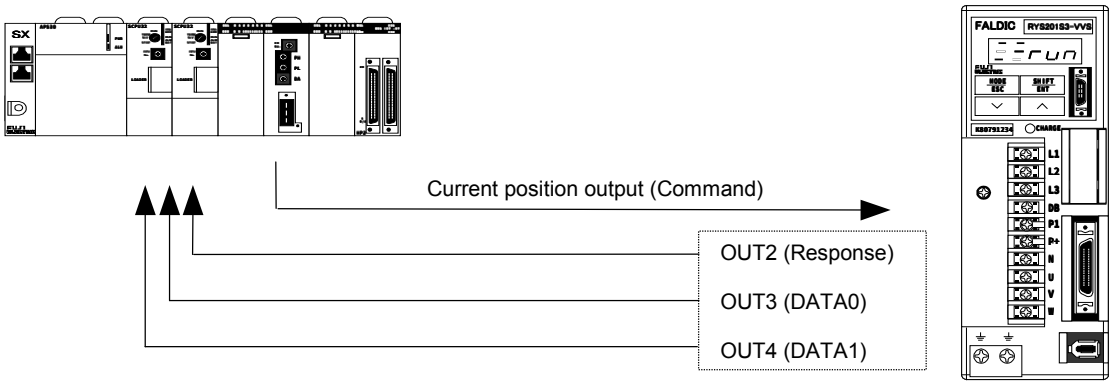


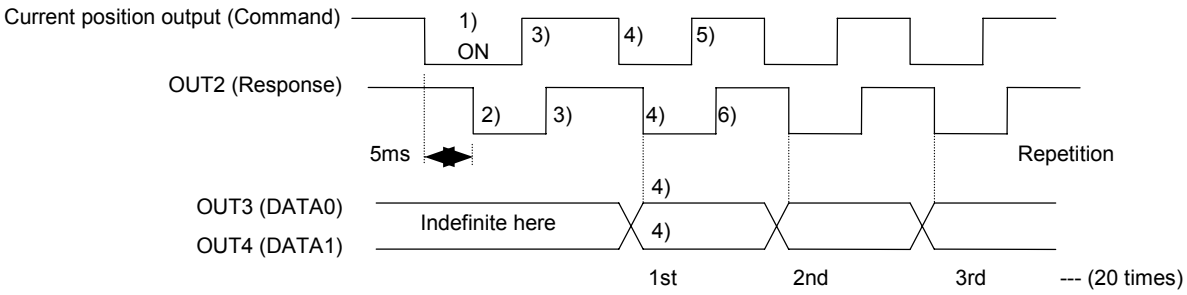
Current position output (56)
ON : Starts transmission of current position
OFF : Stops transmission of current position

■ Parameter setting

To allocate the current position output to the control input terminal, set (56) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

The sequence of current position output is explained as below. Output is in 2-bit unit.





1) Makes the current position output (command) on for 5ms or longer. The current position output sequence starts.
2) OUT2 (response) turns on.
3) Makes the current position output (command) off. OUT2 (response) turns off.
4) Makes the current position output (command) on. When OUT3 (DATA0) and OUT4 (DATA1) are established, OUT2 (response) turns on.
5) When OUT3 (DATA0) and OUT4 (DATA1) are recognized, makes current position output (command) off.
6) OUT2 (response) turns off.
7) Steps 4) to 6) are repeated the remained 19 times. When OUT2 (response) turns off at the 19th times, terminals OUT3 and OUT4 output the control output signals preset beforehand.

Current position output (command) and OUT2 (response) are interlocked in ON/OFF level.
If ON period of current position output (command) is too long, current position output sequence does not proceed.
Data transmission or receiving cannot be stopped without completing sequence. And the current position output sequence terminates forcibly in 5 seconds.

Current position output (command) is always effective. While the motor is rotating, the current position is transferred at the first ON edge of current position output (command).
Because the function of terminal OUT2, OUT3 and OUT4 is forcibly changed, do not make the current position output (command) on while the running command [RUN] is on.

The last 8 bit of the 40 bit data of current position output is for check sum, This is the resultant lower 8 bit after each 8 bit in the current position 32 bit data is added. Make sure that the addition data executed by the host controller is same as the transmitted data.
Terminal OUT 4 [DATA1] outputs 2 bit data on MSB side.

See Appendix 2 for the example program.

5.4.6 Deviation excessive

This function sets the deviation amount of deviation excessive (alarm detection) of amplifier.

■ Related items

Basic parameter 54

Para.	Name	Setting range	Initial value	Change
54	Deviation excessive width	10 to 65535 (in increments of 1) [x 100 pulse]	10000	Always

* Setting is made by motor encoder pulse count.

Sets the pulse count for alarm detection about deviation excessive. Initial value at factory setting is 10,000 and detects the deviation amount with 1,000,000 pulses. At factory setting, deviation excessive is detected when the difference (deviation) between command position and feedback position becomes approximately 15.2 revolution when converted to motor rotation.
The deviation excessive width is set for use with alarm detection, and becomes effective when the stopping status is in “servo lock” in position control and speed control.

5.5 Signal for safety

This section explains the functions and input/output signals for safety operation contained in amplifier.

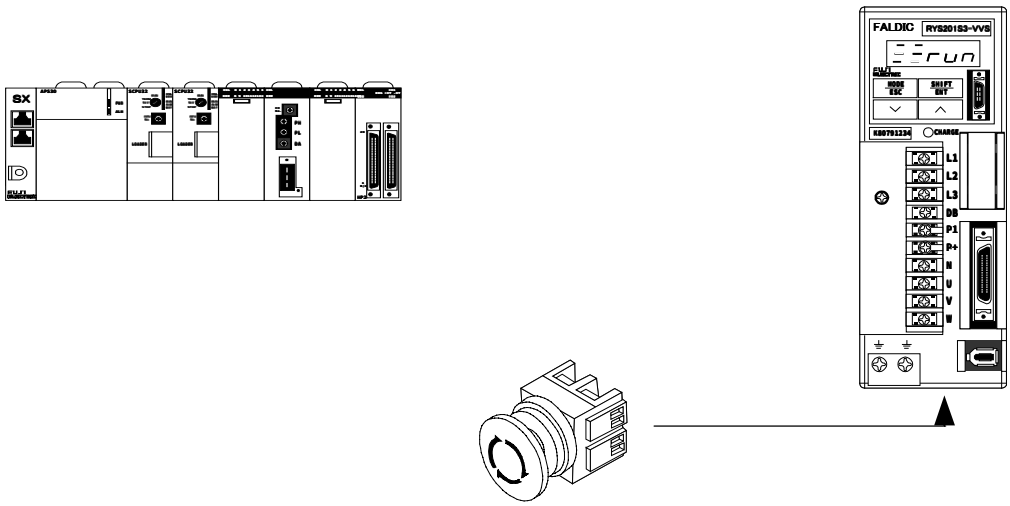
Control input signal : Forced stop [EMG](10)
Edit permit command (55)
+ direction overtravel [+OT] (7), - direction overtravel [-OT] (8)
Torque limit [TLMT](30)
External fault input (34)

Control output signal : Forced stop detection (41)
Edit permit on (29)
OT detection (20)
+OT detection (38), -OT detection (39)
Torque limit detection (26)
Overload early warning (27)

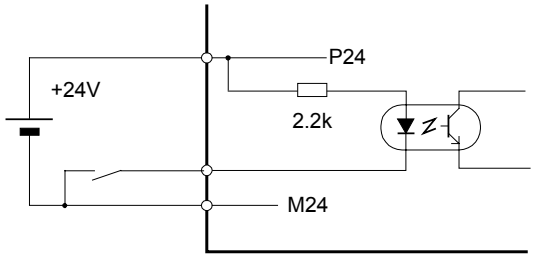
5.5.1 Forced stop [EMG], Forced stop detection

Stops the motor forcibly using the signal to control input terminal.

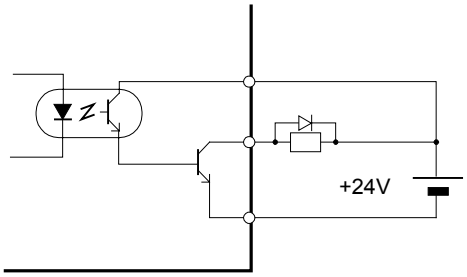
While the forced stop (10) signal is off, the motor forced stop is kept.
This input signal is always effective in any control condition, and has the highest priority. (all other commands are ignored.)
Normally, connect this terminal to a push-lock type (NC contact) pushbutton switch (FUJI's COMMAND SWITCH recommended).



■ Interface



Forced stop [EMG] (10)
ON : Motor can rotate.
OFF : Stops the motor forcibly



Forced stop detection (41)
ON : Forced stop is off.
OFF : Forced stop is on.

■ Parameter setting

To allocate the forced stop signal to the control input terminal, set (10) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always on."

■ Related items

- Forced stop detection (41)
  Connect the forced stop (10) signal directly to the control input terminal of amplifier because the safe operation and detection speed are most important. When the forced stop (10) signal is turned off, the forced stop detection (41) signal is turned on to inform the current status externally.
  However, the forced stop detection (41) signal is turned off while external fault input (34) is off.

- Ready [RDY]
  After the forced stop (10) signal is allocated to the control terminal, when the ready [RDY] signal is turned on with both the run command [RUN] (1) and the forced stop signals on, the motor can rotate.

- Forced stop status
  While the forced stop (10) signal is off and the run command [RUN] (1) is on, the motor makes a stop in the "speed zero" status making the motor speed command zero. The speed zero status is effective in any kind of control mode.
  Current position cannot be retained in the speed zero status. As the current position has been stored, the origin return action is not necessary again when the forced stop signal is off. Turning on the forced stop signal allows the motor to rotate.
  If the run command [RUN] signal is off, the motor is in free-run status.

- Rotation command
  While the forced stop signal is off, all of the rotational commands are ignored.

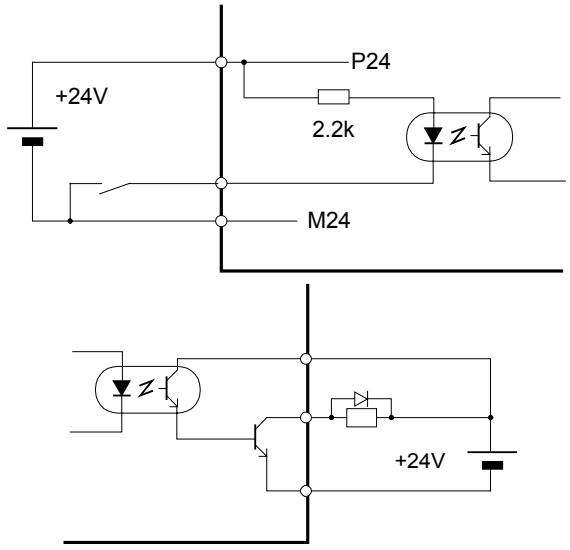
5.5.2 Edit permit command, Edit permit ON

This function allows external signal to limit editing the parameter etc.

On/off to the control input signal can limit editing or trial operation using keypad panel, exclusive loader or PC loader.
Only while edit permit command (55) is on, the following operation is possible.
1) Parameter edit mode (Positioning data edit mode)
2) Trial operation mode

When edit permit command (55) is turned off, only monitor mode is effective.
The move of motor or fall of machine etc. can be prevented, occurring from careless operation of keypad panel, exclusive loader or PC loader.

■ Interface



Edit permit command (55)
ON : Editing parameter enabled
OFF : Only monitor mode is enabled

Edit permit ON (29)
ON : Outputs edit enable
OFF : Outputs edit disable

■ Parameter setting

To allocate the edit permit command to the control input terminal, set (55) to the system para. Set (29) for the edit permit ON.

■ Related items

System parameter 94

Para.	Name	Setting range	Initial value	Change
94	Parameter rewrite inhibit	0: Edit permitted, 1: Edit inhibited	0	Always

When 1 is set at system parameter 94, parameter editting with keypad panel is disabled, same as with PC loader or exclusive loader. The system parameter 94 is always rewritable.

The relation between the edit permit command and system parameter 94 is as follows:

Edit permit command (55)	System para. 94	Edit permit ON (29)	Edit/Initialize
Not assigned	0 : Edit permitted	ON	Yes
ON	0 : Edit permitted	ON	Yes
OFF	0 : Edit permitted	OFF	No
Not assigned	1 : Edit inhibited	OFF	No
ON	1 : Edit inhibited	OFF	No
OFF	1 : Edit inhibited	OFF	No

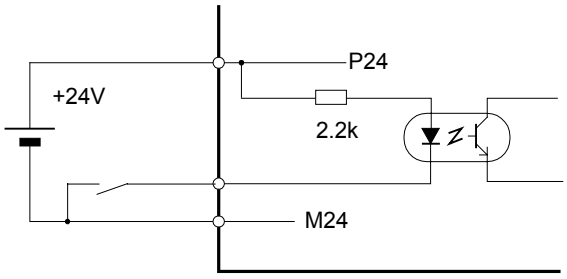
5.5.3 Overtravel

Move of machine can be forcibly stopped by inputting signals from limit switch etc.

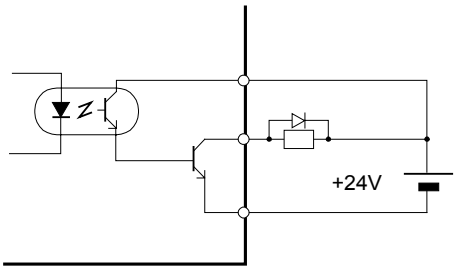
- + direction overtravel [+OT] (7), - direction overtravel [-OT] (8)
  Input signal is from overtravel (OT) preventive limit switch placed at machine moving direction end.
  Both signals are always valid except for in torque control.
  When the input signal turns off, motor rapidly decelerates to a stop in negligence of the rotation command in the detecting direction.
  Motor can rotate by pulse train input in the direction opposite to detecting direction, or by manual feed (forward command or reverse command).

- +OT detection (38), -OT detection (39)
  While [+OT] (7) control input signal is off, the +OT detection (38) output signal is on. While [-OT] (8) control input signal is off, the -OT detection (39) output signal is on.

■ Interface



+OT (7), -OT (8)
ON : Motor can rotate
OFF : Ignores rotation command and stops the motor.



+OT detection (38), -OT detection (39)
OT detection
ON : OT is detected
OFF : OT is not detected

■ Parameter setting

To allocate the +OT signal to the control input terminal, set (7) to the system para. Set (8) for the -OT signal. If these signals are not allocated to the control input terminal, these signals are deemed "always on."

■ Related items

• Detecting direction

+OT signal is detected when the motor rotates toward positive direction. Positive direction is the direction set by system para.80. The motor rotates toward negative direction, and stops by detecting + OT signal.
Afterwards, the motor cannot rotate in any direction.

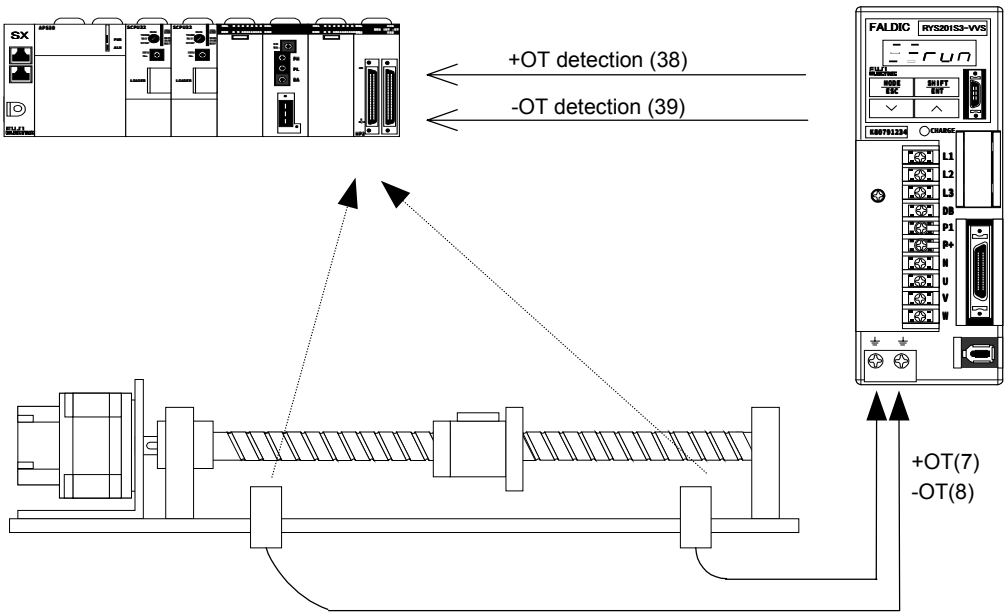
System parameter 80

Para.	Name	Setting range	Initial value	Change
80	Rotating direction change	0: Positive direction/Forward rotation 1: Positive direction/Reverse rotation	0	Power

* Forward rotation : Counter-clockwise when viewed from a point facing the shaft extension of motor

• +OT detection (38), -OT detection (39)

The detection speed take precedence because the amplifier detects this signal at the moving direction end of mechanical equipment system. The amplifier sends the detection result to the host controller by the output signal, +OT detection or -OT detection signal. If the host controller is equipped with OT input, OT signal is directly sent to the host controller, in general.



• OT detection (20)

The OT detection (20) is a control output signal and turns on when the control input +OT(7) or –OT(8) is off, or when the soft OT of system parameter 75 to 77 is detected.

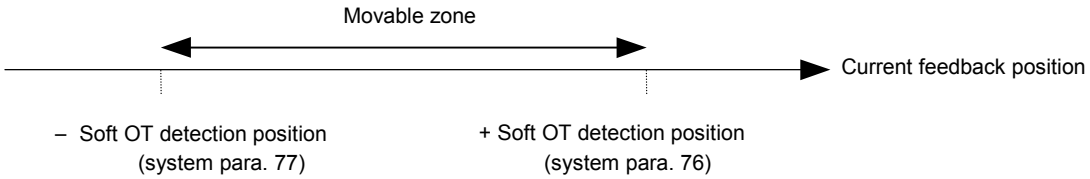
System parameter 75 to 77

Para.	Name	Setting range	Initial value	Change
75	Soft OT valid/invalid	0: Invalid, 1: Valid	0	Power
76	+ Soft OT detection position	0 to±79,999,999 (in increments of 1)	79,999,999	Always
77	- Soft OT detection position	0 to±79,999,999 (in increments of 1)	-79,999,999	Always

• Function of soft OT

When 1 is set at system para.75, the soft OT is able to operate on condition that the current position is between +soft OT and –soft OT detection position (system para. 77 and 76 setting).

In case the current position goes out of range, stops the motor forcibly, a control output OT detection (20) is turned on. When the pulse train input with opposite direction to the detection direction is input, or manual feed (forward command/reverse command) is input, and the current position retruns to within the range, OT detection (20) is turned off, and it allows the mechanical equipment system to move in both directions.



The soft OT function can be also valid after the origin return complete by basic para. 67 setting.

Basic parameter 67

Para.	Name	Setting range	Initial value	Change
67	Position detection valid/invalid	0: Effective after end of origin return, 1: Always	0	Always

*When the origin return action is completed or the position preset is executed, the origin return is completed.

5.5.4 Torque limit [TLMT], torque limit detection

This function limits the motor output torque.

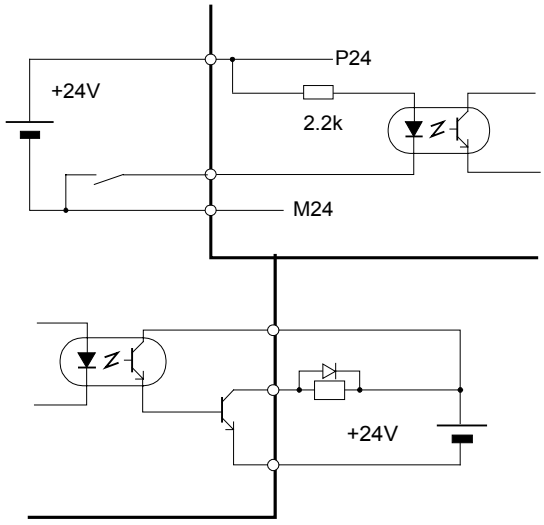
Motor output torque can be limited while torque limit [TLMT] (30) signal is on.
Torque limit value can be set by basic para. 59, from 0 to maximum output torque in 1% steps.
Maximum output torque depends on motor type.
Maximum output torque is set assuming the rated torque is 100%.

Torque limit is always effective in any control condition.
If output torque is limited during acceleration or deceleration, acceleration or deceleration may not follow the accel./decel. time set by basic para.

• Torque limit detection

This signal is turned on while motor torque reaches the torque limit value.
This torque limit detection (26) is effective in all control condition.

■ Interface



Torque limit (30)
ON : The motor output torque is limited to the value set by para. 59.
OFF : The motor can output torque to its max. torque

Torque limit detection (26)
ON : Maximum torque is being output.
OFF : Maximum torque is not output.

■ Related items

Basic parameter 59

Para.	Name	Setting range	Initial value	Change
59	Max. torque limit value	0 to Max. torque (in 1% steps)	0	Always

* Set the value assuming the motor rated torque as 100%.

■ Parameter setting

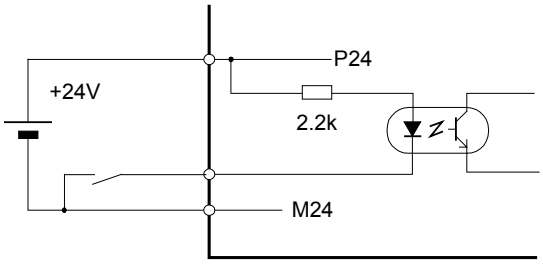
To allocate the torque limit signal to the control input terminal, set (30) to the system para.
If torque limit is not allocated to the control input terminal, the value by basic para. 59 setting is always effective.
Set (26) for the torque limit detection.

5.5.5 External fault input

External signal forcibly stops the motor.

While this signal is turned off, the motor is stopped forcibly.
While external fault input is applied (signal off), the operation is the same as forced stop [EMG] (10).
While external fault input is applied (signal off), forced stop detection (41) signal is turned on.

■ Interface



External fault input (34)
ON : Motor is in normal operation status
OFF : Motor is in forced stop status

■ Parameter setting

To allocate the external fault input signal to the control input terminal, set (34) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always on."

■ Related item

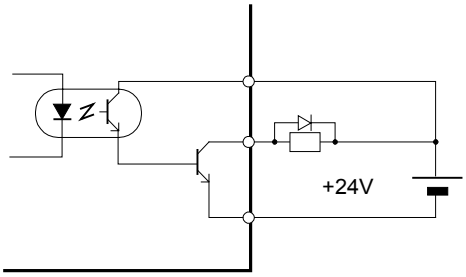
See 5.5.1 for the forced stop (10).

5.5.6 Overload early warning

Motor's overload level, or load factor can be checked.

This signal is turned on when the motor load factor has reached the overload early warning level set at the basic para. 58. This signal cannot be reset by the control input signal (external signal input.)
Early warning signal can be output before the amplifier trips due to motor overload alarm.

■ Interface



Overload early warning (27)
ON : Load factor has reached the setting level.
OFF : Load factor has not reached the setting level.

■ Parameter setting

To allocate the overload early warning signal to the control output terminal, set (27) to the system para.

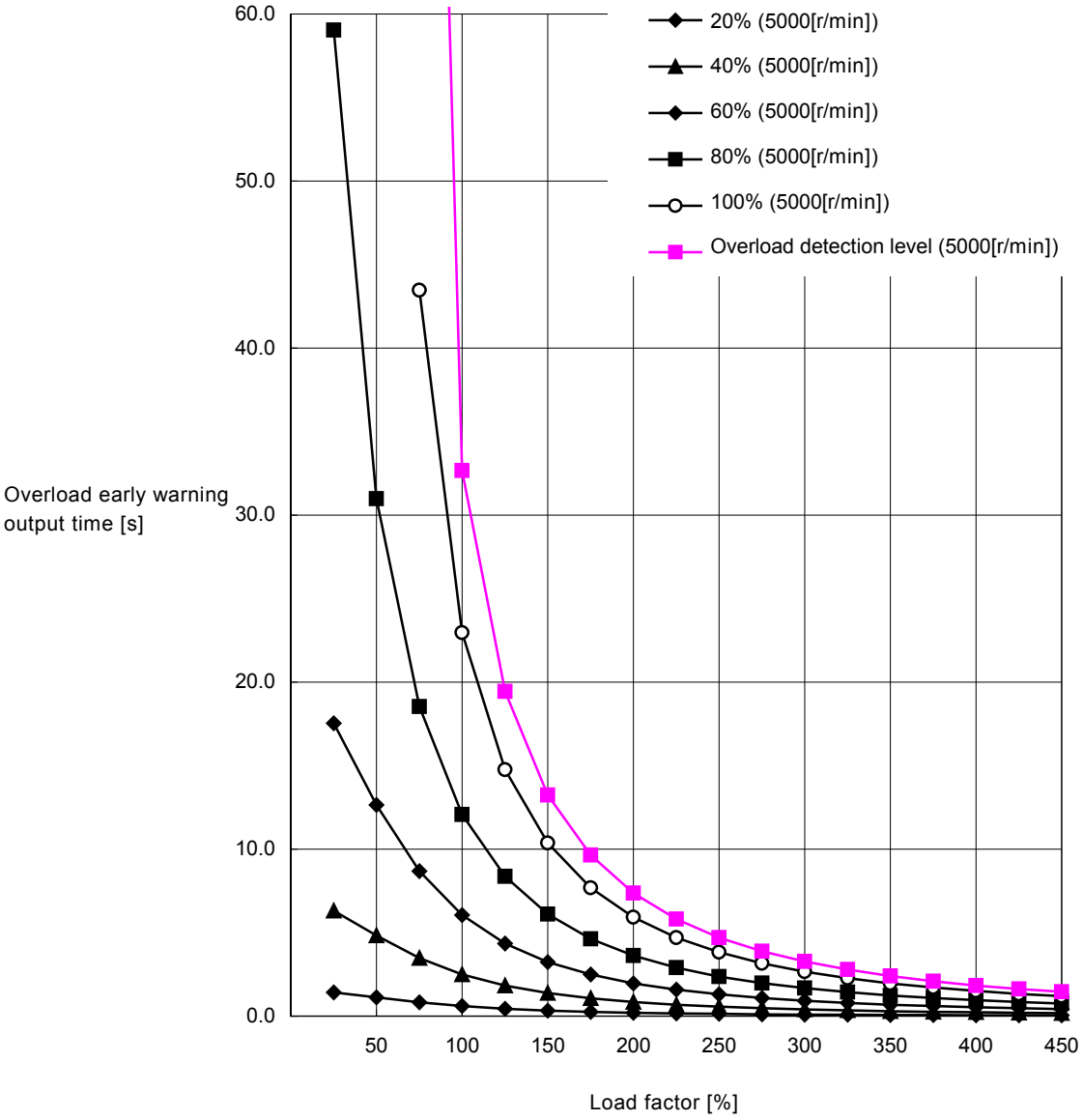
■ Related items

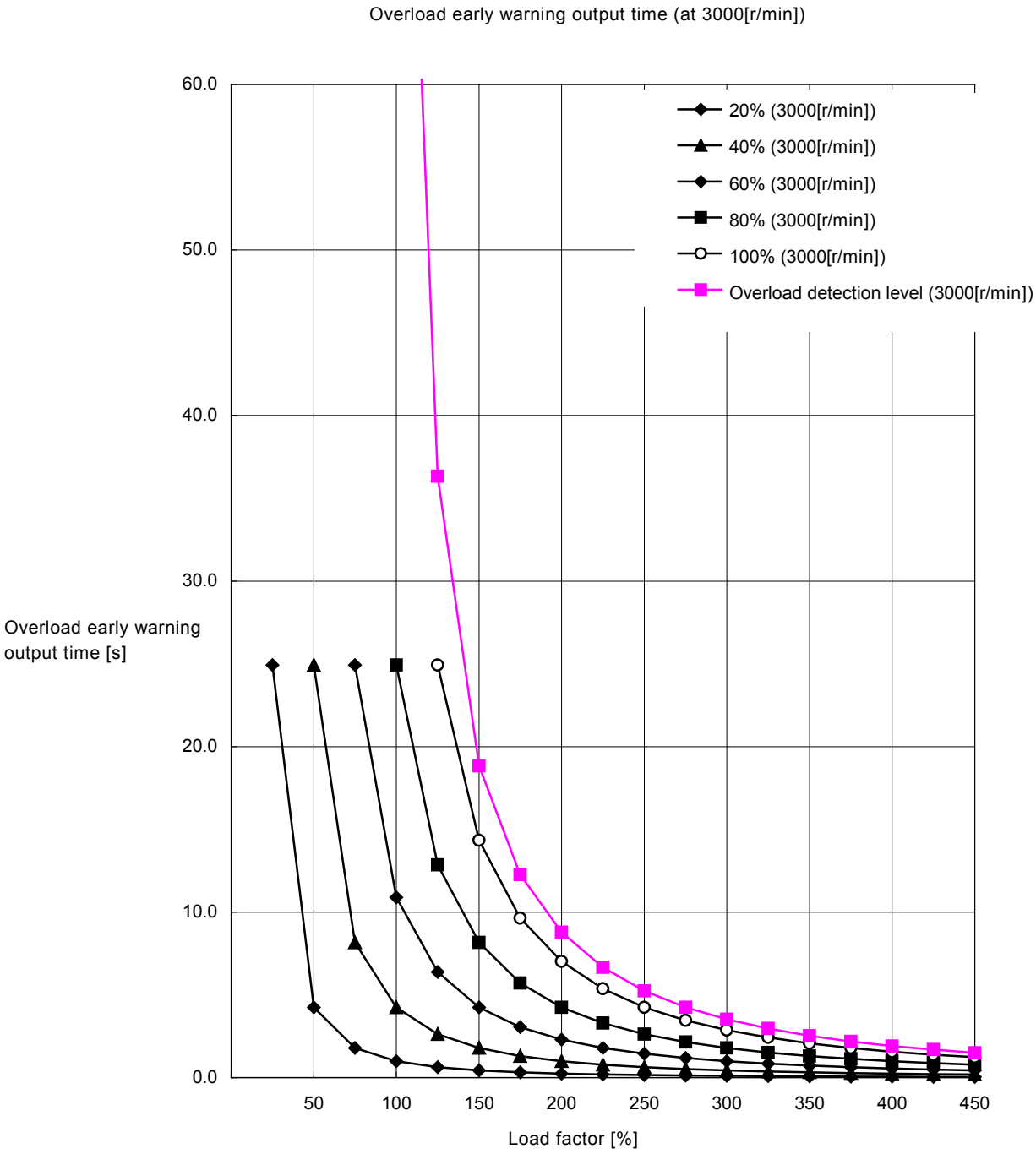
Basic parameter 58

Para.	Name	Setting range	Initial value	Change
58	Overload early warning level	10 to 100% (in increments of 1)	50	Always

* Overload early warning level is set assuming the amplifier trip level 100%

Overload early warning output time (at 5000[r/min])




Overload early warning output time (at 3000[r/min])
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Overload early warning output time [s]
20% (3000[r/min])
40% (3000[r/min])
60% (3000[r/min])
80% (3000[r/min])
100% (3000[r/min])
Overload detection level (3000[r/min])
50
100
150
200
250
300
350
400
450
Load factor [%]

5.6 Torque control

This section explains the signal concerning torque control.

Control input signal : Torque control (38)

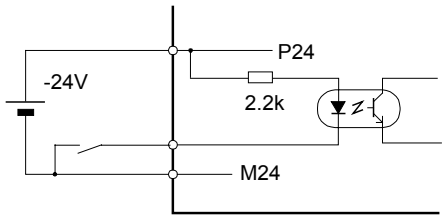
5.6.1 Torque control

While torque control (38) signal is on, the amplifier can control the output torque of motor shaft using the torque control function.
With “speed zero” [NZERO] output on, “torque control” signal on, torque control is enabled.
Torque is actually output during the on period of forward command [FWD] or reverse command [REV].
Torque command is given as the input voltage to the terminal [TREF].

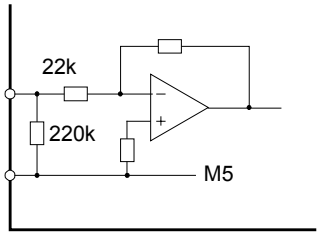
[TREF] terminal voltage	Output torque (rated torque as 100%)
±9 [V]	±300%

The rotational direction depends on forward command [FWD] or reverse command [REV]. See 6.1.1 Change of rotational direction.

■ Interface



Torque control (38)
ON : In torque control status
OFF : In speed control status



Torque command [TREF]
Input impedance 20kΩ

■ Parameter setting

To allocate the torque control signal to the control input terminal, set (38) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

■ Related items

- Maximum speed

  If the motor is rotating at no-load, the motor speed fluctuates by some ±100[r/min] though the speed is being limited by basic para. 16. This is because speed control is not carried out in torque control.

  Basic parameter 16

Para.	Name	Setting range	Initial value	Change
16	Maximum speed	0.01 to Max. speed [r/min] (in 0.01 steps)	(Max. speed)	Always

  Maximum speed depends on the basic para. 16 at factory shipment. Maximum speed can also be limited by the input voltage to speed command [NREF] terminal by setting system para. 61.

System parameter 61

Para.	Name	Setting range	Initial value	Change
61	Speed limit changeover	0 : Basic para. 16 1: Speed command [NREF]	0	Power

*Maximum speed at +10V

• Torque command filter

Torque control voltage can be changed by a filter time constant concerning torque command voltage [TREF] by setting basic para. 43.

Basic parameter 43

Para.	Name	Setting range	Initial value	Change
43	Torque command filter	0.0 to 9.9s (in 0.1s steps)	0	Always

• Torque command gain, offset

The input gain or offset to torque command [TREF] terminal can be adjusted by system para. 65 or 66.

System parameter 65

Para.	Name	Setting range	Initial value	Change
65	Torque command gain	±0.10 to ±1.50 (in 0.01 steps)	1.00	Always

System parameter 66

Para.	Name	Setting range	Initial value	Change
66	Torque command offset	−200 to +200 (in increment of 1)	(Individval)	Always

• Output torque

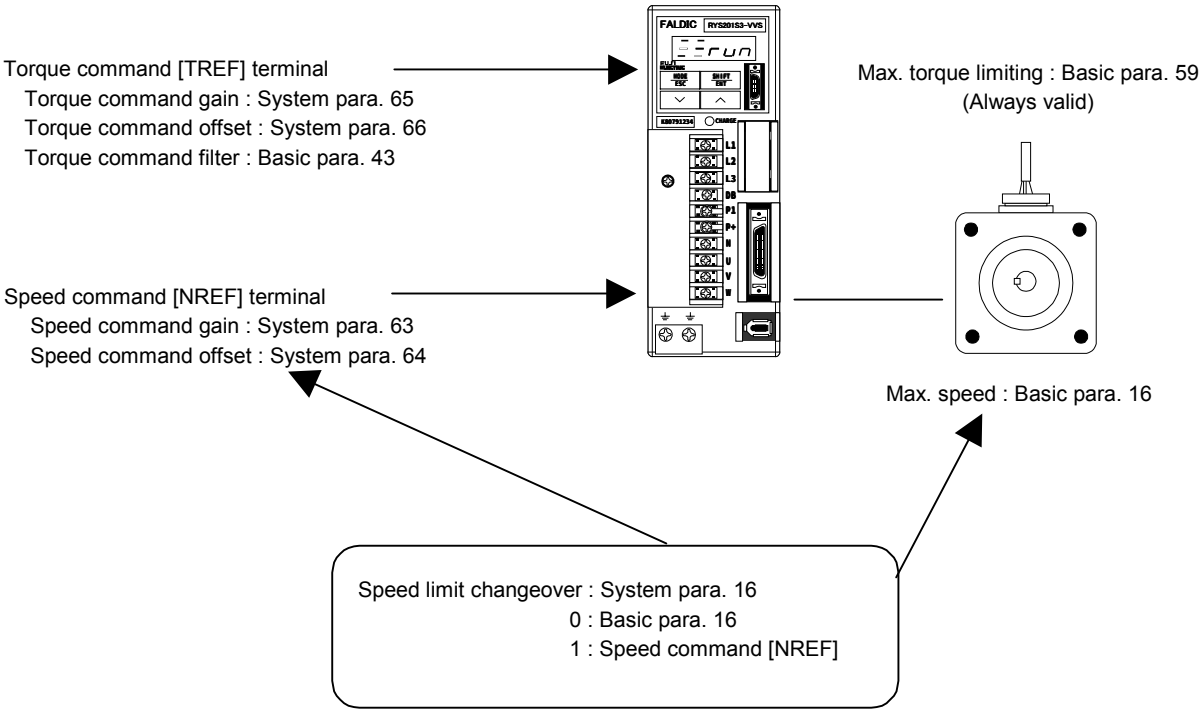
There is an output torque dispersion of approximately ±10% between indiviclual motors.
If the output torque is the rated torque or lower, a continuous running is available.

• Torque limiting

Output torque can be limited by basic para.59. Maximum torque limit value is always effective.

Basic parameter 59

Para.	Name	Setting range	Initial value	Change
59	Maximum torque limiting	0 to Max. torque [%] (in increment of 1)	300	Always



5.7 Incidental functions

This section explains other control functions that the amplifier supports.

Control input signal: Origin return (5)
Origin LS (6)
Interrupt valid (48)
Interrupt input (49)
Override effective (43)
Override1 (44)
Override2 (45)
Override4 (46)
Override8 (47)
Free-run [BX] (54)
P-action (29)

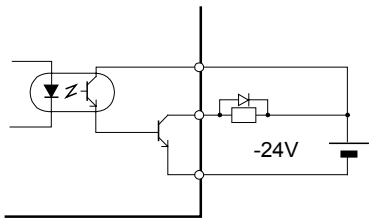
Control output signal : Brake timing (14)
Origin return end (22)
Origin LS detection (40)
Positioning end (2)
Fixed, passing point 1 (17)
Fixed, passing point 2 (18)
Dynamic braking (15)
Address error (31)
CPU ready (28)

5.7.1 Brake timing

The amplifier outputs this signal to automatically turn on or off the brake operation of the motor.

This signal turns excite or release the motor brake in accordance with the rotation command sent to the amplifier.
The control condition when the motor is stopped can be set by system para. 80.

■ Interface



Brake timing output (14)
ON/OFF : Output automatically

■ Parameter setting

To allocate the brake timing output to the control output terminal, set (14) to the system para. If this signal is not allocated to the control output terminal, this signal is deemed "always off."

■ Related items

- Brake timing

The step to set the brake timing at the control output terminal is as follows:

1) Setting of control output terminal
Assign the value (14) corresponding to the brake timing to any one of the system para. from 31 to 35. If "14" is set at "31", OUT1 terminal is the output terminal of brake timing.

2) Setting at stoppage
Set "2" or "3" at the system para. 81 to select the motor status while motor is stopping. When "3" is set at para. 81, the motor comes to free-run status when activating the brake and the motor exciting noise is eliminated.

3) Brake operation time/releasing time

Assign the operating time and releasing time of external brake to system parameters 82 and 83.

To each time period, add the scan time of PLC, the response time of external relay, magnetic contactor and the brake itself.

Brake operation time : Time period from when the amplifier output is off, to when the external brake starts braking actually.
Brake releasing time : Time period from when the amplifier output is on, to when the external brake release is completed.

If too long brake operation time is set, the brake cannot operate when the movement restarts within that time.

System parameter 81, 82, 83

Para.	Name	Setting range	Initial value	Change
81	Operation at stoppage	0 : Speed zero 1 : Servo-lock 2 : External brake (P-action) 3 : External brake (Free-run)	0	Always
82	Brake operation time	0.01 to 9.99 [s] (in 0.01 steps)	0.50	Always
83	Brake releasing time	0.01 to 9.99 [s] (in 0.01 steps)	0.20	Always

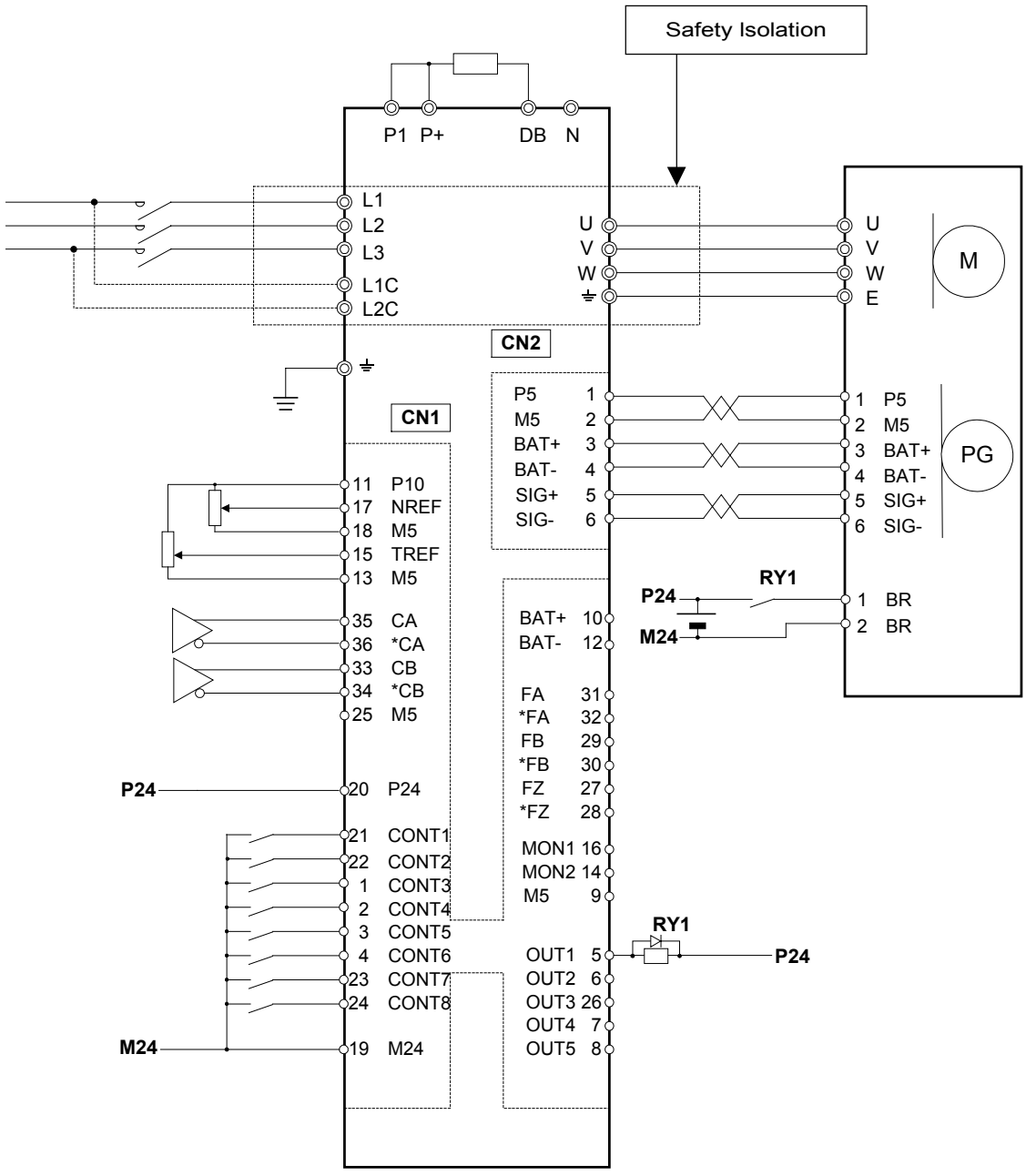
Note : PLC : Programmable Logic Controller

● Brake timing (on pulse train/manual run)

The brake timing output is held off from when the power supply is applied until any kind of rotation command is given.
When the following control input signals are given, the brake timing output is turned on.

1) Forward command [FWD], reverse command [REV]
2) Pulse train ratio 1, pulse train ratio 2

Wiring example of brake timing signal



When starting a movement : 1) Forward command/reverse command

The brake timing is turned on simultaneously when control input signal ([FWD] or [REV]) is on.
After the brake releasing time (system para. 83) has elapsed, a rotation starts assuming that it has been actually released. If [FWD] or [REV] has been turned off during the brake releasing time, the motor will not start rotation.

2) Pulse train ratio 1, 2

The brake timing is turned on simultaneously when the control input signal is on.
After the brake releasing time (system para. 83) has elapsed, pulse train input becomes effective assuming that it has been actually released. If the control input signal has been turned off during the brake releasing time, the pulse train input is not effective

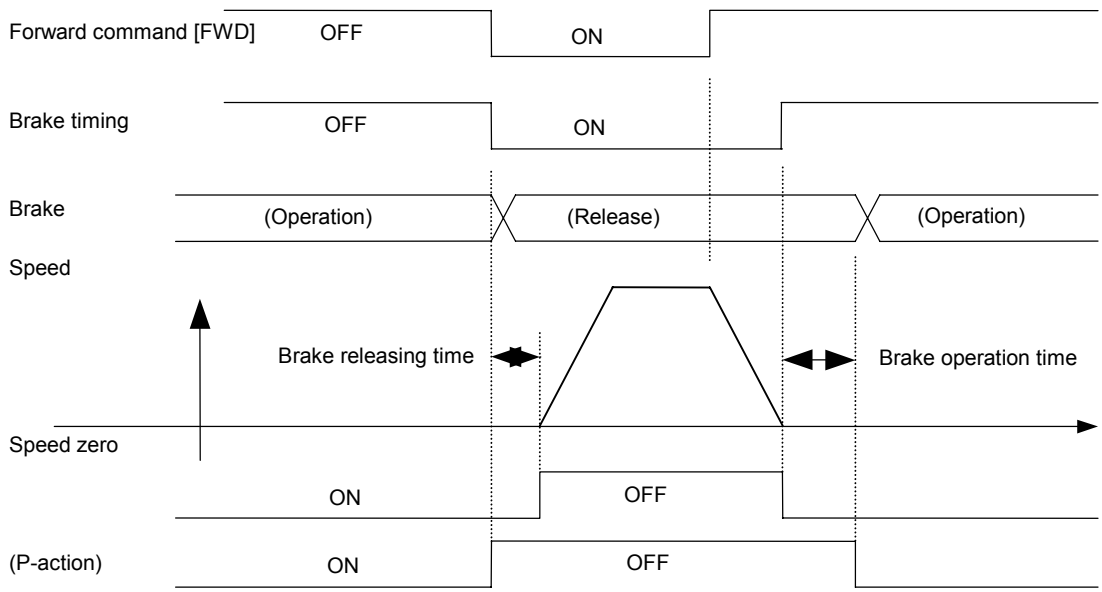
When terminating the movement : 1) Forward command/reverse command

When [FWD] or [REV] has turned off, the motor starts deceleration. After the speed zero [NZERO] signal on is confirmed, brake timing turns off, and when brake operation time (system para. 82) has elapsed, the amplifier turns P-action signal on. (For [FWD] or [REV] off in position control, the deviation zero signal on is confirmed.) Brake timing does not turn off if a movement starts with [FWD] or [REV] signal turned on during the brake operation time (set by system para. 82).

2) Pulse train ratio 1, 2

After [FWD] or [REV] signal is off, pulse train input becomes invalid with deviation zero signal on.
After the deviation zero signal on is confirmed, brake timing turns off, and when brake operation time (system para. 82) has elapsed, the amplifier turns P-action signal on.
Brake timing does not turn off if a movement starts when [FWD] or [REV] signal turned on during brake operation time (set by system para. 82).

Brake timing (Validated signal at ON level)



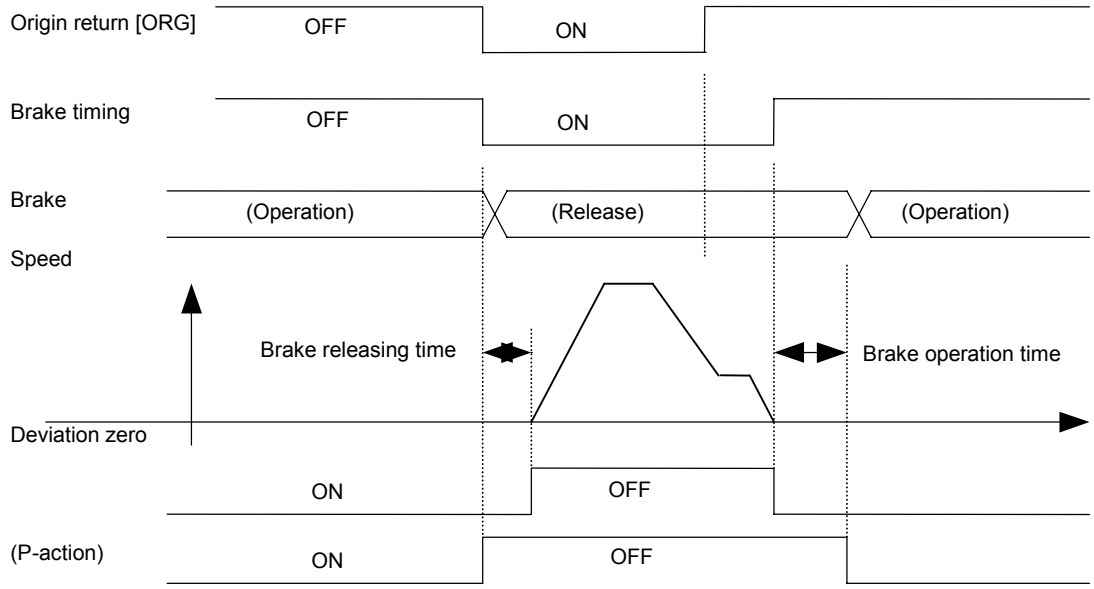
● Brake timing (on origin return, interrupt positioning)

- The brake timing output is held off from when the power supply is applied until any kind of rotation command is given.
  When the following control input (ON edge) signals are given, the brake timing output is turned on.

