OPERATION MANUAL

AC Servo Drive

FDA5000 Series

Ver 3.3 (Soft. Ver. 6.02 ~)

FDA5000 Series

Servo Drive User Manual

HIGEN

< CAUTION >

1. Check Motor ID certainly. (P1-01)

2. Check Drive Amp-Type certainly. (P1-10)

Model	5001	5002	5004	5005	5010	5012	5015	5020	5030	5045	5075
Amp Type	0	1	2	5	6	7	11	12	13	14	15

3. Check Encoder Pulse certainly. (P1-12)

Example) **FMALN09-AA00**

Encoder Type

Symbol	Pulse	Type
A	2000	Incremental 15 wires
B	2500	
C	3000	
D	5000	
E	6000	
F	2048	
G	2048	Absolute 11/13bit

4. Operate servo system after autotuning is off. (P2-24)

5. Avoid impacting to the Motor in connecting. Especially, avoid impacting to the Encoder in connecting coupling to the Motor shaft or operating.

6. Recommended specifications in Encoder wiring.
Check Encoder Type and use authorized shield cable.

Encoder Type	Reference Page
Incremental Encoder	3-17
Absolute Encoder	3-20

7. Treatment of the servo motor attached holding brake .
: The brake built in the servo motor is a normal closed type brake. Which is used only to hold and can not be used for braking. Use the holding brake only to hold a stopped servo motor.

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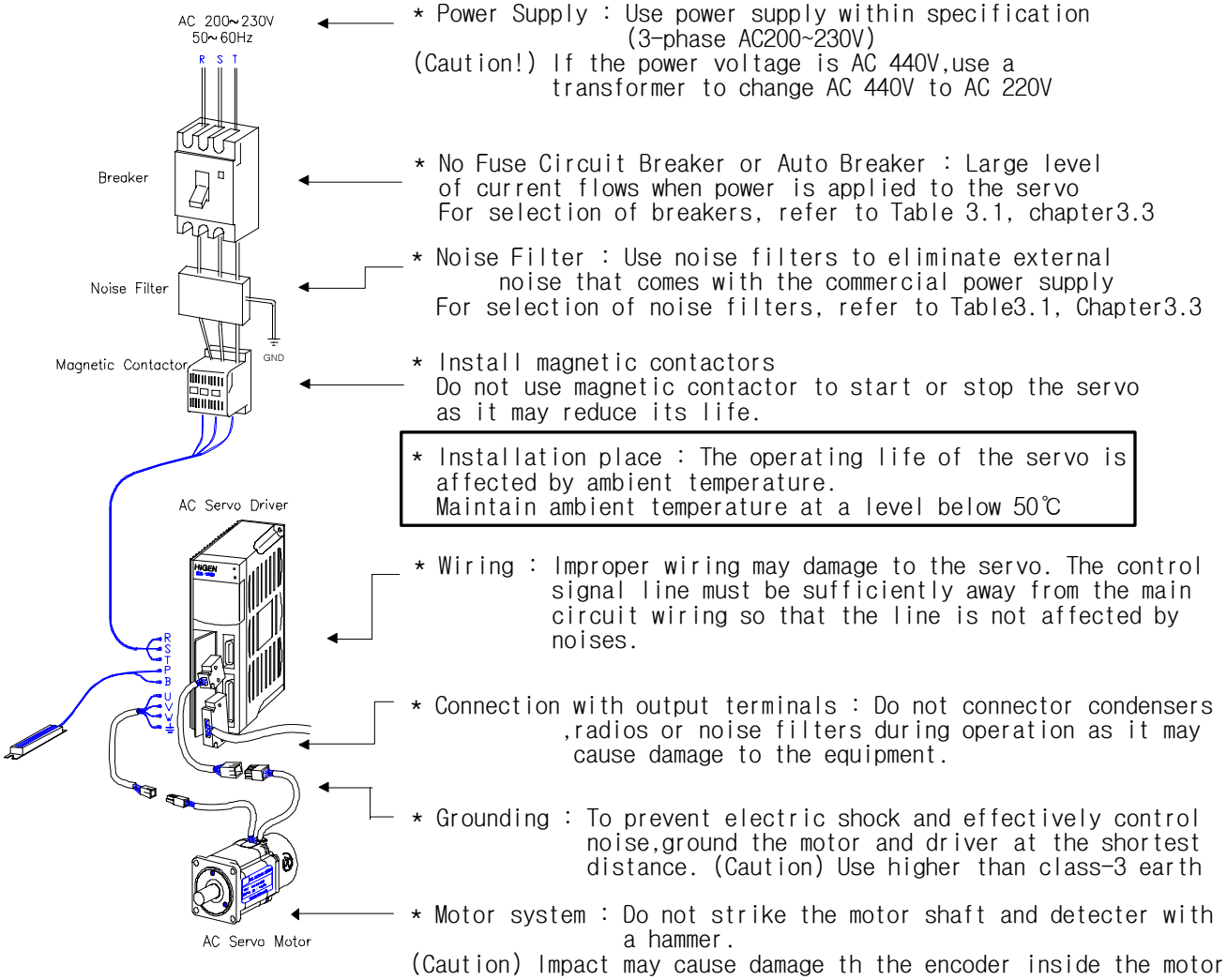
1. Checking and Handling

1.1 Handling (Connection of main circuit and motor)

Thank you for purchasing HIGEN AC Servo Driver. Incorrect handling of the driver may lead to unsatisfactory operation or, in some cases, to the rapid reduction of its life, or damage to the servo. Handle and operate the driver according to the instructions given in this manual.

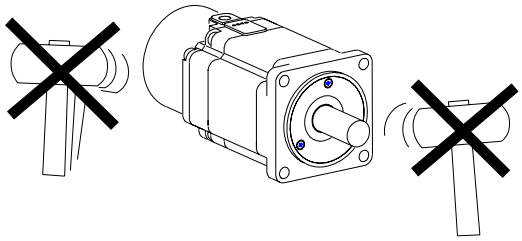


1.2 Caution during Use

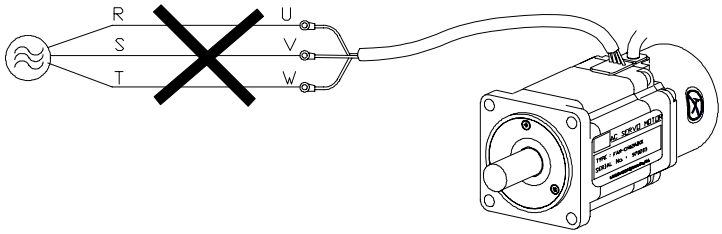
Improper handling of the driver may lead to unexpected accident or damage. The following are important points in operating the driver.

1.2.1 Handling

- Avoid impact to the encoder, the motor detector.
  Striking the shaft with a hammer may cause the motor to drop leading to unexpected damage.



- Do not connect commercial power supply (AC 220V) directly to the motor.
  Direct connection induces flow of overcurrent leading to the deterioration of the magnetic effect.
  Always use specified servo driver.



1.2.2 Wiring

- Connect the driver and the motor earth terminals in the direction of the driver, and ground the terminals at the shortest distance in one operation. To prevent electric shock and improper operation, use class-3 earth (Less than 100 Ω).
- Always match the U, V ,W and FG terminals of the motor with those of the driver. You cannot change the direction of rotation by changing 2 wires as in the case of widely used common motors.
- Connecting commercial power supply to the U, V, W and FG terminals of the driver may cause damage.
  (Apply 200V power supply to R, S and T terminals)
  Use a transformer in case power supply is other than 200V.
- Connect standard regenerated resistance to the P and B terminals of the driver.

1.2.3 Operation

- Use the magnetic brake of the motor only for emergency and maintenance (preservation).
  The brake is designed for maintenance (preservation) during power outage. If used to reduce speed, the brake wears out fast.

- Install brakes and magnetic contactors on power supply terminals R, S and T.
  In case an error occurs or abnormal current flows, shut off the circuit to prevent secondary fire.

1.2.4 Maintenance and inspection

- "High voltage" still remains inside the driver for a while even after power supply is shut off.
  (Danger!)
  To prevent electric-shock, carry out wiring work or inspection at least l0 minutes after the power is cut off and the charge lamp is turned off.

- The regenerated resistance and the servo motor remain hot for a while after power is turned off. Touching them may cause burns.

- Conducting megger test on the driver may cause damage to the driver. Do not perform megger test.

- The motor detector is not detachable. Never remove the cover.

1.3 Installation

1.3.1 Installation of servo driver

- Operating environment

Ambient temperature	0-50℃ (There should be no freezing) Note)
Ambient humidity	90% RH or lower (There should be no steam)

Note) Inside panel temperature specifications: To ensure maximum operating life and reliability of the driver, maintain the average panel temperature at 40℃ or lower.
If the driver is installed in a place within arm's reach, install the fan to maintain the temperature of driver at 70℃ or lower.

- Installation direction and intervals
  - Install the servo driver in such a way that FDA-5000 can be seen from the front.
  - If the drivers are installed in a closed panel, maintain an interval of more than 10 mm between drivers and more than 40 mm between top and bottom. If multiple number of panels are installed in parallel, about 100 mm space is required on the upper side. Avoid heat by installing fans.
  - Install heat sources, such as regenerated resistance, away from the driver.

- Prevention of ingress of foreign matter
  - Exercise caution when drilling control panels to prevent chips produced by drilling from getting into the driver.
  - Take appropriate measures to prevent oils, water and metal powder from getting into the driver from openings in the control panels and the fan installed on the ceiling.
  - If the driver is used in a place with large amount of toxic gases and dust, protect the driver with an air purge.

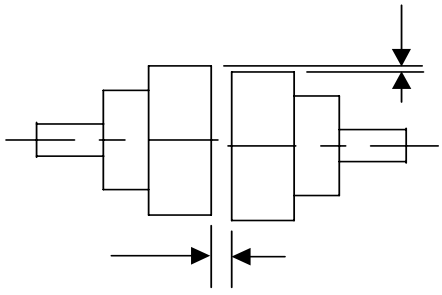
1.3.2 Servo motor installation

- Operating environment

Ambient temperature	0-40℃ (There should be no freezing)
Ambient humidity	80% RH or lower (There should be no steam)
External vibration	X, Y = 19.6 m/s2 (2G)

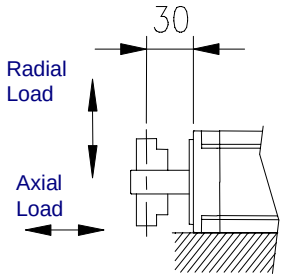
- Caution when assembling load system (Prevent impact on shaft)
  It is important to accurately match the motor shaft with the shaft center of the connecting machine. Unmatched shaft center causes vibration, and may cause damage to the bearing. Use a rubber hammer to install couplings to prevent excessive force from being applied to the shaft and bearing.

Check 4 places in turn. The difference between maximum and minimum should be 0.03 or lower.



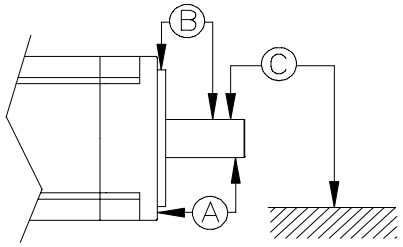
Load tolerance on shaft

- Use flexible couplings, and maintain the shaft center deviations within the specified tolerance. Use pulleys and sprockets that can accomodate the allowable load.

MOTOR MODEL		RADIAL LOAD		AXIAL LOAD		REFERENCE DIAGRAM
Series	Type	N	Kgf	N	kgf	
CN	CN01~CN05	196	20	68	7	
	CN06~CN08	245	25	98	10	
	CN09~CN15	490	50	196	20	
	CN20~CN30	686	70	343	35	
	CN30A~CN50A	1470	150	490	50	
KN	KN03~KN07	245	25	98	10	
	KF08~KN11	490	50	196	20	
	KF15~KN22	686	70	343	35	
	KN22A~KN55	1470	150	490	50	
TN	TN05~TN09	490	50	196	20	
	TN13~TN17	686	70	343	35	
	TN20~TN75	1470	150	490	50	
LN	LN03~LN06	490	50	196	20	
	LN09~LN12	686	70	343	35	
	LN12A~LN40	1470	150	490	50	
KF	KF08~KF10	490	50	196	20	
	KF15	686	70	343	35	
	KF22~KF50	1470	150	490	50	
TF	TF05~TF09	490	50	196	20	
	TF13	686	70	343	35	
	TF20~TF44	1470	150	490	50	
LF	LF03~LF06	490	50	196	20	
	LF09	686	70	343	35	
	LF12~LF30	1470	150	490	50	

- Accuracy of attachments

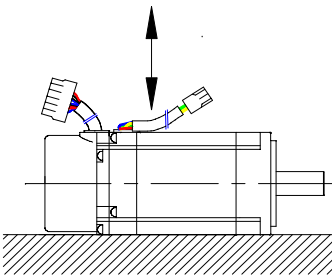
  The accuracies of the output shaft and attachments of the AC servo motor are shown on the following table.

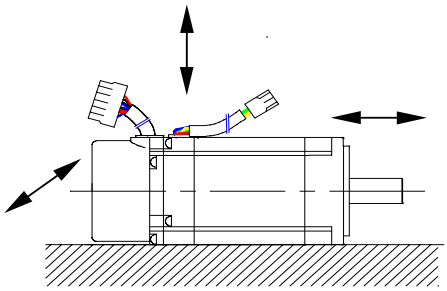
Item	Accuracy (T.I.R.)	Reference Diagram
Perpendicularity of flange attachment plane and output shaft (A)	0.04mm	
Eccentricity of flange fitting outer diameter (B)	0.04mm	
Vibration of output shaft end (C)	0.02mm	

(Note) T.I.R : Total Indicator Reading

- **Impact resistance**

The driver withstands an acceleration of 10G and two times of impacts when up-and-down impacts are applied after setting the motor shaft horizontally.
However, a precision detector is attached to the end of the shaft on the opposite side of the load. Take caution not to apply impact directly to
this end.





- **Vibration resistance**

The driver withstands a vibration acceleration of 2.0G when vibration is applied in up and down, left and right, and front and back directions after setting the motor shaft horizontally.

- **Vibration grade**

The vibration grade of the AC servo motor is V15 at the rated rpm.

- **Direction of installation**

  - Motor can be installed horizontally or at the top or bottom of the shaft.
  - Keep the motor cable downward.
  - If the motor is installed vertically, install a cable trap so that oils or water do not flow into the motor.

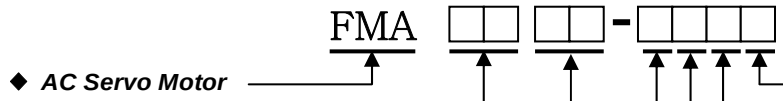
- **Cable disconnection**

  - Take caution not to cause stress or damage to the cables.
  - If the motor is used as a mobile motor, use movable cables.

1.4 Order Specifications

Prior to installing the product, check the ratings plate to see if the related specifications match with those of the order.

1.4.1 Servo motor model marking



Symbol	Use
CN,CK	High-speed, Low torque type
KF,KN	Medium-speed, Standard type
TF,TN	Medium-speed, High torque type
LF,LN	Low-speed, High torque type

Symbol	Rated Output (W)	Symbol	Rated Output (W)
01	100	15	1500
02	200	16	1600
03	300	20	2000
04	400	22	2200
05	450/500	30	3000
06	550/600	35	3500
07	650	40	4000
08	750/800	44	4400
09	850/900	50	5000
10	1000	55	5500
12	1200	75	7500
13	1300		

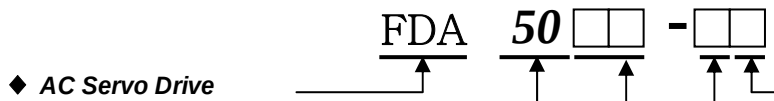
Symbol	Item
0	None
1	Oil seal attached

Symbol	Item
0	None
1	Oil seal attached
2	130 Flange (Brake for 24V)

Symbol	Item
A	Straight & No Key
B	Straight & Key
C	Tapper & Key

Symbol	Pulse	Type
A	2000	Incremental 15 line
B	2500	
C	3000	
D	5000	
E	6000	
F	2048	
G	2048	Absolute 11/13 bit

1.4.2 Servo driver model marking



Symbol	Power (W)	Symbol	Power (W)	Symbol	Power (W)
01	100	10	1000	30	3000
02	200	12	1200	45	4500
04	400	15	1500	75	7500
05	500	20	2000		

Symbol	Encoder Type
None	Incremental
A	Absolute

Symbol	Encoder Type
None	Standard type
M	Standard type + M/Loader
C	Position decision type

1.4.3 AC Servo application table

Motor	Flange	Model	FDA-5001	FDA-5002	FDA-5004	FDA-5005	FDA-5010	FDA-5012	FDA-5015	FDA-5020	FDA-5030	FDA-5045	FDA-5075
CK Series *3000 /5000 (r/min)*	**40**	**CKZ5**	◎										
		CK01	◎										
	60	**CK02**		◎									
		CK04			◎								
CN Series *3000 /5000 (r/min)*	**60**	**CN01**	◎										
		CN02		◎									
		CN03			◎								
		CN04			◎								
		CN05			◎								
	80	**CN04A**			◎								
		CN06				◎							
		CN08				◎							
		CN10					◎						
	130	**CN09**					◎						
		CN15							◎				
		CN22								◎			
		CN30									◎		
	180	**CN30A**								◎			
		CN50A										◎	
		CN70											◎
KN Series *2000 /3000 (r/min)*	**80**	**KN03**			◎								
		KN05			◎								
		KN06				◎							
		KN07					◎						
	130	**KN06A**				◎							
		KN11					◎						
		KN16							◎				
		KN22								◎			
	180	**KN22A**								◎			
		KN35									◎	◎	
		KN55											
		KN70											
TN Series *1500 /3000 (r/min)*	**130**	**TN05**				◎							
		TN09					◎						
		TN13							◎				
		TN17								◎			
	180	**TN20**								◎			
		TN30									◎	◎	
		TN44											
		TN55											
		TN75											◎

Motor	Drive Flange	Model	FDA-5001	FDA-5002	FDA-5004	FDA-5005	FDA-5010	FDA-5012	FDA-5015	FDA-5020	FDA-5030	FDA-5045	FDA-5075
LN Series *1000 /2000 (r/min)*	**130**	**LN03**			◎								
		LN06				◎							
		LN09					◎						
		LN12						◎					
	180	**LN12A**						◎					
		LN20								◎			
		LN30									◎	◎	
		LN40										◎	
KF Series *2000 /3000 (r/min)*	**130**	**KF08**					◎						
		KF10					◎						
		KF15							◎				
	180	**KF22**								◎			
		KF35									◎		
		KF50										◎	
TF Series *1500 /3000 (r/min)*	**130**	**TF05**				◎							
		TF09					◎						
		TF13							◎				
	180	**TF20**								◎			
		TF30									◎		
		TF44										◎	
LF Series *1000 /2000 (r/min)*	**130**	**LF03**			◎								
		LF06				◎							
		LF09					◎						
	180	**LF12**						◎					
		LF20								◎			
		LF30									◎		

1.5 Functions that facilitate starting

The following are the functions that help diagnosing and starting of the control panel and the machine.

Major function	Description
Autotuning	This function automatically calculates the load's inertia moment by detecting the current and speed at the time of starting. Adjusting of the machine, which so far has been carried out based on experience and senses (six senses and intuition), can easily be performed. **[Refer to Control Mode, P2-23, 24]**
Test operation carried out without external instructions (Jog operation)	Motor can be run with only the servo driver loader without positioning system or separate operation panel. Motor speed can also be selected freely, and machine operation can be tested easily. **[Refer to Test Mode, P6]**
Motorless operation (Simulation operation)	This test mode operation function can operate the servo amplifier without the motor. The control panel can independently check functions or sequences. **[Refer to Test Mode, P6]**
Abundant status display functions	With abundant status displays, such as command speed, rpm, load ratio, pulse error and I/O status, the digital servo enables simplified diagnosis of operations. **[Refer to Status Window, St--]**

2. Ratings and Specifications

2.1 Ratings and specifications for AC servo driver FDA-5000 series

Item \ Model		FDA-5001	FDA-5002	FDA-5004	FDA-5005	FDA-5010	FDA-5012	FDA-5015	FDA-5020	FDA-5030	FDA-5045	FDA-5075
Input power supply	Power supply voltage *(Note 1)	3 phase AC200~230V +10/-15%, 50/60Hz										
	Power capacity [kVA]	0.5	0.8	1.3	1.5	2.1	2.5	3.1	4.1	6.0	8.0	12.0
Applicable motor	Voltage type	3-phase sine wave drive AC servo motor										
	Continuous output current [A]	1.25	2.1	3.2	4.2	6.9	9.8	11	16	21	32	50
	Maximum output current [A]	3.8	6.3	9.6	12.6	19.2	29	33	48	63	96	132
Detector	Detector model	Standard: Incremental 2000 [p/rev] 15-wire type										
	Output signal type	Differential line driver output										
	Detector accuracy	1000-10000 [p/rev] (Not to exceed 400 [kp/sec])										
	Detector power supply	Not to exceed DC 5 [V], 0.3 [A]										
Drive system		3-phase voltage type PWM drive (IPM used)										
Speed control specifications	Speed control range	1:5000										
	Frequency response characteristics	250 Hz										
	Speed command input	DC -10 ~ +10 [V], maximum speed (can be adjusted on loader) Internal digital command (operation can be set in 7 steps)										
	Speed fluctuation rate	Not exceeding ±0.01% (Rated load: 0-100%) Not exceeding ±0.01% (Rated power supply: ±10%) Not exceeding ±0.1% (Temperature fluctuation : 25 ±25℃)										
	Acceleration/deceleration time	Can be accelerated/decelerated in straight line or in "S" shape (0-100 [sec] in unit of 0.01 sec)										
Position control specifications	Position input frequency	300 [kpps]										
	Position input type	Direction + pulse, forward run pulse + reverse run pulse 2-phase pulse (A phase + B phase)										
	Position input type	Open collector, line driver system										
Torque control specifications	Torque command input	DC -10 ~ +10 [V], Maximum command (can be adjusted on loader)										
	Torque linearity	Not exceeding 4 [%]										
	Limit speed command	DC -10 ~ +10 [V], Maximum speed (can be adjusted on loader)										
Built-in functions	Protective functions	Overcurrent, regenerated overvoltage, overload, motor miswiring, drive overheat, encoder error, voltage shortage, overspeed and excessive error.										
	Regenerated resistance	Standard separately attached type										
	Load inertia (GD^2)	See motor specifications table										
	Monitor output	Speed, torque (-4 ~ +4 [V])										
	Dynamic brake	built in										
	Additional functions	Testing function (jog and motorless operation), alarm history, forward and backward run, encoder signal frequency division output										
Option		Power cable, encoder cable, CN1 connector, CN2 connector										
		Loader: Mount Loader Digital Loader										D/Loader
Environmental specifications	Operating ambient temperature	0-50 [℃]										
	Ambient humidity	Not to exceed 90 [%] (Should be free of dewing)										
	Storage temperature	-20 ~ +80 [℃]										
	Insulating resistance	To be greater than DC 500 [V] 10 [MΩ]										
Structure		Book Type										

(Note 1) The model name of the servo driver which uses absolute value encoder is FDA-5000A.

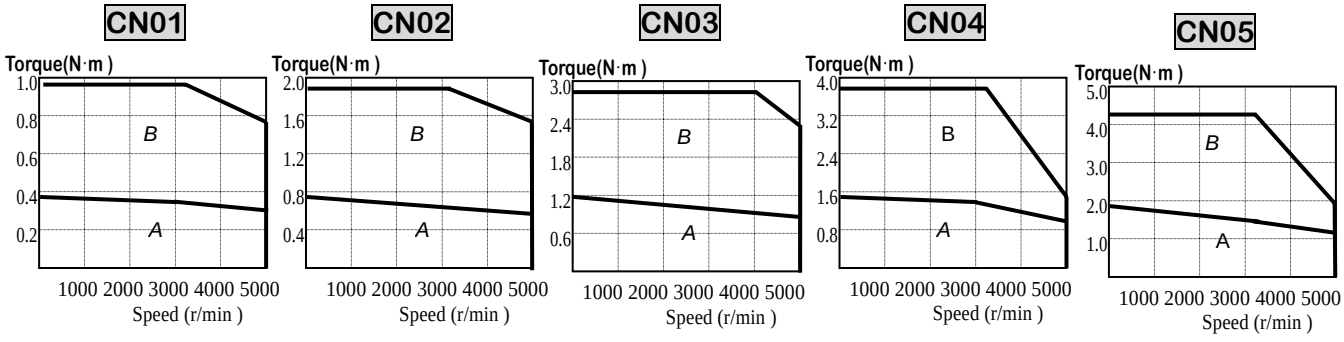
(Note 2) Single-phase AC 220V can also be used. However, as output may become lower than the rated value, increase the servo driver capacity by 1 step if possible.

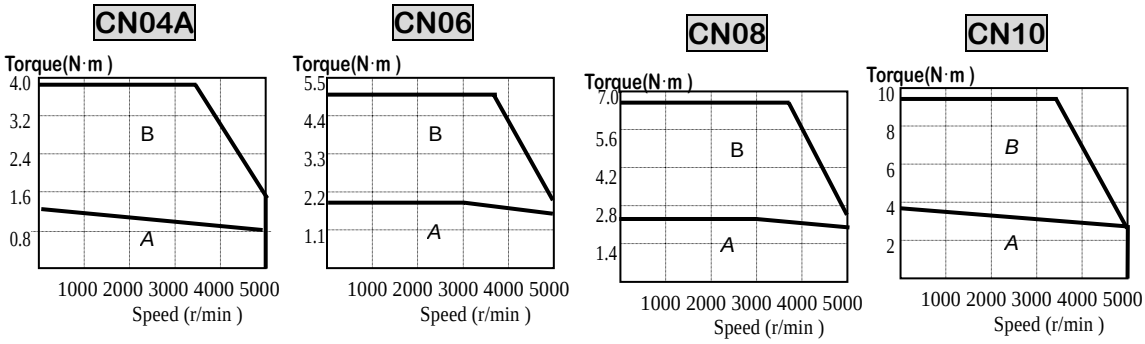
2.2 AC Servo Motor Ratings and Specifications

Spec. \ Model	Motor	CN01	CN02	CN03	CN04	CN05	CN04A	CN06	CN08	CN10
	Driver	5001	5002	5004				5005		5010
Flange size (□)		60					80			
Rated output	(W)	100	200	300	400	500	400	600	800	1000
Rated torque	(N·m)	0.32	0.64	0.96	1.27	1.59	1.27	1.91	2.54	3.18
	(kgf·cm)	3.25	6.5	9.75	13.0	16.2	13.0	19.5	26.0	32.5
Maximum instantaneous torque	(N·m)	0.96	1.92	2.88	3.81	4.77	3.81	5.3	6.85	9.53
	(kgf·cm)	9.75	19.5	29.3	39.0	48.7	39.0	54.5	70.2	97.5
Rated rpm	(r/min)	3000								
Maximum rpm	(r/min)	5000								
Rotor inertia (= $GD^2/4$)	($gf \cdot cm \cdot s^2$)	0.061	0.095	0.126	0.160	0.204	1.1	1.5	1.77	2.11
	($kg \cdot m^2 \times 10^{-4}$)	0.06	0.093	0.129	0.163	0.208	1.08	1.47	1.74	2.07
Allowable load inertia Ratio(Versus rotor)		Not exceeding 30 times					Not exceeding 20 times			
Rated power rate	(kW/s)	17.0	43.6	73.9	103.5	126.1	15.0	24.8	37.4	49.0
Detector type	Standard	Incremental 2000								
	Option	Absolute 11/13bit 2048P/rev								
Weight	(kg)	0.85	1.14	1.43	1.73	2.03	2.1	2.55	3.1	3.7

■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

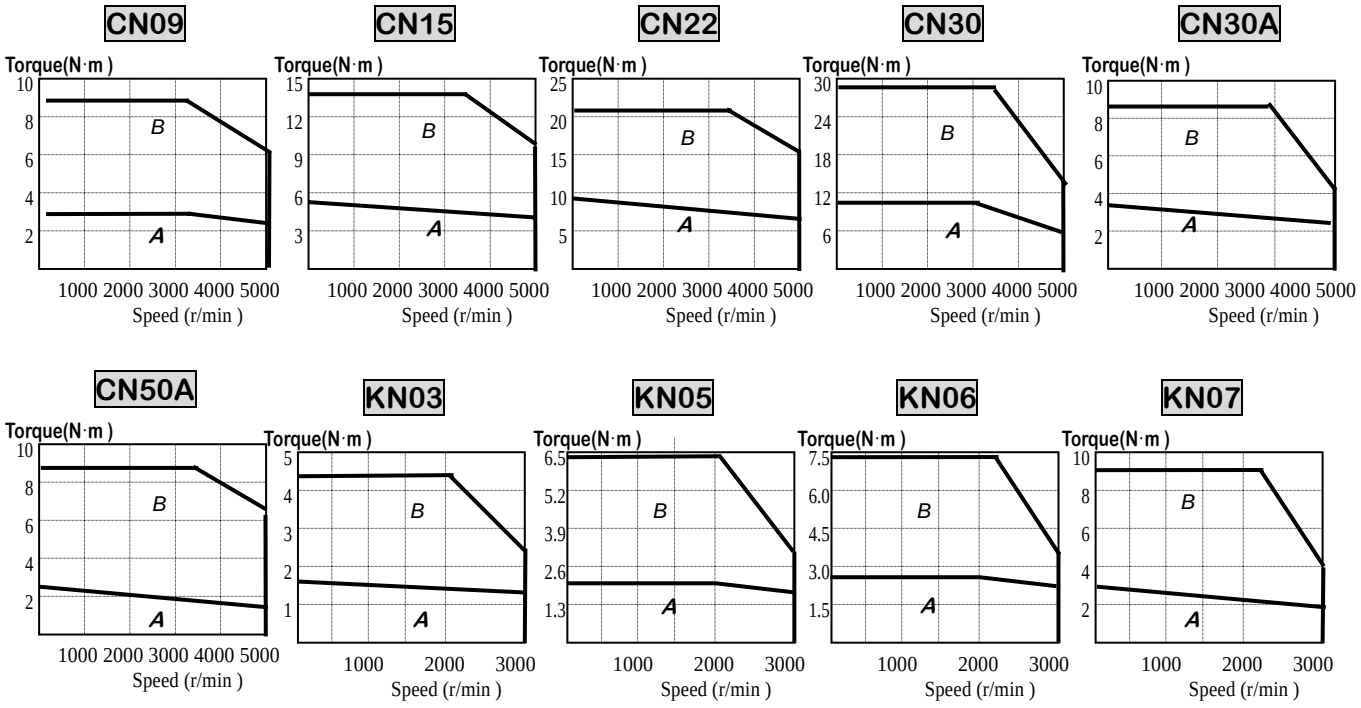




Model / Spec.	Motor	CN09	CN15	CN22	CN30	CN30A	CN50A	KN03	KN05	KN06	KN07
	Driver	5010	5015	5020	5030	5030	5045	5004	5004	5005	5010
Flange size (□)		130				180		80			
Rated output (W)		900	1500	2200	3000	3000	5000	300	450	550	650
Rated torque	(N · m)	2.86	4.77	7.0	9.54	9.54	15.9	1.43	2.15	2.57	3.04
	(kgf · cm)	29.2	48.7	71.4	97.4	97.4	162.3	14.6	21.9	26.2	31
Maximum instantaneous torque	(N · m)	8.6	14.3	21	28.6	23.9	39.8	4.29	6.45	7.42	9.12
	(kgf · cm)	87.6	146	214	292	243.5	405.8	43.8	65.7	72.7	93
Rated rpm (r/min)		3000						2000			
Maximum rpm (r/min)		5000				4500		3000			
Rotor inertia (= $GD^2/4$)	(gf · cm · s^2)	4.12	7.63	11.12	14.63	26.1	43.8	1.1	1.5	1.77	2.11
	(kg · m^2 x 10^{-4})	4.04	7.48	10.9	14.34	25.6	42.9	1.08	1.47	1.74	2.07
Allowable load inertia Ratio(Versus rotor)		Not exceeding 10 times						Not exceeding 20 times			
Rated power rate (kW/s)		20.4	30.6	45.1	63.9	35.7	58.9	18.9	31.3	38.0	44.6
Detector type	Standard	Incremental 2000									
	Option	Absolute 11/13bit 2048P/rev									
Weight (kg)		5.5	7.0	8.5	10.0	12.9	18.2	2.1	2.55	3.1	3.7

■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

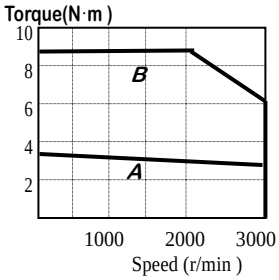


Spec. \ Model	Motor	KN06A	KN11	KN16	KN22	KN22A	KN35	KN55
	Driver	5005	5010	5015	5020	5020	5030	5045
Flange size (□)		130				180		
Rated output	(W)	600	1100	1600	2200	2200	3500	5500
Rated torque	(N·m)	2.86	5.25	7.64	10.5	10.49	16.67	26.18
	(kgf·cm)	29.2	53.6	77.9	107	107	170	267
Maximum instantaneous torque	(N·m)	8.6	14.2	22.5	28.6	26.2	41.7	65.4
	(kgf·cm)	87.6	145	230	292	267.5	425.0	667.5
Rated rpm	(r/min)	2000						
Maximum rpm	(r/min)	3000						
Rotor inertia (= $GD^2/4$)	($gf \cdot cm \cdot s^2$)	4.12	7.63	11.12	14.63	26.1	43.8	67.8
	($kg \cdot m^2 \times 10^{-4}$)	4.04	7.48	10.9	14.34	25.6	42.9	66.4
Allowable load inertia Ratio(Versus rotor)		Not exceeding 10 times						
Rated power rate	(kW/s)	20.4	30.6	53.5	76.7	43.0	64.7	103.0
Detector type	Standard	Incremental 2000						
	Option	Absolute 11/13bit 2048P/rev						
Weight	(kg)	5.5	7.0	8.5	10.0	12.9	18.2	26.8

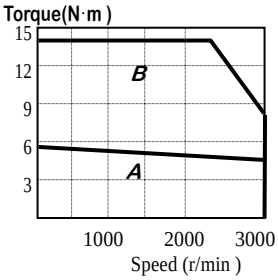
■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

KN06A



KN11



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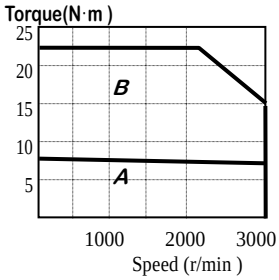
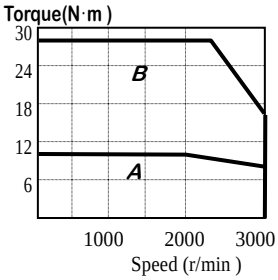
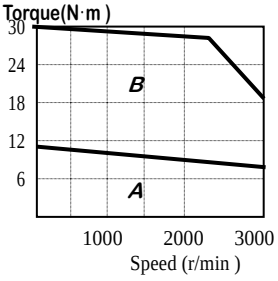


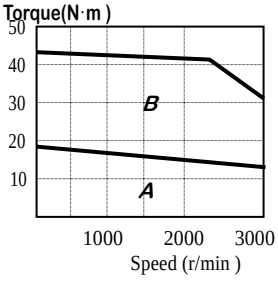
KN22



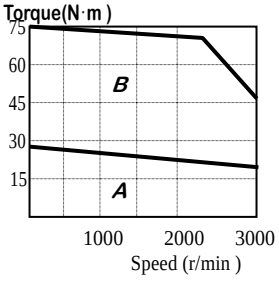
KN22A



KN35



KN55

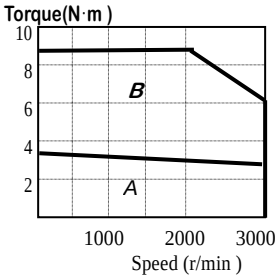


Spec. \ Model	Motor	TN05	TN09	TN13	TN17	TN20	TN30	TN44	TN75
	Driver	5005	5010	5015	5020	5020	5030	5045	5075
Flange size (□)		130				180			
Rated output	(W)	450	850	1300	1700	1800	2900	4400	7500
Rated torque	(N·m)	2.87	5.41	8.27	10.8	11.5	18.6	27.9	47.7
	(kgf·cm)	29.3	55.2	84.4	110	117	190	285	486.9
Maximum instantaneous torque	(N·m)	8.61	14.2	22.5	29.4	28.7	46.6	69.9	119.3
	(kgf·cm)	89.5	145	230	300	292.5	475	712.5	1217
Rated rpm	(r/min)	1500							
Maximum rpm	(r/min)	3000							
Rotor inertia (= $GD^2/4$)	($gf \cdot cm \cdot s^2$)	4.12	7.63	11.12	14.63	26.1	43.8	67.8	126.4
	($kg \cdot m^2 \times 10^{-4}$)	4.04	7.48	10.9	14.34	25.1	42.9	66.4	123.9
Allowable load inertia Ratio(Versus rotor)		Not exceeding 10 times							
Rated power rate	(kW/s)	20.5	39.1	62.8	81.1	51.5	80.8	117.4	183.8
Detector type	Standard	Incremental 2000							
	Option	Absolute 11/13bit 2048P/rev							
Weight	(kg)	5.5	7.0	8.5	10.0	12.9	18.2	26.8	45.7

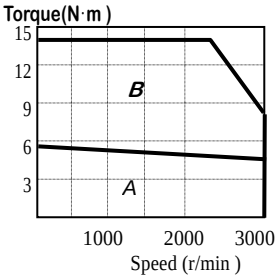
■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

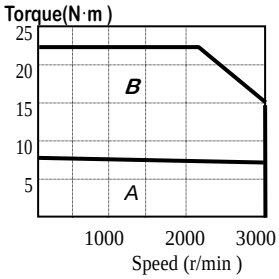
TN05



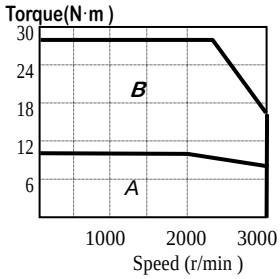
TN09



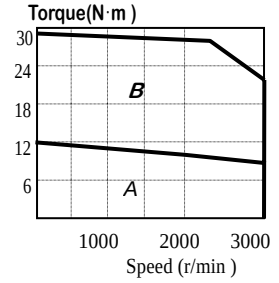
TN13



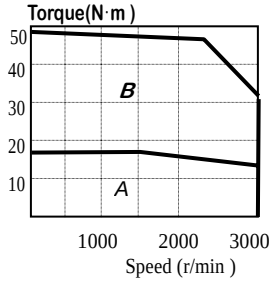
TN17



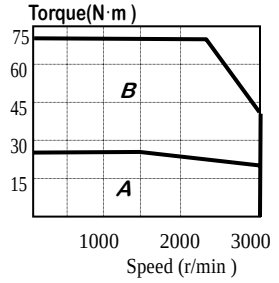
TN20



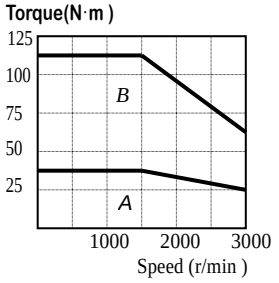
TN30



TN44



TN75

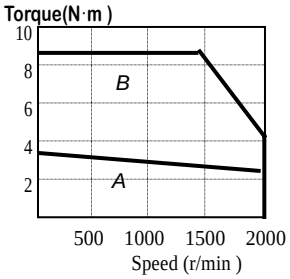


Spec. \ Model	Motor	LN03	LN06	LN09	LN12	LN12A	LN20	LN30	LN40
	Driver	5004	5005	5010	5012	5012	5020	5030	5045
Flange size (□)		130				180			
Rated output	(W)	300	600	900	1200	1200	2000	3000	4000
Rated torque	(N·m)	2.86	5.72	8.6	11.5	11.5	19.1	28.6	38.2
	(kgf·cm)	29.2	58.4	87.7	117	116.9	194.8	292.2	389.6
Maximum instantaneous torque	(N·m)	8.6	14.3	22.1	34.4	28.7	47.8	71.6	95.5
	(kgf·cm)	87.6	146	226	351	292.3	487	730.5	974
Rated rpm	(r/min)	1000							
Maximum rpm	(r/min)	2000							
Rotor inertia (= $GD^2/4$)	($gf \cdot cm \cdot s^2$)	4.12	7.63	11.12	14.63	26.1	43.8	67.8	100.1
	($kg \cdot m^2 \times 10^{-4}$)	4.04	7.48	10.9	14.34	25.6	42.9	66.4	98.1
Allowable load inertia Ratio(Versus rotor)		Not exceeding 10 times							
Rated power rate	(kW/s)	20.5	43.3	68.2	91.7	51.4	84.9	123.4	148.6
Detector type	Standard	Incremental 2000							
	Option	Absolute 11/13bit 2048P/rev							
Weight	(kg)	5.5	7.0	8.5	10.0	12.9	18.2	26.8	36.1

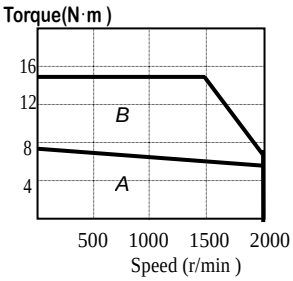
■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

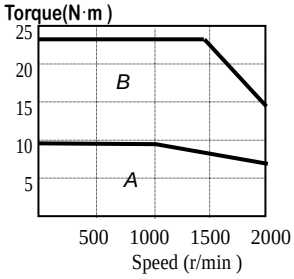
LN03



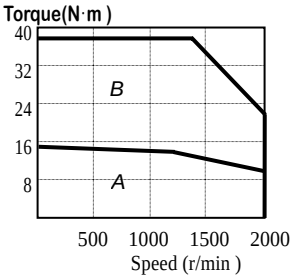
LN06



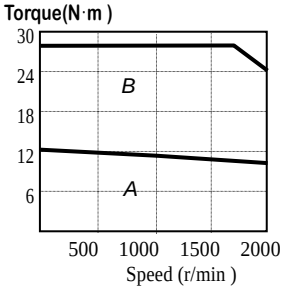
LN09



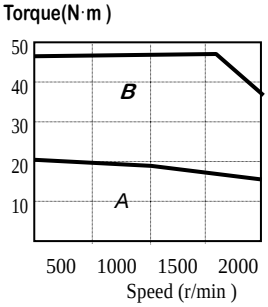
LN12



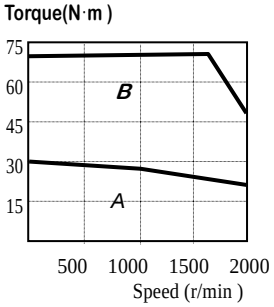
LN12A



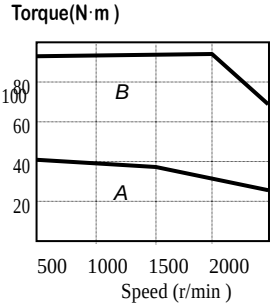
LN20



LN30



LN40

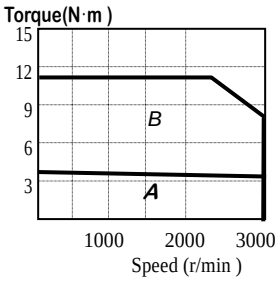


Spec. \ Model	Motor	KF08	KF10	KF15	KF22	KF35	KF50
	Driver	5010		5015	5020	5030	5045
Flange size (□)		130			180		
Rated output	(W)	750	1000	1500	2200	3500	5000
Rated torque	(N·m)	3.58	4.77	7.16	10.5	16.7	23.9
	(kgf·cm)	36.53	48.7	73.1	107	170	244
Maximum instantaneous torque	(N·m)	10.74	14.31	21.56	31.4	50.0	71.7
	(kgf·cm)	109.5	146.0	220.0	321	510	732
Rated rpm	(r/min)	2000					
Maximum rpm	(r/min)	3000					
Rotor inertia (= $GD^2/4$)	($gf \cdot cm \cdot s^2$)	10.5	15.5	25.3	65.3	100.5	159.1
	($kg \cdot m^2 \times 10^{-4}$)	10.3	15.2	24.8	64.0	98.5	156
Allowable load inertia Ratio(Versus rotor)		Not exceeding 10 times					
Rated power rate	(kW/s)	12.3	15.0	20.7	17.2	28.2	36.4
Detector type	Standard	Incremental 2000					
	Option	Absolute 11/13bit 2048P/rev					
Weight	(kg)	8.2	11.6	15.8	17.2	27.4	38.3

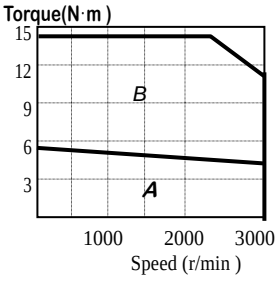
■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

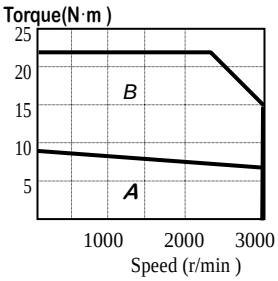
KF08



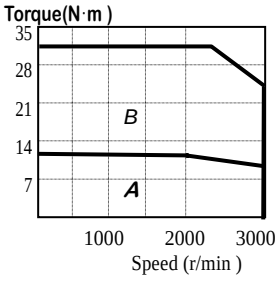
KF10



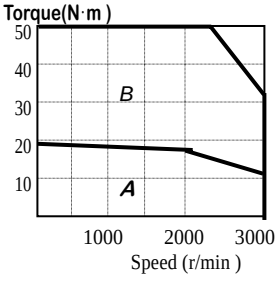
KF15



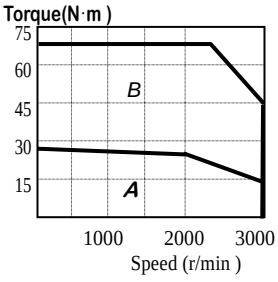
KF22



KF35



KF50

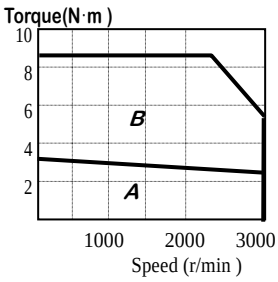


Model / Spec.	Motor	TF05	TF09	TF13	TF20	TF30	TF44
	Driver	5005	5010	5015	5020	5030	5045
Flange size (□)		130			180		
Rated output (W)		450	850	1300	1800	2900	4400
Rated torque	(N·m)	2.87	5.41	8.27	11.5	18.6	27.9
	(kgf·cm)	29	55	85	117	190	285
Maximum instantaneous torque	(N·m)	8.61	14.7	24.5	34.4	55.9	77.5
	(kgf·cm)	89.5	150	250	351	570	790
Rated rpm (r/min)		1500					
Maximum rpm (r/min)		3000					
Rotor inertia (= $GD^2/4$)	($gf \cdot cm \cdot s^2$)	10.5	15.5	25.3	65.3	100.5	159.1
	($kg \cdot m^2 \times 10^{-4}$)	10.3	15.2	24.8	64.0	98.5	156
Allowable load inertia Ratio(Versus rotor)		Not exceeding 10 times					
Rated power rate (kW/s)		7.85	19.1	28.0	20.5	35.2	50.0
Detector type	Standard	Incremental 2000					
	Option	Absolute 11/13bit 2048P/rev					
Weight (kg)		8.2	11.6	15.8	17.2	27.4	38.3

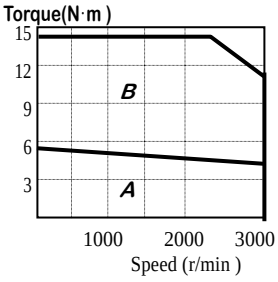
■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