  When starting a movement : Brake timing turns on at the ON edge of control input signal.
  After the brake releasing time (system para. 83), a rotation starts assuming that the brake has actually been released.

  When terminating the movement : After the amplifier has checked the "deviation zero" (positioning complete), turned off the brake timing, and the brake operation time (system para. 82) has elapsed, the amplifier turns on P-action signal. Brake timing output does not turn off if a movement restarts at the ON edge of control input signal during the brake operation time.

Brake timing (Validated signal at the ON edge)



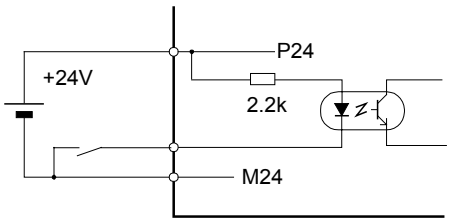
* If an external brake is used, the motor comes to free-run status at the timing of P-action as shown on the above figure.

5.7.2 Origin return

This function executes the origin return action and determines the origin.

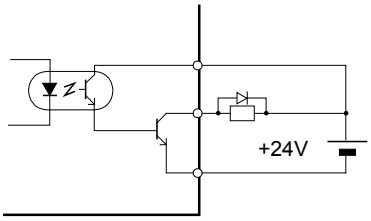
This function executes the origin return action at the ON edge of origin return (5).
This function is not used when origin return is executed from a host controller (such as positioning module of PLC).
Origin return action depends on basic para. setting 71 to 79.

■ Interface



Origin return (5)
ON edge : Starts origin return action

Origin LS (6)
ON / OFF : Input for detecting the origin



Origin return end (22)
Outputs ON signal when origin return end

Origin LS detection (40)
Outputs ON signal while “Origin LS” is on.

■ Parameter setting
To allocate the origin return signal to the control input terminal, set (5) to the system para.

Signal name	Setting value to system para.
Origin return (control input)	5
Origin LS (control input)	6
Origin return end (control output)	22
Origin LS detection (control output)	40

■ Related items

• Parameter setting

Origin return action depends on basic parameter 71 to 79 setting.

Para.	Name	Setting range	Initial value	Change
71	Origin return pattern	1 : Pattern 1, 2 : Pattern 2 3 : Pattern 3, 4 : Pattern 4	1	Power
72	Origin return direction	0 : Positive, 1 : Negative direction	0	Power
73	Z-phase valid/invalid	0 : Valid 1 : Invalid	0	Power
74	Origin LS logic	0 : NO contact 1 : NC contact	0	Always
75	Origin return speed	0.01 to Max. speed [r/min] (in 0.01 steps)	500.00	Always
76	Origin detection creep speed	0.01 to Max. speed [r/min] (in 0.01 steps)	50.00	Always
77	Origin shift quantity	1 to 2,000,000 (in increments of 1) [x unit q'ty]	1000	Always
78	Origin return reversing quantity	1 to 79,999,999 (in increments of 1) [x unit q'ty]	0	Always
79	Origin return position	1 to ±79,999,999 (in increments of 1) [x unit q'ty]	0	Always

*After changing basic para. 71 to 73, power supply need be turned on again.

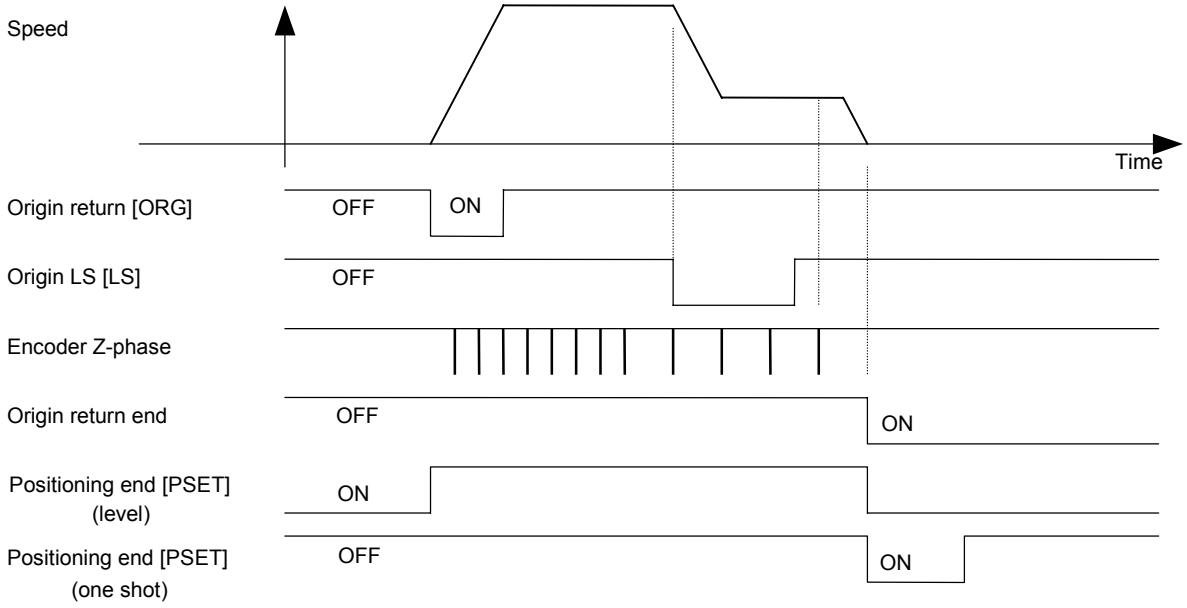
• Origin return action

At the ON edge of origin return [ORG] signal, the following operations are automatically carried out.

(a) At the ON edge of [ORG] signal, motor starts at "Origin return speed" (basic para. 75) in "Origin return direction" (basic para. 72)
(b) When the [LS] signal turns from off to on, speed is reduced to "Origin detection creep speed" (basic para. 76). While [LS] on, motor runs at constant speed.
(c) The first encoder Z-phase signal is detected following the transition of [LS] signal from OFF to ON.
(d) The motor stops after rotating by "Origin shift q'ty" (basic para. 77) from the detection of Z-phase signal.
(e) The [PSET] signal turns on with the stopped position as "Origin return position" (basic para. 79). "Origin return complete" signal as the control output signal turns on.

An origin return action can be selected out of 4 patterns in the "Origin return pattern" (basic para. 71).
Also, with the Z-phase input invalid (1) selected in the "Z-phase valid/invalid" (basic para. 73), motor can be stopped after running by the "Origin shift q'ty" (basic para. 77) from the ON to OFF edge of [LS] signal.
The ON/OFF status of [LS] signal can be inverted using "Origin LS logic" (basic para. 74)

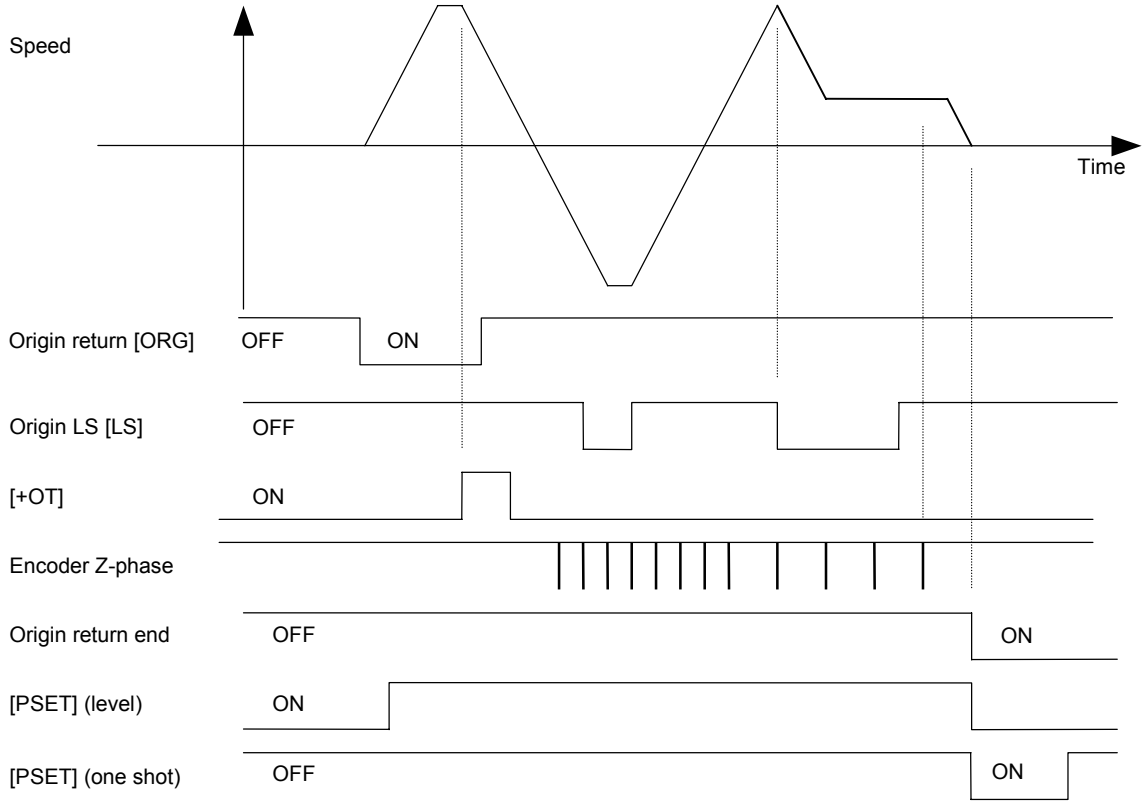
• Origin return pattern 1 (pattern 1 in basic para. 71)
At the ON edge of [ORG] signal, the aforementioned operations (a) through (e) are carried out.
If the [+OT] or [-OT] signal of the "Origin return direction" is detected during origin return operation, the motor stops immediately. In this case, origin return is not completed. The "Origin return end" signal still remains off.
The origin return operation can be carried out again regardless of the on/off status of "Origin return end" signal.



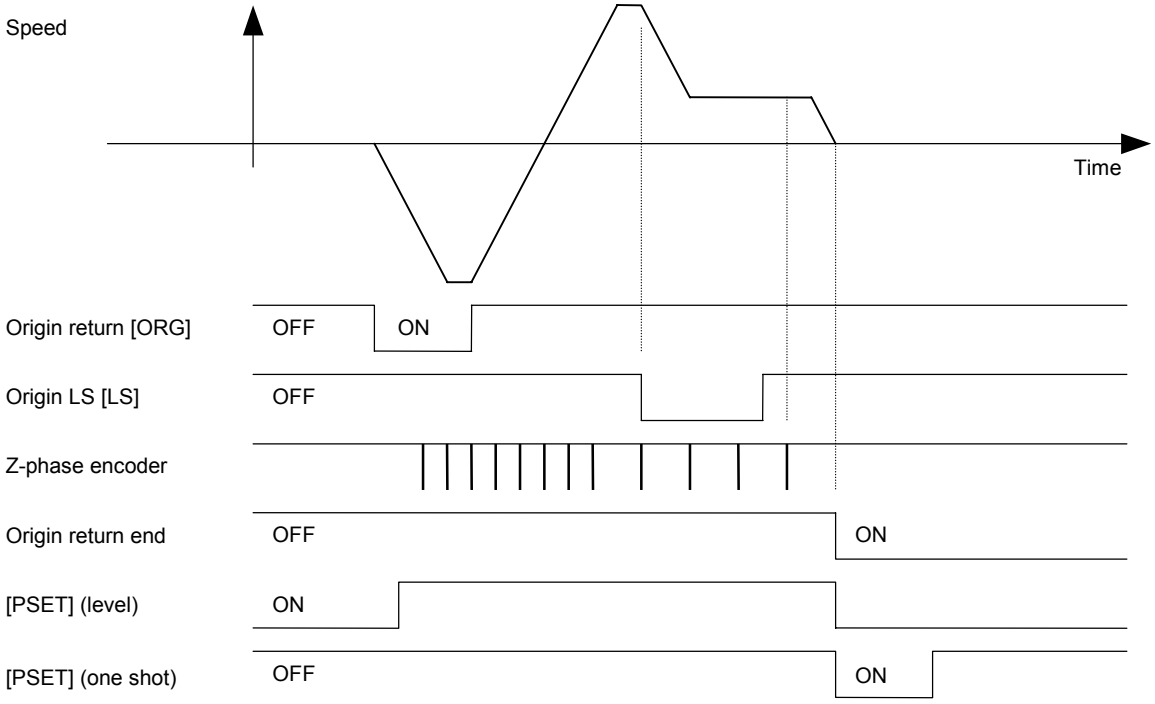
- Origin return pattern 2 (pattern 2 in basic para. 71)
  At the ON edge of [ORG] signal, the aforementioned operations (a) through (e) are carried out.
  If the [+OT] or [-OT] signal in the origin return direction is detected in the course of origin return, the motor stops once. Then, the following operations are carried out.

  (f) The motor starts rotation at the origin return speed in the opposite to the origin return direction.
  (g) The motor stops on detection of OFF to ON to OFF transition of the "Origin LS" [LS] signal.
  (h) Operations (a) through (e) are carried out again.

  In case the [OT] signal toward the opposite to the origin return direction is detected during (f) operation in the origin return operation, the motor stops immediately ([LS] on is not detected).
  In this case, origin return operation has not been completed.

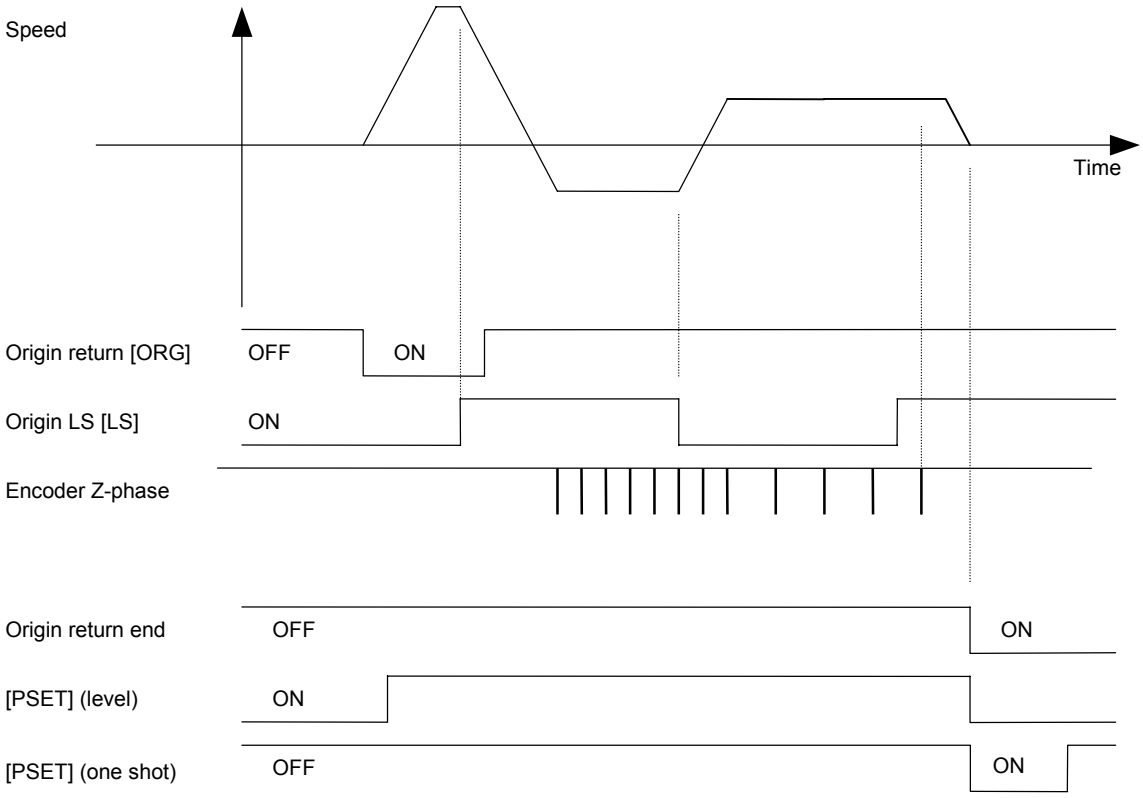


• Origin return pattern 3 (pattern 3 in basic para. 71)
At the ON edge of [ORG] signal, the motor rotates by the origin return reversing quantity at the origin return speed. Then, the operation from (a) through (e) is carried out.
If the [OT] signal toward the opposite to the origin return direction is detected during rotation by the origin return reversing quantity, the movement stops once, and then carries out the "Origin return pattern 1".



• Origin return pattern 4 (pattern 4 in basic para. 71)

(a) At the ON edge of [ORG] signal, the rotation starts in the origin return direction at the origin return speed.
(b) The movement stops once at the falling edge from ON to OFF level of [LS] signal.
(c) The motor rotates in the direction opposite to origin return at the origin detection creep speed.
(d) The movement stops once at the rising edge from OFF to ON level of [LS] signal.
(e) The motor rotates in the origin return direction at the origin detection creep speed.
(f) After detecting again a falling edge from ON to OFF level of [LS], the movement shifts by the origin shift quantity from the first Z-phase detection and then stops.
(g) The stopped position is considered ‘‘Origin return end’’ position, and the ‘‘Origin return end’’ signal is turned on.



• Origin return pattern

Four kinds of origin return patterns are selectable from the basic para. 71 setting.

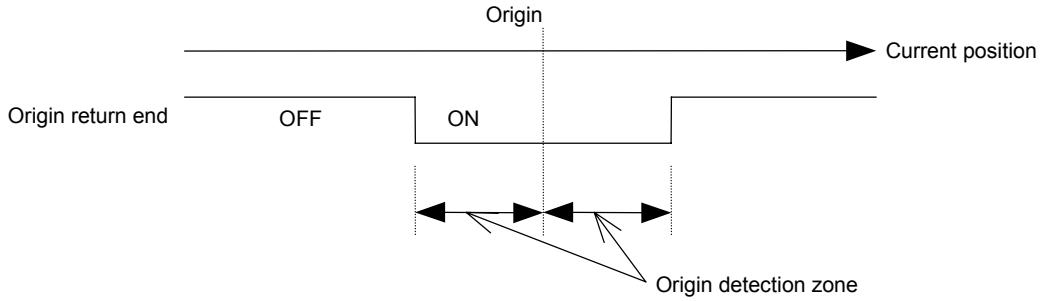
Origin return pattern	Comparison to other patterns
Pattern 1	When the machine stop position is in the opposite direction to the origin return direction, the time required for origin return action can be shortened.
Pattern 2	When the machine stop position is in the origin return direction viewed from the origin LS, the time required for origin return action can be shortened. (where it is near the OT signal in the return direction)
Pattern 3	When the machine stop position is just behind the origin return direction viewed from the origin LS, the time required for origin return action can be shortened. The origin return reversing quantity can be changed by basic para.
Pattern 4	When the machine stop position is in the opposite direction to the origin return direction, the detecting speed of origin LS is always constant even if the origin return speed is changed.

• Origin return end (22)

This signal is turned on when the origin return action has been normally completed. After this, this signal is held on when the current feedback position is within the origin detection range (basic para. 66) viewed from the origin return complete position (basic para. 79). If the origin detection range is widened to the maximum, this signal is always on after the origin return completion.

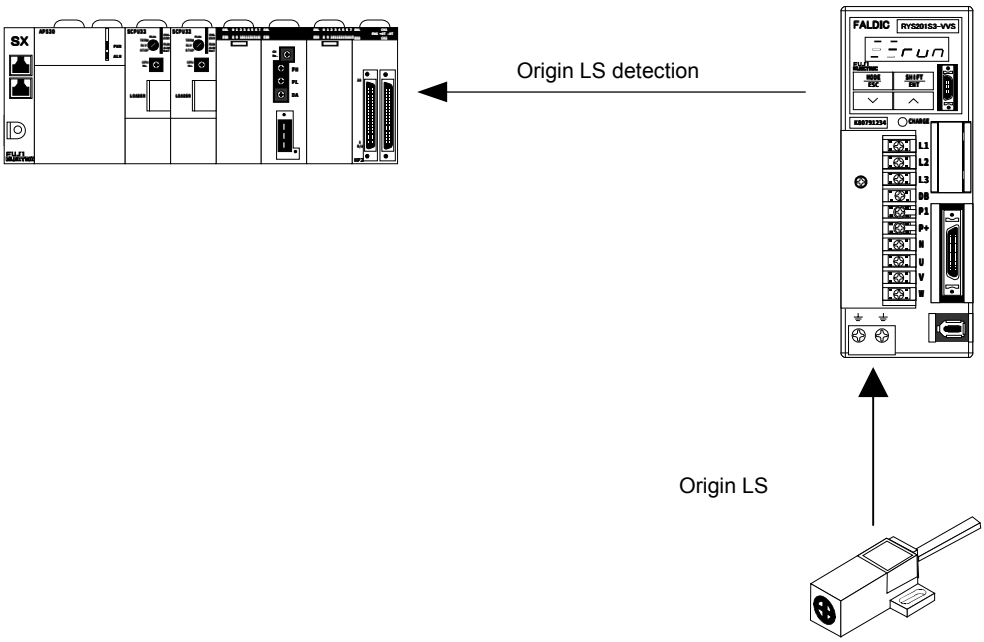
Basic parameter 66

Para.	Name	Setting range	Initial value	Change
66	Origin detection zone	1 to 79,999,999 (in increments of 1) [x unit q'ty]	100	Always

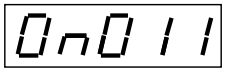


Note : The origin is the position where the machine has stopped after completed the origin return action, or has executed the position preset. It is not necessary the "origin" (where the current position is at zero position).

- Origin LS (limit switch) detection (40)
  Because the origin LS signal requires quick response, this should be directly input to the amplifier in general. When the host controller needs the origin signal, the origin LS detection signal can be output.
  While the origin LS [LS] signal is on, the origin LS detection signal (40) is on.



- LS-Z pulse
  The encoder pulse count from the time when the origin LS signal goes to OFF level until Z-phase signal is detected can be monitored.
  [OnO11]

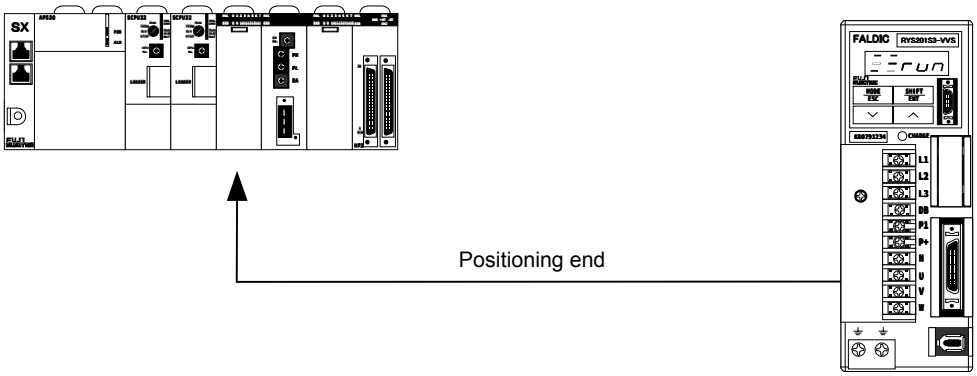


  If this count is small, Z-phase signal of one rotation later may have been detected, depending on the origin LS response. Move the mechanical position of the origin LS.

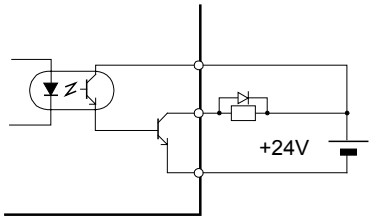
5.7.3 Positioning end［PSET］

The completion of positioning can be confirmed by this signal on.

The output form of positioning end［PSET］signal can be selected by setting basic para. 55.
In speed and torque controls, the on/off status at position control is retained.



■ Interface



Positioning end (2)
ON : In positioning complete status
OFF : Motor is rotating

■ Parameter setting

To allocate the positioning end signal to the control output terminal, set (2) to the system para.

■ Related items

• Output form of positioning end signal is selectable by setting of basic para. 55 and 56.

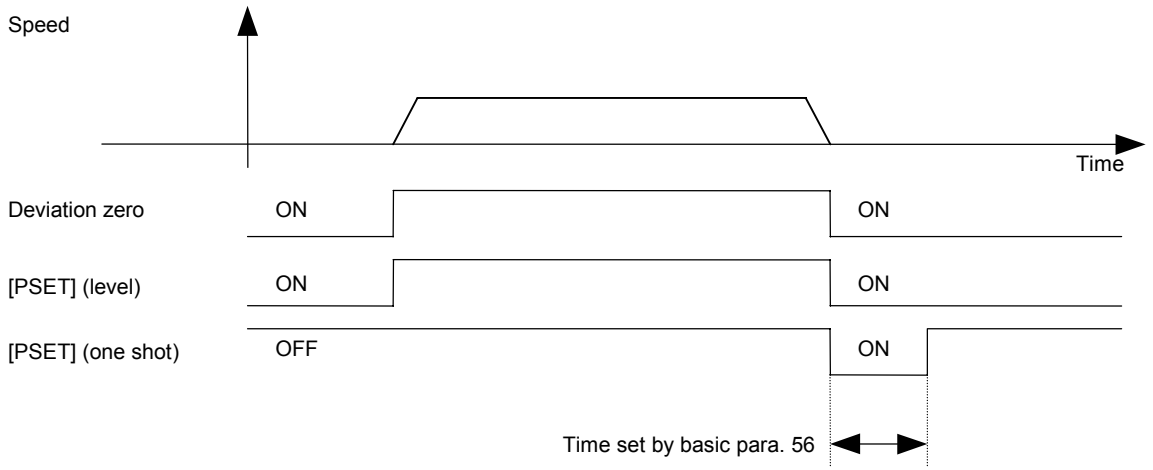
Basic parameter 55, 56

Para.	Name	Setting range	Initial value	Change
55	Positioning end output form	0 : Level, 1 : One shot	0	Power
56	Positioning end output time	0.01 to 1.00 [s] (in 0.01s steps)	0.10	Always

* The on period is specified when the positioning end output form is one shot.

(a) At power on
Level : ON
One shot : OFF. Automatically turns off after the elapsed time set by basic para. 56 has elapsed. So it turns on for about 1.5s in order tocheck function.

(b) Pulse train
Level : Turns on when the difference (deviation) between command position (pulse train input) and feedback position is within the deviation zero width (basic para. 53). For the pulse train input, the form of output signal is same as that of deviation zero signal.
One shot : Turns on for the specified period when the deviation q'ty is within the deviation zero width (basic para. 56)



With one shot selected, when deviation zero signal is off within the time set by basic para. 56, operation is stopped forcibly.

(c) Interrupt positioning

Level : Turns on when the positioning end judgment time (basic para. 57) has elapsed after the difference (deviation) between the command position (pulse train input) and feedback position came within the deviation zero width (basic para. 53)

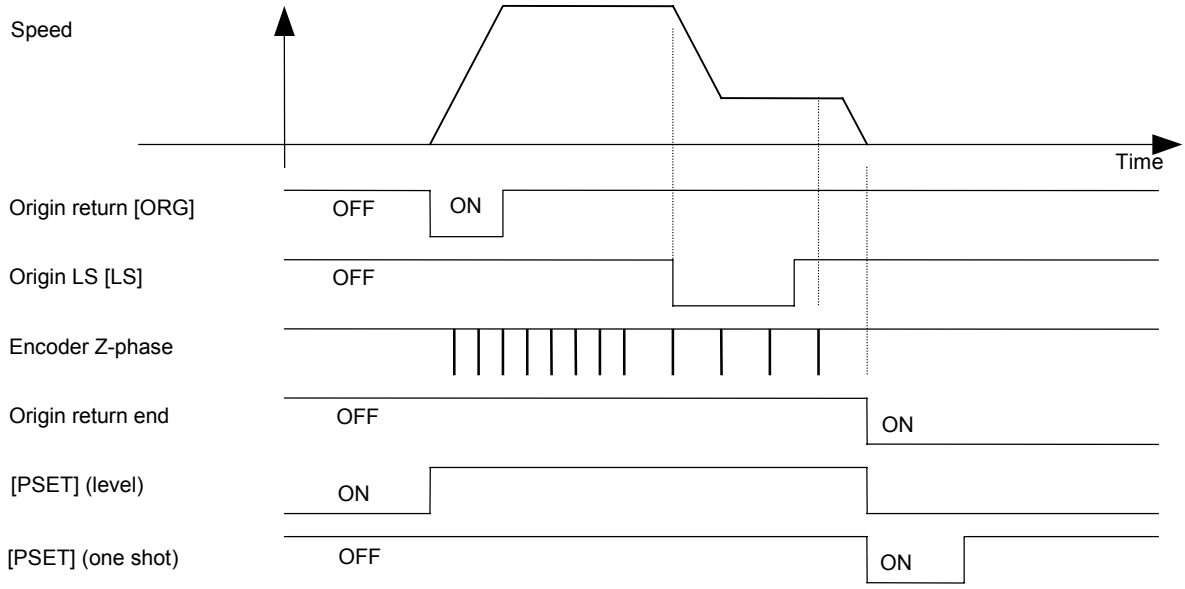
One shot : Turns on for the determined period of time (basic para. 56) on condition that the positioning end level is on.

With one shot selected, when positioning has started within the time set by basic para. 56, operation is stopped forcibly.

(d) Origin return

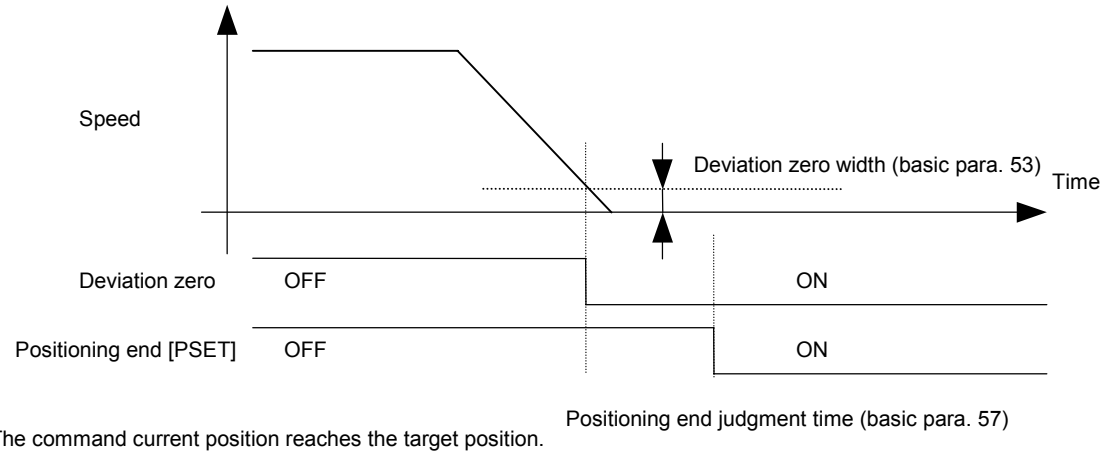
Level : Turns on when the positioning end judgment time (basic para. 57) has elapsed after the difference (deviation) between the command position (pulse train input) and feedback position came within the deviation zero width (basic para. 53)

One shot : Turns on for the determined period of time (basic para. 56) on condition that the positioning end level is on.



With one shot selected, when positioning has started within the time set by basic para. 56, operation is stopped forcibly.

• Positioning end judgment time
The output timing of positioning end signal is shown below.



1) The command current position reaches the target position.
2) The motor's feedback current position follows the command current position to reach the target position.
3) When the difference (deviation) between the command position and the feedback position is less than the deviation zero width (zone) (basic para. 53), the deviation zero signal is turned on.
4) When the deviation zero signal is continuously held on during the positioning end judgment time (basic para. 57), the positioning end signal [PSET] is turned on.

Basic parameter 57

Para.	Name	Setting range	Initial value	Change
57	Positioning end judgment time	0.000 to 1.000 [s] (in 0.001s steps)	0.050	Always

• Positioning end [PSET] output at alarm detection

Cause	Deceleration form	Positioning end [PSET]	Remarks
Run command [RUN] off	"Forced zero speed" to "base off"	On at stopping	Ready [RDY] off
Forced stop [EMG] off	Forced zero speed	Off	On at forced stop [EMG] release
OT detection Soft OT detection	"Forced zero speed" to " servo lock"	On at stopping	Movable when pulse train input, forward command or reverse command on
Alarm detection (minor fault)	"Forced zero speed" to "base off"	Off at stopping	Turns on when reset by alarm reset [RST]
Alarm detection (major fault)	Base off	Off at stopping	Turns on when reset by alarm reset [RST]

Note : Minor fault … Deviation over [OF], Resistor overheat [rH], Amplifier overheat [AH], Encoder overheat [EH] and Bus communication error [tE]
Major fault … Alarm detection other than minor fault
Forced zero speed … Decelerates to a stop by regenerative braking torque (maximum braking torque)
Base off … Motor has no driving force (free-run)

5.7.4 Interrupt positioning

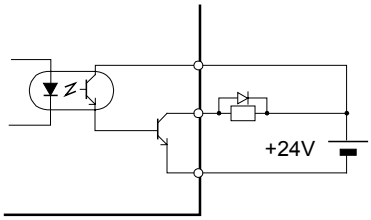
An interrupt input causes movement by the determined amount and the stop.

Interrupt positioning can be carried out in position control condition with the position control (37) signal on.
Interrupt positioning makes a start when motor has started rotation with forward (or reverse) command while interrupt valid (48) signal on.
Speed in interrupt positioning follows X1, X2 or X3 signals. An override can be applied to the speed.

Motor moves by the determined distance from the time at the ON edge of "interrupt input" (49) signal, and then automatically stops. The move amount from interrupt input is set by basic para. 81.
The rotating speed maintains the speed of the time of rising edge of interrupt input.

While "interrupt valid" (48) signal is off, interrupt input (49) is invalid.

■ Interface



Interrupt valid (48)
ON : Interrupt input is effective
OFF : In position control status
Interrupt input (49)
ON edge: Moves by the determined distance and then stops

■ Parameter setting

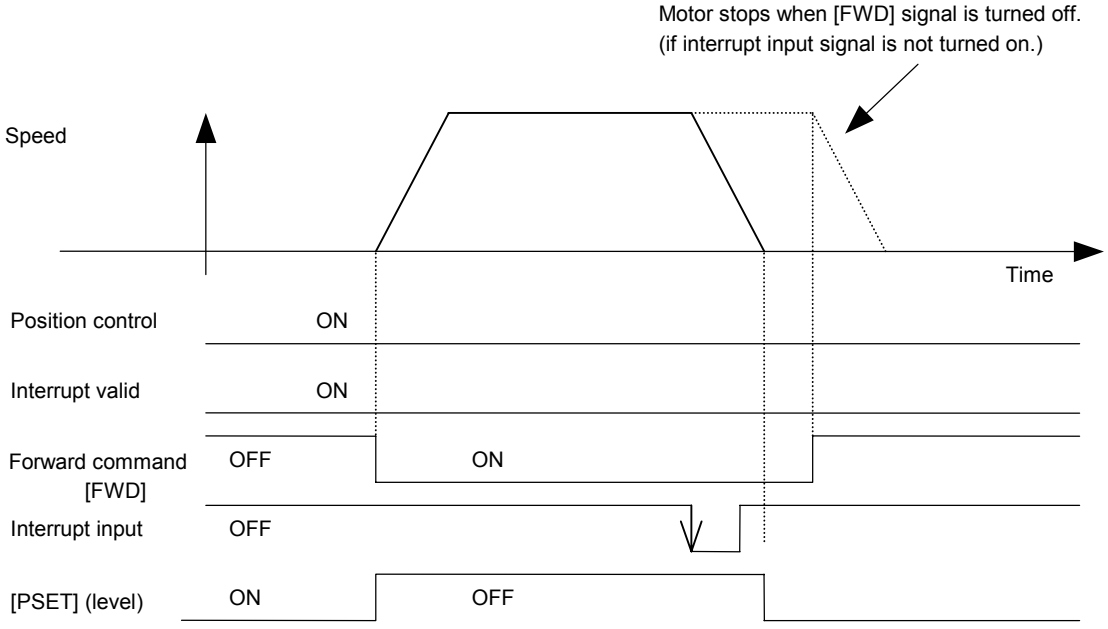
To allocate the interrupt valid signal to the control input terminal, set (48) to the system para. Set (49) for the interrupt input. If these signals are not allocated to the control input terminal, these are deemed "always off."

■ Related items

- Interrupt movement
  Move amount after interrupt input can be set at basic para. 81

Basic parameter 81

Para.	Name	Setting range	Initial value	Change
81	Interrupt move amount	1 to 79,999,999 (in increments of 1) [x unit q'ty]	100,000	Always



• Interrupt positioning accuracy
Interrupt input signal is affected by “hardware filter time 0.1ms and “software sampling time interval 0.2ms.
Interrupt input signal is on at the same time of sampling, or approximately 0.2ms later. Therefore, the signal input timing varies within ±0.1ms.

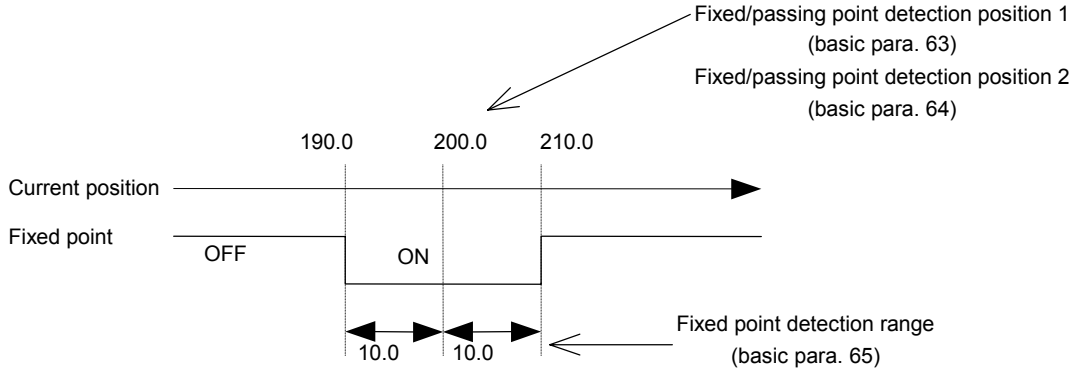
When mechanical equipment system moving speed N=1,000mm/s (60m/min),
1000 x 0.0001 = 0.1mm
The response rate of the sensor which will be used for interrupt input should be considered.

5.7.5 Fixed/passing point

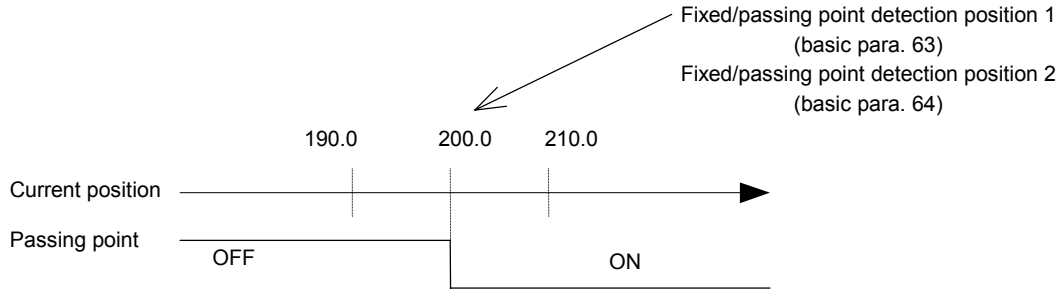
Current position of motor can be checked.

Three types of output forms can be selected by the basic para. 62 setting.

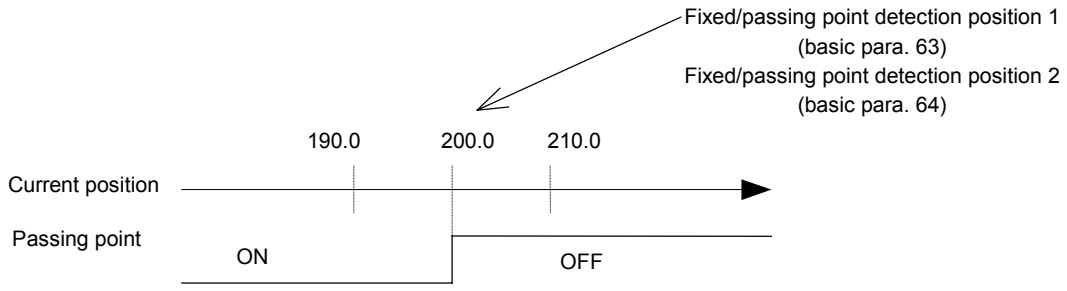
1) Fixed point (basic para. 62 : 0)
This output signal is on when current position is near the basic para. setting point.



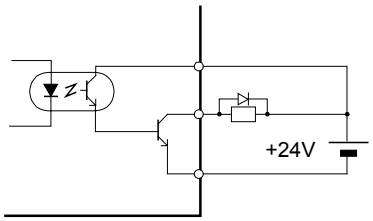
2) Passing point from off to on (basic para. 62 : 1)
This signal is on when current position is beyond the basic para. setting point. The signal is off when it is less than the setting point.



3) Passing point from on to off (basic para. 62 : 2)
This signal is on when current position is less than the basic para. setting point. The signal is off when it is beyond the setting point.



■ Interface



Fixed/passing point 1 (17)
Fixed/passing point 2 (18)
ON/OFF : Automatically turns on or off according to the current position

■ Parameter setting

To allocate the fixed/passing point 1 signal to the control output terminal, set (17) to the system para. Set (18) for the fixed/passing point 2.

■ Related items

• Selection of output form
Output form can be set by basic para. 62 to 65.

Basic parameter 62 to 65

Para.	Name	Setting range	Initial value	Change
62	Fixed/passing point detection	0 : Fixed point 1 : Passing point off →on 2 : Passing point on → off	0	Always
63	Fixed/passing point detection position 1	0 to ±79,999,999 (in increments of 1) [x unit q'ty]	0	Always
64	Fixed/passing point detection position 2	0 to ±79,999,999 (in increments of 1) [x unit q'ty]	0	Always
65	Fixed point detection range (zone)	0 to ±79,999,999 (in increments of 1) [x unit q'ty]	100	Always

• Valid or invalid of position detection function
Position detection function such as fixed/passing point 1 can be effective after origin return end.

Basic parameter 67

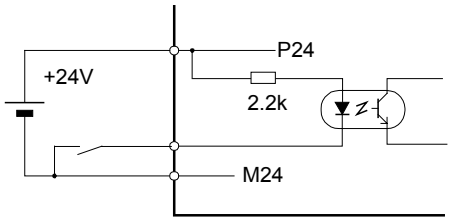
Para.	Name	Setting range	Initial value	Change
67	Position detection function valid/invalid	0 : Valid after origin return 1 : Always	0	Always

5.7.6 Override

This function changes the current motor speed.

While "override effective" (43) signal is turned on, the motor speed is variable by a scale factor specified by "override 1/2/4/8" up to 1.5 times the current speed.
Weighting of scale factor corresponding to override 1/2/4/8 can be changed by basic para.
This function is effective for any rotation command except for torque control, pulse train input (pulse train ratio 1 or 2).
This function will not be effective after the ON edge of interrupt input in interrupt positioning.

■ Interface



Override effective (43)
Override 1 (44)
Override 2 (45)
Override 4 (46)
Override 8 (47)

■ Parameter setting

To allocate the override effective signal to the control input terminal, set (43) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

Signal name	Set value at system para.
Override effective	43
Override 1	44
Override 2	45
Override 4	46
Override 8	47

■ Related items

• Override scale factor

The scale factors while the override effective signal is on are as follows.
If “override effective” goes off, the 100% moving speed is obtained.
The signal not allocated to the control input terminal is deemed “always off.”

Override 8	Override 4	Override 2	Override 1	Moving speed [%]
OFF	OFF	OFF	OFF	0
OFF	OFF	OFF	ON	10
OFF	OFF	ON	OFF	20
OFF	OFF	ON	ON	30
OFF	ON	OFF	OFF	40
OFF	ON	OFF	ON	50
OFF	ON	ON	OFF	60
OFF	ON	ON	ON	70
ON	OFF	OFF	OFF	80
ON	OFF	OFF	ON	90
ON	OFF	ON	OFF	100
ON	OFF	ON	ON	110
ON	ON	OFF	OFF	120
ON	ON	OFF	ON	130
ON	ON	ON	OFF	140
ON	ON	ON	ON	150

*Where override weighting is at initial value.

• Override weighting

Override weighting can be changed by using basic para. 17 to 20.

Basic parameter 17 to 20

Para.	Name	Setting range	Initial value	Change
17	Override 1	0 to 150% (in increments of 1)	10	Always
18	Override 2	0 to 150% (in increments of 1)	20	Always
19	Override 4	0 to 150% (in increments of 1)	40	Always
20	Override 8	0 to 150% (in increments of 1)	80	Always

When override 8, 4, 2 and 1 are all on, adding all initial values gives 150 (= 80 + 40 + 20 + 10). If the initial value has been changed and resultant sum exceeded 150, the current speed is retained.

• Maximum speed

Maximum speed of the motor output shaft can be set by basic para.16 setting. However, this setting is invalid while pulse train input exists.

5.7.7 Free-run [BX]

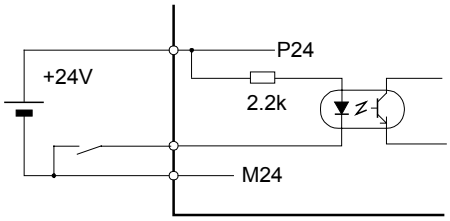
This function puts the motor into free-run status forcibly.

While free-run [BX] signal is on, the motor is in free-run status. Motor decelerates (or accelerates) with the loaded torque.
The [BX] signal is always effective in any control status (position control, speed control and torque control).

For safety purpose, do not use this signal to the machine which moves vertically.

In position control, while this signal is on, the motor free-runs. If this signal is turned on when performing position control using pulse train, the output pulse count of the host controller may differ from the motor rotational quantity.
In speed control or torque control, the motor immediately free-runs. If this signal is turned off during deceleration, the command speed or command torque can be output.

■ Interface



Free-run (54)
ON : In free-run status
OFF : In normal operation status

■ Parameter setting
To allocate the free-run signal to the control input terminal, set (54) to the system para.

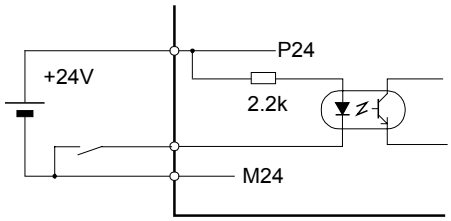
■ Related item
The free-run signal takes the precedence over any other signals in all the control modes.

5.7.8 P-action

The speed control is subordinate to proportional band control.

This signal should be turned on while locking the motor shaft mechanically, with the run command [RUN] on. See 5.7.1 Brake timing.
Speed control or position control becomes unstable if P-action signal is on during motor running. Never put this signal on during motor running.

■ Interface



P-action (29)
ON : In P-action (proportional band control)
OFF : In normal operation

■ Parameter setting
To allocate the P-action signal to the control input terminal, set (29) to the system para. If this signal is not allocated to the control input terminal, this signal is deemed "always off."

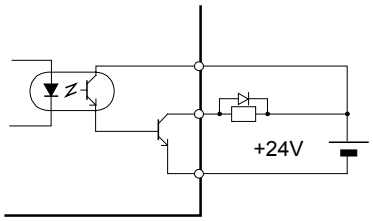
5.7.9 Dynamic braking

This signal is output when the amplifier detects major fault.

This signal is turned on when such a major fault has occurred that the amplifier cannot drive the motor, and is retained until alarm reset signal is input.
Dynamic braking is a braking type to short-circuit the coils between three phases of a synchronous motor to generate power.
Once the motor is stopped, braking force is not retained.

The output terminal of dynamic braking is +30V DC, 50mA. This cannot directly close a magnetic contactor. Use a general purpose relay or FUJI SSC (solid state contactor).

■ Interface



Dynamic braking (15)
ON : Major fault is detected
OFF : In normal operation

■ Parameter setting

To allocate the dynamic braking signal to the control output terminal, set (15) to the system para.