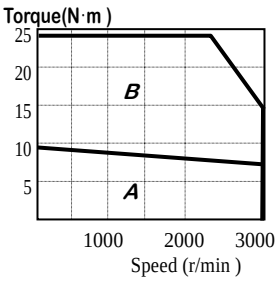
TF05



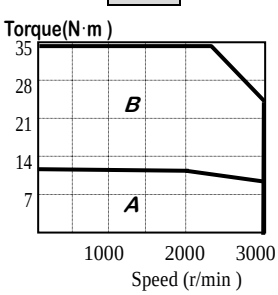
TF09



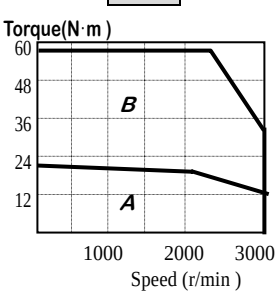
TF13



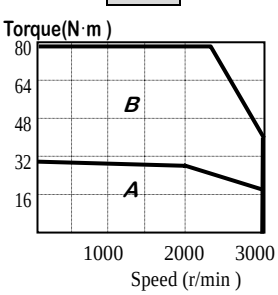
TF20



TF30



TF44

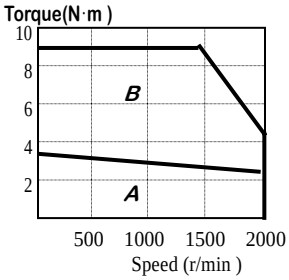


Model / Spec.	Motor	LF03	LF06	LF09	LF12	LF20	LF30
	Driver	5004	5005	5010	5012	5020	5030
Flange size (□)		130			180		
Rated output	(W)	300	600	900	1200	2000	3000
Rated torque	(N·m)	2.84	5.68	8.62	11.5	19.1	28.4
	(kgf·cm)	29	58	88	117	195	290
Maximum instantaneous torque	(N·m)	8.7	16.5	23.0	34.4	57.3	78.7
	(kgf·cm)	90	169	235	351	585	803
Rated rpm	(r/min)	1000					
Maximum rpm	(r/min)	2000					
Rotor inertia (= $GD^2/4$)	($gf \cdot cm \cdot s^2$)	10.5	15.5	25.3	65.3	100.5	159.1
	($kg \cdot m^2 \times 10^{-4}$)	10.3	15.2	24.8	64.0	98.5	156
Allowable load inertia Ratio(Versus rotor)		Not exceeding 10 times					
Rated power rate	(kW/s)	7.85	21.3	30.0	20.5	37.0	51.8
Detector type	Standard	Incremental 2000					
	Option	Absolute 11/13bit 2048P/rev					
Weight	(kg)	8.2	11.6	15.8	17.2	27.4	38.3

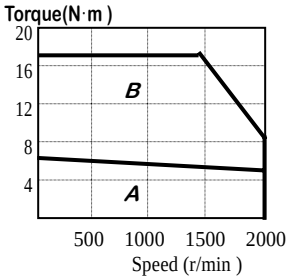
■ Speed and Torque Characteristics

A : Continuous duty zone & B : Intermittent duty zone

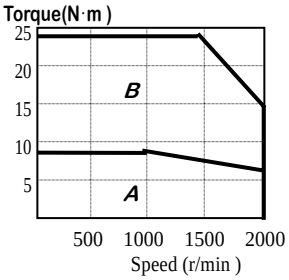
LF03



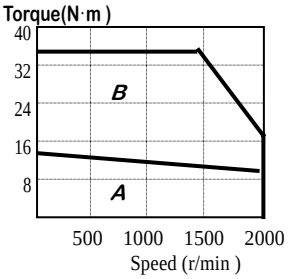
LF06



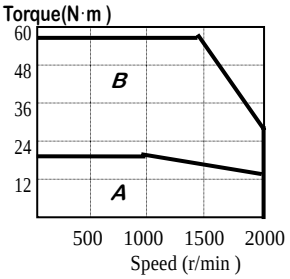
LF09



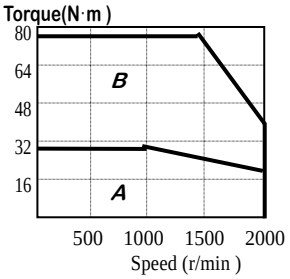
LF12



LF20

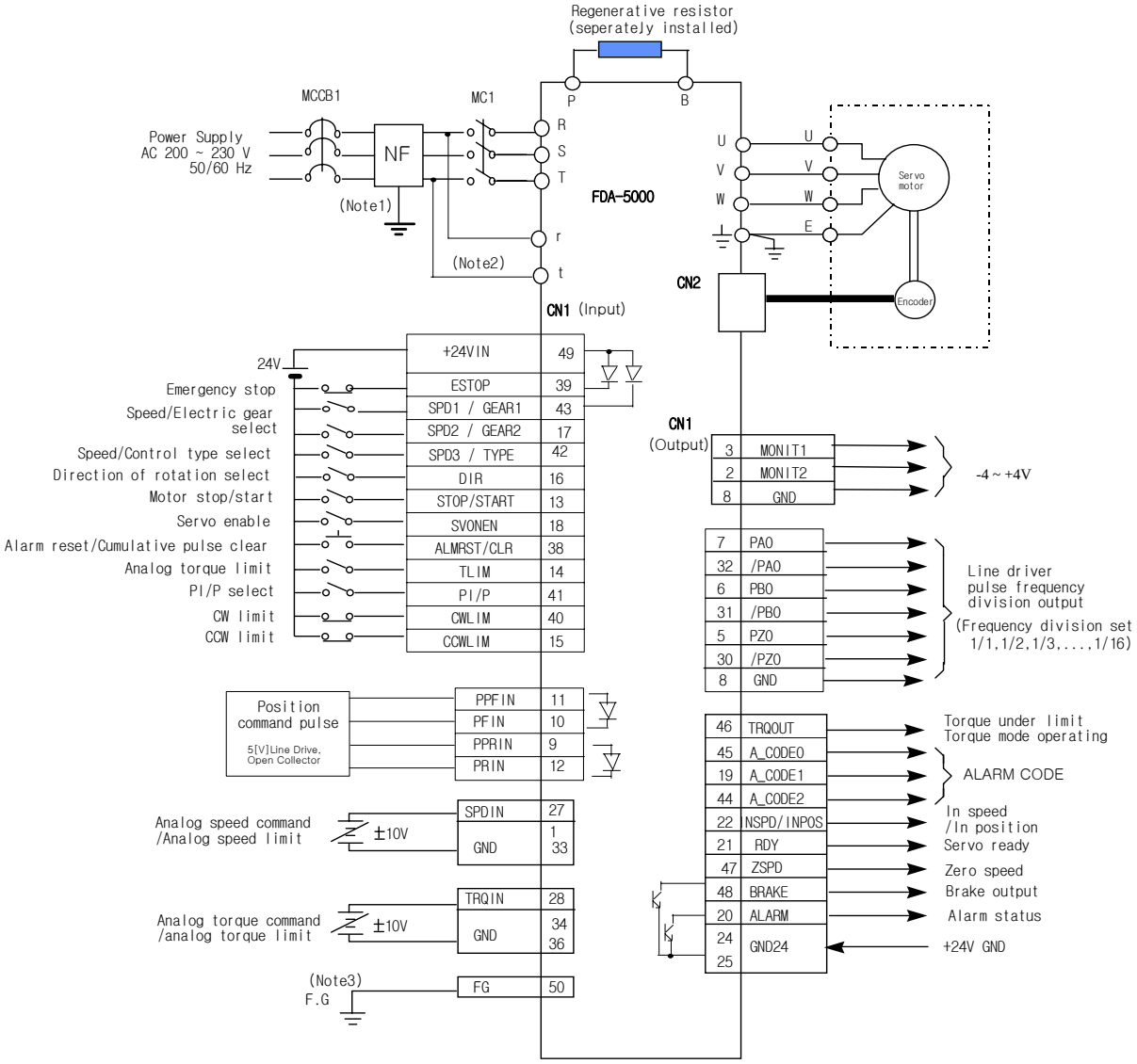


LF30



3. Wiring and Signals

3.1 Representative wiring



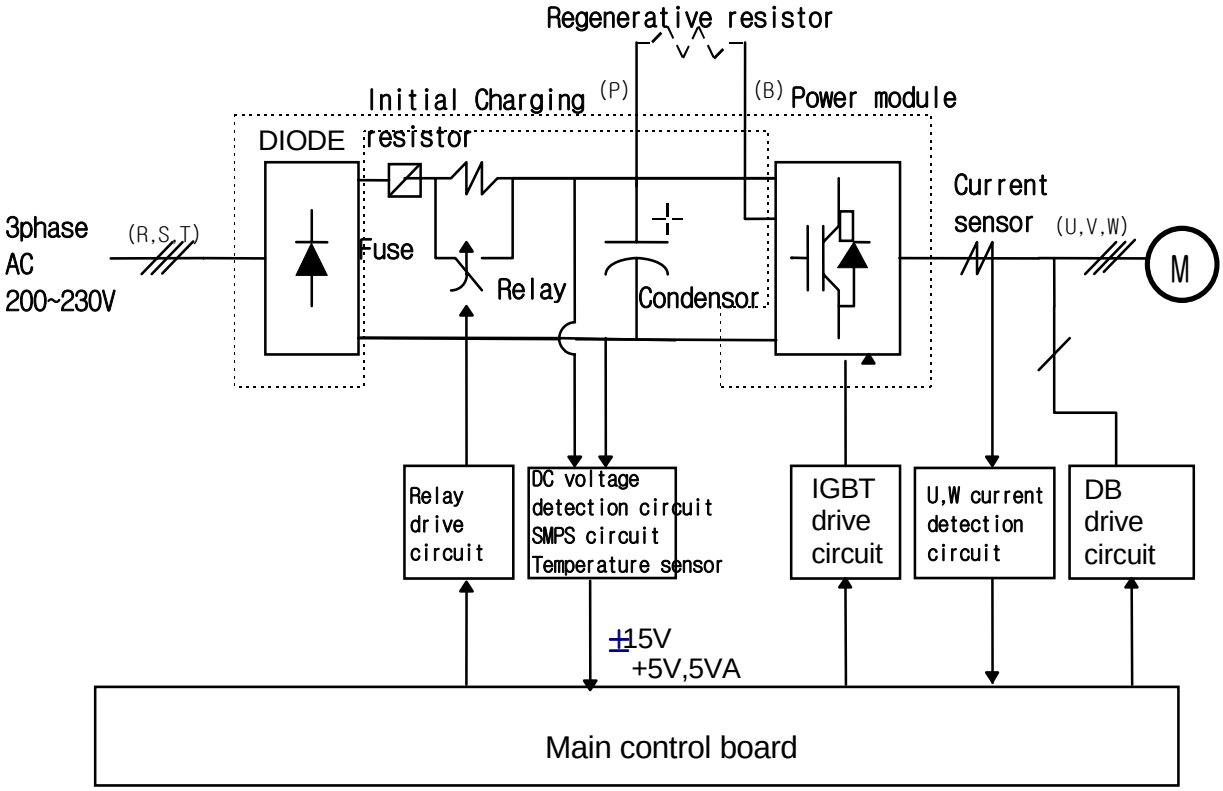
- **Note 1:** NF is an abbreviation for Noise Filter. Use this to prevent infiltration of noise from external sources.

- **Note 2:** For FDA-5005-75 type, connect single-phase AC220 [V] to the r and t terminals of the spare power supply.
  FDA-5001-4 type is not provided with r and t terminals.

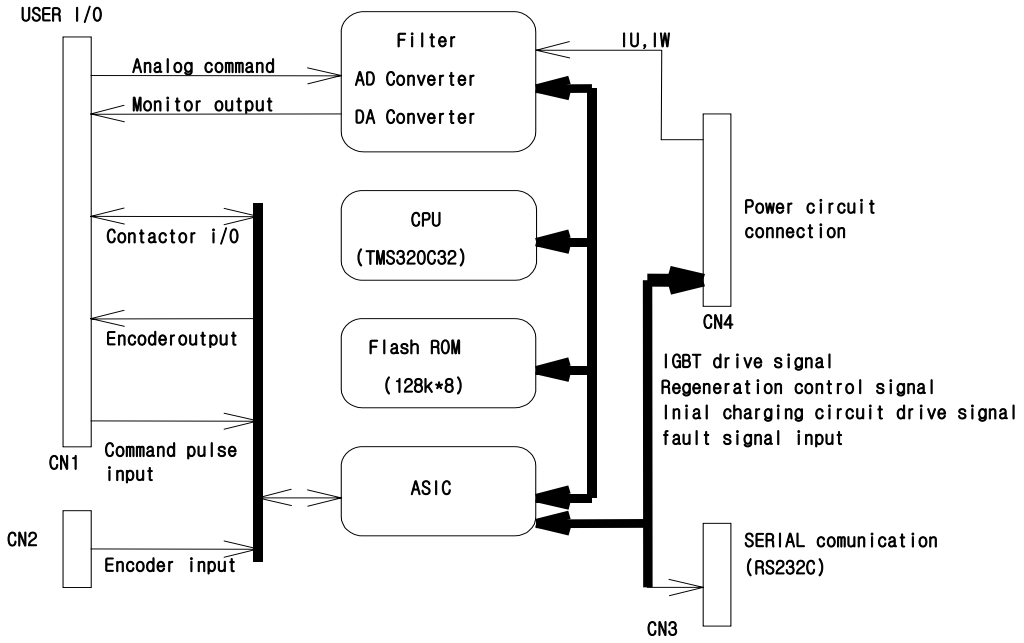
- **Note 3:** Use CN1 earth cable to ground the F.G. (Frame Ground) terminals.

3.2 Internal Configuration

3.2.1 Power board configuration

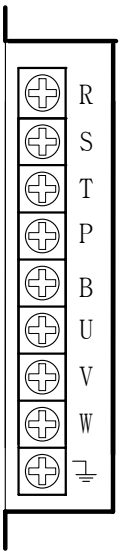


3.2.2 Control board configuration



3.3 Main Circuit Terminal Board Wiring

3.3.1 Main circuit terminal board wiring



Open the main circuit terminal board cover to see the terminal board. Terminal names are located on the right side of the terminal board. (See figure on the right side.)

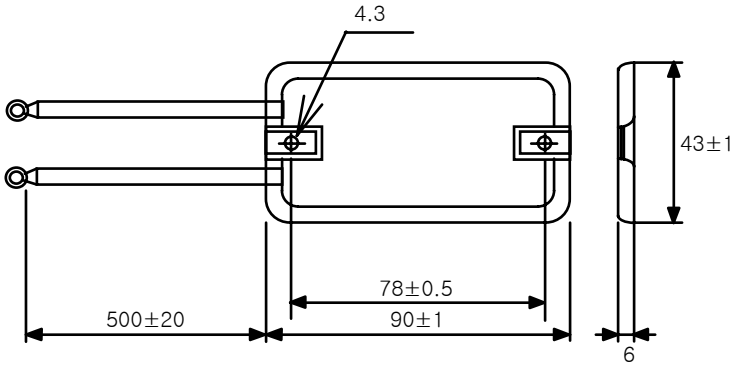
Uses and wiring methods of FDA-5001□-5004□ are as follows.

1) The R, S and T terminals are used to connect main power supply of 3-phase AC 200-230 [V] to the power circuits.
   *__(Note)__ Single-phase AC 220V may also be used; however, output may be lower than the rated value.
   Install overcurrent breaker on the main power supply input unit. Also, install noise filter on the power supply input terminal to shut off noise coming from the power lines.
2) Connect regenerated resistance between P and B terminals. The standard regenerated resistance (See Table 3.1) is a standard item. (Install it on the electric panel.)
3) Connect the U, V and W phases of the servo motor to the U, V and W terminals.
4) Ground the terminal. Also connect the servo motor earth cable to this terminal.

[Table 3.1. Recommended parts to be installed on electric panel]

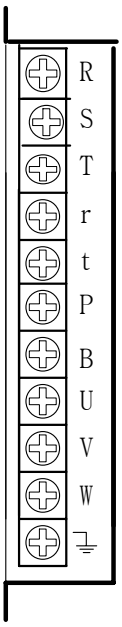
AC Servo drive system	FDA-5001	FDA-5002	FDA-5004
Wire thickness	AWG #16 (1.25 mm^2)		
Drive system side press terminal	KET GP110012		
Switch	GMC-12 (13A) or equivalent		
Breaker	ABS 33b (5A) or equivalent		
Noise filter	NFS 305 or NFS 310		
Standard regenerated resistance (for P and B terminals)	50W 50Ω (Size: Refer to external view1)		

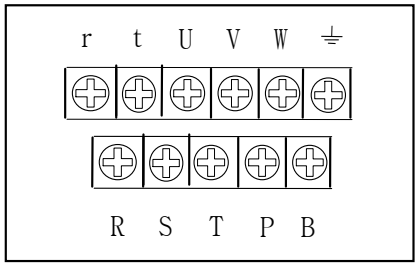
[External view1] 50W 50Ω



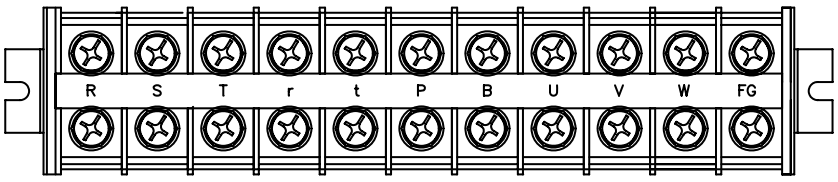
Uses and wiring methods of FDA-5005□-5075□ are as follows.

1) The R, S and T terminals are used to connect main power supply of 3-phase AC 200-230[V] to the power circuits.
   *__(Note)__ Single-phase AC 220V may also be used; however, output may be lower than the rated value.
   Install overcurrent breaker on the main power supply input unit. Also, install noise filter on the power supply input terminal to shut off noise coming from the power lines.
2) The R and T terminals are for the auxiliary power supply of the power circuit. Connect single-phase AC 200-230 [V] to these terminals.
3) Connect regenerated resistance between P and B terminals.
   The standard regenerated resistance (See Table 3.1) is a standard item. (Install it on the electric panel.)
4) Connect the U, V and W phases of the servo motor to the U, V and W terminals.
5) Ground the terminal. Also connect the servo motor earth cable to this terminal.





[FDA-5005□-5012□ Main circuit terminal] **[FDA-5015□-5045□ Main circuit terminal]**

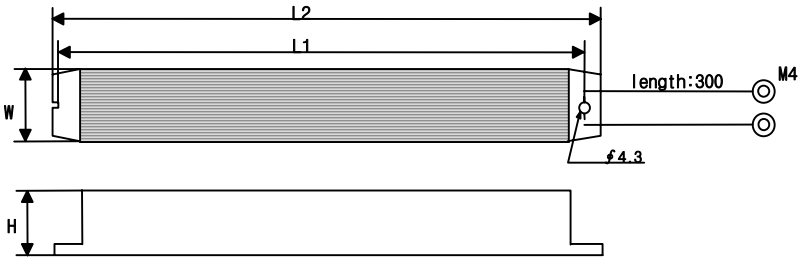


[FDA-5075□ Main circuit terminal]

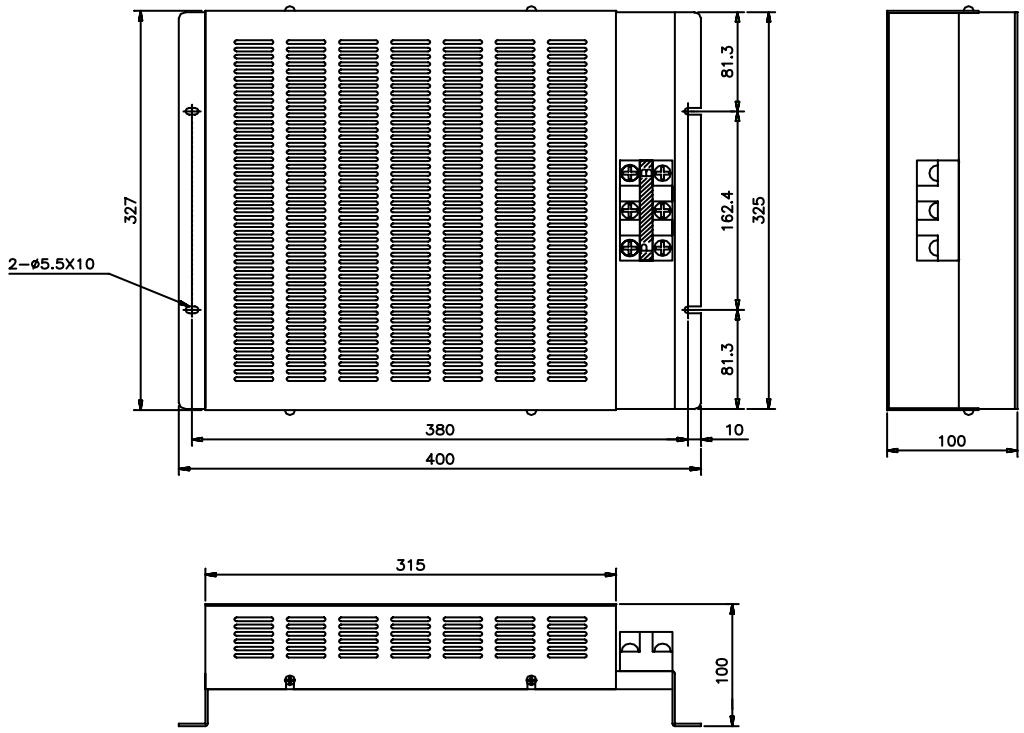
[Table 3.2. Recommended parts to be installed on electric panel]

<table>
<tr><th>AC SERVO Drive system</th><th>FDA-5005□</th><th>FDA-5010□</th><th>FDA-5012□</th><th>FDA-5015□</th><th>FDA-5020□</th><th>FDA-5030□</th><th>FDA-5045□</th><th>FDA-5075□</th></tr>
<tr><td>Wire thickness</td><td>AWG #14 (2.0mm^2)</td><td colspan="4">AWG #12 (3.5mm^2)</td><td colspan="2">AWG #10 (5.5mm^2)</td><td>AWG #8 (8.0mm^2)</td></tr>
<tr><td>Drive system side press terminal</td><td>KET GP110012</td><td colspan="4">KET GP110721</td><td colspan="2">KET GP110027</td><td>KET GP110733</td></tr>
<tr><td>Switch</td><td>GMC-12(13A) equivalent</td><td colspan="2">GMC-22(20A) equivalent</td><td colspan="2">GMC-40(35A) equivalent</td><td colspan="2">GMC-65(65A) equivalent</td><td>GMC-85(80A) equivalent</td></tr>
<tr><td>Breaker</td><td>ABS33b (5A) or equivalent</td><td colspan="3">ABS33b (10A) or equivalent</td><td>ABS33b (20A) or equivalent</td><td colspan="2">ABS33b (30A) or equivalent</td><td>ABS53b (50A) or equivalent</td></tr>
<tr><td>Noise Filter</td><td colspan="6">NFZ-4030SG</td><td>NFZ-4040SG</td><td>NFZ-4050SG</td></tr>
<tr><td rowspan="2">Standard regenerated resistance (for P and B terminals) Size</td><td colspan="3">150W 50Ω
(L1=172, L2=188, W=42, H=20)</td><td>250W 25Ω
(L1=220, L2=239, W=60,H=30)</td><td colspan="3">250W 25Ω
2 units in parallel (same as left)</td><td>250W 25Ω 4 units in parallel</td></tr>
<tr><td colspan="7">See external view 2</td><td>See External view 3</td></tr>
</table>

[External view 2] 150W / 250W

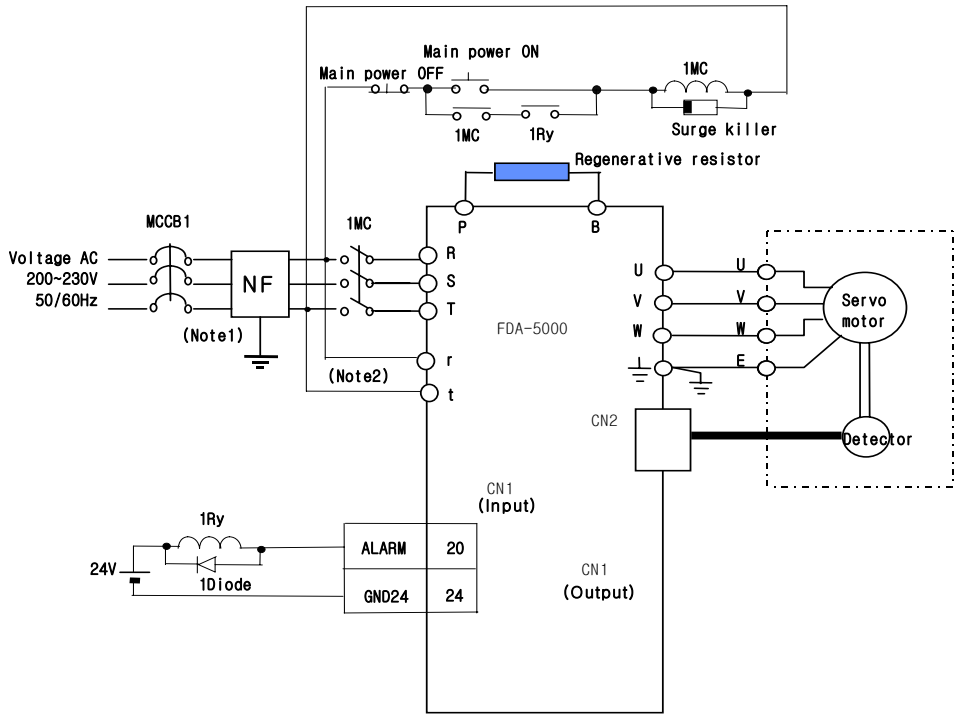


[External view 3] 250W*4 (FDA-5075)



3.3.2 Turning ON/Off of power supply

As the main circuit of the servo driver is designed in condenser input type, high charging current (charging time approximately 03-0.5 seconds) flows when main power is connected. If the main power supply is turned ON/OFF frequently, the main circuit element may be deteriorated leading to an error. Use SVONEN (CN1-18) terminal and Stop (CN1-13) terminal to start or stop the motor. The following is an example of wiring showing how to turn off/on power supply.



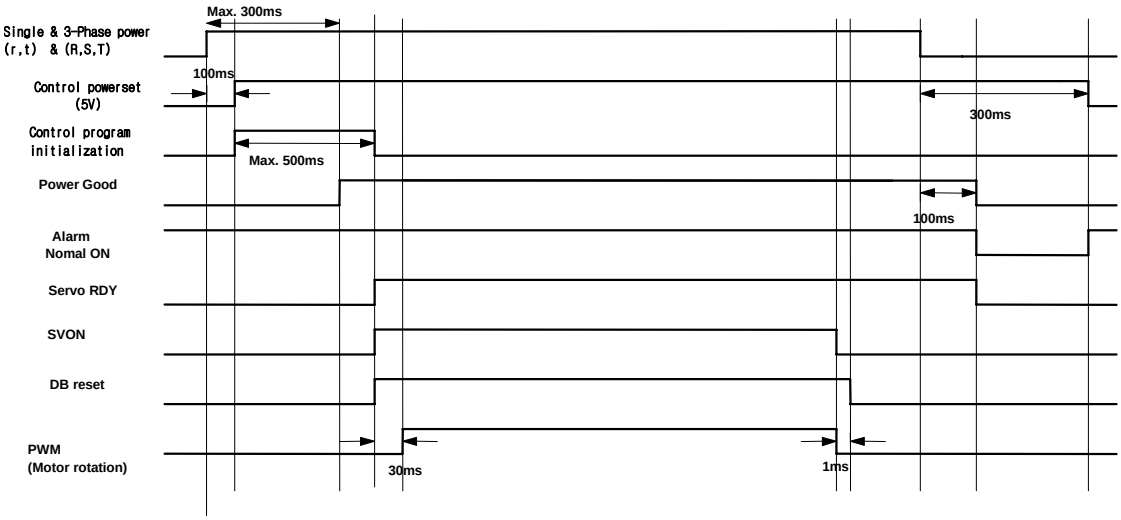
- **Note 1:** NF is an abbreviation for Noise Filter. Use this to prevent infiltration of noise from external sources.
- **Note 2:** For FDA-5005-75 type, connect single-phase AC220[V] to the r and t terminals of spare power supply.
  FDA-5001-4 type is not provided with the r and t terminals.

(Caution!)

1) It takes approximately 1-2 seconds before Alarm signal is activated after power is connected. Press power switch for at least 2 seconds or longer.
2) If the main power is connected immediately after power is shut off, Power Fail (AL-04) alarm may occur. Connect power at least 10 seconds after the power is turned off.
3) The above wiring diagram shows that only the main power is turned off when alarm occurs and you can check the details of the alarm.

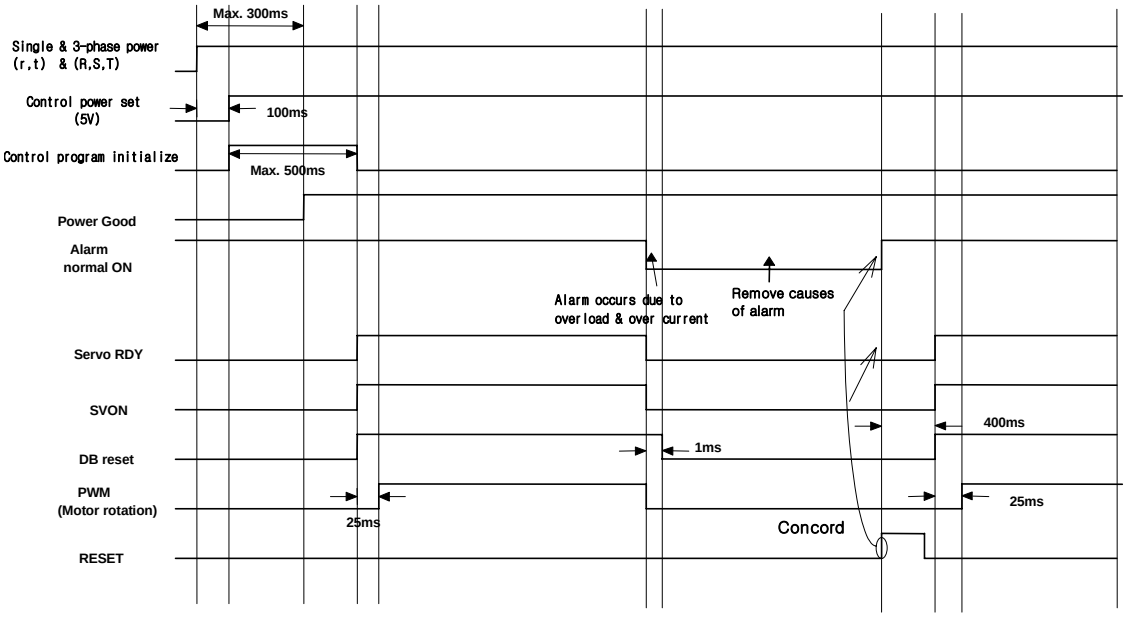
3.3.3 Timing diagram at the time of power connection

In the case of FDA-5001-4, power is supplied to the control circuit if 3-phase power is connected to the R, S and T terminals. In the case of FDA-5005-10, power is supplied to the control circuit if single-phase power is connected to the r and t terminals.
Servo becomes RDY after maximum 300 ms, the time required to initialize the inside of the drive system; and if the servo drive signal is turned on, operation starts 25 ms later.



3.3.4 Timing diagram at the time of Alarm occurrence

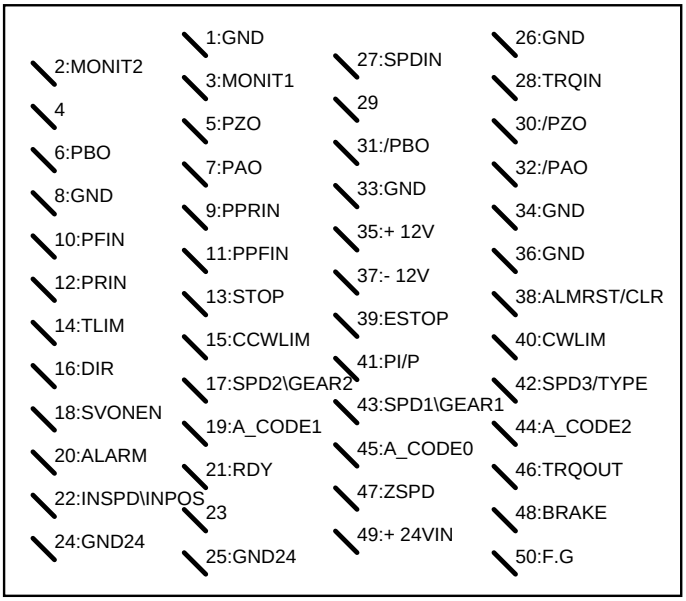
If Alarm occurs on the drive system, PWM is shut off and the motor stops.
(Caution!) Check and remove causes of Alarm and turn off the servo motor drive command (SVONEN) before resetting Alarm.



3.4 CN1 Wiring and Signal

CN1 is the connector located at the right lower part of the front of drive system. This connector is used to connect the drive system with the upper control system which commands the operation.

The figure on the right side shows the pin array of the connector CN1 seen from the user side connector.
(Note 1) CN1 connector is an option item.
∗ Maker: 3M
∗ Case name: 10350-52FO-008
∗Connector (For soldering): 10150-3000VE



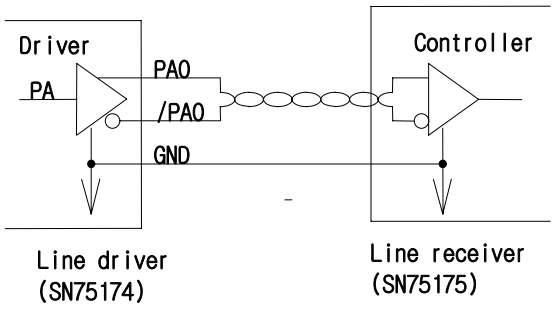
PIN Array of CN1

(Based on the soldered side of the user connector)

3.4.1 Encoder output signal

The encoder signal is produced based on 0 [V] (GND) of control power supply. Connect 0 [V] terminal of the circuit which receives this signal from the upper control system to the GND terminal of CN1. Encoder signal is produced in line driver system after the AC servo motor encoder signal received from CN2 is divided according to the frequency dividing ratio set by the sub-menu [Pulse Out Rate (P2-07)] of the main menu [Control Mode (P2-)]. Functions of each signal is as follows.

Signal function	A phase output	B phase output	Z phase output
PIN No(CN1-)	PAO(7)/PAO(32)	PBO(6)/PBO(31)	PZO(5)/PZO(30)



Encoder signal connection example

3.4.2 Analog I/O signal

Analog signal is based on 0 [V] (GND terminal) of the control power supply. Connect the GND terminal of the circuit connected to this signal with the GND terminal of CN1. The analog speed command input (CN1-27) runs the motor at a speed determined from the [10V Speed [RPM] (P3-13)] menu of [Speed Mode (P3-13)]. The motor runs at a maximum speed in the forward direction if +10 [V] is loaded, and in the reverse direction if -10 [V] is loaded. Analog torque limit (CN1-28) is activated when the analog torque limit function (CN1-14) terminal is turned on, and if the analog torque limit input is 0 [V] while the torque limit function remains turned on, motor torque does not occur at all.

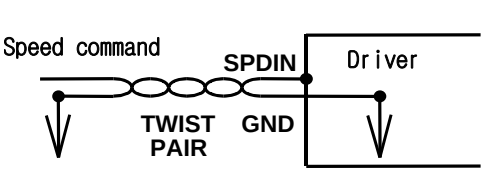
If the torque limit input is 10 [V], the function can be used up to the torque set at [10V Torque P5-02]. As the torque limit command input uses the absolute value of voltage, operation during 10 [V] is the same as in the case of -10 [V]. If the analog torque limit function is not selected, the function can be used up to the torque set at [TRQ LMT (+) (P2-05)], [TRQ LMT (-) (P2-06)]. To wire analog signals, connect GND wire with the signal wire by twisting them using twist pair wire in order to minimize noise. Functions of each analog signal are as follows.

Pin Name	SPDIN (27)	TRQIN (28)	MONIT1 (3)	MONIT2 (2)
Signal function	Speed command *1 Speed limit *2 -10～+10 [V] input	Torque limit *1, *3 Torque command *2 -10～+10 [V] input	Monitor output 1 -4～+4 [V] output	Monitor output 2 -4～+4 [V] output

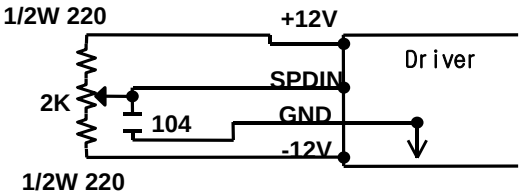
*1: Effective in speed control mode *2: Effective in speed torque mode *3: Effective in position control mode

Analog signal is based on GND signal, and produces ±12 [V] power just in case speed commands, speed limits, torque limits and torque commands are applied through the use of variable resistance. The output capacity of this power supply is 30 [mA] at maximum. Do not exceed the maximum capacity. The power supply pin array is shown on the following table.

Pin Name	+ 12 V (35)	- 12 V (37)	GND (1,8,26,33,34,36)
Signal function	+ 12 [V]	- 12 [V]	0 [V]



[Analog signal connection]



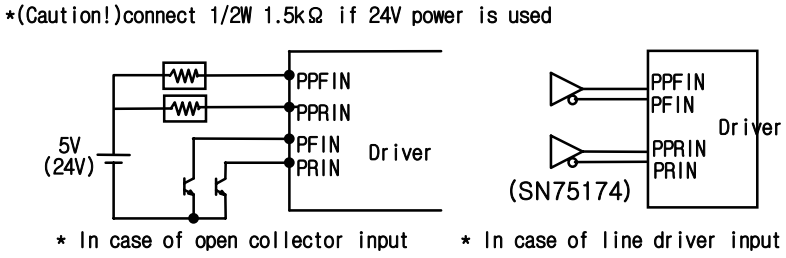
[Using the internal power for the analog command]

3.4.3 Position command pulse input signal

To use the servo driver in position servo mode, input the position command pulse by using the open collector input, line drive input, and pulse output of the MPG (Manual Pulse Generator) or PLC position control card using external power supply of 5 [V] and 24 [V]. The types of pulses that can be used are "direction + pulse", "forward pulse + reverse pulse", and "LEAD pulse + LAG pulse". Select the type of pulse from the [Pulse Logic (P4-14)] menu of the front operation panel [Position Mode (P4--)] menu.

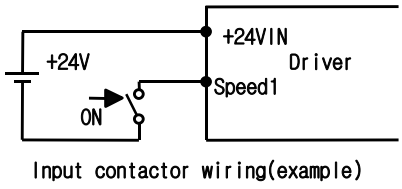
Photo coupler has been used in the pulse input circuit to insulate the internal control unit of the drive system from the external pulse signal. However, if 5 [V] is used as the open collector input, connect 1/2W 150Ω resistance, or 1/2W 1.5kΩ resistance if 24 [V] is used.

Pin No (CN1-)	PPRIN (9)	PRIN (12)	PPFIN (11)	PFIN (10)
Signal function	+ 5V	R pulse input	+ 5V	F pulse input



[Position command pulse application circuit(example)]

3.4.4 Input contact signal



Input contactor wiring(example)

The function of the input contact signal used to control the drive system partially changes in the speed control mode, position control mode, and torque control mode.
Function of each input contact signal is shown on the following table. The input contacts are classified into A contact and B contact depending on the contact characteristics. Check before use. Connect external power supply greater than DC +24 [V], 1 [A] to the +24 [V] power input terminal (CN1-49) to use the contact input.

Turning on the servo motor drive command signal (CN1-18) will reset the base block of IGBT and generation braking, turning the servo motor at a speed set by the speed command select signal.

To select speed command, combine rpm selection 1 (CN1-43), rpm selection 2 (CN1-17), rpm selection 3 (CN1-42) and select internal speed command or analog speed command. The internal speed command [Speed CMD 1, 2, 3, 4, 5, 6, 7 (P3-1, 2, 3, 4, 5, 6, 7)] sets value at the applicable menu of [Speed Mode].

The rotation direction select signal (CN1-16) changes the rotating direction of the motor. Using this signal even when the external analog command is used will enable changing the direction of rotation in reverse. However, when this is used in combination with the upper position controller, turn off this signal except in special case.

The Alarm Reset/Cumulative Pulse Clear signal (CN1-38) resets servo alarm, and clears discrepancies between the command pulse and current position in position control mode.

(Caution!) Execute Alarm Reset only after the servo drive Enable (SVONEN) signal is turned off.

The stop signal (CN1-13) stops the motor after forcibly making the speed command value 0, and maintains stop torque.

The analog torque limit select signal (CN1-46) determines whether to use the motor torque limit function according to the voltage value of the analog torque limit command input. If the torque limit command input is 0 [V], motor torque never occurs. If the torque limit command input is 10 [V], the function can be used up to the torque set at [10V Torque P5-02]. As the torque limit input uses the absolute value of voltage, operation during 10 [V] is the same as in the case of -10 [V]. The function can be used up to the maximum motor torque even when the torque limit function is not selected.

The emergency stop signal (CN1-39) inputs external alarm into the drive system. Once emergency stop is loaded, the drive system ignores all inputs and shuts off the servo drive after decelerating to the stopped position in the fastest method (Turned on during normal operation).

Connect the forward run prohibition signal (CN1-15) and the reverse run prohibition signal (CN1-40) to the limit switch in the case of linear drive (Turned on during normal operation).

If the speed control P/PI select signal (CN1-41) maintains servo motor at 0 speed for a long period of time, sometimes the motor moves from drift effects. If the PI/P select signal is turned on in such case, the servo motor is stopped by the friction torque.

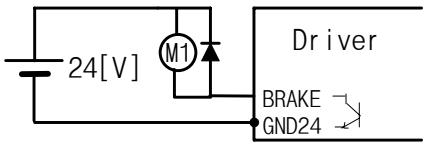
(Caution !) Always turn off PI/P select signal during normal operation.

[Types and functions of CN1 input contact signal]

Pin Name (CN1-)	Speed control signal function	Position control signal function	Torque control signal function	Contact status
SVONEN (18)	Servo drive ENABLE	Servo drive ENABLE	Servo drive ENABLE	ON = Servo drive ENABLE
SPD1/GEAR1 (43)	rpm select 1	Electronic gear select 1	Speed limit select 1	Refer to: 7.7 Speed command input 8.7 Position command input 9.6 Speed limit method
SPD2/GEAR2 (17)	rpm select 2	Electronic gear select 2	Speed limit select 2	
SPD3/TYPE (42)	rpm select 3			Refer to: 7.7 speed command input, Chapters 10, 11 and 12
DIR (16)	Rotation direction select			ON = opposite direction of speed command OFF = same direction of speed Command
CCWLIM (15)	CCW limit	CCW limit	CCW limit	Off = CCW limit
CWLIM (40)	CW limit	CW limit	CW limit	Off = CW limit
TLIM (14)	Analog torque limit	Analog torque limit	Analog torque limit	On = Analog torque limit Off = Digital torque limit
ALMRST/CLR (38)	ALARM RESET	Alarm reset/Cumulative pulse clear	Alarm reset	ON = Alarm reset ON = Cumulative pulse clear
ESTOP (39)	Emergency stop	Emergency stop	Emergency stop	Contact form can be selected at parameter [P2-30]
PI/P (41)	PI/P select	PI/P select		ON = Controls speed controller P Off = Controls speed controller PI
STOP/START (13)	Stop/Start			Can be selected at parameter [P2-29]

Where ON: Applicable contact connected to "GND 24"
OFF: Applicable contact connected to "+24V", or applicable contact not connected.
For more details, refer to Chapter 7 through Chapter 12.

3.4.5 Output contact signal



Output contactor wiring(example)

The output contact signal functions are shown on the following table. The output contact internally uses transistor switch. Take precaution because overvoltage or overcurrent may cause damage to the system. (Power supply: DC +24 [V] ±10%).
Brake signal is used to drive the brake installed inside the motor. The sequence must be configured so when this output is turned on, power is supplied to the brake and the break is released . Other signals are the outputs which indicate the status of the drive system and the motor. Each function is shown on the following table.

[Types and functions of CN1 output contact signals]

Pin Name	Speed control signal function	Position control signal function	Torque control signal function	Contact status
BRAKE (48)	Brake activates	Brake activates	Brake activates	ON = Resets OFF = Activates
INSPD/ INPOS (22)	In speed completed	Positioning completed		ON = Completed
ALARM (20)	Alarm status	Alarm status	Alarm status	ON = Alarm
A_CODE0, A_CODE1, A_CODE2 (45,19,44)	Alarm code	Alarm code	Alarm code	See following table
ZSPD (47)	Zero speed	Zero speed	Zero speed	ON = Zero speed
RDY (21)	Servo ready	Servo ready	Servo ready	ON = Ready
TRQOUT (46)	Torque under limit	Torque under limit	Torque mode in operation	ON = Torque under Limit ON = Torque mode

Where ON: Applicable contact connected to "GND 24"
OFF: Applicable contact connected to "+24V", or applicable contact not connected.

The alarm type output differs according the types of the alarm. Use this signal in case it is necessary to identify the alarm details of the drive system from external control system. The status of output by type of alarm is shown on the following table.

[Alarm code outputs]

Alarm type	E-stop	Over-current	Over-voltage	Over-load	Power error	Encoder error	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

Where ON: Applicable contact connected to "GND 24"
OFF: Applicable contact connected to "+24V", or applicable contact not connected.

Other items are the alarms that are not designated in the above table, such as miswiring or set value error.

3.4.6 CN1 I/O signal function and use table

Name	Pin No.	Function and use
PAO,/PAO PBO,/PBO PZO,/PZO	7,32 6,31 5,30	Outputs the AC servo motor encoder signal received from CN2 in line drive system after dividing it according to the frequency dividing ratio set by the sub-menu [Pulse Out Rate (P2-07)] of the main menu [Control Mode (P2--)].
SPDIN	27	Inputs speed command in analog when operating in speed mode. See "7.7 Speed Command Input."
		Inputs speed limit command in analog when operating in torque mode. See "9.6 Speed Limiting"
TRQIN	28	Inputs analog torque limit when operating in speed and position mode. See "7.6 Output Torque Limiting" or "8.6 Output Torque Limiting."
		Inputs analog torque command when operating in torque mode. See "9.7 Torque Command Input."
MONIT1	3	Outputs within the range of -4 ~ +4 [V] according to values set to [Monitor1 Select (P2-11)], [Monitor1 ABS (P2-12)], [Monitor1 Scale (P2-13)], [Monitor1 offset (P2-14)]. [Monitor1 Select] - 0: speed, 1: torque, 2: speed command See section 6.11 for [Monitor1 ABS (P2-12)], [Monitor1 Scale (P2-13)], [Monitor1 offset (P2-14)].
MONIT2	2	Outputs within the range of -4 ~ +4 [V] according to values set to [Monitor2 Select (P2-15)], [Monitor2 ABS (P2-16)], [Monitor2 Scale (P2-17)], and [Monitor2 offset (P2-18)]. [Monitor2 Select] - 0: speed, 1: torque, 2: speed command See section 6.11 for [Monitor2 ABS (P2-15)], [Monitor2 Scale (P2-16)], and [Monitor2 offset (P2-18)].
+12 -12	35 37	Outputs ±12 [V] used when the speed command and torque limit command are simply applied.
GND	1,8 26,33 34,36	This is the power supply Common Ground Terminal for speed command, torque limit command, speed, torque monitor output, and encoder output terminals.
PPFIN PFIN PPRIN PRIN	11 10 9 12	Operates after receiving specific position command form inputs in negative logic and positive logic according to values set to [Pulse Logic]. For more details about pulse forms, refer to 11.7.1 Position command pulse input, Chapter 11 Using Position Servo.
SVONEN	18	Determines whether servo motor can be started. (ON: can start, OFF: cannot start)
SPD1 SPD2 SPD3		Selects internal command speed by combining 3 signals when controlling speed. Refer to "7.7 Speed Command Input."
GEAR1 GEAR2 TYPE	43 17 42	Selects electronic gear ratio by selecting 2 signals when controlling position. See "8.7 Position Command Input." Selects controller type (See Chapter 10 through 12).
SPD1 SPD2 TYPE		Selects speed limit by selecting 2 signals when controlling torque. Refer to "9.6 Speed limiting." Selects controller type (See Chapter 10 through 12).

Name	Pin No.	Function and use
DIR	16	Selects direction of servo rotation when controlling speed (Off: in command direction, ON: in reverse command direction)
PI/P	41	Selects speed controller type. (Off: PI control, ON: P control)
STOP/ START	13	Forcibly zeros (stops) speed command value, or starts operation. (Can be selected from parameter P2-29)
CCWLIM CWLIM	15 40	In the case of linear drive, set the extreme limit switch signal to CW side and CCW side. (ON: Rotation able; Off: Rotation unable)
TLIM	14	Selects whether the torque limit signal input at the analog torque limit command (TRQIN) terminal is to be used. (ON: Analog torque limit used, OFF: Digital torque limit used)
ALMRST/ CLR	38	Resets alarm. Clears error pulse between the command pulse and current position when controlling position.
ESTOP	39	In case of external emergency, forcibly ignores all input status of servo driver and stops motor drive (free-run) after rapidly decelerating the motor. (Contact can be selected from parameter P2-30)
+24VIN	49	Input external power supply greater than +24 (VDC) ±10% 1.0 [A] for external I/O contact (Shall be provided by user). * Note) If used as I/O contact power supply simultaneously, recalculate the power supply capacity according to the number of output points.
GND24	24,25	Connect the ground of the external I/O contact power supply +24 (VDC) ±10% (Shall be provided by user).
BRAKE	48	This is the output signal intended to drive external brake. See [Brake SPD (P2-09)], [Brake time (P-10)] of [Control mode (P2--)]. (If this is turned ON, brake power is applied, enabling motor operation.)
RDY	21	This is No Alarm, Power Good status when power is turned ON.
INSPD/ INPOS	22	Turned on when the instructed speed is reached. (See [In speed range (P3-23)]) Turned on when the instructed position is reached. (See [In position (P4-04)]
ALARM	20	Turned off if alarm is detected. (Turned on during normal operation)
A_CODE0 A_CODE1 A_CODE2	45 19 44	Output status varies according to alarm types. This signal is used when it is necessary to check the servo alarm status from the external upper control system.
ZSPD	47	Indicates servo motor has stopped.
TRQOUT	46	Indicates servo motor is under torque limit when used as position control and speed control. Indicates torque mode is operating when used as torque control.
FG	50	Connects earth cable of CN1.