■ Related items

• Major fault
Fault that cannot drive motor

Indication	Detection contents
OL	Overload
OS	Overspeed
Hu	Overvoltage
Et	Encoder error
EC	Encoder communication error
Ct	Control power error
dE	Memory error
Lu	Undervoltage
OC	Overcurrent
CE	Combination error
rH2	Resistor heat 2
CtE	CONT signal error
SE	System error

• Minor fault
Protection against overheat etc.

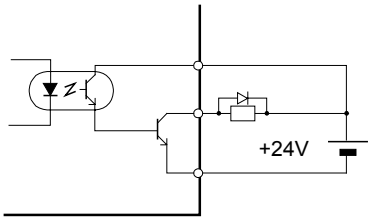
Indication	Detection contents
rH	Resistor overheat
OF	Deviation over
AH	Amplifier overheat
EH	Encoder overheat
AL	ABS data lost
AF	Multiple rotation overflow
bE	Bus communication error

5.7.10 Address error

Address error in rewriting parameters can be checked.

This signal turns on when detecting the following errors while rewriting the parameters.
1) Data (format) other than BCD was input
2) Data outside the setting range was input
3) Negative sign was input (negative sign against positive data)
Once the correct data has been input, this signal goes off.
Even if address error occurs, motor will not stop.

■ Interface



Address error (31)
ON : Error in rewriting para. has been detected
OFF : Under normal rewriting

■ Parameter setting
To allocate the address error signal to the control output terminal, set (31) to the system para.

5.7.11 CPU ready [CPURDY]

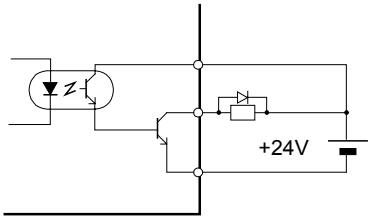
Normal operation of amplifier and motor can be checked.

This signal is turned on for the following conditions when power is applied.

- CPU in the amplifier is operating normally.
- The amplifier recognizes motor (encoder).
- An alarm such as memory error (dE) which cannot be reset is not detected.

CPU ready signal output has no relation with control input signal on/off status.

■ Interface



CPU ready (28)
ON : The amplifier is in normal operation.
OFF : Memory error or motor cannot be recognized

■ Parameter setting
To allocate the CPU ready signal to the control output terminal, set (28) to the system para.

6.PARAMETER SETTING

6.1 Mechanical equipment system

This section explains the parameter setting according to the mechanical equipment system driven by motor.

6.1.1 Change of rotational direction

This parameter makes the motor rotational direction match the machine moving direction.

System parameter 80

Para.	Name	Setting range	Initial value	Change
80	Rotational direction changeover	0 : Positive direction / forward 1 : Positive direction / reverse	0	Power

A selected rotational direction affects any of speed control, position control and torque control.

Speed control: The positive direction means the rotational direction when a positive (+) voltage is applied to speed command voltage terminal [NREF] (multistep speed), and forward command [FWD] is given. The motor output shaft rotates forward.

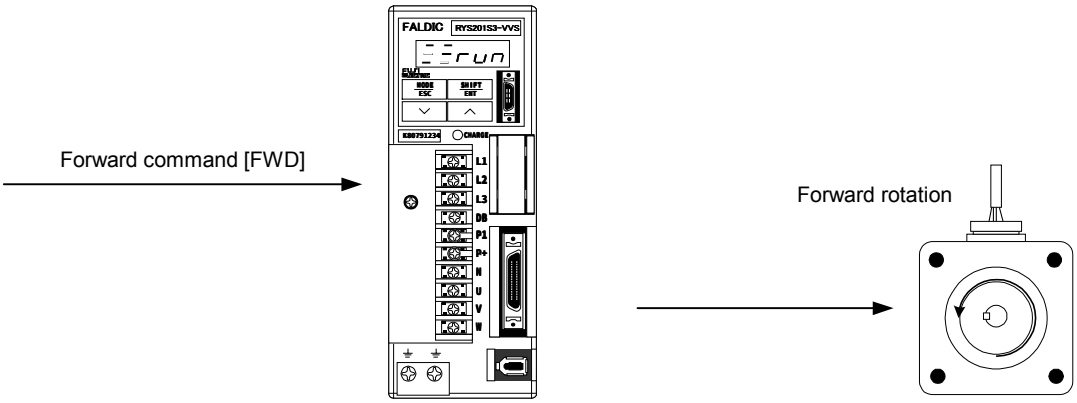
Position control: The positive direction means the rotational direction when a forward pulse or command code at H level, or a pulse train of two 90° phase-different (B-phase advance) signal is applied. The motor output shaft rotates forward.

Torque control: The positive direction means the rotational direction when a positive (+) voltage is applied to the torque command voltage terminal [TREF], and forward command [FWD] is given. The motor output shaft rotates forward.

■Related items

- Forward rotation, reverse rotation

Forward rotation is counter-clockwise (CCW) rotation when viewed from a point facing the drive-end of motor. Clockwise rotation is reverse rotation.



When forward command [FWD] is given to amplifier and speed command (reference) voltage is positive (+), the motor rotates forward. To rotate its direction in reverse, change the system para. 80 setting.

- Speed command [NREF], Torque command [TREF]

Each terminal accepts dual polarity voltage input of -10 to 0 to +10V.
When a negative (-) voltage is input and reverse command [REV] is given, the motor rotates forward.

- Resolution of speed command [NREF]

The resolution is 14 bit at full scale. When a speed reference voltage of 5000[r/min] /10V is given, (-5000 to +5000) [r/min] / 2^{14}= 0.6 [r/min] is obtained.

- Resolution of torque command [TREF]

The resolution is 10 bit at full scale. When a torque reference voltage of 300% /10V is given, (-300 to +300) % / 2^{10} = 0.6 % (100% at rated torque) is obtained.

6.1.2 Operation at stopping

The status when the motor is stopping can be selected.

System parameter 81

Para.	Name	Setting range	Initial value	Change
81	Operation at stopping	0 : Speed zero 1 : Servo lock 2 : External brake (P-action) 3 : External brake (free-run)	0	Power

A selected operation at stopping affects to any of speed control, position control and torque control.

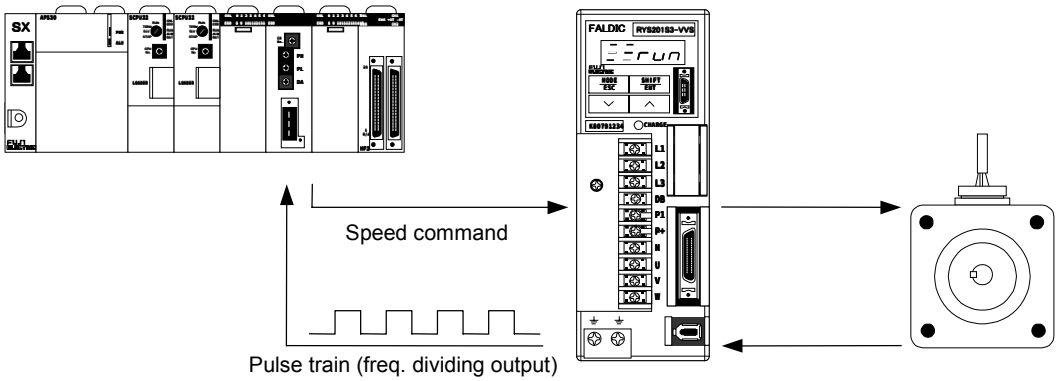
- Speed control - Position control - Torque control

Operation at stopping	Speed control	Position control	Torque control
Speed zero	Zero-speed	Servo lock	Zero-torque
Servo lock	Servo lock	Servo lock	Zero-torque
External brake (P-action)	External brake (P-action)	External brake (P-action)	External brake (zero-torque)
External brake (free-run)	External brake (free-run)	External brake (free-run)	External brake (free-run)

1) Speed zero

The motor is stopping without holding the corrent position by “servo lock” assuming that the speed command is zero, If the motor is rotated by the load machine system, a counter force is activated in the opposite direction to the driven direction (as the speed is not zero.)
In speed control, if “servo lock” is selected as the operation at stopping, the motor can be stopped retaining the current position. “Servo lock” should be done at the speed lower than “speed zero width” set by basic para. 52.

Set the “operation at stopping” at “zero-speed” in order to generate an analog speed command voltage with the host controller and to obtain feedback signal via the freq. dividing output from amplifier.



2) Servo lock

The motor can be stopped retaining the current position (current position of motor’s encoder).

3) External brake (P-action)

The motor can be stopped by the motor’s brake, by using the “brake timing” outputted from amplifier. The motor output shaft is mechanically locked and the control system gain on the amplifier side is lowered.

4) External brake (free-run)

The motor can be stopped by the motor’s brake, by using the “brake timing” outputted from amplifier. Noise or vibration will not be generated because the no motor control is made.

See 5.7.1 for the use of external brake.

6.1.3 Soft-start

This function can gradually accelerate or decelerate the motor.

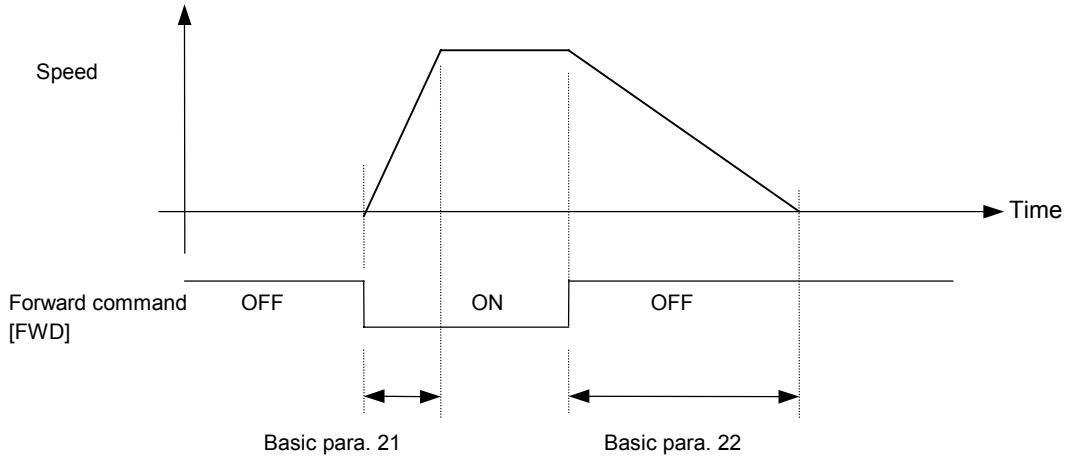
Basic parameter 21 to 24

Para.	Name	Setting range	Initial value	Change
21	Acceleration time 1	0.000 to 99.999s (in 0.001s steps)	0.100	Always
22	Deceleration time 1	0.000 to 99.999s (in 0.001s steps)	0.100	Always
23	Acceleration time 2	0.000 to 99.999s (in 0.001s steps)	0.500	Always
24	Deceleration time 2	0.000 to 99.999s (in 0.001s steps)	0.500	Always

-Speed control -Position control Using “Soft-start”

This function is effective for all of the accel./decel. operation in speed control and position control (except for pulse train input).
The time setting is for the speed range of 0 to 2000 [r/min].
Acceleration time 2 and deceleration time 2 are effective while ACC0 signal is on.
ON/OFF input of ACC0 is always effective and accel. time/decel. time can also be changed over. The ACC0 is a signal allocated to CONTrol of system parameters.

Acceleration time 1 and deceleration 1 can be set separately. For example, only deceleration time can be lengthened. Most suitable deceleration time can be selected depending on the load volume in driving a carrier machine.



Set the accel. and decel. time at 0.000s to send the analog speed reference voltage signal from the host controller and to feedback the freq. dividing output from the amplifier.
Non-linear (S-curve) filter coefficient can be set for pulse train input in position control. See 6.1.5.
Torque control voltage can be changed by a filter time constant concerning torque command voltage. See 5.6 Torque control.

6.1.4 Soft OT

The soft OT (overtravel preventive signal set by software) can be set.

System parameter 75 to 77

Para.	Name	Setting range	Initial value	Change
75	Soft OT valid/invalid	0: Invalid 1: Valid	0	Power
76	+Soft OT detection position	–79,999,999 to +79,999,999 (in increments of 1) [x unit q’ty]	79999999	Always
77	–Soft OT detection position	–79,999,999 to +79,999,999 (in increments of 1) [x unit q’ty]	–79999999	Always

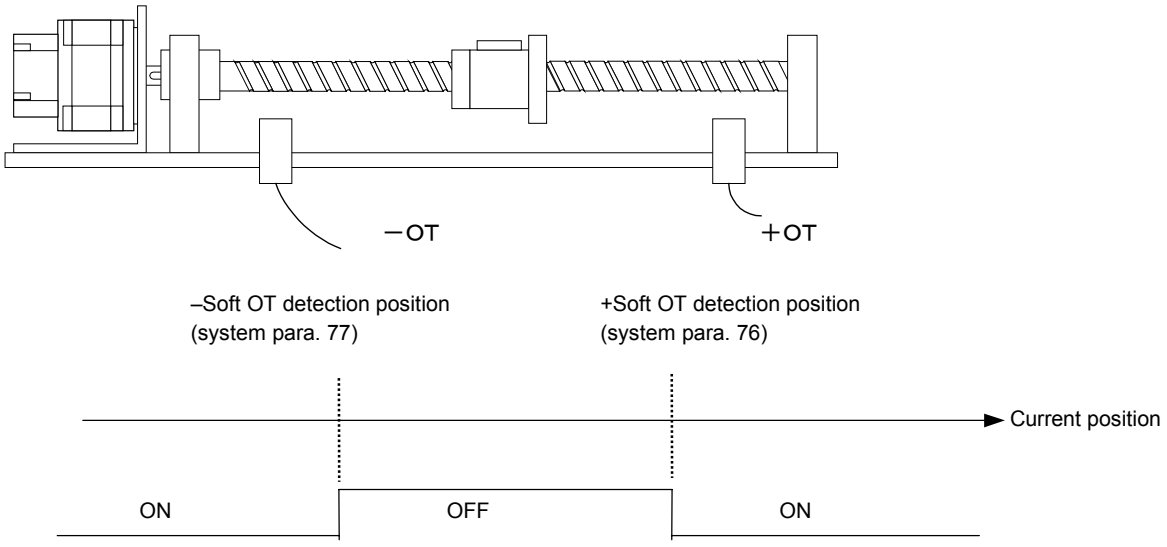
The position detection function can be effective after end of origin return by basic para. 67.

Basic parameter 67

Para.	Name	Setting range	Initial value	Change
67	Position detection function valid / invalid	0: Valid after end of origin return 1: Always	0	Always

- Speed control - Position control

Different from the +OT, -OT of the control input signal, the soft OT function stops the motor forcibly when the motor current position is beyond the setting value. When the motor has stopped, OT detection (20) of the control output signal is turned on.



Soft OT cannot be used for OT detection invert operation in origin return pattern 2, 3 or 4.

6.1.5 Non-linear (S-curve) filter coefficient

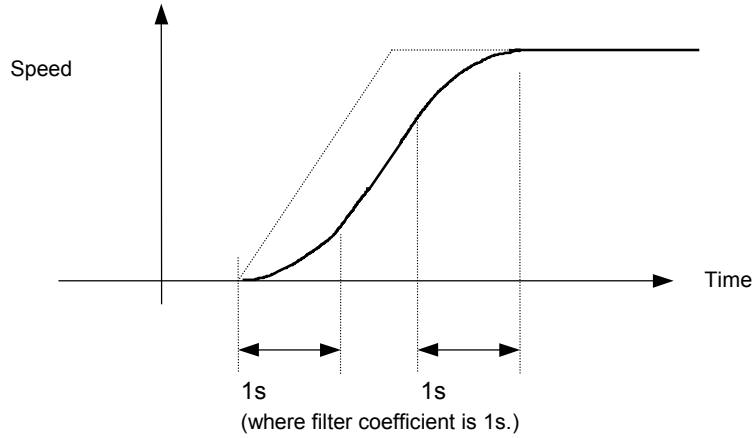
The motor can be accelerated by drawing an S-curve.

Basic parameter 25

Para.	Name	Setting range	Initial value	Change
25	Non-linear (S-curve) filter coefficient	0.001 to 1.000s (in 0.001s steps)	0	Always

- Speed control

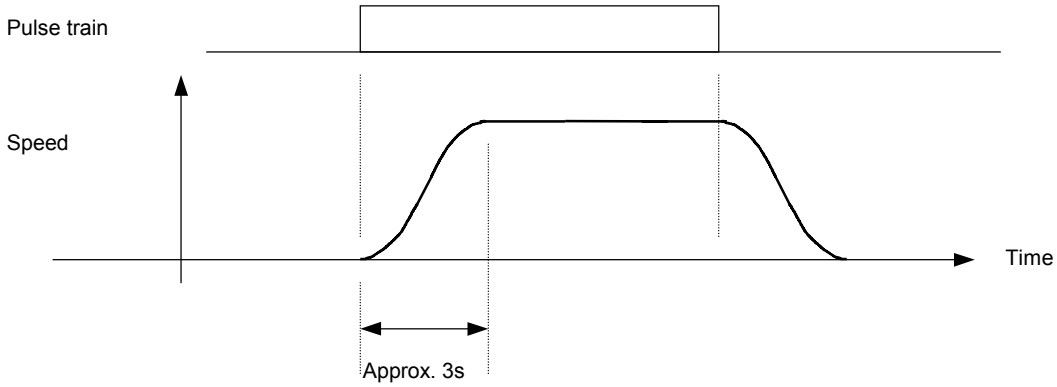
In speed control, S-shaped curve is drawn at the beginning and at the end of acceleration with the setting of the filter coefficient.



(where filter coefficient is 1s.)

- Position control

Accel./decel. can be adjusted by using the time constant of the filter coefficient when the pulse train input is given by constant frequency.
The motor rotates as much as the pulse train input.
Even if the host controller cannot perform linear acceleration, smooth acceleration can be realized.



(filter coeff.: 1s, accel./decel.: 1s, filter coeff.: 1s)

6.1.6 Auto-tuning

This function adjusts the motor's response rate according to the mechanical equipment system.

Basic parameter 31 to 33

Para.	Name	Setting range	Initial value	Change
31	Tuning method	0: Manual 1: Auto (low stiffness) 2: Auto (high stiffness)	1	Always
32	Load inertia ratio	0.0 to 100.0 (in 0.1 step)	0.0	Always
33	Operating speed response	10 to 1000Hz (in increments of 1)	100	Always

- Position control - Speed control

Auto-tuning is effective in position control and speed control, but not in torque control.

Set the following two parameters to activate the auto-tuning.
(1) Tuning method (basic para. 31)
(2) Operating speed response (basic para. 33)

■ Tuning method (basic para. 31)

Set this para. according to mechanical equipment system. In general, “auto (low stiffness)” is selected for most of mechanical equipment system. This is a factory setting value.

Basic parameter 31

Set value	Target machine
1: Auto (low stiffness)	Ball-screw (with speed reducer) Rack and pinion Timing belt Conveyor Chain drive Feed roll Table indexing (dividing) Spindle drive (with speed reducer)
2: Auto (high stiffness)	Ball-screw (direct coupling of motor and screw) Spindle drive (Direct coupling)
0: Manual	All of the para. must be set individually.

Auto-tuning is always effective when the load inertia ratio (basic para.32) is set at 0.0. The load inertia ratio after auto-tuning is executed can be checked in the monitor mode on the keypad panel. (Auto-tuning is invalid when basic para. is set at 0.)

Remarks : The load inertia ratio after auto-tuning will be canceled when power supply is shut down. Auto-tuning will be executed again when power supply is on.
To save the resultant load inertia ratio, set the load inertia ratio (basic para. 32) so that it can be monitored on the keypad panel. (in monitor mode [On0 14])

■ Adjustment of response rate (basic para. 33)

Motor’s response rate can be adjusted by setting the operating speed response (basic para. 33).

Basic parameter 33

Para.	Name	Setting range	Initial value	Change
33	Operating speed response	10 to 1000Hz (in 1Hz steps)	100	Always

Use the motor with the initial value of 100Hz in ordinary mechanical equipment system. The higher is the setting value, the quicker is the motor’s response rate. If the setting value is too high, vibration may be generated depending on the mechanical equipment system. Mechanical equipment system having direct-coupled ball-screw can have a higher setting value (higher response rate as well).

The following 3 basic para. can be automatically adjusted according to the setting value of the operating speed response (basic para. 33).

Basic parameter 37 to 39

Para.	Name	Setting range	Initial value	Change
37	Torque filter time constant	0.00 to 20.00 [ms] (in 0.01s steps)	0.30	Always
38	Speed regulator integration time	1 to 1000 [ms] (in 1ms steps)	20	Always
39	Position controller gain	1 to 1000 (in increments of 1)	50	Always

Basic para. 37 to 39 can be automatically rewritten only when the “auto” has been selected in the tuning method (basic para. 31).

Remark : The values of basic para. 37 to 39 are rewritten once the operating speed response (basic para. 33) is changed.
Basic para. 37 to 39 can also be set manually after these have been changed by the amplifier. Usually amplifier set value is used.

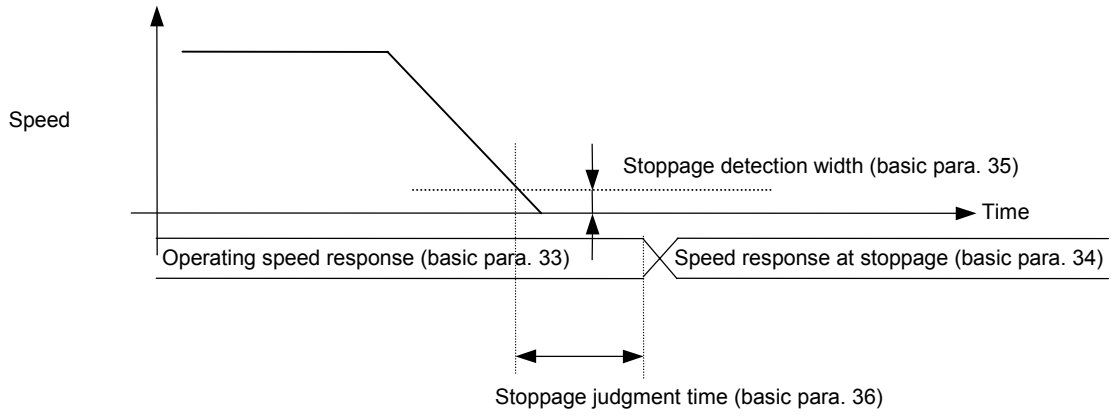
Auto-tuning related parameters

■ Changeover of response rate

The motor response rate can be changed over between when the motor is rotating and when the motor is stopping. This is effective to reduce the noise when stopping and suppress the resonance with the mechanical equipment system.

Basic parameter 34 to 36

Para.	Name	Setting range	Initial value	Change
34	Speed response at stoppage	10 to 1000 [Hz] (in 1Hz steps)	100	Always
35	Stoppage detection width	5 to 100 [r/min] (in increments of 1)	20	Always
36	Stoppage judgment time	0.0 to 1.00s (in 0.01s steps)	0.0	Always



Remarks : “Operating speed response” and “speed response at stoppage” should be changed after the speed has been lower than the stoppage detection width (basic para. 35) and the stoppage judgment time (basic para. 36) has elapsed. This can prevent the motor shaft from starting rotating after the motor has stopped if the setting of “speed response at stoppage” is low. Set an appropriate time for the stoppage judgment time as its initial value is 0.0s.

■ Speed feedback filter

When you use 16 bit serial encoder in GYC or GYS series, do not change the setting of the speed feedback filter.

Basic parameter. 42

Para.	Name	Setting range	Initial value	Change
42	Speed feedback filter	0: OFF 1: ON	0	Always

Auto-tuning related parameter

■ Speed setting filter (basic para. 41)

The speed command [NREF] input can be adjusted by the speed setting filter. This is useful when the motor speed is influenced by the turbulence to the speed command input terminal. The maximum value of the filter time is 20.0ms.

Basic parameter 41

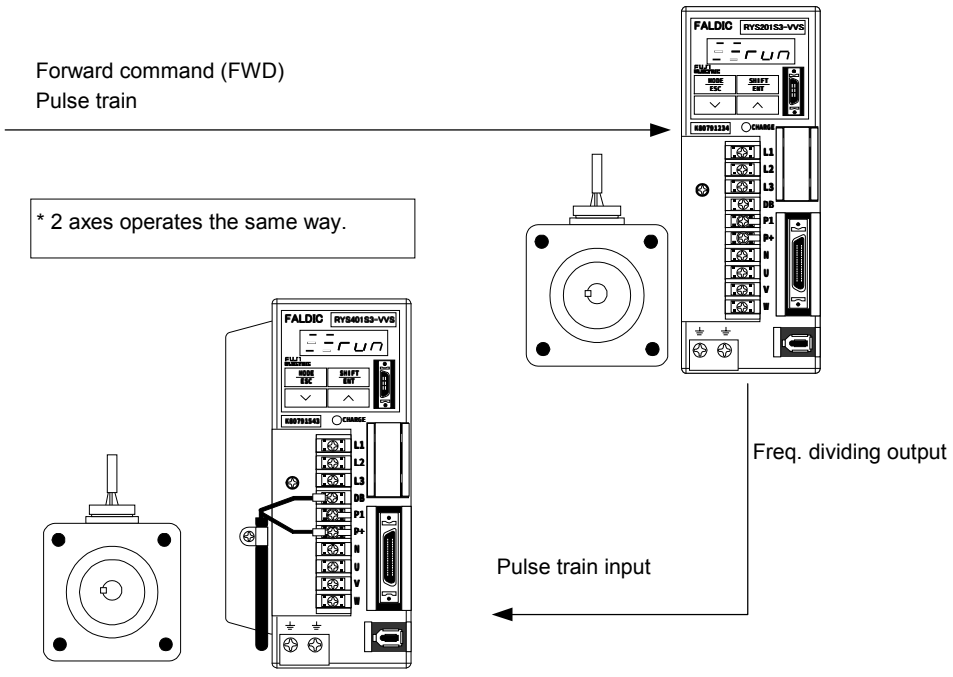
Para.	Name	Setting range	Initial value	Change
41	Speed setting filter	0.0 to 20.0 [ms] (in 0.1ms steps)	0.0	Always

■ Feed forward gain (basic para. 40)

Basic parameter 40

Para.	Name	Setting range	Initial value	Change
40	Feed forward gain	0.000 to 1.500 (in 0.001 steps)	0.000	Always

If the feed forward gain is set at 1.0, a smaller deviation (difference between command position and feedback position) can be expected. Set the gain at 1.000 to carry out a synchronous operation between 2 axes using the pulse train input.



Feed forward gain setting value: 1,000

Auto-tuning related parameter

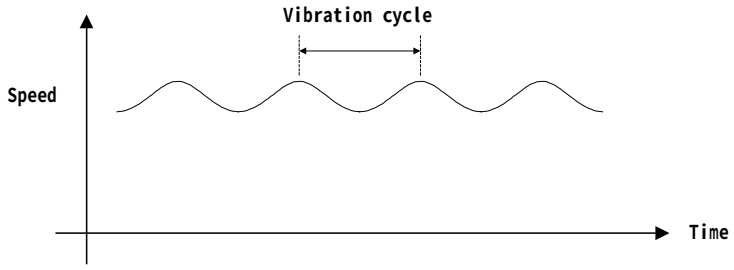
■ Vibration suppression parameter (basic para. 44, 45)

A periodical vibration in motor rotation speed may occur due to the moment of inertia of mechanical equipment system and the motor's response rate. This parameter is always effective regardless of tuning method (basic para. 31).

Basic parameters. 44, 45

Para.	Name	Setting range	Initial value	Change
44	Vibration suppression time constant	10 to 1000 [ms] (in 1ms steps)	100	Always
45	Vibration suppression gain	0.00 to 1.00 (in increments of 0.01)	0.00	Always

The vibration suppression time constant (basic para. 44) sets the vibration cycle of rotational speed. Larger effect can be obtained with the higher setting for the vibration suppression gain.



6.2 Peripheral device

This section explains the peripheral devices to be directly connected to the amplifier.

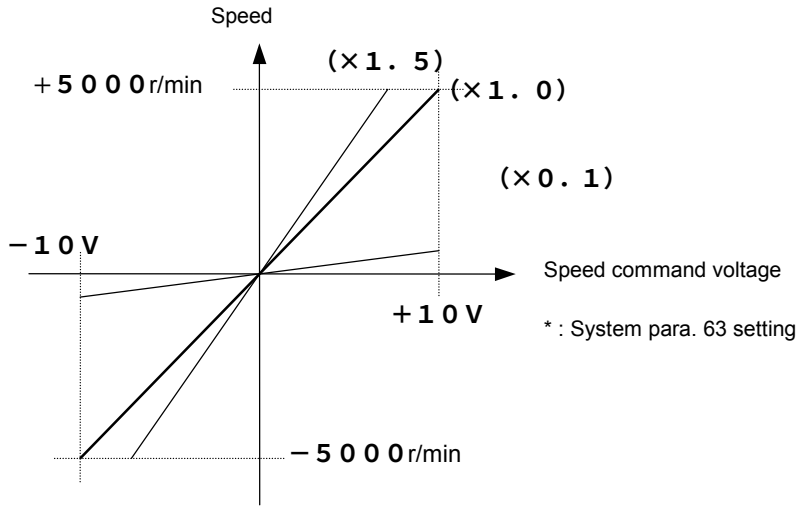
6.2.1 Speed command, torque command

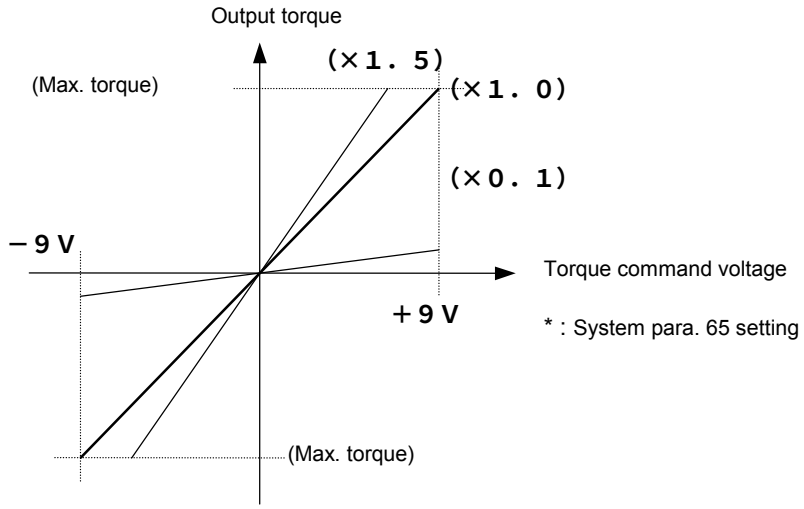
The gain or offset of speed command [NREF] terminal and torque command [TREF] terminal can be adjusted..

System parameter 63 to 66

Para.	Name	Setting range	Initial value	Change
63	Speed command gain	±0.10 to ±1.50 times (in increments of 0.01)	1.00	Always
64	Speed command offset	–2000 to + 2000 (in increments of 1)	(Individual)	Always
65	Torque command gain	±0.10 to ±1.50 times (in increments of 0.01)	1.00	Always
66	Torque command offset	–200 to + 200 (in increments of 1)	(Individual)	Always

- Speed control - Position control





■ Speed command gain (63) / Torque command gain (65)
These gains can be set from ±0.10 to ±1.50 times in increments of 0.01.
Specifying the negative sign can invert the rotational direction.

■ Speed command offset (64)
This can be set from –2000 to + 2000 in increments of 1. The setting value has no unit. The initial value has been set at factory shipment individually. Automatic offset adjustment is enable in the trial operation mode by the keypad panel ([Fn008]). The value after adjustment will be saved in the system para.64.

■ Torque command offset (66)
This can be set from –200 to + 200 in increments of 1. The setting value has no unit. The initial value has been set at factory shipment individually. Automatic offset adjustment is enable in the trial operation mode by the keypad panel ([Fn008]). The value after adjustment will be saved in the system para.66.

The terminal function of speed command [NREF] and torque command [TREF] terminal can be selected.

System parameter 60 to 62

Para.	Name	Setting range		Initial value	Change
60	Torque command function select	0: Torque command	1: Speed command (aux.)	0	Power
61	Speed limit select	0: Parameter	1: Speed command terminal	0	Power
62	Torque limit select	0: Parameter	1: Torque command terminal	0	Power

■ Speed limit select (system parameter 61)
Selects the motor speed limiting method in torque control.

Setting	Description
0: Parameter	Limits the speed by basic para. 16.
1: Speed command terminal	Limits the speed by the speed in response to the input voltage to speed command terminal.

When “1: Speed command terminal” is selected, gain and offset can be adjusted by system para. 63 and 64.

■ Torque limit select (system parameter 62)
Selects the motor output torque limiting method. Torque limit is effective in speed control and position control.

Setting	Description
0: Parameter	Limits the output torque by basic para. 59.
1: Torque command terminal	Limits the output torque by the torque in response to the input voltage to torque command terminal.

When “1: Torque command terminal” is selected, gain and offset can be adjusted by system para. 65 and 66.
When “0: Parameter” is selected, the setting of basic para. 59 is always effective.
In torque control mode, the setting of basic para. 59 is always effective. In torque control, the function of the torque command terminal does not change.
The torque limit (30) signal is assigned to the control input terminal, the basic para. 59 setting and the motor’s maximum torque can be changed over. If the torque command is selected by the system para. 62, the motor torque can be selected between the maximum torque and the one in proportion to the torque command terminal voltage.

• Where the torque limit (30) is not assigned to the control input terminal.
The setting of basic para. 59 is always effective.

• Torque limit (system parameter 62 : 0: Parameter)

Torque limit (30)	Torque limit value
OFF	Motor max. torque
ON	Basic para. 59 setting value.

• Torque limit (system parameter 62 : 1: Torque command terminal)

Torque limit (30)	Torque limit vallue
OFF	Motor max. torque
ON	Torque command terminal

Torque limit (30) can be set “always effective.” See 6-3-6 Always valid.

■ Torque command function select (system para. 60)
Changes the function of torque command terminal to speed command (aux.) terminal.
The system para. 60 setting is valid in position control and speed control.

Setting	Description
0 : Torque command	Torque command terminal [TREF] functions as torque command terminal.
1 : Speed command (aux.)	Torque command terminal [TREF] functions as speed command (aux.) terminal.

In torque control mode, torque command terminal [TREF] operates an input terminal of the torque command terminal.
When “1: Speed command (aux.)” is selected, the motor rotates according to the added voltage of the speed command [NREF] terminal and the torque command [TREF] terminal.
For the gain of the torque command [TREF] terminal, the torque command gain (system para. 65) setting is effective. For the offset of [TREF] terminal, the torque command offset (system para. 66) setting is effective.
When “1: Speed command (aux.)” is selected, [TREF] terminal does not function as the torque command terminal, the torque command function select (system para. 60) have the precedence over this.
The resolution of analog voltage of the speed command terminal is different from the one of the torque command terminal.
See 5-3-1 Forward command, Reverse command

When the torque command terminal [TREF] is used as the speed command (aux.) terminal, 100ms of filter can be inserted automatically.

6.2.2 Analog meter output
The output form of monitor 1 and monitor 2 terminals can be selected.

The output signal form of the monitor 1 [MON1] and monitor 2 [MON2] terminals can be selected.
Output form is common to position control, speed control and torque control.

System parameters 67 to 73

Para.	Name	Setting range	Initial value	Change
67	Monitor 1 signal assignment	1: Speed command 2: Speed feedback 3: Torque command 4: Position deviation	2	Always
68	Monitor 2 signal assignment	1: Speed command 2: Speed feedback 3: Torque command 4: Position deviation	3	Always
69	Monitor 1 scale	±2.0 to ±10V (in 0.1V steps)	7.0	Always
70	Monitor 1 offset	–50 to +50 (in increments of 1)	0	Always
71	Monitor 2 scale	±2.0 to ±10V (in 0.1V steps)	6.0	Always
72	Monitor 2 offset	–50 to +50 (in increments of 1)	0	Always
73	Monitor 1/2 output form	0: Monitor 1 (two-way deflection) / Monitor 2 (two-way deflection) 1: Monitor 1 (one-way deflection) / Monitor 2 (two-way deflection) 2: Monitor 1 (two-way deflection) / Monitor 2 (one-way deflection) 3: Monitor 1 (one-way deflection) / Monitor 2 (one-way deflection)	0	Always

■ Monitor 1/ Monitor 2 signal assignment

Sets the output signal from monitor 1 [MON1] and monitor 2 [MON2].

Setting	Output signal
1: Speed command	Speed command to the motor recognized by the amplifier
2: Speed feedback	Motor's actual rotational speed
3: Torque command	Torque command value to the motor recognized by the amplifier
4: Position deviation	Difference (deviation) between position command and position feedback

■ Monitor 1/ Monitor 2 scale

Sets the full scale of signal of monitor 1 [MON1] and monitor 2 [MON2] terminals. If the negative sign is specified, the polarity of output voltage can be inverted.

Setting	Output signal
1: Speed command	Output voltage in response to max. speed. Max. speed depends on motor specs.
2: Speed feedback	Output voltage in response to max. speed. Max. speed depends on motor specs.
3: Torque command	Output voltage in response to max. torque. Max. torque depends on motor specs.
4: Position deviation	Difference (deviation) between position command and position feedback. Output voltage in response to 1048576 pulses.

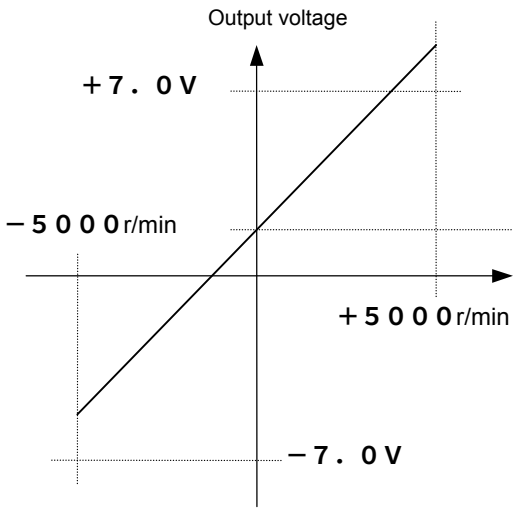
■ Monitor 1/ Monitor 2 offset

The offset voltage of monitor 1 [MON1] and monitor 2 [MON2] terminals can be adjusted. The setting range is from –50 to 0 to +50 in increment of 1. The setting value has no unit.

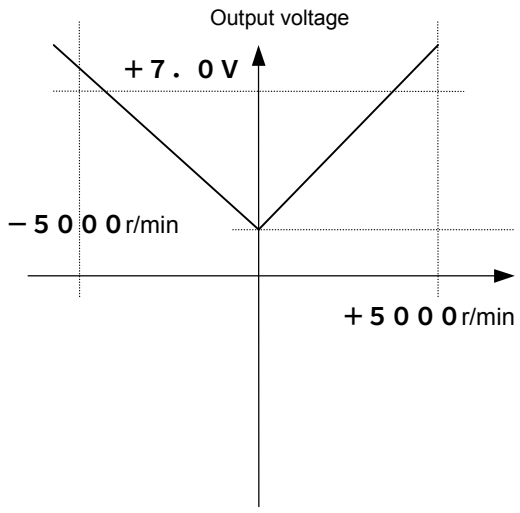
■ Monitor 1/ Monitor 2 output signal

Two-way deflection or one-way deflection can be selected for the signal assignment, scale and offset of the monitor 1 [MON1] and monitor 2 [MON2] terminals.

Terminal "Monitor 1" (Initial value)



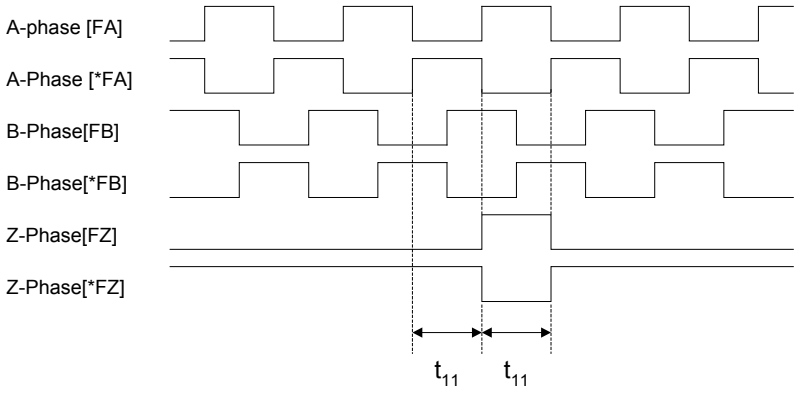
Terminal "Monitor 1" (one-way deflection)



6.2.3 Frequency dividing output

The pulse count in proportion to motor rotational quantity will be output.

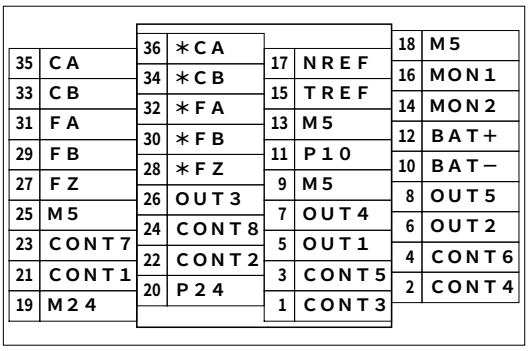
The output pulse count can be set for the freq. dividing output terminals [FA], [*FA], [FB], [*FB], [FZ], and [*FZ]. The output pulse count is common to position control, speed control and torque control.



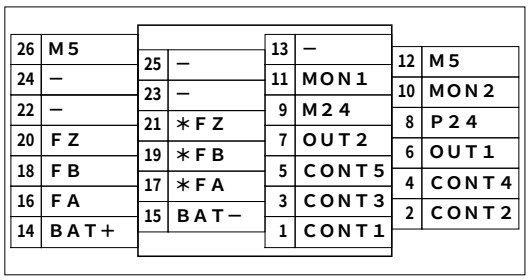
Pulse width : t11 ≧ 1μs (equivalent to 500kHz)

A-phase and B-phase signals are 50% duty.
The output pulse counts of A-phase and B-phase signal are determined by system para. 79 setting.
Z-phase signal is output one pulse per revolution. The pulse width depends on the A-phase output pulse count.
A-phase signal and Z-phase signal are synchronized. Recommended output frequency is approx. 500kHz. The output frequency is not restricted by the amplifier.
The position of the motor output shaft has no relation with Z-phase.

RYS□□□S3 - VVS



RYS□□□S3 - VSS



System parameter 79

Para.	Name	Setting range	Initial value	Change
79	Output pulse count	16 to 16384 [pulse/rev] (in increment of 1)	2048	Power

The freq. dividing output pulse count per one rotation of motor is set. The output form is two 90° phase-different signal.
When the motor rotates forward, a B-phase advanced pulse is output. This does not depend on the rotational direction changeover setting (system para. 80)
Two 90° phase-different signal is output based on the level at the time of power on.
Max. output frequency depends on the performance of IC (differential driver: AM26LS31 or equivalent) for output terminal. The output frequency is not restricted by the amplifier.

Remark : Where the motor rotates at 5000[r/min] at output pulse count setting 3000[pulse/rev]
The output pulse count is

$$\frac{3000\,[\text{pulse}/\text{rev}]}{60} \times 5000\ [\text{r}/\text{min}] = 250000\,[\text{Hz}]$$

If the motor rotation exceeds 5000[r/min] at 16384[pulse/rev] max., the pulse count will exceed 1.3[MHz].

6.2.4 Pulse train input

The pulse form of pulse train input terminal can be selected.

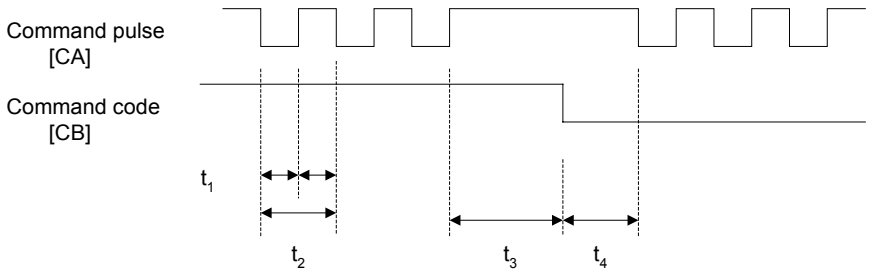
The pulse form of pulse train input terminal [CA], [*CA], [CB], [*CB] can be selected. The maximum input frequency is 400kHz.

System parameter 78

Para.	Name	Setting range	Initial value	Change
78	Pulse train input form	0 : Command code, command pulse 1: Forward pulse, reverse pulse 2: Two 90° phase-different signal	1	Power

■ Command pulse, command code

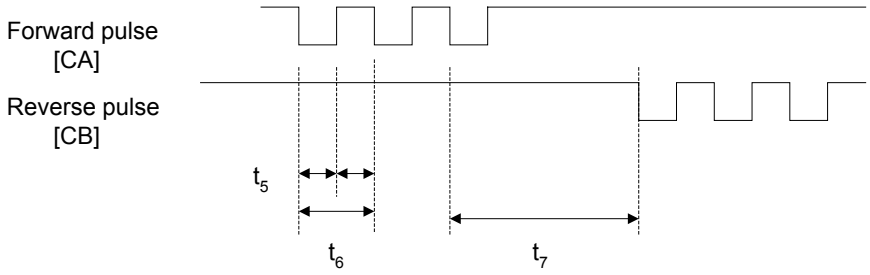
The command pulse indicates rotational quantity and the command code indicates rotational direction.



Pulse level : $t_1 > 1.25\,\mu s$
Pulse cycle : $t_2 \geqq 2.5\ \mu s$
Before sign change : $t_3 > 1.25\,\mu s$
After sign change : $t_4 \geqq 1.25\,\mu s$

■ Forward pulse, reverse pulse

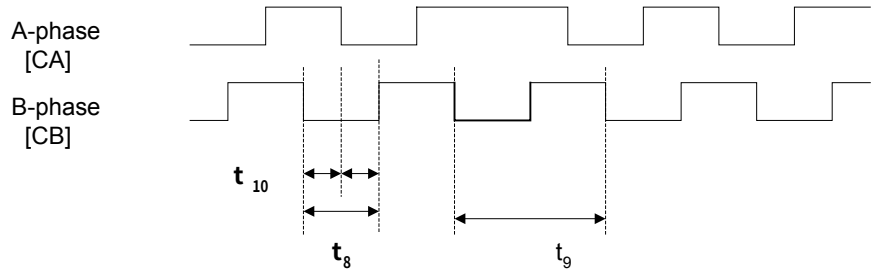
Forward pulse indicates forward direction, reverse pulse indicates the reverse direction.



Pulse level : $t_5 > 1.25\,\mu s$
Pulse cycle : $t_6 \geqq 2.5\,\mu s$
Edge interval : $t_7 > 1.25\,\mu s$

■ Two 90° phase-different signal

A-phase and B-phase signal indicate rotational direction and rotational quantity, respectively.
Each edge of A-phase and B-phase signals corresponds to one pulse.



Pulse width : $t_8 > 1.25\,\mu s$
Pulse cycle : $t_9 \geqq 2.5\,\mu s$

Edge interval : $t_{10} > 1.25\,\mu s$

6.2.5 Braking resistor

Connects the NTC thermistor of braking resistor to the control input terminal to protect the resistor.

System parameter 86

Para.	Name	Setting range	Initial value	Change
86	Braking resistor thermal overload relay	0: Electronic thermal O/L relay 1: External thermal O/L relay	0	Power

Setting	Overheat detection of braking resistor
0: Electronic thermal O / L relay	Calculates the regenerated power by amplifier to protect the resistor.
1: External thermal O / L relay	Directly detects resistor overheat using NTC thermistor built-in the resistor.

To use external thermal relay, set the external alarm input (34) at the control allocation terminal, connect NTC thermistor for the external resistor.
Protective function by electronic thermal relay built-in the amplifier will be disabled.

6.3 Amplifier

This section explains the various setting of amplifier itself.

6.3.1 INC/ABS

Incremental or absolute system can be selected.

System parameter 99

Para.	Name	Setting range	Initial value	Change
99	INC/ABC system	0: INC (Incremental) 1: ABS (Absolute)	0	Power

Setting	Current position backup
0: INC (Incremental)	Current position will be deleted if power is shut down. Motor rotational quantity is not limited.
1: ABS (Absolute)	Current position will be recovered if power supply recovers. Motor rotational quantity is limited.

■ Pulse encoder

A 16-bit serial encoder built-in the motor is an INC/ABS common-use encoder.
An ABS system can be established if a battery is installed in the amplifier.
The encoder can output a freq. dividing output pulse of 16 to 16384 pulse per revolution.
The multiple rotation count is –32767 to 32767 in an ABS system.

■ Alarm detection in ABS system

The alarms against absolute data overflow (AF) and absolute data lost (AL) will be detected only in the ABS system. These alarms will be reset by the position preset.

■ Current position backup

When power failure occurs, the absolute data of encoder can be backed up by the battery built-in the amplifier. The backup time is approx. one hour after the motor encoder cable is disconnected from the amplifier.