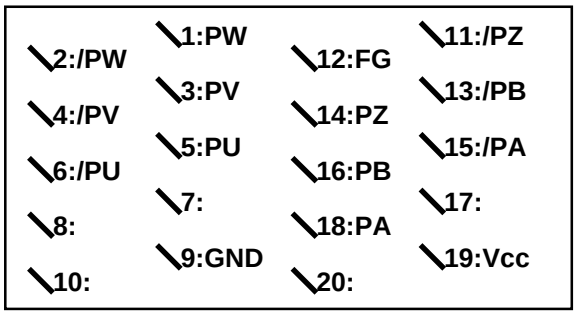
Where ON: Applicable contact connected to "GND 24"
OFF: Applicable contact connected to "+24V", or applicable contact not connected.

3.5 Description of CN2 Wiring and Signals

3.5.1 Wiring and signals of incremental encoder

CN2 is a connecter located in the right center of the front part of the drive system. This is used to connect the drive system and servo motor encoder.

The right figure shows pin array viewed from the user connector. Encoder signal varies slightly according to the types of encoder.



PIN array of CN2
[Based on the soldered side of the user connector]

(Danger!!) Product may be damaged by burn in case the servo is started without connecting the CN2 encoder wiring.

Wiring of CN2 and the FMA-CN series AC servo motor's incremental encoder is shown on the following table.

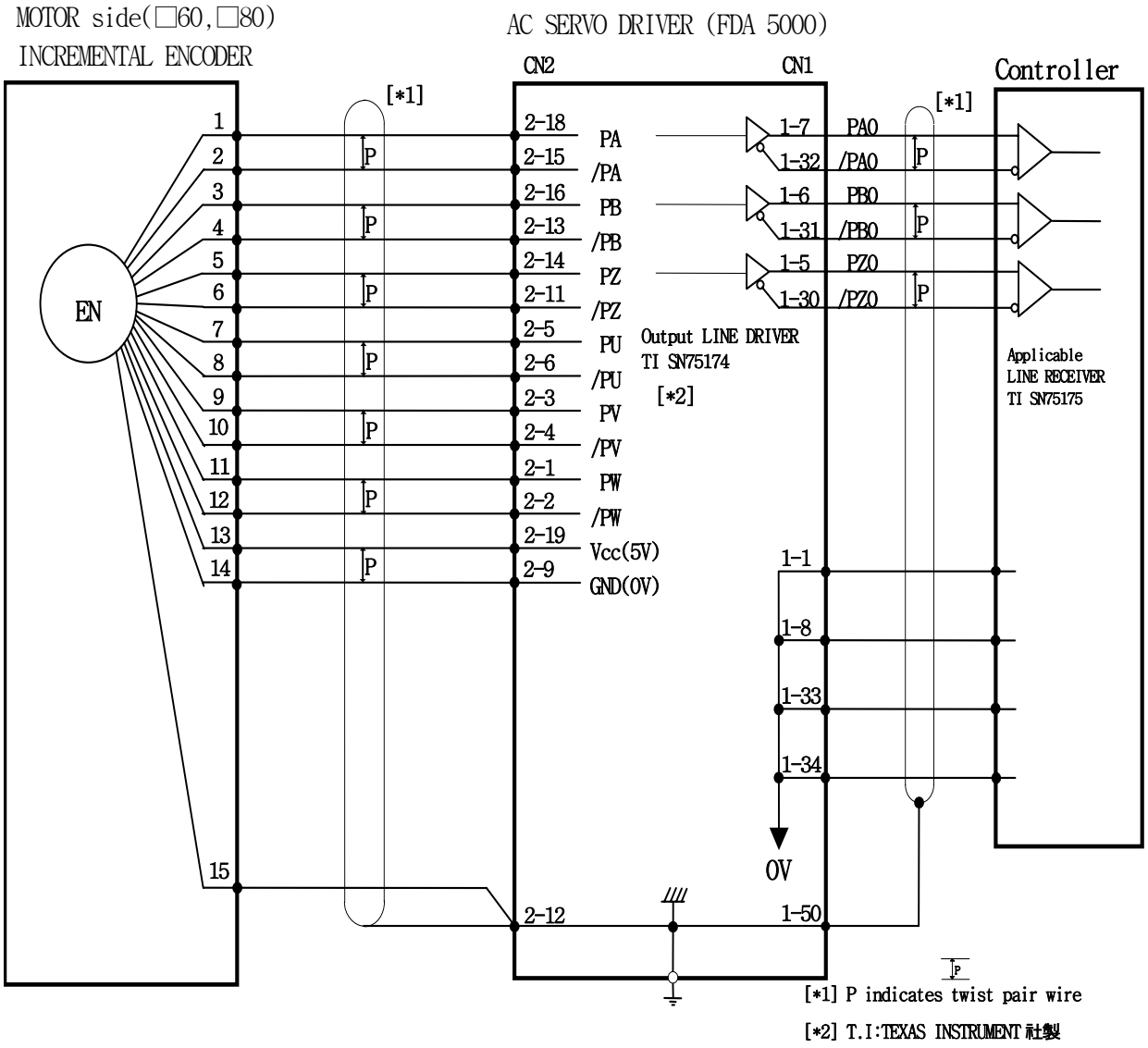
(Caution!) When absolute value encoder is used, refer to Chapter 3.5.2. Interface and Use of Absolute Value Encoder.

CN2 pin No.	Signal name	Motor (□60, 80 series) side encoder connector pin No.	Motor (□130, 180 series) side encoder connector pin No.
1	PW	11	P
2	/PW	12	R
3	PV	9	M
4	/PV	10	N
5	PU	7	K
6	/PU	8	L
7			
8			
9	GND	14	G
10			
11	/PZ	6	F
12	F.G.	15	J
13	/PB	4	D
14	PZ	5	E
15	/PA	2	B
16	PB	3	C
17			
18	PA	1	A
19	Vcc(DC 5V)	13	H
20			

(Caution!) Connect the earth cable of the encoder wiring to F.G.

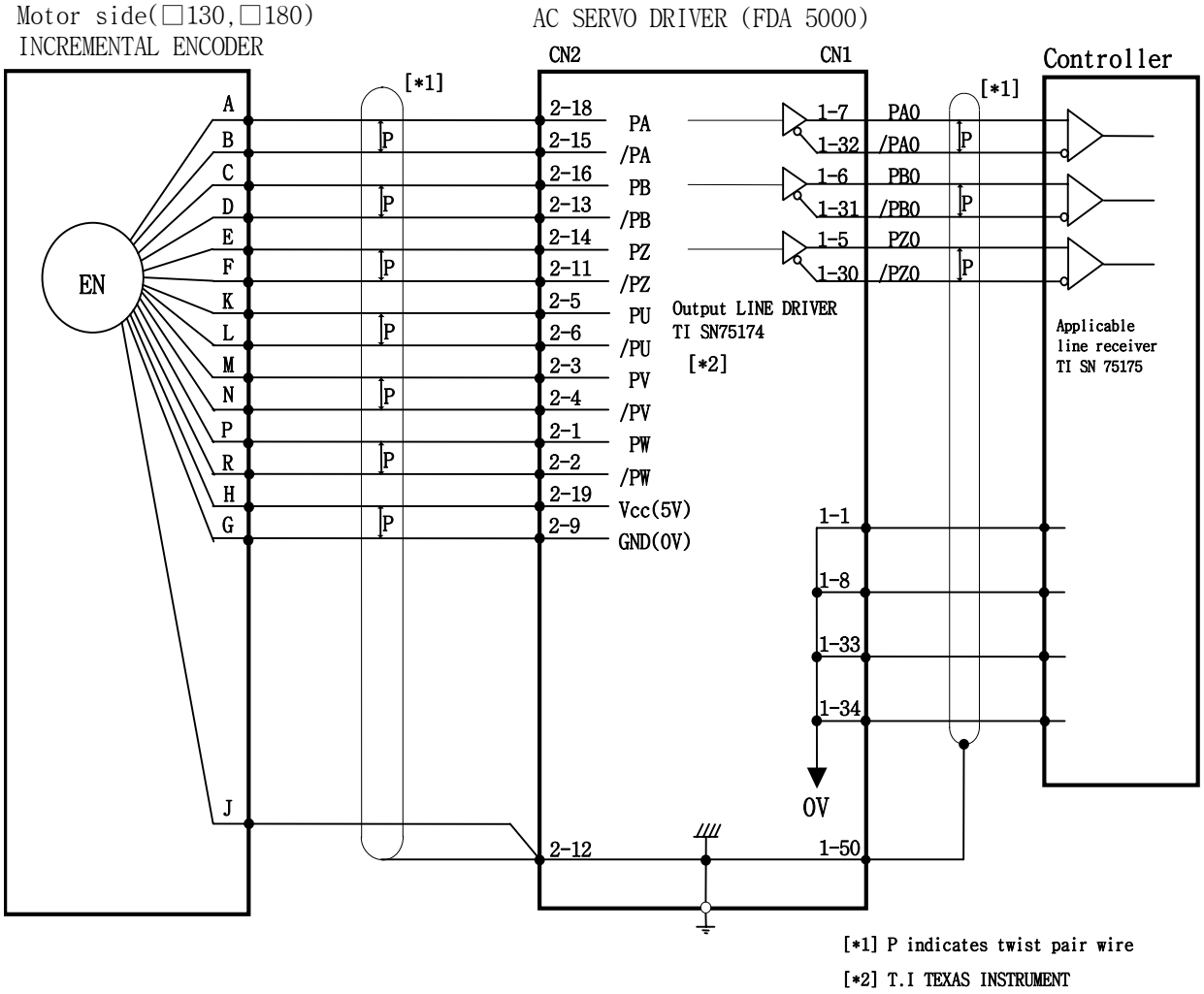
(Caution!) Cable specifications: AWG24 x 9 pair twist, shield cable (maximum length: 20 m) COVV(Maker : LS cable) or equivalent.

[Example of wiring between motor side (□60, 80 series) and FDA 5000 CN2 when incremental encoder is used]



[CN2 wiring diagram]

[Example of wiring between motor side (□130, 180 series) and FDA 5000 CN2 when incremental encoder is used]

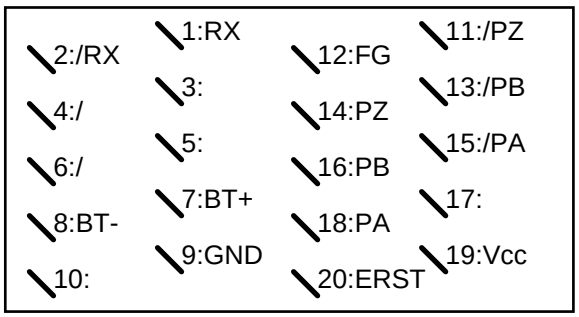


[CN2 wiring diagram]

3.5.2 Wiring and signal of absolute value encoder

CN2 is a connecter located in the right center of the front part of the drive system. This is used to connect the drive system and servo motor encoder.

The right figure shows pin array viewed from the user connector. Encoder signal varies slightly according to the types of encoder.



PIN array of CN2

(Based on the soldered side of the user connector)

(Note) CN2 connector is an option item.

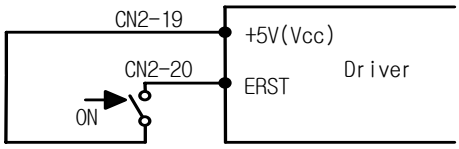
∗ Maker: 3M
∗ Case product name: 10320-52FO-008
∗ Connector (For soldering): 10120-3000VE

Wiring between CN2 and the FMA-series AC servo motor absolute value encoder is shown on the following table.

CN2 pin No.	Signal name	Motor (□60, 80 series) side encoder connector pin No.	Motor (□130, 180 series) side encoder connector pin No.
1	RX	11	P
2	/RX	12	R
3			
4			
5			
6			
7	BAT+	9	K
8	BAT-	10	L
9	GND	14	G
10			
11	/PZ	6	F
12	F.G.	8	N
13	/PB	4	D
14	PZ	5	E
15	/PA	2	B
16	PB	3	C
17			
18	PA	1	A
19	Vcc(DC 5V)	13	H
20	ERST	7	M

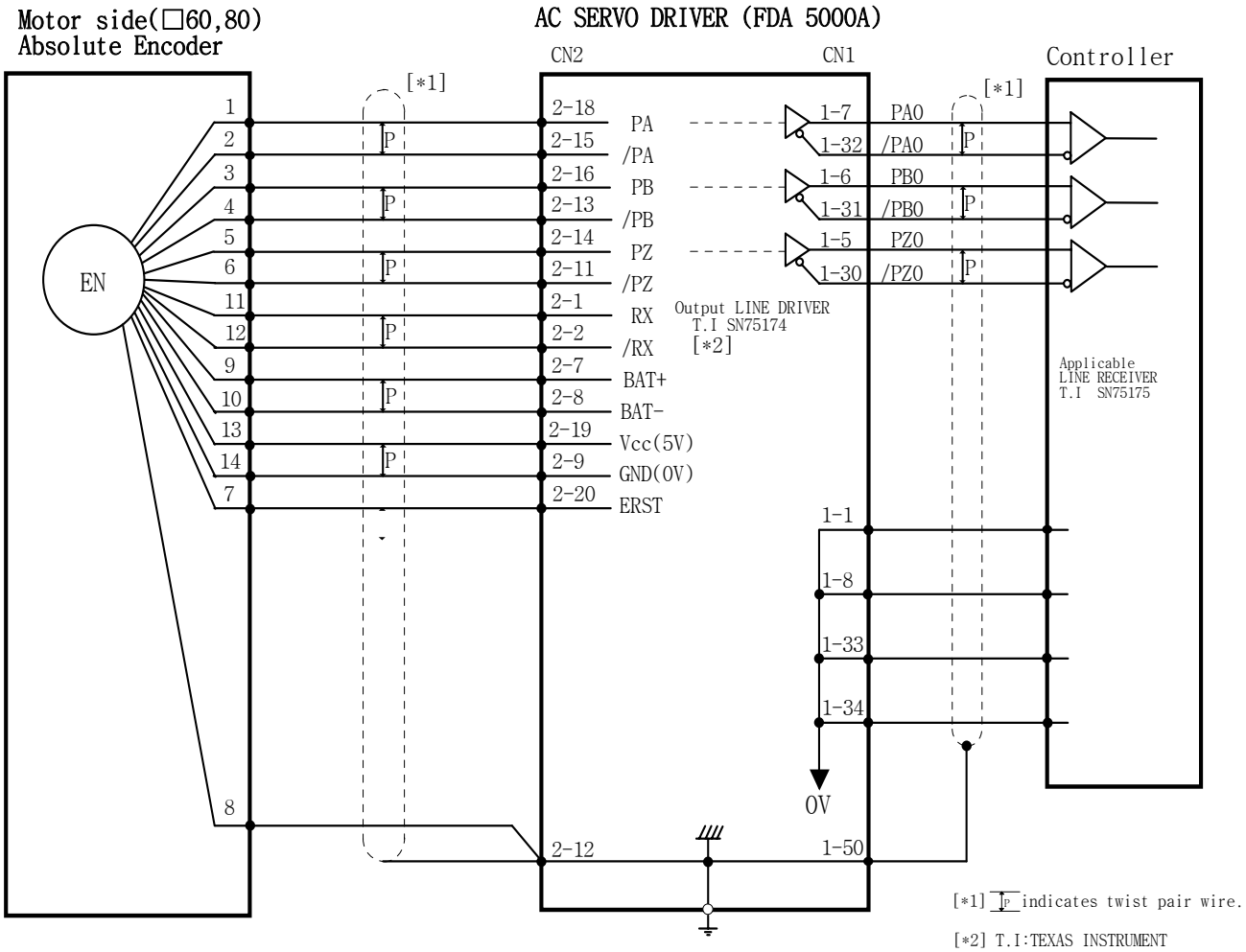
∗ Connect the earth cable of the encoder wiring to F.G.
∗ Cable specifications: AWG24 x 9 pair twist, shield cable (maximum length: 20 m)
COVV(Maker : LS cable) or equivalent.

Press the encoder Reset switch connected between the encoder reset terminal ERST (CN2-20) and the Vcc terminal (CN2-19) for longer than 4 seconds to set the zero point of the absolute value encoder itself or in case of alarm.



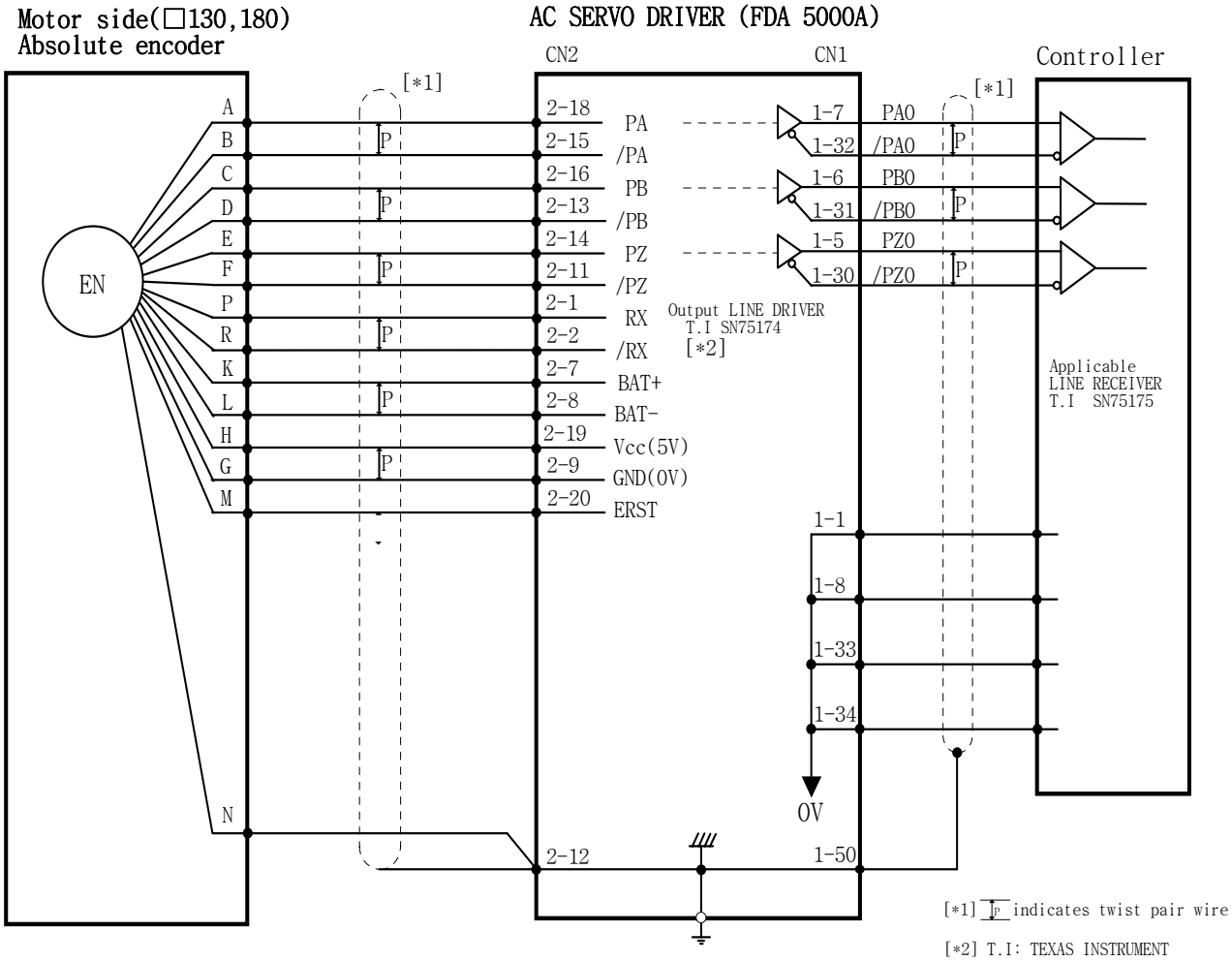
[Wiring of encoder reset switch]

[Example of wiring between motor side (□60, 80 series) and FDA 5000 CN2 when absolute value encoder is used]



[CN2 Wiring diagram]

[Example of wiring between motor side (□130, 180 series) and FDA 5000 CN2 when absolute value encoder is used]



[CN2 wiring diagram]

■ Caution when using the absolute value encoder

Set [Encoder type (P1-1)] to 6 when the absolute value encoder is used.
When [Encoder type (P1-1)] is set to 6, the input contact (SPD3/type) is automatically reset to the absolute position request (ABSREQ).

[Selection of servo model]

Set value of [Controller type (P2-01)]	Servo model	
	When incremental encoder is used	When absolute value encoder is used
0	Torque servo	Torque servo
1	Speed servo	Speed servo
2	Position servo	Position servo
3	Speed/position servo	Position servo
4	Speed/torque servo	Torque servo
5	Position /torque servo	Torque Servo

[Selection of speed command] (when used as speed servo)

If the absolute value encoder is used to configure servo, the input contact (SPD3) is reset to (ABSREQ). Hence, (SPD3) cannot be used to select speed command.
The speed command can be input freely in 3 methods:
① Based on 3 digital speed commands ([Speed CMD1 (P3-1)]-([Speed CMD3 (P3-3)]),
② Based on external analog speed command, and
③ Based on override operation by combining ① and ②.
The internal speed command selection based on these 3 methods is determined as follows according to the rpm selection contacts [(SPD1), (SPD2)] of CN1 and the set values of [Override ON/OFF (P3-18)].

[P3-18]	Speed selection 2	Speed selection 1	Speed command
0	OFF	OFF	Analog command speed
0	OFF	ON	[Speed CMD1 (P3-01)] set speed
0	ON	OFF	[Speed CMD1 (P3-02)] set speed
0	ON	ON	[Speed CMD1 (P3-03)] set speed
1	OFF	OFF	Analog command speed
1	OFF	ON	[Speed CMD1 (P3-01)] set speed + analog command speed
1	ON	OFF	[Speed CMD1 (P3-02)] set speed + analog command speed
1	ON	ON	[Speed CMD1 (P3-03)] set speed + analog command speed

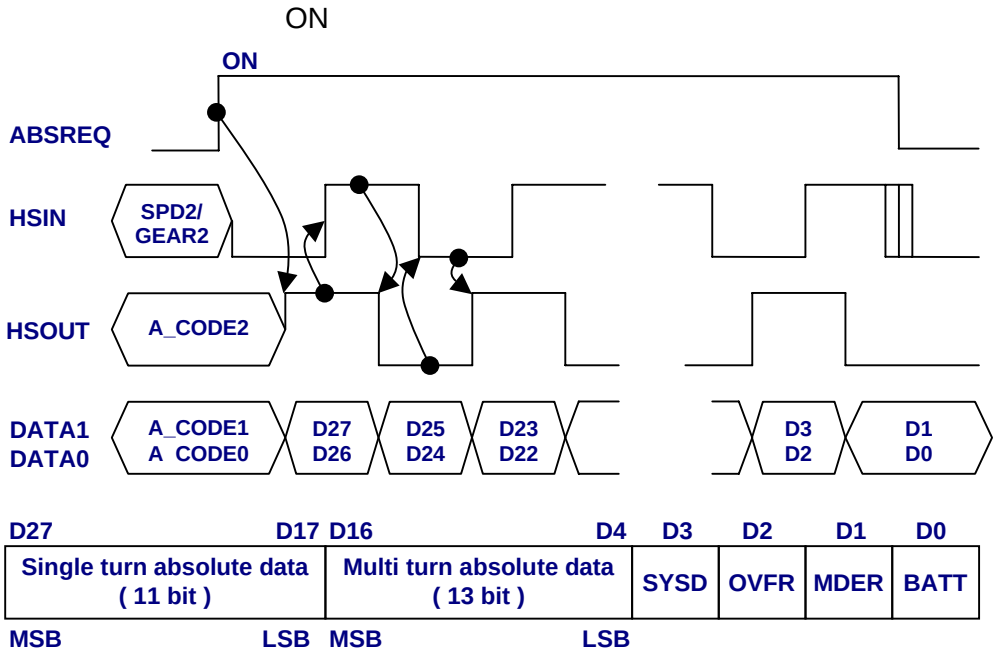
Where ON: Applicable contact connected to "GND 24"
OFF: Applicable contact connected to "+24V", or applicable contact not connected.

■ Absolute position data transmission

To request absolute position transmission, change the absolute position request (ABSREQ) signal from OFF to ON when the servo is turned OFF.

The absolute position request (ABSREQ) must remain ON from the time absolute position transmission is requested to the time transmission is completed, and if the absolute position request (ABSREQ) is turned OFF during transmission, transmission stops and the mode returns to initial state. When the absolute position request (ABSREQ) is turned ON, the servo start Enable signal (SVONEN) is ignored, and the absolute position request (ABSREQ) is ignored when the servo start Enable signal is turned ON. When the absolute position transmission starts based on the absolute position request (ABSREQ), the following I/O signals are reset to function pins for transmission.

If ABSREQ signal is turned OFF	If ABSREQ signal is turned ON
Speed selection 2/Electronic gear selection 2 (SPD2/GEAR2)	Handshake input (HSIN)
ALARM CODE 0 (A_CODE0) ALARM CODE 1 (A_CODE1)	Transmission data 0 (Data 0) Transmission data 1 (Data 1)
ALARM CODE 2 (A_CODE2)	Handshake output (HSOUT)



1. In the initial phase, servo is turned OFF, and A_CODE0, A_CODE1, and A_CODE2 indicate ALARM code is turned ON (All OFF in normal condition). If the servo is turned ON, following process will not start.

2. If ABSREQ is turned ON from external control like PLC, the servo driver reads the absolute value at this time, turns ON HSOUT, and displays 2 MSB (D27 and D26) on DATA1 and DATA0. Servo ON is ignored until transmission is completed thereafter. (a)

3. The external control (PLC) verifies HSOUT is turned ON, reads D27 and D26, and turns ON HSIN. (b)

4. The servo driver verifies that HSIN has been turned ON, turns OFF HSOUT, and displays D25 and D24 on DATA1 and DATA0. (c)

5. The external control (PLC) verifies HSOUT is turned OFF, reads D24 and D25, and turns OFF HSIN. (d)

6. The servo driver verifies that HSIN has been turned OFF, turns ON HSOUT, and displays D23 and D22 on DATA1 and DATA0. (e)

7. The external control (PLC) reads absolute value by repeating the process of item 3 through 6 above, turns OFF ABSREQ, and completes absolute position transmission. (f)

8. The functions of HSIN, HSOUT, DATA1 and DATA0 pins are automatically reset to the pins of original SPD2/GEAR2, A_CODE2, A_CODE1, and A_CODE0 respectively, and the servo can be turned ON.

Note 1) In case alarm occurs when attempting to transmit absolute position, reset alarm first and turn ON ABSREQ.

Note 2) If ABSREQ is turned ON, the functions of SPD2/GEAR2 are automatically reset to HSIN. If SPD2/GEAR2 pins are turned ON at this time, HSIN is recognized as being turned ON, and transmission error might occur. Therefore, when ABSREQ is turned ON, turn OFF the SPD2/GEAR2 (HSIN) pins.

4. Digital Loader Operation

Prior to connecting power and turning ON the servo, check the parameters [Motor parameters (P1--)] related to the motor at the digital loader. In order for the servo system to operate satisfactorily based on the information on the motor connected to the servo, accurate value must be set.
Next, monitor [Status Window (St--)] and verify that all commands and limit values are properly set. For initial operation, verify certain degree of stability through autotuning and trial operation (jog, simulation). Autotuning can be achieved through on-line system, but it is not necessary to use this function in case stabilized control gain is acquired through off-line system.

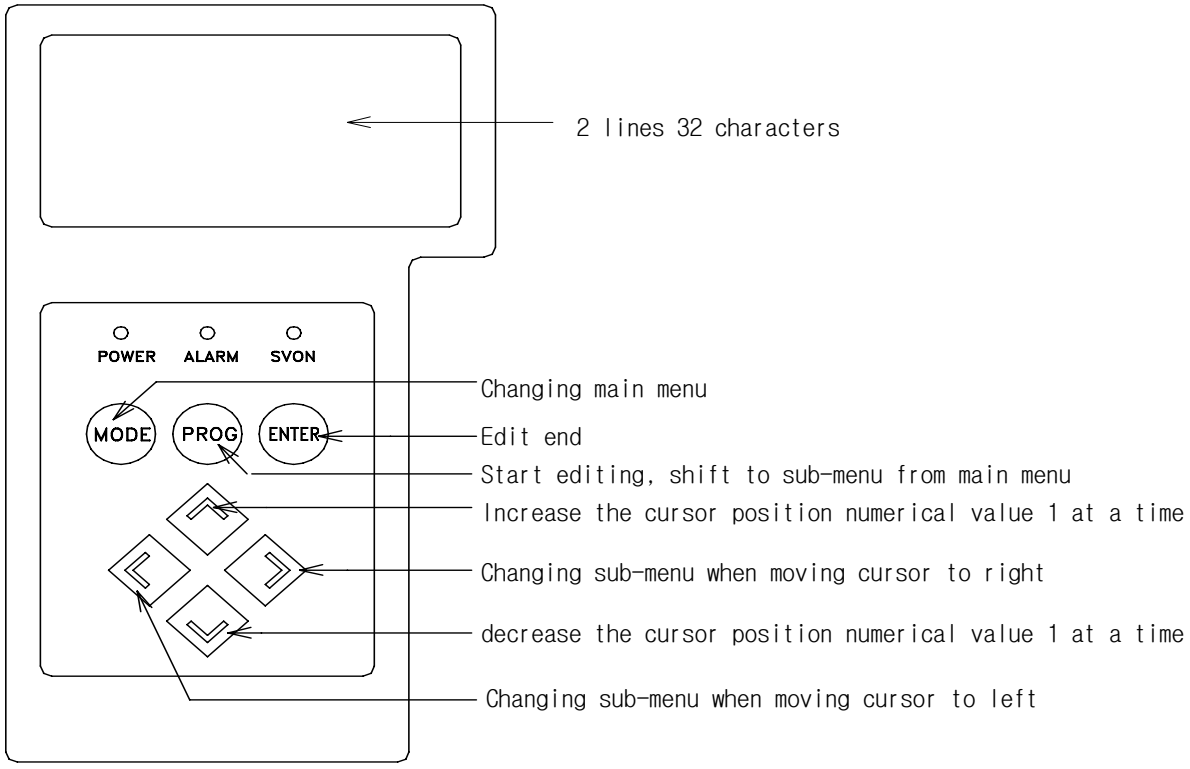


Figure 4.1 External view of digital loader

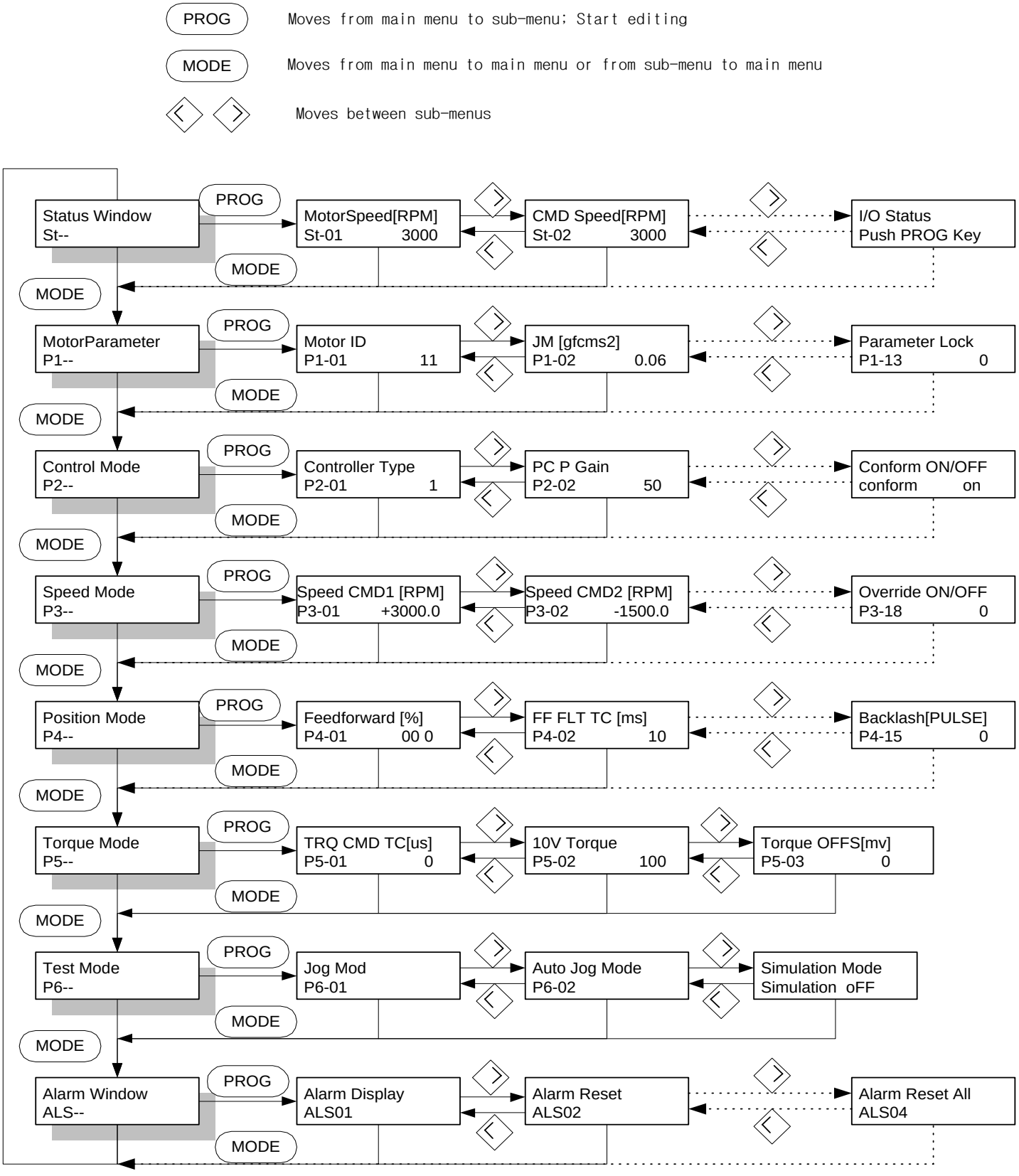
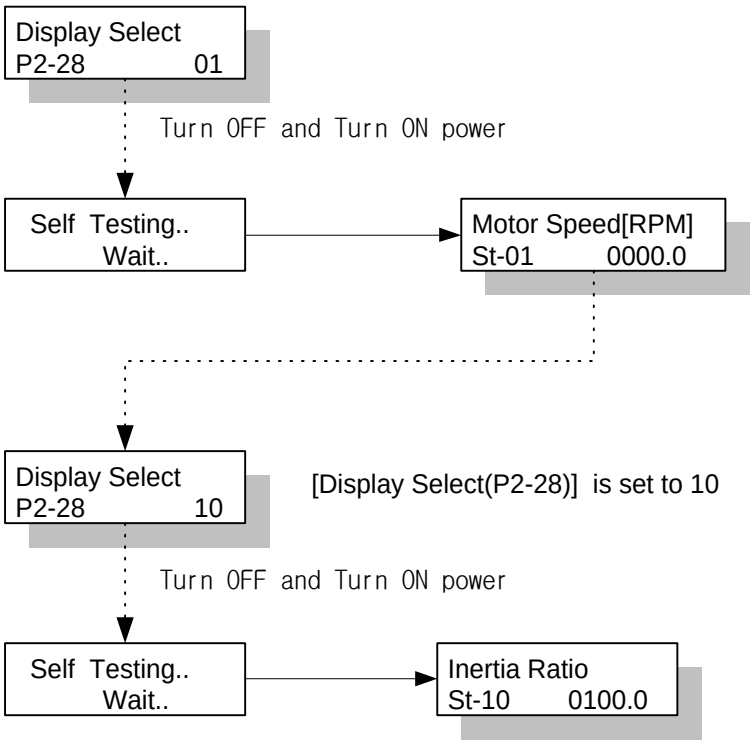


Figure 4.2 Block diagram of operation method

4.1 Displays after power is connected

4.1.1 Setting initial menu after power is connected

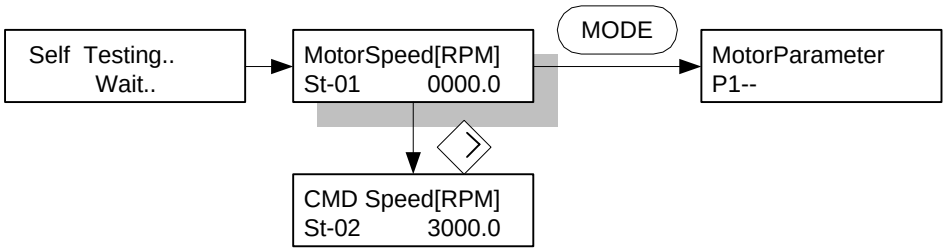


When power is connected according to the set value of [Display Select (P2-28)], the following menus are displayed.

[Display Select(P2-28)]	Initial menu when power is turned ON
1	Motor Speed[RPM],(St-01)
2	CMD Speed[RPM] ,(St-02)
3	CMD Pulse,(St-03)
4	Feedback Pulse,(St-04)
5	Pulse ERR,(St-05)
6	Speed Limit[RPM] ,(St-06)
7	Torque Limit[%],(St-07)
8	Load Rate[%],(St-08)
9	Max Load Rate[%],(St-09)
10	Inertia Ratio,(St-10)

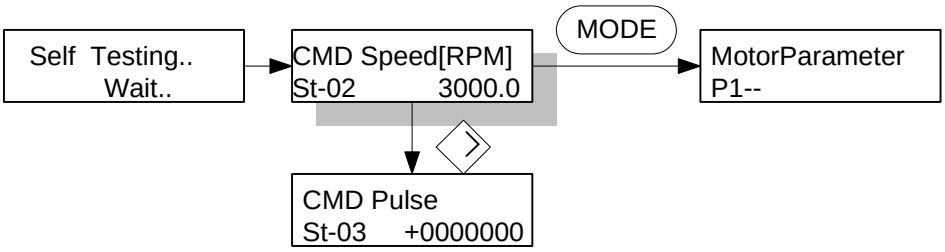
Initial set value of [Display Select (P2-28)]: 1

4.1.2 When the initial menu is set to motor speed after power is turned ON in No alarm status



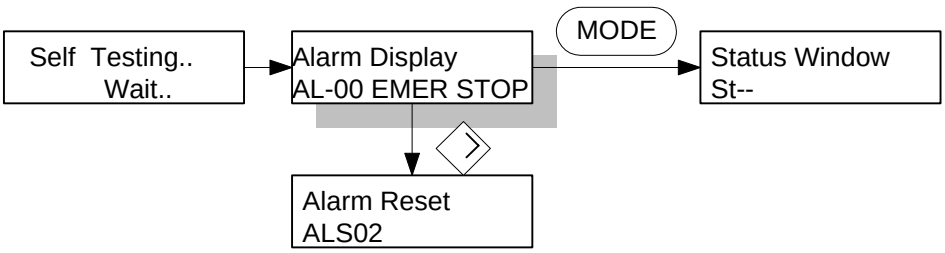
When there is no alarm after power is connected in the initial stage, and if the initial menu set value is motor speed, [Motor speed [RPM](St-01)] is displayed as above.
You can move to other menus from [Motor speed [RPM](St-01)] by using "MODE", "PROG" and "RIGHT" keys.

4.1.3 When the initial menu is set to command speed after power is turned ON in No alarm status.



When there is no alarm after power is connected in the initial stage, and if the initial menu set value is command speed, [CMD speed [RPM](St-02)] is displayed as above.
You can move to other menus by using "MODE", "PROG" and "RIGHT" keys.

4.1.4 If power is connected in Emergency Alarm state



If power is turned ON in the initial stage in the Emergency alarm status, [Alarm Display] is displayed as above.
You can move to other menus by using "MODE", "PROG" and "RIGHT" keys.

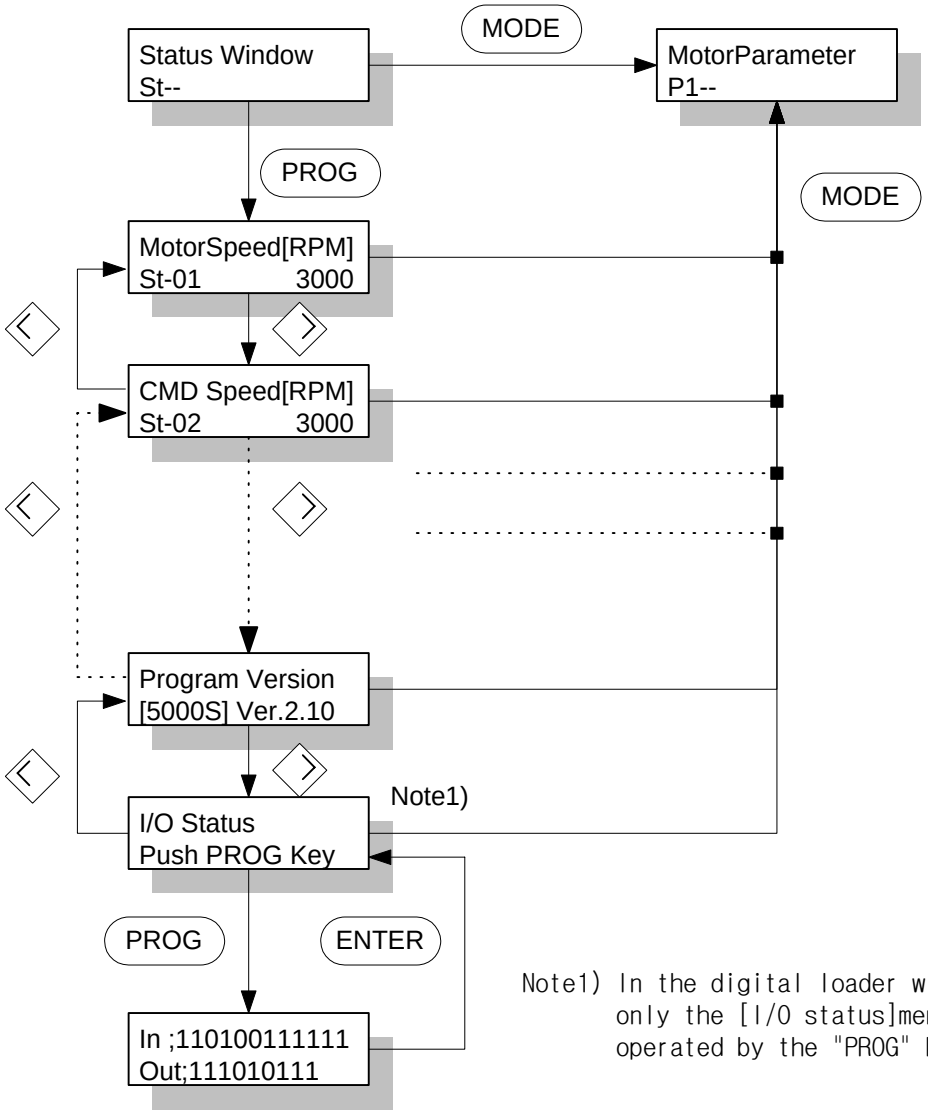
4.2 Sub-menu Group

Menus are classified into 3 main groups: a menu capable of editing or inputting information required for operation, a menu which monitors operation status, and a menu which carries testing function.

- Operation monitoring menu: Status Window, Alarm Status
- Edit menu: Motor Parameter, Control Mode, Speed Mode, Position Mode, Torque Mode
- Testing menu: Test Mode

4.3 Operation Monitoring Menu

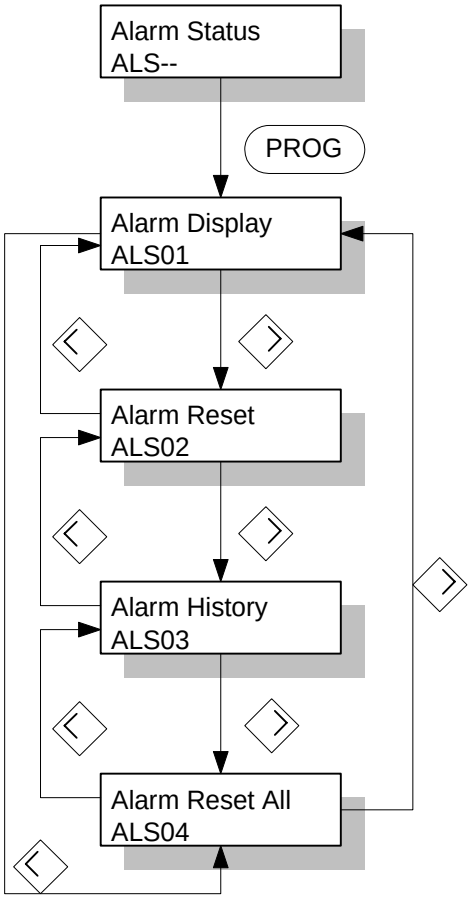
4.3.1 Operation status display menu



You can move to other menus from the operation status display menu by using "MODE", "PROG", "LEFT" and "RIGHT" keys.
The digital loader display meaning and value of each menu from the operation status display menu.
However, the [I/O Status] menu which monitors the contact I/O status can be monitored only when the "PROG" key is pressed once more.
The [Program Version] menu displays the operation program version as follows.

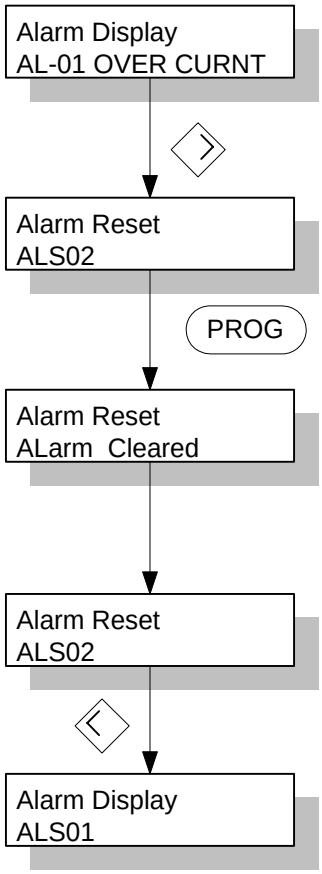
(Example displays)
[5000S] Ver. 4.00: Small capacity (FDA-5001-4 grade) 4.00 version
[5000M] Ver. 4.00: Medium capacity (FDA-5005-10 grade) 4.00 version
[5000H] Ver. 4.00: Large capacity (FDA-5015-75 grade) 4.00 version

4.3.2 Alarm menu



The alarm group is composed of 4 sub-menus.
The main menu of the alarm group is [Alarm Status (ALS--)], and description of each menu is provided as follows.

(1) Current alarm reset, [Alarm Status (ALS02)]



Displays for 2 seconds

The current alarm reset [Alarm Status (ALS-02)] menu resets the current system alarm. This function is the same as that of the external input reset.