Backup time by encoder alone (Super capacitor)	Approx. one hour

Other than the above, some backup methods are available.

1) Battery built-in amplifier (type : WBS-S)
This is a lithium (primary) battery built in the amplifier and cannot be recharged.
The lifetime is approx. 7 years on condition that it is turned on for 8 hours per day (it backups 16 hours)

Lifetime of optional battery (16 hour backup after 8 hour power on per day)	Approx. 7 years

2) External power supply
The connector 1 (CN1) for control input/output is equipped with the input terminals [+BAT], [-BAT] for backup power. Connect 3.6V power to these trminalls.
Do not install the backup battery into the amplifier itself if you connect the backup power.

3) Power supply for control circuit
If a UPS is prepared as a peripheral device, connect its power to the control power input terminal so that power can be supplied to the control circuit only (backup is available at the same time)

6.3.2 Rewriting inhibit

Parameter rewriting on the keypad panel can be prohibited.

System parameter 94

Para.	Name	Setting range	Initial value	Change
94	Parameter rewriting inhibit	0: Rewriting allowed 1: Rewriting inhibit	0	Always

Setting	Parameter editing
0: Rewriting allowed	Enable
1: Rewriting inhibit	Disabled

Even if “1 : Rewriting inhibit” is selected, only the system para. 94 is rewritable.

Remark : Rewrite operation can be restricted by the control input terminal. See 5-5-2 Edit permit on.

6.3.3 Terminal function assignment

Various functions can be assigned to the control input terminals and output terminals.

System parameter 1 to 8

Para.	Name	Setting range	Initial value	Change
01	CONT1 signal assignment	0 to 56 (in increments of 1)	1	Power
02	CONT2 signal assignment	0 to 56 (in increments of 1)	2	Power
03	CONT3 signal assignment	0 to 56 (in increments of 1)	3	Power
04	CONT4 signal assignment	0 to 56 (in increments of 1)	11	Power
05	CONT5 signal assignment	0 to 56 (in increments of 1)	51	Power
06	CONT6 signal assignment	0 to 56 (in increments of 1)	52	Power
07	CONT7 signal assignment	0 to 56 (in increments of 1)	27	Power
08	CONT8 signal assignment	0 to 56 (in increments of 1)	37	Power

System parameter 31 to 35

Para.	Name	Setting range	Initial value	Change
31	OUT1 signal assignment	0 to 41 (in increments of 1)	1	Power
32	OUT2 signal assignment	0 to 41 (in increments of 1)	28	Power
33	OUT3 signal assignment	0 to 41 (in increments of 1)	24	Power
34	OUT4 signal assignment	0 to 41 (in increments of 1)	0	Power
35	OUT5 signal assignment	0 to 41 (in increments of 1)	0	Power

Function (Input signal) number assigned to system para.1 to 8 (CONT1 to CONT8)

0: Not assigned	37: Position control
1: Run command [RUN]	38: Torque control
2: Forward command [FWD]	43: Override valid
3: Reverse command [REV]	44: Override1
5: Origin return [ORG]	45: Override2
6: Origin LS [LS]	46: Override4
7: +OT	47: Override8
8: -OT	48: Interrupt input valid
10: Forced stop [EMG]	49: Interrupt input
11: Alarm reset [RST]	50: Deviation clear
14: ACC0	51: X1
16: Position preset	52: X2
27: Pulse train ratio 1	53: X3
28: Pulse train ratio 2	54: Free-run [BX]
29: P-action	55: Edit permit command
30: Torque limit	56: Current position output
34: External fault input	

Function (Output signal) assigned to system para.31 to 35 (OUT1 to OUT5)

0: Not specified	32: Alarm code 0
1: Ready [RDY]	33: Alarm code 1
2: Positioning end [PSET]	34: Alarm code 2
14: Brake timing	35: Alarm code 3
15: Dynamic braking	36: Alarm code 4
16: Alarm detection [ALM]	38: +OT detection
17: Fixed, passing point 1	39: -OT detection
18: Fixed, passing point 2	40: Origin LS detection
20: OT detection	41: Forced stop detection
22: Origin return end	
23: Deviation zero	
24: Speed zero [NZERO]	
25: Speed arrive [NARV]	
26: Torque limit detection	
27: Overload early warning	
28: CPU ready [CPURDY]	
29: Edit permit on	
31: Address error	

Set a number corresponding to signal name at desired system parameter, so that the signal can be assigned to the terminal.

■ Setting example

Set “1” at the “system parameter 1” so that the terminal [CONT1] of the control input/output connector [CN1] functions as the input terminal for the “Run command” [RUN] signal.

■ Duplicated allocation

For the control input terminals, a signal cannot be assigned to more than one terminal simultaneously.
However, only the following signals can be assigned to more than one terminal:

- Forced stop (10)
- Free-run (54)
- External fault input (34)

In case of “forced stop” and “external fault input”, the motor will stop forcibly if an input terminal is off.
In case of “free-run”, the motor will be in free-run status if an input terminal is turned on.
If the signals other than the above have been assigned to more than one terminal, a control signal error [CtE] will be detected when turning on power supply again.

For the control output terminals, a signal can be assigned to more than one terminal simultaneously.
Each terminal goes on or off at the same timing.

■ Interrupt input (49)

Be sure to assign the interrupt input (49) to any one of the terminals [CONT1] to [CONT8].
In case it is assigned to [CONT9] through [CONT13], a control signal error [CtE] will be detected.

■ Always valid

The functions can be assigned to the terminals by setting a numerical value at the system para. 1 to 8.
Similarly, the assigned functions can be always valid by setting the function (signal) number at the system para. 87 or 88. (See 6.3.6.)

Remark : If a number has been assigned to system para. 1 to 8 and system para. 87, 88 simultaneously, a control signal error [CtE] will not be detected.
The assigned signal is always effective.

6.3.4 Storage at RAM

The contents of basic parameter setting can be stored in built-in RAM and rewritable infinitely.

System parameter 22 to 30

Para.	Name	Setting range	Initial value	Change
22	Parameter RAM storage 1	0: Not specified 1 to 99: Basic para. No.	0	Power
23	Parameter RAM storage 2	0: Not specified 1 to 99: Basic para. No.	0	Power
24	Parameter RAM storage 3	0: Not specified 1 to 99: Basic para. No.	0	Power
25	Parameter RAM storage 4	0: Not specified 1 to 99: Basic para. No.	0	Power
26	Parameter RAM storage 5	0: Not specified 1 to 99: Basic para. No.	0	Power
27	Parameter RAM storage 6	0: Not specified 1 to 99: Basic para. No.	0	Power
28	Parameter RAM storage 7	0: Not specified 1 to 99: Basic para. No.	0	Power
29	Parameter RAM storage 8	0: Not specified 1 to 99: Basic para. No.	0	Power
30	Parameter RAM storage 9	0: Not specified 1 to 99: Basic para. No.	0	Power

The contents of basic parameter is stored in the EEPROM (electrically erasable program read only memory) for retaining purpose at power shut down. By specifying RAM, infinite rewriting is enable.
Set the basic para. number to be stored in RAM at the system para. 22 to 30.

6.3.5 Keypad panel

The contents of indication on the keypad panel at power on can be changed.

System parameter 89

Para.	Name	Setting range	Initial value	Change
89	Initial indication	0 to 20 (in increments of 1)	0	Power

Setting	Initial indication	
0	[SnOO 1]	Sequence
1	[SnOO2]	Sub mode
2	[SnOO3]	Alarm detection
3	[SnOO4]	Alarm history
4	[SnOO5]	Amplifier setting
5	[SnOO6]	Motor setting
6	[SnOO7]	Station No. indication

Setting	Initial indication	
7	[OnOO 1]	Feedback speed
8	[OnOO2]	Command speed
9	[OnOO3]	Actual torque
10	[OnOO4]	Feedback position
11	[OnOO5]	Command position
12	[OnOO6]	Deviation amount
13	[OnOO7]	Cumulated pulse
14	[OnOO8]	Peak torque
15	[OnOO9]	Input voltage 1
16	[OnO 10]	Input voltage 2
17	[OnO 11]	LS-Z pulse
18	[OnO 12]	Input signal
19	[OnO 13]	Output signal
20	[OnO 14]	Load inertia ratio

6.3.6 Always valid

Arbitrary signals among the control input signals can be always effective.

System parameter 87, 88

Para.	Name	Setting range	Initial value	Change
87	CONT always valid 1	0 to 56 (in increments of 1)	0	Power
88	CONT always valid 2	0 to 56 (in increments of 1)	0	Power

Function (Input signal) number to system para. 1 to 8

0: Not assigned	11: Alarm reset [RST]	38: Torque control	51: X1
1: Run command [RUN]	14: ACC0	43: Override valid	52: X2
2: Forward command [FWD]	16: Position preset	44: Override1	53: X3
3: Reverse command [REV]	27: Pulse train ratio 1	45: Override2	54: Free-run [BX]
5: Origin return [ORG]	28: Pulse train ratio 2	46: Override4	55: Edit permit command
6: Origin LS [LS]	29: P-action	47: Override8	56: Current position output
7: +OT	30: Torque limit	48: Interrupt input valid	
8: -OT	34: External fault input	49: Interrupt input	
10: Forced stop [EMG]	37: Position control	50: Deviation clear	

The assignable signals are as follows:

1 : Run command [RUN]	The run command becomes always effective.
14 : ACC0	Only acceleration time 2 and deceleration time 2 become always effective.
27 : Pulse train ratio 1 28 : Pulse train ratio 2	Pulse train ratio 1 or 2 becomes always effective. Do not assign these two signals 1 and 2 at system para. 87 and 88 at the same time.
29 : P-action	P-action is always effective. Assignment is not necessary.
30 : Torque limit	Torque limit value becomes always effective. Unless assigned, maximum torque limit value (basic para. 59) setting is effective.
37 : Position control 38 : Torque control	Position control or torque control becomes always effective.
43 : Override valid	Override becomes always effective.
44 to 47 : Overeride 1, 2, 4, 8	Only specifically determined magnification becomes effective.
48 : Interrupt input valid	Interrupt input becomes always effective.
51 to 53 : [X1], [X2], [x3]	Only specifically determined multistep speed becomes effective.

Remarks: The signals that have been assigned to system para. 87 or 88 are always effective.
The only two signals can be “always effective.”

6.3.7 Undervoltage

Selects the operation when undervoltage at main circuit input is detected.

System parameter 84, 85

Para.	Name	Setting range	Initial value	Change
84	Operation at undervoltage	0: Rapid deceleration to a stop 1: Free-run	0	Power
85	Alarm detection at undervoltage	0: No detection 1: Detects	1	Power

■ Operation at undervoltage (system para. 84)

Specifies the motor operation when undervoltage has been detected while the run command [RUN] is on.

Setting range	Operation
0: Rapid decel. to a stop	The motor rapidly decelerates to a stop (within amplifier's highest capacity).
1: Free-run	The motor decelerates (or accelerates) with free-run condition according to the load torque.

■ Alarm detection at undervoltage (system para. 85)

Specifies the alarm detection operation when undervoltage has been detected while the run command [RUN] is on.

Setting range	Operation
0: No detection	Alarm is not detected.
1: Detects	Undervoltage alarm was detected.

If "0" has been set, the motor stops according to the preset operation to be made at undervoltage, and alarm detection will not be output.

Remark: If the power voltage decrease (undervoltage) due to momentary power failure is detected, the motor decelerates by system para. 84 setting. Due to regenerative power generated by the motor during deceleration, voltage level may exceed undervoltage level. In this case, the motor starts deceleration at the undervoltage level. After that, the motor will accelerate again after alarm detection of undervoltage is released.

6.4 Communication

This section explains the communication setting for amplifier.

6.4.1 Station number

Sets the station number about communication.

System parameter 96

Para.	Name	Setting range	Initial value	Change
96	Station number	1 to 31 (In increments of 1)	1	Power

Specifies the amplifier station number at 1 through 31 in decimal.
If the station number is hexadecimal, see the following conversion table.

Station No. setting (decimal)	Station No. setting (hexadecimal)	Station No. setting (decimal)	Station No. setting (hexadecimal)	Station No. setting (decimal)	Station No. setting (hexadecimal)
1	01H	11	0BH	21	15H
2	02H	12	0CH	22	16H
3	03H	13	0DH	23	17H
4	04H	14	0EH	24	18H
5	05H	15	0FH	25	19H
6	06H	16	10H	26	1AH
7	07H	17	11H	27	1BH
8	08H	18	12H	28	1CH
9	09H	19	13H	29	1DH
10	0AH	20	14H	30	1EH
				31	1FH

6.4.2 Baud rate

Specifies the RS485 interface baud rate. This baud rate is different from that of the exclusive loader or PC loader.

System parameter 97

Para.	Name	Setting range	Initial value	Change
97	Baud rate	0 : 9600[bps] 1 : 19200[bps] 2 : 38400[bps]	0	Power

6.5 List of parameter

Basic parameter
The basic parameters are rather frequently adjusted. Changing almost any basic parameter immediately affects the amplifier and the motor actions.

■ Basic parameter for RYS-V type (1/2)

Para.	Name	Setting range	Initial value	Change
01	Manual feed speed 1	0.01 to Max. speed [r/min] (in 0.01 steps)	100.00	Always
02	Manual feed speed 2	0.01 to Max. speed [r/min.] (in 0.01 steps)	500.00	Always
03	Manual feed speed 3	0.01 to Max. speed [r/min.] (in 0.01 steps)	1000.00	Always
04	Manual feed speed 4	0.01 to Max. speed [r/min.] (in 0.01 steps)	100.00	Always
05	Manual feed speed 5	0.01 to Max. speed [r/min.] (in 0.01 steps)	100.00	Always
06	Manual feed speed 6	0.01 to Max. speed [r/min.] (in 0.01 steps)	100.00	Always
07	Manual feed speed 7	0.01 to Max. speed [r/min.] (in 0.01 steps)	100.00	Always
08 to 15	Unused		0	–
16	Maximum speed	0.01 to Max. speed [r/min.] (in 0.01 steps)	5000.00	Always
17	Override 1	0 to 150% (in 1% steps)	10	Always
18	Override 2	0 to 150% (in 1% steps)	20	Always
19	Override 4	0 to 150% (in 1% steps)	40	Always
20	Override 8	0 to 150% (in 1% steps)	80	Always
21	Acceleration time 1	0.000 to 99.999s (in 0.001s steps)	0.100	Always
22	Deceleration time 1	0.000 to 99.999s (in 0.001s steps)	0.100	Always
23	Acceleration time 2	0.000 to 99.999s (in 0.001s steps)	0.500	Always
24	Deceleration time 2	0.000 to 99.999s (in 0.001s steps)	0.500	Always
25	Non-linear (Scurve) filter coefficient	0.000 to 99.999s (in 0.001s steps)	0.000	Always
26 to 30	Unused	–	–	–
31	Tuning method	0: Manual 1: Auto(Low stiffness) 2: Auto (High stiffness)	1	Always
32	Load inertia ratio	0.0 to 100. 0 times (in 0.1 steps)	0.0	Always
33	Operation speed response	10 to 1000Hz (in 1Hz steps)	100	Always
34	Speed response at stoppage	10 to 1000Hz (in 1Hz steps)	100	Always
35	Stop detection width	5 to 100 [r/min] (in 1 steps)	20	Always
36	Stop judgment time	0.00 to 1.00s (in 0.01s steps)	0.00	Always
37	Torque filter time constant	0.00 to 20.00 [ms] (in 0.01ms steps)	0.30	Always
38	Speed regulator integration time	1 to 1000 [ms] (in 1 steps)	20	Always
39	Position regulator gain	1 to 1000 (in 1 steps)	50	Always
40	Feed forward gain	0.000 to 1.5000 (in 0.001 steps)	0.000	Always
41	Speed setting filter	0.0 to 20. 0 [ms] (in 0.1 steps)	0.0	Always
42	Speed feedback filter	0: OFF 1: ON	0	Always
43	Torque setting filter	0.0 to 9.9s (in 0.1 steps)	0.1	Always
44	Vibration suppression time constant	10 to 1000 [ms] (in 1 steps)	100	Always
45	Vibration suppression gain	0.00 to 1.00 (in 0.01 steps)	0.00	Always
46 to 50	Unused	–	–	–

■ Basic parameter for RYS-V type (2/2)

Para.	Name	Setting range	Initial value	Change
51	Speed arrival width	10 to Max. speed [r/min] (in 1 steps)	50	Always
52	Speed zero width	10 to Max. speed [r/min] (in 1 steps)	20	Always
53	Deviation zero width	10 to 10000 [pulses] (in 1 steps)	20.0	Always
54	Deviation over width	10 to 65535 (in 1 steps) [x 100 pulse]	10000	Always
55	Positioning end output form	0: Level 1: One shot	0	Power
56	Positioning end output time	0.01 to 1.00s (in 0.01s steps)	0.10	Always
57	Positioning end judgment time	0.000 to 1.000s (in 0.001s steps)	0.050	Always
58	Overload early warning level	10 to 100% (in 1 steps)	50	Always
59	Maximum torque limit level	0 to Max. torque [%] (in 1 steps)	300	Always
60 to 61	Unused	–	–	–
62	Fixed, passing point detection	0: Fixed point 1: Passing point OFF/ON 2: Passing point ON/OFF	0	Always
63	Fixed, passing point detection position 1	-79999999 to 0 to 79999999 (in 1 steps) [x unit q'ty]	0	Always
64	Fixed, passing point detection position 2	-79999999 to 0 to 79999999 (in 1 steps) [x unit q'ty]	0	Always
65	Fixed position detection range	0 to 79999999 (in 1 steps) [x unit q'ty]	100	Always
66	Origin detection range	1 to 79999999 (in 1 steps) [x unit q'ty]	100	Always
67	Position detection valid/invalid	0: Valid after origin return end 1: Always	0	Always
68 to 70	Unused	–	0	–
71	Origin return pattern	1: Pattern 1 2: Pattern 2 3: Pattern 3 4: Pattern 4	1	Power
72	Origin return direction	0: Positive direction 1: Negative direction	0	Power
73	Z-phase detection valid/invalid	0: Valid 1: Invalid	0	Power
74	Origin LS logic	0: NO contact 1: NC contact	0	Always
75	Origin return speed	0.01 to Max. speed [r/min] (in 0.01 steps)	500.00	Always
76	Origin detection creep speed	0.01 to Max. speed [r/min] (in 0.01 steps)	50.00	Always
77	Origin shift quantity	1 to 2000000 (in 1 steps) [x unit q'ty]	1000	Always
78	Origin return reversing quantity	0 to 79999999 (in 1 steps) [x unit q'ty]	0	Always
79	Origin return position	-79999999 to 0 to 79999999 (in 1 steps) [x unit q'ty]	0	Always
80	Preset position	-79999999 to 0 to 79999999 (in 1 steps) [x unit q'ty]	0	Always
81	Interrupt positioning amount	1 to 79999999 (in 1 steps) [x unit q'ty]	100000	Always
82 to 90	Unused	–	0	–
91	Command pulse correction α	1 to 32767 (in 1 steps)	8	Always
92	Command pulse correction β	1 to 32767 (in 1 steps)	1	Always
93	Pulse train ratio 1	0.01 to 100.00 (in 0.01 steps)	1.00	Always
94	Pulse train ratio 2	0.01 to 100.00 (in 0.01 steps)	10.00	Always
95	Position data decimal point position	0: 1 1: 0.1 2: 0.01 3: 0.001 4: 0.0001 5: 0.00001	0	0
96 to 99	Unused	–	0	–

System parameter
The system parameter is used for the function setting of the control input/output terminals of amplifier.
Changed setting of most parameters is effective only after turning off and on power.

■ System parameter for RYS-V type (1/2)

No.	Name	Setting range	Initial value	Change
01	CONT1 signal assignment	0 to 56 (in 1 steps)	1	Power
02	CONT2 signal assignment	0 to 56 (in 1 steps)	2	Power
03	CONT3 signal assignment	0 to 56 (in 1 steps)	3	Power
04	CONT4 signal assignment	0 to 56 (in 1 steps)	11	Power
05	CONT5 signal assignment	0 to 56 (in 1 steps)	51	Power
06	CONT6 signal assignment	0 to 56 (in 1 steps)	52	Power
07	CONT7 signal assignment	0 to 56 (in 1 steps)	27	Power
08	CONT8 signal assignment	0 to 56 (in 1 steps)	37	Power
09 to 21	Unused	–	0	–
22	Parameter RAM storage 1	0: Not assigned 1 to 99: Basic parameter No.	0	Power
23	Parameter RAM storage 2	0: Not assigned 1 to 99: Basic parameter No.	0	Power
24	Parameter RAM storage 3	0: Not assigned 1 to 99: Basic parameter No.	0	Power
25	Parameter RAM storage 4	0: Not assigned 1 to 99: Basic parameter No.	0	Power
26	Parameter RAM storage 5	0: Not assigned 1 to 99: Basic parameter No.	0	Power
27	Parameter RAM storage 6	0: Not assigned 1 to 99: Basic parameter No.	0	Power
28	Parameter RAM storage 7	0: Not assigned 1 to 99: Basic parameter No.	0	Power
29	Parameter RAM storage 8	0: Not assigned 1 to 99: Basic parameter No.	0	Power
30	Parameter RAM storage 9	0: Not assigned 1 to 99: Basic parameter No.	0	Power
31	OUT1 signal assignment	0 to 41 (in 1 steps)	1	Power
32	OUT2 signal assignment	0 to 41 (in 1 steps)	28	Power
33	OUT3 signal assignment	0 to 41 (in 1 steps)	24	Power
34	OUT4 signal assignment	0 to 41 (in 1 steps)	0	Power
35	OUT5 signal assignment	0 to 41 (in 1 steps)	0	Power

Function (Input signal) number assigned to system para.1 to 8 (CONT1 to CONT8)

0: Not assigned
1: Run command [RUN]
2: Forward command [FWD]
3: Reverse command [REV]
5: Origin return [ORG]
6: Origin LS [LS]
7: +OT
8: -OT
10: Forced stop [EMG]
11: Alarm reset [RST]
14: ACC0
16: Position preset
27: Pulse train ratio 1
28: Pulse train ratio 2
29: P-action
30: Torque limit
34: External fault input
37: Position control
38: Torque control
43: Override valid
44: Override1
45: Override2
46: Override4
47: Override8
48: Interrupt input valid
49: Interrupt input
50: Deviation clear
51: X1
52: X2
53: X3
54: Free-run [BX]
55: Edit permit command
56: Current position output

Function (Output signal) assigned to system para.31 to 35 (OUT1 to OUT5)

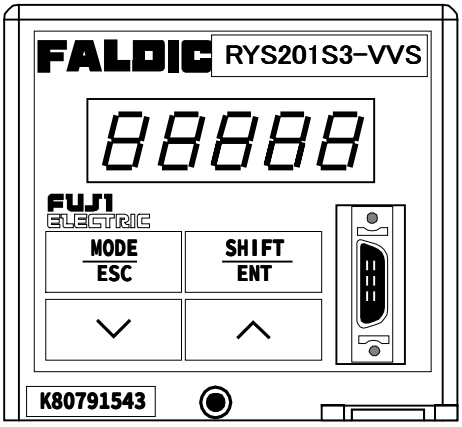
0: Not specified
1: Ready [RDY]
2: Positioning end [PSET]
14: Brake timing
15: Dynamic braking
16: Alarm detection [ALM]
17: Fixed, passing point 1
18: Fixed, passing point 2
20: OT detection
22: Origin return end
23: Deviation zero
24: Speed zero [NZERO]
25: Speed arrive [NARV]
26: Torque limit detection
27: Overload early warning
28: CPU ready [CPURDY]
29: Edit permit on
31: Address error
32: Alarm code 0
33: Alarm code 1
34: Alarm code 2
35: Alarm code 3
36: Alarm code 4
38: +OT detection
39: -OT detection
40: Origin LS detection
41: Forced stop detection

■ System parameter for RYS-V type (2/2)

No.	Name	Setting range	Initial value	Change
36 to 59	Unused	–	0	–
60	Torque command function select	0: Torque command 1: Speed command (aux.)	0	Power
61	Speed limit select	0: Parameter 1: Speed command terminal	0	Power
62	Torque limit select	0: Parameter 1: Torque command terminal	0	Power
63	Speed command gain	±0.10 to ±1.50 times (in 0.01 steps)	1.00	Always
64	Speed command offset	-2000 to +2000 (in 1 steps)	(Individual)	Always
65	Torque command gain	±0.10 to ±1.50 times (in 0.01 steps)	1.00	Always
66	Torque command offset	-200 to +200 (in 1 steps)	(Individual)	Always
67	Monitor1 signal assignment	1: Speed command 2: Speed feedback 3: Torque command 4: Position deviation	2	Always
68	Monitor2 signal assignment	1: Speed command 2: Speed feedback 3: Torque command 4: Position deviation	3	Always
69	Monitor1 scale	±2.0 to ±10.0V (in 0.1V steps)	7.0	Always
70	Monitor1 offset	-50 to +50 (in 1 steps)	0	Always
71	Monitor2 scale	±2.0 to ±10.0V (in 0.1V steps)	6.0	Always
72	Monitor2 offset	-50 to +50 (in 1 steps)	0	Always
73	Monitor1, 2 output form	0: Monitor1(two-way deflection) / Monitor 2 (two-way deflection) 1: Monitor1(one-way deflection) / Monitor 2 (two-way deflection) 2: Monitor1(two-way deflection) / Monitor 2 (one-way deflection) 3: Monitor1(one-way deflection) / Monitor 2 (one-way deflection)	0	Power
74	Unused	–	0	Power
75	Soft OT valid/invalid	0: Valid 1: Invalid	0	Power
76	+Soft OT detection position	-79999999 to 0 to 79999999 (in 1 steps) [x unit q'ty]	79999999	Always
77	-Soft OT detection position	-79999999 to 0 to 79999999 (in 1 steps) [x unit q'ty]	-79999999	Always
78	Pulse train input form	0: Command code/pulse 1:Forward/reverse pulse 2: Two 90 ° phase-different signal	1	Power
79	Output pulse count	16 to 16384 [pulse/rev] (in 1 steps)	2048	Power
80	Rotational direction changeover	0: Positive direction/forward 1: Positive direction/reverse	0	Power
81	Operation at stoppage	0: Speed zero 1: Servo lock 2: Brake (P-action) 3: Brake (free-run)	0	Power
82	Brake operation time	0.01 to 9.99s (in 0.01s steps)	0.50	Always
83	Brake releasing time	0.01 to 9.99s (in 0.01s steps)	0.20	Always
84	Operation at undervoltage	0: Rapidly decelerates to stop 1: Free-run	0	Power
85	Alarm detection at undervoltage	0: No detection 1: Detect	0	Power
86	Resistor thermal relay	0: Electronic thermal relay 1: External thermal relay	0	Power
87	CONT always valid 1	0 to 56 (in 1 steps)	0	Power
88	CONT always valid 2	0 to 56 (in 1 steps)	0	Power
89	Initial indication	0 to 20 (in 1 steps)	0	Power
90 to 93	Unused	–	0	–
94	Parameter rewriting inhibit	0: Rewriting enable 1: Rewriting disable	0	Power
95	Unused	–	0	Power
96	Station number	1 to 31 (in 1 steps)	1	Power
97	Baud rate	0: 9600 1: 19200 2: 38400 [bps]	0	Power
98	Unused	–	0	Power
99	INC/ABS system	0: INC (Incremental) 1: ABS (Absolute)	0	Power

7. KEYPAD PANEL

7.1 Summary



The amplifier is provided with a keypad panel. It has a display section of five 7-segment LED digits and 4 operation keys. Figures and letters are displayed on the display section. (See left figure.)

Remark: The keypad panel cannot be removed.

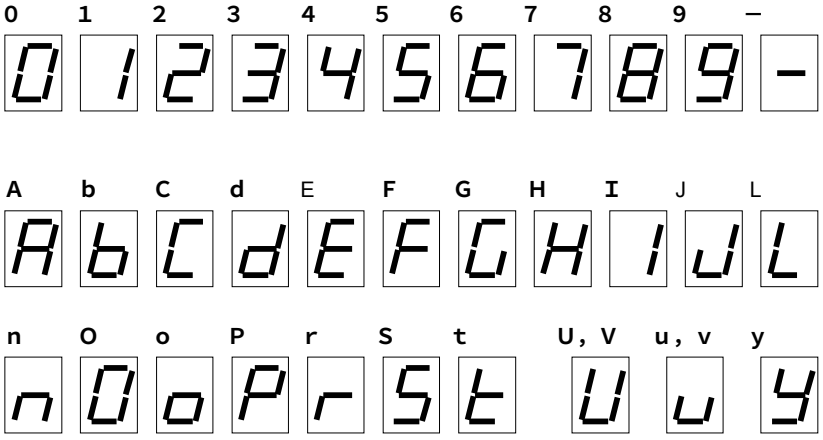
(1) Mode

The keypad panel operation can be classified into 5 modes.

Sequence mode ····· Indicates the amplifier status.
Monitor mode ····· Monitors the motor speed and the input/output signal status.
Parameter edit mode ····· Edits the parameter setting.
Positioning data edit mode ····· Edits the positioning data.
Test running mode ····· Operates the motor with the keypad operation.

- Some modes cannot be selected depends on amplifier models.

List of 7-segment indication



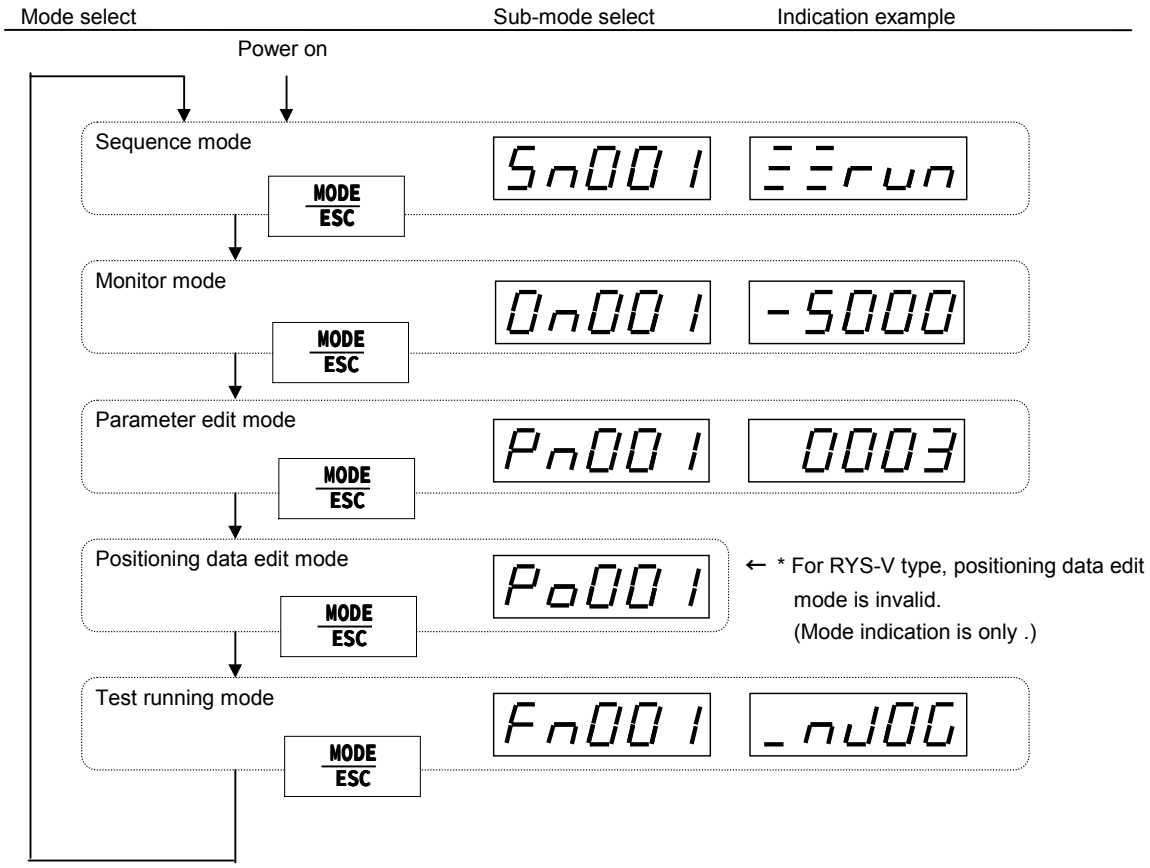
(2) Operation key

MODE / ESC	Change the mode (MODE). Returns from the mode (ESC).
SHIFT / ENT	Moves the cursor to the right at data change (SHIFT). Stores the mode and figure (ENT). Press more than 1s to store the data.
∨	Selects the sub-mode. Decreases the figure (-1). When a figure decreases from 0 to 9, the figure on the one higher digit decreases by one.
∧	Selects the sub-mode. Increases the figure (+1). When a figure increases from 9 to 0, the figure on the one higher digit increases by one.

Pressing the MODE / ESC key while pressing the SHIFT / ENT key changes over the indication between the upper 4 digits and lower 4 digits.

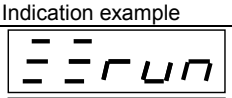
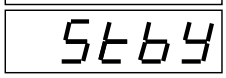
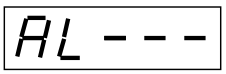
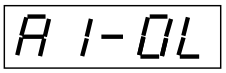
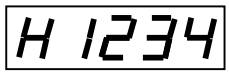
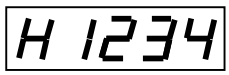
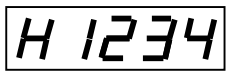
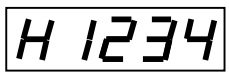
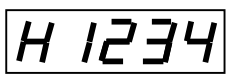
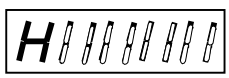
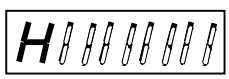
(3) Mode select

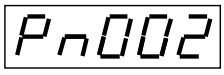
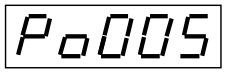
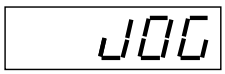
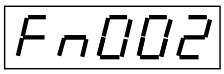
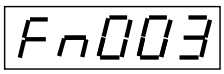
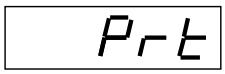
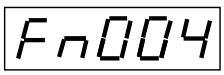
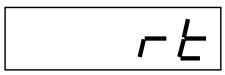
Each mode can be selected by [MODE] key.



7.2 Function list

The setting value can be changed in parameter edit mode and positioning data edit mode.

Mode	Sub-mode	Sub-mode select	Indication example
Sequence mode	Sequence		
	Sub-mode		
	Alarm detection		
	Alarm history		
	Amplifier setting		
	Motor setting		
	Station No. setting		
Monitor mode	Feedback speed		
	Command speed		
	Actual torque		
	Feedback position		
	Command position		
	Deviation amount		
	Cumulated pulse		
	Peak torque		
	Input voltage 1		
	Input voltage 2		
	LS-Z pulse		
	Input signal		
	Output signal		
	Load inertia ratio		

Mode	Sub-mode	Sub-mode select	Indication example
Parameter edit mode	Basic para.		
	System para.		
Positioning data edit mode	Position data		
	Speed data		
	Timer data		* Positioning data edit mode is not valid in RYS-V type. (Mode indication is only available)
	Status		
	M code		
Test running mode	Manual feed		
	Origin return		
	Position preset		
	Alarm reset		
	History initialization		
	Parameter initialization		
	Positioning data initialization		
	Automatic offset adjust		

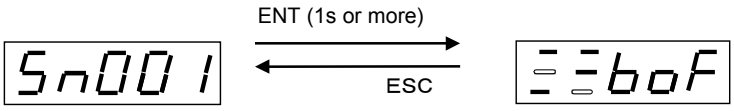
7.3 Sequence mode

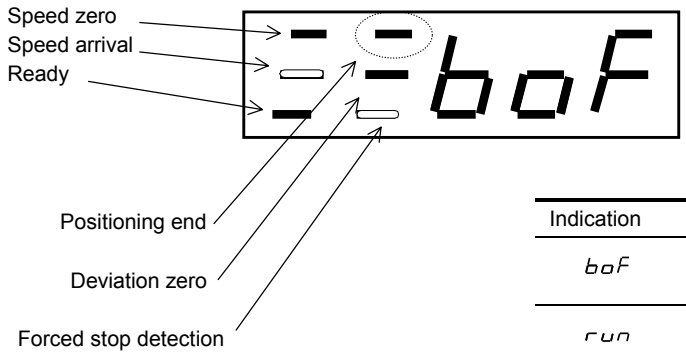
In the sequence mode, the amplifier current status and the alarm detection history can be displayed.
Press “MODE” key to display [Sn00n] and then press “ENT” key for more than 1s .

- Sn001 : Sequence
- Sn002 : Sub mode
- Sn003 : Alarm detection
- Sn004 : Alarm history
- Sn005 : Amplifier setting
- Sn006 : Motor setting
- Sn007 : Station number indication

(1) Sequence

Indicates the amplifier output signal status and operation status.





* The corresponding LED goes on when the above each output signal is on.

Indication	Description
boF	In base-off condition. The motor does not have driving force and in free-run status. (Figure above)
run	The motor can rotate.
Pot	The amplifier has detected an overtravel signal in positive direction and stops.
not	The amplifier has detected an overtravel signal in negative direction and stops.
nO	The amplifier has received a forced stop signal and stops with the speed zero.

Remark : When power is applied to the amplifier, the sequence mode is displayed. The type of indication at power on can be changed by system para. 89 setting.

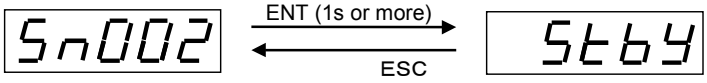
System parameter 89 setting

Setting	Initial indication	
0	[Sn001]	Sequence
1	[Sn002]	Sub-mode
2	[Sn003]	Alarm detection
3	[Sn004]	Alarm history
4	[Sn005]	Amplifier setting
5	[Sn006]	Motor setting
6	[Sn007]	Station No. indication

Setting	Initial indication	
7	[On001]	Feedback speed
8	[On002]	Command speed
9	[On003]	Actual torque
10	[On004]	Feedback position
11	[On005]	Command position
12	[On006]	Deviation amount
13	[On007]	Cumulated pulse
14	[On008]	Peak torque
15	[On009]	Input voltage 1
16	[On010]	Input voltage 2
17	[On011]	LS-Z pulse
18	[On012]	Input signal
19	[On013]	Output signal
20	[On014]	Load inertia ratio

(2) Sub-mode

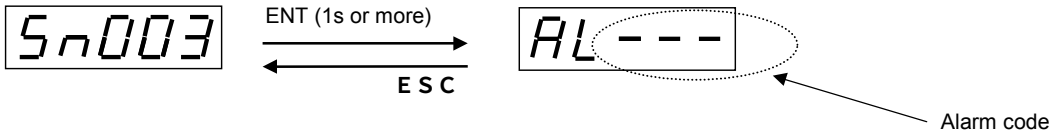
Indicates the sub-mode of the sequence mode.



Indication	Description
boF	In base-off condition. The motor does not have driving force and in free-run status.
Stby	The motor can rotate and is waiting run command.
JOG	The motor can rotate and is executing manual feed.
P In	The motor can rotate and the pulse train input is valid.
AutO	The motor can rotate and is executing positioning operation.
OrG	The motor can rotate and is executing origin return.
IntP	The motor can rotate and is executing interrupt positioning.
PCLP	The amplifier is executing deviation clear.
brEA	The motor can rotate and is measuring the brake timing.
StoP	The motor is stopping with positioning cancel signal.
Pot	The amplifier has detected an overtravel signal in positive direction and stops.
not	The amplifier has detected an overtravel signal in negative direction and stops.

(3) Alarm detection

The contents of current alarm can be displayed with codes. When [Sn004] is displayed, the alarm history can be displayed. When an alarm is detected, the following indication will appear.



Major fault

Indication	Description
---	No alarm (Figure above)
OL	Overload (OL)
OS	Overspeed (OS)
Hu	Overvoltage (Hv)
Et	Encoder trouble (Et)
EC	Encoder communication error (EC)
Ct	Circuit trouble (Ct)
dE	Memory error (dE)
Lu	Undervoltage (Lv)
OC	Overcurrent (OC)
CE	Combination error (CE)
rH2	Resistor heat 2
CtE	Cont (Control signal) error (CtE)
SE	System error (SE)

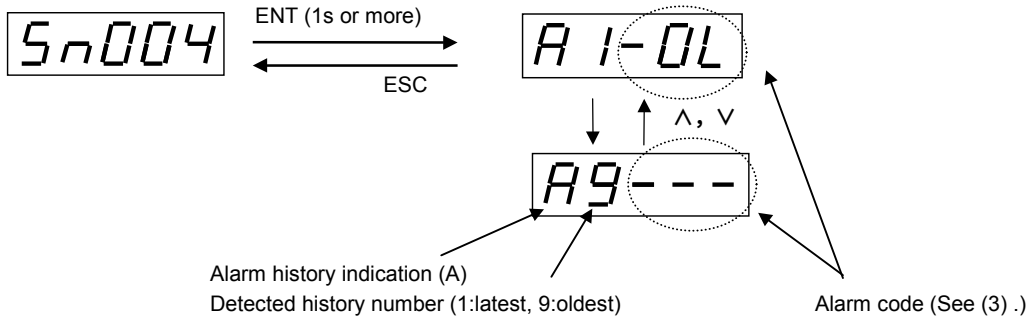
Minor fault

Indication	Description
rH	Resistor heat (rH)
OF	Deviation excessive (OF)
AH	Amplifier overheat (AH)
AL	Absolute data lost (AL)
AF	Absolute data overflow (AF)
tE	Terminal error (tE)

Remarks : The alarm codes are indicated automatically. In alarm history, if AI of [AL ∗∗∗] is flickering, the alarm has not reset yet. On this indication, if the alarm detection is reset by the control input signal, the initial screen (system para. 89 setting) is displayed. The reset of alarm detection can be carried out by trial operation mode [Fn004].
Press the ∧ key and ∨ key simultaneously for 1s or more while alarm detection is indicated to reset the alarm detection.

(4) Alarm history

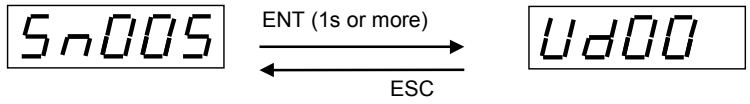
The last 9 times of alarm detection history can be indicated. The indication can be scrolled by the ∧ key and ∨ key.



Remark : The alarm history can be deleted by trial operation mode [FnOOS].
Press the ∧ key and ∨ key simultaneously for 1s or more while alarm detection is indicated to reset the alarm detection.

(5) Amplifier setting

The amplifier control function and connecting form are indicated.



Control function (1st digit, left end digit)

Indication	Function
U	Speed control
r	Rotation indexing (dividing)
L	Linear positioning

Main control connector (2nd digit)

Indication	Function
d	DI/DO standard
S	SX bus

Extension connector 1 (3rd digit)

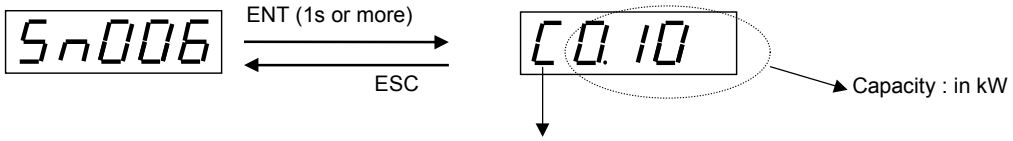
Indication	Function
0	Not mounted
P	DI/DO extension
r	RS-485

Extension connector 2 (4th digit)

Indication	Function
0	Not mounted
t	T-link
P	Parallel
A	ANY bus
F	Multi bus

(6) Motor setting

The motor type and capacity being connected the amplifier are indicated.

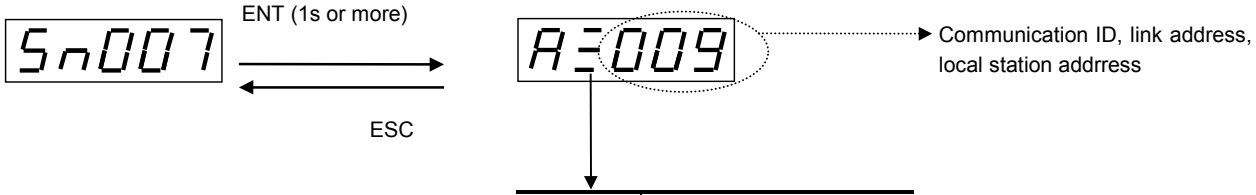


Indication	Motor type
C	Cubic type
S	Slim type
A	High stiffness
F	Flat
U	Large capacity

The sample indication above means a cubic type motor of 0.1kW.

(7) Station number

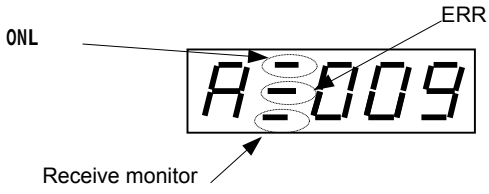
The communication ID of the amplifier being connected to various network and link is indicated.



Indication	Communication interface
=	SX bus
t	T-link
r	RS-485
J	JPCN-1
0	No interface

The amplifier having no interface for communication displays [A0001].

For SX bus, the 2nd digit indication is as follows.



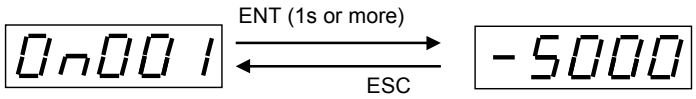
7.4 Monitor mode

In monitor mode, the motor speed or the cumulative value of input pulse can be displayed.

On001	: Feedback speed	On008	: Peak torque
On002	: Command speed	On009	: Input voltage 1
On003	: Actual torque	On010	: Input voltage 2
On004	: Feedback position	On011	: LS-Z pulse
On005	: Command position	On012	: Input signal
On006	: Deviation amount	On013	: Output signal
On007	: Cumulated pulse	On014	: Load inertia ratio

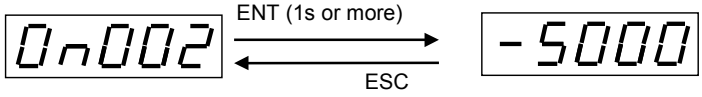
(1) Feedback speed

The motor's current speed. Even if the motor is driven by the load (mechanical system), the correct speed will be indicated. The indication is in 1[r/min] unit. The negative sign is added when the motor rotates in reverse (clockwise viewed from shaft extension).



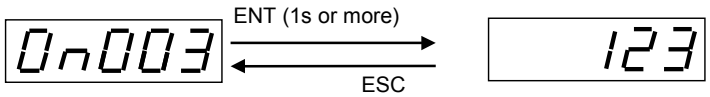
(2) Command speed

The speed given to the motor. The speed command voltage, multistep speed and pulse train are the command speed.
The indication is in 1[r/min] unit. The negative sign is added when the motor rotates in reverse (clockwise viewed from shaft extension).



(3) Actual torque

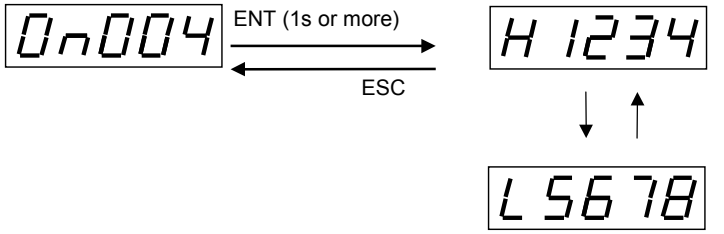
The motor's current load factor. The average value per second, assuming the rated torque as 100%, is indicated.
The indication is from 0% through the max. torque in 1% steps. The negative sign is not added.



(4) Feedback position

The motor rotational quantity is indicated in unit q'ty after pulse correction. If pulse correction is not used, the motor encoder rotation q'ty itself will be indicated.

(In case of 16 bit serial encoder, 65536 pulses per rotation)



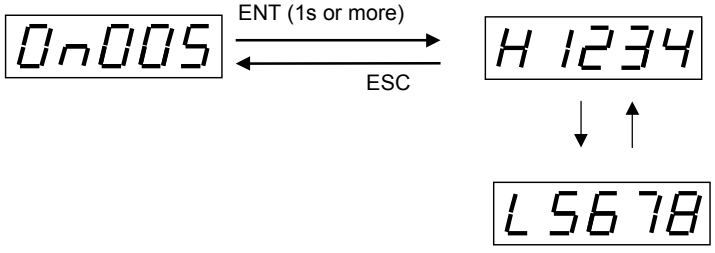
Pressing the MODE key holding down the SHIFT key interchanges the high order 4 digits and low order 4 digits.

Remarks : If the rotating direction has been altered by system para. 80, an increase from the current position raises the reading.
The maximum positive count of 99,999,999 is followed by 0. The maximum negative count of -99,999,999 is followed by 0.
I.e., the count becomes 0 every ± 100,000,000. The indication is correct even when rotated by the load (mechanical system).
4 digits preceded by "H" are high order 4 digits, and those by "L" are low order 4 digits.
In case of a negative value, H (or L) and - (minus sign) appears alternately.