4.4 Changing Parameters

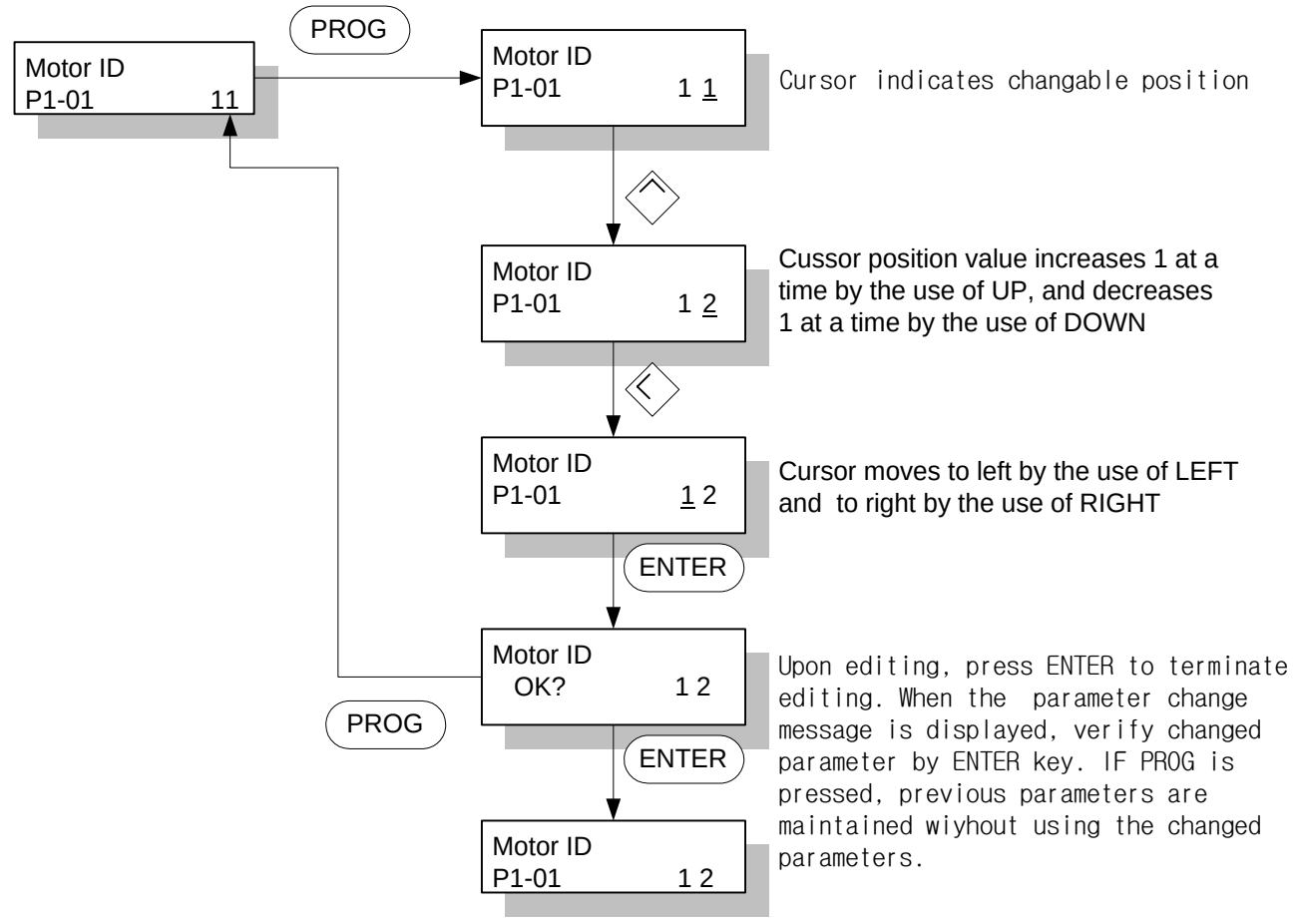
The parameter value can be changed in the same method.
Even though the changeable range varies according to menu, operation methods are the same.
Hence, [Motor ID (P1-01)] is presented here as a representative example.

PROG Starts parameter editing and cancels parameter change

ENTER Verifies changed parameter

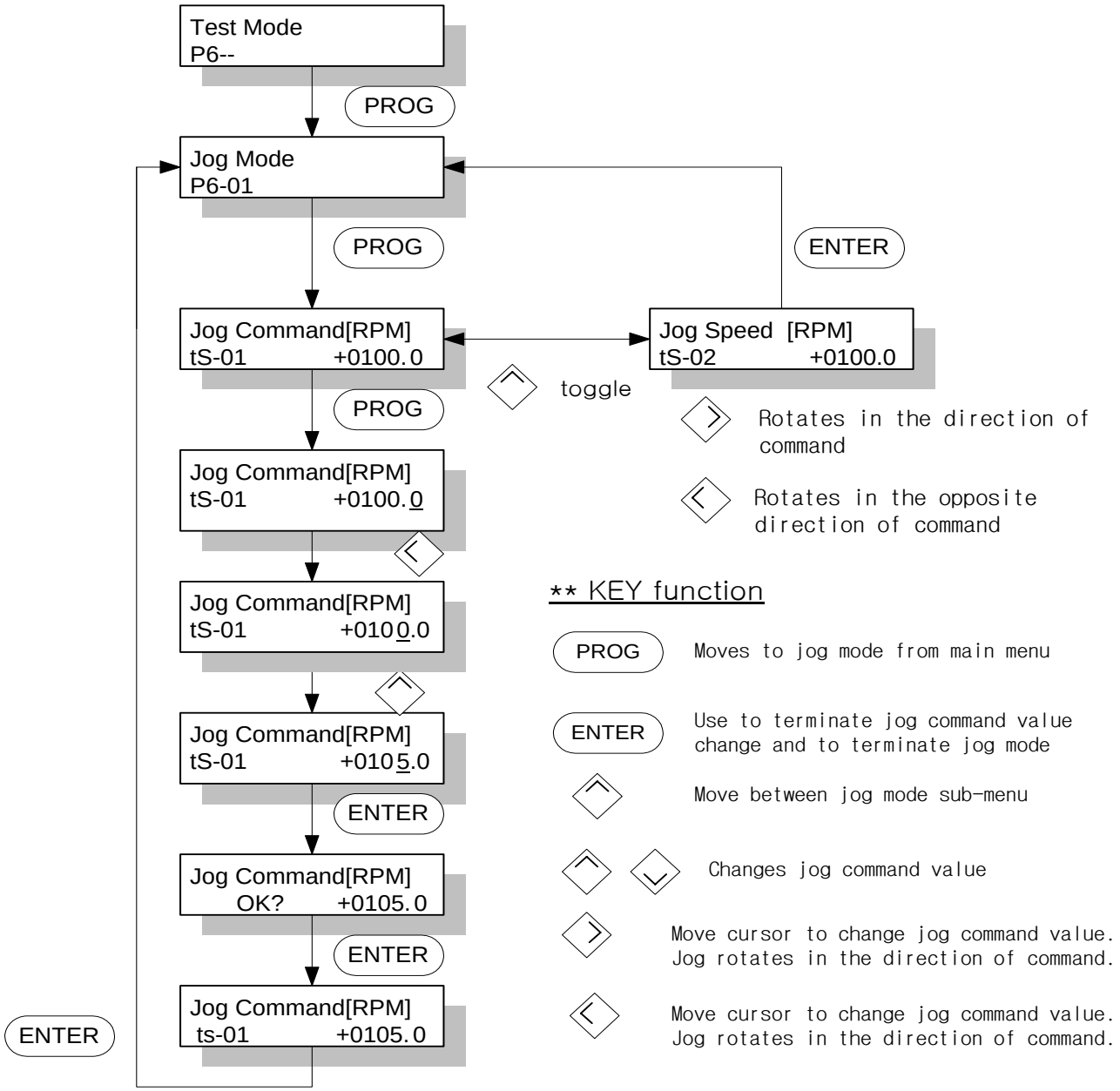
Increases or decreases cursor position value

Moves cursot to left or right



4.5 Test Mode (Test Mode: P6--)

4.5.1 Jog mode (P6-01): Motor can independently operate without upper controller

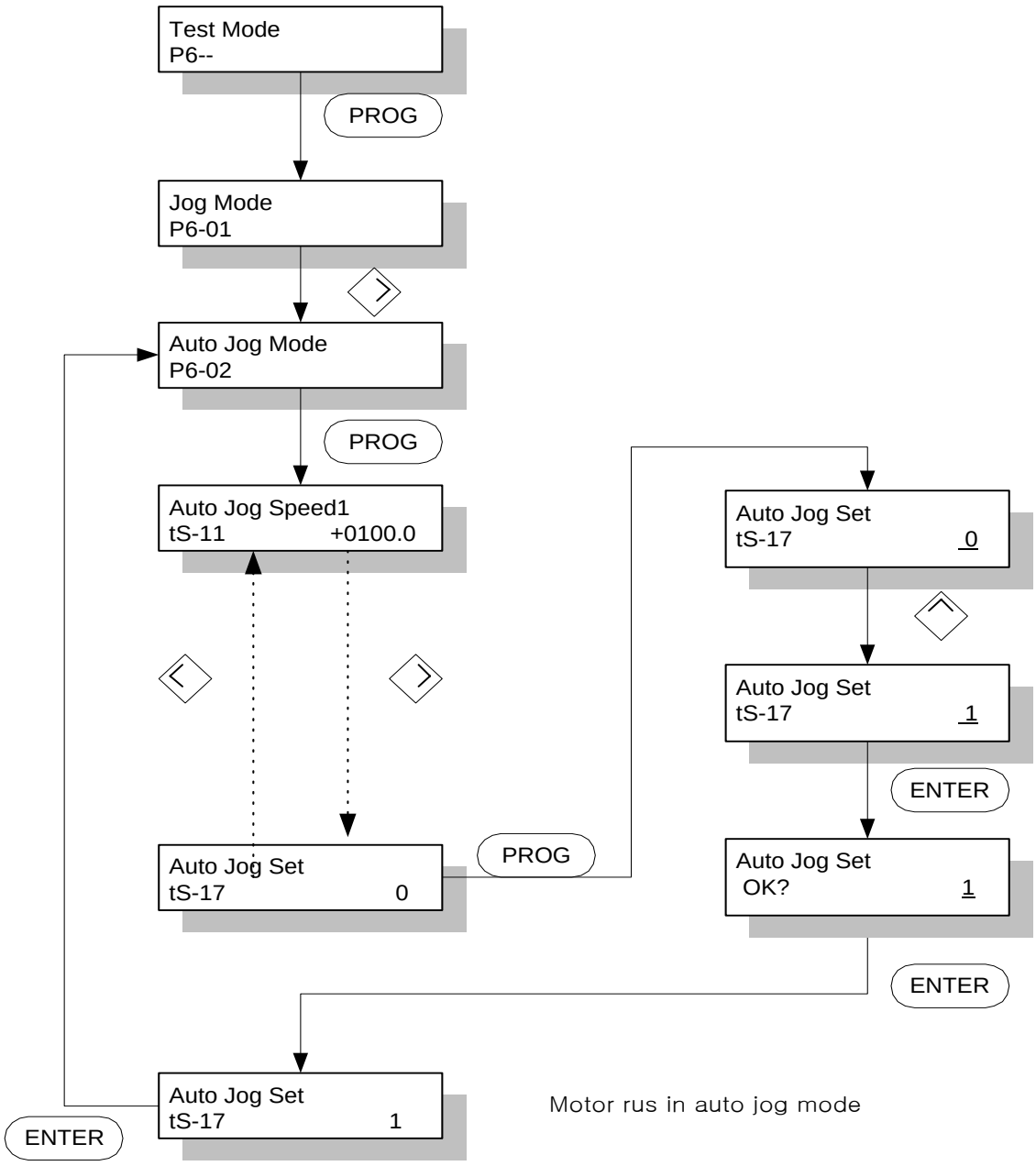


In jog mode, the motor can be test-run with the servo only without separate system required to input contact to the servo. This means that this menu allows operation without connection to the connector CN1. However, the motor parameter menu set value must be input. Left and Right keys are used to move the cursor when changing jog command values, but are used to rotate the jog in each sub-menu (tS-01, tS-02).

In [Jog Speed [RPM](tS-02)], motor speed is indicated when the motor is running in jog mode. The jog mode has another separate sub-menu in the sub-menu. If the system returns to the initial screen of jog mode, the servo function is returned to normal state.

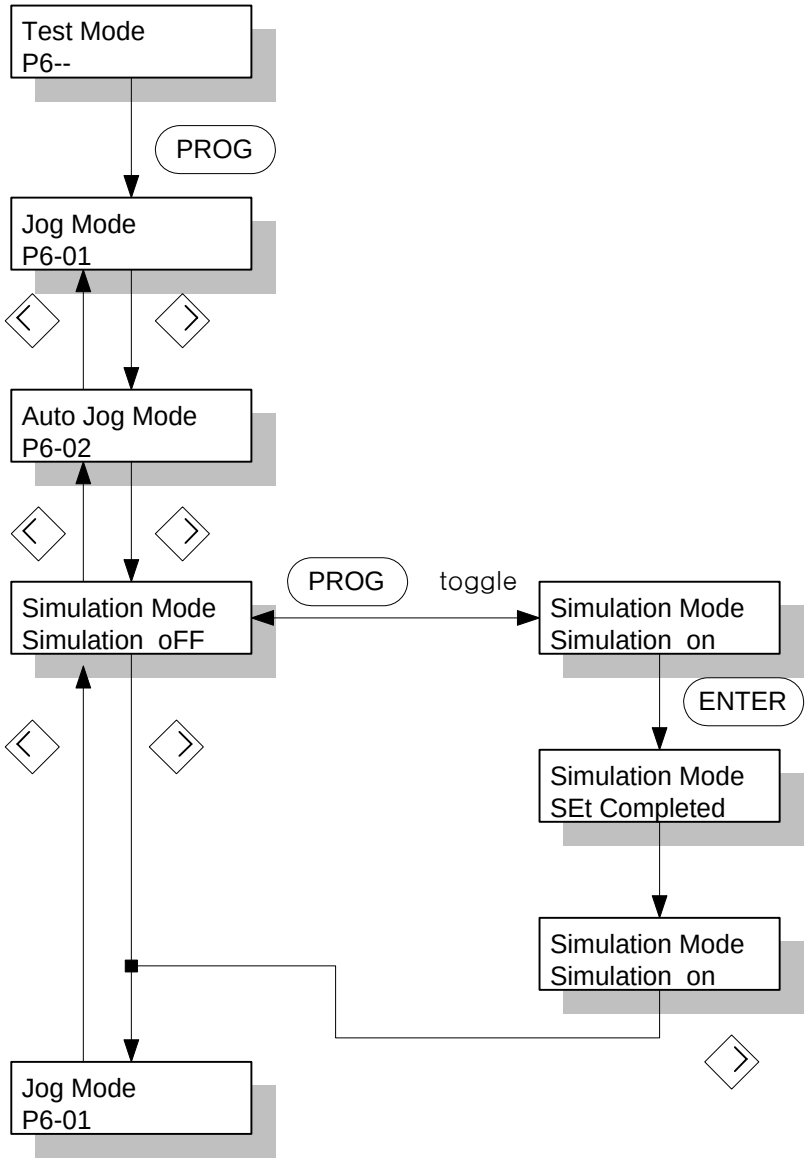
4.5.2 Auto jog mode (P6-02): Motor can independently operate without upper controller

Motor can run without the need of connecting the contact input connector CN1 in Auto jog mode just like in Jog mode. However, unlike the Jog mode in which the Left and Right keys must be continuously pressed to run the motor, the motor runs continuously for a given period of time and at given speed if the value of [Auto Jog Set(tS-17)] is set to 1.
(See 6.6.2 Auto Jog)
To reset the auto jog function and return to normal servo function while the motor is running after setting [Auto Jog Set(tS-17)] to 1 for auto jog operation, do one of the following: Exit to the auto jog mode from the sub-menu of the auto jog mode; set [Auto Jog Set(tS-17)] to 0; or turn ON main power after turning it OFF.



4.5.3 Simulation operation [Simulation mode (P603)]

While the motor is connected and is operated without contact input in Jog and Auto Jog modes, simulated operation is a condition under which, while the connector CN1 is connected in normal state, the menu displays data just as the motor is running when the motor wire and encoder are separated.



To cancel simulation mode, reset or turn OFF the main power.

5. Mount Loader Operation

Prior to connecting power and turning ON the servo, check the parameters [Motor parameters (P1--)] related to the motor at the digital loader. In order for the servo system to operate satisfactorily based on the information on the motor connected to the servo, accurate value must be set.

Next, monitor [Status Window (St--)] and verify that all commands and limit values are properly set.

For initial operation, verify certain degree of stability through autotuning and trial operation (jog, simulation). Autotuning can be achieved through on-line system, but it is not necessary to use this function in case stabilized control gain is acquired through off-line system.

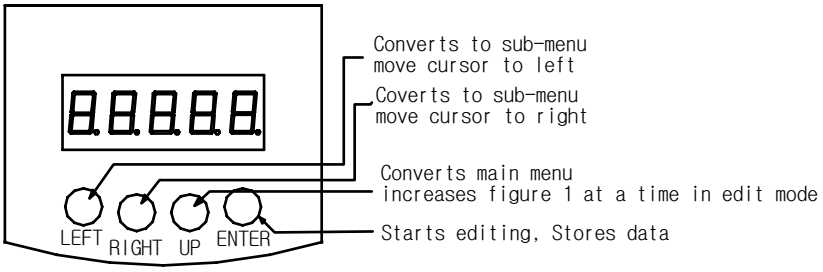


Figure 5.1 Rough sketch of mount loader

St-01, ..., ALS04 : sub-menu

St--, P1--, ..., ALS-- : Main menu

UP : Moves from main menu to main menu and from sub-menu to main menu.

ENTER : Moves from main menu to sub menu

RIGHT, LEFT : Moves between sub-menu

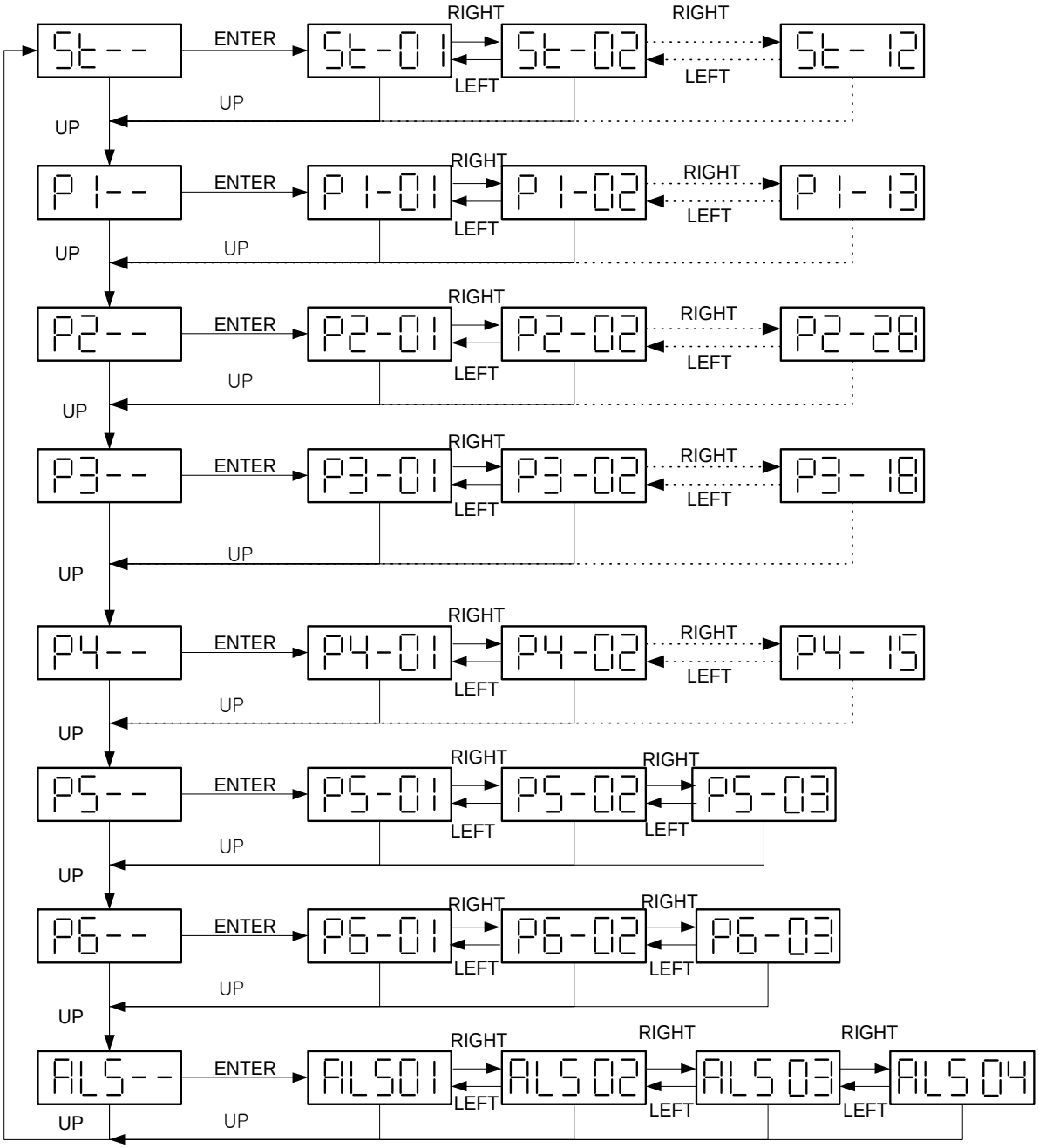


Figure 5.2 Overall block diagram of operation method

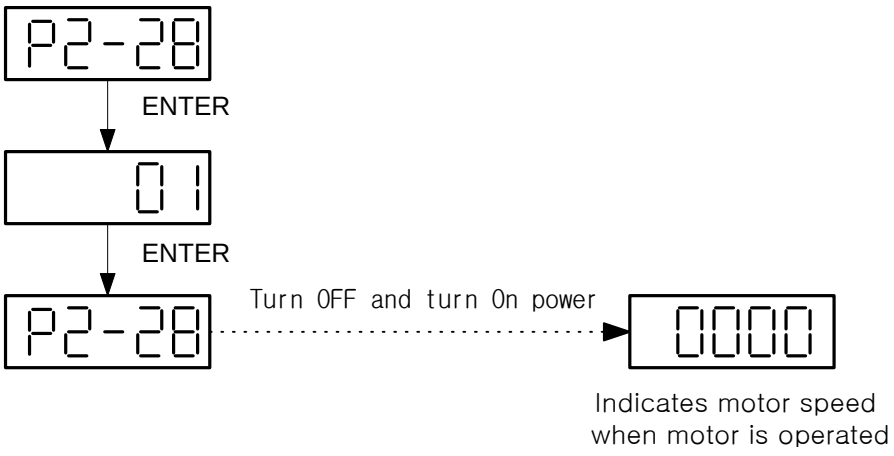
5.1 Initial screen after power is connected

Menus displayed after power is connected can be set according to [Display Select(P2-28)] set value.

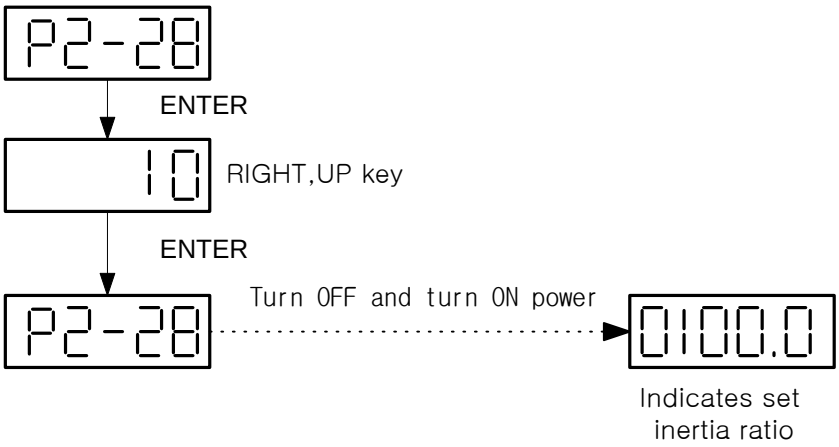
[Display Select(P2-28)]	Initial menus after power is connected
1	Motor Speed[r/min], (St-01)
2	CMD Speed[r/min] , (St-02)
3	CMD Pulse, (St-03)
4	Feedback Pulse, (St-04)
5	Pulse ERR, (St-05)
6	Speed Limit[r/min] , (St-06)
7	Torque Limit[%], (St-07)
8	Load Rate[%], (St-08)
9	Max Load Rate[%], (St-09)
10	Inertia Ratio, (St-10)

Initial set value of [Display Select(P2-28)]: 1

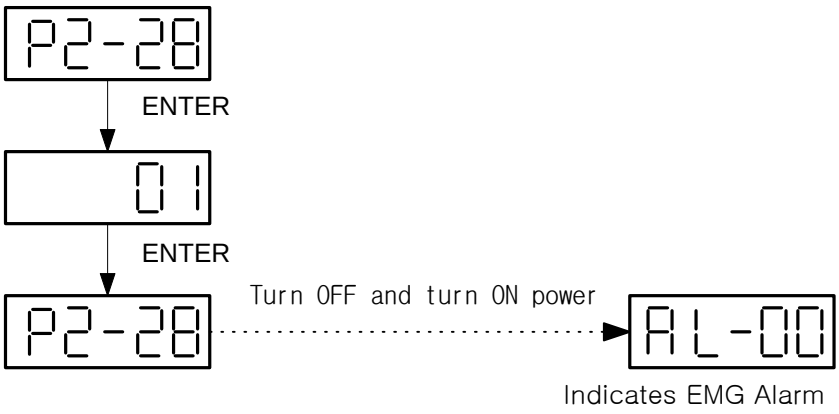
5.1.1 Connecting power when No alarm and initial menu are set to motor speed



5.1.2 Connecting power when No alarm and initial menu are set to inertia ratio



5.1.3 Connecting power in Emergency alarm state after setting initial menu to motor speed

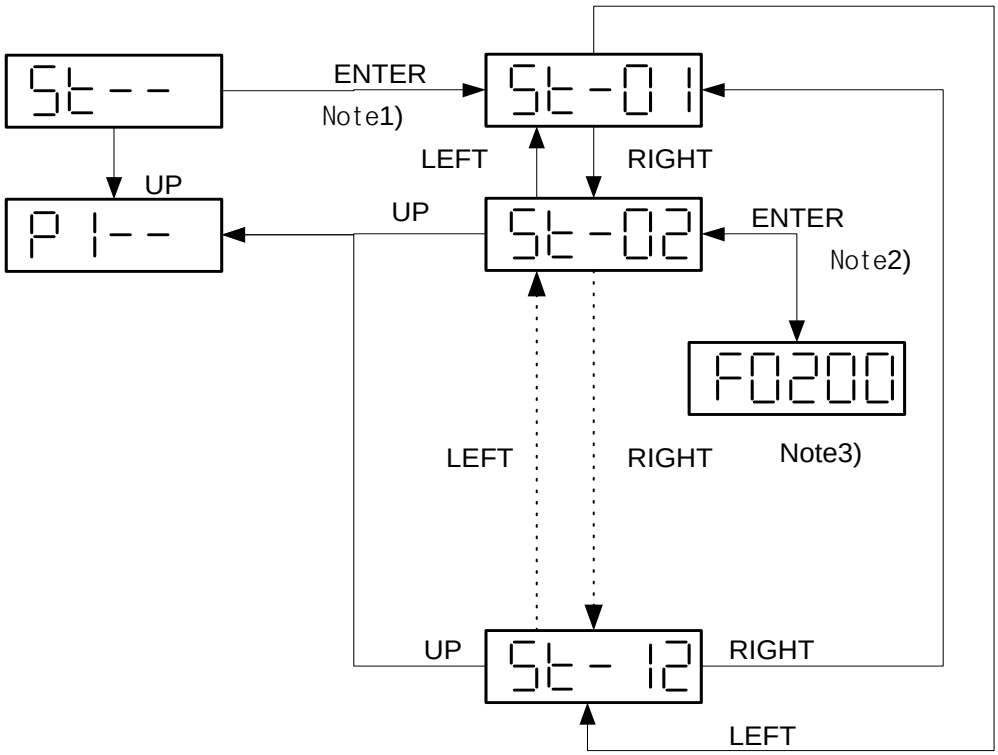


5.2 Sub-menu Group

Menus are classified into 3 main groups: a menu capable of editing or inputting information required for operation, a menu which monitors operation status, and a menu which carries testing function.

5.3 Operation Monitoring Menu

5.3.1 Operation monitoring window



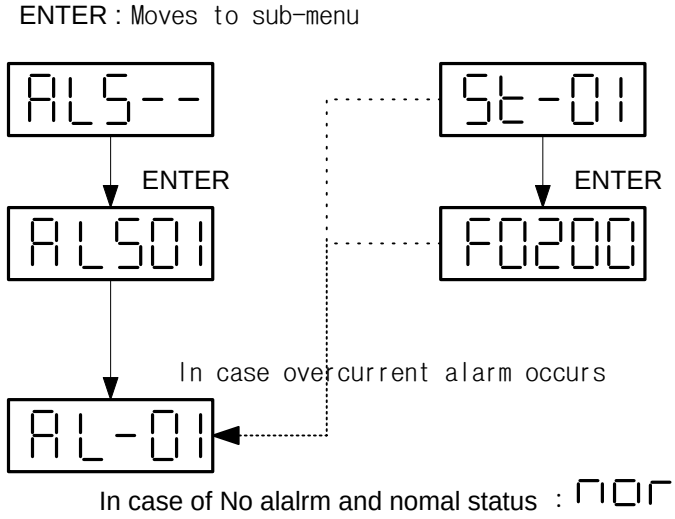
Note1) Press ENTER to move from main menu to sub-menu

Note2) Press ENTER also to monitor actual value from the sub-menu

Note3) "F" indicates "+","r" and "-" in the case of motor speed and command speed
In the figure, the motor command speed(St-02) is +200[r/min]

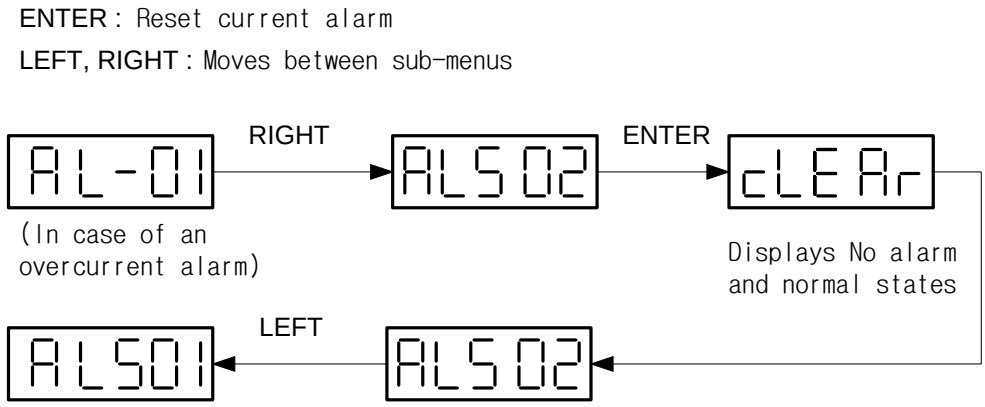
5.3.2 Alarm window

(1) Menu displaying current alarm status (ALS-01)



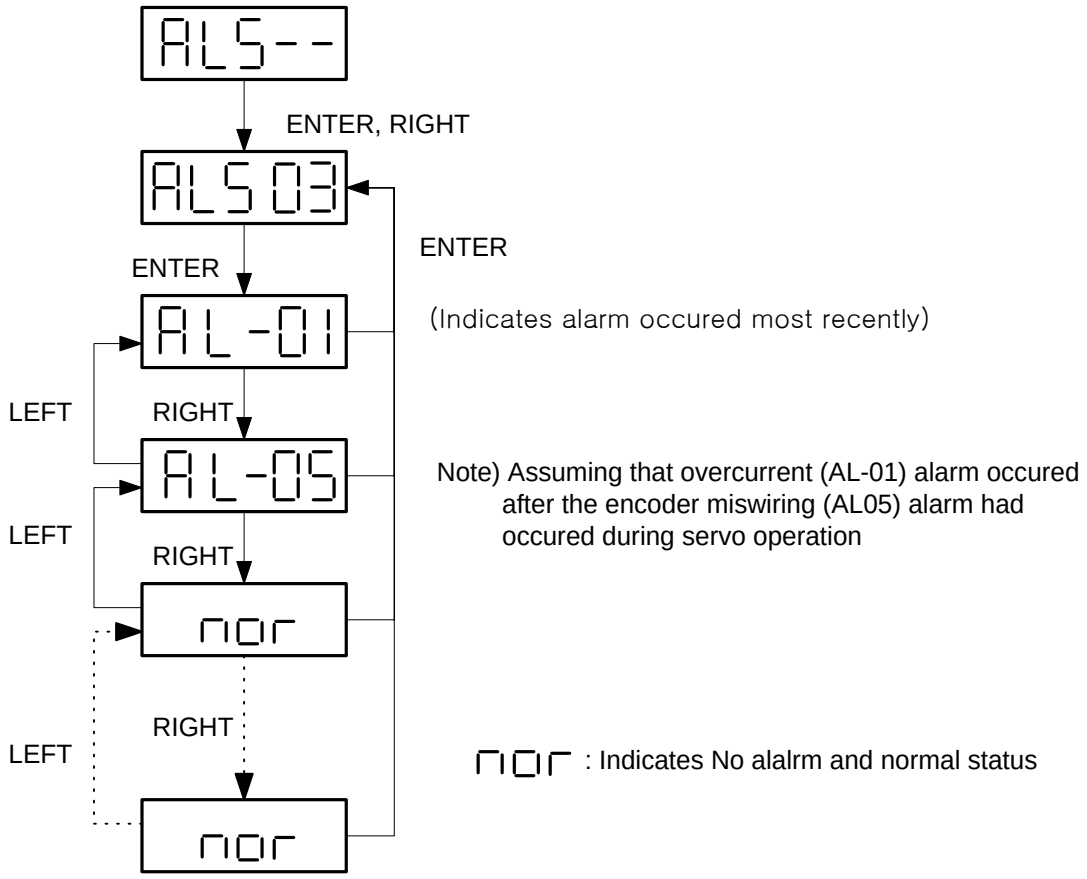
The alarm status display menu displays the current alarm.
In case of an alarm, it is displayed in the alarm display window of any menu.
Screen can freely move to another menu, but the motor cannot be run unless the alarm is reset.

(2) Current alarm reset menu



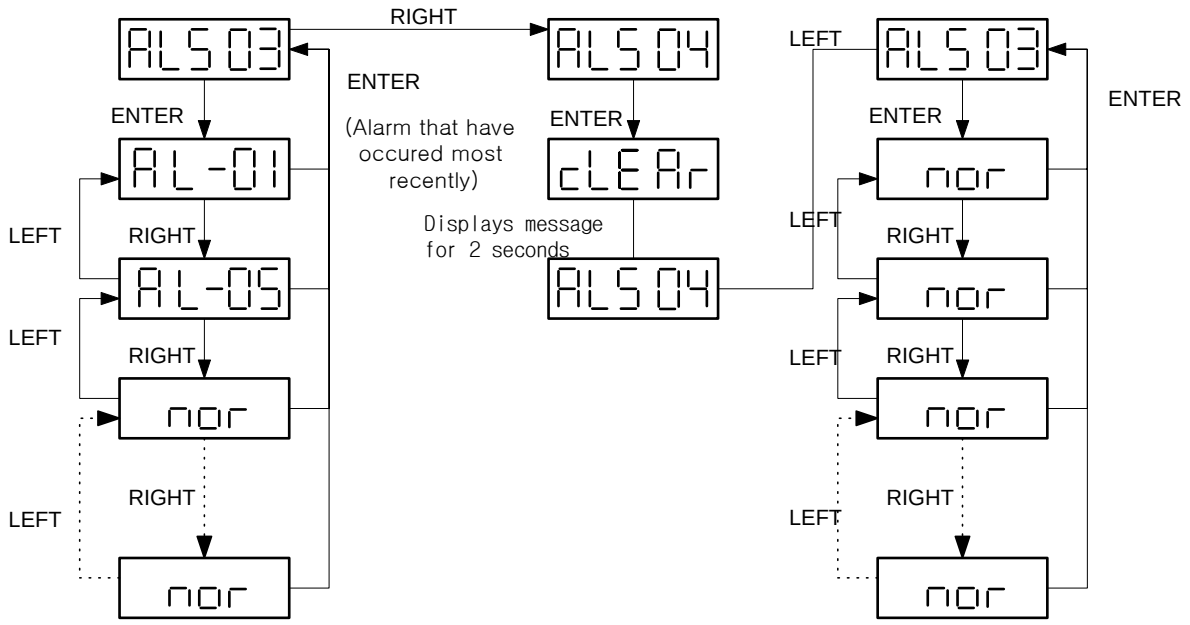
The current alarm reset (ALS-02) menu resets the alarm that has occurred on the system, a function which is the same as that of the external input reset.

(3) Alarm history (ALS-03) display menu



The alarm history menu displays up to 10 alarms that have occurred most recently.
The above figure is based on the assumption that overcurrent (AL-01) alarm occurred after the encoder miswiring (AL-095) alarm had occurred during servo operation.
"nor" is indicated when there is no alarm.
However, EMER STOP (AL-00) is not stored in the alarm history (ALS03).

(4) Alarm history reset (ALS04) menu



The above figure is a block diagram showing how to erase the system alarm history.
This is based on the assumption that overcurrent (AL-01) alarm occurred after the encoder miswiring (AL-095) alarm had occurred during servo operation in alarm history menu.
If there is no alarm after the alarm history reset (ALSO4) is activated, "nor" is displayed.
However, EMER STOP (AL-00) is not stored in the alarm history (ALS03).

5.4 Changing Parameters

The difference in editing between the mount loader and digital loader is that ENTER must be pressed once more to see the actual value of menu items in the case of the mount loader, and that only UP key may be used to change values during the process of editing.
In most menus, such as [Motor Parameter (P--)], [Control Mode (P2--)], [Speed Mode (P3--)], [Position Mode (P4--)] and [Torque Mode (P5--)], input desired values in the same method as that of changing parameters described below.

Two of the menus, autotuning (P2-24) menu and parameter initialization menu, are explained separately (see 5.2.4).

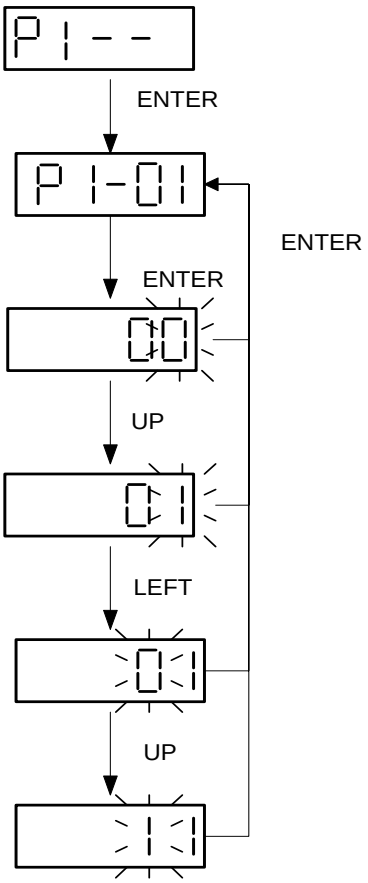
5.4.1 Changing parameters

ENTER : Starts and ends parameter change

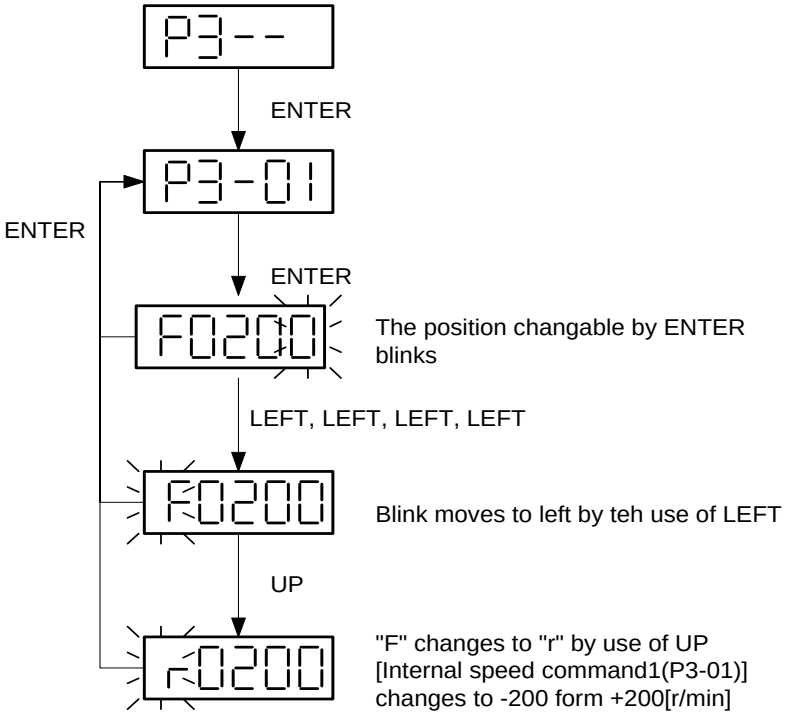
UP : Increase of value where blink is located

LEFT, RIGHT : Moves blink to left or right

Example1) Motor ID input (00->11)



Example2) Input of internal speed command1



5.5 Test Mode (P6--)

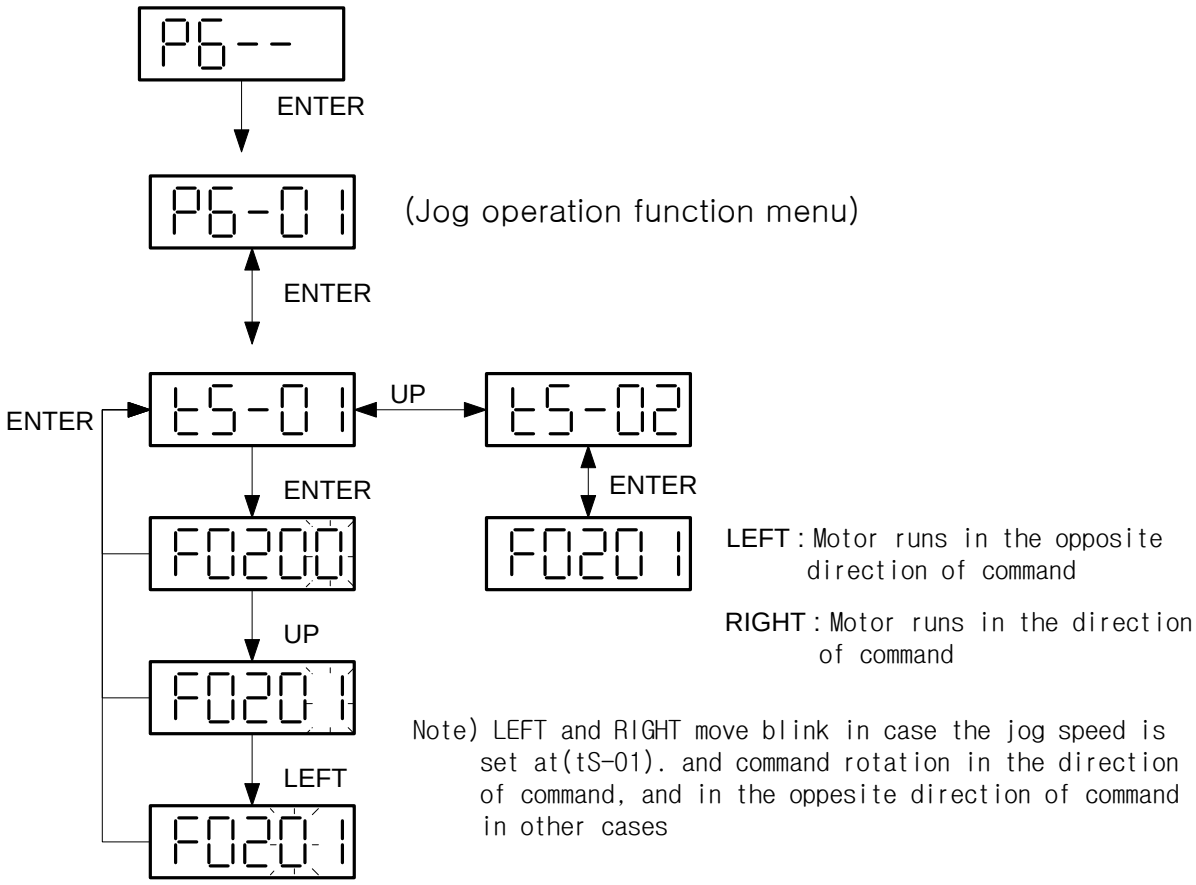
5.5.1 Jog operation function (P6-01)

ENTER : Starts/ends jog mode; starts/ends jog speed input; starts/ends jog speed monitor

LEFT : Blink moves to left when motor is running in the opposite direction of command, and jog speed is input

RIGHT : Blink moves to right when motor is running in the direction of command, and jog speed is input

UP : Changes menu on jog mode. Increase by 1 at a time when jog speed is input

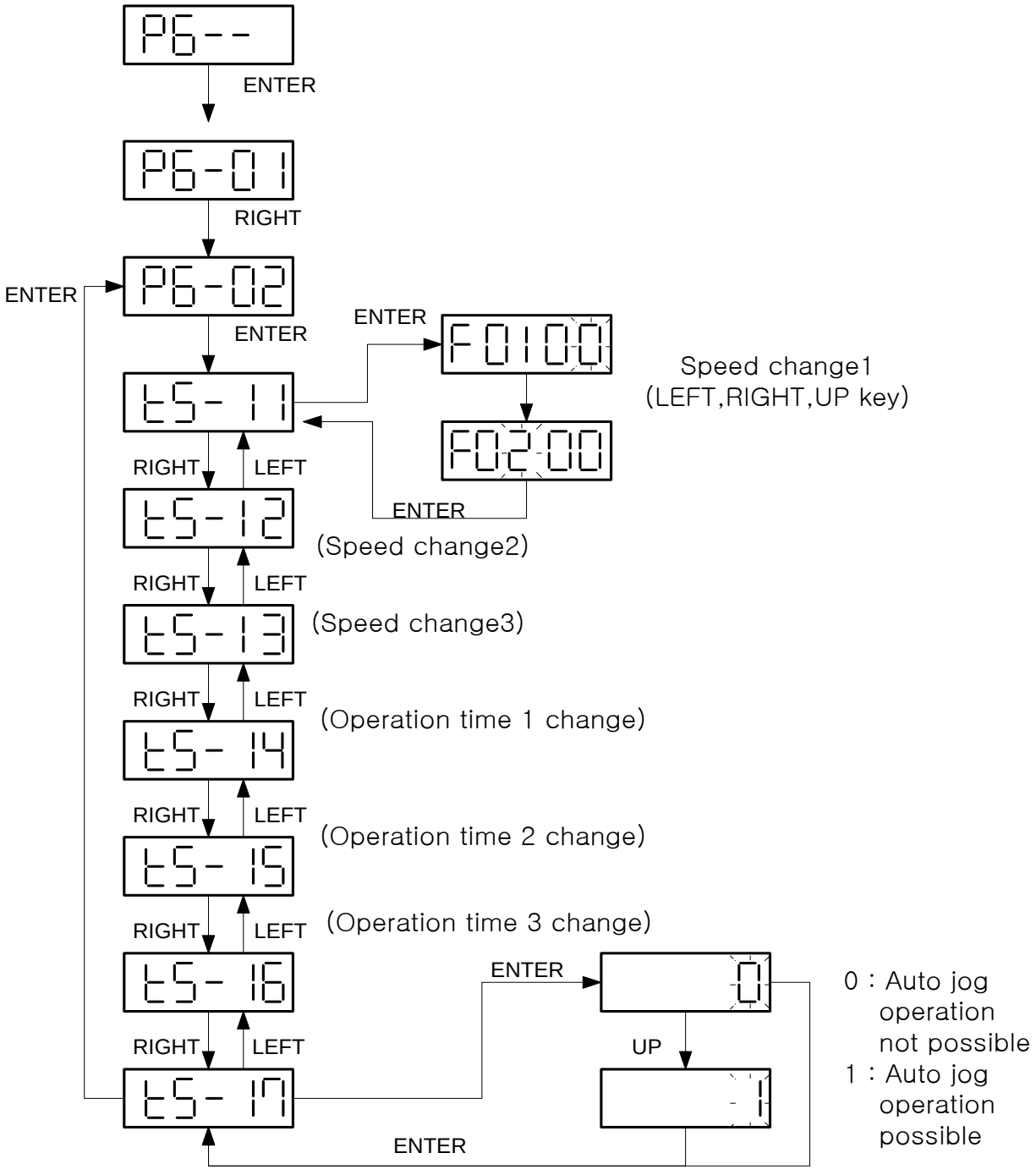


In jog mode, the motor can be test-run with the servo only without separate system required to input contact to the servo. This means that this menu allows operation without connection to the connector CN1. However, the motor parameter menu set value must be input. Left and Right keys are used to move the cursor when changing jog command values, but are used to rotate the jog in each sub-menu.

In (tS-02), motor speed is indicated when the motor is running in jog mode.

The jog mode has another separate sub-menu in the sub-menu. If the system returns to the initial screen of jog operation function (P6-01), the servo function is returned to normal state.