(5) Command position

The position of motor controlled by the amplifier is displayed in unit quantity after pulse correction.

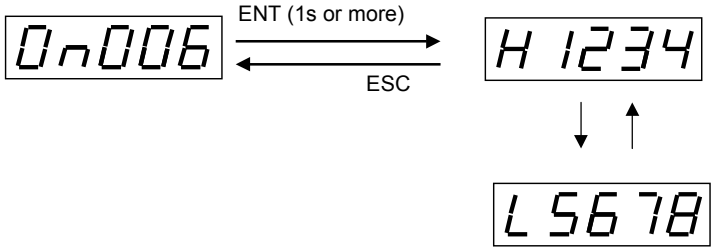
If, after a target position is attained, the run command has been turned off and if the motor is rotated by the load (mechanical system), a correct position is not displayed.



Pressing the MODE key holding down the SHIFT key interchanges the high order 4 digits and low order 4 digits.

(6) Deviation amount

Displays the difference between command position and feedback position. The deviation is displayed in terms of encoder pulse count.

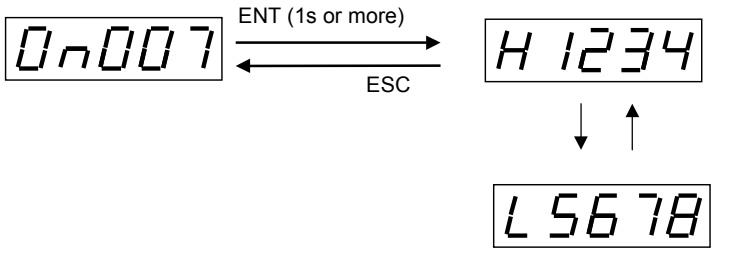


Pressing the MODE key holding down the SHIFT key interchanges the high order 4 digits and low order 4 digits.

(7) Cumulated pulse

Displays the number of pulse trains inputted to the pulse train input terminal. Inputting the forward pulses increases the integrated value or inputting the reverse pulses decreases the integrated value.

In case of two 90° phase-different signals, each edge is counted (quadrupling). The count increases if B phase is in lead.

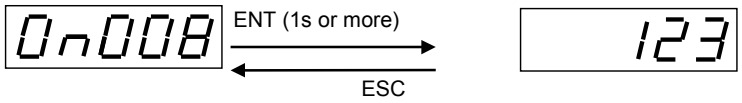


Pressing the MODE key holding down the SHIFT key interchanges the high order 4 digits and low order 4 digits.

Remarks : The maximum positive count of 99,999,999 is followed by 0.
The maximum negative count of -99,999,999 is followed by 0.
I.e., the count becomes 0 every ± 100,000,000.
4 digits preceded by "H" are high order 4 digits, and those by "L" are low order 4 digits. In case of a negative value, H (or L) and - (minus sign) appears alternately.

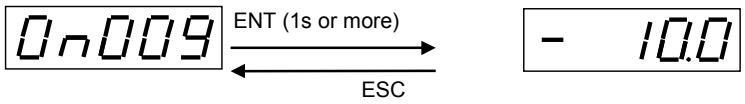
(8) Peak torque

Current load factor of motor. The peak value is displayed every second in percentage with respect to rated torque.
The indication is from 0% to maximum torque without minus sign.



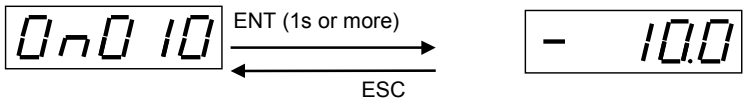
(9) Input voltage 1

Indicates the input voltage at the control input terminal [NREF] in 0.1 V steps. "-" denotes a negative voltage.



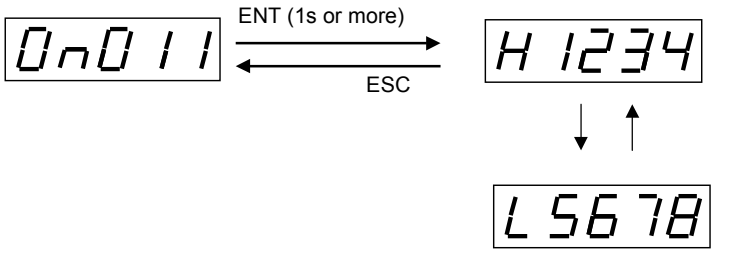
(10) Input voltage 2

Indicates the input voltage at the control input terminal [TREF] in 0.1 V steps. "-" denotes a negative voltage.



(11) LS-Z pulses

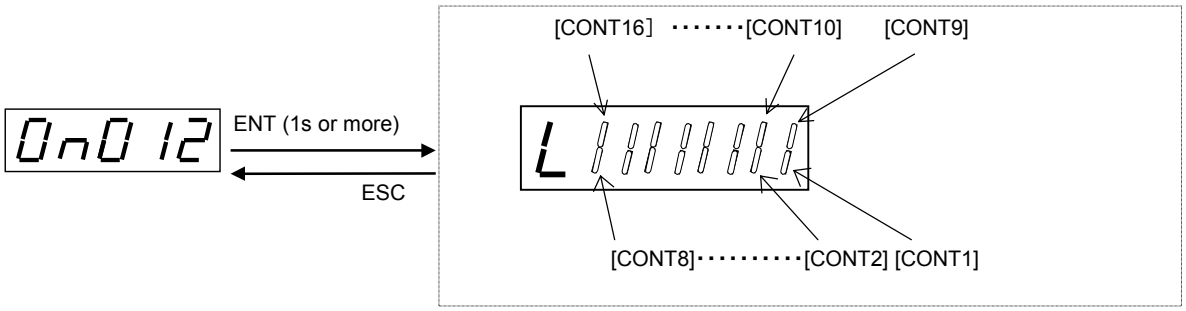
Displays a pulse count from when the origin LS signal has turned off at origin return until when Z-phase of motor encoder has been detected. The indication is updated at every origin return action. Since the value is in the origin return direction, there is no "-".



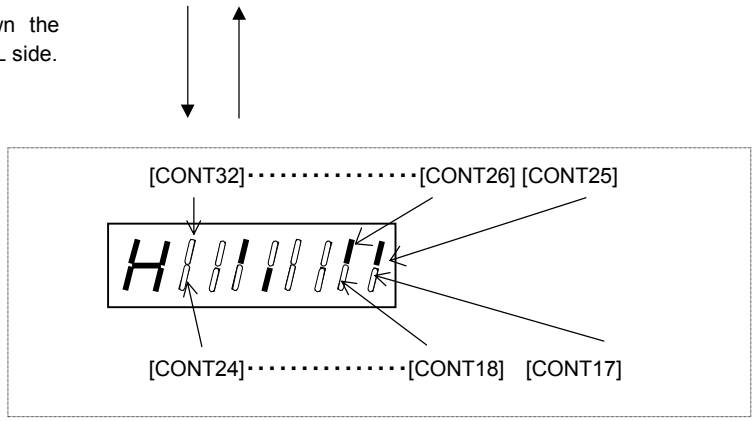
Pressing the MODE key holding down the SHIFT key interchanges the high order 4 digits and low order 4 digits.

(12) Input signal

Displays whether the control input signals to the amplifier are turned on or off. If signals are turned on, corresponding LEDs are lit.



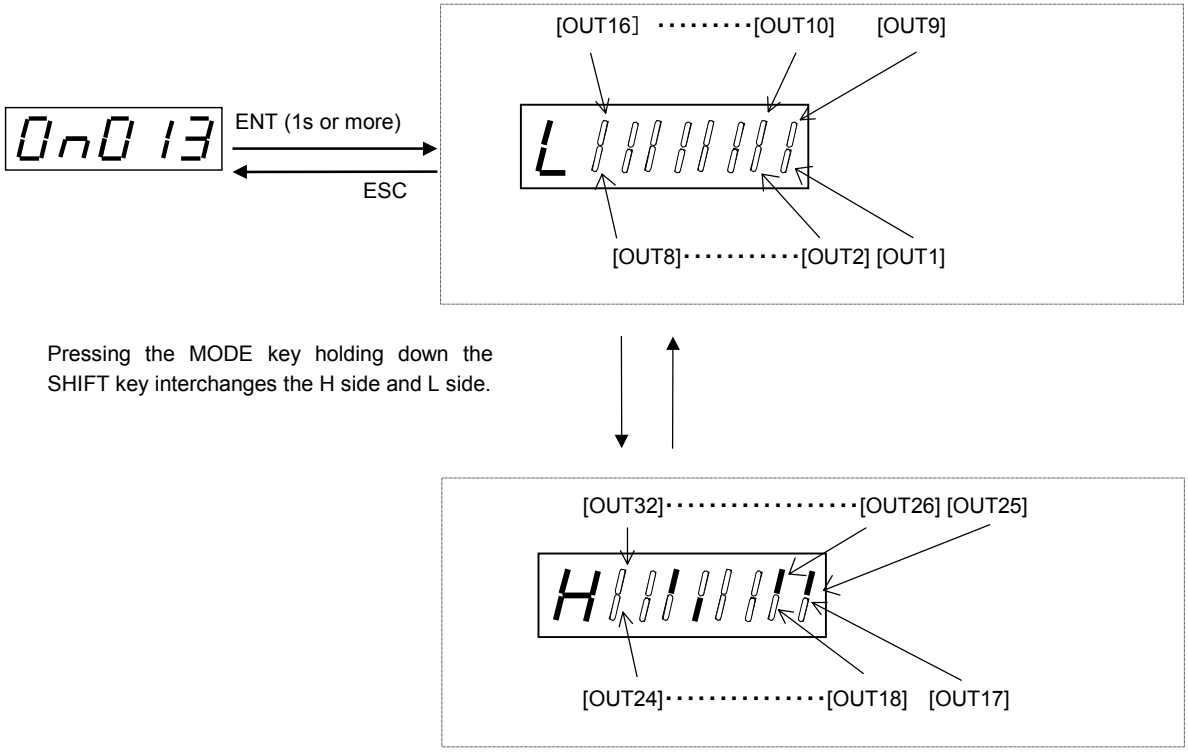
Pressing the MODE key holding down the SHIFT key interchanges the H side and L side.



Note : Depending on the amplifier type, the number of control input signals changes.

(13) Output signal

Displays whether the control output signals from the amplifier are turned on or off. If signals are turned on, corresponding LEDs are lit.

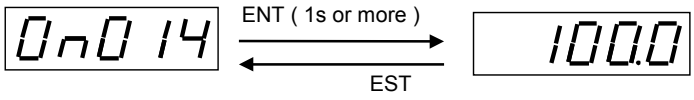


Note : Depending on the amplifier type, the number of control output signals changes.

(14) Load inertia ratio

Displays the load inertia ratio recognized by the amplifier regardless of the tuning method (basic para. 31)

$$(\text{Load inertia ratio}) = \frac{(\text{Moment of inertia recognized by amplifier})}{(\text{Moment of inertia of motor})}$$



Displays the magnification (in 0.1 times unit) of the moment of inertia of the motor.

7.5 Parameter edit mode

In the parameter edit mode, basic paras. and system paras. can be edited.

Display [PnOOn] by the MODE key and hold down the ENT key for at least 1 second to select the basic para. or system para.

PnOO1 : Basic para.

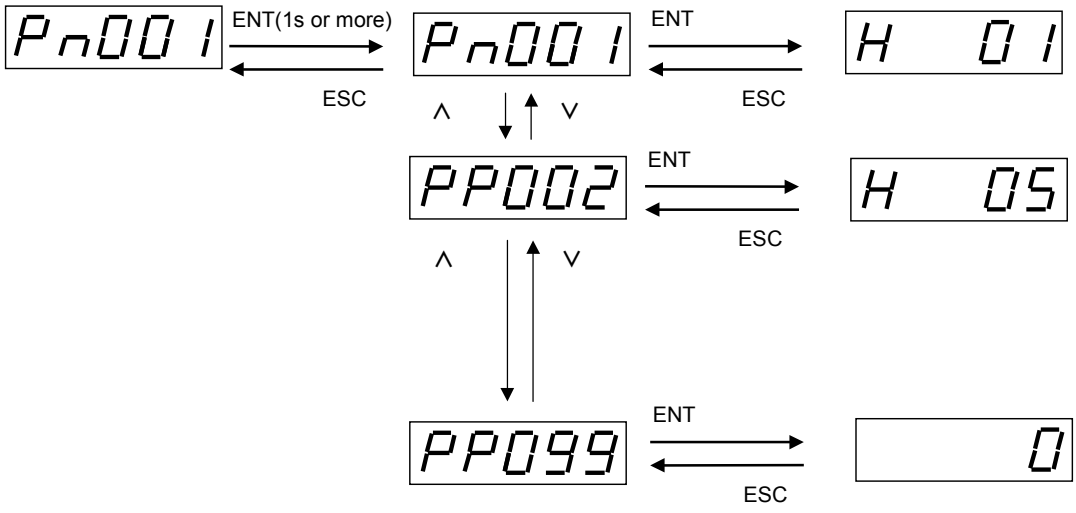
PnOO2 : System para.

By ∧ key or ∨ key, select a number of para. By pressing the ENT key, its contents can be edited.

PPOnn : Basic or system para. number.

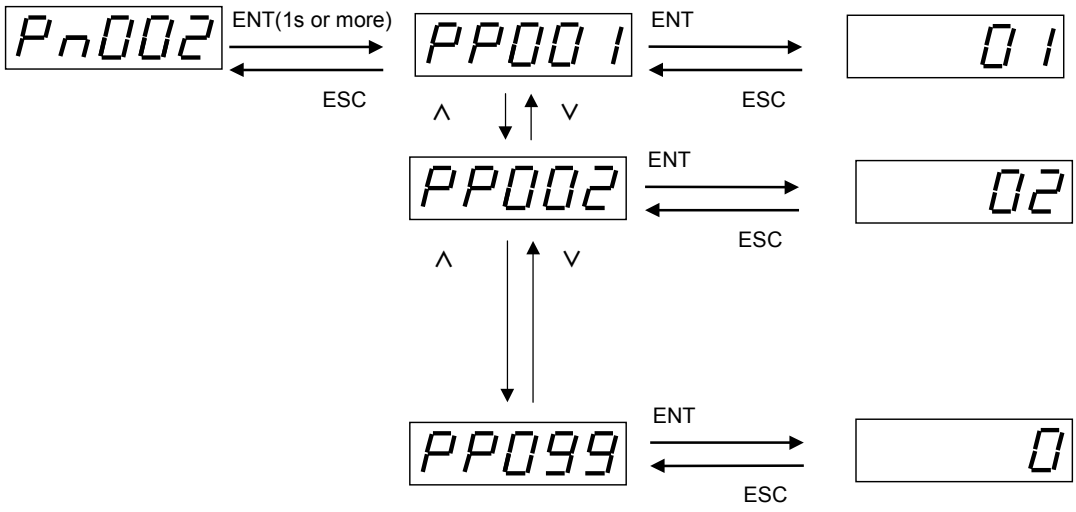
(1) Basic paras.

In basic paras., rather frequently used contents are registered. Changing almost any basic para. immediately affects the amplifier and motor actions.



(2) System parameter

System paras. register the functions of input/output terminals and other contents related to system setting. Changed setting of most system paras. is effective only after turning off and on power.



(3) Indication and editing

The indication and editing methods for paras. are as follows.

• Value indication

A value of unsigned 5 digits or signed 4 digits or less is displayed as it is.

Left example shows a value of 2 digits is selected

For clearly indicating the number of digits of a selectable value, zeroes of other columns are suppressed.

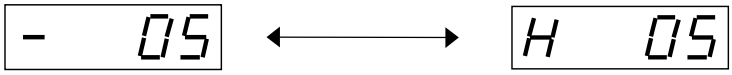
A signed value of 5 digits or more is preceded by "H" or "L".

The above example shows a value has 6 digits. (The value will be 500.00.) For interchanging the H side and L side, press the MODE key holding down the SHIFT key.

• Sign indication

In case of data with minus sign, "H" (or "L") indications and "-" blink alternately.

In case of data with plus sign, "H" (or “L”) indication blanks.



Alternately lights

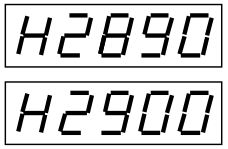
Example : Data with minus sign (H side)

• Editing a value

After reading a para., 1 digit or sign blinks at about 1 second intervals, prompting you to change that part.

Pressing the ∧ key or ∨ key changes the value. As for the sign, pressing the ∧ key or ∨ key while the cursor is located at "H" selects a plus sign (H and blank) or a minus sign (H and -).

If 9 is followed up by 0, the value at the immediately upper place increases by 1. Or, if 0 is followed down by 9, the value at the immediately upper place decreases by 1.



Example / 9 is followed up by 0 to give 2900

Note that there is no borrow nor carry from H side to L side or reversely.

The shifting order is as follows.

(2) (3) (1) (4) (5)

(1) Reading a para. allows to change the LSD of H side.
(2) Shifting allows to change the sign.
(3) Shifting locates the cursor to the MSD of H side. Shifting repeatedly goes to the right and then sequentially circulates within the display range of H side.
(4) To jump from the H side to the L side, press the MODE key holding down the SHIFT key. On the L side, the MSD can be changed first.
(5) Each press of the shift key moves the cursor to the right. The LSD is followed by the MSD within the L side.

• Storing the value

Holding down the ENT key for at least 1 second stores the value, blinking all digits simultaneously 3 times. The stored value remains displayed.

Pressing the ESC key resumes the para. selecting screen.

• Value beyond specified range

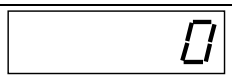
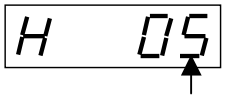
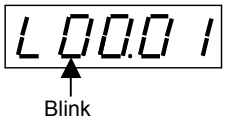
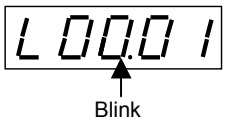
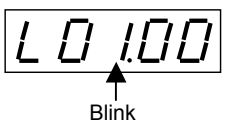
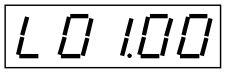
A value can be inputted within the range from minimum to maximum specified for each para.

A value beyond the specified range cannot be inputted.

LSD : Least Significant Digit

• Example of editing

Let us change the setting of basic para.02 “Manual feed speed 2” to 1.0.

Keying	Indication	Remarks
		The feedback speed monitor is displayed.
MODE/ESC		Resumes the mode selection.
MODE/ESC		Press the MODE key for selecting the para. edit mode.
SHIFT/ENT 1 [sec] min.		Hold down the ENT key for at least 1 [sec] for designating the para. number.
^		Select the basic para. 2.
SHIFT/ENT	 Blink	Pressing the ENT key reads the setting contents. The LSD blinks. (Two MSDs of initial value 500.00 are displayed.)
v		Decrease the value to 0.
SHIFT/ENT MODE/ESC	 Blink	Press the MODE key holding down the SHIFT key to display the L side (low order 4 digits).
SHIFT/ENT	 Blink	Press the SHIFT key to shift the cursor to the adjacent digit on the right.
^	 Blink	Set the value to 1. Likewise, change the LSD to 0.
SHIFT/ENT 1 [sec] min.		Hold down the ENT key for at least 1 [sec] to store the new value.
		Storing the value keeps it displayed. Pressing the ESC key resumes the para. number selecting screen.

7.6 Positioning data edit mode

> * For RYS-V type, positioning data edit mode is invalid.
> (Mode indication is only.)

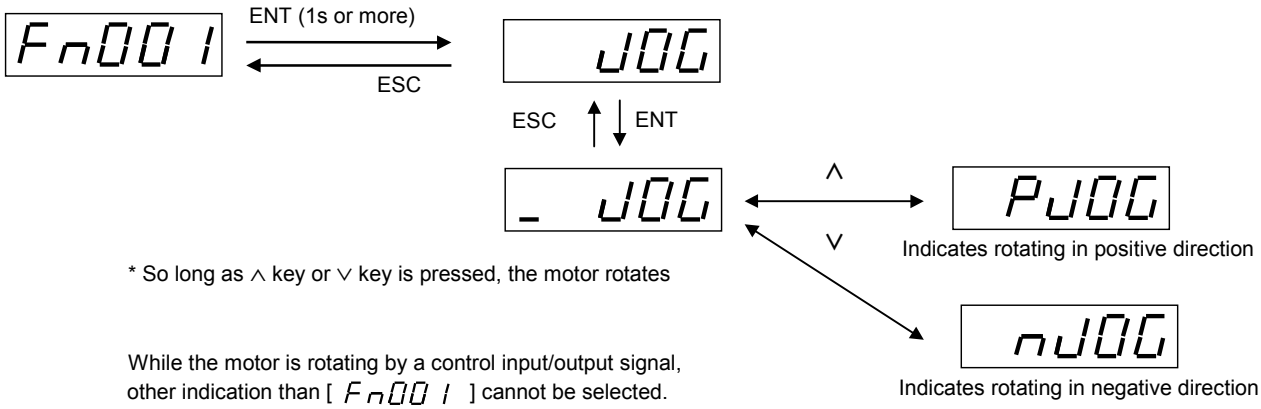
7.7 Test running mode

In the test running mode, keying on the keypad panel can rotate the motor or reset the different items.
Upon displaying [FnOOn] by the MODE key, holding down the ENT key for at least 1 [sec] executes a test running.

FnOO1	: Manual feed	FnOO5	: Initializing the history
FnOO2	: Origin return	FnOO6	: Initializing the paras.
FnOO3	: Position preset	FnOO7	: Initializing the positioning data
FnOO4	: Alarm reset	FnOO8	: Automatic offset addjust

(1) Manual feed (FnOO1)

So long as a key on the keypad panel is pressed, the motor rotates. The motor speed is as set by basic para. 1.

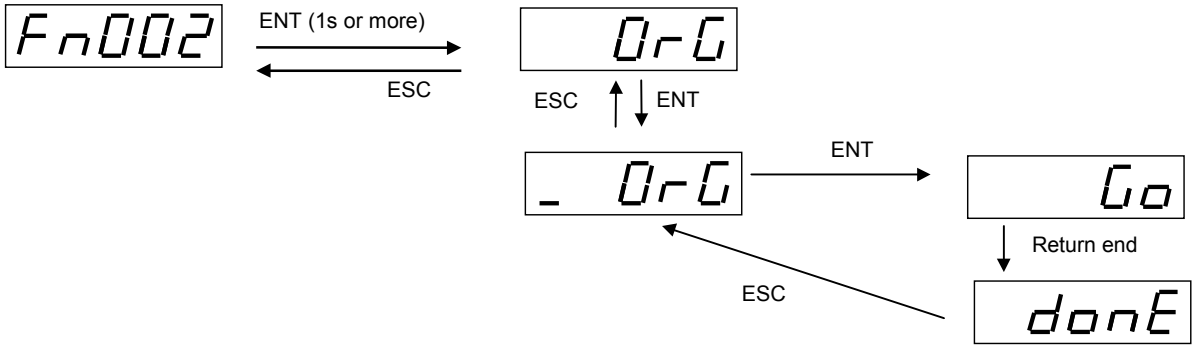


* So long as ∧ key or ∨ key is pressed, the motor rotates

While the motor is rotating by a control input/output signal, other indication than [FnOO1] cannot be selected.

(2) Origin return (FnOO2)

Keying on the keypad panel performs an origin return. The origin return is made according to basic paras. 71 to 79. Change of basic para. 71 to 73 settings is effective only after turning off and on power.

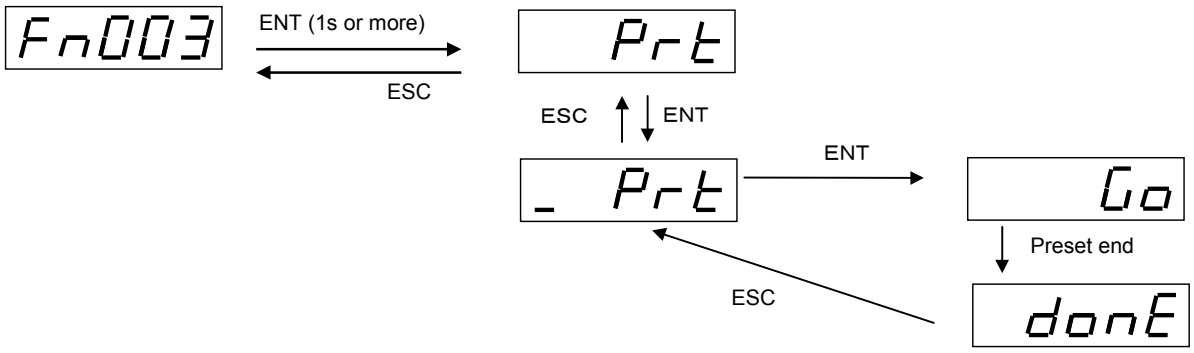


After the end of origin return, the indication remains [donE]. Pressing the ESC key resumes a sub-mode selection.

(3) Position preset (Fn003)

The current position of motor can be preset. The following alarm detected can be reset.

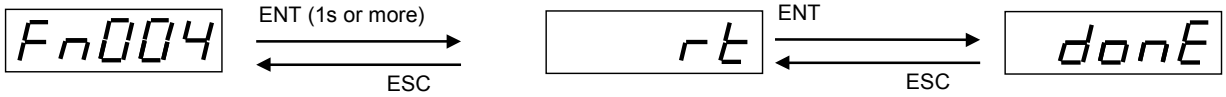
- ABS data loss
- Absolute data overflow



The current position is set by basic para. 80.
Position preset cannot be made while the motor is rotating.

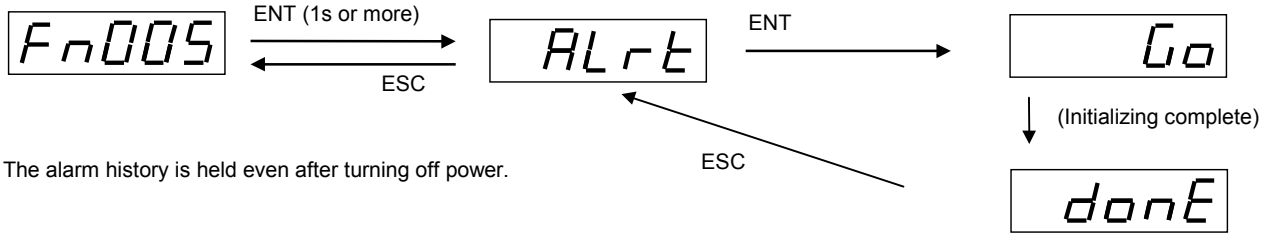
(4) Alarm reset (Fn004)

Resets the alarm detected by the amplifier.



(5) Initializing the history (Fn005)

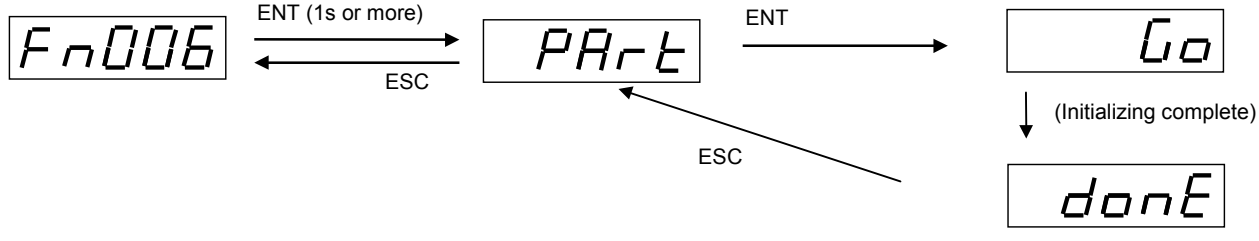
Deletes the history of alarms detected held by the amplifier.
This history can be monitored by a sequence mode of [Sn004].



The alarm history is held even after turning off power.

(6) Initializing the paras. (Fn006)

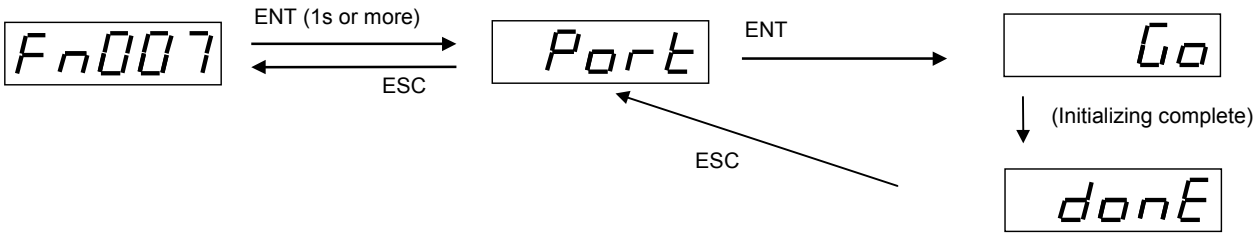
Initializes the basic paras. and system paras.
* After initializing, be sure to turn off and on power.



(7) Initializing the positioning data (Fn007)

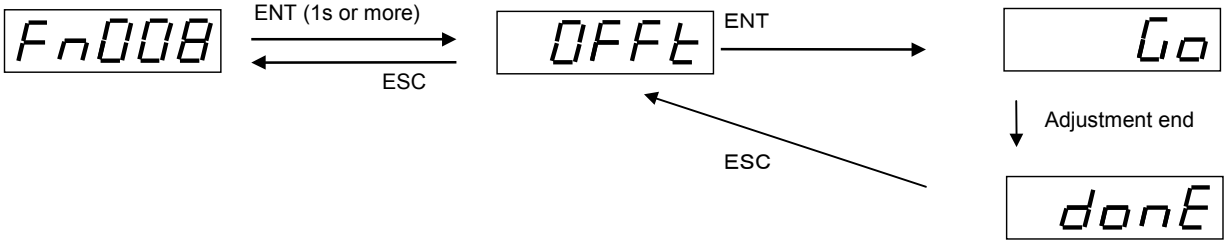
Initializes all positioning data.

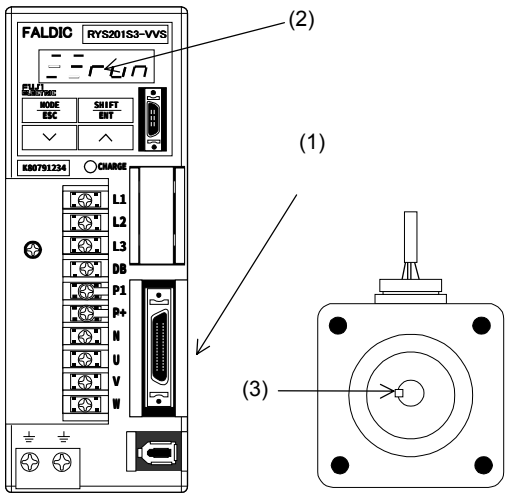
* After initializing, be sure to turn off and on power.



(8) Automatic offset adjust (Fn008)

Sets the input voltage to the control input terminals [NREF] and [TREF] at 0 [V].





When the motor rotates slowly with the run command given, the speed command voltage offset is generated. (Where the speed command voltage is selected in speed control)

(1) Sets 0 [V] at the terminal [NREF].
Whether the run command is given or not has no influence.

(2) Select [Fn008] on the keypad panel and press ENT key, then the offset can adjusted automatically.

(3) Make sure that the motor will not rotate even if the run command is ON.

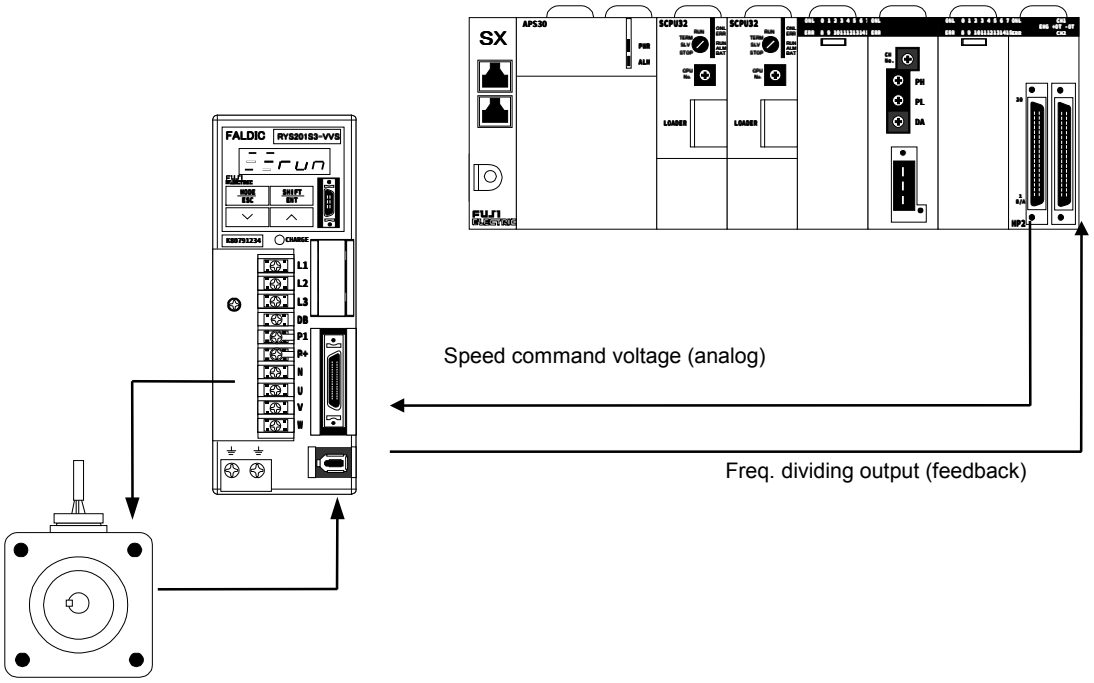
Remarks:

Both the terminal [TREF] and [NREF] can be adjusted simultaneously by the automatic offset adjust.

The adjustment result will be stored in system paras. 64 and 66.

Along with the change of ambient environment, the offset adjust may be required again.

With the setting of system para. 81, the operation at stoppage can be selected. When “servo lock” is selected, the motor can be stopped by “servo lock” even in speed control mode. However, when the host controller is controlling the amplifier using the speed command voltage and freq. dividing output pulse (feedback), do not select the “servo lock.


SX
APS30
SCPU32
SCPU32
FALDIC
RYS201S3-VVS
run
L1
L2
L3
DB
P1
P+
N
U
V
W
Speed command voltage (analog)
Freq. dividing output (feedback)

8. TEST (TRIAL) RUNNING OPERATION

8.1 Preparation

(1) Preparation

A test running is carried out upon connecting the amplifier and motor. For the wiring method, see 4.
For the test running, the motor is not connected to the mechanical equipment system and, when the operation is normal, it is connected to the mechanical equipment system.

(a) Main circuit power input
The amplifier power supply includes main circuit power input (L1, L2, L3) and control power input (LIC, L2C).

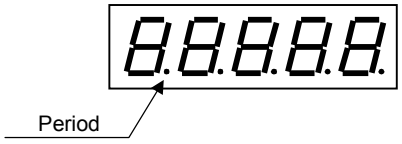
(b) Main circuit power supply
Connect the motor power line to the (U, V, W) terminals on the amplifier terminal block (board). Changing the phase sequence cannot change the motor rotational direction.

(c) Encoder wiring
Connect the encoder for the motor to CN2 on the amplifier using a specified cable.

(d) Control input/output wiring
Do not connect CN1 and CN3 to the amplifier, when the test running temporary.

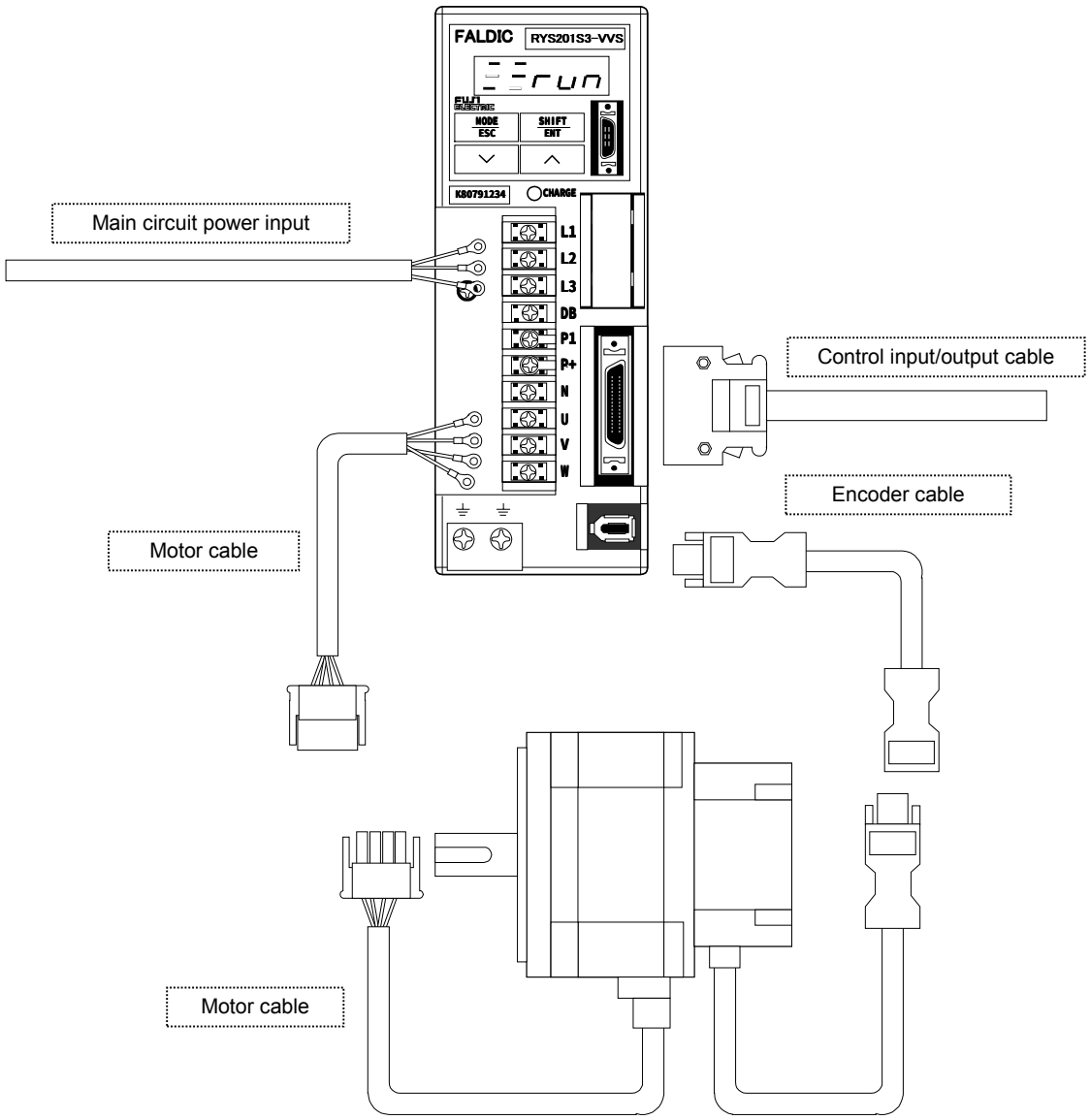
(2) Power supply

Supply the main circuit power to the amplifier.
If the status is as follows, the amplifier is operating properly.
When power is supplied, the "CHARGE" LED under the touch panel of amplifier is lit red.
Periods for all of five 7-segment digits light once simultaneously.



If the para.(*) are as set at factory, the sequence of sequence mode appears.
(7-segment digit display on touch panel.)

(*) Para. : Parameter(s)



Remark : The ‘‘CHARGE’’ LED lights on either the main circuit power supply or control power supply.
Depending on the system para. setting, ‘‘ABS data lost ‘‘ [AL] or other alarms may occur but it is not abnormal.
If a system error is displayed, contact us.

(3) Absolute system [ABS]

If an absolute system is used, carry out a start up in the following procedure.

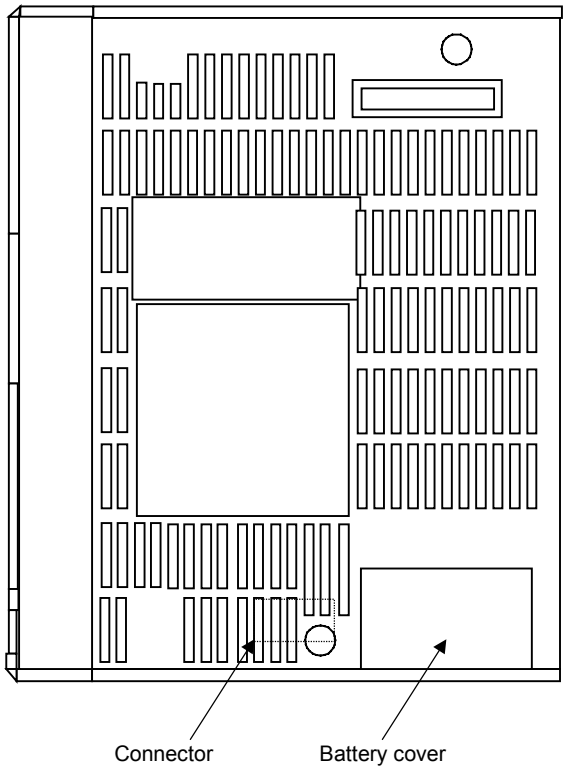
(a) Battery

Install a battery (WSB-S type) on the amplifier as follows.

(i) Pull open downward the cover for the battery space located on the right side of amplifier.

(ii) On the left of the battery space, there is a connector which is to be engaged with the connector provided for the battery.

(iii) Engage the connectors and close the cover in place.



(b) System para.

Turn on the power supply, and system para. 99 sets to "1".

(c) Turning off power

To validate the set value of system para. 99, turn off and on power. Make sure the CHARGE LED is extinguished (goes out) when turning on again.

(d) Power supply

Supplying power produces an alarm "Absolute data lost".

(e) Resetting the detected alarm

Execute the position preset [Fn003] in the test running mode to reset the alarm.

Thereafter, the ABS system is validated.

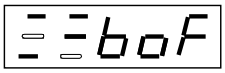
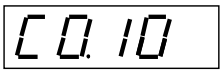
8.2 Touch panel

After making sure of status when power is turned on, carry out a test running from the touch panel.

> **CAUTION**
>
> **At the test running, the motor must not be connected to the mechanical equipment system, to be prevent unexpectedly break the mechanical equipment system.**
> **Before the test running, firmly tightened the mounting-flange so that the motor will not dislocated. Remove the coupling bolts for mechanical connection.**

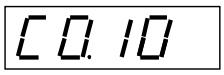
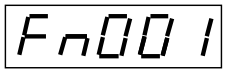
(1) Motor

Check the motor model type and rated output [kW].

Key input	LC display (example)	Remark
		The sequence is displayed.
MODE ESC		By the ESC key, select the sub mode.
∨		By ∧ key or ∨ key, select [Sn006]
SHIFT ENT		Pressing the ENT key for at least 1 [sec] displays the motor model type. GYC type (“C” of cubic) motor of 0.1 [kW] is displayed on the left example.

(2) Test running mode

By the touch panel of amplifier, rotate the motor.
Select the test running mode.

Key input	LC display (example)	Remark
		Example of sequence mode display.
MODE/ESC		ESC key resumes selecting the mode.
MODE/ESC		The monitor mode is posted.
MODE/ESC		The para. edit mode is posted.
MODE/ESC		The positioning data edit mode is posted.
MODE/ESC		The test running mode is posted.
SHIFT/ENT		Pressing the ENT key for at least 1 [sec] can execute manual feed.
SHIFT/ENT		By pressing the ENT key, motor can be rotated.
∨		Holding down the ∨ key rotates the motor forward (∗).
		Releasing the key stops motor.
MODE/ESC		Pressing the ESC key resumes selecting the mode.

Remark : In case of a vertical-feed load machine such as elevator, a motor with provided brake is applied.
In this case, the brake release and excitation must be performed according to keying in the test running mode.
For brake timing, use the control output signal "brake timing".

(∗) Direction of motor shaft rotation (when viewed from a point facing the drive-end of motor) is designed according to Japanese standards :
• Forward direction : Counter-clockwise (CCW) rotation
• Reverse direction : Clockwise (CW) rotation

8.3 Control input signal

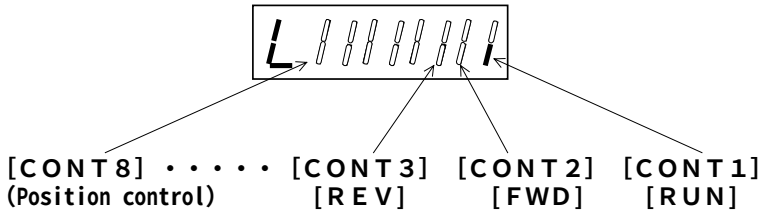
Carry out a test running using the control input signals.
Turn off power and connect the control input/output wiring to CN1.

(1) Control input signals

In the monitor mode of the touch panel, control input signal ON/OFF can be checked.

Key input	LC display (example)	Remark
	Fn001	Example of test running mode display
MODE/ESC	Sn006	The MODE key selects a mode.
MODE/ESC	On001	Select the monitor mode.
∧	On012	By ∧ key or ∨ key, select [On012]
SHIFT/ENT	L 8 8 8 8 8 8 8 1	Holding down the ENT key for at least 1 [sec] allows to check the input signal ON/OFF.

If a control input signal on CN1 turns ON, the corresponding LED lights.
The input signal display [On012] in the monitor mode is updated in real-time.



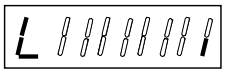
Remark : CN1 is not factory assigned to the following signals.

- Forced stop (10)
- +OT (7)
- External fault input (34)
- -OT (8)

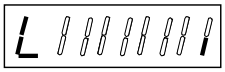
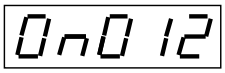
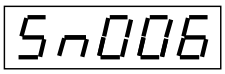
These signals are N.C. (or "b") break contact. Connecting the CN1 allows to run the motor.
At the factory set status, the amplifier carried out a speed control.
Assign a position control (37) for position control by pulse train, etc., or a torque control (38) for torque control.
These signals can be validated at all times by assigning the system para. 87 or 88.

(2) Speed control

By turning on the run command [RUN] of amplifier (as factory set), the motor can be rotated.
If output signals (PLC, etc.) to the amplifier are not inputted to the amplifier, check the +24[V] DC power supply to CN1.
(a) Supply power to the amplifier.
(b) Make sure a voltage is outputted from the +24[V] DC power supply.
(c) If a variable resistor is connected to speed command [NREF] terminal and torque command [TREF] terminal, adjust it so as to be 0 [V] at the terminal.
(d) Turn on the run command [RUN] signal.
By the touch panel of amplifier, make sure the LEDs light according to the run command.



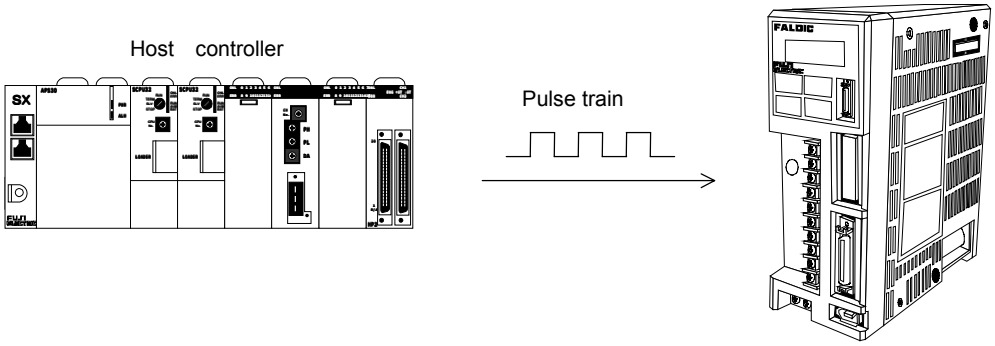
(e) On the touch panel, the sequence mode recognized by the amplifier can be checked.

Key input	LC display (example)	Remark
		Example of monitor mode display
MODE ESC		The MODE key selects a mode.
MODE ESC		Change the mode.
MODE ESC		Change the mode.
MODE ESC		Change the mode.
MODE ESC		Change the mode.
∧		By ∧ key or ∨ key, select [Sn001]
SHIFT ENT		Holding down the ENT key for at least 1 [sec] causes a sequence display.
		Turning on [RUN] signal displays [run].

(f) The motor starts running by turning on the forward command [FWD] signal.
Check that raising the voltage at the speed command [NREF] terminal gradually increases the motor speed accordingly.
(g) Turning off the forward command [FWD] stops the motor whether a voltage is present at the speed command [NREF] terminal or not.
(h) Turn off the [RUN] signal to turn off power.

(3) Position control

According to a pulse train (output) of a host controller mainly, a positioning control is made.



(a) Pulse train form

Match the output form of the pulse train with the host controller.

On the amplifier side, set the system para. 78. Forward pulse/reverse pulse is factory selected (0: Command pulse/command code, 1: Forward pulse/reverse pulse, 2: Two 90° phase-different signals.)

(b) Maximum input frequency

The maximum input frequency of the pulse train is 400 [kHz].

(c) Position control

For executing a position control, turn on the "position control" by an external input signal.

The position control signal can be validated at all times by other than external input signal upon para. setting.

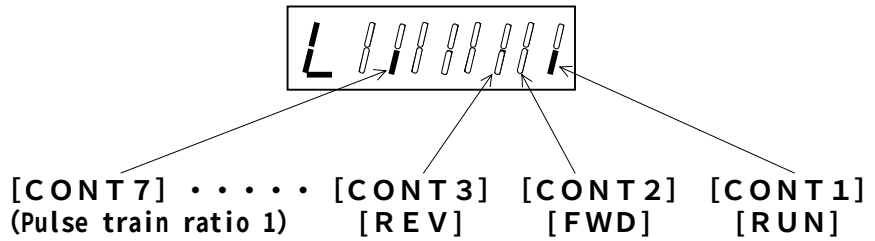
(i) Set the system para. 78 to an output form of the pulse train.

(ii) Set the system para. 87 or 88 to 37 (position control). The position control signal is validated at all times.

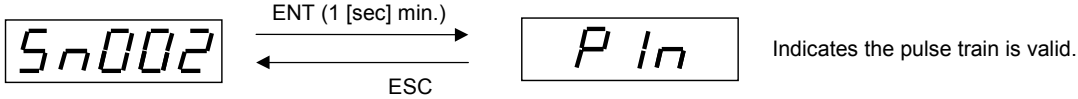
(iii) Turn off and then on power.

(iv) So long as the run command [CONT 1] terminal and pulse train ratio 1 [CONT 7] terminal on CN1 are on, the motor rotates according to a pulse train (as factory set).

With [On012], the input signal can be checked.

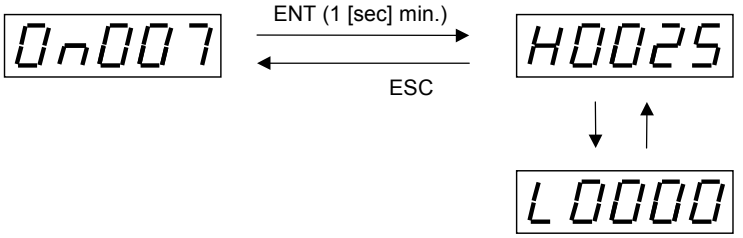


With [Sn002], the sequence sub-mode can be checked.



Indicates the pulse train is valid.

(v) In the monitor mode [On007] on the touch panel, make sure the output pulse count of the host controller and integrated pulse count of the amplifier coincide with each other.



Pressing the MODE key holding down the SHIFT selects the high order 4-digit or low order 4-digit.

The example of display indicates the integrated input pulse count is 250000. Forward pulse input counts it up or reverse pulse input counts it down.
Two 90° phase-different signals indicate 4 times the input pulse count (quadrupling).

9. INSPECTION AND MAINTENANCE

9.1 Inspection

(1) Before inspection

> **DANGER**
>
> - **Prior to inspection, turn off power and wait for at least five minutes. Otherwise, there is a risk of electric shock.**
> - **Do not touch the amplifier when the commercial power is supplied. Otherwise, there is a risk of electric shock.**

(2) Inspection items

Device	Inapplicable item
Motor	Abnormal vibration (on motor-shaft and bearing-housings, etc.) Direct exposure to water, steam or oil Misalignment of mechanical coupling at shaft extension
Amplifier	Loose screws of terminal block (board) and fastening parts Excessive accumulation of dust Damage due to heat, external deformation, cable-wire discontinuation, etc.

Ensure that the “CHARGE* LED is extinguished (goes out) on touch panel, before the checking of electrical wirings.

> **CAUTION**
>
> **Withstand voltage and insulation test with megger and connection test of PC-board and terminals of amplifier must not be conducted.**

9.2 Memory backup

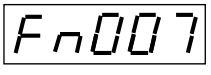
(1) Memory backup

An electrically rewritable EEPROM is used for retaining the following items after turning off power supply.
(i) Basic para. and system para.
(ii) Positioning data (RYS-L type amplifier only)
(iii) Alarm detection history
Each area can be initialized by turning off the run command [RUN] of the amplifier (while motor is de-energized).
(a) Initialization of para.
To initialize, select the initialization [Fn006] of para. in the test running mode and press the ENT key.
Notice : After the initialization, be sure to turn on power again.

The initialization is not allowed if rewrite is inhibited by system para. 94.

The initialization is impossible while the motor is energized with the [RUN] signal on.

(b) Initialization of positioning data (RYS-L type amplifier only)
To initialize, select the initialization [Fn007] of positioning data in the test running mode and press the ENT key.
Notice : After the initialization, be sure to turn on power again.

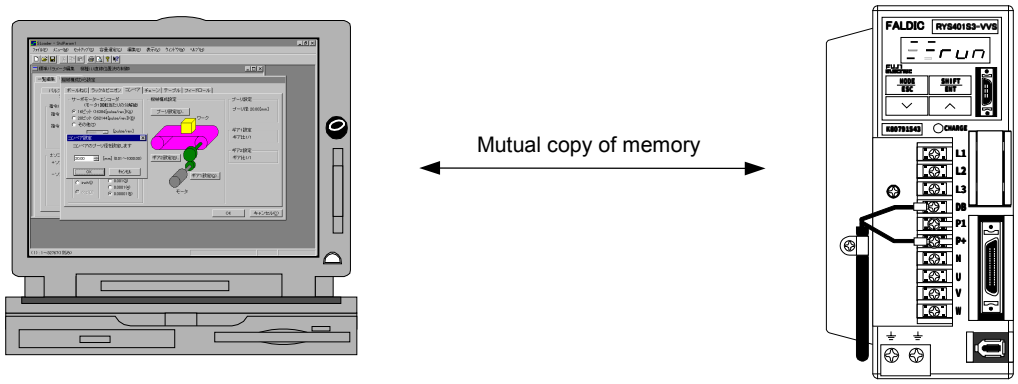


The initialization is not allowed if rewrite is inhibited by system para. 95.

The initialization is impossible while the motor is energized with the [RUN] signal on.

(c) Initialization of alarm detection history
The alarm detection history is held at all times. It can be initialized by the initialization [Fn005] of history in the test running mode of the touch panel.

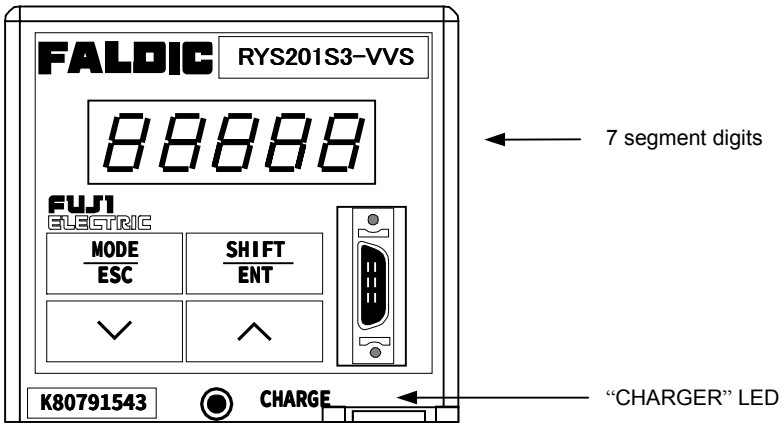
(2) Copying the memory
Use of a handy-loader or PC-loader can copy the setting contents of amplifier to the loader or, reverse, the loader contents can be transferred to the amplifier.
If you have no technical documents for operation of handy-loader or PC-loader, contact us.



(3) Saving the setting contents into RAM
The EEPROM reaches its end of expected-service life after approx. 100,000 operations.
If basic para. and positioning data are saved in RAM, rewriting is available any number of times.
For saving in RAM, refer to 6.3.4.
Para. and positioning data saved in RAM can be rewritten any number of times.
Turning on power selects default values.

9.3 Fault display
The fault diagnosis is explained in three sections below.
(i) Initial status
(ii) When error (failure) is not displayed
(iii) Faults with alarm indication

(1) Initial status
After turning on commercial power for the amplifier, some of 7 segments on the touch panel lit (light up). The “CHARGR” LED lights on the touch panel.

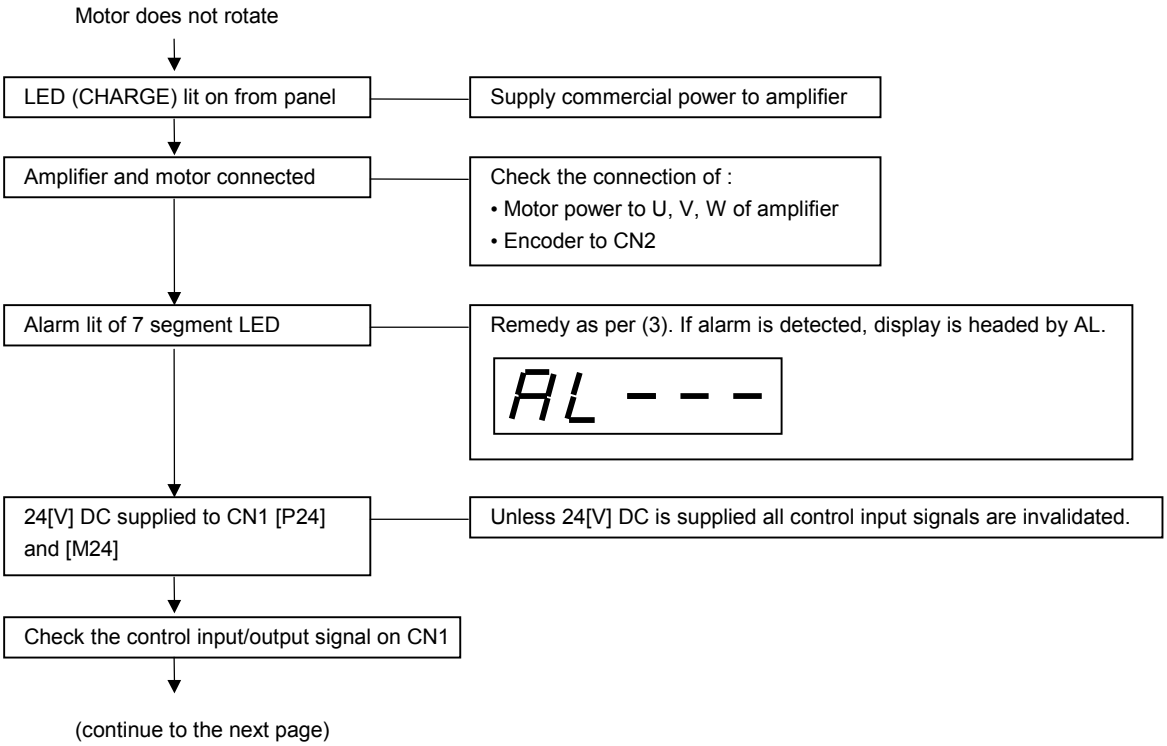


If turning on power displays nothing, contact us.
Supplying only the control power lights the display.

(2) When error (failure) is not displayed

The following exemplifies checkup procedure. As required, contact us.

(a) Motor does not rotate



(i) Step 1

Press MODE ESC repeatedly until Sn001 appears.

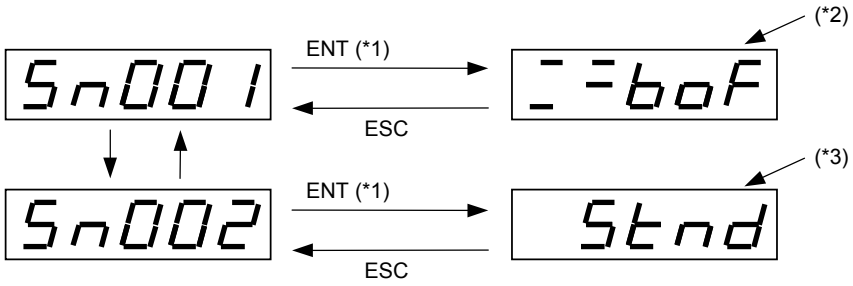
(ii) Step 2

(*1) 1[sec] min.
(*2) Displays current (present) status

LC display	Cause and check	Remedy
boF	Base off. Motor has no drive force.	• [RUN] turned on. • Free run [BX] turned on.
run	Running is available.	Proceed to (iii) Step 3
Pot	Stopped with +OT is detected.	Reset [+OT] by on.
not	Stepped with −OT is detected.	Reset [−OT] by on.
n0	Stopped by speed zero at [EMG] input.	Reset [EMG] by on.

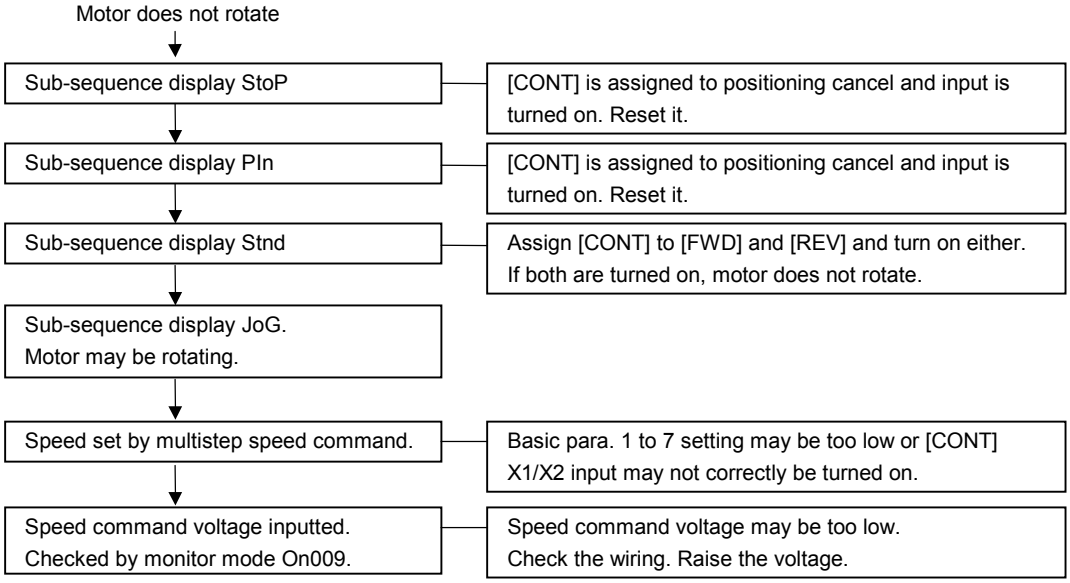
Remark : The control input [CONT] is amplifier can be checked on the touch panel.

(iii) Step 3 : Indicate the sub-sequence mode display.



(*1) 1[sec] min. (*2) Sequence mode display (*3) Sub-sequence mode display

LC display	Cause and check : At rotational status
Stnd	Waits for rotation command (above figure).
JoG	Executes manual feed.
P In	Pulse train is valid.
orG	Origin return is in progress.
IntP	Interrupt position is in progress.
PCLP	Clears the position deviation.
Auto	Positioning control by address designation is in progress.
brEA	Brake timing is being measured.
StoP	Halts by positioning cancel signal.

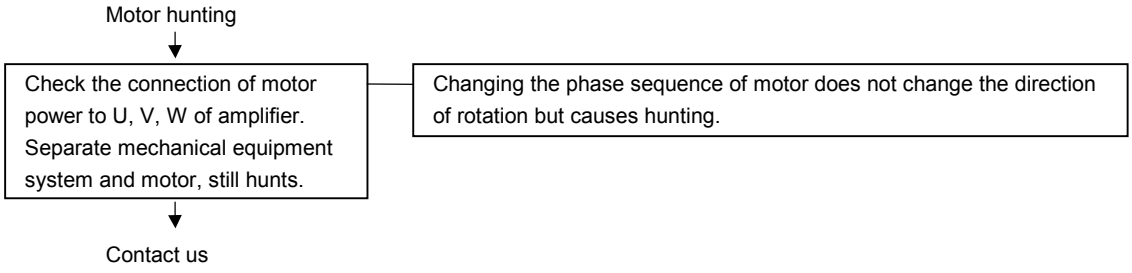


Remark : The analog speed command voltage can be checked on the touch panel.

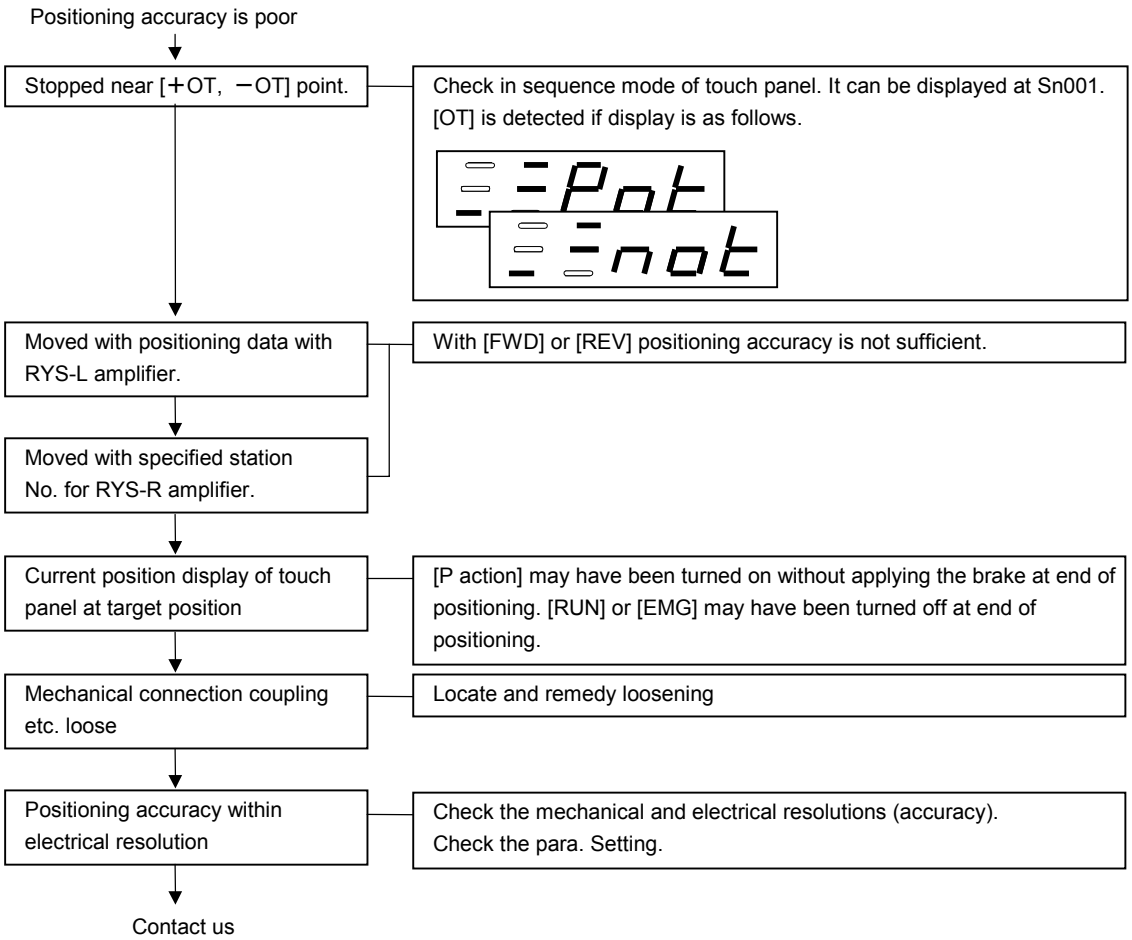
(b) Motor hunting rotation (motor shaft rotates forward/reverse repeatedly)

The amplifier which incorporates a real-time turning function estimates the mechanical equipment system at all times. For the amplifier, the real-time turning function is factory validated.

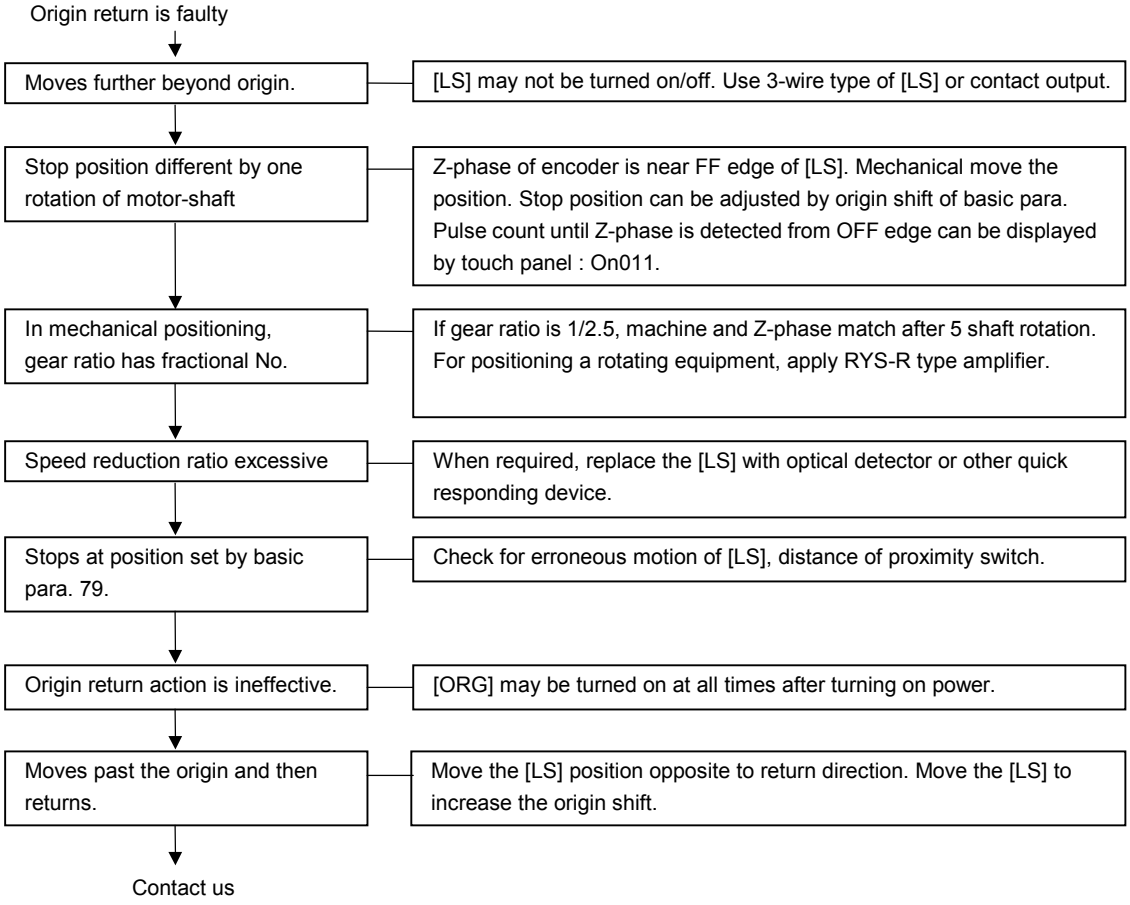
The real-time turning function is valid for mechanical equipment systems except some examples. If it does not work, contact us.



(c) Positioning accuracy is poor



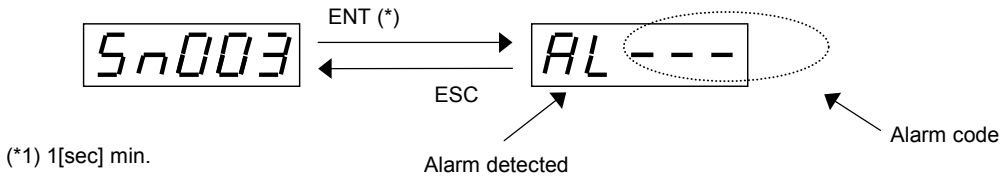
(d) Returning is faulty



(3) Faults with alarm indication

If an alarm is detected, the detected contents are displayed on the touch panel of amplifier.
If multiple alarms are detected simultaneously, light-up occurs in accordance with the priority order given below.

Priority order	Display	Description
1	SE	System error
2	OC	Overcurrent, output overcurrent
3	OS	Overspeed
4	Lu	Low voltage, undervoltage
5	Hu	High voltage, overvoltage
6	Et	Encoder trouble
7	Ct	Circuit trouble, amplifier trouble
8	dE	Data error, memory error
9	CE	Combination error
10	rH2	Resistor heat 2
11	EC	Encoder communication error
12	CtE	Cont (control signal) error
13	OL	Over load, motor overheat
14	AH	Amp heat, amplifier overheat
15	rH	Resistor heat, baking (OB) resistor overheat
16	OF	Over flow, deviation excessive
17	EH	Encoder heat, encoder overheat
18	AL	Absolute data lost
19	AF	Absolute data over flow
20	tE	Terminal error
21	---	(non)



(*1) 1[sec] min.

Remark : An alarm is displayed if detected.
If, at a displayed status, the alarm detection is reset by a control input signal, the initial screen (system para. 89 setting) appears. The alarm detection can be reset in the test running mode [Fn004] also.
Holding down the ∧ key and ∨ key simultaneously for at least 1[sec] at a status where an alarm detection is displayed resets the alarm detection.

(a) Overload, motor overload

• Touch panel display

• Detection (example)

The rms (root-mean-square) value of torque (command value) of motor exceeded the value allowed to the motor (detected by electronic thermal relay built-in amplifier).

• Cause, check and remedy

Overload (OL)

Detected while motor is at standstill.	Power wiring for motor and amplifier may be disconnected. Power wiring may not be connected to U-U, V-V, W-W phases. Check the resistance values.
Display torque value in monitor mode [On003].	
Overload detected while motor is rotating at constant speed.	Overload is detected if monitor value of [On003] exceeds 100 at all times.
Motor dwell time or constant speed running time is short.	Accel./decel. (*) may frequently be repeated and overload may be detected on account of accel. (decel.) torque. • Increase the accel./decel. time • Increase the dwell time If after the above trials, overload is not detected, alarm is attributable to torque at accel./decel.

(b) Absolute data lost

• Touch panel

• Detection (example)

Absolute value data of the 16-bit serial encoder built-in GYC/GYS type motor are lost.

• Cause, check and remedy

This alarm is detected only when ABS (absolute system) is selected by setting of system para. 99.
Use an absolute system upon presetting the current position. This alarm detection cannot be reset by alarm reset [RST] signal.
(i) Mount a battery (WSB-S type) on the amplifier or supply power to the control input/output terminal on CN1.
(ii) Connect the encoder wiring from CN2 to the encoder wires of motor.
The current position information is destroyed if approx. 1[hour] elapses at a status where the encoder wiring is not connected.
(iii) Preset the current position in the test running mode [Fn003].
Executing the position preset simultaneously resets the alarm detection with the current position as set value of basic para. 80.

(*) Accel. : Acceleration, accelerating
Decel. : Deceleration, decelerating

(c) Absolute data over flow

• Touch panel

• Detection (example)

The shaft extension of GYC/GYS type motor rotated beyond the range of −32768 to 0 to +32768 revolutions.

• Cause, check and remedy

On an absolute system, the number of revolutions of the motor shaft extension is limited.
For the alarm resetting method, see (b) above.

(d) Combination error

• Touch panel

• Detection (example)

The combination of connected amplifier and motor is not correct.

• Cause, check and remedy

Use amplifier and motor as a specified pair of model types given in the table below.

Amplifier type	Combinable motor type as a pair		
RYS	(*)	GYS□□□DC1-S	GYC□□□DC1-S
300S3-VVS	(a)		
300S3-VSS	(b)	300	
	(c)	500	
500S3-VVS	(a)	300	
500S3-VSS	(b)	500	
	(c)	101	101
101S3-VVS	(a)	500	
101S3-VSS	(b)	101	101
	(c)	201	201
201S3-VVS	(a)	101	101
201S3-VSS	(b)	201	201
	(c)	401	401
401S3-VVS	(a)	201	201
401S3-VSS	(b)	401	401
	(c)	751	751
751S3-VVS	(a)	401	401
751S3-VSS	(b)	751	751
	(c)	102	102
102S3-VVS	(a)	751	751
102S3-VSS	(b)	102	102
	(c)	152	152
152S3-VVS	(a)	102	102
152S3-VSS	(b)	152	152
	(c)	202	202
202S3-VVS	(a)	152	152
202S3-VSS	(b)	202	202
	(c)	302	302
302S3-VVS	(a)	202	202
302S3-VSS	(b)	302	302
	(c)	402	402
402S3-VVS	(a)	302	302
402S3-VSS	(b)	402	402
	(c)	502	502
502S3-VVS	(a)	402	402
502S3-VSS	(b)	502	502
	(c)		

(*)

(a) : Motor frame No. (size) is one step smaller than optimum frame No. (size).

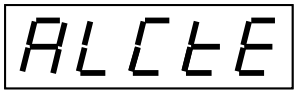
(b) : Motor of same model type as amplifier (optimum frame No. size).

(c) : Motor frame No. (size) is one step larger than optimum frame No. (size).

Refer to (*1) of 2.2 (1) (a).

(e) Cont (control signal) error

• Touch panel display



• Detection (example)

Several control input signal (CONTn) terminals on CN1 of amplifier are assigned to the same signal.

• Cause, check and remedy

RYS □□□S3-VVS type amplifier : System para. 1 to 8 have the same set value.

RYS □□□S3-VSS type amplifier : System para. 1 to 5 have the same set value.

Since several terminals cannot be assigned to the same signal, any one setting should be selected. Forced stop (10), free run (54), external fault input (34) and not specified (0) may be present on several terminals. Several control output terminals can be assigned to the same signal.

Remark : "Cont error" does not occur in case of [CONT] assign valid at all times 1 (2) by system para. 87 and 88, and overlap setting of system para. 1 to 8.

A signal set as [CONT] assign valid at all times is valid at all times.

Do not position the interrupt input (49) to [CONT1 to 8]. If they are positioned to [CONT9 to 13], the "Cont error" is detected.

(f) Low voltage, undervoltage

• Touch panel display

• Detection (example)

The voltage supplied to the amplifier is below the minimum specified level.

• Cause, check and remedy

The supply voltage may have dropped on account of momentary failure, etc. or the power supply capacity may be poor.

Remark : The detection of undervoltage can be invalidated by setting of system para. 85.

If, in this case, free run is selected by setting of system para. 84, the running can be continued at momentary failure.

(g) High voltage, overvoltge

• Touch panel display

• Detection (example)

The DC intermediate voltage in the amplifier is higher than the upper limit.

• Cause, check and remedy

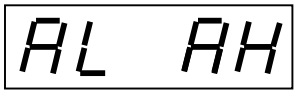
Overvoltage (Hv)

Occurs when turning on power.	Power supply voltage may be higher than specified.
Power capacitor is turned ON/OFF on same line.	Study a use of AC reactor.
Braking resistor is connected.	Study a use of external braking resistor (0.2 [kW] max.).
Braking resistor is free from disconnect.	Check the resistance of braking resistor. For resistance of braking resistor, see 10.6.

Contact us

(h) Amp heat, amplifier overheat

• Touch panel display



• Detection (example)

The temperature of cooling-fins of the amplifier is above 100 [°C]

• Cause, check and remedy

The ambient temperature for the amplifier should be below +55 [°C]

(i) Encoder communication error

• Touch panel display

• Detection (example)

The communication is not made between 16-bit serial encoder and amplifier.

• Cause, check and remedy

The encoder wiring may be detached or disconnected.

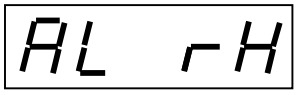
The serial communication is performed at 4[Mbps] of data rate. Do not extend the wiring by connecting several short cables.

Connect the encoder by option cable or specified cables.

The encoder wiring has about 5[V] of voltage amplitude. Do no install it in a location where a strong electric or magnetic field exists.

(j) Resistor heat, braking (OB) resistor overheat

• Touch panel display



• Detection (example)

The heating power of the braking resistor of amplifier exceeded a specified value.

• Cause, check and remedy

If an alarm is detected immediately after turning on power, the power supply voltage may be higher than specified.
If detected while running, the frequency of braking operation may be high, and the braking resistor may overheat. In such a case,
• use an external braking resistor,
• prolong the accel./decel. time. or
• raise the reduction speed ratio, if possible.

(k) Over flow, deviation excessive

• Touch panel display

• Detection (example)

Deviation quantity (difference between the command position and current position after feedback) exceeded the set value of basic para. 54.

• Cause, check and remedy

The initial set value of basic para. 54 is 10000 (x100) [pulse].
If the difference between commanded position and current position after feedback exceeds 1,000,000 [pulse], an alarm is detected.
Under normal operating conditions, the deviation quantity increases in proportion to the motor speed.
If an alarm is detected when rotating the motor by turning on the [RUN], the motor power wiring phases U, V, W may not be connected to the corresponding terminals (U, V, W) of the amplifier.
The set value of basic para. 54 need not be decreased.
The deviation can be reduced by setting the feed forward of basic para. 40 to near 1.000.

(l) Other protection functions

If following alarms appeared, contact us.

(i) Encoder heat, encoder overheat

• Touch panel display

• Detection (example)

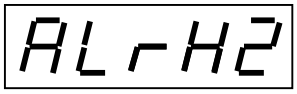
The temperature of encoder exceeded a specified value.

• Cause, check and remedy

The ambient temperature for the motor should be 40 [°C] max.
If an alarm appeared before running such as immediately after turning on power, contact us.

(ii) Resistor heat 2

• Touch panel display



• Detection (example)

The regenerative power processing transistor mounted on the amplifier overheats.

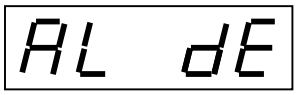
• Cause, check and remedy

The ambient temperature of amplifier should be 55 [°C] max.

If an alarm appeared before running such as immediately after turning on power, contact us.

(iii) Data error, memory error

• Touch panel display



• Detection (example)

Contents of the non-volatile storage memory mounted on the amplifier are destroyed.

• Cause, check and remedy

If an alarm appeared immediately after turning on power, contact us.

(iv) Circuit trouble, amplifier trouble

• Touch panel display

• Detection (example)

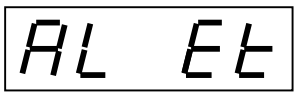
The control power supply circuit mounted on the amplifier is abnormal.

• Cause, check and remedy

If an alarm appeared immediately after turning on power, contact us.

(v) Encoder trouble

• Touch panel display



• Detection (example)

The encoder may be broken.

• Cause, check and remedy

If an alarm appeared immediately after turning on power, contact us.

(vi) Over current, output overcurrent

• Touch panel display

• Detection (example)

The output current from the amplifier to the motor exceeded a specified value.

• Cause, check and remedy

The power wiring to the motor is short-circuited or grounded.

As a general rule, minimum insulation resistance between motor terminals and ground (earth) terminal (symbol "E" or " ⏚ ") is about 1 [MΩ] at room temperature.

The motor winding resistance value between each phase, at room temperature, is given on the table below.

Motor type	GYS□□□DC1			GYC□□□DC1			
	101	201	401	101	201	401	751
Resistance value between phases [Ω]	4.6	2.2	0.72	7.2	4.1	1.8	0.68

9.4 Items to specify when faulty

If an alarm appeared, remedy it referring to 9.3.

When contacting us, specify the following items.

(a) Data on rating plate : Type, serial equipment No.

(b) Device configuration : Example, type of external braking resistor etc.

(c) Outline of mechanical equipment system driven by motor : Example, ball-screw feed, vertical drive, reduction speed ratio 1/2

(d) Fault contents

(i) Running duration (years)

(ii) Alarm occurrence frequency, conditions : Example, when a certain device operates, the motor steps

(iii) Alarm display contents

(iv) Whether reproducible

(v) While accelerating, rotating at constant speed or decelarating

(vi) Whether different between forward and reverse rotation of motor

(vii) Whether at particular conditions : Example, when [RUN] signal has been turned on. When advancing mechanical-table has come to a particular position.

(viii) Whether trouble persists even after replacing the machine or amplifier with one of the same specification

9.5 Others informations

(1) Operating conditions : Refer to 3.

(a) Power-on

> ⚠ **CAUTION**
>
> **Do not touch the amplifier when the commercial power is supplied. Otherwise, there is a risk of electric shock.**

(b)Specifications : Refer to 2.

(c) Operation

Do not repeatedly turn on and off the power supply to start and stop the motor.

(d) Radio noise : Refer to 3.2 (1) (b) (iv) and 10.4

The amplifier and motor are not protected from radio noise. Therefore, following devices may receive noises:

• AM radios near the amplifier or motor

• Wired broadcst, etc. near the wiring

• Measuring instruments or household appliances

(2) Expected-service-life

(a) Motor

The motor bearings should be replaced with new ones, when required. If the bearings produce unusual noise, replace bearings.
The motor incorporates (built-in) encoder, etc. Therefore, inquire us for how to repalce the bearings.

(b) Cooling fan built-in motor and amplifier

The expected-service-life of the fan will be approx. 20,000 [hour].

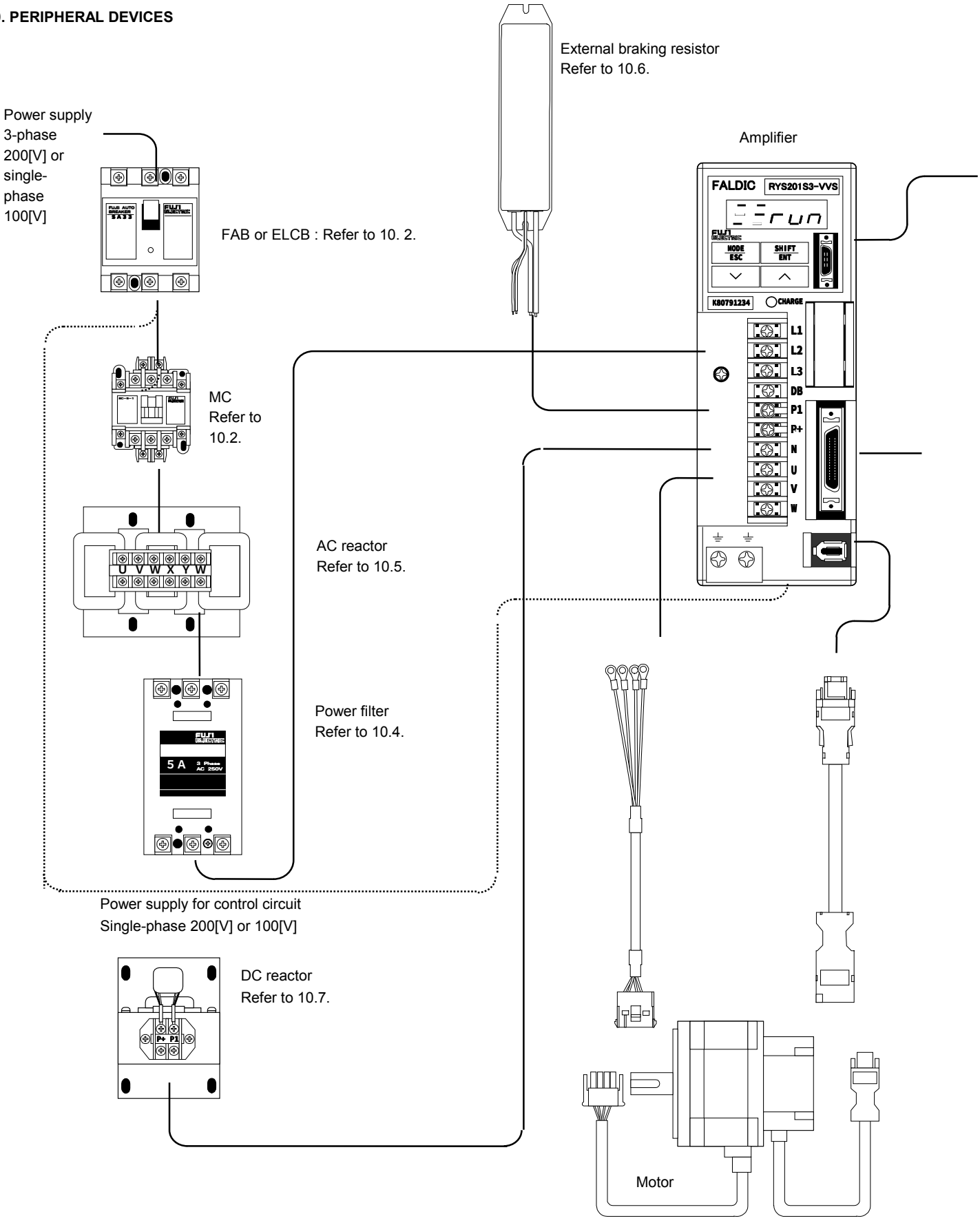
(c) Brake built-in motor

The expected-service-life will be approx. 20,000 operations at rated torque.

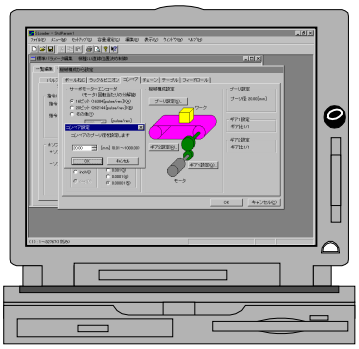
(d) Capacitor built-in amplifier

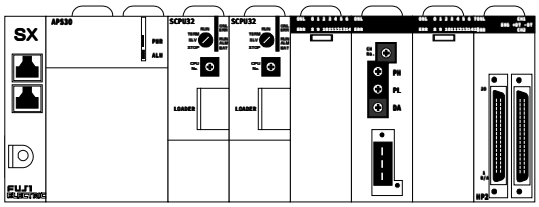
The amplifier incorporates large capacitors. Contact us when a replacement with new one is required.

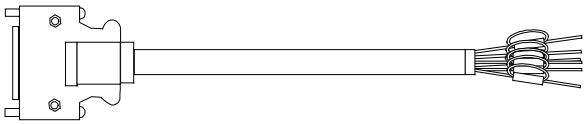
10. PERIPHERAL DEVICES



Personal computer loader







Optional cables
Refer to 10.8.

Programmable logic controller (PLC)
MICREX-SX
MICREX-F
FREX-PC

10.1 Cables

Power supply and control circuit cables in the internal of the control panels are as follows :

(1) Power supply and motor input cables

(a) Cable size

Input voltage class [V]		100	200			
Amplifier output [kW]		0.05 to 0.2	0.03 to 0.4	0.75 to 1.5	2, 3	4, 5
Amplifier type RYS□□□S3-		VVS6	VVS			
		500 to 201	300 to 401	751 to 152	202, 302	402, 502
Conductor sectional area of cable [mm^2]	Power supply, motor input, ground (earth)	1.25		2	3.5	5.5
	Brake	1.25				
	Power supply for control	0.75				

(b) Cable type

(i) 600V class, poly-vinyl insulated cable (JIS C 3307) or

(ii) Poly-vinyl insulated cable “KIV” (JIS C 3316) or

(iii) 600V class, cross-link polyethylene insulated cable “FSCL” (JCS 360)

or equivalent

(2) Control input/output cables for CN1 : + 24 [V], 50 [mA] max.

(a) Cable size

18-core twisted-pair shielded cable. AWG No.26

(b) Cable type

“XEBV” or “XEWV” (The Furukawa Electric Co. , Ltd.) or equivalent

(3) Host interface for CN3

(a) Digital input/output and analog signal cable : Same as (2) above.

(b) T-link, JPCN-1 and SX bus : Specified cables should be applied.

(4) Encoder cables for CN2 (4Mbps serial communication)

Cross-link polyethylene insulated, poly-vinyl sheath cables RMCV-SV type :

Wiring length within	Cable size and pair, core quantities (∗)
10 [m]	AWG No.25 / 4-pair and AWG No.23 / 2-core
50 [m]	AWG No.25 / 4-pair and AWG No.17 / 2-core

or optional cable : See 10.8.

(∗) AWG : Refer to Remark of 4.3 (2) (d).

10.2 Auto circuit breaker (FAB, MCCB), earth leakage circuit breaker (ELCB) and magnetic contactor (MC) : Recommended Fuji's type

FAB or ELCB is installed on the power supply side for turning power supply and promptly cutting off a fault current such as short-circuit current. MC is used when amplifiers are disconnected from the power supply with an external signal or in the case of power ON/OFF from remote operation panels.

The types are applicable to the power supply capacity is up to 500 [kVA], specified cable diameter size with the wiring length within 20 [m] is used, and ON/OFF of the primary side of one amplifier is performed. Connect an AC reactor if the power supply capacity exceeds 500 [kVA].

(i) For 200[V] class input voltage of amplifier

Amplifier output				[kW]	0.03 to 0.2	0.4	0.75 to 1.5	2	3	4, 5
Amplifier type				RYS□□□S3-VVS	300 to 201	401	751 to 152	202	302	402, 502
Fuji's Recommended type	For each amplifier	FAB	type	SA	33B/5	33B/10	33B/15	53B/30	53B/40	33B/50
			current	[A]	5	10	15	30	40	50
		ELCB type		EG	33B/5	33B/10	33B/15	53B/30	53B/40	53B/50
	MC type			SC-	5-1(19A)			5-1 (32A)	1N (50A)	2N (60A)

(ii) For 100[V] class input voltage of amplifier

Amplifier output				[kW]	0.05	0.1	0.2
Amplifier type				RYS□□□S3-VVS6	500	101	201
Fuji's Recommended type	For each amplifier	FAB	type	SA	33B/3	33B/5	33B/10
			current	[A]	3	5	10
		ELCB type		EG	33B/3	33B/5	33B/10
	MC type			SC-	5-1(32A)		

10.3 Surge suppressor (surge killer)

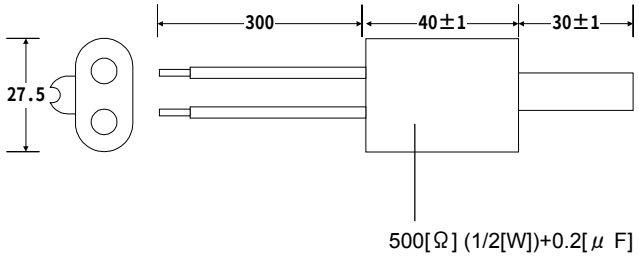
Shown below are recommended surge suppressors (for 250 [V] or less) to be installed on peripheral devices (magnetic contactor, solenoid, brake, etc.) of amplifier.

DC equipment should be equipped with a diode for surge voltage suppression.

[unit : mm]

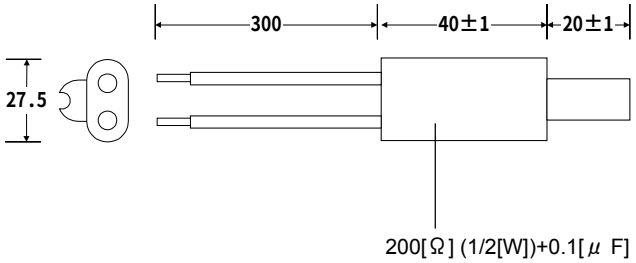
For magnetic contactor, etc.

Type : S2-A-O



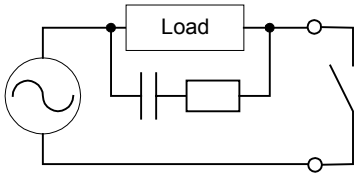
For control relay, etc.

Type : S1-B-O

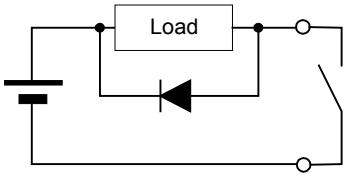


Protection circuit, example

AC circuit (C-R circuit)



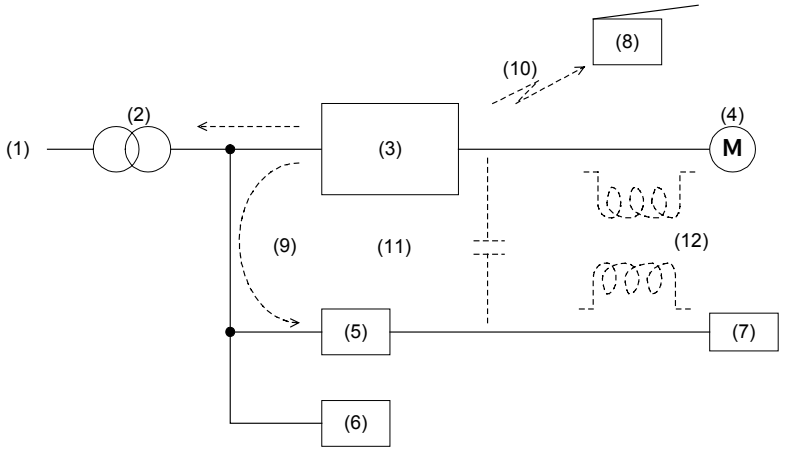
DC circuit (diode)



10.4 Power filter

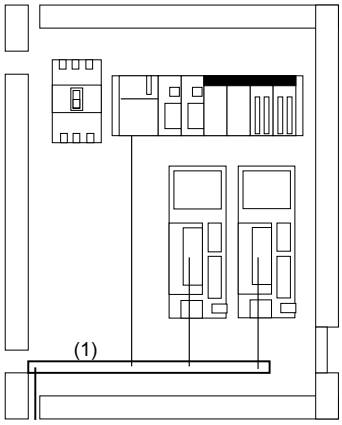
Power filter is installed to prevent the PWM circuit in amplifier from exerting influence over the power supply side.