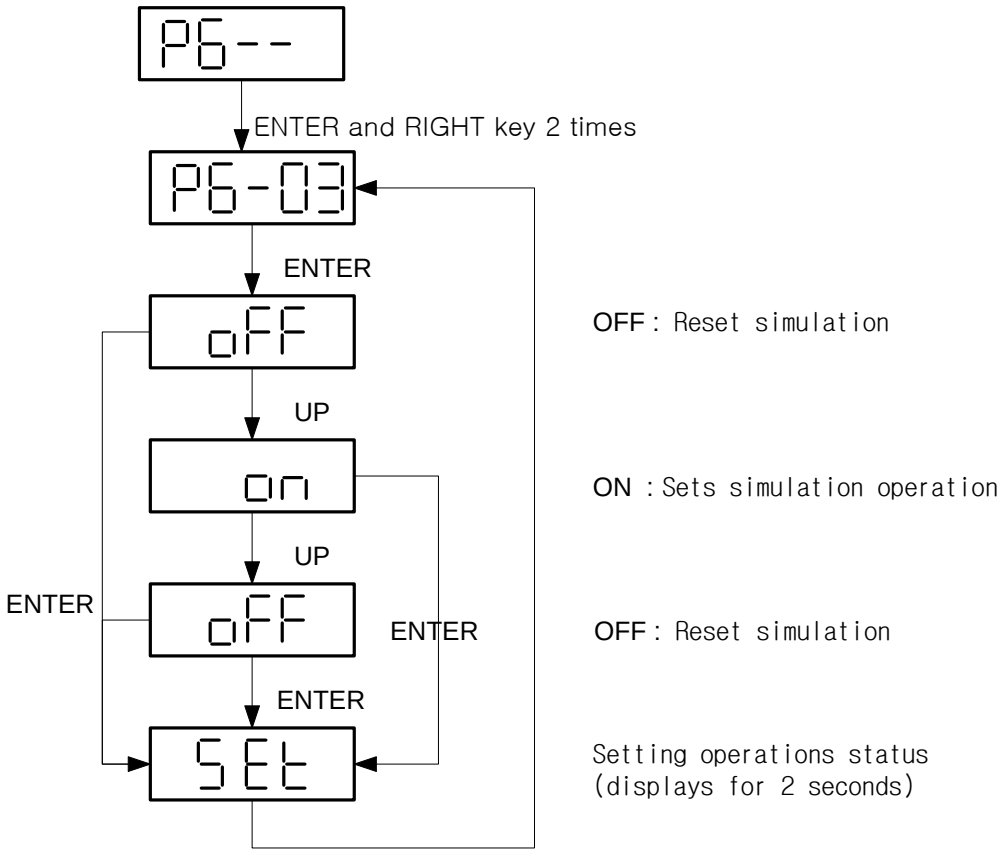
5.5.2 Auto job operation function (P6-02)



In jog mode, the motor runs by the use of LEFT and RIGHT. In [Auto jog operation mode], speed and time are set in [tS-11) - [tS-17); and if 1 is input in [tS-17), the motor runs repeatedly. Set value can be changed in each sub-menu of [tS-11) - [tS-17) in the same method of changing previous motor parameters and control-related parameters. If, after changing the sub-menu set value, ENTER is pressed without moving to sub-menu by the use of LEFT and RIGHT, the screen changes to [P6-02], the initial screen of [Auto jog operation mode}. The auto jog operation mode is then automatically reset, and the system returns to the normal servo function. (See 6.6.2 Auto Jog)

5.5.3 Simulation function (P6-03)

While the motor is connected and is operated without CN1 contact input in Jog and Auto Jog modes, simulated operation is a condition under which, while the connector CN1 is connected in normal state, menu displays data just as the motor is running when the motor wire and encoder is separated.



6. Parameter Setting

Menus can be set by the digital loader and mount loader. See Chapter 4 and 5 for information on how to use the digital loader and mount loader.

Abbreviations used in this manual and their meanings are as follows.

Abbreviation	Meaning	Abbreviation	Meaning
PC	Position Controller	ACCEL	Acceleration
SC	Speed Controlller	DECEL	Deceleration
LMT	Limit	VOLT	Voltage
RPM	r/min	SPD	Speed
ms	msec	OFFS	Offset
μs	μsec	TC	Time Constant
FRQ	Frequency	FF	Feedforward
FLT	Filter	FB	Feedback
ENB	Enable	ERR	Error
INIT	Initialize	FLLW	Follow
DFLT	Default	ELCTR	Electric
PROG	Program	NUM	Numerator
CMD	Command	DEN	Denominator

Meanings of the modes in the following parameter summary are shown below.

Mode	Meaning
S	Effective in speed control mode
P	Effective in position control mode
T	Effective in torque control mode

6.1 Parameter Summary

Digital loader displays menus along with menu names, but the mount loader shows only menus.

(1) Status window (Status window: St--)

Menu	Menu name	Unit	Display range	Initial value	Mode
St-01	Motor Speed[RPM]	r/min	-9999.9~9999.9	0	SPT
St-02	CMD Speed[RPM]	r/min	-9999.9~9999.9	0	SP
St-03	CMD Pulse	pulse	-9999999~9999999	0	P
St-04	Feedback Pulse	pulse	-9999999~9999999	0	P
St-05	Pulse ERR	pulse	0 ~ 99999	0	P
St-06	Speed Limit[RPM]	r/min	0 ~ 9999.9	0	T
St-07	Torque Limit[%]	%	0 ~ 999	0	SPT
St-08	Load Rate[%]	%	-99999 ~ 99999	0	SPT
St-09	Max Load Rate[%]	%	-99999 ~ 99999	0	SPT
St-10	Inertia Ratio	Multiple	0~500.0	1.0	SPT
St-11	Program Version			Version	SPT
St-12	I/O Status				SPT

(2) Motor and system menu (Motor parameters: P1--)

Menu	Menu name	Unit	Display range	Initial value	Mode
* P1-01	Motor ID		0 ~ 99		SPT
* P1-02	JM [gfcms2]	gf-cm-sec^2	0.01 ~ 999.99		SPT
* P1-03	KT [kgfcm/A]	kgf-cm/A	0.01 ~ 999.99		SPT
* P1-04	Ls(Phase)[mH]	mH	0.01 ~ 999.99		SPT
* P1-05	Rs(Phase)[ohm]	Ω	0.01 ~ 999.99		SPT
* P1-06	Is(Rated)[Arms]	Arms	0.01 ~ 999.99		SPT
* P1-07	SPD(Max)[RPM]	r/min	0.1 ~ 9999.9		SPT
* P1-08	SPD(Rated)[RPM]	r/min	0.1 ~ 9999.9		SPT
* P1-09	Pole Number	pole	2 ~ 98	8	SPT
* P1-10	Power Amp Type		0 ~ 20	By capacity	SPT
* P1-11	Encoder Type		0 ~ 9	0	SPT
* P1-12	Encoder PLS[PPR]	ppr	1 ~ 10000	2000	SPT
*P1-13	Parameter Lock		0/1	0	SPT

(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

(3) Common control menu (Control mode: P2--)

Menu	Menu name	Unit	Display range	Initial value	Mode
* P2-01	Controller Type		0 ~ 5	1	SPT
P2-02	PC P Gain	rad/sec	0 ~ 500	50	P
P2-03	SC LOOP Gain	rad/sec	0 ~ 5000	(Note 1) By capacity	SPT
P2-04	SC I TC [ms]	ms	1 ~ 10000	20	SPT
P2-05	TRQ LMT(+) [%]	%	0 ~ 300	300	SP
P2-06	TRQ LMT(-) [%]	%	0 ~ 300	300	SP
P2-07	Pulse Out Rate	division	1 ~ 16	1	SPT
P2-08	Current Offset		0, 1	0	SP
P2-09	Brake SPD[RPM]	r/min	0.0 ~ 9999.9	50.0	SPT
P2-10	Brake Time[ms]	ms	0 ~ 10000	10	SPT
P2-11	Monitor1 Select		0 ~ 2	0	SPT
P2-12	Monitor1 ABS		0,1	0	SPT
P2-13	Monitor1 Scale	multiple	1.00 ~ 20.00	1.00	SPT
P2-14	Monitor1 offset	%	-100.0 ~ 100.0	0	SPT
P2-15	Monitor2 Select		0 ~ 2	1	SPT
P2-16	Monitor2 ABS		0,1	0	SPT
P2-17	Monitor2 Scale	multiple	1.00 ~ 20.00	1.00	SPT
P2-18	Monitor2 offset	%	-100.0 ~ 100.0	0	SPT
P2-19	Resonant RQ[Hz]	Hz	0 ~ 1000	300	SP
P2-20	Resonant BW[Hz]	Hz	0 ~ 1000	100	SP
P2-21	De-Resonant ENB		0,1	0	SP
P2-22	Inertia Ratio	multiple	1.0~500.0	(Note 2) 1.0	SPT
P2-23	Autotune Range		0~9	0	SP
P2-24	Autotune ON/OFF		ON/OFF	OFF	SP
* P2-25	Parameter Init		currt/dFLT	currt	SPT
P2-26	SPDIN Delay	ms	0~100	0	S
P2-27	DB Control		0,1	1	SPT
P2-28	Display Select		1~10	1	SPT
P2-29	Start/Stop		0,1	0	SPT
P2-30	Emergency Type		0,1	0	SPT
P2-31	Power fail Mode		0,1	1	SPT
P2-32	Zero SPD VIB RJT	r/min	0.0~100.0	0.0	SP
	Confirm ON/OFF		ON/OFF	ON	SPT

(Note 1) SC Loop gain by capacity - FDA-5001-4: 500, FDA-5005-75: 200

(Note 2) For Inertia Ratio [P-22], input multiples in case of Soft Ver 4.23 or higher; and input % (i.e. multiple * 100) in case of Soft Ver 4.22 or less.

(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

(4) Speed menu (Speed Mode : P3--)

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-01	Speed CMD1[RPM]	r/min		10	ST
P3-02	Speed CMD2[RPM]	r/min		200	ST
P3-03	Speed CMD3[RPM]	r/min		500	ST
P3-04	Speed CMD4[RPM]	r/min		1000	S
P3-05	Speed CMD5[RPM]	r/min		1500	S
P3-06	Speed CMD6[RPM]	r/min		2000	S
P3-07	Speed CMD7[RPM]	r/min		3000	S
P3-08	Accel Time[ms]	ms	0 ~ 100000	0	S
P3-09	Decel Time[ms]	ms	0 ~ 100000	0	S
* P3-10	S TYPE ENB		0, 1	0	S
P3-11	Zero Speed[RPM]	r/min	0 ~ 9999.9	100	SPT
P3-12	Inspeed Range	r/min	0 ~ 9999.9	100	S
* P3-13	10V Speed[RPM]	r/min	0 ~ 9999.9	3000	ST
P3-14	SPD CMD OFFS[mV]	MV	-1000.0~1000.0	0.0	ST
P3-15	Zero Clamp Mode		0 ~ 2	0	S
P3-16	Clamp VOLT[mV]	mV	-1000 ~ 1000	0	S
* P3-17	FDELAY	ms	0.0 ~ 100.0	0	SPT
* P3-18	Override ON/OFF		0,1	0	S

(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

(5) Position menu (Position Mode : P4--)

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-01	Feedforward[%]	%	0 ~ 100	0	P
P4-02	FF FLT TC[ms]	ms	0 ~ 10000	0	P
P4-03	CMD FLT TC[ms]	ms	0 ~ 10000	0	P
P4-04	In Position[PLS]	pulse	0 ~ 99999	100	P
P4-05	FLLW ERR [Pulse]	pulse	0 ~ 99999	20000	P
* P4-06	ELCTR Gear1 NUM		1 ~ 99999	1	P
* P4-07	ELCTR Gear1 DEN		1 ~ 99999	1	P
* P4-08	ELCTR Gear2 NUM		1 ~ 99999	1	P
* P4-09	ELCTR Gear2 DEN		1 ~ 99999	2	P
* P4-10	ELCTR Gear3 NUM		1 ~ 99999	1	P
* P4-11	ELCTR Gear3 DEN		1 ~ 99999	3	P
* P4-12	ELCTR Gear4 NUM		1 ~ 99999	1	P
* P4-13	ELCTR Gear4 DEN		1 ~ 99999	4	P
* P4-14	Pulse Logic		0 ~ 5	1	P
* P4-15	Backlash[Pulse]	pulse	0 ~ 10000	0	P

(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

(6) Torque menu (Torque Mode : P5--)

Menu	Menu name	Unit	Display range	Initial value	Mode
P5-01	TRQ CMD TC[ms]	ms	0.0 ~ 1000.0	0.0	SPT
* P5-02	10V Torque	%	0 ~ 300	100	SPT
P5-03	Torque OFFS	mV	-1000.0 ~ 1000.0	0.0	T

(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

(7) Test mode (Test Mode : P6--)

Menu	Menu name	Unit	Display range	Initial value	Mode
P6-01 (tS-01)	Jog Command[RPM]	r/min	-5000.0~5000.0	100	
(tS-02)	Jog Speed[RPM]	r/min	-5000.0~5000.0	0	
P6-02 (tS-11)	Auto Jog Speed1	r/min	-5000.0~5000.0	100	
(tS-12)	Auto Jog Speed2	r/min	-5000.0~5000.0	-200	
(tS-13)	Auto Jog Speed3	r/min	-5000.0~5000.0	300	
(tS-14)	Auto Jog Time1	sec	1 ~ 50000	1	
(tS-15)	Auto Jog Time2	sec	1 ~ 50000	2	
(tS-16)	Auto Jog Time3	sec	1 ~ 50000	3	
(tS-17)	Auto Jog Set		0, 1	0	
* P6-03	Simulation Mode		on/off	off	

(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

(8) Alarm status (Alarm Status : ALS--)

Menu	Menu name	Unit	Display range	Initial value	Mode
ALS01	Alarm Display				SPT
ALS02	Alarm Reset				SPT
ALS03	Alarm History				SPT
ALS04	Alarm Reset All				SPT

6.2 Description of servo status (Status Window: St--)

Screen display	Description
Motor Speed[RPM] St-01	Indicates current motor speed in [RPM]
CMD Speed[r/min] St-02	Indicates servo motor speed command in [RPM]
CMD Pulse St-03	Indicates current command pulse when controlling positions
Feedback Pulse St-04	Indicates feedback pulse when controlling positions
Pulse ERR St-05	Indicates the difference between the current command pulse and feedback pulse when controlling positions
Speed Limit[r/min] St-06	Current speed limit value when controlling torques
Torque Limit[%] St-07	Indicates current torque limit value in [%]
Load Rate [%] St-08	Indicates current motor load in [%] based on torque
Max Load Rate[%] St-09	Indicates maximum servo torque
Inertia Ratio St-10	Indicates inertia ratio (system inertia/motor inertia) in [multiple]
Program Version St-11	Indicates current program version
I/O CON. STATUS	Indicates contact I/O status

Note) In case of contact I/O status (meaning of each contact may vary according to control mode; however, contact is displayed based on control mode in this case)

6.2.1 Digital loader signal display

(1) Input signal display

The status of input contact recognized within the system is indicated with either "0" or "1". Therefore, if the status input from the external sources is different from the displayed information, it indicates problem on the input system. As each signal carries different meaning, explanation is provided through examples below.

(Example of display)

Signal	ALM RST	STOP	ESTOP	TLIM	CWLIM	CCWLIM	P/PI	DIR	SPD3	SPD2	SPD1	SVONEN
Display	0	0	1	0	0	1	0	0	0	0	1	1

1: Input signal operating
0: Input signal not operating

Signal	Display	Description
ALMRST	0	Alarm reset function not used
STOP	0	Motor stop not used
ESTOP	1	Emergency stop not used
TLIM	0	Analog torque limit not used
CWLIM	0	CW direction rotation not possible
CCWLIM	1	CCW direction rotation possible
P/PI	0	Operates as PI control
DIR	0	Rotates in the direction of command
SPD3	0	Internal command speed 1 used
SPD2	0	
SPD1	1	
SVONEN	1	Servo motor start command operating

The above examples are based on the current status of each signal. System operates in reverse if signals are in opposite status.

(2) Output signal display

The output contact status is displayed with either "0" or "1".
Therefore, if the status actually output on the outside is different from the displayed information, it indicates problem on the input system. As each signal carries different meaning, explanation is provided through examples below.

(Example of display)

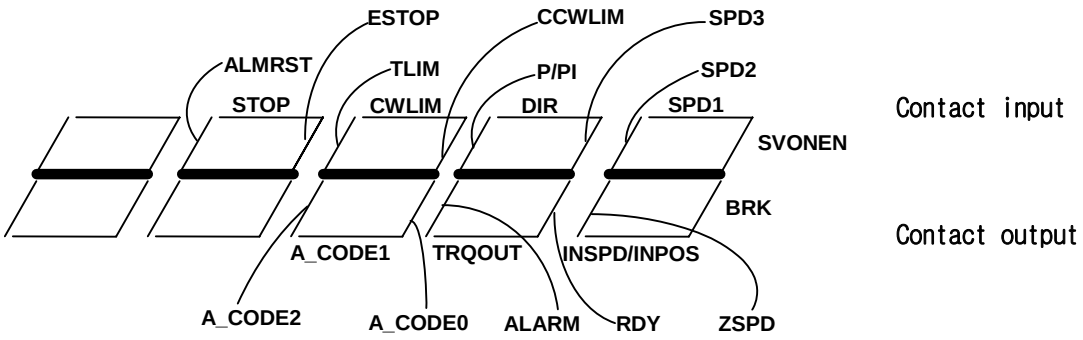
Signal	ALARM3	ALARM2	ALARM1	ALARM	TRQOUT	RDY	ZSPD	INSPD/ INPOS	BRK
Display	0	0	0	1	0	1	0	1	1

1: Output signal operating
0: Output signal not operating

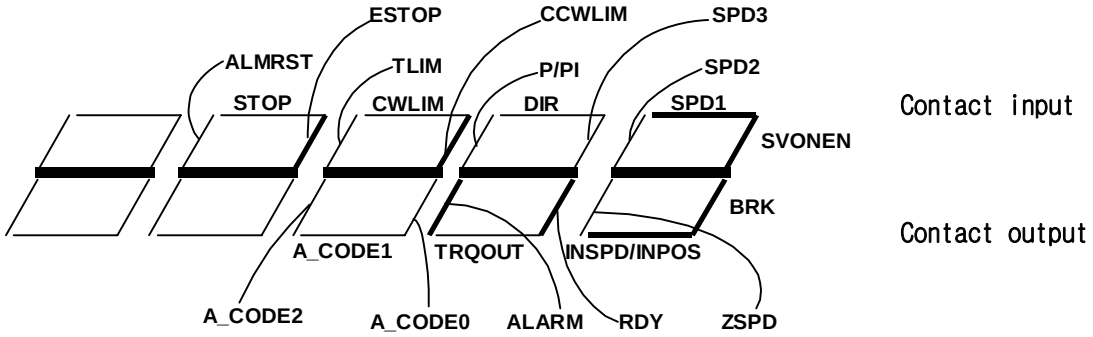
Signal	**Display**	**Description**
ALARM 3	0	No Alarm Code Normal status
ALARM 2	0	
ALARM 1	0	
ALARM	1	No Alarm, normal status
TRQOUT	0	Torque not limited
RDY	1	No Alarm, Power Good, Servo Ready
ZSPD	0	Motor not stopped
INSPD/INPOS	1	Command speed or command position reached
BRK	1	Motor brake reset signal displayed

6.2.2 Mount loader signal display

The following figure shows magnified 7segment of the mount loader.
Each segment of the mount loader's 7segment has its own meaning.
The part above the solid line indicates the contact input status, while the part below the solid line, the contact output status. The current status is displayed by each segment being turned on or off.



From the following figure, the segments indicated in thick line are those turned on.
Segments can be displayed as follows assuming the I/O status is the same as explained in section 6.8.1. In other words, the status which is displayed as "1" on digital loader is displayed by the segment on the mount loader being turned on.



6.3 Motor and System Parameters (Motor Parameters: P1--)

These parameters are used to set the motor and the system. User must set parameters to suit the motor and the system prior to use.

(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

Menu	Menu name	Description	Unit	Setting range	Initial value	Mode
*P1-01	Motor ID	Motor ID		0 ~ 99	0	SPT

ID	Model	ID	Model	ID	Model	ID	Model	ID	Model
0	Individual input	20	TF05	40	LF03	60	KN03	80	LN03
1		21	TF09	41	LF06	61	KN05	81	LN06
2		22	TF13	42	LF09	62	KN06	82	LN09
3		23	TF20	43	LF12	63	KN07	83	LN12
4		24	TF30	44	LF20	64	KN06A	84	LN12A
5	CKZ5	25	TF44	45	LF30	65	KN11	85	LN20
6	CK01	26	TF09-05	46		66	KN16	86	LN30
7		27		47		67	KN22	87	LN40
8	CK02	28		48		68	KN22A	88	
9	CK04	29		49		69	KN35	89	
10		30	KF08	50	CN04A	70	TN05	90	
11	CN01	31	KF10	51	CN06	71	TN09	91	
12	CN02	32	KF15	52	CN08	72	TN13	92	
13	CN03	33	KF22	53	CN10	73	TN17	93	
14	CN04	34	KF35	54	CN09	74	TN20	94	
15	CN05	35	KF50	55	CN15	75	TN30	95	
16		36		56	CN22	76	TN44	96	
17		37		57	CN30	77	TN75	97	
18		38		58	CN30A	78		98	
19		39		59	CN50A	79	KN55	99	

♦ Above ID is applied to Ver5.32 over

If the motor is used in the above table, input motor ID to [Motor ID(P1-01)].
In such case, [JM (P1-02)], [KT (P1-03)], [Ls(Phase) (P1-04)], [Rs(Phase) (P1-05)], [Is(Rated) (P1-06)], [SPD(Max) (P1-07)], [SPD(Rated) (P1-08)], [Pole Number (P1-09)] among the set values are automatically set, and individual editing is not allowed.
If the motor used is not shown on the above table, or if it is desired to change one or more of the set values related to the motor, input 0 to [Motor ID (P1-01)]..

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-02	JM [gfcms2]	gf-cm-sec^2	0.01 ~ 999.99		SPT

Convert the motor inertia moment in [gf-cm-sec^2] and input the data.

In this mode, input the inertia of the motor which does not include load inertia.

For information on how to input load inertia, see section [Inertia Ratio (P2-22)].

Procedure of converting general unit to that of [gf-cm-sec^2] is as follows.

1[kg-cm^2] $\rightarrow$ 1.02 [gf-cm-sec^2]

1[kg-m^2] $\rightarrow$ 1.02 $\times$ 10^4[gf-cm-sec^2]

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-03	KT [kgfcm/A]	kgf-cm/A	0.01 ~ 999.99		SPT

Convert the motor torque constant in [kgf-cm/A] and input the data.

Torque constant is defined in the torque level corresponding to 1[A, rms].

Procedure of converting MKS unit to that of [kgf-cm/A] is as follows.

1[N-m/A] $\rightarrow$ 10.2[kgf-cm/A]

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-04	Ls(Phase)[mH]	MH	0.01 ~ 999.99		SPT
*P1-05	Rs(Phase)[ohm]	Ω	0.01 ~ 999.99		SPT

Convert the motor phase inductance in [mH] and input the data.

Convert the motor phase resistance in [Ω] and input the data.

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-06	Is(Rated)[Arms]	A (rms)	0.01 ~ 999.99		SPT

Convert the motor rated current in [A] and input the data.

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-07	SPD(Max)[RPM]	RPM	0.1 ~ 9999.9	5000.0	SPT
*P1-08	SPD(Rated)[RPM]	RPM	0.1 ~ 9999.9	3000.0	SPT

Input motor's maximum speed and rated speed in RPM (r/min).

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-09	Pole Number	Pole	2 ~ 98	8	SPT

Input the number of motor poles.
The number of motor poles is always expressed in even number. Take caution not to input odd numbers.
HIGEN servo motor has 8 numbers in all.

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-10	Power Amp Type		0 ~ 20	By capacity	SPT

Input the following set values according to the capacity of the servo motor.

5001	5002	5004	5005	5010	5012	5015	5020	5030	5045	5075
0	1	2	5	6	7	11	12	13	14	15

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-11	Encoder Type		0 ~ 9	0	SPT

The value has been set to "0" at the time of delivery based on general incremental encoder (A Lead in case of forward run).
(Based on using HIGEN standard motor)
If other encoders are used, set the value according to the following classification.

Type of encoder	Set value	Remarks
General incremental encoder	0	A lead in case of forward run
General incremental encoder	1	A lead in case of forward run
Sumtak 9-wire incremental encoder	5	Optional
Sumtak absolute value encoder (2048p/r)	6	Optional

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-12	Encoder PLS[PPR]	PPR	1 ~ 10000	2000	SPT

Input the number of pulses on the encoder A and B phases.

Menu	Menu name	Unit	Display range	Initial value	Mode
*P1-13	Parameter Lock		0/1	0	SPT

Set whether parameter locking is to be executed.
0: Parameter correction possible
1: Parameter correction not possible

6.4 Common Parameters Related to Control (Control Mode: P2--)

In this group, functions of common parameters related to control and several additional functions can be executed.
(Caution !) Menus marked with "*" cannot be corrected during Servo-ON.

Menu	Menu name	Unit	Display range	Initial value	Mode
*P2-01	Controller Type		0 ~ 5	1	SPT

Designate servo controller model as follows:

Servo model	Set value	Remarks
Torque servo	0	
Speed servo	1	Basic set value
Position servo	2	
Speed/position servo	3	Speed servo, if contact (type) is ON; and position servo, if contact (type) is OFF
Speed/torque servo	4	Speed servo, if contact (type) is ON; and torque servo, if contact (type) is OFF
Position/torque servo	5	Position servo, if contact (type) is ON; and torque servo, if contact (type) is OFF

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-02	PC P Gain	rad/sec	0 ~ 500	50	P

If the proportional gain is large, the time to reach the command position is reduced. However, if the proportional gain is excessively large, vibration occurs when the motor stops, or overshoot occurs in transient status.

Recommended maximum set value $= \frac{\text{[SC LOOP Gain (P2 - 03)]}}{10}$ **[rad/sec]**

Recommended maximum set value $= \frac{\text{[SC LOOP Gain (P2 - 03)]}}{4}$ **[rad/sec]**

If the maximum set value is exceeded, overshoot may occur on the position.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-03	SC LOOP Gain	rad/sec	0 ~ 5000	By capacity	SPT

If the speed loop gain is large, high speed response characteristics may be obtained but the normal condition characteristics may become deteriorated. Set appropriate level of loop gain to ensure desired performance.
The servo speed response is closely related to the system inertia. Set accurate motor inertia (JM(P1-02)], and set the ratio of the overall system inertia (Sum of motor inertia and load inertia) to the motor inertia in [Inertia Ratio (P2-22)]. If the accurate system inertia is unknown, use the autotuning function provided with the servo.
(Caution!) Initial value by capacity - FDA-5001-4: 500, FDA-5005-75: 200

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-03	SC LOOP Gain	rad/sec	0 ~ 5000	By capacity	SPT

(Description continued)
If the ratio of the overall system inertia (Sum of motor inertia and load inertia) to the motor inertia is set in [Inertia Ratio (P2-22)], or if the value set by using the autotuning [Autotuning (P2-24)] provided with the servo is the same as the following, the recommended set values of [SC Loop Gain (P2-03)] by servo capacity are as follows.

[Table]

Servo driver capacity	FDA5001~04	FDA5005~5075
Inertia Ratio (P2-22) set value	Recommended SC Loop Gain (P2-03) set value	Recommended SC Loop Gain (P2-03) set value
1.0	500 ~ 1000	100 ~ 200
2.0	350 ~ 500	70 ~ 200
3.0	300 ~ 500	50 ~ 150
5.0	200 ~ 300	40 ~ 100
10.0	150 ~ 250	30 ~ 80
20.0	100 ~ 150	20 ~ 60
30.0	60 ~ 100	-

(Caution !!) However, the recommended SC Loop Gain (P2-03) set values may be deviated according to the status of the load.
If the □80 or □130 motor is controlled by servo FDA-5004, use SC Loop Gain (P2-03) of FDA-5005.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-04	SC I TC [ms]	ms	1 ~ 10000	20	SPT

Reducing the speed integrating time constant can improve the transient response characteristics of speed control and normal status characteristics. However, if the time constant is reduced excessively, overshoot may occur. Select appropriate value. If 10,000 is input, the speed integrating time constant is considered indefinite, and the speed control turns to P control form.

$$\text{Recommended set value} = \frac{10000}{[\text{SC LOOP Gain (P2 - 03)}]}\ [\text{ms}]$$

$$\text{Recommended minimum set value} = \frac{3000}{[\text{SC LOOP Gain (P2 - 03)}]}\ [\text{ms}]$$

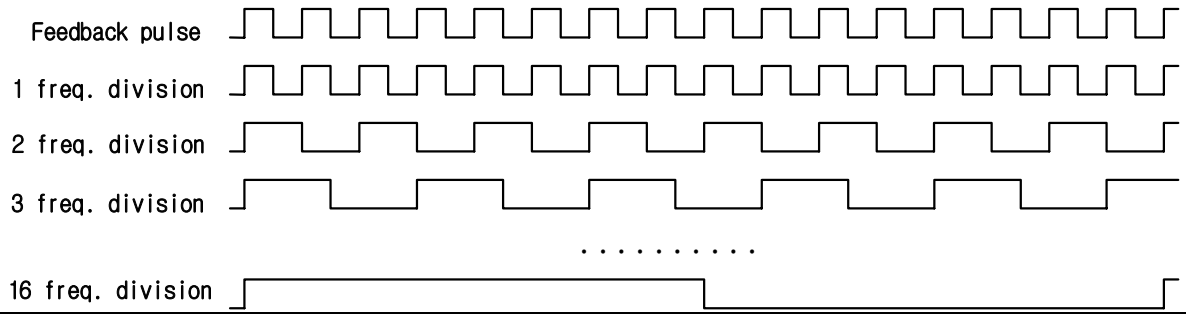
Menu	Menu name	Unit	Display range	Initial value	Mode
P2-05	TRQ LMT(+) [%]	%	0 ~ 300	300	SP
P2-06	TRQ LMT(-) [%]	%	0 ~ 300	300	SP

$$\text{Maximum CW torque} = \frac{[\text{TRQ LMT(+) (P2-05)}]}{100} \times \text{rated torque}$$

$$\text{Maximum CCW torque} = \frac{[\text{TRQ LMT(+) (P2-06)}]}{100} \times \text{rated torque}$$

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-07	Pulse Out Rate	Division	1 ~ 16	1	SPT

Divide the A and B phase encoder pulses fed back from the motor, and set the encoder pulse dividing ratio to be output in line drive method. The allowable dividing ratio is from 1 division to 16 division. Input desired dividing ratio in this item. Frequency division is defined as follows.



Menu	Menu name	Unit	Display range	Initial value	Mode
P2-08	Currnet Offset		0, 1	0	SP

Motor speed may have periodic ripple due to the effects of the servo current offset. If this happens, use the current offset function.
"1" = Automatically offsets current offset during Servo-On.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-09	Brake SPD[RPM]	RPM	0.0 ~ 9999.9	50.0	SPT

If the servo is turned OFF during servo motor operation and the brake speed is reduced, set the speed which activates the external machine brake in RPM (r/min). The output contact (Brake) is turned OFF at this time.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-10	Brake Time[ms]	ms	0 ~ 10000	10	SPT
If the servo is turned OFF during servo motor operation and the brake speed is reduced, set the time which activates the machine brake after a specific time irrespective of [Brake SPD (P-29)] in [ms]. The output contact (Brake) is turned OFF at this time. If "0" is input: The machine brake is activated only by [Brake SPD (P-29)], but is not activated according to time.					

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-11	Monitor1 Select		0 ~ 2	0	SPT
P2-15	Monitor2 Select		0 ~ 2	1	SPT
Set parameter to be displayed on the monitor. (0: Speed, 1: torque, 2: speed command)					

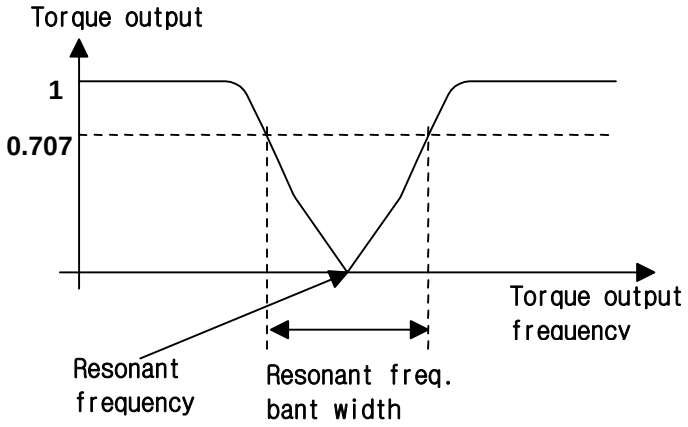
Menu	Menu name	Unit	Display range	Initial value	Mode
P2-12	Monitor1 ABS		0,1	0	SPT
P2-16	Monitor2 ABS		0,1	0	SPT
0: Displays type of symbols 1: Displays absolute values regardless of the type of symbols.					

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-13	Monitor1 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
P2-17	Monitor2 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
This function, in case viewing is difficult because the analog output value is small, enables viewing by multiplying the parameter by appropriate multiples. For example, if 3 is input, the size of the parameter is enlarged by 3 times. Basic magnification: speed, speed command (maximum speed /4[V]) Torque (3 x rated torque /4[V]					

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-14	Monitor1 offset	%	-100.0 ~ 100.0	0.0	SPT
P2-18	Monitor2 offset	%	-100.0 ~ 100.0	0.0	SPT
This function enables output by applying appropriate offset to the analog output value. This is to allow adjustment of the value displayed on 0[V] potential, by applying offset to the monitor display. Unit is [%] and maximum value is 100[%]. Assuming maximum speed is 5000[RPM] and if offset 20 is input to display speed, 1000[RPM], 20[%] of 5000, is displayed on 0[V]					

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-19	Resonant FRQ[Hz]	Hz	0 ~ 1000	300	SP
P2-20	Resonant BW[Hz]	Hz	0 ~ 1000	100	SP

Input the band width of resonant frequency and resonant frequency band in [Hz].



Use resonant frequency greater than $\frac{[\text{SC LOOP Gain (P2-03)}]}{6}$ **[Hz]**

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-21	De-Resonant ENB		0,1	0	SP

0: Resonance removal operation stop
1: Resonance removal operating

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-22	Inertia Ratio	Multiple	1.0 ~ 500.0	1.0	SPT

The system inertia is the sum of motor inertia and load inertia. This item sets the ratio of system inertia to motor inertia in terms of [times].

Input the value of $\frac{\text{System intertia (Motor inertia+load inertia)}}{\text{Motor inertia}}$

For example, input "1.0" in case of no load, and "2.0" if the ratio of motor inertia to load inertia is 1:1.

If it is difficult to obtain accurate ratio of system inertia to motor inertia, use the autotuning function described in section 8.4.3

(Caution !) For Inertia Ratio [P-22], input multiples in case of Soft Ver 4.23 or higher; and input % (i.e. multiple * 100) in case of Soft Ver 4.22 or less.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-23	Autotune Range		0 ~ 9	0	SP

Prior to using the automatic setting function, input approximate ratio of system inertia to motor Inertia $\frac{\text{System inertia (Motor inertia + load inertia)}}{\text{Motor inertia}}$ to define the range.

If the ratio of system inertia to motor inertia is unknown, input "0".

Ration of system inertia to motor inertia (multiples)	Input value
1 ~ 500	0
2 ~ 3	1
2 ~ 10	2
3 ~ 15	3
10 ~ 25	4
15 ~ 100	5
25 ~ 200	6
100 ~ 300	7
200 ~ 400	8
300 ~ 500	9

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-24	Autotune ON/OFF		ON/OFF	OFF	SP

ON: Auto set function is activated and the results are automatically stored in [SC LOOP Gain (P2-03)], [Inertia Ratio (P2-22)].

Menu	Menu name	Unit	Display range	Initial value	Mode
*P2-25	Parameter Init		Currt/dFLT	currt	SPT

When servo is used, parameters are set in various values. To restore parameters to servo's initial value (basic set value) during operation, press Prog key. When "Parameter dFlt" is displayed on the screen, press Enter key. All parameters except the motor parameters ([P1-01] - [P1-09]) are restored to their initial values.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-26	SPDIN Delay	ms	0~100	0	S

Sets the analog speed command (SPDIN) delay in terms of [ms].
Recommended set value range: 0 – SCI TC (P2-04)/20
(Example) If SCI TC (PP2-04) is 50 (ms], the set range is 0 - 2.5[ms].

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-27	DB Control		0,1	1	SPT

Enables quick motor control during servo operation by turning off SVONEN terminal and forming DB control circuit while the gating motion is turned off when the motor stops. However, if the DB control status is continuously maintained while the motor remains stopped, it is not easy to achieve free-run of the motor in case the user so desires. This menu therefore helps the user to achieve free-run of the motor by turning off the SVONEN terminal to create DB control circuit when controlling the motor and by opening the DB control circuit when the motor comes to a stop.

(Caution !) However, this function is not available in model FDA-5005-75.

0: The DB control circuit is activated only during motor control by turning off the SVONEN terminal of the motor, and free-run is activated only below the (P3-11) Zero Speed set value after the motor stops.

1: DB control always operates even when the motor servo is turned off.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-28	Display Select		1~10	1	SPT

Depending on the set value of [Display Select (P2-28)], the following initial menus can be displayed.

[Display Select (P2-28)]	Initial menu after power is connected
1	Motor Speed[RPM], (St-01)
2	CMD Speed[RPM], (St-02)
3	CMD Pulse, (St-03)
4	Feedback Pulse, (St-04)
5	Pulse ERR, (St-05)
6	Speed Limit[RPM], (St-06)
7	Torque Limit[%], (St-07)
8	Load Ratel[%], (St-08)
9	Max Load Rate[%], (St-09)
10	Intertia Ratio, (St-10)

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-29	Start/Stop		0,1	0	SPT

Select the input contact STOP (CN1-13) terminal function.

If 0 is selected: Motor stops when the stop contact is turned ON.

If 1 is selected: Motor stops when the stop contact is turned OFF (i.e. can be used as Start signal).

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-30	Emergency Type		0,1	0	SPT

Select the input contact ESTOP (CN1-39) terminal function.
If 0 is selected: Emergency stops when ESTOP contact is turned OFF (Normal B contact).
If 1 is selected: Emergency stops when ESTOP contact is turned ON (Normal A contact).

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-31	Power fail Mode		0,1	1	SPT

In case the main power (R, S, T terminals) is turned OFF and Power Fail Alarm occurs, reconnect power and determine if the Alarm auto reset is to be activated.
If 0 is selected: Alarm status is maintained until the reset terminal is input.
If 1 is selected: Automatically reset when power is reconnected.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-32	Zero SPD VIB RJT	[rpm]	0.0 ~ 100.0	ON	SP

If the motor vibrates at low speed, including zero speed, input the speed range desired to remove vibration from in terms of [rpm].
In this case, in crease the set value on a gradual basis until vibration is reduced.
However, when 0.0 is set, the zero speed vibration suppression function will not operate.

Menu	Menu name	Unit	Display range	Initial value	Mode
	Conform ON/OFF		ON/OFF	ON	SPT

This menu controls confirmation work when parameters are input. If ON is selected, the servo reconfirms parameter change through the message "OK?" prior to changing parameters. If OFF is selected, the servo changes parameters without going through confirmation process.
This menu is supported only on digital loaders. Parameters are changed without confirmation on mount loaders.

6.5 Speed control parameters (Speed Mode: P3--)

(Caution !) Menus marked with "*" cannot be corrected during Servo-On.

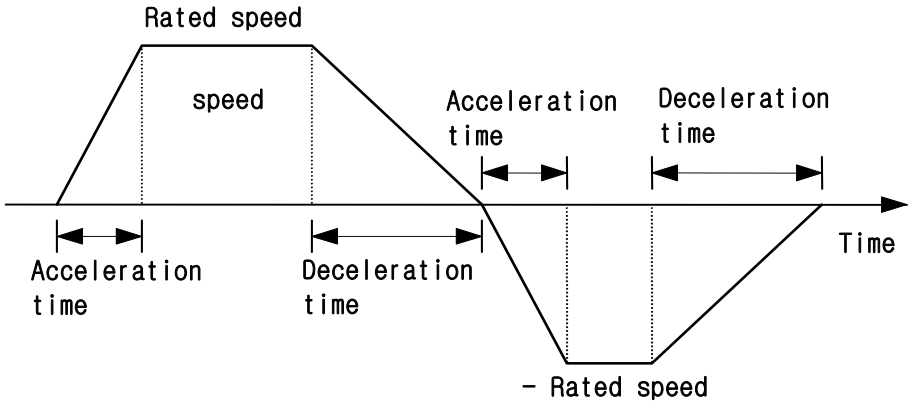
Menu	Menu name	Unit	Display range	Initial value	Mode
P3-01	Speed CMD1[RPM]	RPM	-Maximum~Maximum	10	ST
P3-02	Speed CMD2[RPM]	RPM	-Maximum~Maximum	200	ST
P3-03	Speed CMD3[RPM]	RPM	-Maximum~Maximum	500	ST
In case of speed control: Input digital speed command in [rpm]. In case of torque control: Input digital speed limit in [rpm].					

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-04	Speed CMD4[RPM]	RPM	-Maximum~Maximum	1000	S
P3-05	Speed CMD5[RPM]	RPM	-Maximum~Maximum	1500	S
P3-06	Speed CMD6[RPM]	RPM	-Maximum~Maximum	2000	S
P3-07	Speed CMD7[RPM]	RPM	-Maximum~Maximum	3000	S
Input digital speed command in [rpm]					

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-08	Accel Time[ms]	ms	0 ~ 100000	0	S
P3-09	Decel Time[ms]	ms	0 ~ 100000	0	S

[Accel Time] inputs acceleration time in terms of 1[ms] from the stopped status up to the rated speed. If 10 is loaded, speed is accelerated for 10 [ms] up to the rated speed from the stopped status. To increase the acceleration time to the maximum, input 0.

[Decel Time] inputs deceleration time in terms of 1[ms] from the rated speed to the stopped status. If 10 is loaded, speed is decelerated for 10 [ms] from the rated speed to the stopped status. To increase the deceleration time to the maximum, input 0.



Menu	Menu name	Unit	Display range	Initial value	Mode
*P3-10	S TYPE ENB		0, 1	0	S
If 1 is selected in this menu, the motor deceleration/acceleration is activated in S-letter form when the load inertia is large so that the motor can run smoothly. 0 : Linear deceleration/acceleration operation 1 : S-letter form deceleration/acceleration					

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-11	Zero Speed[RPM]	RPM	0 ~ 9999.9	100	SPT
This menu sets the speed range, at which the contact is turned ON externally after recognizing the speed as Zero speed, in units of [RPM]. For example, if the value of this item is set to 100, (ZSPD) is turned ON between motor speed -100 [RPM] and 100 [RPM] and zero speed is displayed externally.					

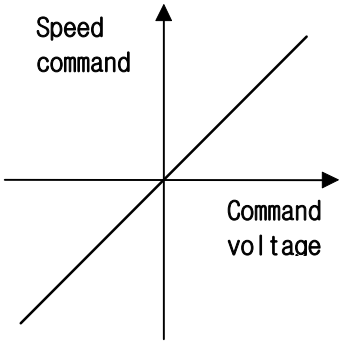
Menu	Menu name	Unit	Display range	Initial value	Mode
P3-12	Inspeed Range	RPM	0 ~ 9999.9	100	S
Input the error range of the speed at which the (INSPD) contact is turned ON. In other words, if the difference between the motor speed and command speed is within the range set at [Inspeed Range (P3-12)], (INSPD) is turned ON.					

Menu	Menu name	Unit	Display range	Initial value	Mode
*P3-13	10V Speed[RPM]	RPM	0 ~ 9999.9	3000	ST
In case of speed control: Input the rotation speed in [RPM] when the analog speed command 10[V] is loaded. In case of torque control: Input the limit speed in [RPM] when the analog speed limit 10[V] is loaded.					

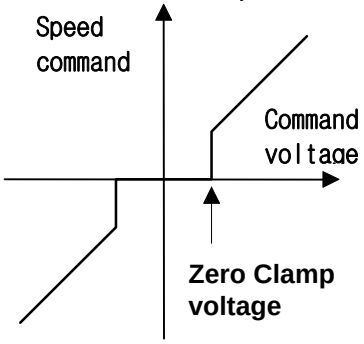
Menu	Menu name	Unit	Display range	Initial value	Mode
P3-14	SPD CMD OFFS[mV]	MV	-1000.0~1000.0	0.0	ST
In case of speed control: Input the analog speed command offset in [mV]. In case of torque control: Input the analog speed limit offset in [mV].					

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-15	Zero Clamp Mode		0 ~ 2	0	S

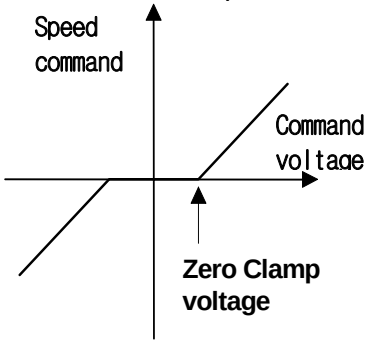
0 : Zero Clamp Mode0



1 : Zero Clamp Mode1



2 : Zero Clamp Mode2



Menu	Menu name	Unit	Display range	Initial value	Mode
P3-16	Clamp VOLT[mV]	mV	-1000 ~ 1000	0	S
Input Zero Clamp voltage in [mV].					

Menu	Menu name	Unit	Display range	Initial value	Mode
*P3-17	FDELAY	ms	0.0 ~ 100.0	0.0	SPT

To use the filter output as the speed detection value after the motor speed detection value passes through the primary delay filter, input the delay time constant in [ms]. In case noise occurs on the motor shaft during feeding due to vibration, adjust the delay time constant value to reduce noise level. If the value is adjusted too much at a time, problem may occur on speed control. Gradually increase the [FDELAY (P-37)] set value from 0.
Recommended maximum set value = [SCITC (P2-04) set value]
(Example) If P2-04 is 20 [ms], the maximum FDELAY set value is 20, and the speed feedback delay time is 20 [ms].

Menu	Menu name	Unit	Display range	Initial value	Mode
*P3-18	Override ON/OFF		0,1	0	S

If the value of this menu is set to 1, the analog speed command is added to the digital speed command to become the speed command. If fine adjustment is necessary in special speed area, set the internal digital speed command to the special speed, and gradually adjust the analog voltage by selecting the range requiring fine adjustment at [10V Speed (P3-13)]. However, if the speed selection switch is selected as the analog speed command, override operation is not performed. Make sure to select one of the digital speed command with the speed selection switch.
1: Selects override function
0: Resets override function

6.6 Position control parameters (Position Mode: P4--)

(Caution !) Menus marked with "*" cannot be corrected during Servo-On.

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-01	Feedforward[%]	%	0 ~ 100	0	P

Input the Feedforward rate of the position command speed in [%]. The delay element of the position controller can be reduced if the value of this item is increased. However, if the value is increased excessively, overshoot may occur on the position system, or performance of the position controller is deteriorated. Select appropriate value. If this value is 0, the position controller becomes a simple position proportional controller.

Refer to the following MAX [Feedforward] value for each K=[SC LOOP Gain]/[PC P Gain] value.

K= [SC LOOP Gain]/[PC P Gain]	MAX[Feedforward]
5	Not exceeding 70
7	Not exceeding 80
10	Not exceeding 85
20	Not exceeding 90

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-02	FF FLT TC[ms]	ms	0 ~ 10000	0	P

Input the primary filter time constant of the position command speed Feedforward in [ms]. The loaded position command is differentiated and passes through the primary filter before it is used as the Feedforward input. The time constant of this filter can be adjusted. Increase this value in applications where the position command is rapidly changed, and decrease this value in applications where the position command is slowly changed. Input 0 in case it is not needed to use this filter.

(Recommended setting conditions)

F FLT TC] ≤ 1000 X (MAX[Feedforward] −[Feedforward]/100/[PC P Gain]

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-03	CMD FLT TC[ms]	ms	0 ~ 10000	0	P
Input the filter time constant of the position command input in [ms]. The output which passes through the primary filter is used as the position command for the loaded position command. Set the time constant of this filter. Enter 0 in case it is not needed to use this filter.					

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-04	In Position[PLS]	Pulse	0 ~ 99999	100	P
Input the error range of the position where (INPOS) contact is turned ON in the unit (after multiplying by 4) of pulse quantity. In other words, if the difference between the position pulse and command pulse is within the range set at [In Position (P4-04)], (INPOS) is turned ON.					

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-05	FLLW ERR [PULSE]	Pulse	0 ~ 99999	20000	P
Set the range of the transient position error detection in the unit (after multiplying by 4) of feedback pulse quantity. In normal condition, the pulse error is $\frac{1\text{-}0.01\times[\text{Feedforward (P4-01)}]}{[\text{PC P Gain (P2-02)}]} \times$ (Input command pulse frequency [Hz]). In case ([Pulse Logic (P4-14]) is 0 or 3, set value greater than x4) value.					