In the amplifier, the PWM circuit performs high frequency switching. This causes power line noise, radiation noise from the amplifier and noise from the motor power cable, and these noises may have an adverse influence over external equipment. To prevent such an influence, the following methods are available. Refer to figure below.



(1) Power supply
(2) Power transformer
(3) Amplifier
(4) Motor
(5) Measuring instrument
(6) Electronics device
(7) Sensor
(8) Radio
(9) Power line noise
(10) Radiation noise
(11) Electrostatic induced noise
(12) Electromagnetic induced noise

(a) Installation of amplifier in a grounded steel container. Avoid close installation with personal computer and measuring instrument.
(b) Installation of power filter at primary side of amplifier to prevent : PWM from exerting influence over power source.
(c) Install the cable from each amplifier to motor in a grounded metal conduit.
(d) Minimize the distance of ground connection by using a larger size copper bar. Ground connection should be wiried to each equipment separately. See figure below.



(1) Copper bar

(e) Avoid mutual connection of the following cables.
(i) Ground : Power system and frame (enclosure)
(ii) + 24 [V] DC for control input/output and 0 [V] of power supply
(iii) 0 [V] power supply : Speed command and encoder
(f) Avoid binding together the 200 [V] power supply and amplifier output cable, + 24/+ 15 [V] DC control signal cable and encoder cable or laying them in parallel.
(g) Separate 200 [V] power source with that of 100 [V]-system device by use of an insulating transformer : Fuji “TRAFY”, etc. .

Input voltage class [V]	100		200				
Amplifier output [kW]	0.05, 0.1	0.2	0.03 to 0.2	0.4	0.75 to 2	3	4, 5
Amplifier type RYS□□□S3-	VVS6		VVS				
	500, 101	201	300 to 201	401	751 to 202	302	402, 502
Power filter type FHF-TA/	5/250	10/250	5/250	10/250	20/250	30/250	50/250

10.5 AC reactor (reactor for impedance matching)

(1) AC reactor application

Provide and connect an AC reactor in any of the following cases.

(a) Power supply capacity is large

When the power supply capacity exceeds 500 [kVA] (*), the input current of the amplifier becomes large at the time of power on, and there is a possibility where the rectifying diodes of the amplifier are damaged.

Note : (*) Cable length of 20 [m] with specified cable diameter size.

(b) Power supply voltage is unbalanced

Connect an AC reactor if the power supply voltage unbalance rate is 3 % or higher.

$$\text{Unbalance rate of power supply voltage [\%]} = \frac{\text{Max. voltage [V]} - \text{Min. voltage [V]}}{3-\text{phase average voltage [V]}} \times 100$$

(c) Suppression of higher harmonics

Higher harmonics current is generated because an amplifier is of capacitor input type.

AC reactor suppresses voltage distortion in the power supply system.

(2) Connection

Connect an AC reactor to the primary (power supply) side of the amplifier.

Input voltage class [V]	100		200					
Amplifier output [kW]	0.05, 0.1	0.2	0.03 to 0.2	0.4	0.75	1, 1.5	2, 3	4, 5
Amplifier type RYS□□□S3-	VVS6		VVS					
	500, 101	201	300 to 201	401	751	102, 152	202, 302	402, 502
AC reactor type ACR2-	0.4A	0.75A	0.4A	0.75A	1.5A	2.2A	3.7A	5.5A

10.6 External braking resistor : External dimension : Refer to 10.8 (3)

A braking resistor is provided (built-in) with the amplifier for 0.2[kW] over.

However, if load variation is wide, elevation (hoisting) load, or higher frequent operation, the following external braking resistor should be added.

(1) Data of external braking resistor

Input voltage class [V]		100		200					
Amplifier output [kW]		0.05, 0.1	0.2	0.03 to 0.2	0.4	0.75	1, 1.5	2, 3	4, 5
Amplifier type RYS□□□S3-		VVS6		VVS					
		500, 101	201	300 to 201	401	751	102, 152	202, 302	402, 502
Resistor	type			WSR-401		WSR-751	WSR-152	DB11-2	DB22-2
	(**) [W]	17		17		25	75	115	130
Resistance [Ω]		27		68		15		10	5.8
Built-in resistor (**) [W]		Not applicable	12	Not applicable	12		20	30	60
[Ω]			27		68	33	18	9	5.5

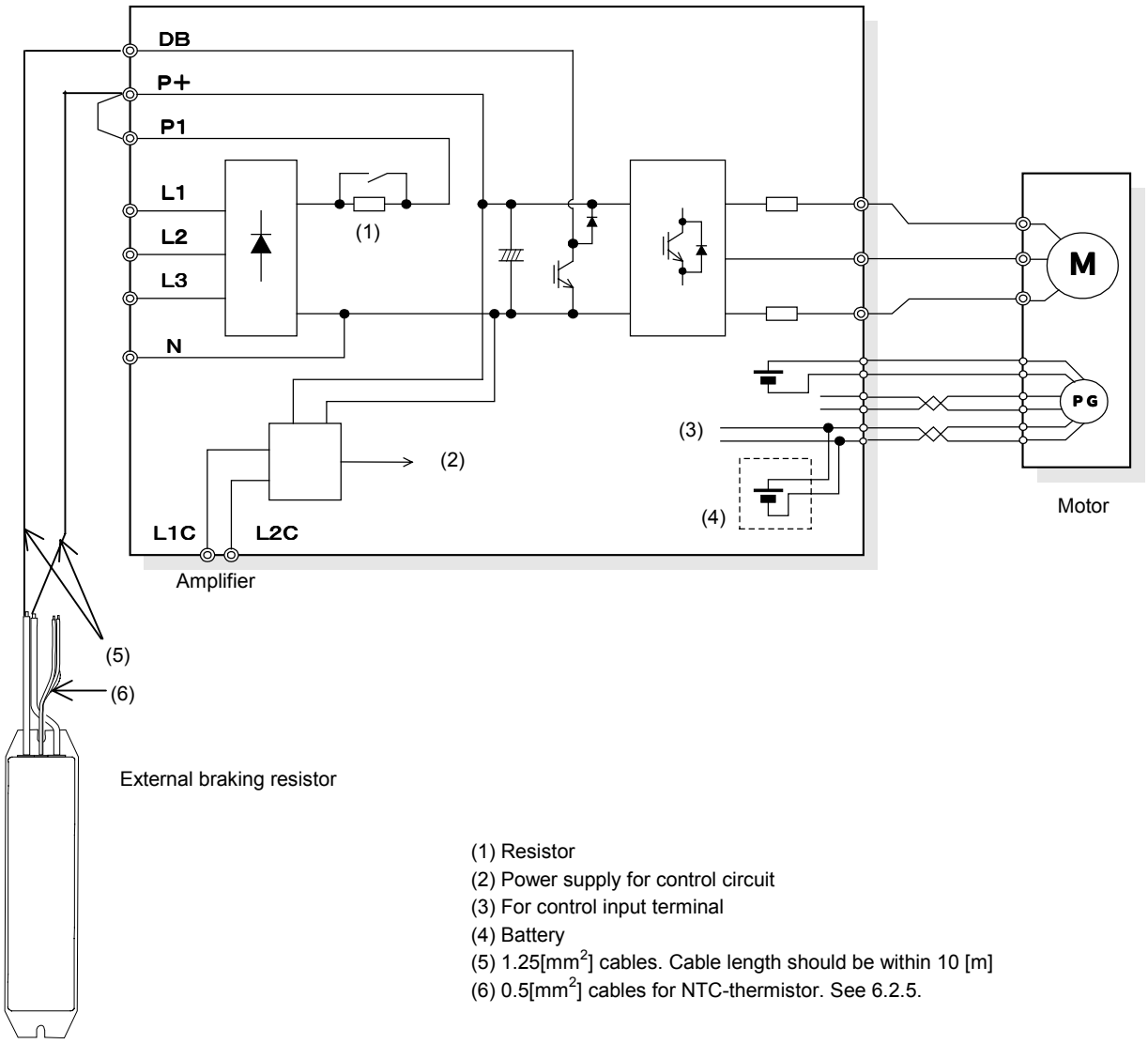
Note : (**) Cont. : Continuous operation duty at 25[**℃**], allowable

(2) Data of NTC-thermistor embedded in the external braking resistor

Resistor type WSR-	Open circuited the thermistor at the following temperature [**℃**]	Withstand AC voltage tested for one minute [kV]	Contact capacity DC
401	135 ± 5	1.5	30 [V], 3 [A]
751		2.5	
152	150 ± 10		

(3) External braking resistor connection

Terminal assignment : see 6.3.3.



(1) Resistor
(2) Power supply for control circuit
(3) For control input terminal
(4) Battery
(5) 1.25[mm^2] cables. Cable length should be within 10 [m]
(6) 0.5[mm^2] cables for NTC-thermistor. See 6.2.5.

10.7 DC reactor

(1) DC reactor application

Provide and connect an DC reactor in any of the following cases.

(a) Power supply capacity is large

When the power supply capacity exceeds 500 [kVA] (*), the input current of the amplifier becomes large at the time of power on, and there is a possibility where the rectifying diodes of the amplifier are damaged.

Note : (*) Cable length of 20 [m] with specified cable diameter size.

(b) Power supply voltage is unbalanced

Connect an DC reactor if the power supply voltage unbalance rate is 3% or higher.

$$\text{Unbalance rate of power supply voltage [\%]} = \frac{\text{Max. voltage [V]} - \text{Min. voltage [V]}}{\text{3 - phase average voltage [V]}} \times 100$$

(c) Suppression of higher harmonics

Higher harmonics current is generated in the amplifier.

DC reactor suppresses voltage distortion in the power supply system.

(2) Connection

Connect an DC reactor to the primary (power supply) side of the amplifier.

Input voltage class [V]	100			200								
Amplifier output [kW]	0.05	0.1	0.2	0.03 to 0.1	0.2	0.4	0.75	1, 1.5	2	3	4	5
Amplifier type RYS□□□S3-	VVS6			VVS								
	500	101	201	300 to 101	201	401	751	102, 152	202	302	402	502
DC reactor type DCR2-	0.2	0.4	0.75	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11
Inductance [mH]	20	12	7	20	12	7	4	3	1.7	1.2	0.8	0.6

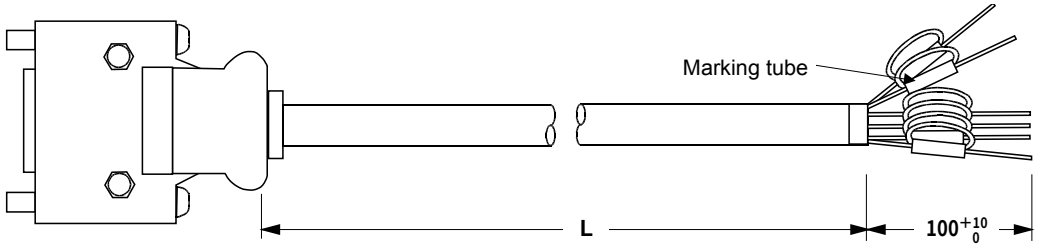
10.8 Optional cables, connector kits, battery and external braking resistors

(1) Connecting cables [unit : mm]

(a) Control input/output (expanded I/O of L and R types)

Cable type : WSC-D20P03 (20-pin)

Application : CN3 of RYS□□□S3-LPS, RPS amplifier



(i) Connector : CN1

Plug	10120-3000V
Shell	10320-52A0-008

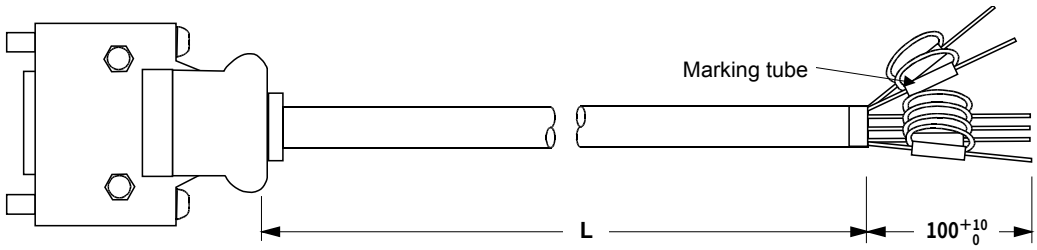
(ii) Wire color

Pin No. for CN1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Marking tube	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Wire color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink	
Marking	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2

(iii) Cable length (L) and mass

Cable type	L [mm]	Mass [g]
WSC-D20P03	3000^{+300}_{0}	400

(b) Control input/output (SX bus)
Cable type : WSC-D26P03 (26-pin)
Application : CN1 of RYS□□□S3-VSS, LSS, RSS amplifier



(i) Connector : CN1

Plug	10126-3000V
Shell	10326-52A0-008

(ii) Wire color

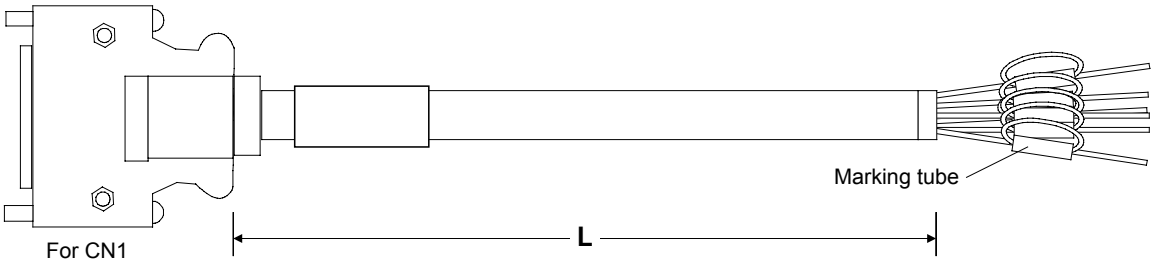
Pin No. for CN1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Marking tube	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Wire color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink	
Marking	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2

Pin No. for CN1	21	22	23	24	25	26
Marking tube	21	22	23	24	25	26
Wire color	Orange		Gray		White	
Marking	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3

(iii) Cable length (L) and mass

Cable type	L [mm]	Mass [g]
WSC-D26P03	3000^{+300}_{0}	450

(c) Control input/output (V type)
Cable type : WSC-D36P03 (36-pin)
Application : CN3 of RYS□□□S3-VSS, LPS, RPS amplifier



(i) Connector : CN1

Plug	10136-3000V
Shell	10336-52A0-008

(ii) Wire color

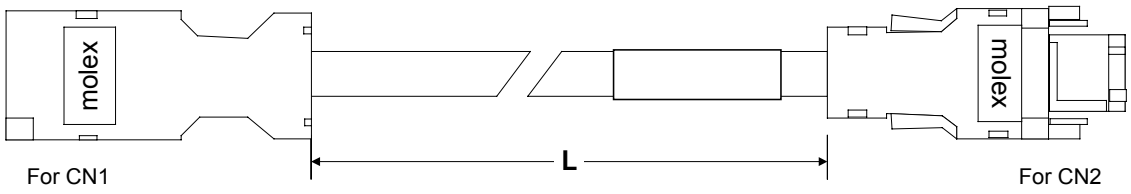
Pin No. for CN1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Marking tube	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Wire color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink	
Marking	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2

Pin No. for CN1	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Marking tube	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Wire color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White	
Marking	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3	Red 4	Black 4	Red 4	Black 4	Red 4	Black 4

(iii) Cable length (L) and mass

Cable type	L [mm]	Mass [g]
WSC-D36P03	3000^{+300}_{0}	550

(d) Encoder cable
Cable type : WSC-P06P05, P06P10 and P6P20



(i) Connector
1) CN1

Housing		53988 - 0611
Socket	shell cover	58300 - 0600
	mold cover	53989 - 0605
		53990 - 0605
Cable clamp		53303 - 0000
Clamp screw		59832 - 0009

2) CN2 (5 or 10 [m] cable length)

Housing		51145 - 0601
Terminal		50639 - 8091
Plug Shell	cover	58098 - 0600
	body	58099 - 0600
Cable clamp		54017 - 0615
Clamp screw		54018 - 0605

3) CN2 (20 [m] cable length)

Plug	housing	54180 - 0611
	shell cover	58299 - 0600
	shell body	58300 - 0600
	mold cover	54181 - 0615
		54182 - 0605
Cable clamp		58303 - 0000
Clamp screw		59832 - 0009

(ii) Wire color

Pin No. for	CN1	1	2	3	4	5	6
	CN2	1	2	3	4	5	6
Wire color		Red	Black	Orange	Orange / White	Sky blue	Sky blue / White
	or	White	Black	Yellow	Brown	Red	Blue

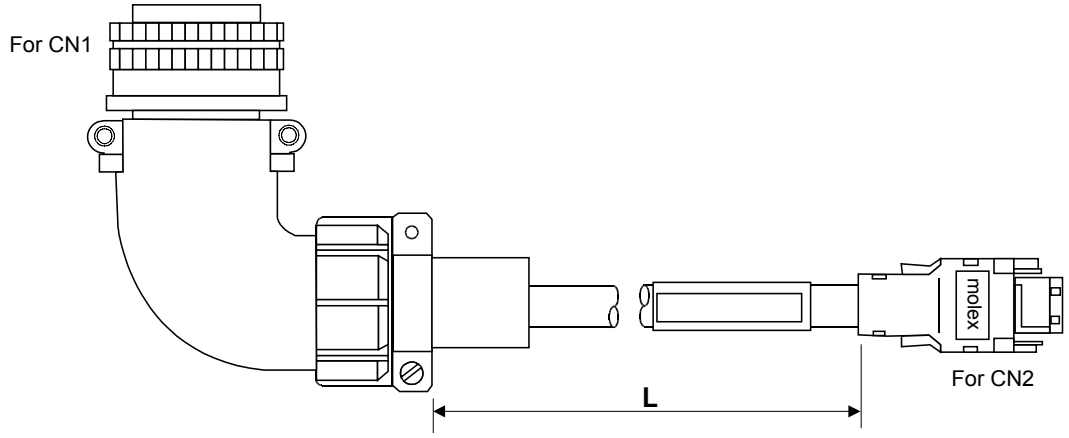
(iii) Cable length (L) and mass

Cable type		L [mm]	Mass [g]
WSC-P06	P05	5000^{+500}_{0}	300
	P10	10000^{+1000}_{0}	500
	P20	20000^{+2000}_{0}	1200

CAUTION

Do not extend the wiring distance by connecting two or more encoder wiring cables.
A voltage drop by contact resistance of connerctor may stop the operation abruptly.

(e) Encoder cable
Cable type : WSC-P06P05-C, P06P10-C and P06P20-C



(i) Connector

1) CN1

Connector	MS3108B20 - 29S
Cable clamp	MS3057 - 12A

2) CN2

Plug	housing	54180 - 0611
	shell cover	58299 - 0600
	shell body	58300 - 0600
	mold cover	54181 - 0615
		54182 - 0605
Cable clamp		58303 - 0000
Clamp screw		59832 - 0009

(ii) Wire color

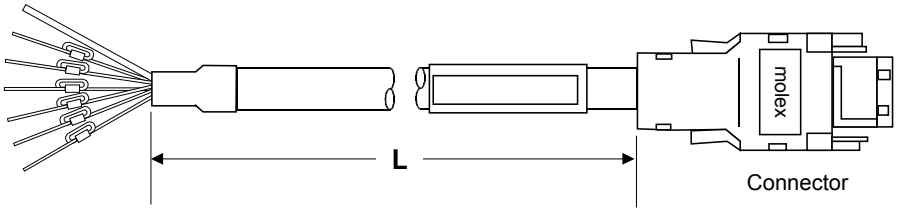
Pin No. for	CN1	H	G	T	S	C	D
	CN2	1	2	3	4	5	6
Wire color		Red	Black	Orange	Orange / White	Sky blue	Sky blue / White
	or	White	Black	Yellow	Brown	Red	Blue

(iii) Cable length (L) and mass

Cable type		L [mm]	Mass [g]
WSC-P06	P05-C	5000^{+500}_{0}	450
	P10-C	10000^{+1000}_{0}	650
	P20-C	20000^{+2000}_{0}	1400

(f) Encoder cable

Cable type : WSC-P06P05-W to WSC-P06P20-W



(i) Connector

Housing	54180 - 0611
Plug shell cover	58299 - 0600
	58300 - 0600
Cable clamp	54181 - 0615
Clamp screw	54182 - 0605

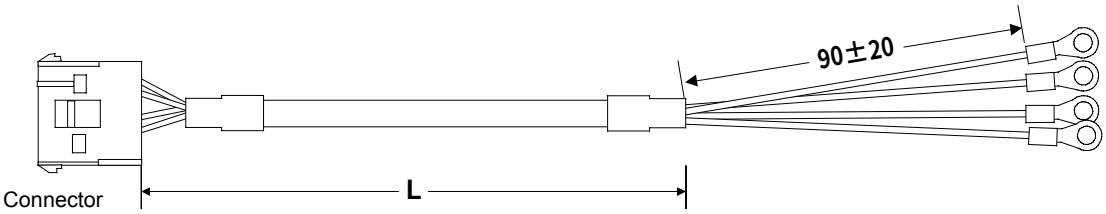
(ii) Wire color

Marking tube		P5	M5	BAT+	BAT−	SIG+	SIG−
Pin No. for CN2		1	2	3	4	5	6
Wire color		Red	Black	Orange	Orange / White	Sky blue	Sky blue / White
	or	White	Black	Yellow	Brown	Red	Blue

(iii) Cable length (L)

Cable type		L [mm]
WSC-P06	P05-W	5000^{+500}_{0}
	P10-W	10000^{+1000}_{0}
	P20-W	20000^{+2000}_{0}

(g) Motor power cable for motor without providing brake
Cable type : WSC-M04P05, M04P10 and M04P20
Application : 0.75 [kW] and below

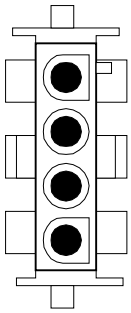


(i) Connector

Cap housing	350780 - 1
Socket	350570 - 1

(ii) Wire color

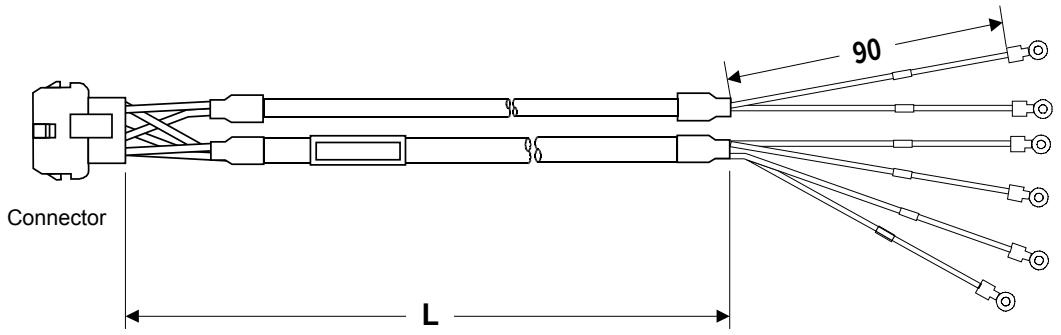
Pin No. for CN1	1	2	3	4
Marking	U	V	W	E
Cable color	Red	White	Black	Green / Yellow



(iii) Cable length (L) and mass

Cable type		L [mm]	Mass [g]
WSC-M04	P05	5000^{+500}_{0}	700
	P10	10000^{+1000}_{0}	1700
	P20	20000^{+2000}_{0}	2700

(h) Motor power cable for motor with providing brake
Cable type : WSC-M06P05 to WSC-M06P20
Application : 0.75 [kW] and below



(i) Connector

Cap housing	350781 - 1
Socket	350570 - 1

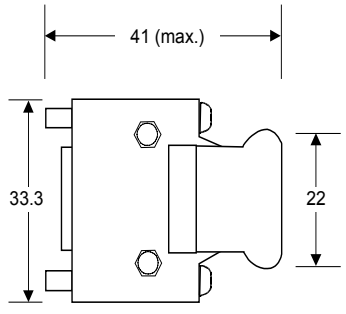
(ii) Wire color

Pin No. for CN1	1	2	3	4	5	6
Marking	U	V	W	E		
Wire color	Red	White	Black	Green / Yellow	Red	Black

(iii) Cable length (L) and mass

Cable type		L [mm]	Mass [g]
WSC-M06	P05	5000^{+500}_{0}	900
	P10	10000^{+1000}_{0}	1750
	P20	20000^{+2000}_{0}	3400

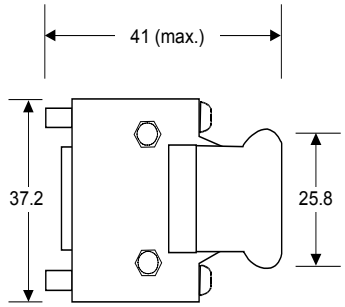
(2) Connector kits [unit : mm]
(a) Control input/output (expanded I/O for L, R types)
Connector kit type : WSK-D20P (20-pin)
Application : CN1 of RYS□□□S3-LPS, RPS amplifier



Plug	10120 - 3000VE
Shell kit	10320 - 52A0 - 008

Mass : 20 [g]

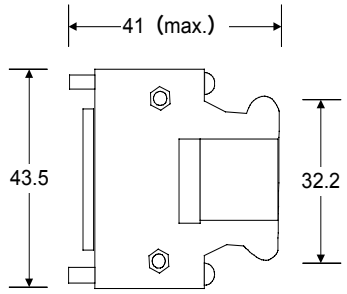
(b) Control input/output (SX bus)
Connector kit type : WSK-D26P (26-pin)
Application : CN1 of RYS□□□S3-VSS, LSS, RPS amplifier



Plug	10126 - 3000VE
Shell kit	10326 - 52A0 - 008

Mass : 20 [g]

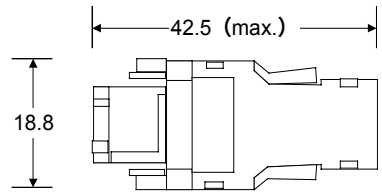
(c) Control input/output (V type)
Connector kit type : WSK-D36P (36-pin)
Application : CN1 of RYS□□□S3-VVS, LPS, RPS amplifier



Plug	10136 - 3000V
Shell kit	10336 - 52A0 - 008

Mass : 20 [g]

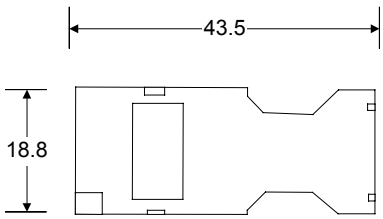
(d) Encoder
Connector kit type for amplifier side (CN2) : WSK-P06-M



Mass : 10 [g]

Housing	54180 - 0611
Shell cover	58299 - 0600
	58300 - 0600
Mold cover	54181 - 0615
	54182 - 0605
Cable clamp	58303 - 0000
Clamp screw	59832 - 0009

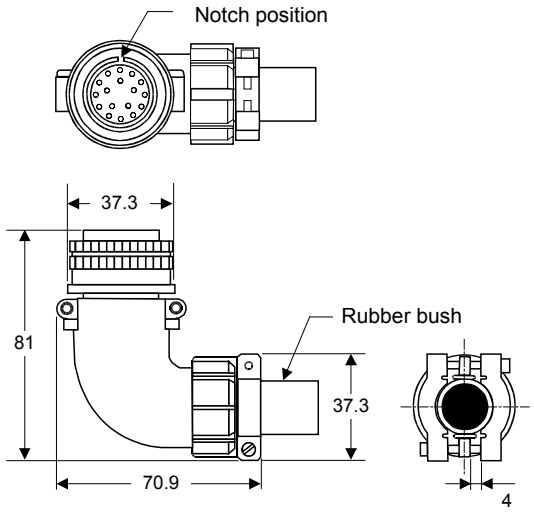
(e) Encoder
Connector kit type for motor side (CN2) : WSK-P06P-F
Application : 0.75[kW] and below



Mass : 10 [g]

Housing	53988 - 0611
Shell baby, clamp side	58302 - 0600
Mold cover, latch side	53989 - 0605
Mold cover	53990 - 0605
Cable clamp	58303 - 0000
Clamp screw	59832 - 0009

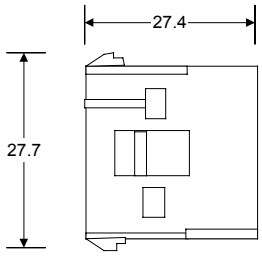
(f) Encoder
Connector kit type for motor side (CN2) : WSK-P06P-C
Application : 1 [kW] and above



Connector	MS3108B20 - 29S
Cable clamp	MS3057 - 12A

Mass : 150 [g]

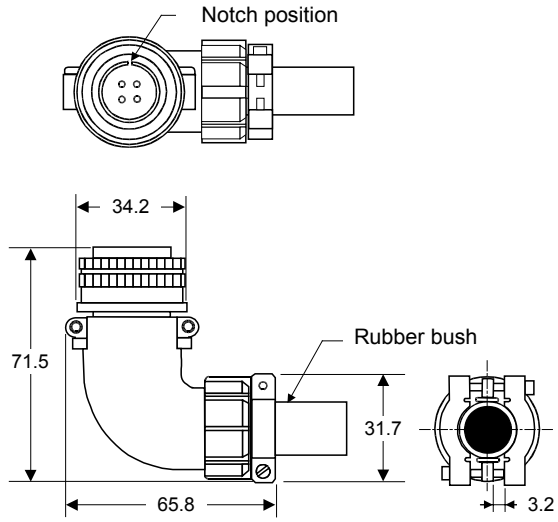
(g) Motor power for motor without providing brake
Connector kit type : WSK-MO4 (4-pin)
Application : 0.75 [kW] and below



Cap	350780 - 1
Shell body, clamp side	350570 - 1 or 350689 - 3

Mass : 10 [g]

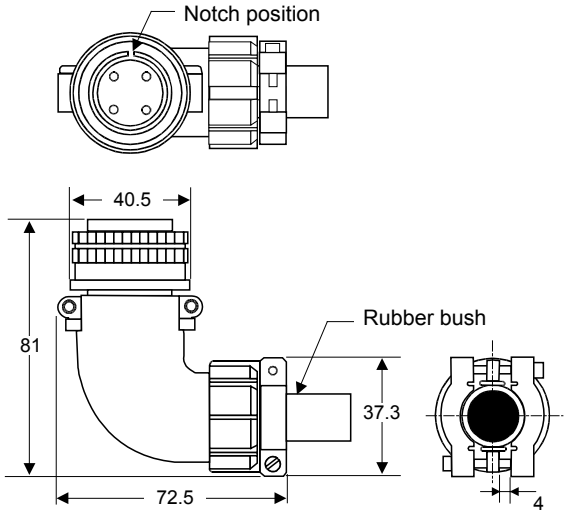
(h) Motor power for motor without providing brake
Connector kit type : WSK-M04P-CA (4-pin)
Application : GYS type motor 1 and 1.5 [kW]



Connector	MS3108B18 - 10S
Cable clamp	MS3057 - 10A

Mass : 100 [g]

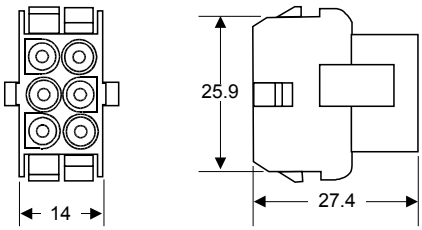
(i) Motor power for motor without providing brake
Connector kit type : WSK-M04P-CB (4-pin)
Application : GYC type motor 1 [kW] and above



Connector	MS3108B22 - 22S
Cable clamp	MS3057 - 12A

Mass : 150 [g]

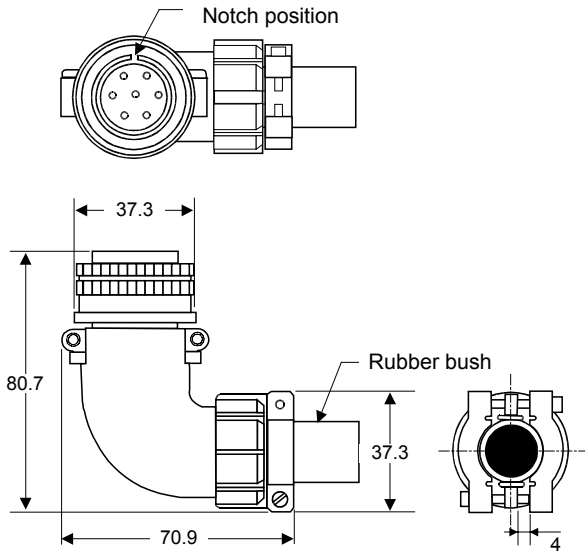
(j) Motor power for motor with providing brake
Connector kit type : WSK-M06P (6-pin)
Application : 0.75 [kW] and below



Cap housing	350781 - 1
Socket	350570 - 1

Mass : 10 [g]

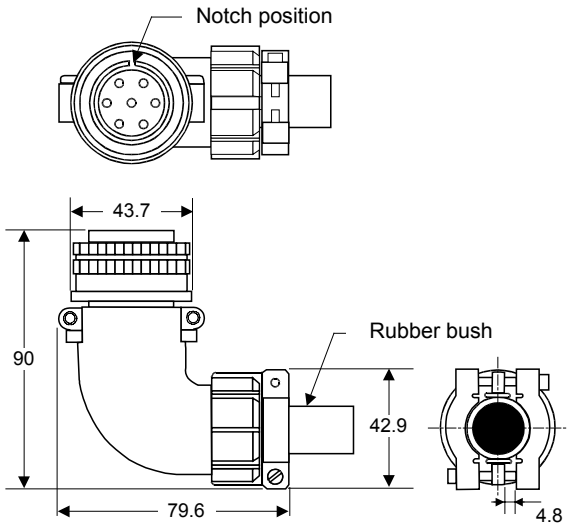
(k) Motor power for motor with providing brake
Connector kit type : WSK-M06P-CA (6-pin)
Application : GYC type motor 1 and 1.5 [kW]



Connector	MS3108B20 - 15S
Cable clamp	MS3057 - 12A

Mass : 150 [g]

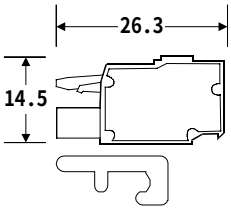
(λ) Motor power for motor with providing brake
Connector kit type : WSK-M06P-CB (6-pin)
Application : GYS type motor 1 [kW] and above



Connector	MS3108B24 - 10S
Cable clamp	MS3057 - 16A

Mass : 200 [g]

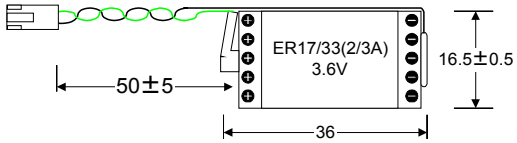
(m) Control power input
Connector kit type : WSK-LO2P
Application : 0.75[kW] and below



Connector	231702/026 - 000
Manual lever	231 - 131

Mass : 4 [g]

(n) Battery
Connector kit type : WSB - S



Battery	ER1733WK41 1PP

- Nominal voltage : 3.6 [V]
- Capacity : 1500 [mAh]

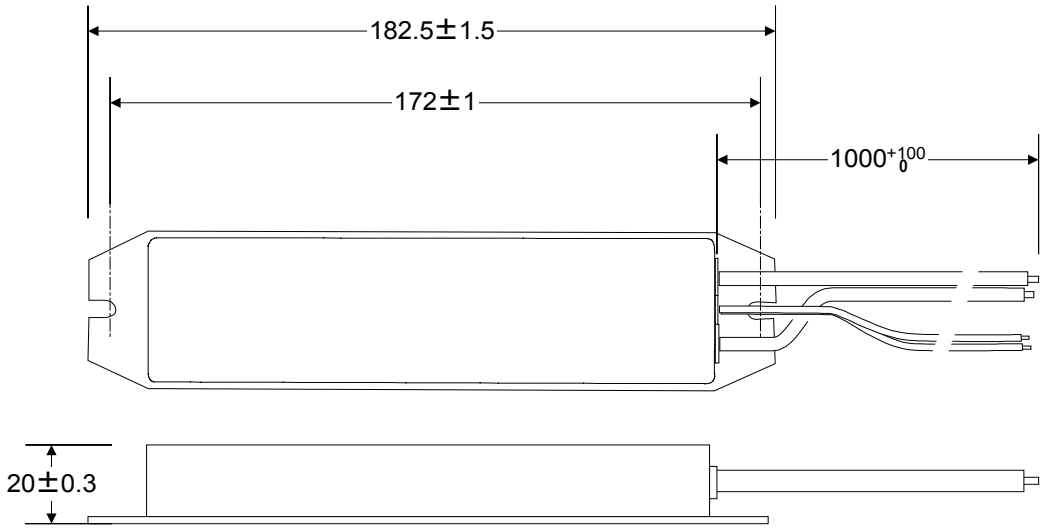
Refer to 6.3.

Storage of battery
If a battery has been out of service for long-term, the following procedures should be followed.
Battery should be stored in the storeroom. The storeroom should be well ventilated, and selected for possible protection against temperature and moisture.
Surrounding condition should be kept within－10 to + 75 [**℃**] temperature and 10 to 90[%]RH humidity.
Storage term should be within two years.

(3) External braking resistor [unit : mm]

(a) Resistor type : WSR-401

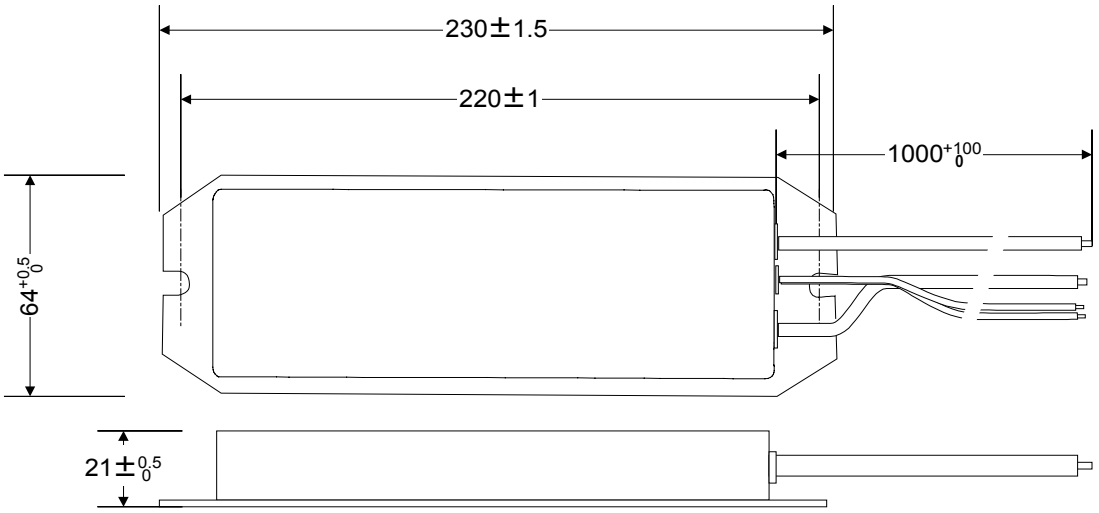
Application : RYS type amplifier, 0.4 [kW] and below



Thickness of mounting plate is 1.2 [mm], mass : 235 [g]

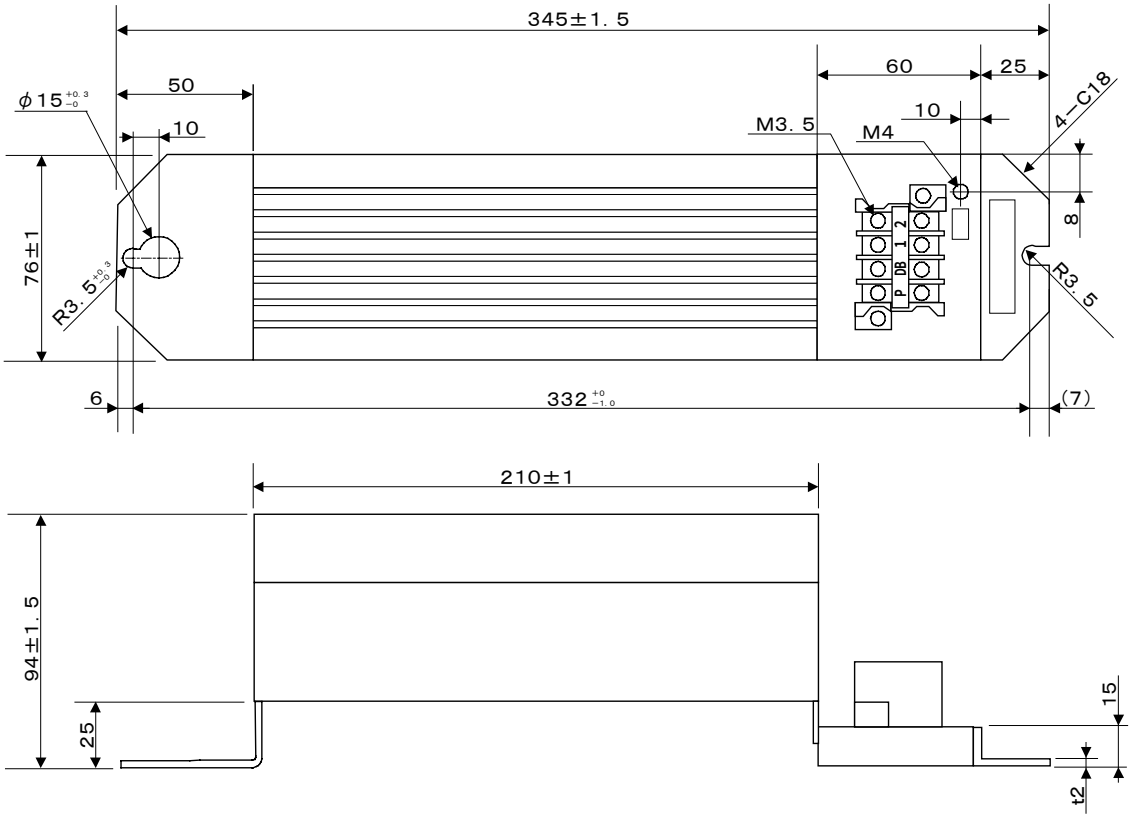
(b) Resistor type : WSR-751

Application : RYS type amplifier, 0.75 [kW]



Thickness of mounting plate is 1.5 [mm], mass : 520 [g]

(c) Resistor type : WSR-152
Application : RYS type amplifier, 1 and 1.5 [kW]

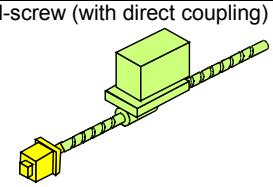
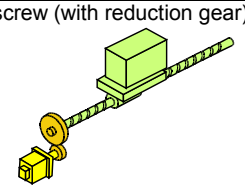
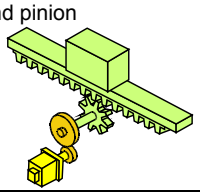
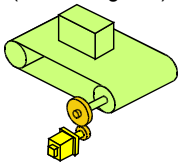
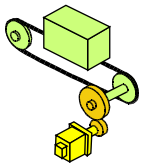
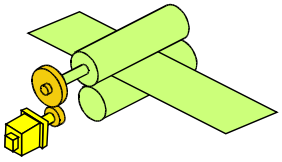
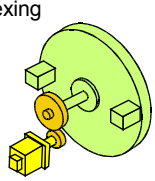
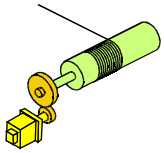


11. APPENDIXES

11.1 Model type selection

(1) Load machine system

Load machine systems driven by adjustable (variable) speed motor are generally as follows.

Mechanical system	Description
Ball-screw (with direct coupling) 	Used for high-accuracy positioning in a short dimension.
Ball-screw (with reduction gear) 	Load torque is increased through deceleration. Compensation is required for gear backlash.
Rack and pinion 	Used for positioning in a large dimension. Movement per revolution of pinion involves a π value. π compensation is required.
Conveyor (with timing belt) 	Used for light loads. π compensation is required.
Chain drive 	Mostly used for transfer line, etc. For positioning, countermeasures for chain elongation is needed. Reduction ratio is large. Moving speed of load machine system is low.
Feed roll drive 	A material having a plate shape is emitted and sandwiched between rolls. An error appears over a large length due to a difference in roll diameter. π compensation is required. Feed amount becomes inadequate due to slip at rapid accel./decel..
Table indexing 	A large reduction speed ratio is required for a large inertia moment of the machine table. Rotational speed of the table is low and a worm-gear is often used.
Spindle dreive 	In winding of wire material, etc., inertia moment becomes larger. Larger reduction speed is necessary. For constant peripheral velocity control, a control system should be checked.