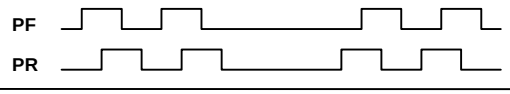
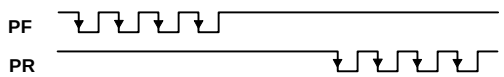
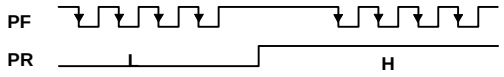
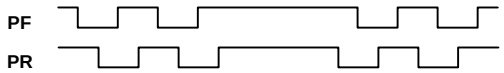
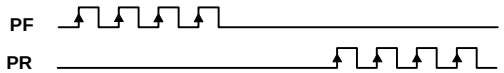
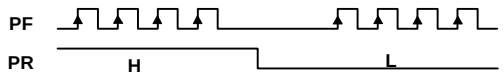
Menu	Menu name	Unit	Display range	Initial value	Mode
*P4-06	ELCTR Gear1 NUM		1 ~ 99999	1	P
*P4-07	ELCTR Gear1 DEN		1 ~ 99999	1	P
Set the numerator and denominator of the electronic gear 1 in constant values. **(Caution !)** The calculation value of ELCTR Gear NUM/DEN must be between 0.05-20.					

Menu	Menu name	Unit	Display range	Initial value	Mode
*P4-08	ELCTR Gear2 NUM		1 ~ 99999	1	P
*P4-09	ELCTR Gear2 DEN		1 ~ 99999	2	P
Set the numerator and denominator of the electronic gear 2 in constant values. **(Caution !)** The calculation value of ELCTR Gear NUM/DEN must be between 0.05-20.					

Menu	Menu name	Unit	Display range	Initial value	Mode
*P4-10	ELCTR Gear3 NUM		1 ~ 99999	1	P
*P4-11	ELCTR Gear3 DEN		1 ~ 99999	3	P
Set the numerator and denominator of the electronic gear 3 in constant values. **(Caution !)** The calculation value of ELCTR Gear NUM/DEN must be between 0.05-20.					

Menu	Menu name	Unit	Display range	Initial value	Mode
*P4-12	ELCTR Gear4 NUM		1 ~ 99999	1	P
*P4-13	ELCTR Gear4 DEN		1 ~ 99999	4	P
Set the numerator and denominator of the electronic gear 3 in constant values. **(Caution !)** The calculation value of ELCTR Gear NUM/DEN must be between 0.05-20.					

Menu	Menu name	Unit	Display range	Initial value	Mode
*P4-14	Pulse Logic		0 ~ 5	1	P

	[Pulse Logic]	Type of command pulse		Remark
		CCW	CW	
Negative logic	0			A phase +B phase
	1			CCW pulse + CW pulse
	2			Direction + pulse
Positive logic	3			A phase +B phase
	4			CCW pulse + CW pulse
	5			Direction + pulse

Menu	Menu name	Unit	Display range	Initial value	Mode
*P4-15	Backlash [PULSE]	Pulse	0 ~ 10000	0	P
If the direction of position is changed, sometimes the actual position may be moved less than the commanded position due to mechanical backlash. In such case, the mechanical backlash can be compensated if the value is set in the unit (after multiplying by 4) of the encoder feedback pulse quantity.					

6.7 Torque control parameters (Torque Mode: P5--)

(Caution !) Menus marked with "*" cannot be corrected during Servo-On.

Menu	Menu name	Unit	Display range	Initial value	Mode
*P5-01	TRQ CMD TC[ms]	ms	0.0 ~ 1000.0	0.0	SPT
Torque control: Set the filter time constant of the torque command input terminal. Speed or position control: Set the filter time constant of the torque control input terminal. Noise occurs because the torque command (limit) is loaded to the input terminal, and this menu is used to eliminate this noise. If large value is selected, noise is reduced considerably; however, the transient characteristics of the torque command (limit) being loaded is reduced. Input 0 in case it is not needed to use this filter.					

Menu	Menu name	Unit	Display range	Initial value	Mode
P5-02	10V Torque	%	0 ~ 300	100	SPT
Torque control: Input the output torque in terms of [%] of the rated torque when loading the analog torque command 10[V]. In other words, in case of 100, the servo outputs 100[%] of the rated torque when 10[V] is applied. Speed or position control: Input the output torque limit value in terms of [%] of the rated torque when the analog torque limit 10[V] is loaded. This means that in case of 100, the servo is limited at 100[%] of the rated torque when 10[V] is applied.					

Menu	Menu name	Unit	Display range	Initial value	Mode
P5-03	Torque OFFS	mV	-1000.0 ~ 1000.0	0.0	T
As the torque command is the analog level, offset exists on the command value. In such case, the command offset can be compensated if the value of this item is loaded in terms of [mV].					

6.8 Test mode parameters (Test Mode: P6--)

6.8.1 Jog Mode (P6-01)

The Jog Mode carries sub-menus related to Jog.
The Jog Mode operates even when there is no external contact signal.

Menu	Menu name	Unit	Display range	Initial value	Mode
tS-01	Jog Command[RPM]	RPM	-5000.0~5000.0	100	
Set the jog operation command speed in [rpm].					

UP -Key

Menu	Menu name	Unit	Display range	Initial value	Mode
tS-02	Jog Speed[RPM]	RPM	-5000.0~5000.0	0	
Set the actual jog operation speed in [rpm].					

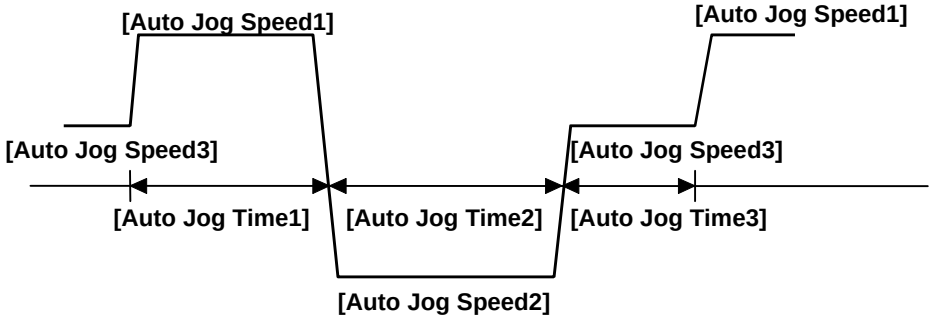
Motor runs clockwise if the >(right) key is pressed, and counterclockwise if <(left) key is pressed.

6.8.2 Auto Jog (P6-02)

This is a special type of jog mode. CW or CCW run can be set with specific speed and time even without pressing >(right) or <(left) keys.
As in the case of Jog Mode, Auto Jog operates when the motor is connected to the encoder without external contact signal.

Menu	Menu name	Unit	Display range	Initial value	Mode
tS-11	Auto Jog Speed1	RPM	-5000.0~5000.0	100	
tS-12	Auto Jog Speed2	RPM	-5000.0~5000.0	-200	
tS-13	Auto Jog Speed3	RPM	-5000.0~5000.0	300	

Input the auto jog mode set speed in [rpm].



Menu	Menu name	Unit	Display range	Initial value	Mode
tS-14	Auto Jog Time1	sec	1 ~ 50000	1	
tS-15	Auto Jog Time2	sec	1 ~ 50000	2	
tS-16	Auto Jog Time3	sec	1 ~ 50000	3	
Input the auto jog mode set time in [sec].					

Menu	Menu name	Unit	Display range	Initial value	Mode
tS-17	Auto Jog Set		0, 1	0	
Setting Auto Jog mode operation 0: Auto Jog mode not activated 1: Auto Jog mode activated (Motor starts running)					

6.8.3 Simulation Mode (P6-03): Motorless operation

Operates just like when the motor is connected even when there is no actual motor.
Motor speed is displayed in the window at this time just as the motor is running at the commanded speed.
This function enables indirect test of the wiring status between the current servo driver and the upper controller before the motor is actually connected.
(Caution !) Menus marked with "*" cannot be corrected during Servo-On.

P6 – 03
↓ ENTER key (use only Mount Loader)
OFF
↓ UP key (Mount Loader), PROG key (Digital Loader)
ON
↓ ENTER key
P6 – 03
↓ Press UP key 2 times (Mount Loader), or press MODE key 2 times (Digital Loader)
St --
↓ ENTER key (Mount Loader), PROG key (Digital Loader)
St – 01
Indicates virtual motor speed according to the conditions of the I/O connected to CN1.

6.9 Alarm status display (Alarm Status: ALS--)

Menu	Menu title	Description	Mode
ALS01	Alarm Display	Displays current alarms (In normal condition: displays "normal").	SPT
ALS02	Alarm Reset	Resets current alarms.	SPT
ALS03	Alarm History	Displays the latest 10 alarms.	SPT
ALS04	Alarm Reset All	Resets all alarm history stored in the Alarm History.	SPT

In case of an alarm, the alarm signal output contact (Alarm) is turned OFF, and the motor stops by the action of the dynamic brake.

[Details of ALARM displays (sub-menus)]

Menu	Menu title	Cause
Normal		Normal operating condition
AL-00	EMER STOP	External ESTOP contact input turned OFF
AL-01	OVER CURNT	Driver output terminal (U, V, W) short-circuited; output overcurrent
AL-02	OVER VOLT	Input voltage excessive (greater than 280V); regeneration brake resistance burned; load GD^2 excessive
AL-03	OVER LOAD	Mechanical overload; motor miswiring
AL-04	POWER FAIL	Main power disconnected when Servo is ON
AL-05	LINE FAIL	Motor and encoder set value error, motor miswiring, and mechanical overload
AL-06	OVER HEAT	Heat shield overheated
AL-07	OVER SPEED	Gain excessive, menu set value error, excessive gravity load
AL-08	FOLLOW ERR	Rapid deceleration/acceleration, gain set value error, command pulse frequency excessive (greater than 300 kpps), miswiring, mechanical overload
AL-09	Output NC	Output (U, V, W) open phase
AL-10	PPR ERROR	Encoder pulse level setting error
AL-11	ABS DATA	Absolute value encoder data transmission error
AL-12	ABS BATT	Battery level below 2.8V
AL-13	ABS MDER	Absolute value encoder multi-rotation data transmission error
Parameter Err 1		Unchangeable parameter input tried during servo ON, parameters locked
Parameter Err 2		Set value input error

The alarm type output varies according to the types of the alarm. If it is necessary for the external control system to identify the alarm details of the drive system, use these signals. Output status of each alarm is as follows.

[Output status of ALARM CODES]

Alarm type	Emerg. stop	Over-current	Over-voltage	Over-load	Power error	Encoder miswiring	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

Others include alarms not displayed in the above table, such as overheat, overspeed or set value error.

To reset the contents of current alarms, use the Alarm Reset (ALS02) menu, or use the input contact ALMRST (CN1-38) terminal.

The submenu of Alarm History (ALS03) includes Alarm 1, Alarm 2, Alarm 3, Alarm 4, Alarm 5, Alarm 6, Alarm 7, Alarm 8, Alarm 9, and Alarm 10 which are the past alarms. Alarm 1 indicates the latest alarm, while the remaining alarms indicates those which occurred previously.

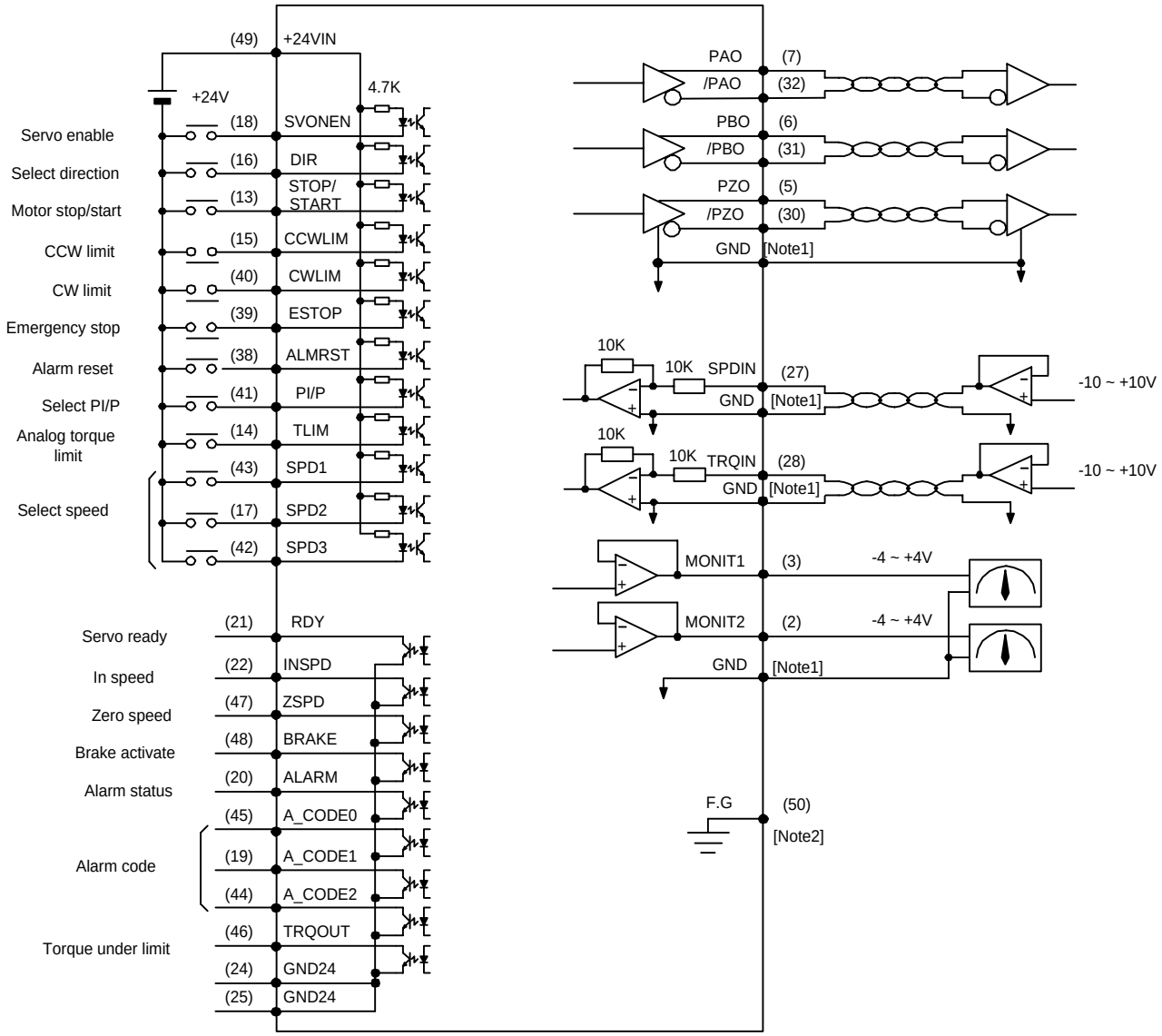
To reset all past alarm history, use the menu Alarm Reset All (ALSO4). However, EMER STOP (AL-00) cannot be stored in the Alarm History (ALS03).

7. How to Use Speed Servo

7.1 Power Supply Wiring

For wiring, see "3.3 Main Circuit Terminal Board Wiring".

7.2 CN1 Wiring



Note1 : Select GND terminal from among 1,8,26,33,34 and 36.

Note2 : Use CN1 shield wire to ground the F.G.(Frame Ground) terminal.

7.2.1 Input contact signal function and use table

Name	Pin No.	Function and Use
SVONEN	18	ON: Servo start command OFF: Servo start command reset
DIR	16	Selects servo rotation direction (Off: Command direction rotation, ON: Counter-command direction rotation)
STOP/ START	13	Forcibly zeros (stops) the speed command value, or starts operation. (Can be selected from parameter P2-29)
CCWLIM	15	OFF: Motor CCW running limited ON: Motor CCW running allowed
CWLIM	40	OFF: Motor CW running limited ON: Motor CW running allowed
ESTOP	39	Forcibly ignores all input status of the servo drivers in case of external emergency, and shuts off (free-run) motor operation after rapidly decelerating the motor. (Contact type can be selected from parameter P2-30)
ALMRST	38	Resets alarm status if turned ON
PI/P	41	Selects speed control mode (Turned OFF during normal operation) ON: Proportional control, OFF: Proportional integration control
TLIM	14	ON: Analog torque limit; Off: Digital torque limit. See section 7.6.
SPD1 SPD2 SPD3	43 17 42	Selects rotation speed command by the combination of SPD 1, 2 and 3. See section 7.7.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

7.2.2 Output contact signal function and use table

Name	Pin No.	Function and Use
RDY	21	ON: Main power and auxiliary power are connected to servo without any alarm.
INSPD	22	ON: Motor speed reached designated level.
ZSPD	47	ON: Motor speed is zero.
BRAKE	48	Output signal for external machine brake drive ON: Brake reset, OFF: Brake drive
ALARM	20	ON: Normal status, OFF: Alarm detected
A_CODE0 A_CODE1 A_CODE2	45 19 44	Displays alarm type. See the table below [Alarm Code output status].
TRQOUT	46	ON: Servo is under torque limit. See section 7.6 for information on output torque limit.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

[Output status of ALARM CODES]

Alarm type	Emerg. stop	Over-current	Over-voltage	Over-Load	Power error	Encoder miswiring	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

7.2.3 Analog input use and function table

Name	Pin No.	Function and Use
SPDIN	27	Inputs external analog speed (-10V ~ +10V).
TRQIN	28	Inputs external torque limit command (-10V ~ +10V).

7.2.4 Analog output use and function table

Name	Pin No.	Function and Use
MONIT1	3	Monitor output 1 (-4V ~ +4V)
MONIT2	2	Monitor output 2 (-4V ~ +4V)
PAO, /PAO	7, 32	A phase, /A phase encoder signal output
PBO, /PBO	6, 31	B phase, /B phase encoder signal output
PZO, /PZO	5, 30	Z phase, /Z phase encoder signal output

7.2.5 I/O contact power supply

Name	Pin No.	Function and Use
GND	1, 8, 26 33, 34, 36	Power ground for analog I/O, such as speed command, torque limit command, monitor output and encoder output.
+24VIN	49	DC 24V power supply for the external I/O contact
GND24	24, 25	DC 24V ground for the external I/O contact

(Note) See section 3.4.6 for the capacity of +24V power supply.

7.3 CN2 Wiring

For information on CN2 wiring, see "Section 3.5 CN2 Wiring and Signal Description".

7.4 Setting Parameters Related to Motor and Servo

When the servo start ENABLE contact (SVONEN) is turned OFF after power is connected, set the following parameters.

7.4.1 Setting motor and models

Parameter		Description
No.	Name	
P1-01	Motor ID	Sets ID number according to the type of servo motor.
P1-10	Amp Type	Sets ID number according to the type of driver.
P1-11	Encoder Type	Sets number according to encoder signal system.
P1-12	Encoder Pulse	Sets encoder pulse quantity.
P2-01	Controller Type	Sets sped control mode number to "1".

☯ See Chapter 6. Parameter Setting.

7.4.2 Setting built-in brake use

Parameter		Description
No.	Name	
P2-09	Brake SPD	Sets brake start speed when stopped.
P2-10	Brake Time	Brake starts after the set time elapsed when stopped.

Example) If [Brake SPD (P2-09)]=30, [Brake Time (P2-10)] = 10

If the motor speed drops below 30[RPM} after decelerating when the servo is turned OFF while the motor is run by the servo, or if 10[ms] is passed after the servo is turned OFF, the output contact (brake) is turned Off.

7.4.3 Setting control system gains satisfying loads

Parameter		Description
No.	Name	
P2-03	SC LOOP Gain	See below
P2-04	SC I TC	"
P2-22	Inertia Ratio	"
P2-23	Autotune Range	"
P2-24	Autotune ON/OFF	"

a) Autotuning

Use autotuning only when the motor is running at a speed greater than 1/5 times the rated speed. Turn Off Autotuning when the motor is running in normal condition.

☞ Set (P2-23) range according to approximate inertia ratio.

Inertia ratio	Set value	Inertia ratio	Set value	Inertia ratio	Set value
1 ~ 3	**1**	10 ~ 25	**4**	100 ~ 300	**7**
2 ~ 10	**2**	15 ~ 100	**5**	200 ~ 400	**8**
3 ~ 15	**3**	25 ~ 200	**6**	300 ~ 500	**9**

☯ Inertia ratio = (Motor inertia + load inertia) / Motor inertia

☞ Decelerating/accelerating for about 5 times after turning ON autotuning (P2-24) will allow the inertia value to be stored in (P2-22).

☞ Turn off autotuning (P2-24).

b) Adjusting control system gains

☞ Manually input inertia ratio (P2-22) if the inertia ratio is known.

☞ Adjust the following value according to inertia ratio.

Inertia ratio		**Set value**		
Motor □ 60, 80	**Motor □ greater than 130**	**SC LOOP Gain (P2-03)**	**SC I TC (P2-04)**	
			Recommended	Minimum
1		500	20	6
2		350	30	9
3		290	35	11
5	1	220	45	14
10	2	160	60	19
20	3	110	90	27
50	5	70	140	42
100	10	50	200	60
	20	30	300	100

☯ If the SC Loop gain is too low, vibration occurs and response becomes fast if it is high, but vibration occurs if the gain is excessively high. Response becomes fast if SCI TC is reduced, but overshoot occurs if it is reduced excessively.

7.4.4 Setting feedback delay

Menu	Menu name	Unit	Display range	Initial value	Mode
*P3-17	FDELAY	ms	0.0 ~ 100.0	0.0	SPT
Adjust FDELAY (P3-17) when noise occurs due to motor vibration. Use FDELAY value within the speed integrating time constant [SCI TC] (P2-04) value. Recommended value = [SC I TC] / 5 ~ [SC I TC] / 2					

7.5 Limiting Output Torque

The output torque can be limited within 300% of the rated torque. The output torque can be limited by digital signal and also by the analog signal. To limit output torque by digital signal, turn Off contact input (TLIM); and to limit output torque by analog signal, turn ON the contact input (TLIM). If the output command value is greater than the output torque limit value, the output torque is limited by the output torque limit value, and the (TRQOUT) output contact is turned ON.

7.5.1 Limiting digital output torque (TLIM) = OFF

The digital output torque limit can be set for the CW torque limit and CCW torque limit respectively. Set the submenus [TRQ LMT(+) (P2-05)] and [TRQ LMT(-) (P2-06) of the main menu [Controller Type (P2--)] as follows.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-05	TRQ LMT(+) [%]	%	0 ~ 300	300	SP
P2-06	TRQ LMT(-) [%]	%	0 ~ 300	300	SP

7.5.2 limiting analog output torque (TLIM) = ON

Apply voltage between -10[V] ~ +10[V] to analog input (TRQIN) to limit analog output torque. As the analog output torque limit command input uses the absolute value of the voltage, voltage of the same size in different code is treated as the same input. For example, +5[V] input and -5[V] are treated as the same input. The internally used output torque is limited as follows according to the size of (TRQIN) voltage and the [10V Torque (P5-02)] set value.

$$\text{Maximum CW torque} = \text{LPF}\left\{\frac{(\text{TRQIN})}{10}\times\frac{[\text{10V Torque (P5-02)}]}{100}\right\}\times\text{rated torque}$$

$$\text{Maximum CCW torque} = -\text{LPF}\left\{\frac{(\text{TRQIN})}{10}\times\frac{[\text{10V Torque (P5-02)}]}{100}\right\}\times\text{rated torque}$$

LPF: Low Pass Filter (Low pass primary filter)

Menu	Menu name	Unit	Display range	Initial value	Mode
P5-01	TRQ CMD TC [ms]	ms	0.0 ~ 1000.0	0.0	SPT
*P5-02	10V Torque	%	0 ~ 300	100	SPT

7.6 Inputting Speed Commands

Speed command can be input freely by using 3 methods:

① Using 7 digital speed commands ([Speed CMD1 (P3-01)] - [Speed CMD7 (P3-07)]
② Using external analog speed command
③ Based on override operation by combining methods of items ① and ②
The internal speed command selection effected based on these 3 methods is decided as follows based on CN1 speed selection ((SPD1), (SPD2), (SPD3)) contact and the [Override ON/OFF (P3-18)] set values.

[P3-18]	Speed selection 3	Speed selection 2	Speed selection 1	Speed command
0	OFF	OFF	OFF	Analog command speed
0	OFF	OFF	ON	[Speed CMD1 (P3-01)] speed
0	OFF	ON	OFF	[Speed CMD2 (P3-02)] speed
0	OFF	ON	ON	[Speed CMD3 (P3-03)] speed
0	ON	OFF	OFF	[Speed CMD4 (P3-04)] speed
0	ON	OFF	ON	[Speed CMD5 (P3-05)] speed
0	ON	ON	OFF	[Speed CMD6 (P3-06)] speed
0	ON	ON	ON	[Speed CMD7 (P3-07)] speed
1	OFF	OFF	OFF	Analog command speed
1	OFF	OFF	ON	[Speed CMD1 (P3-01)] set speed + analog command speed
1	OFF	ON	OFF	[Speed CMD2 (P3-02)] set speed + analog command speed
1	OFF	ON	ON	[Speed CMD3 (P3-03)] set speed + analog command speed
1	ON	OFF	OFF	[Speed CMD4 (P3-04)] set speed + analog command speed
1	ON	OFF	ON	[Speed CMD5 (P3-05)] set speed + analog command speed
1	ON	ON	OFF	[Speed CMD6 (P3-06)] set speed + analog command speed
1	ON	ON	ON	[Speed CMD7 (P3-07)] set speed + analog command speed

7.6.1 Inputting digital speed commands

The following is how to input 7 digital speed commands. First, move to [Speed Mode (P3--)], the speed-related parameter group, from the main menu. Then, input the desired digital speed command in [RPM].

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-01	Speed CMD1	r/min	-Maximum~Maximum	10	ST
P3-02	Speed CMD2	r/min	-Maximum~Maximum	200	ST
P3-03	Speed CMD3	r/min	-Maximum~Maximum	500	ST
P3-04	Speed CMD4	r/min	-Maximum~Maximum	1000	S
P3-05	Speed CMD5	r/min	-Maximum~Maximum	1500	S
P3-06	Speed CMD6	r/min	-Maximum~Maximum	2000	S
P3-07	Speed CMD7]	r/min	-Maximum~Maximum	3000	S

7.6.2 Inputting analog speed commands

To input analog speed commands, apply voltage between -10[V] and 10[V] to the analog input (SPDIN). The speed command used inside the servo can be adjusted according to the level of the voltage of the analog input (SPDIN) and the set values of [10V Speed (P3-13)], [SPD CMD OFFS (P3-14)], [Zero Clamp Mode (P3-15)] and [Clamp VOLT (P3-16)]. The following shows how to set menus required to set the analog speed command. These menus are located in the submenus of the main menu [Speed Mode (P3--)].

Menu	Menu name	Unit	Display range	Initial value	Mode
*P3-13	10V Speed	r/min	0 ~ 9999.9	3000	ST
P3-14	SPD CMD OFFS[mV]	mV	-1000.0~1000.0	0	ST
P3-15	Zero Clamp Mode		0 ~ 2	0	S
P3-16	Clamp VOLT[mV]	mV	-1000 ~ 1000	0	S

Relations between the speed command input inside the servo and the analog input (SPDIN) are as follows.

(1) In case of Zero Clamp Mode = 0

$$\text{Internal speed command [rpm]} = \frac{\text{[10V Speed (P3-13)}}{10} \times \left\{ \text{(SPDIN)} + \frac{\text{[SPD CMD OFFS (P3-14)]}}{1000} \right\}$$

(2) In case of Zero Clamp Mode = 1

$$\text{Internal speed command [rpm]} = 0 \text{ in case of (SPDIN)} + \frac{\text{[SPD CMD OFFS (P3-14)]}}{1000} < \frac{\text{[Clamp VOLT (P3-16)]]}}{1000} \text{ and}$$

$$\text{Internal speed command [rpm]} = 0 \text{ in case of (SPDIN)} + \frac{\text{[SPD CMD OFFS (P3-14)]}}{1000} \geq \frac{\text{[Clamp VOLT (P3-16)]]}}{1000}$$

$$\text{nternal speed command [rpm]} = \frac{\text{[10V Speed (P3-13)}}{10} \times \left\{ \text{(SPDIN)} + \frac{\text{[SPD CMD OFFS (P3-14)]}}{1000} \right\}$$

(3) In case of Zero Clamp Mode = 2

$$\text{Internal speed command [rpm]} = 0 \text{ in case of (SPDIN)} + \frac{\text{[SPD CMD OFFS (P3-14)]}}{1000} < \frac{\text{[Clamp VOLT (P3-16)]]}}{1000} \text{ and}$$

$$\text{Internal speed command [rpm]} = 0 \text{ in case of (SPDIN)} + \frac{\text{[SPD CMD OFFS (P3-14)]}}{1000} \geq \frac{\text{[Clamp VOLT (P3-16)]]}}{1000}$$

Internal speedcommand [rpm] =

$$\frac{\text{[10V Speed (P3-13)}}{10} \times \left\{ \text{(SPDIN)} + \frac{\text{[SPD CMD OFFS (P3-14)]}}{100} \right\} - \frac{\text{[Cklamp VOLT (P3-16)}}{1000}$$

7.6.3 Override Function

Using the Override function enables the creation of speed command by adding the analog speed command to the digital speed command. If fine adjustment is needed in specific speed area, set the internal digital speed command to specific speed; select the range requiring fine adjustment at [10V Speed (P3-13)], and adjust analog voltage gradually.
As Override is not activated when the speed command switch is set to the analog command speed, use the speed command switch to select one of digital speed commands.

Menu	Menu name	Unit	Display range	Initial value	Mode
*P3-18	Override ON/OFF		0, 1	0	S

For example

[Override ON/OFF (P3-18)]=1, ((SPD1), (SPD2), (SPD3)) = (ON, OFF, OFF),
[Speed CMD1 (P3-01)]=1000, [Zero Clamp Mode (P3-15)]=0, [SPD CMD OFFS (P3-14)]=0, [10V Speed (P3-13)]=20, and if the analog speed input (SPDIN) is 5V, the internal speed command is set to 1010 [RPM].

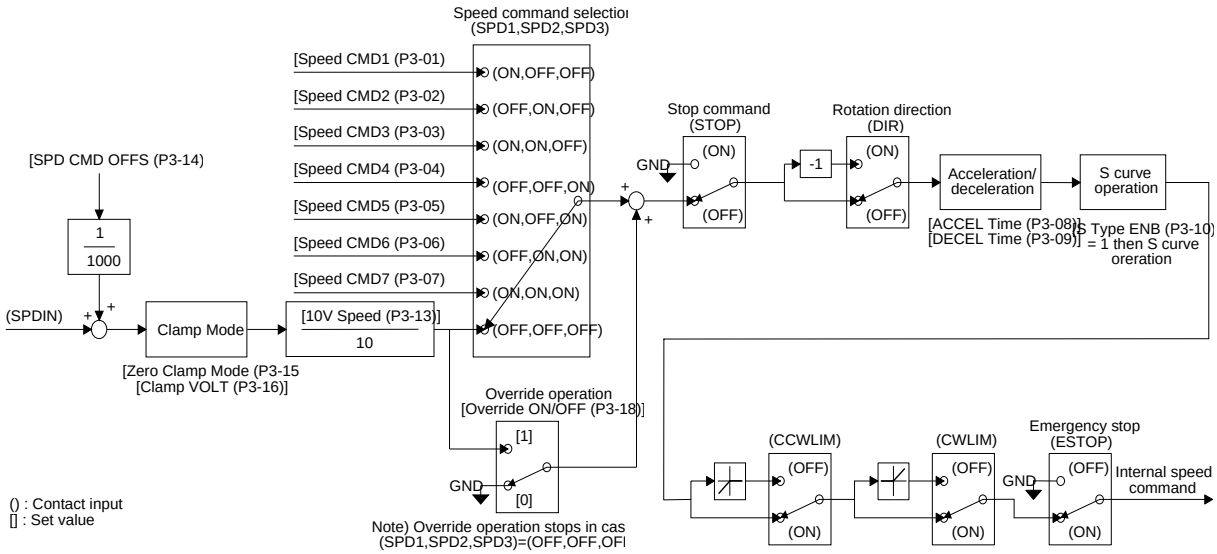
7.6.4 Setting in-speed range

Offset value can be set to output in-speed signal prior to the completion of in-speed.

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-12	Inspeed Range	RPM	0 ~ 9999.9	100	S

7.7 Setting Motor Deceleration/Acceleration Characteristics

Speed command occurring in the servo are as follows.



The following are the set values of the deceleration/acceleration and S-shape operation shown on the above figure.

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-08	Accel Time[ms]	ms	0 ~ 100000	0	S
P3-09	Decel Time[ms]	ms	0 ~ 100000	0	S
*P3-10	S TYPE ENB		0, 1	0	S

7.8 Using Monitor

The servo's internal speed command and torque, and the feedback motor speed can be monitored from outside through the analog output (MONIT1) and (MONIT2). The range of output voltage is -4[V] - 4[V]. The following are the parameters related to the use of the motor.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-11	Monitor1 Select		0 ~ 2	0	SPT
P2-15	Monitor2 Select		0 ~ 2	1	SPT
Sets parameters to be output on the monitor. (0: speed, 1: torque, 2: speed command)					

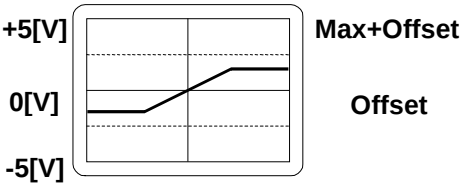
Menu	Menu name	Unit	Display range	Initial value	Mode
P2-12	Monitor1 ABS		0, 1	0	SPT
P2-16	Monitor2 ABS		0, 1	0	SPT
0: Outputs codes by type. 1: Outputs absolute values without classifying codes.					

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-13	Monitor1 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
P2-17	Monitor2 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
This is used to allow viewing by multiplying parameters by appropriate scale in case the analog output values are too small to monitor. For example, if 3 is input, the size of the parameter is magnified by 3 times. Basic scale: Speed, and speed command (Maximum speed/4[V]) Torque (3 x rated torque)/4[V]					

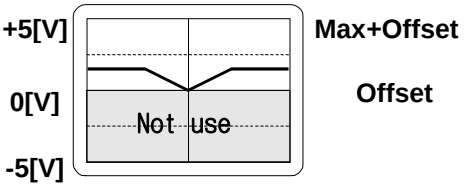
Menu	Menu name	Unit	Display range	Initial value	Mode
P2-14	Monitor1 offset	%	-100.0 ~ 100.0	0.0	SPT
P2-18	Monitor2 offset	%	-100.0 ~ 100.0	0.0	SPT
This is used to output values by applying appropriate offset to the analog output values. This is to enable adjustment of the values output on 0[V] potential by applying offset to the monitor output. Unit used is [%], and the maximum value is 100 [%]. If the speed is output assuming the maximum speed as being 5000[RPM], 1000[RPM], 20[%] of 5,000, is displayed on 0[V] when offset 20 is loaded.					

Monitor outputs according to the parameter set values are as follows. As the method of using monitor 1 and monitor 2 is the same, the following figures show outputs of monitor 1 only.

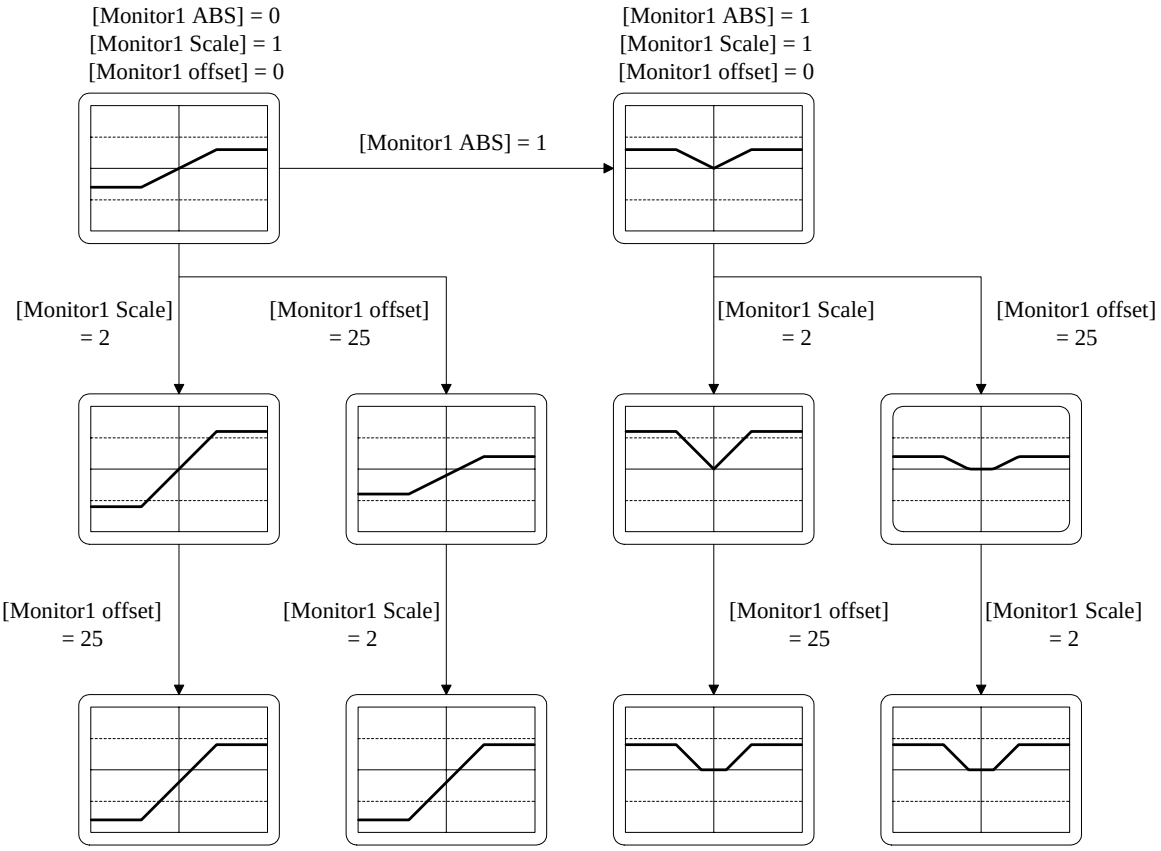
(1) In case of [Monitor 1 ABS (P2-12)] = 0



(2) In case of [Monitor 1 ABS (P2-12)] = 1



	Speed, speed command	Torque
Max	$\frac{\text{1.25 x maximum speed}}{\text{[Monitor1 Scale (P2-13)]}}$	$\frac{\text{1.25 x 3 times rated torque}}{\text{[Monitor1 Scale (P2-13)]}}$
Offset	$\text{Maximum speed} \times \frac{\text{[Monitor1 offset (P2-14)]}}{100}$	$\text{(3 times rated torque)} \times \frac{\text{[Monitor1 offset (P2-14)]}}{100}$



7.9 De-resonance Frequency Operation

Mechanical resonance of specific frequency may occur when a system is constructed by using servo.
To remove such resonance, input the resonant frequency occurring on the system to the [Resonant FRQ (P2-19)] in terms of [Hz]; input the band width of the resonant frequency to be removed to the [Resonant BW (P2-20)] in terms of [Hz]; and select [De-Resonance ENB (P2-21)] as 1.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-19	Resonant FRQ[Hz]	Hz	0 ~ 1000	300	SP
P2-20	Resonant BW[Hz]	Hz	0 ~ 1000	100	SP
P2-21	De-Resonant ENB		0,1	0	SP

7.10 Other Set Values

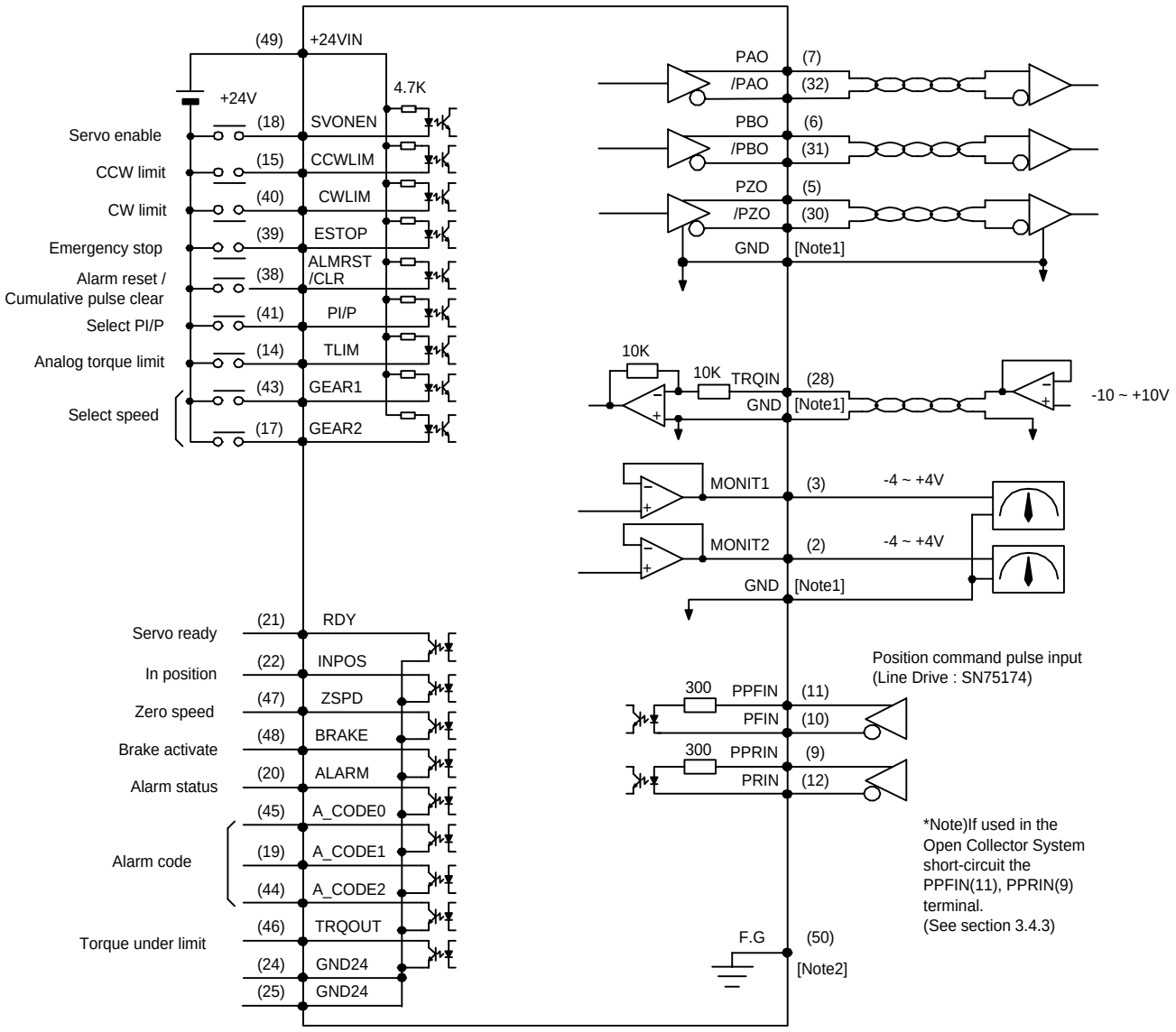
Menu	Menu name	Unit	Display range	Initial value	Mode
P2-08	Current Offset		0, 1	0	SP
*P2-25	Parameter Init		currt/dFLT	currt	SPT
P2-26	SPDIN Delay	ms	0~100	0	S
P2-27	DB Control		0,1	1	SPT
P2-28	Display Select		1~10	1	SPT
P2-29	Start/Stop		0,1	0	SPT
P2-30	Emergency Type		0,1	0	SPT
P2-31	Power fail Mode		0,1	1	SPT
P2-32	Zero SPD VIB RJT	[RPM]	0.0 ~ 100.0	ON	SP

8. How to Use Position Servo

8.1 Power Supply Wiring

For wiring, see "3.3 Main Circuit Terminal Board Wiring".

8.2 CN1 Wiring



Note1 : Select GND terminal from among 1,8,26,33,34 and 36.

Note2 : Use CN1 shield wire to ground the F.G.(Frame Ground) terminal.

Make wiring as follows to use FDA5000 as the position control mode.

8.2.1 Input contact signal function and use table

Name	Pin No.	Function and Use
SVONEN	18	ON: Servo start command OFF: Servo start command reset
CCWLIM	15	OFF: Motor CCW running limited ON: Motor CCW running allowed
CWLIM	40	OFF: Motor CW running limited ON: Motor CW running allowed
ESTOP	39	Forcibly ignores all input status of the servo drivers in case of external emergency, and shuts off (free-run) motor operation after rapidly decelerating the motor. (Contact type can be selected from parameter P2-30)
ALMRST	38	At ON, reset alarm and clear error pulse between command pulse and current position.
PI/P	41	Selects speed control mode (Turned OFF during normal operation) ON: Proportional control, OFF: Proportional integration control
TLIM	14	ON: Analog torque limit; Off: Digital torque limit. See section 8.6.
SPD1 SPD2	43 17	Selects electronic gear by combination of the two signals. See section 8.7.

Where ON: Applicable contact is connected to "GND24".

OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

8.2.2 Output contact signal function and use table

Name	Pin No.	Function and Use
RDY	21	ON: Main power and auxiliary power are connected to servo without any alarm.
INSPD	22	ON: Motor speed reached designated level.
ZSPD	47	ON: Motor speed is zero.
BRAKE	48	Output signal for external machine brake drive ON: Brake reset, OFF: Brake drive
ALARM	20	ON: Normal status, OFF: Alarm detected
A_CODE0 A_CODE1 A_CODE2	45 19 44	Displays alarm type. See the table below
TRQOUT	46	ON: Servo is under torque limit. See section 8.6 for information on output torque limit.

Where ON: Applicable contact is connected to "GND24".

OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

[Output status of ALARM CODES]

Alarm type	Emerg. Stop	Over-current	Over-voltage	Over-load	Power error	Encoder miswiring	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

8.2.3 Analog input use and function table

Name	Pin No.	Function and Use
TRQIN	27	Inputs external torque limit command (-10V ~ +10V).
PPFIN, PFIN PPRIN, PRIN	11, 10 9, 12	Inputs position command pulse.

8.2.4 Analog output use and function table

Name	Pin No.	Function and Use
MONIT1	3	Monitor output 1 (-4V ~ +4V)
MONIT2	2	Monitor output 2 (-4V ~ +4V)
PAO, /PAO	7, 32	A phase, /A phase encoder signal output
PBO, /PBO	6, 31	B phase, /B phase encoder signal output
PZO, /PZO	5,30	Z phase, /Z phase encoder signal output

8.2.5 I/O contact power supply

Name	Pin No.	Function and Use
GND	1, 8, 26 33, 34, 36	Power ground for analog I/O, such as torque limit command, monitor output and encoder output.
+24VIN	49	DC 24V power supply for the external I/O contact
GND24	24, 25	DC 24V ground for the external I/O contact

(Note) See section 3.4.6 for the capacity of +24V power supply.

8.3 CN2 Wiring

For information on CN2 wiring, see "Section 3.5 CN2 Wiring and Signal Description".

8.4 Setting Parameters Related to Motor and Servo

When the servo start ENABLE contact (SVONEN) is turned OFF after power is connected, set the following parameters.

8.4.1 Setting motor and models

Parameter		Description
No.	Name	
P1-01	Motor ID	Sets ID number according to the type of servo motor.
P1-10	Amp Type	Sets ID number according to the type of driver.
P1-11	Encoder Type	Sets number according to encoder signal system.
P1-12	Encoder Pulse	Sets encoder pulse quantity.
P2-01	Controller Type	Sets sped control mode number to "2".

☯ See Chapter 6. Parameter Setting.

8.4.2 Setting built-in brake use

Parameter		Description
No.	Name	
P2-09	Brake SPD	Sets brake start speed when stopped.
P2-10	Brake Time	Brake starts after the set time elapsed when stopped.

Example) If [Brake SPD (P2-09)]=30, [Brake Time (P2-10)] = 10
If the motor speed drops below 30[RPM} after decelerating when the servo is turned OFF while the motor is run by the servo, or if 10[ms] is passed after the servo is turned OFF, the output contact (brake) is turned Off.

8.4.3 Setting control system gains satisfying loads

Parameter		Description
No.	Name	
P2-03	SC LOOP Gain	See below
P2-04	SC I TC	“
P2-22	Inertia Ratio	“
P2-23	Autotune Range	“
P2-24	Autotune ON/OFF	“

a) Autotuning
Use autotuning only when the motor is running at a speed greater than 1/5 times the rated speed. Turn Off Autotuning when the motor is running in normal condition.

☞ Set (P2-23) range according to approximate inertia ratio.