In designing the mechanical equipment system, the following shoud be examined as required.
(a) Reduction gear ratio
Use near the rated speed of motor is recommended where possible.
(b) Pre-load torque
When applying a pre-load to screw, load torque increases.
(c) Holding torque at vertical drive.
At stop of a vertical-feed load machine, energized-motor has a holding torque unless an extermal-braking device is used.
(d) Mechanical efficiency
(e) Rough estimated mechanical-coefficients

(i) Friction coefficient **μ**

Application	**μ**
Rail and iron wheel (crane traveling, traverse motion, traveling carriage)	0.05
Linear way Linear pole slide unit Roller system	0.05 to 0.2

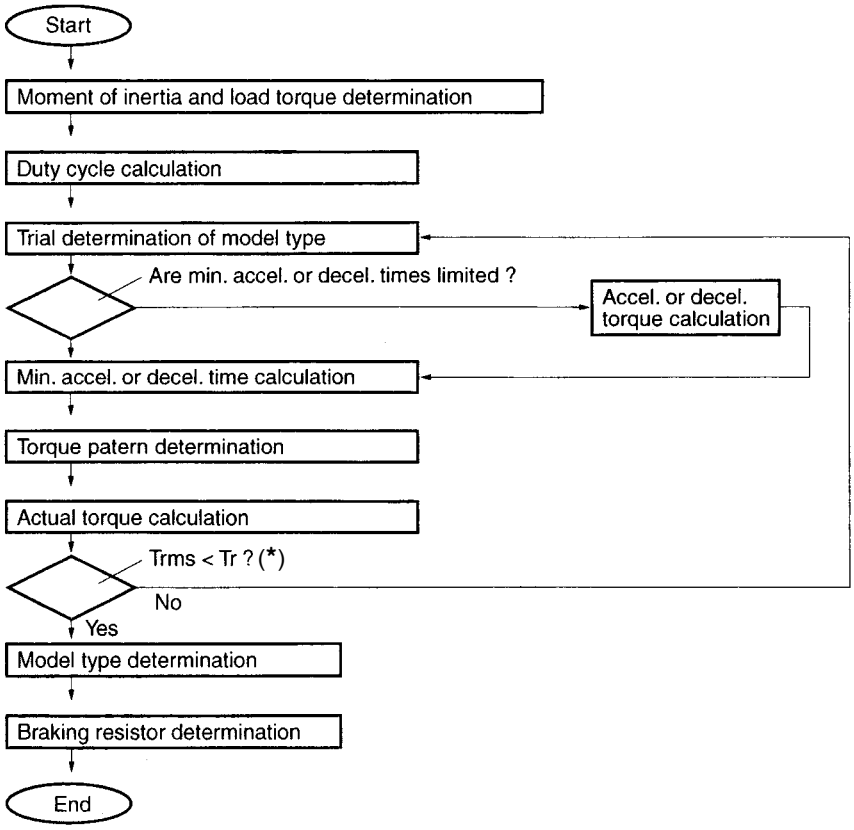
(ii) Mechanical efficiency **η**

Application		**η**
Screw		0.5 to 0.8
Ball-screw		0.9
Rack and pinion		0.8
Spur gear reduction		0.8 to 0.95
Worm reduction gear	At start	0.5 to 0.7
	During operation	0.6 to 0.8
Belt drive		0.95
Chain drive		0.9

(iii) Densities of major materials **ρ** [kg/m^3]

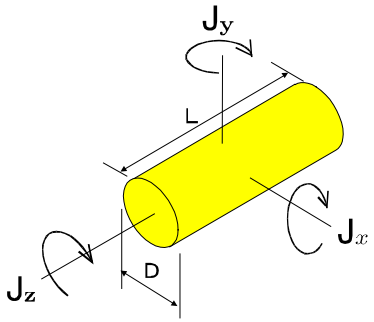
Steel	7850
Stainless steel	7910
Copper	8960
Aluminum	2700
Brass	8540
Poly-acetal	1430

(2) Model type selection determination
(a) Flow chart for selecting a model type



(*) : Trms : Actual torque
Tr : Rated torque

(b) Moment of inertia, basic form

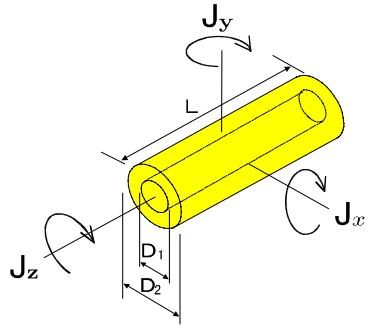


$$J_z = \frac{W}{8}\left[\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right]$$

$$= \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left[\left(\frac{D_2}{10^3}\right)^2 - \left(\frac{D_1}{10^3}\right)^2\right]$$

$$J_x = J_y = \frac{W}{16}\left[\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right] + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left[\left(\frac{D_2}{10^3}\right)^2 - \left(\frac{D_1}{10^3}\right)^2\right]$$

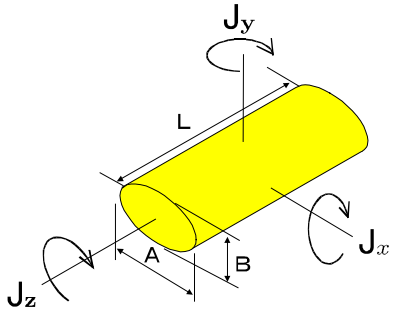


$$J_z = \frac{W}{8}\left(\frac{D}{10^3}\right)^2$$

$$= \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^4$$

$$J_x = J_y = \frac{W}{16}\left(\frac{D}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^2$$

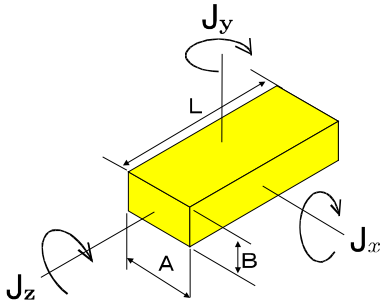


$$J_z = \frac{W}{16}\left[\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right]$$

$$J_x = \frac{W}{16}\left(\frac{B}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$J_y = \frac{W}{16}\left(\frac{A}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$

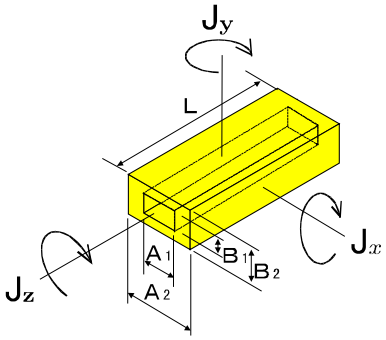


$$J_z = \frac{W}{12}\left[\left(\frac{B}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right]$$

$$J_x = \frac{W}{12}\left[\left(\frac{L}{10^3}\right)^2 + \left(\frac{A}{10^3}\right)^2\right]$$

$$J_y = \frac{W}{12}\left[\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right]$$

$$W = \rho\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$



$$J_x = \frac{W_2}{12}\left[\left(\frac{B_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right] - \frac{W_1}{12}\left[\left(\frac{B_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right]$$

$$J_y = \frac{W_2}{12}\left[\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right] - \frac{W_1}{12}\left[\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right]$$

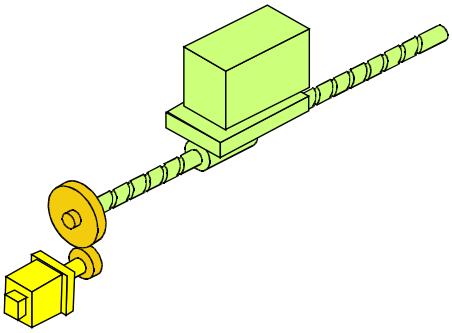
$$J_z = \frac{W_2}{12}\left[\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{B_2}{10^3}\right)^2\right] - \frac{W_1}{12}\left[\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{B_1}{10^3}\right)^2\right]$$

$$W = \rho\left[\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right) - \left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\right]\left(\frac{L}{10^3}\right)$$

$$W_2 = \rho\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right)\left(\frac{L}{10^3}\right) \qquad W_1 = \rho\left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\left(\frac{L}{10^3}\right)$$

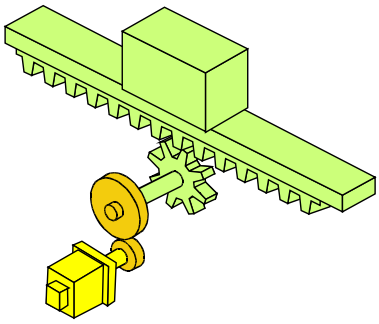
(c) Moment of inertia, typical application

Ball-screw



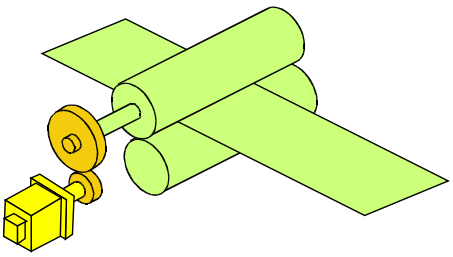
$$J_1 = W \left(\frac{1}{2\pi} \times \frac{BP}{10^3} \right)^2 \times GL^2$$

Rack and pinion, conveyor or chain drive



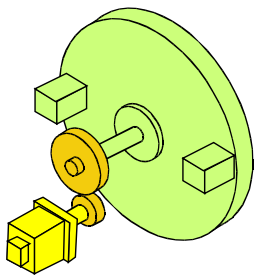
$$J_2 = \frac{W}{4} \left(\frac{D}{10^3} \right)^2 \times GL^2$$

Feed roll drive



$$J_3 = \frac{W}{4} \left(\frac{D}{10^3} \right)^2 \times GL^2$$

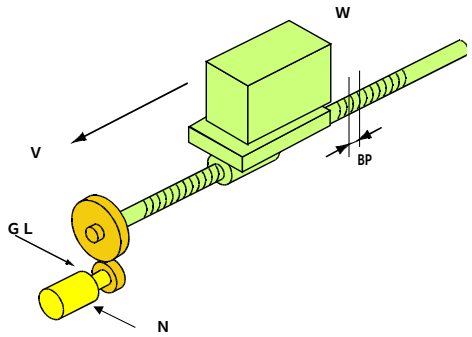
Table indexing



$$J_4 = \left(J + W \left(\frac{L}{10^3} \right)^2 \right) \times GL^2$$

(d) Torque determination

Ball-screw



$$T_L = \frac{(\mu W + F) \times 9.81}{2\pi\eta}\left(\frac{BP}{10^3}\right) \times GL$$

• T_L at load lifting :

$$T_L = \frac{((\mu + 1)W_1 - W_2) \times 9.81}{2\pi\eta}\left(\frac{BP}{10^3}\right) \times GL$$

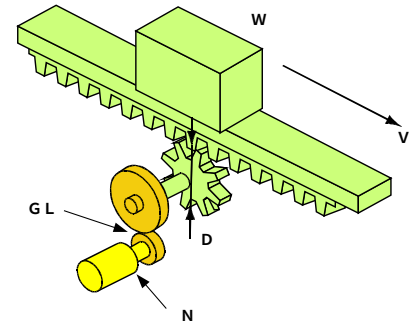
• T_L at lowering :

$$T_L = \frac{((\mu - 1)W_1 - W_2) \times 9.81}{2\pi\eta}\left(\frac{BP}{10^3}\right) \times GL$$

• T_L at stop (servo lock) :

$$T_L = \frac{(W_1 - W_2) \times 9.81}{2\pi\eta}\left(\frac{BP}{10^3}\right) \times GL$$

Rack and pinion, conveyor



$$T_L = \frac{(\mu W + F) \times 9.81}{\eta}\left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

• T_L at load lifting :

$$T_L = \frac{((\mu + 1)W_1 - W_2) \times 9.81}{\eta}\left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

• T_L at lowering :

$$T_L = \frac{((\mu - 1)W_1 - W_2) \times 9.81}{\eta}\left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

• T_L at stop (servo lock) :

$$T_L = \frac{(W_1 - W_2) \times 9.81}{\eta}\left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

Where

BP : Screw-pitch [mm]
D : Pulley, pinion or roll diameter [mm]
F : Thrust (axial) force (opposes feed on is + direction)
GL : Reduction speed ratio
J : Moment of inertia, total
J_L : Ditto, load parts
J_M : Ditto, motor rotor
where,
$J_L = J_M$ x 100 : Load of low moving velocity
$J_L = J_M$ x 50 : Load of positioning
$J_L = J_M$ x 10 : Load of high frequent positioning

L : Length or distance of parts
N : Motor speed
T_L : Load torque, total
v : Moving velocity
W : Mass (weight)
W_1 : Ditto, movable part
W_2 : Ditto, counter movable part
η : Mechanical efficiency
μ : Friction coefficient

(e) Calculation of accel./decel. torque and accel./decel. time (shortest)
(i) Accel./decel. torque
For application to soft start/stop operation, etc, accel./decel. torque should be calculated according to the formula below.

• Accel./decel. torque (T_{AC})

$$T_{AC} = \frac{(J_M + J_L) \times 2\pi \times (N_1 - N_0)}{60 \times (t_{AC})} \pm T_L \text{ [N • m]}$$

Where,
J_L : Moment of load inertia after conversion into motor shaft extension [kg·m^2]
J_M : Moment of inertia motor rotor [kg·m^2]
N_0 : Motor speed before the speed change [r/min]
N_1 : Speed after the speed change [r/min]
t_{AC} : Accel./decel. time [s]
T_{AC} : Max. accel./decel. (breakdown (max.)) motor torque
T_L : Load torque after conversion into motor shaft [N·m]

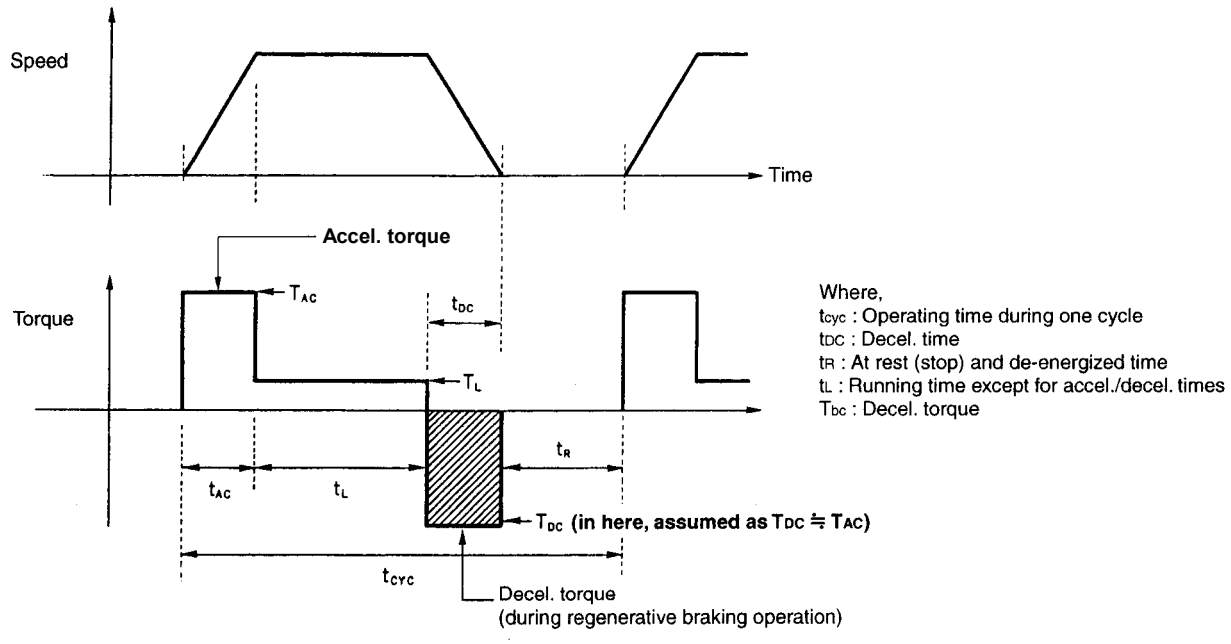
The result of the above calculation should be within the allowable maximum accel. /decel. torque of motor.

(ii) Shortest accel./decel. time
For obtaining the target speed in the shortest time, calculation is required by the formula below.

$$t_{AC} = \frac{(J_L + J_M) \times 2\pi \times (N_1 - N_0)}{60 \times (T_{AC} \pm T_L)} \text{ [S]}$$

When $T_{AC} + T_L$: t_{AC} : (shortest decel. time)
$T_{AC} - T_L$: t_{AC} : (shortest accel. time)

(iii) Operation pattern, basic



(f) Actual torque (Trms) determination
In application to a machine which performs rapid feed frequency, the motor may overheat due to the energy required for accel. and decel.. To prevent this, calculate the actual torque in the following procedure depending on the given repetitive operation pattern and ensure that the value is not larger than motor rated torque.
Shown below are the formula for actual torque in the typical operation pattern.

$$T_{rms} = \sqrt{\frac{(T_{AC}^2 \times t_{AC}) + (T_L^2 \times t_L) + (T_{DC}^2 \times t_{DC})}{t_{CYC}}}$$

If the actual torque surpasses the rated torque, the following items should be reviewed.
• Slightly reduce the frequency of acceleration and deceleration.
• Review decel. method or decel. ratio, etc. and set feed speed appropriately.
• If motor torque is generated even during stop, a mechanical equipment system should be selected so as to minimize the necessity for torque at stop.
• To maintain motor response at a satisfactory level, it is recommended to restrict the moment of inertia load within the twofold value of moment of inertia of motor rotor. If higher frequent operation is absolutely required, the moment of inertia of load should be further reduced.

(g) Regenerative brakign power
(i) Horizontally moving, deceleration

$P_1 = 0.105 \times T_{DC} \times N_{10} \times (1/2)$ [W]

Where,
T_{DC} = Decel. torque [N • m]
N_{10} = Speed at decel. duration [r/min]

(ii) Vertically, lowering

$P_2 = 0.105 \times T_{L0} \times N_{20}$ [W]

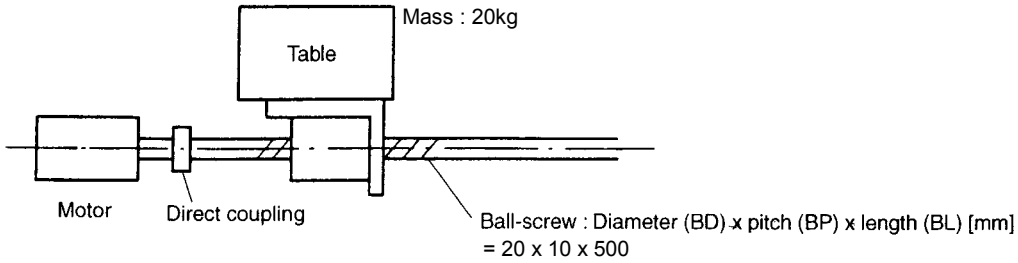
Where,
T_{L0} = Load torque at lowering [N • m]
N_{20} = Speed at lowering [r/min]

(iii) Mean braking power per cycle

$$P = \frac{P_1 \times t_1 + P_2 \times t_2}{t_{CYC}} \quad [W]$$

Where,
t_1, t_2 : Decel. time during P_1/P_2 operation

(3) Examples of calculation for model type selection
Selection of the output of the motor used for driving the table (horizontally moving body) shown below is exemplified here.



For capacity selection, calculation is required in the following selection procedure.

(i) Moment of inertia of load via conversion into motor shaft
a) Movable part (table) (J_{L1})

$$J_{L1} = W\left\{\frac{1}{2\pi} \times \frac{BP}{10^3}\right\}^2 \times GL^2 = 20\left\{\frac{1}{2\pi} \times \frac{10}{10^3}\right\}^2 \times (1/1)^2 = 0.05 \times 10^{-3} [kg \cdot m^2]$$

Where, W : Mass (weight) of table

b) Ball-screw (J_{L2})

$$J_{L2} = \frac{\pi\rho}{32} \times \frac{BL}{10^3} \times \left\{\frac{BD}{10^3}\right\}^4 \times GL^2 = \frac{\pi \times 7.85 \times 10^3}{32} \times \frac{500}{10^3} \times \left\{\frac{20}{10^3}\right\}^4 \times (1/1)^2 = 0.06 \times 10^{-3} [kg \cdot m^2]$$

Where, ρ : Density of ball-screw (assumed as 7850 [kg/m^3])
thus, $J_L = J_{L1} + J_{L2} = 0.11 \times 10^{-3}$ [kg • m^2]

(ii) Load torque via conversion into motor shaft (T_L)

$$T_L = \frac{(\mu)W \times 9.81}{2\pi\eta} \times \frac{BP}{10^3} \times GL = \frac{0.1 \times 20 \times 9.81}{2\pi \times 0.9} \times \frac{10}{10^3} \times (1/1) = 0.03[N \cdot m]$$

Where, μ : Friction coefficient = 0.1, η : Mechanical efficiency = 0.9

(iii) Shortest accel./decel. time (tac/tdc)
Of the motor which meets the following conditions ; $J_L \leqq 5 \times J_M$ and $T_L \leqq T_R$ (rated torque) $\times$ 0.9
0.2 [kW] motor is temporarily selected. :

Where,
T_L = 0.03 [N • m], $J_L = 0.11 \times 10^{-3}$ [kg • m^2], from motor data of 2.1 : rated torque = 0.637 [N • m], breakdown (max.) torque = 1.91 [N • m], moment of motor rotor inertia = 0.0216×10^{-3} [kg • m^2] for 0.2 [kW], GYC 201DC1-S motor.

a) Shortest accel./decel. time

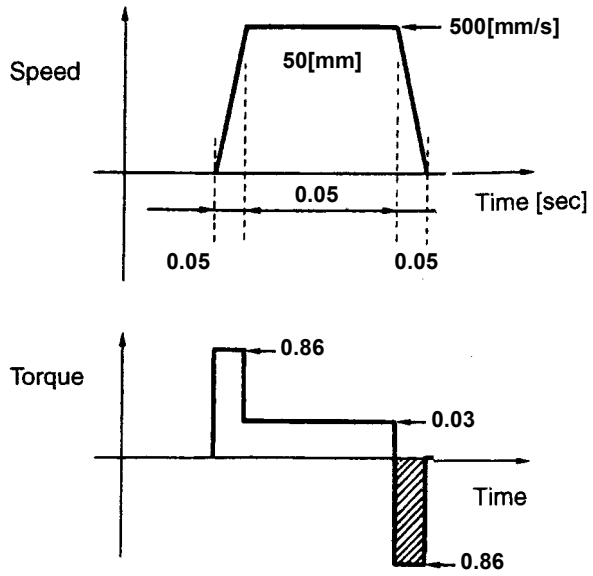
$$t_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60(T_{AC} - T_L)} = \frac{(0.0216 \times 10^{-3} + 0.11 \times 10^{-3}) \times 2\pi \times 3000}{60(1.91 - 0.03)} = 0.022 \text{ [s]}$$

b) Accel./decel. torque for application to soft operation (0.05 [s] accel. time) from 0 to 3000 [r/min] speed

$$T_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60 \times t_{ac}} + T_L = \frac{(0.0216 \times 10^{-3} + 0.11 \times 10^{-3}) \times 2\pi \times 3000}{60 \times 0.05} + 0.03 = 0.86[N \cdot m]$$

Where,
J_M : Moment of inertia of motor
N : Motor speed [r/min]
T_{AC} : Max. torque which can be output within an increase from 0 to 3000 [r/min]

(iv) Operation pattern



(v) Moving length of ball-screw
Moving velocity (v) of mechanical equipment system at 3000 [r/min] motor speed (N)

$$V = \frac{N}{60} \times BP \times GL = \frac{3000}{60} \times 10 \times (1/1) = 500 \text{ [mm/s]}$$

(vi) Calculation of actual torque (Trms)
Actual torque can be calculated by the following formula.

$$T_{rms} = \sqrt{\frac{((0.86^2 \times 0.05 \times 2) + (0.03^2 \times 0.05)) \times 1}{0.5}} = 0.38 \text{ [N • m]}$$

Since the rated torque of 0.2[kW] motor is 0.637 [N • m], a relation of “actual torque < rated torque “ is satisfied. Therefore, the temporarily selected motor is actually applicable.

(vii) Examination of braking resistor
In the above torque pattern, the hatched area corresponds to the regenerative braking mode. Braking power is as follow.

$P_1 = 0.105 \times T_{AC} \times N \times (1/2) = 0.105 \times 0.86 \times 3000 \times (1/2) = 135$ [W]

From the above result, mean braking power per cycle is :

$$P = \frac{135 \times 0.05}{0.5} = 14 \text{ [W]}$$

(4) Determination of external braking resistor
Because of the braking resistor is not built-in the 0.2[kW] motor, requiring of external braking resistor provision is reviewed as follows :
(a) Energy (E_G) on the mechanical equipment system during deceleration

$$E_G = \frac{1}{2}(J_M + J_L) \cdot (2\pi N / 60)^2$$
$$= \frac{1}{2}(0.0216 \times 10^{-3} + 0.11 \times 10^{-3}) \times \left[\frac{2\pi \times 3000}{60}\right]^2 = 6.5 \text{ [J]}$$

(b) Consumption energy (E_L) due to load torque

$E_L = (2\pi / 60) \times T_L \times N \times t_{DC} \times (1/2)$
$= (2\pi / 60) \times 0.03 \times 3000 \times 0.05 \times (1/2) = 0.24$ [J]

(c) Consumption energy (E_M) in motor winding

$E_M = 3 \times (R \times I^2) \times t_{DC} = 3 \times R \times ((T_{DC} / T_R \times I_R)^2) \times t_{DC}$
$= 3 \times 2 \times ((0.86 / 0.637 \times 1.5)^2) \times 0.05 = 1.2$ [J]

(d) Absorbing energy (E_S) of motor

$$E_S = \frac{1}{2}CV^2 = \frac{1}{2}(660 \times 10^{-6}) \times (370^2 - (200 \times 2^{\frac{1}{2}})^2) = 18.7 \text{ [J]}$$

Where,
R : Phase resistance of stator winding of GYC201 type motor is 2[Ω], at room temperature
V : Power supply voltage 200 [V]
C : DC intermediate capacity of RYS201 amplifier 660[μF]

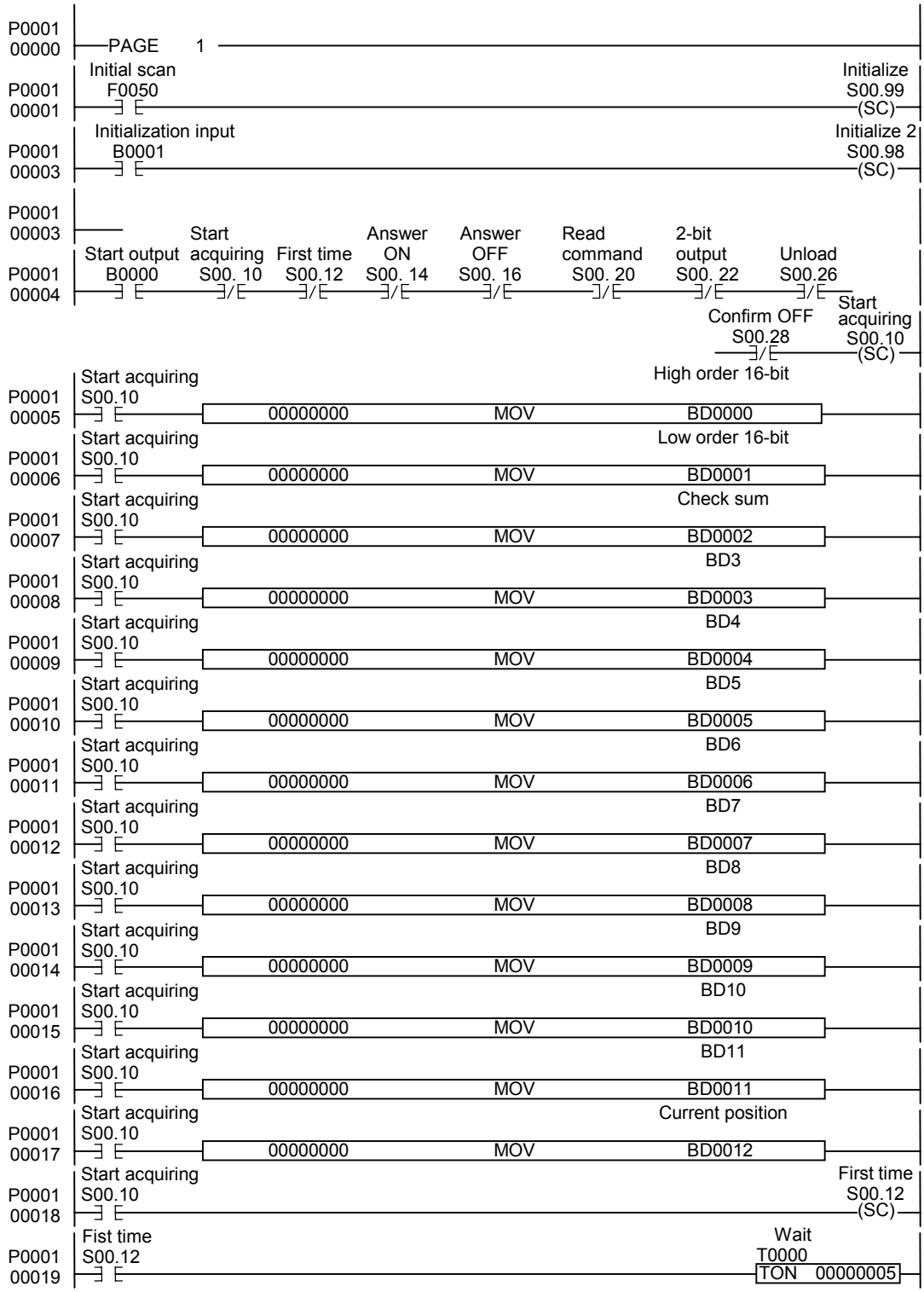
(e) Consumption and absorbing energies ($E_L + E_M + E_S$) is 20 [J], which is larger than the energy on the mechanical equipment system (E_G = 6.5 [J]). Therefore, external braking resistor provision is not required in this example.

11.2 Example of program

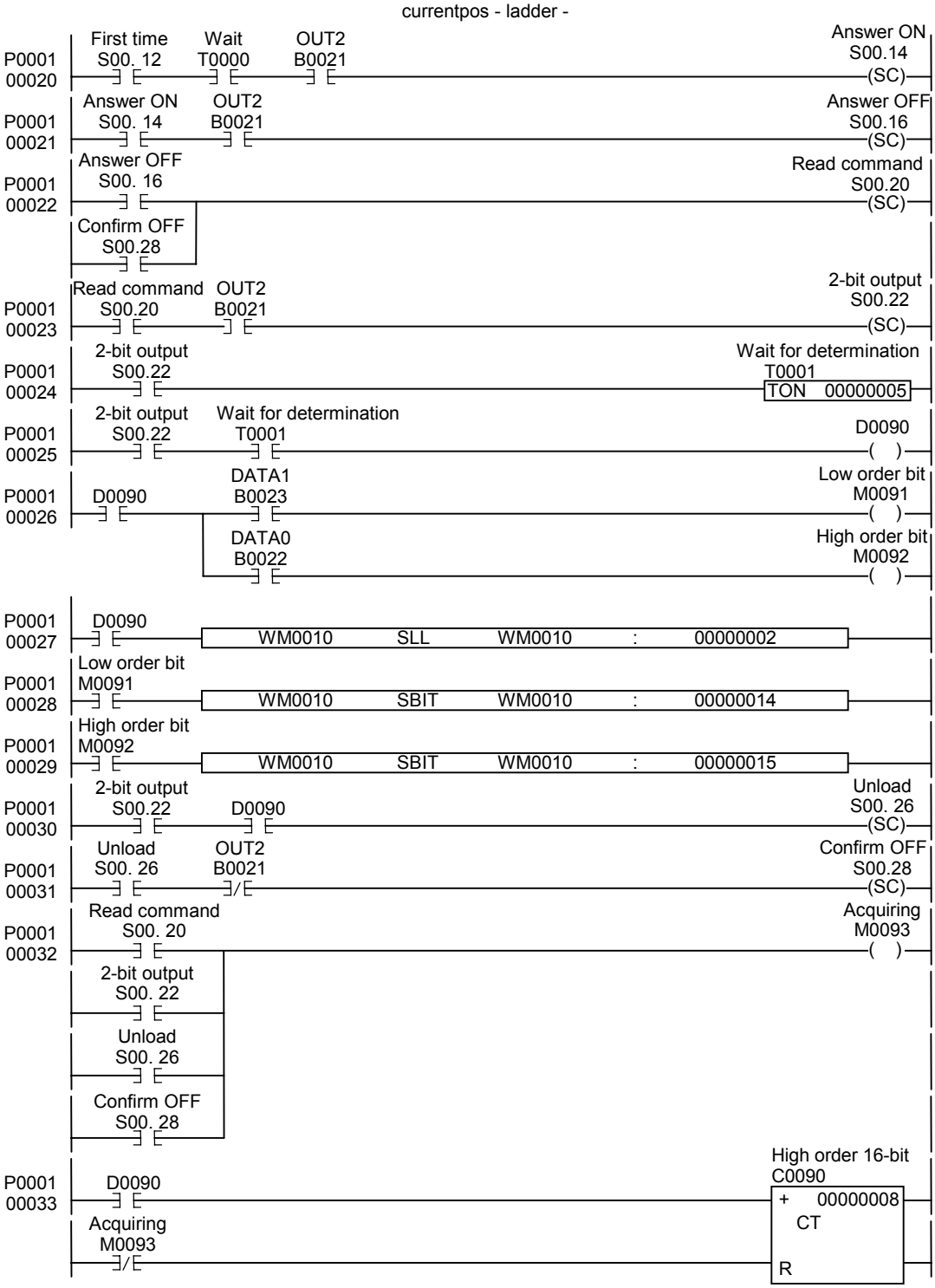
(1) MICREX-F F70

An example is shown for PLC side program for current position ouput (see 5.4.5).
Connecting the amplifier output terminal to PLC input terminal acquires the current position of motor.
B0 : Start acquires (input)
B1 : End (input)
B17 : Current position output [CONTn]
B22 : DATA0 [OUT3]
B23 : DATA1 [OUT4]
In the example of program, BD0 to BD12 are used as a working area.
Finally, the current position is stored in the area of BD12 (BCD 7-digit).
Allocate 56 (current position output) to control signal of amplifier corresponding to B17 (output).

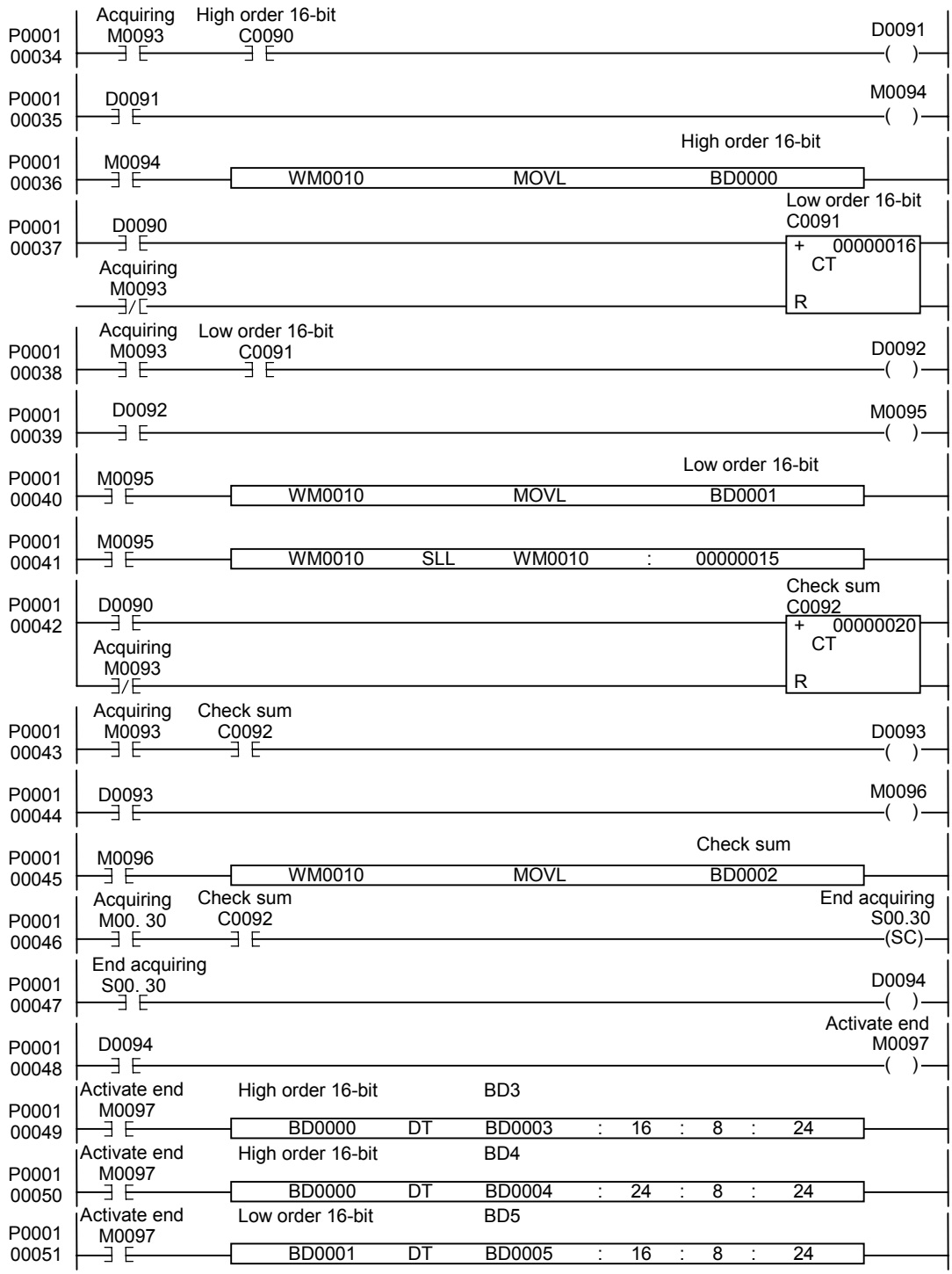
currentpos - ladder -



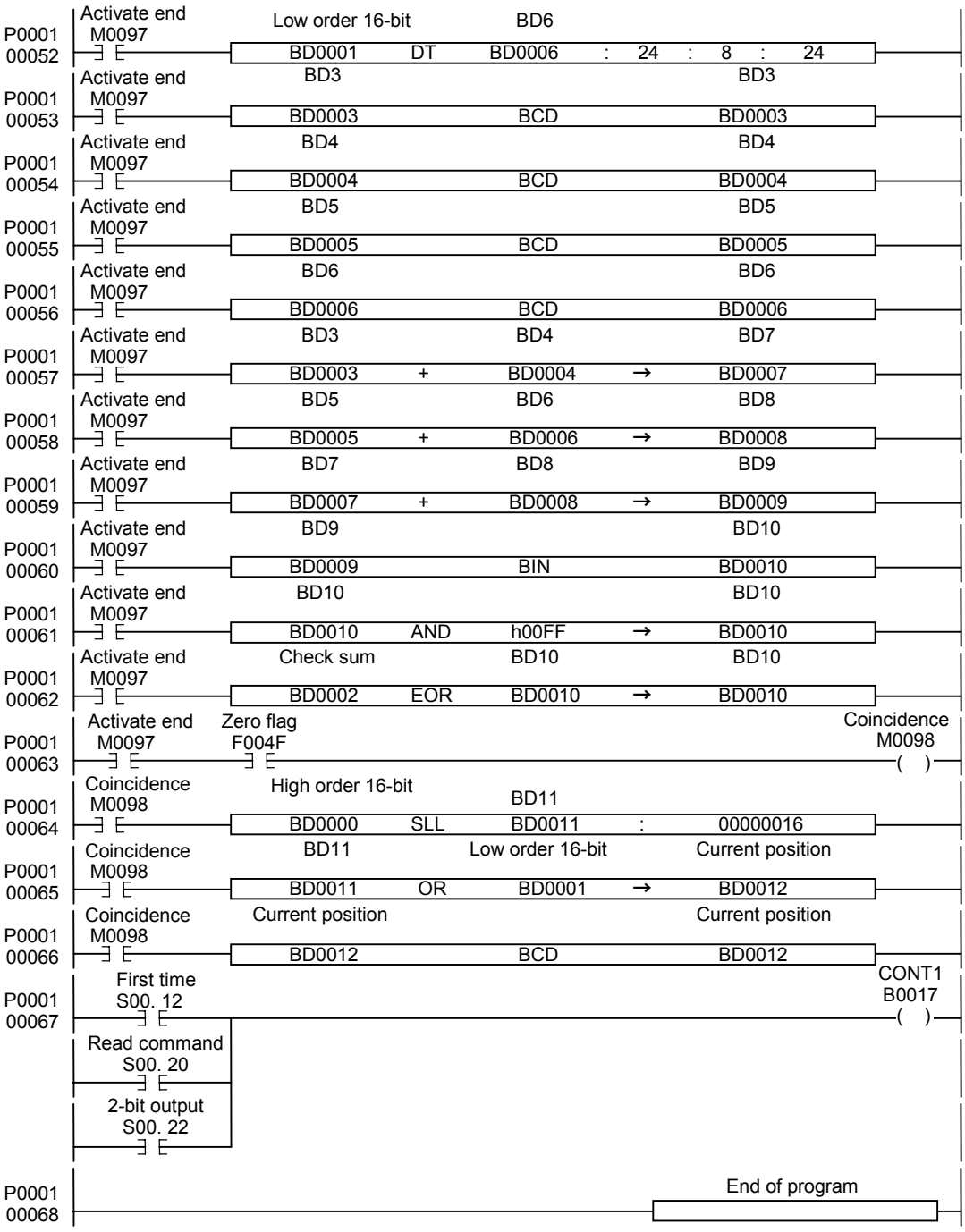
currentpos - ladder -



currentpos - ladder -

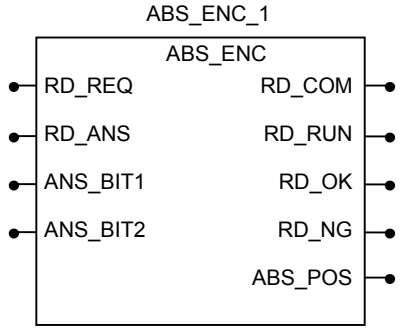


currentpos - ladder -



(2) MICREX-SX

FB (function block) for acquiring a current position output (see 5.4.5).



RD_REQ : Request current position read [BOOL]
RD_ANS : Answer current position read [BOOL]
ANS_BIT1 : Amplifier data bit 1 [BOOL]
ANS_BIT2 : Amplifier data bit 2 [BOOL]
RD_COM : Read command to amplifier [BOOL]
RD_RUN : Reading [BOOL]
RD_OK : Normal end of read [BOOL]
RD_NG : Abnormal end of read [BOOL]
ABS_POS : Current position data [DINT]

Turning on "RD_REQ" executes a sequence of current position acquisition.
The current position is outputted in [DINT] form to "ABS_POS" terminal.
Connect each terminal to the amplifier.

RD_COM : Current position output command (control assign No. 56)
RD_ANS : OUT2
ANS_BIT1 : OUT3 } of amplifier terminals
ANS_BIT2 : OUT4

11.3 Control block diagram

The control block diagram for RYS-V type amplifier is shown on the next page.

(1) Override

Validated by assigning the control assign terminals [CONTn] to signals.

Set value, value set at system para.	No.	Signal name
	43	Override valid
	44	Override 1
	45	Override 2
	46	Override 4
	47	Override 8

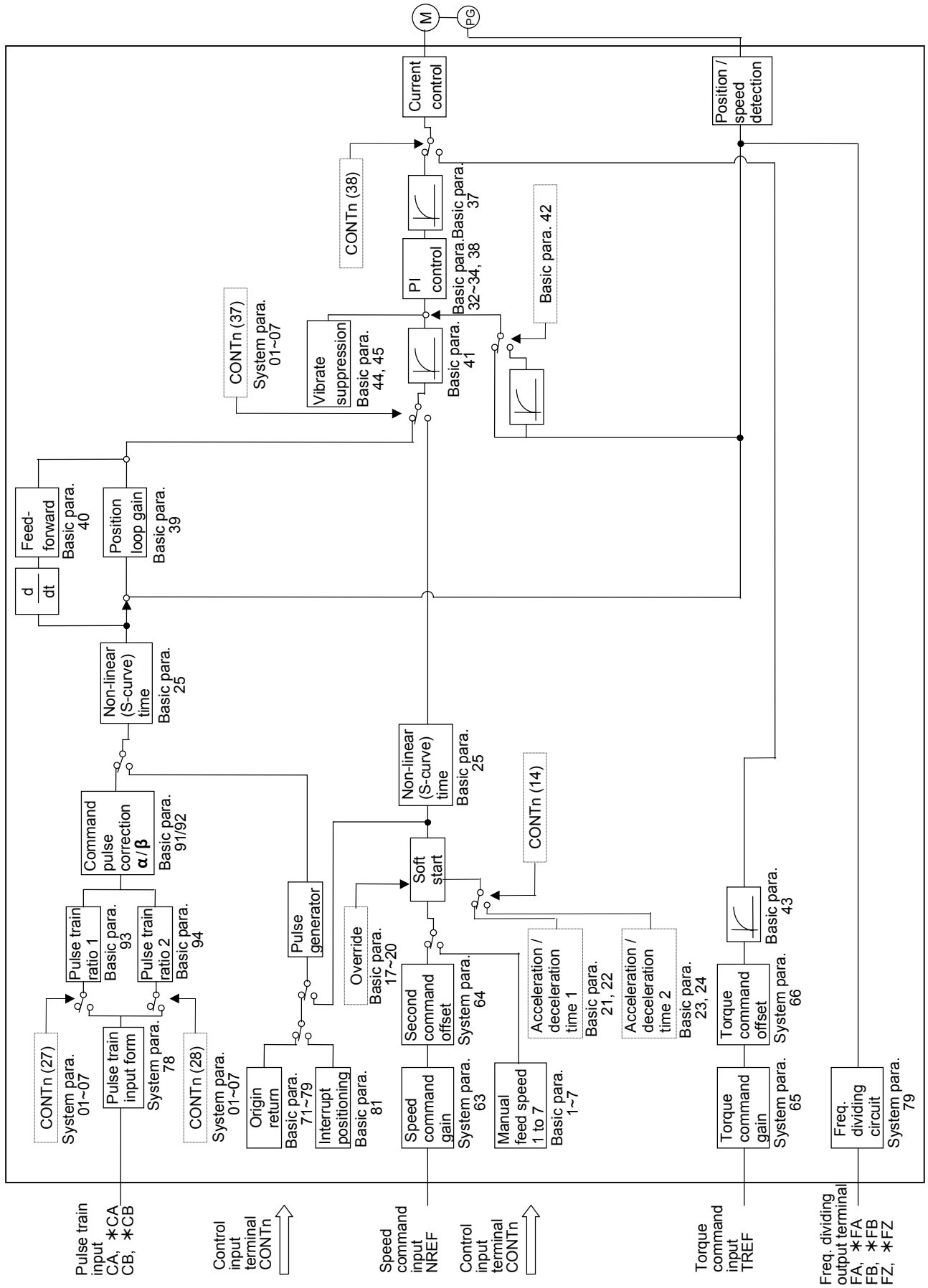
(2) Manual feed

The speed of manual forward or reverse revolution can be selected from 8 levels.

X3	X2	X1	Speed	
OFF	OFF	OFF	NREF terminal (speed command voltage)	
OFF	OFF	ON	1	of manual feed speed (basic para.)
OFF	ON	OFF	2	
OFF	ON	ON	3	
ON	OFF	OFF	4	
ON	OFF	ON	5	
ON	ON	OFF	6	
ON	ON	ON	7	

Validated by assigning the signals to control assign terminals [CONTn]

Signal function	No.	Functional name
	51	X1
	52	X2
	53	X3


M
PG
Current control
Position / speed detection
CONTn (38)
PI control
Basic para. 32~34, 38
Basic para. 37
Basic para. 42
CONTn (37)
System para. 01~07
Vibrate suppression
Basic para. 44, 45
Basic para. 41
Feed-forward
Basic para. 40
Position loop gain
Basic para. 39
d/dt
Non-linear (S-curve) time
Basic para. 25
Command pulse correction α/β
Basic para. 91/92
Pulse train ratio 1
Basic para. 93
Pulse train ratio 2
Basic para. 94
Pulse generator
Override
Basic para. 17~20
Soft start
Non-linear (S-curve) time
Basic para. 25
CONTn (14)
Second command offset
System para. 64
Acceleration / deceleration time 1
Basic para. 21, 22
Acceleration / deceleration time 2
Basic para. 23, 24
Torque command offset
System para. 66
Basic para. 43
CONTn (27)
System para. 01~07
Pulse train input form
System para. 78
CONTn (28)
System para. 01~07
Origin return
Basic para. 71~79
Interrupt positioning
Basic para. 81
Speed command gain
System para. 63
Manual feed speed 1 to 7
Basic para. 1~7
Torque command gain
System para. 65
Freq. dividing circuit
System para. 79
Pulse train input CA, ∗CA CB, ∗CB
Control input terminal CONTn
Speed command input NREF
Control input terminal CONTn
Torque command input TREF
Freq. dividing output terminal FA, ∗FA FB, ∗FB FZ, ∗FZ

Worldwide Operations

Fuji Service Centers

Asia and Oceania

●A/O Service Center, Fuji Electric
11-2, Osaki 1-chome, Shinagawa-ku, Tokyo 141-0032, JAPAN
Phone :Tokyo 5435-9058
Facsimile : 03-5435-7525

America

●USA Service Center, Fuji Electric
5550 Cerritos Ave., Suite H Cypress, CA 90630 U.S.A.
Phone : 714-220-1879
Facsimile : 714-220-1870

EC, Middle East and Africa

●EC Service Center, Fuji Electric
Senefelder Str. 1, 63110 Rodgau, F.R. GERMANY
Phone : 06106-75013
Facsimile : 06106-72713

South East Asia

●South East Asia Service Center, Fuji Electric
Block 5000 Ang Mo Kio Ave. 5 #02-03 SINGAPORE 569870
Phone : 481-5079
Facsimile : 481-5476

Contracted Service Companies

Asia and Oceania

●CNC and Robotic Automated Services
20 Hackett Terrace Marryatville, S.A. 5068 AUSTRALIA
Phone : 08-8378-6081
Facsimile : 08-8364-4021

●Fuji-Electric Technology and Service (Shenzhen) Co., Ltd.
Room 209 Liming Bldg. No.144, Zhongxing Rd., Luohu Ku. Shenzhen City, CHINA
Phone : 0755-220-2745
Facsimile : 0755-218-5812

●Fuji Electric (Asia) Co., Ltd.
Room 1001, 10th Fl., Tsimshatsui Center 66 Mody Rd., Tsimshatsui East Kowloon, HONG KONG
Phone : 2311-8282
Facsimile : 2312-0566

●Autonum Controls Pvt. Ltd.
17, Adukia Apartment, S. Mody Rd., Kandivli (West), Mumbai-400 067, INDIA
Phone : 022-8658136
Facsimile : 022-8073246

●Donghai Corporation
Donghai Bldg., 1056-28, Namhyun-dong, Kwanak-ku, Seoul, R.O. KOREA
Phone : 02-586-0058
Facsimile : 02-586-0057

●Gaius Industries Co., Ltd.
2nd Fl., Young Shin Bldg., 954-4, Dogok-dong, Kangnam-gu, Seoul, 135-270, R.O. KOREA
Phone : 02-554-0766
Facsimile : 02-554-1118

●Taiwan Optical Measuring Instrument Co., Ltd.
6th Fl.-3, No.190, Sec. 2, Chung Hsing Rd., Hsin Tien City, Taipei Hsien, TAIWAN R.O.C.
Phone : 02-29118420
Facsimile : 02-29189378

America

●OESS Corporation

- New Jersey Head Office
  800 Huyler St., Teterboro, NJ 07608, U.S.A.
  Phone : 201-288-4422
  Facsimile : 201-288-4496
- Chicago Office
  4825 N Scott Suite 210, Schiller Park, IL 60126, U.S.A.
  Phone : 847-233-9412
  Facsimile : 847-233-9413
- Los Angeles Office
  5550 Cerritos Ave., Suite H, Cypress, CA 90630, U.S.A.
  Phone : 714-220-1879
  Facsimile : 714-220-1870
- Portland Office
  7921 SW Cirrus Drive, Beaverton, OR 97008, U.S.A.
  Phone : 503-520-5044
  Facsimile : 503-526-0188
- Sunnyvale Office
  1090 E. Arques Ave., Sunnyvale, CA 94086, U.S.A.
  Phone : 408-732-0789
  Facsimile : 408-732-0785

EC, Middle East and Africa

●OESS GmbH.
Senefelder Str. 1, 63110 Rodgau, F.R. GERMANY
Phone : 06106-75013
Facsimile : 06106-72719

South East Asia

●A. Royal Pte. Ltd.
Block 5000 Ang Mo Kio Ave. 5 #02-03 SINGAPORE 569870
Phone : 481-5079
Facsimile : 481-5476

Fuji Electric Co.,Ltd.

Gate City Ohsaki, East Tower,
11-2, Osaki 1-chome, Shinagawa-ku, Tokyo 141-0032, Japan
Phone : Tokyo 5435-7111
Telex : J22331 FUJIELEC