Inertia ratio	Set value	Inertia ratio	Set value	Inertia ratio	Set value
1 ~ 3	**1**	10 ~ 25	**4**	100 ~ 300	**7**
2 ~ 10	**2**	15 ~ 100	**5**	200 ~ 400	**8**
3 ~ 15	**3**	25 ~ 200	**6**	300 ~ 500	**9**

☯ Inertia ratio = (Motor inertia + load inertia) / Motor inertia

☞ Decelerating/accelerating for about 5 times after turning ON autotuning (P2-24) will allow the inertia value to be stored in (P2-22).
☞ Turn off autotuning (P2-24).

b) Adjusting control system gains
☞ Manually input inertia ratio (P2-22) if the inertia ratio is known.
☞ Adjust the following value according to inertia ratio.

Inertia ratio		**Set value**		
Motor	**Motor**	**SC LOOP Gain**	**SC I TC (P2-04)**	
□ 60, 80	**□ greater than 130**	**(P2-03)**	Recommended	Minimum
1		500	20	6
2		350	30	9
3		290	35	11
5	1	220	45	14
10	2	160	60	19
20	3	110	90	27
50	5	70	140	42
100	10	50	200	60
	20	30	300	100

☯ If the SC Loop gain is too low, vibration occurs and response becomes fast if it is high, but vibration occurs if the gain is excessively high. Response becomes fast if SC I TC is reduced, but overshoot occurs if it is reduced excessively. Position reaching time is shortened if the PC P gain is increased; however, excessive gain may cause vibration and overshoot.

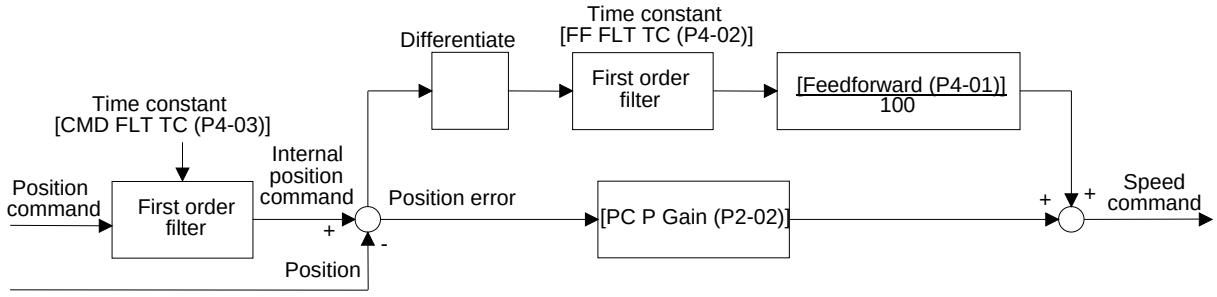
8.4.4 Setting position control gains

Set the following position-control-related parameters.

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-01	Feedforward[%[	%	0 ~ 100	0	P
P4-02	FF FLT TC[ms]	ms	0 ~ 10000	0	P
P4-03	CMD FLT TC[ms	ms	0 ~ 10000	0	P
P4-05	FLLW ERR[PULSE]	Pulse	0 ~ 99999	20000	P

☯ See section 6.6 of Chapter 6, Setting Parameters Related to Position Control.

Position control block diagram



8.5 Limiting Output Torque

The output torque can be limited within 300% of the rated torque. The output torque can be limited by digital signal and also by the analog signal. To limit output torque by digital signal, turn Off contact input (TLIM); and to limit output torque by analog signal, turn ON the contact input (TLIM). If the output command value is greater than the output torque limit value, the output torque is limited by the output torque limit value, and the (TRQOUT) output contact is turned ON.

8.5.1 Limiting digital output torque (TLIM) = OFF

The digital output torque limit can be set for the CW torque limit and CCW torque limit respectively. Set the submenus [TRQ LMT(+) (P2-05)] and [TRQ LMT(-) (P2-06) of the main menu [Controller Type (P2--)] as follows.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-05	TRQ LMT(+) [%]	%	0 ~ 300	300	SP
P2-06	TRQ LMT(-) [%]	%	0 ~ 300	300	SP

8.5.2 limiting analog output torque (TLIM) = ON

Apply voltage between -10[V] - 10[V] to analog input (TRQIN) to limit analog output torque. As the analog output torque limit command input uses the absolute value of the voltage, voltage of the same size in different code is treated as the same input. For example, +5[V] input and -5[V] are treated as the same input. The internally used output torque is limited as follows according to the size of (TRQIN) voltage and the [10V Torque (P5-02)] set value.

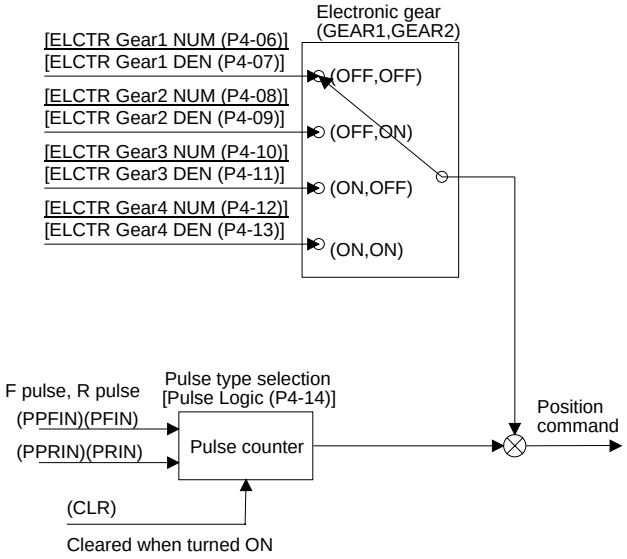
$$\text{Maximum CW torque} = \text{LPF}\left\{\frac{(\text{TRQIN})}{10}\times\frac{[\text{10V Torque (P5-02)}]}{100}\right\}\times \text{rated torque}$$

$$\text{Maximum CCW torque} = -\text{LPF}\left\{\frac{(\text{TRQIN})}{10}\times\frac{[\text{10V Torque (P5-02)}]}{100}\right\}\times \text{rated torque}$$

LPF: Low Pass Filter (Low pass primary filter)

Menu	Menu name	Unit	Display range	Initial value	Mode
P5-01	TRQ CMD TC [ms]	ms	0.0 ~ 1000.0	0.0	SPT
*P5-02	10V Torque	%	0 ~ 300	100	SPT

8.6 Inputting Position Commands



8.6.1 Inputting position command pulse

3 types of command pulses, ① A phase + B phase, ② CW pulse + CCW pulse and ③ direction + pulse, can be selected. Input applicable number to [Pulse Logic (P4-14)]. Command pulse operation is effected based on the encoder pulse value multiplied by 4.

Menu	Menu name	Unit	Display range	Initial value	Mode
P4-14	Pulse Logic		0 ~ 5	1	P

8.6.2 Electronic gear

The electronic gear enables setting of motor feed per input command pulse in a random value. The electronic gear is multiplied by the number of the command pulses to electronically play the role of a gear. FDA 5000 series are capable of inputting 4 different electronic gear ratios, and the selection of the electronic gear is decided by the input contacts (GEAR1) and (GEAR2).

Gear 1	Gear 2	Menu	Menu name	Unit	Display range	Initial value	Mode
OFF	OFF	P4-06	ELCTR Gear1 NUM		1 ~ 99999	1	P
		P4-07	ELCTR Gear1 DEN		1 ~ 99999	1	P
ON	OFF	P4-08	ELCTR Gear2 NUM		1 ~ 99999	1	P
		P4-09	ELCTR Gear2 DEN		1 ~ 99999	2	P
OFF	ON	P4-10	ELCTR Gear3 NUM		1 ~ 99999	1	P
		P4-11	ELCTR Gear3 DEN		1 ~ 99999	3	P
ON	ON	P4-12	ELCTR Gear4 NUM		1 ~ 99999	1	P
		P4-13	ELCTR Gear4 DEN		1 ~ 99999	4	P

[Setting Electronic Gear]

1) Determine the minimum unit (command unit) of the position data which feeds load per pulse.
   Assumed command unit = 0.001 [mm]/ pulse.
2) Obtain the load feed rate per load axis rotation in the unit of command.
   Example) In case the ball screw pitch is 5[mm], and command unit is 0.001 [mm]/pulse.
   Load feed per load axis rotation = 5/0.001 = 5000
3) Get electronic gear ratio in case of reduction ratio (n/m).

$$\text{Electronic gear ratio} = \frac{\text{Number of motor encoder pulse} \times 4}{\text{Feed per load axis rotation}} \times \text{reduction ratio} \left(\frac{\text{motor axis speed}}{\text{load axis speed}}\right) = \frac{\text{Electronic gear ratio (numerator)}}{\text{Electronic gear ratio (denominator)}}$$

4) The results of calculating the electronic gear ratio must be between 0.05-20.

8.7 Using Monitor

The servo's internal speed command and torque, and the feedback motor speed can be monitored from outside through the analog output (MONIT1) and (MONIT2). The range of output voltage is -4[V] - 4[V]. For more information on how to use, see section 7.8 Using Monitor.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-11	Monitor1 Select		0 ~ 2	0	SPT
P2-12	Monitor1 ABS		0,1	0	SPT
P2-13	Monitor1 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
P2-14	Monitor1 offset	%	-100.0 ~ 100.0	0.0	SPT
P2-15	Monitor2 Select		0 ~ 2	1	SPT
P2-16	Monitor2 ABS		0,1	0	SPT
P2-17	Monitor2 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
P2-18	Monitor2 offset	%	-100.0 ~ 100.0	0.0	SPT

8.8 De-resonance Frequency Operation

Mechanical resonance of specific frequency may occur when a system is constructed by using servo.
To remove such resonance, input the resonant frequency occurring on the system to the [Resonant FRQ (P2-19)] in terms of [Hz]; input the band width of the resonant frequency to be removed to the [Resonant BW (P2-20)] in terms of [Hz]; and select [De-Resonance ENB (P2-21)] as 1.

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-19	Resonant FRQ[Hz]	Hz	0 ~ 1000	300	SP
P2-20	Resonant BW[Hz]	Hz	0 ~ 1000	100	SP
P2-21	De-Resonant ENB		0,1	0	SP

8.9 Other Set Values

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-07	Pulse Out Rate	Division	1 ~ 16	1	SPT
P2-08	Current Offset		0, 1	0	SP
P2-25	Parameter Init		currt/dFLT	currt	SPT
P2-27	DB Control		0,1	1	SPT
P2-28	Display Select		1~10	1	SPT
P2-30	Emergency Type		0,1	0	SPT
P2-31	Power fail Mode		0,1	1	SPT

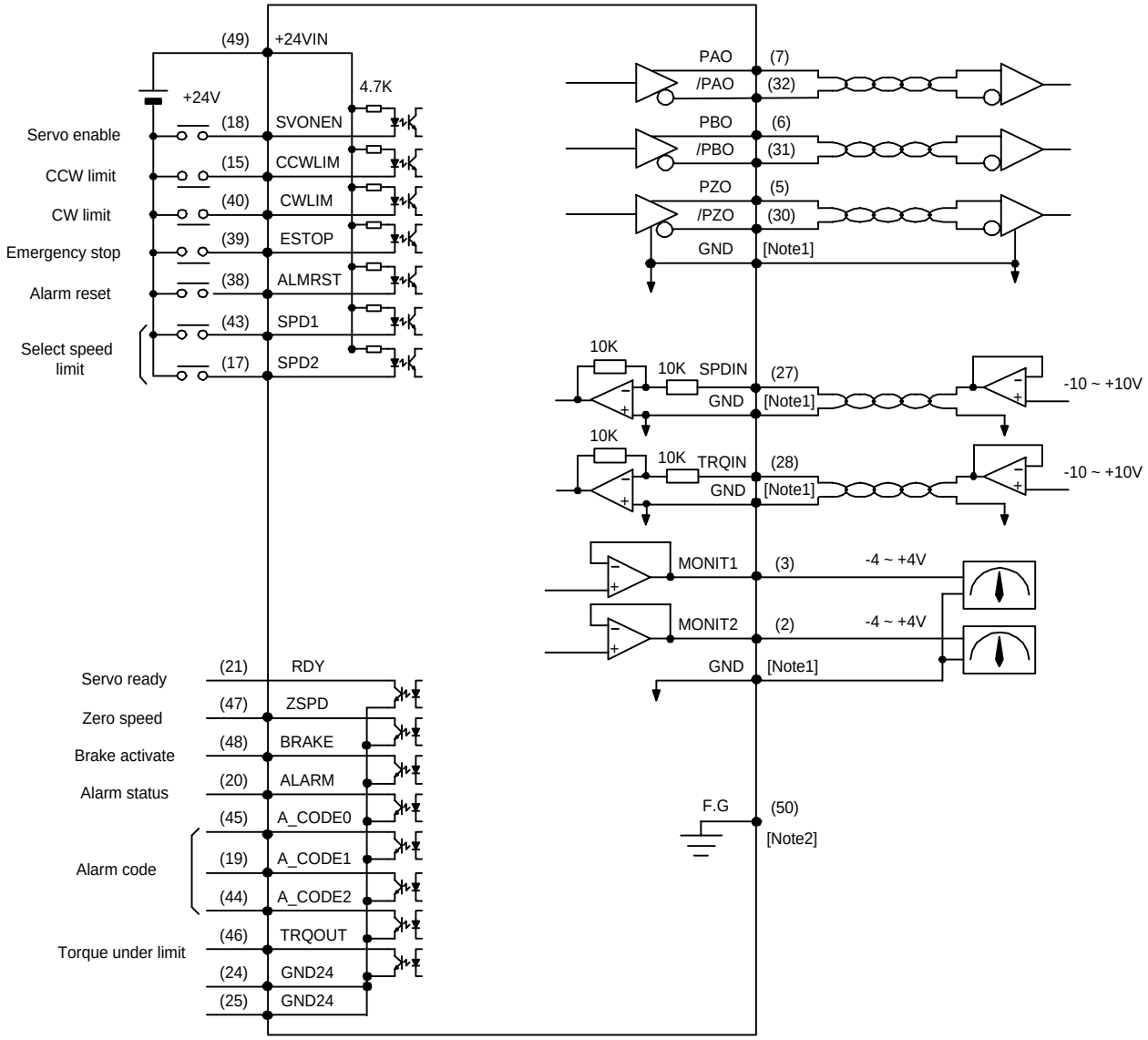
9. How to Use Torque Servo

9.1 Power Supply Wiring

For wiring, see "3.3 Main Circuit Terminal Board Wiring".

9.2 CN1 Wiring

Make wiring as follows to use FDA5000 as the torque control mode.



Note1 : Select GND terminal from among 1,8,26,33,34 and 36.

Note2 : Use CN1 shield wire to ground the F.G.(Frame Ground) terminal.

9.2.1 Input contact signal function and use table

Name	Pin No.	Function and Use
SVONEN	18	ON: Servo start command OFF: Servo start command reset
CCWLIM	15	OFF: Motor CCW running limited ON: Motor CCW running allowed
CWLIM	40	OFF: Motor CW running limited ON: Motor CW running allowed
ESTOP	39	Forcibly ignores all input status of the servo drivers in case of external emergency, and shuts off (free-run) motor operation after rapidly decelerating the motor. (Contact type can be selected from parameter P2-30)
ALMRST	38	Resets alarm status if turned ON.
SPD1 SPD2	43 17	Selects speed limit by combination of the two signals. See section 9.6.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

9.2.2 Output contact signal function and use table

Name	Pin No.	Function and Use
RDY	21	ON: Main power and auxiliary power are connected to servo without any alarm.
ZSPD	47	ON: Motor speed is zero.
BRAKE	48	Output signal for external machine brake drive ON: Brake reset, OFF: Brake drive
ALARM	20	ON: Normal status, OFF: Alarm detected
A_CODE0 A_CODE1 A_CODE2	45 19 44	Displays alarm type. See the table below [Alarm Code output status].
TRQOUT	46	ON: Indicates servo is operating in torque mode. It becomes OFF if speed limit is reached.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V",or applicable contact not connected.

Alarm type	Emerg. Stop	Over-current	Over-voltage	Over-load	Power error	Encoder miswiring	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

9.2.3 Analog input use and function table

Name	Pin No.	Function and Use
SPDIN	27	Inputs external analog speed limit (-10V ~ +10V).
TRQIN	28	Inputs external torque command (-10V ~ +10V).

9.2.4 Analog output use and function table

Name	Pin No.	Function and Use
MONIT1	3	Monitor output 1 (-4V ~ +4V)
MONIT2	2	Monitor output 2 (-4V ~ +4V)
PAO, /PAO	7, 32	A phase, /A phase encoder signal output
PBO, /PBO	6, 31	B phase, /B phase encoder signal output
PZO, /PZO	5,30	Z phase, /Z phase encoder signal output

9.2.5 I/O contact power supply

Name	Pin No.	Function and Use
GND	1, 8, 26 33, 34, 36	Power ground for analog I/O, such as speed command, torque limit command, monitor output and encoder output.
+24VIN	49	DC 24V power supply for the external I/O contact
GND24	24, 25	DC 24V ground for the external I/O contact

(Note) See section 3.4.6 for the capacity of +24V power supply.

9.3 CN2 Wiring

For information on CN2 wiring, see "Section 3.5 CN2 Wiring and Signal Description".

9.4 Setting Parameters Related to Motor and Control

Parameter		Description
No.	Name	
P1-01	Motor ID	Sets ID No. according to servo motor type
P1-10	Amp Type	Sets ID No. according to driver type
P1-11	Encoder Type	Sets No. according to encoder signal system
P1-12	Encoder Pulse	Sets number of encoder pulses
P2-01	Controller Type	Sets torque control mode No. to "0"

☯ See Chapter 6. Parameter Setting

For information on setting motor and control parameters, see section 7.4.

9.5 Speed Limit

If the motor is driven by torque servo, motor speed may continuously be accelerated or decelerated according to load status leading to excessive motor speed. It is therefore necessary to designate maximum speed of torque servo operation to prevent the motor from being run at a speed greater than the set level. The speed that can be limited when the motor is run by torque servo can be set within the maximum motor speed.

The speed limit can be input freely based on the following 2 methods:
① Using 3 digital speed commands ([Speed CMD1 (P3-01)] - [Speed CMD3 (P3-03)]
② Using the external analog speed limit signal (absolute value input)
The selection of the internal speed command based on these 2 methods is determined as follows according to the CN1 speed limit selection ((SPD1), (SPD2)) contacts.

Speed selection 1	Speed selection 2	Speed limit
OFF	OFF	Absolute value of the analog command speed
OFF	ON	Absolute value of [Speed CMD1 (P3-01)] set speed
ON	OFF	Absolute value of [Speed CMD2 (P3-02)] set speed
ON	ON	Absolute value of [Speed CMD3 (P3-03)] set speed

9.5.1 Inputting digital speed limit

The following is how to input 3 digital speed commands. First, move to [Speed Mode (P3--)], the speed-related parameter group, from the main menu. Then, input the desired digital speed command in [RPM]. Speed limit does not have any relation with codes.
Absolute values are used regardless of positive value or negative value. To prevent confusion, always use the positive value.

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-01	Speed CMD1[RPM]	RPM	-Maximum speed~ Maximum speed	100	ST
P3-02	Speed CMD2[RPM]	RPM	-Maximum speed~ Maximum speed	200	ST
P3-03	Speed CMD3[RPM]	RPM	-Maximum speed~ Maximum speed	500	ST

9.5.2 Inputting analog speed limit

To input analog speed limit, apply a voltage between -10[V] and 10[V] to the analog input terminal (SPDIN). The speed limit used inside the servo can be adjusted as follows according to the absolute value of the voltage of the analog input (SPDIN) and the set values of [10V Speed (P3-13)], [SPD CMD OFFS (P3-14)].

Internal speed command [rpm] =

$$\frac{[\text{10V Speed (P3-13)}]}{10} \times \left\{ (\text{SPDIN}) + \frac{[\text{SPD CMD OFFS (P3-14)}]}{1000} \right\}$$

Menu	Menu name	Unit	Display range	Initial value	Mode
P3-13	10V Speed[RPM]	RPM	0 ~ 9999.9	3000	ST
P3-14	SPD CMD OFFS[mV]	mV	-1000.0 ~ 1000.0	0.0	ST

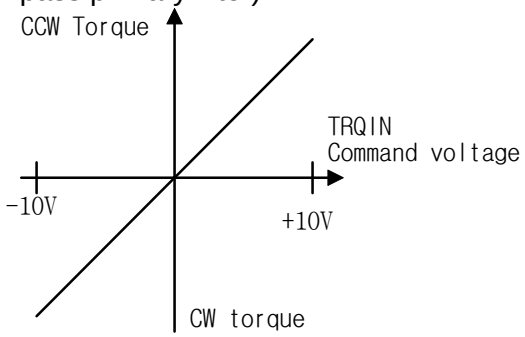
9.6 Inputting Torque Command

The torque command can be input to the analog input terminal (TRQIN). Apply a voltage between -10[V] - 10[V] to (TRQIN). The torque command and voltage have the following relationships.

Torque command =

$$\text{LPF} \left\{ \frac{[\text{10V Torque (P5-02)}]}{10} \times \left\{ (\text{TRQIN}) + \frac{[\text{Ttrque OFFS (P5-03)}]}{1000} \right\} \right\} \times \frac{\text{Rated torque}}{100}$$

LPF: Low Pass Filter (Low pass primary filter)



Menu	Menu name	Unit	Display range	Initial value	Mode
P5-01	TRQ CMD TC[ms]	ms	0.0 ~ 1000.0	0.0	SPT
P5-02	10V Torque	%	0 ~ 300	100	SPT
P5-03	Torque OFFS	mV	-1000.0 ~ 1000.0	0.0	T

9.7 Using Monitor

The servo internal speed command and torque, and the feedback motor speed can be monitored from outside through the analog output (MONIT 1) and (MONIT 2). The range of output voltage is -5[V] - 5[V]. For more details on how to use, see section 6.11 "Using Monitor".

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-11	Monitor1 Select		0 ~ 2	0	SPT
P2-12	Monitor1 ABS		0,1	0	SPT
P2-13	Monitor1 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
P2-14	Monitor1 offset	%	-100.0 ~ 100.0	0.0	SPT
P2-15	Monitor2 Select		0 ~ 2	1	SPT
P2-16	Monitor2 ABS		0,1	0	SPT
P2-17	Monitor2 Scale	Multiple	1.00 ~ 20.00	1.00	SPT
P2-18	Monitor2 offset	%	-100.0 ~ 100.0	0.0	SPT

9.8 Other Set Values

Menu	Menu name	Unit	Display range	Initial value	Mode
P2-08	Current Offset		0, 1	0	SP
P2-25	Parameter Init		currt/dFLT	currt	SPT
P2-27	DB Control		0,1	1	SPT
P2-28	Display Select		1~10	1	SPT
P2-30	Emergency Type		0,1	0	SPT
P2-31	Power fail Mode		0,1	1	SPT

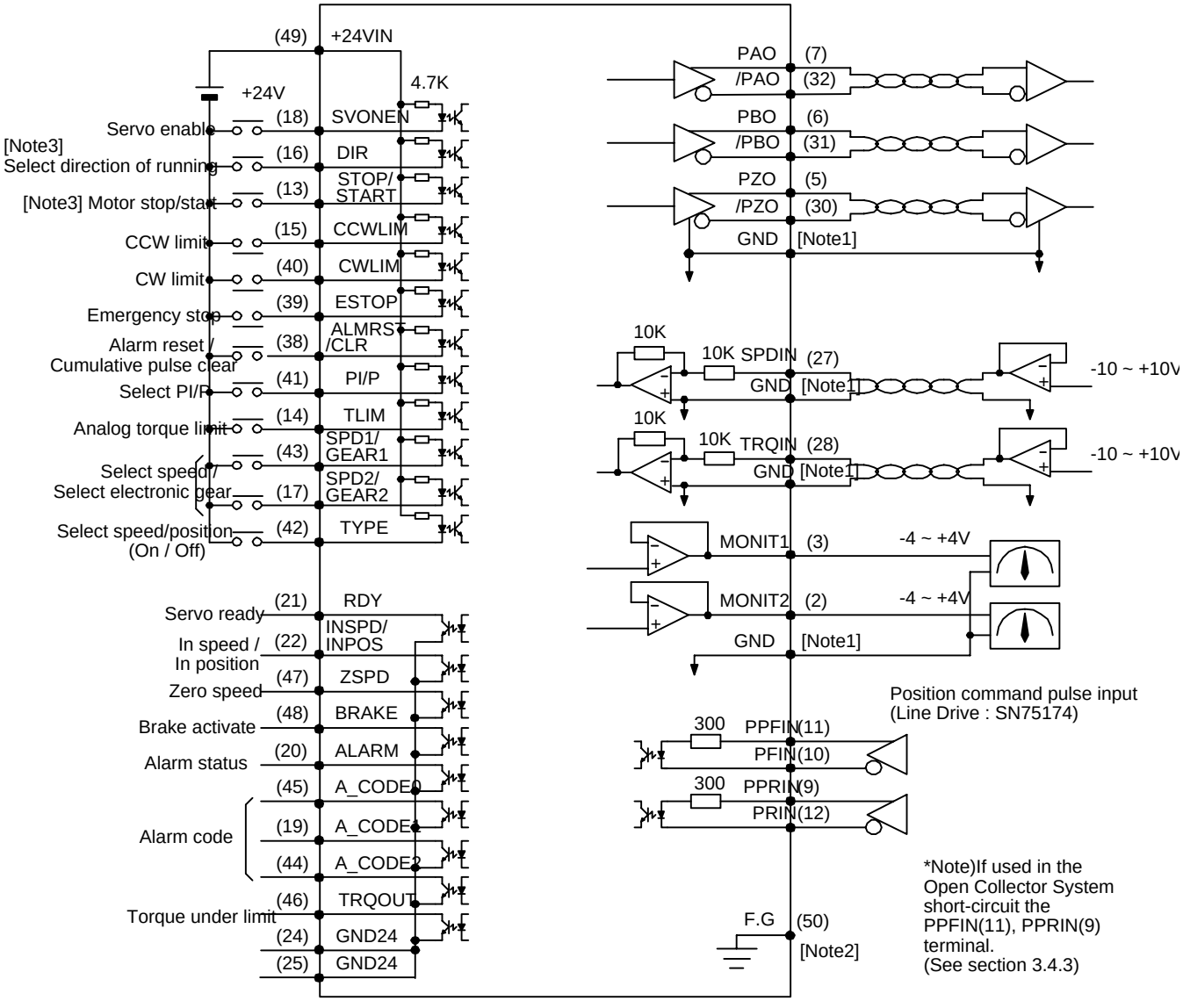
10. How to Use Speed/Position Servo

10.1 Power Supply Wiring

For wiring, see "3.3 Main Circuit Terminal Board Wiring".

10.2 CN1 Wiring

Make wiring as follows to use FDA5000 as the speed/position control mode.



Note1 : Select GND terminal from among 1,8,26,33,34 and 36.

Note2 : Use CN1 shield wire to ground the F.G.(Frame Ground) terminal.

Note3 : Available for speed mode.

10.2.1 Input contact signal function and use table

Name	Pin No.	Function and Use
SVONEN	18	ON: Servo start command OFF: Servo start command reset
DIR	16	Selects servo rotation direction[Valid only in speed control mode] (Off: Command direction rotation, ON: Counter-command direction rotation)
STOP/ START	13	Forcibly zeros (stops) the speed command value, or starts operation. (Can be selected from parameter P2-29)
CCWLIM	15	OFF: Motor CCW running limited ON: Motor CCW running allowed
CWLIM	40	OFF: Motor CW running limited ON: Motor CW running allowed
ESTOP	39	Forcibly ignores all input status of the servo drivers in case of external emergency, and shuts off (free-run) motor operation after rapidly decelerating the motor. (Contact type can be selected from parameter P2-30)
ALMRST CLR	38	Resets alarm status if turned ON(Control speed) At ON, reset alarm and clear error pulse between command pulse and current position. (Control torque)
PI/P	41	Selects speed control mode (Turned OFF during normal operation) ON: Proportional control, OFF: Proportional integration control
TLIM	14	ON: Analog torque limit; Off: Digital torque limit.
SPD1 SPD2	43	Selects rotation speed command by combination of the two signals (Speed control mode).
GEAR1 GEAR2	17	Slects electronic gear by conbination of the two signals.(Position control mode)
TPE	42	ON: Operates as speed servo. OFF: Operates as position servo.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

10.2.2 Output contact signal function and use table

Name	Pin No.	Function and Use
RDY	21	ON: Main power and auxiliary power are connected to servo without any alarm.
INSPD	22	ON: Motor speed reached designated level(Control speed)
INPOS		Reached designated pulse position (Position control)
ZSPD	47	ON: Motor speed is zero.
BRAKE	48	Output signal for external machine brake drive ON: Brake reset, OFF: Brake drive
ALARM	20	ON: Normal status, OFF: Alarm detected
A_CODE0 A_CODE1 A_CODE2	45 19 44	Displays alarm type. See the table below [Alarm Code output status].
TRQOUT	46	ON: Servo is under torque limit.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

[Output status of ALARM CODES]

Alarm type	Emerg. stop	Over-current	Over-voltage	Over-load	Power error	Encoder miswiring	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

10.2.3 Analog input use and function table

Name	Pin No.	Function and Use
SPDIN	27	Inputs external analog speed (-10V ~ +10V).
TRQIN	28	Inputs external torque limit command (-10V ~ +10V).
PPFIN, PFIN PPRIN, PRIN	11, 10 9, 12	Inputs position command pulse. Valid only in position control mode.

10.2.4 Analog output use and function table

Name	Pin No.	Function and Use
MONIT1	3	Monitor output 1 (-4V ~ +4V)
MONIT2	2	Monitor output 2 (-4V ~ +4V)
PAO, /PAO	7, 32	A phase, /A phase encoder signal output
PBO, /PBO	6, 31	B phase, /B phase encoder signal output
PZO, /PZO	5, 30	Z phase, /Z phase encoder signal output

10.2.5 I/O contact power supply

Name	Pin No.	Function and Use
GND	1, 8, 26 33, 34, 36	Power ground for analog I/O, such as speed command, torque limit command, monitor output and encoder output.
+24VIN	49	DC 24V power supply for the external I/O contact
GND24	24, 25	DC 24V ground for the external I/O contact

(Note) See section 3.4.6 for the capacity of +24V power supply.

10.3 CN2 Wiring

For information on CN2 wiring, see "Section 3.5 CN2 Wiring and Signal Description".

10.4 How to Use Speed/Position Servo

To start speed/position servo, set the servo controller type to “3”.

10.4.1 Switching of control modes

Type	ON	OFF
ON	Speed servo	Position servo

(Caution!) Switch speed servo/position servo only when motor is stopped.

10.4.2 How to use by control mode

Refer to sections 7 and 8 for detailed directions by control mode.

Speed command for speed operation can be input freely by using 3 methods:

① Using 3 digital speed commands ([Speed CMD1 (P3-01)] - [Speed CMD3 (P3-03)]
② Using external analog speed command
③ Based on override operation by combining methods of items ① and ②
The internal speed command selection effected based on these 3 methods is decided as follows based on CN1 speed selection ((SPD1), (SPD2)) contact and the [Override ON/OFF (P3-18)] set values.

7[P3-18]	Speed selection 2	Speed selection 1	Speed command
0	OFF	OFF	Analog command sped
0	OFF	ON	[Speed CMD1 (P3-01)] speed
0	ON	OFF	[Speed CMD2 (P3-02)] speed
0	ON	ON	[Speed CMD3 (P3-03)] speed
1	OFF	OFF	Analog command sped
1	OFF	ON	[Speed CMD1 (P3-01)] set speed + analog command speed
1	ON	OFF	[Speed CMD2 (P3-02)] set speed + analog command speed
1	ON	ON	[Speed CMD3 (P3-03)] set speed + analog command speed

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

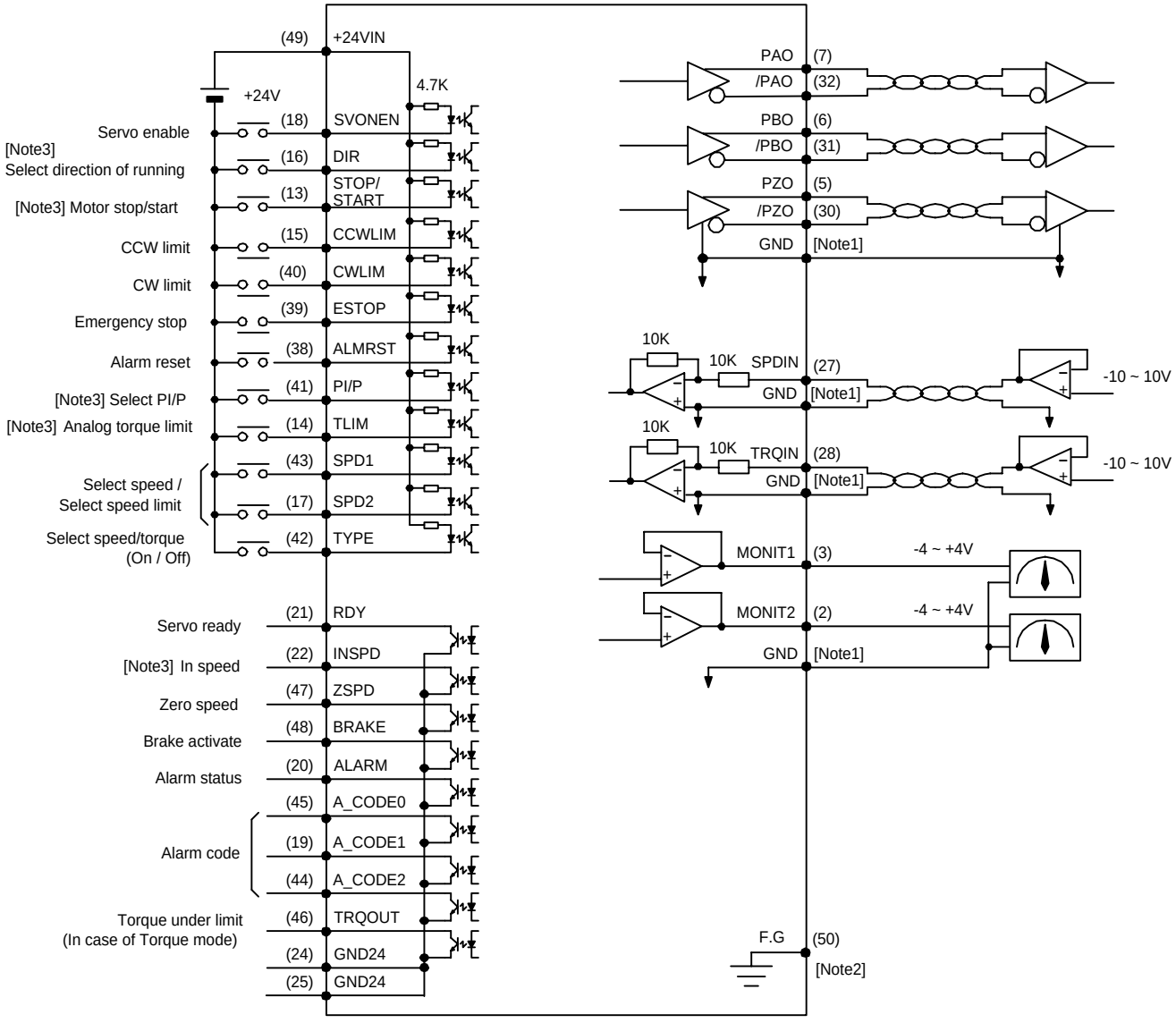
11. How to Use Speed/Torque Servo

11.1 Power Supply Wiring

For wiring, see "3.3 Main Circuit Terminal Board Wiring".

11.2 CN1 Wiring

Make wiring as follows to use FDA5000 as the speed/torque control mode.



Note1 : Select GND terminal from among 1,8,26,33,34 and 36.

Note2 : Use CN1 shield wire to ground the F.G.(Frame Ground) terminal.

Note3 : Available for speed mode.

11.2.1 Input contact signal function and use table

Name	Pin No.	Function and Use
SVONEN	18	ON: Servo start command OFF: Servo start command reset
DIR	16	Selects servo rotation direction[Valid only in speed control mode] (Off: Command direction rotation, ON: Counter-command direction rotation)
STOP/ START	13	Forcibly zeros (stops) the speed command value, or starts operation. (Can be selected from parameter P2-29)
CCWLIM	15	OFF: Motor CW running limited ON: Motor CW running allowed
CWLIM	40	OFF: Motor CCW running limited ON: Motor CCW running allowed
ESTOP	39	Forcibly ignores all input status of the servo drivers in case of external emergency, and shuts off (free-run) motor operation after rapidly decelerating the motor. (Contact type can be selected from parameter P2-30)
ALMRST	38	Resets alarm status if turned ON
PI/P	41	Selects speed control mode (Turned OFF during normal operation) ON: Proportional control, OFF: Proportional integration control Valid only in speed control mode.
TLIM	14	ON: Analog torque limit; Off: Digital torque limit. Valid only in speed control mode.
SPD1 SPD2	43 17	Selects rotation speed command by combination of the two signals (In speed control mode). Slects electronic gear by conbination of the two signals(In position control mode).
TYPE	42	ON: Operates as speed servo. OFF: Operates as position servo.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

11.2.2 Output contact signal function and use table

Name	Pin No.	Function and Use
RDY	21	ON: Main power and auxiliary power are connected to servo without any alarm.
INSPD	22	ON: Motor speed reached designated level. Valid only in speed control mode
		Reached designated pulse position (Position control)
ZSPD	47	ON: Motor speed is zero.
BRAKE	48	Output signal for external machine brake drive ON: Brake reset, OFF: Brake drive
ALARM	20	ON: Normal status, OFF: Alarm detected
A_CODE0 A_CODE1 A_CODE2	45 19 44	Displays alarm type. See the table below [Alarm Code output status].
TRQOUT	46	ON: Servo is under torque limit.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

[Output status of ALARM CODES]

Alarm type	Emerg. stop	Over-Current	Over-voltage	Over-Load	Power error	Encoder miswiring	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

11.2.3 Analog input use and function table

Name	Pin No.	Function and Use
SPDIN	27 28	Speed control mode: Inputs external analog speed (-10V ~ +10V).
TQIN		Inputs external analog torque limit command (-10V ~ +10V).
SPDIN TRQIN		Torque control mode: Inputs external speed limit command (-10V ~ +10V). Inputs external torque command (-10V ~ +10V).

11.2.4 Analog output use and function table

Name	Pin No.	Function and Use
MONIT1	3	Monitor output 1 (-4V ~ +4V)
MONIT2	2	Monitor output 2 (-4V ~ +4V)
PAO, /PAO	7, 32	A phase, /A phase encoder signal output
PBO, /PBO	6, 31	B phase, /B phase encoder signal output
PZO, /PZO	5, 30	Z phase, /Z phase encoder signal output

11.2.5 I/O contact power supply

Name	Pin No.	Function and Use
GND	1, 8, 26 33, 34, 36	Power ground for analog I/O, such as speed command, torque limit command, monitor output and encoder output.
+24VIN	49	DC 24V power supply for the external I/O contact
GND24	24, 25	DC 24V ground for the external I/O contact

(Note) See section 3.4.6 for the capacity of +24V power supply.

11.3 CN2 Wiring

For information on CN2 wiring, see "Section 3.5 CN2 Wiring and Signal Description".

11.4 How to Use Speed/Torque Servo

To start speed/torque servo, set the servo controller type to “4”.

11.4.1 Switching of control modes

Type	ON	OFF
ON	Speed control	Torque control

(Caution!) Switch speed servo1 position servo only when motor is stopped.

11.4.2 How to use by control mode

Refer to sections 7 and 8 for detailed directions by control mode.

Speed command for speed operation can be input freely by using 3 methods:
① Using 3 digital speed commands ([Speed CMD1 (P3-01)] - [Speed CMD3 (P3-03)]
② Using external analog speed command
③ Based on override operation by combining methods of items ① and ②
The internal speed command selection effected based on these 3 methods is decided as follows based on CN1 speed selection ((SPD1), (SPD2)) contact and the [Override ON/OFF (P3-18)] set values.

7[P3-18]	Speed selection 2	Speed selection 1	Speed command
0	OFF	OFF	Analog command sped
0	OFF	ON	[Speed CMD1 (P3-01)] speed
0	ON	OFF	[Speed CMD2 (P3-02)] speed
0	ON	ON	[Speed CMD3 (P3-03)] speed
1	OFF	OFF	Analog command speed
1	OFF	ON	[Speed CMD1 (P3-01)] set speed + analog command speed
1	ON	OFF	[Speed CMD2 (P3-02)] set speed + analog command speed
1	ON	ON	[Speed CMD3 (P3-03)] set speed + analog command speed

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

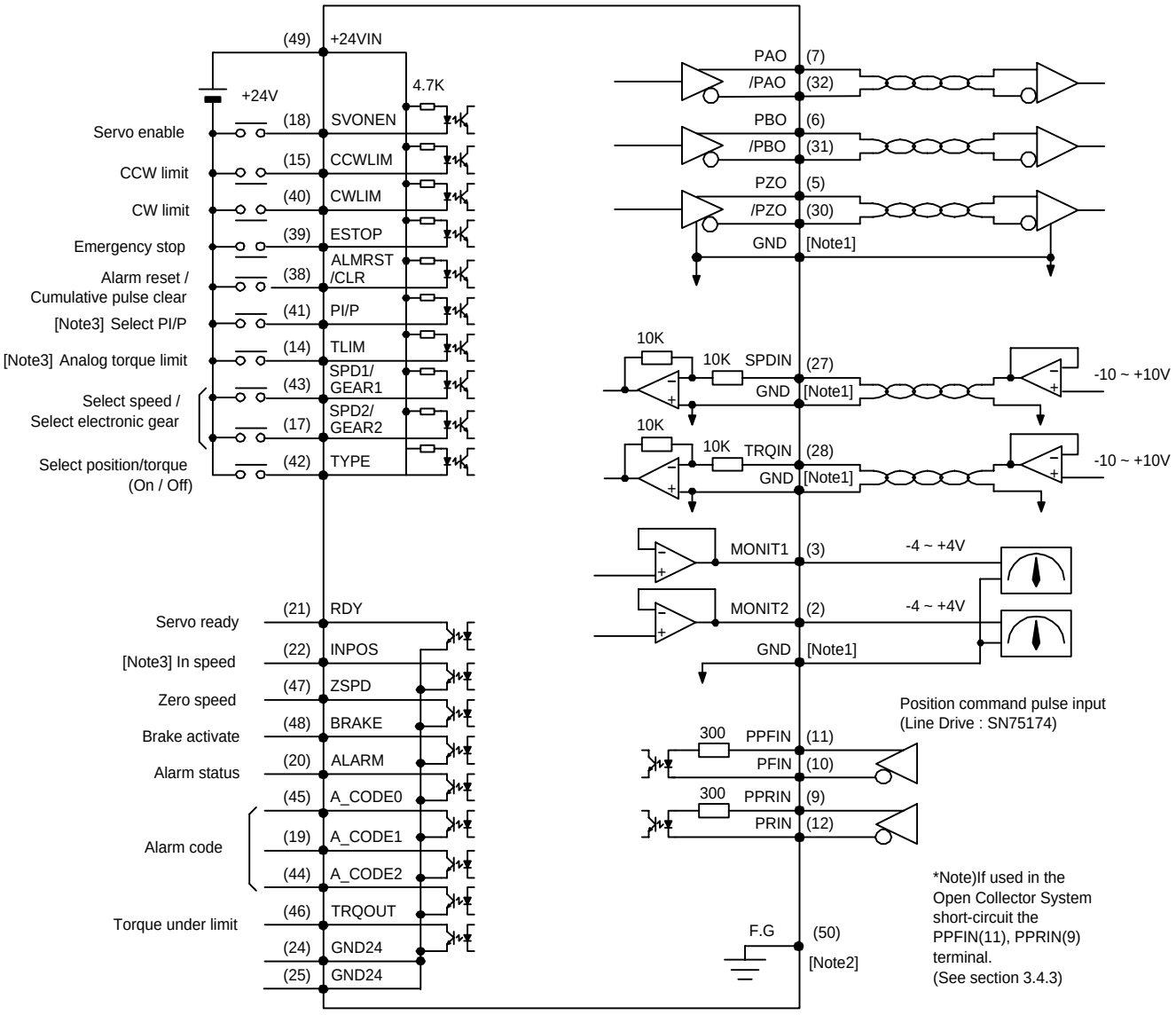
12. How to Use Position/Torque Servo

12.1 Power Supply Wiring

For wiring, see "3.3 Main Circuit Terminal Board Wiring".

12.2 CN1 Wiring

Make wiring as follows to use FDA5000 as the position/torque control mode.



Note1 : Select GND terminal from among 1,8,26,33,34 and 36.

Note2 : Use CN1 shield wire to ground the F.G.(Frame Ground) terminal.

Note3 : Available for position mode.

12.2.1 Input contact signal function and use table

Name	Pin No.	Function and Use
SVONEN	18	ON: Servo start command OFF: Servo start command reset
CCWLIM	15	OFF: Motor CCW running limited ON: Motor CCW running allowed
CWLIM	40	OFF: Motor CW running limited ON: Motor CW running allowed
ESTOP	39	Forcibly ignores all input status of the servo drivers in case of external emergency, and shuts off (free-run) motor operation after rapidly decelerating the motor. (Contact type can be selected from parameter P2-30)
ALMRST CLR	38	Resets alarm status if turned ON(Control torque) At ON, reset alarm and clear error pulse between command pulse and current position. (Control position)
PI/P	41	Selects speed control mode (Turned OFF during normal operation) ON: Proportional control, OFF: Proportional integration control
TLIM	14	ON: Analog torque limit; Off: Digital torque limit. Valid only in position control mode.
SPD1 SPD2	43	Slects electronic gear by conbination of the two signals(In position control mode).
GEAR1 GEAR2	17	Selects speed limit by combination of the two signals (In torque control mode).
TPE	42	ON: Operates as position servo. OFF: Operates as torque servo.

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

12.2.2 Output contact signal function and use table

Name	Pin No.	Function and Use
RDY	21	ON: Main power and auxiliary power are connected to servo without any alarm.
INPOS	22	ON: Reached designated pulse position Valid only in position control mode.
ZSPD	47	ON: Motor speed is zero.
BRAKE	48	Output signal for external machine brake drive ON: Brake reset, OFF: Brake drive
ALARM	20	ON: Normal status, OFF: Alarm detected
A_CODE0 A_CODE1 A_CODE2	45 19 44	Displays alarm type. See the table below [Alarm Code output status].
TRQOUT	46	ON: Servo is under torque limit.(Position control mode) ON: Servo is operating in torque control mode.(Torque control mode)

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

[Output status of ALARM CODES]

Alarm type	Emerg. Stop	Over-current	Over-Voltage	Over-Load	Power error	Encoder miswiring	Others	Normal
A_CODE0	ON	OFF	ON	OFF	ON	OFF	ON	OFF
A_CODE1	ON	ON	OFF	OFF	ON	ON	OFF	OFF
A_CODE2	ON	ON	ON	ON	OFF	OFF	OFF	OFF

Where ON: Applicable contact is connected to "GND24".
OFF: Applicable contact is connected to "+24V", or applicable contact not connected.

12.2.3 Analog input use and function table

Name	Pin No.	Function and Use
SPDIN	27	Inputs external analog speed (-10V ~ +10V). Valid only in torque control mode.
TRQIN	28	Position control mode: Inputs external torque limit command (-10V ~ +10V). Torque control mode: Inputs external torque command (-10V ~ +10V).
PPFIN, PFIN PPRIN, PRIN	11, 10 9, 12	Inputs position command pulse. Valid only in position control mode.

12.2.4 Analog output use and function table

Name	Pin No.	Function and Use
MONIT1	3	Monitor output 1 (-4V ~ +4V)
MONIT2	2	Monitor output 2 (-4V ~ +4V)
PAO, /PAO	7, 32	A phase, /A phase encoder signal output
PBO, /PBO	6, 31	B phase, /B phase encoder signal output
PZO, /PZO	5, 30	Z phase, /Z phase encoder signal output

12.2.5 I/O contact power supply

Name	Pin No.	Function and Use
GND	1, 8, 26 33, 34, 36	Power ground for analog I/O, such as speed command, torque limit command, monitor output and encoder output.
+24VIN	49	DC 24V power supply for the external I/O contact
GND24	24, 25	DC 24V ground for the external I/O contact

(Note) See section 3.4.6 for the capacity of +24V power supply.

12.3 CN2 Wiring

For information on CN2 wiring, see "Section 3.5 CN2 Wiring and Signal Description".

12.4 How to Use Position/Torque Servo

To start speed/position servo, set the servo controller type to “3”.

12.4.1 Switching of control modes

Type	ON	OFF
ON	Position control	Torque control

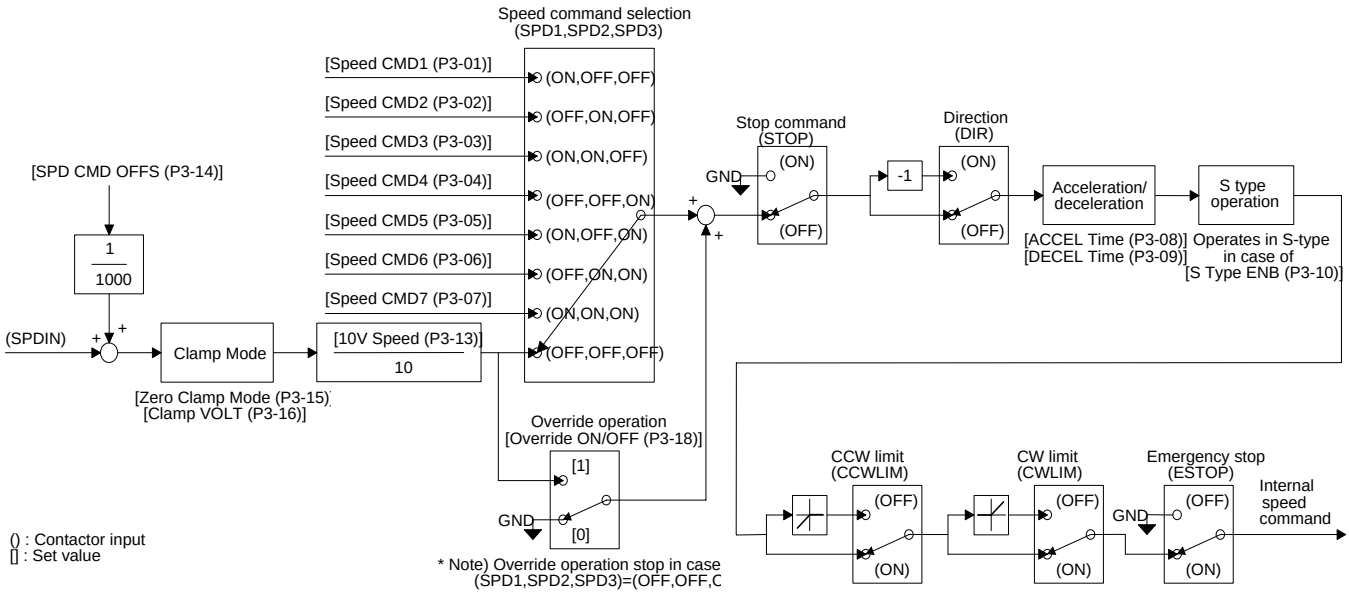
(Caution!) Switch speed servo1 position servo only when motor is stopped.

12.4.2 How to use by control mode

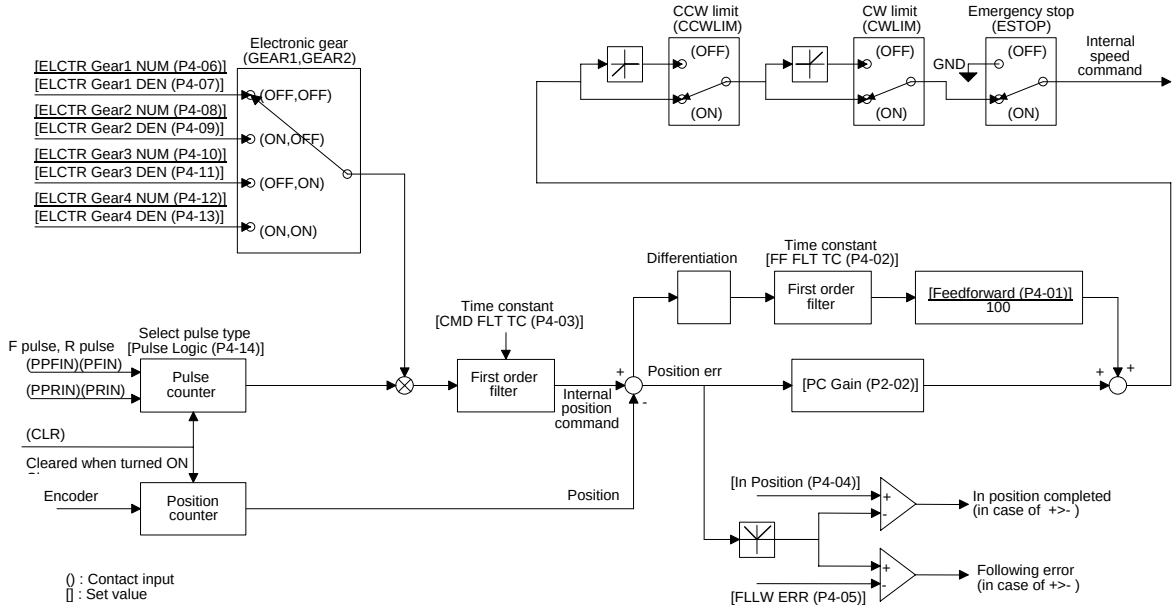
Refer to sections 7 and 8 for detailed directions by control mode.

13. Examples of Operation Flow and PLC Wiring

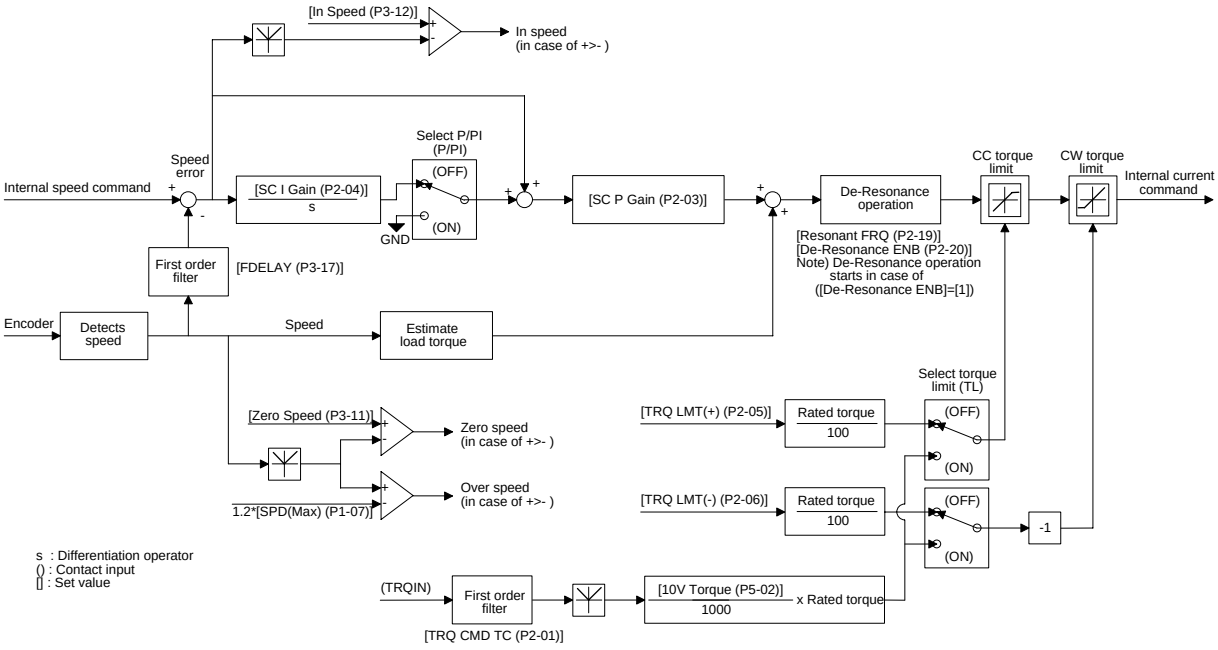
13.1 Generating Speed Command (speed control)



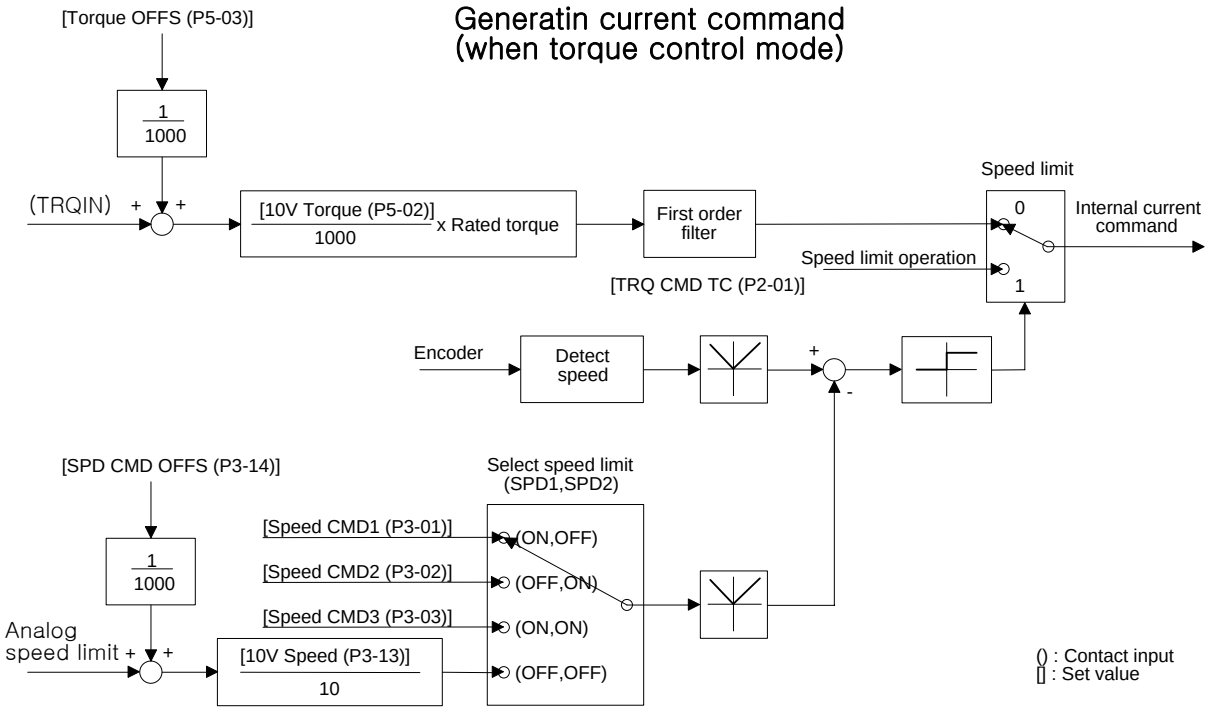
13.2 Generating Speed Command (position control)



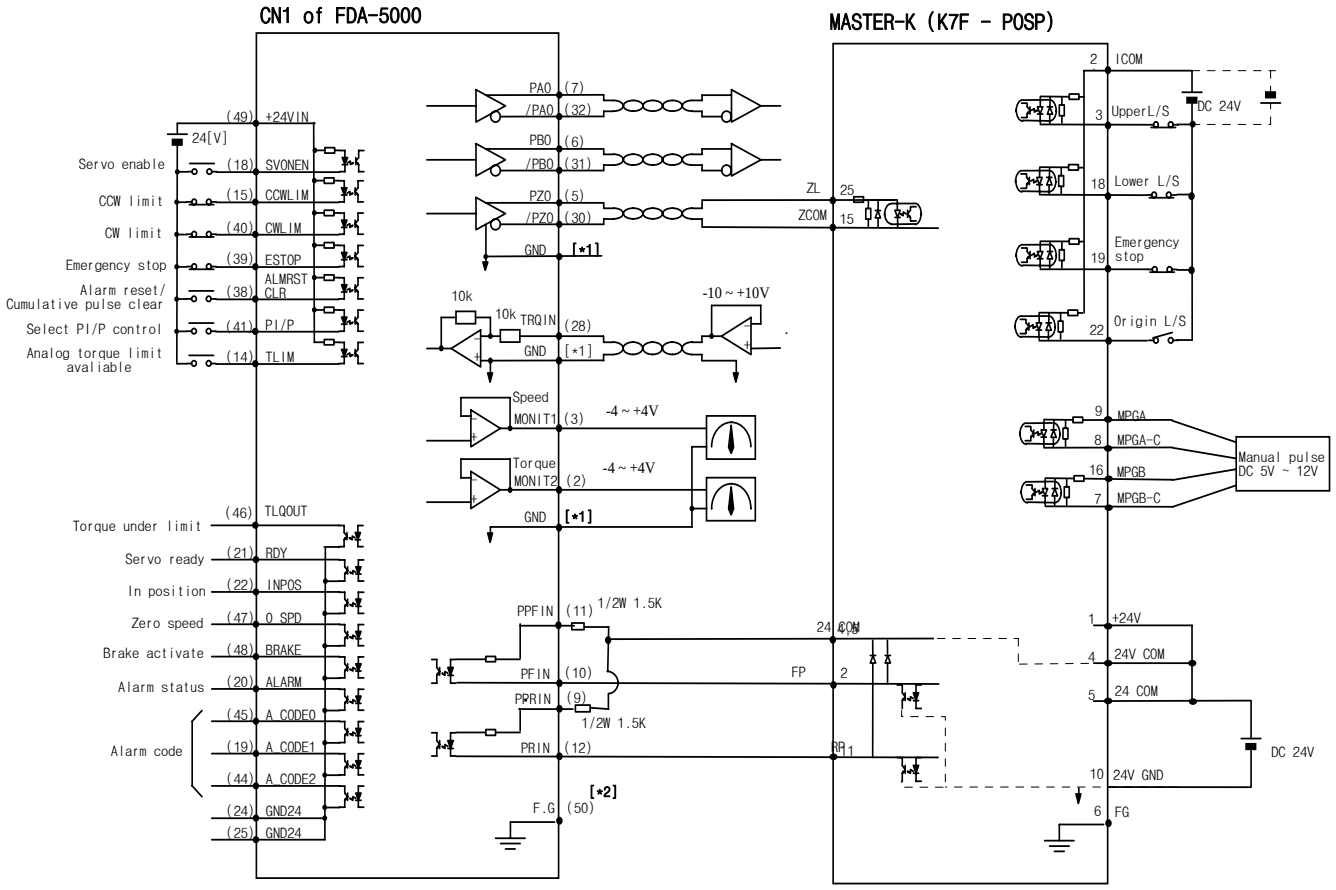
13.3 Generating Current Command (when position and speed are controlled)



13.4 Generating Current Command (when torque is controlled)



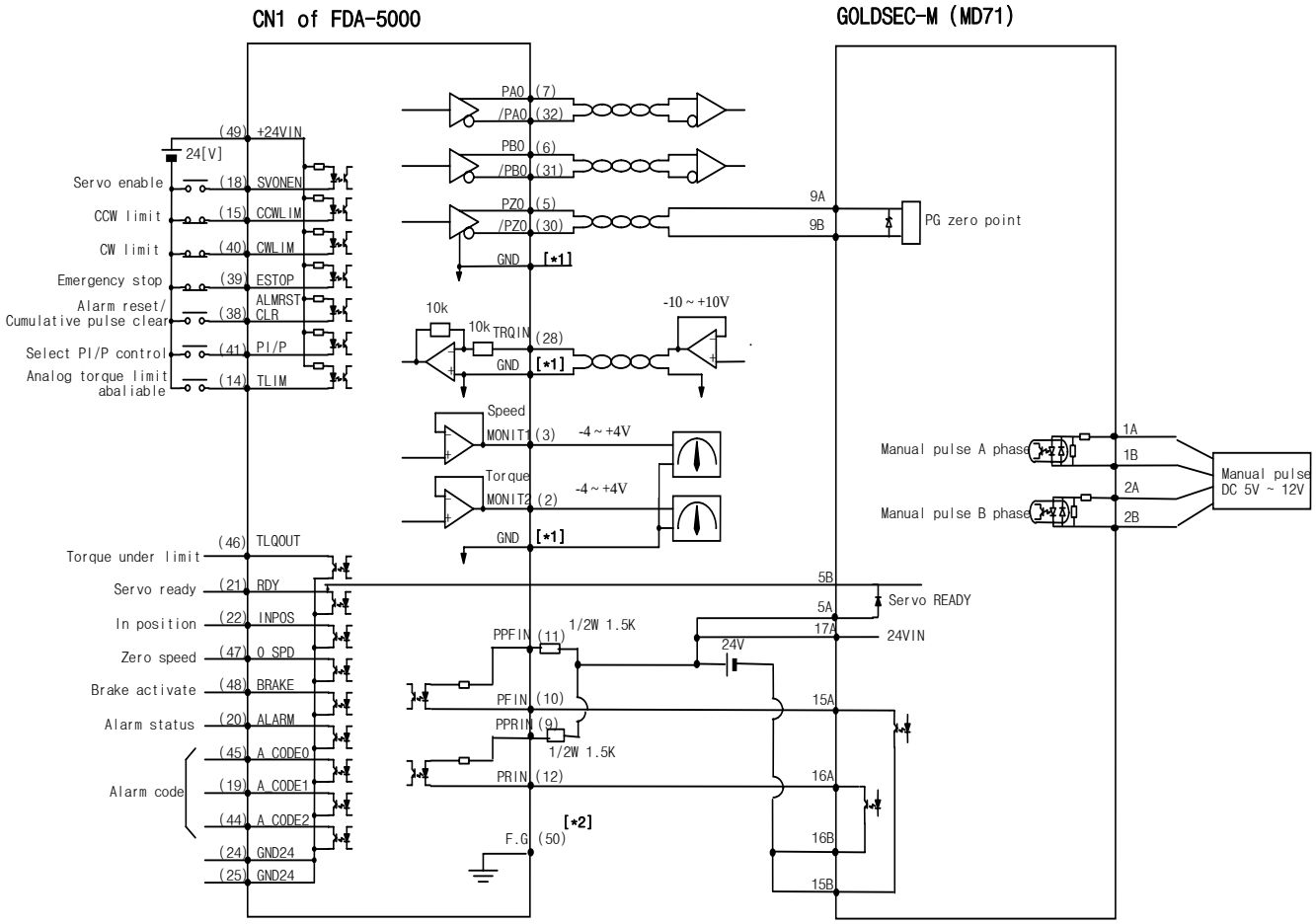
13.5 Example of positioning Unit K7F-POSP connection between FDA-5000, the AC servo driver of HIGEN and PLC MASTER-K



*1 : Use GND terminal from among 1,8,26,33,34,36

*2 : USE CN1 shield wire to groung the F.G(Frame Ground) terminal

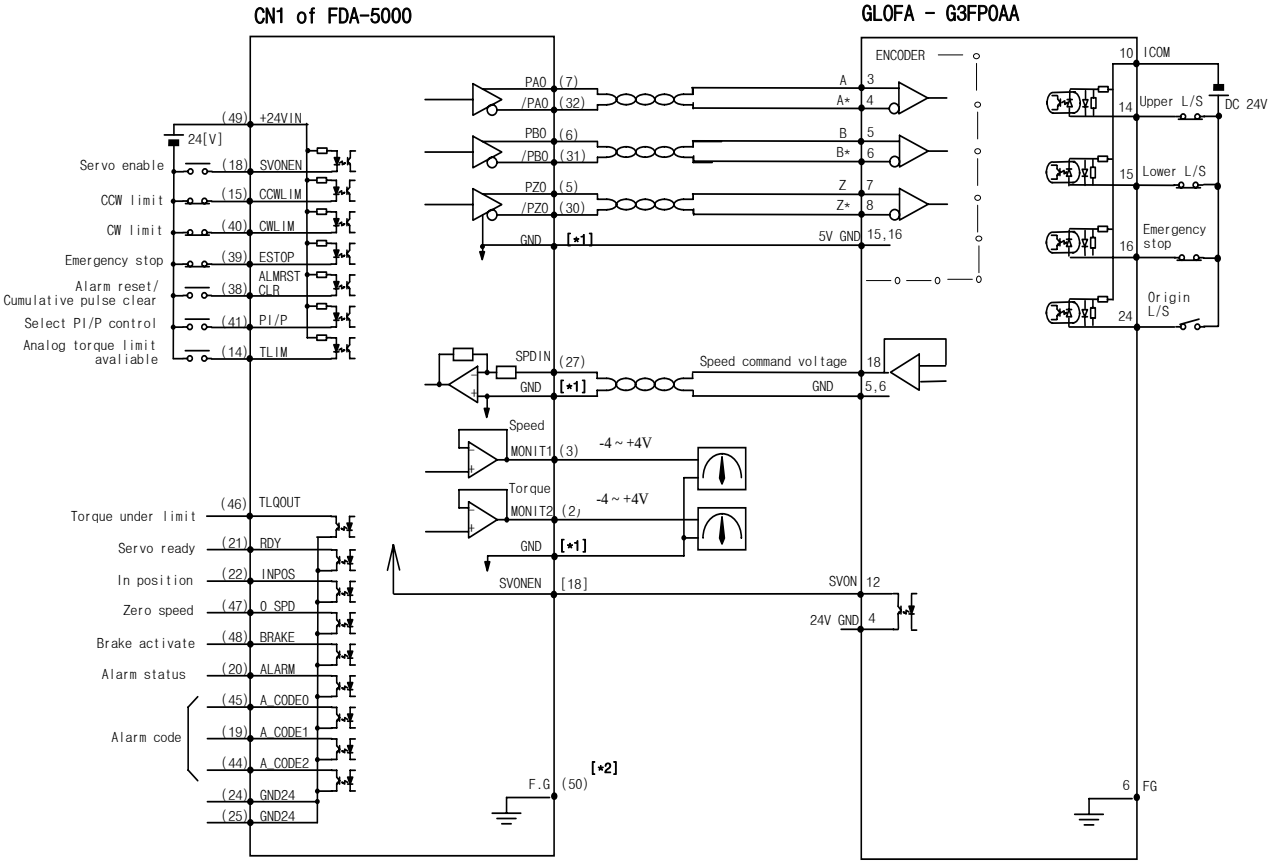
13.6 Example of positioning Unit MD71 connection between FDA-5000, the AC servo driver of HIGEN and PLC GOLDSEC-M



*1 : Use GND terminal from among 1,8,26,33,34,36

*2 : Use CN1 shield wire to ground the F.G(Frame Ground) terminal

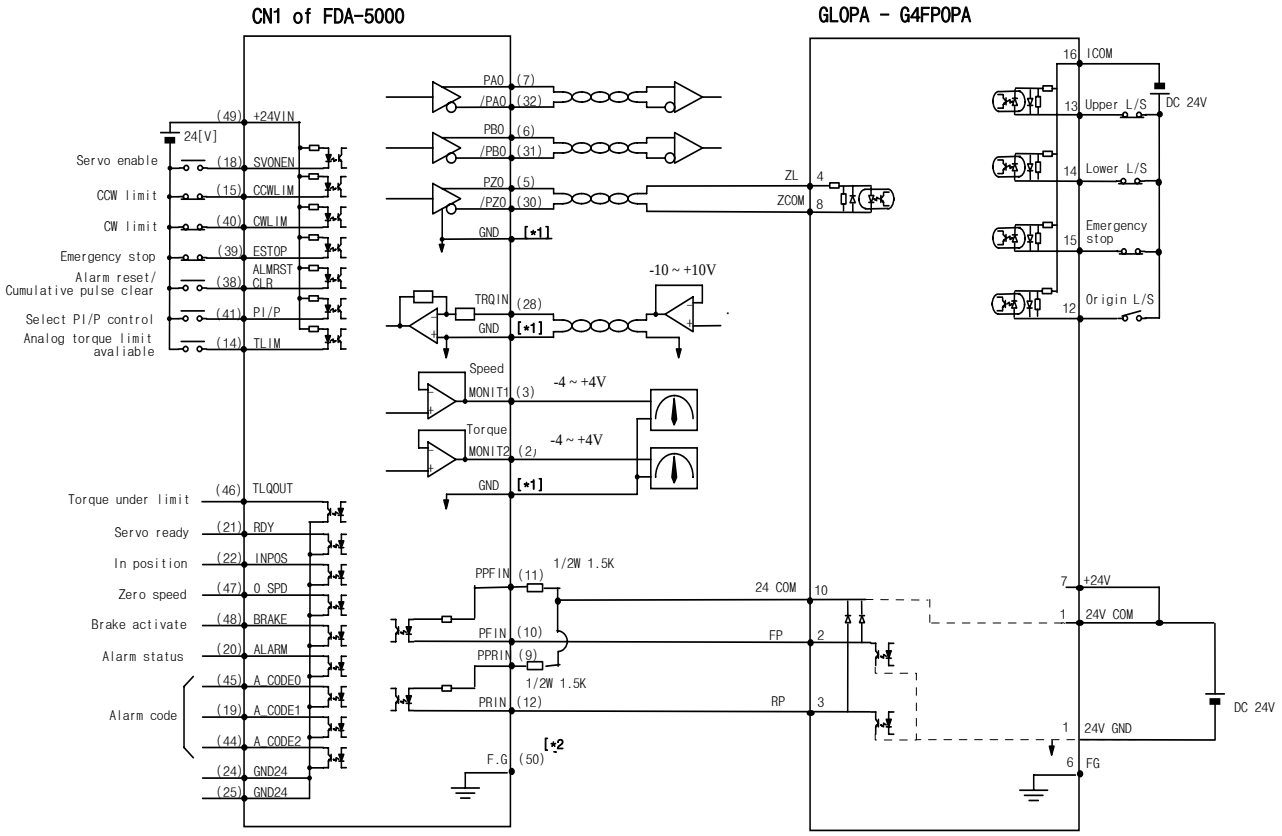
13.7 Example of positioning Unit G3F-P0AA connection between FDA-5000, the AC servo driver of HIGEN and PLC GLOFAPLC



*1 : Use GND terminal from among 1,8,26,33,34,36

*2 : Use CN1 shield wire to ground the F.G(Frame Ground) terminal

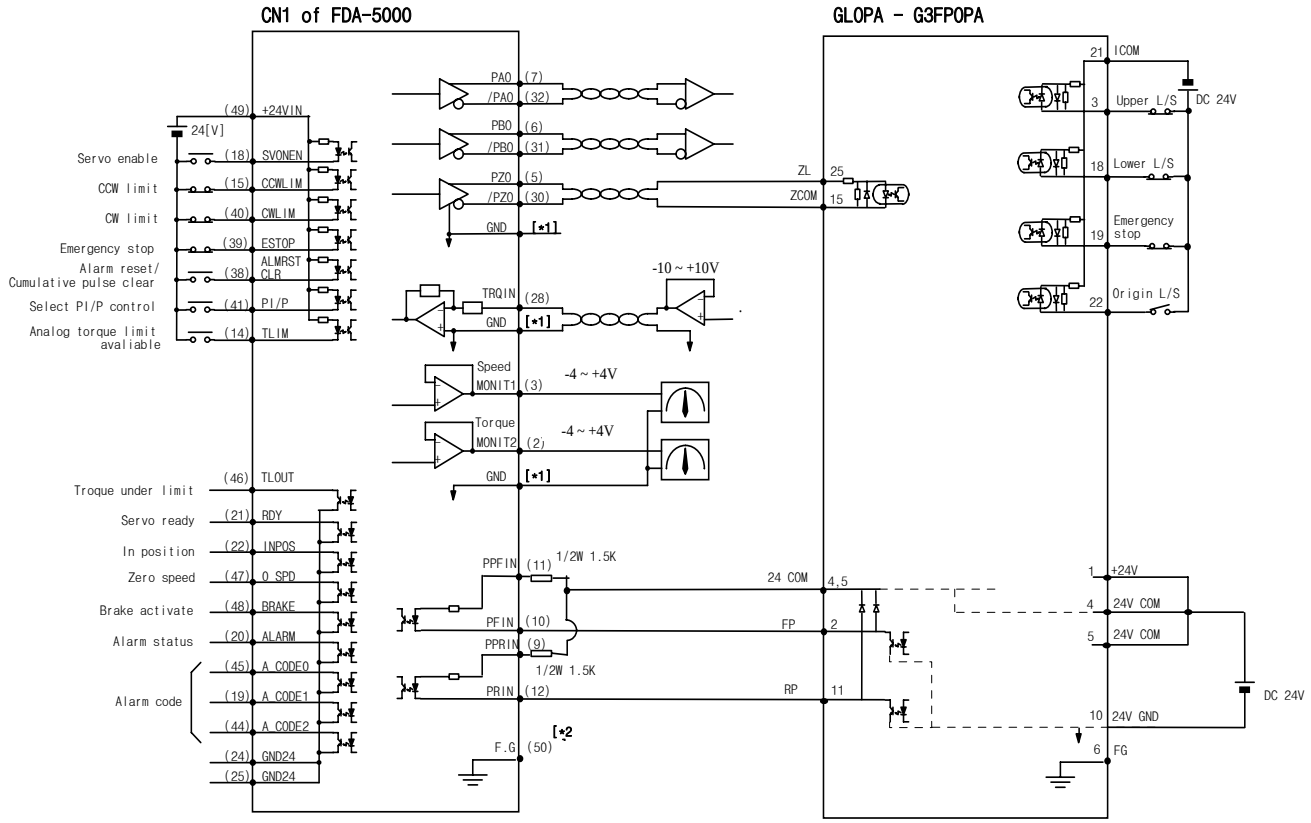
13.8 Example of positioning Unit G4F-POPA connection between FDA-5000, the AC servo driver of HIGEN and PLC GLOFAPLC



*1 : Use GND terminal from among 1,8,26,33,34,36

*2 : Use CN1 shield wire to ground the F.G(Frame Ground) terminal

13.9 Example of positioning Unit G3F-POPA connection between FDA-5000, the AC servo driver of HIGEN and PLC GLOFAPLC



*1 : Use GND terminal from among 1,8,26,33,34 and 36

*2 : Use CN1 shield wire to ground the F.G(Frame Ground) terminal

14. Maintenance and Inspection

The servo driver need not be checked and maintained on a daily basis as it uses highly reliable parts, but inspect it at least once a year. The brushless servo motor is semi-permanent; however, check it periodically for signs of abnormal noise or vibration.

14.1 Caution

1. When checking motor voltage: As the voltage applied to the motor from the servo amplifier is PWM controlled, wave form of pulse phase is displayed. There may be significant difference in indicator value depending on types of meters. Always use rectifier type voltmeter to obtain accurate measurement.

2. When checking motor current: The pulse wave form is smoothed to sine wave to a certain degree by the motor reactance. Connect and use a moving-iron type ampere meter.

3. When checking power: Use an electrodynamic type 3-phase watt-meter.

4. Other meters: Use oscilloscopes or digital voltmeter without letting them make contact with the ground. Use meters with input current of 1 mA or less.

14.2 Inspection Items

(Caution !!) Charged voltage may remain in the smoothing condenser creating an element of danger when inspecting the driver. Turn off power and wait for approximately 10 minutes before starting, inspection.

1. Check the inside of the machine for cable chips, dust or other debris and clean it up.
2. Check the terminal screws for looseness. Tighten them if necessary.
3. Check parts for defects (discoloration caused by heat, damage or disconnection).
4. Use high resistance range of the tester to test the conductivity of the control circuit. Do not use megger or buzzer.
5. Check the cooling fan for normal operation.
6. Check for abnormal noise (motor bearing, brakes)
7. Check cables for signs of damage or defects (particularly the detector cables). Check periodically during operation.
8. Check the load connection axis for center deviation, and make necessary adjustment.

14.3 Replacing Parts

The following parts undergo aging process as time passes due to mechanical friction or the characteristics of the material used, leading to the deterioration of equipment performance or breakdown. Check the parts periodically and replace them, if necessary.

1. **Smoothing condenser:** The characteristics become aged due to the effects of ripple current. The operating life of the condenser varies significantly depending on ambient temperature and operating conditions. When used continuously in normal environment, its standard life span is 10 years. The condenser becomes aged fast during a specific period. Inspect it at least once a year (it is desirable to conduct inspection semi-annually in case the life span is nearing the exhaustion point).

   For judgement criteria, visually check:
   a. Case status: Check if the sides and bottom of the case are expanded.
   b. Cover plate: Check for significant expansion, severe cracks or damage.
   c. Explosion-proof valve: Check for significant expansion or wear.
   d. Check periodically the external condition for cracks, tear, discoloration and water-leakage. If the rated capacity of the condenser drops to 85% or less, it indicates life span has exhausted.

2. **Relays:** Inadequate contact may occur due to contact wear resulting from switching current. The relay wear condition is affected by the power capacity. The standard life span is 100,000 accumulated switching (switching life) operations.

3. **Motor bearing:** Replace bearing when it is used for 20,000-30,000 hours under rated speed and rated load. The motor bearing condition is dependent upon the operating conditions. Replace the bearing if abnormal noise or vibration is discovered.

[Standard replacement period]

Parts	Standard replacement period	How to replace
Smoothing condenser	7-8 years	Replace with new parts (Decide after check)
Relays	-	Decide after check
Fuses	10 year	Replace with new ones
Motor bearing	-	Decide after check
Aluminium electrolytic condenser on PCB	5 years	Replace with new PCB (Decide after check)

14.4 Maintenance

14.4.1 Motor

If the motor is not used immediately, store it in the following manner.

1) Store the motor in a clean and dry place.

Ambient temperature	Ambient humidity
-15 ℃ ~ +70℃	Less than 90 % RH

(Caution !) Must be free of dewing or freezing.

2) If the motor is stored outside or in a place with humidity, cover it with an appropriate type of cover to prevent infiltration of rain or dust.

3) If the motor is to be stored for a long period of time after use, apply rust-proof agent on the shaft or on slideways to prevent rust.

14.4.2 Servo driver

It is not desirable to leave the servo driver unused for a long period of time. If the servo driver is not used immediately, store it in the following manner.

1) Store the driver in a clean and dry place.

Ambient temperature	Ambient humidity
-15 ℃ ~ +65℃	Less than 90 % RH

(Caution !) Must be free of dewing or freezing.
Ambient temperature applies to short period of time, such as during transporting.

2) As the driver is in open structure, exercise caution not to allow dust to be accumulated.

15. Troubleshooting

In case an error occurs during operation, take the following steps. If taking such steps does not correct errors, contact service center.

15.1 Servo Motor

Actions to be taken in case of errors

Symptom	Cause	Inspection	Corrective action
Motor does not start	Parameter misset	Check parameters related to motor, encoder, encoder type and control mode.	Reset parameters. (See sections 5 and 6)
	Overloaded	Check machine running condition.	Readjust mechanical systems.
	Motor defective	Check motor lead terminal with a tester.	If voltage is correct, replace motor.
	Screws loosened	Check the screws.	Retighten loose screws.
	External miswiring, or cable disconnected	Check the motor and encoder wiring.	Rewire. Replace cable.
	Encoder defective	Check the output wave form.	Replace encoder. (Use A/S service)
Motor running unstable	Defective connection	Check connection of the motor lead terminal.	Repair defective part.
	Input voltage low	Check drive input voltage.	Change power supply.
	Overloaded	Check machine condition.	Remove foreign material from the rotator and lubricate (or grease) it.
Motor over-heated	Ambient temperature high	Check the motor ambient temperature. (Should be lower than 40℃)	Change heat-shield structure.
	Motor surface stained	Check motor surface for attached foreign materials.	Clean the surface of the motor.
	Overloaded	Check the load rate of the drive. Check acceleration/deceleration cycle.	Reduce load. Increase acceleration/deceleration time
	Magnetic power deteriorated	Check counter electromotive voltage and wave form.	Replace motor.
Abnormal noise	Defective coupling	Check the tightness of the coupling screws and the concentricity of joints.	Readjust coupling.
	Defective bearing	Check the bearing for vibration or abnormal noise.	Contact LG service center.
	Parameter misset (inertia ratio, gain, time constant)	Check control parameters.	See Chapter 6. Parameter Setting.

15.2 Servo driver

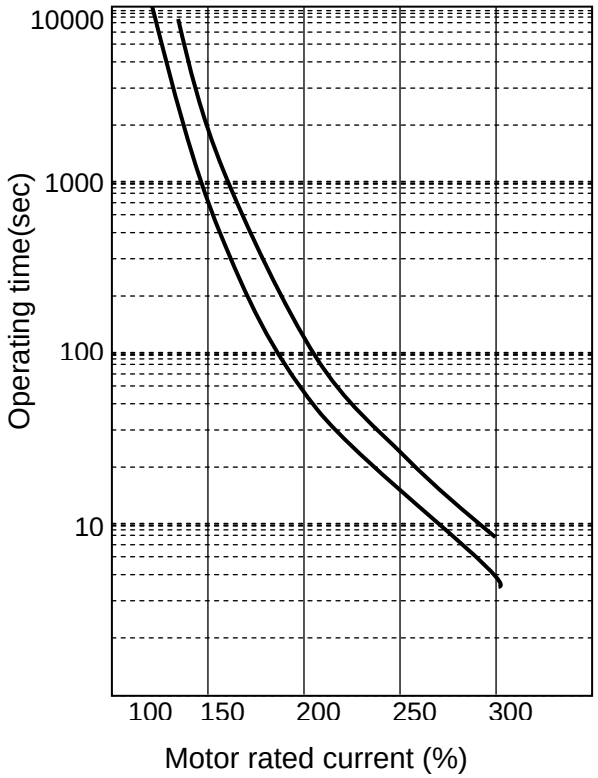
If an alarm occurs, error signal output contact (Alarm) is turned OFF, and the motor stops by the action of dynamic brake.

Actions to be taken in case of an alarm

Screen display	Cause	Corrective action
Normal		
AL-00 EMER STOP	External ESTOP contact input turned OFF.	Check external DC 24V power supply. Check if the ESTOP contact is turned ON.
AL-01 OVER CURNT	Servo driver output terminal (U, V, W) short-circuited, output overcurrent.	Check the output terminal wiring. Restart after resetting alarm. Replace driver if O.C. continues.
AL-02 OVER VOLT	Input voltage excessive (greater than 280V). Regeneration control resistance burned. Load GD^2 excessive.	Use input voltage lower than 230V. Replace control resistance, increase acceleration/deceleration time. Replace servo driver.
AL-03 OVER LOAD	Mechanical overload. Motor miswiring.	Check load condition. Check the motor and encoder wiring.
AL-04 POWER FAIL	Main power shut off during Servo ON status.	Check the 3-phase main power supply (R, S, T) input status.
AL-05 LINE FAIL	Motor and encoder set value error, motor and encoder miswiring, defective encoder, mechanical overload.	Check motor and encoder wiring and set values. Remove excessive load.
AL-06 OVER HEAT	Ambient temperature increased. Continuous overload operation.	Improve heat-shield system condition (ambient temperature to be less than 50℃). Check load condition.
AL-07 OVER SPEED	Excessive gain, parameter set value error, excessive gravity load.	Adjust gain. Check parameters (P3-14). Remove excessive gravity load.
AL-08 FOLLOW ERR	Rapid acceleration/deceleration, gain set value error, command pulse frequency excessive (higher than 300 kpps), miswiring, mechanical overload.	Adjust position gain, increase menu (P4-03) set value, adjust command pulse frequency, check motor and encoder wiring.

Screen display	Cause	Corrective action
AL-09 Output NC	Output (U, V, W) open phase.	Check motor wiring. Replace servo driver.
AL-10 PPR ERROR	No. of encoder pulse set error.	Set the number of encoder pulse (P1-12) accurately.
AL-11 ABS DATA	Absolute value encoder data transmission error.	Reset and retransmit the absolute value encoder data.
AL-12 ABS BATT	Battery voltage drops below 2.8V.	Replace battery (3.6V).
AL-13 ABS MDER	ABS encoder multi-rotation data transmission error.	Reset and retransmit the absolute value encoder data.
Parameter Err 1	Input of parameters, which cannot be changed, is attempted during Servo ON. Parameters locked.	Turn OFF the servo and change the set value. Reset parameter locking menu (P1-13).
Parameter Err 2	Set value input error.	Input values within the set range.

[Overload characteristic curves of Servo Driver]



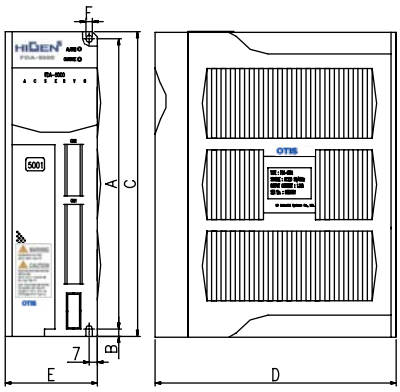
Rated current (%)	Overload operating time		
	Min.	Max.	Set value
100	∞		
120	∞		
150	300	1500	760
200	60	150	107
250	20	40	30
300	6	15	7

(note) If AL-03 (OVER LOAD) happens often, refer servo drive overload characteristic-curve and re-establish suitable load of servo motor.

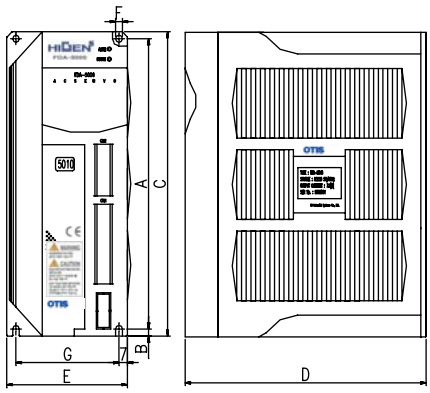
16. External View

16.1 External Dimensions of AC Servo Driver

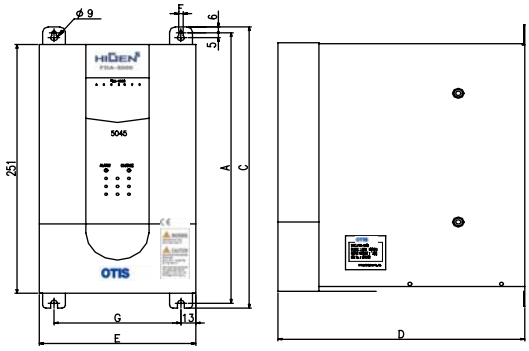
< Outline drawing A >



< Outline drawing B >



< Outline drawing C >



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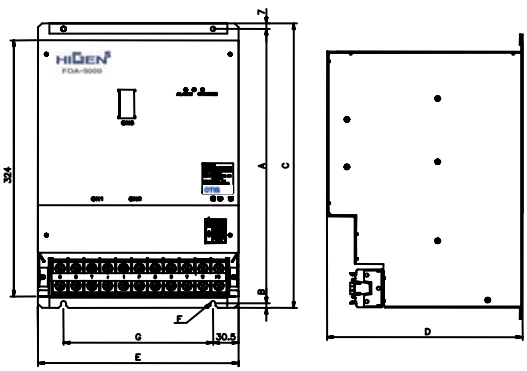
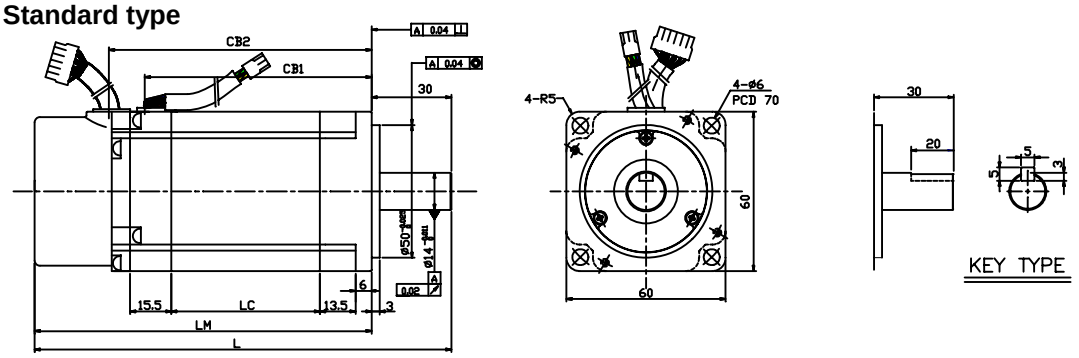


Product	A	B	C	D	E	F	G	Weight [Kg]	Cooling system	Outline Drawing
FDA-5001	164	5	175	130	60	5.5	-	1.0	Self-cooling	A
FDA-5002	164	5	175	130	60	5.5	-	1.0		
FDA-5004	164	5	175	130	77	5.5	63	1.3		B
FDA-5005	200	5	210	184	94	5.5	80	2.0		
FDA-5010	200	5	210	184	94	5.5	80	2.0		
FDA-5012	200	5	210	184	103	5.5	80	2.3	Forced cooling (Fan)	
FDA-5015	272	6	284	218	135	6.0	111	4.5	Self-cooling	C
FDA-5020	272	6	284	218	135	6.0	111	4.8	Forced cooling (Fan)	
FDA-5030	272	6	284	218	135	6.0	111	4.9		
FDA-5045	272	6	284	218	135	6.0	111	5.0		
FDA-5075	347	6	360	234	240	6.0	179	15		D

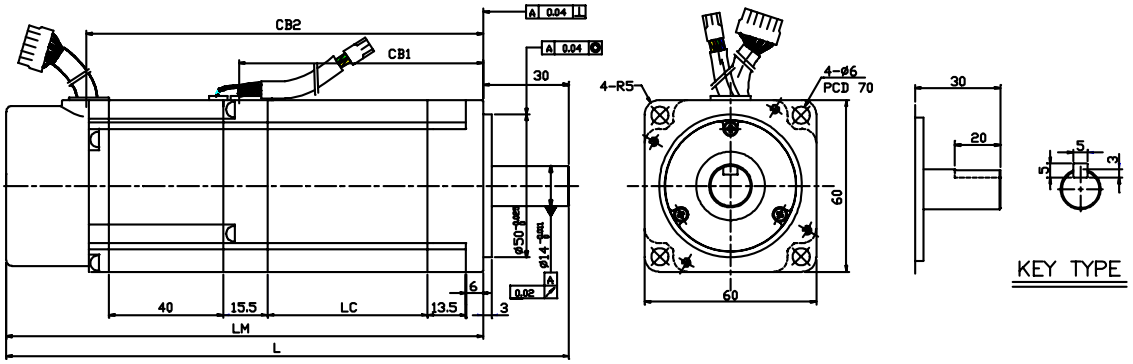
16.2 External Dimensions of AC Servo Motor

16.2.1 Flange 60 Series

Standard type

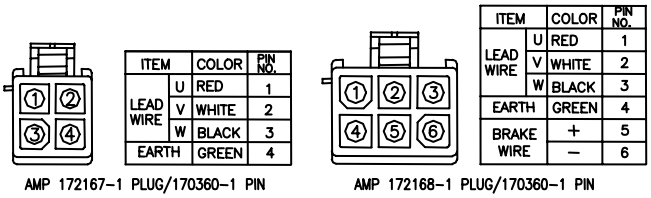


Brake type

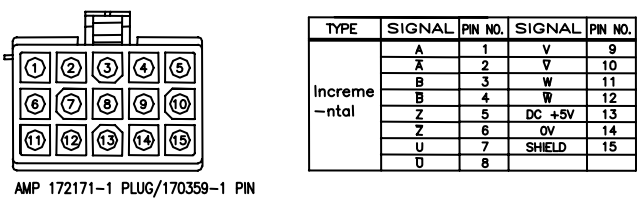


Model	L	LM	LC	CB1	CB2	Weight (kg)
FMA-CN01(B)	115(155)	85(125)	14(14)	44(44)	57(97)	0.85(1.4)
FMA-CN02(B)	129(169)	99(139)	28(28)	58(58)	71(111)	1.14(1.7)
FMA-CN03(B)	143(183)	113(153)	42(42)	72(72)	85(125)	1.43(2.0)
FMA-CN04(B)	157(197)	127(167)	56(56)	86(86)	99(139)	1.73(2.3)
FMA-CN05(B)	171(211)	141(181)	70(70)	100(100)	113(153)	2.03(2.6)

* Figures in ( ) indicate brake-attached type.
* Use DC 24V for brake input power supply.
* In case of applying absolute encoder, Motor length is extended 15mm.



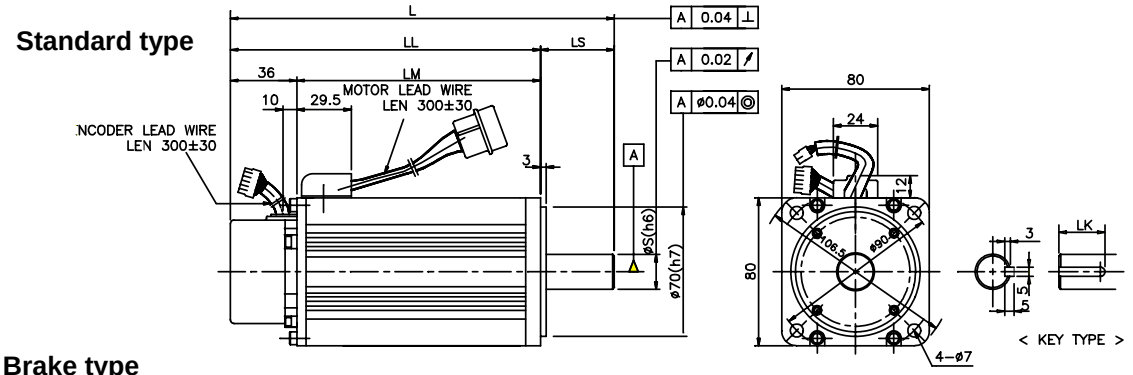
MOTOR CONNECTOR DIAGRAM



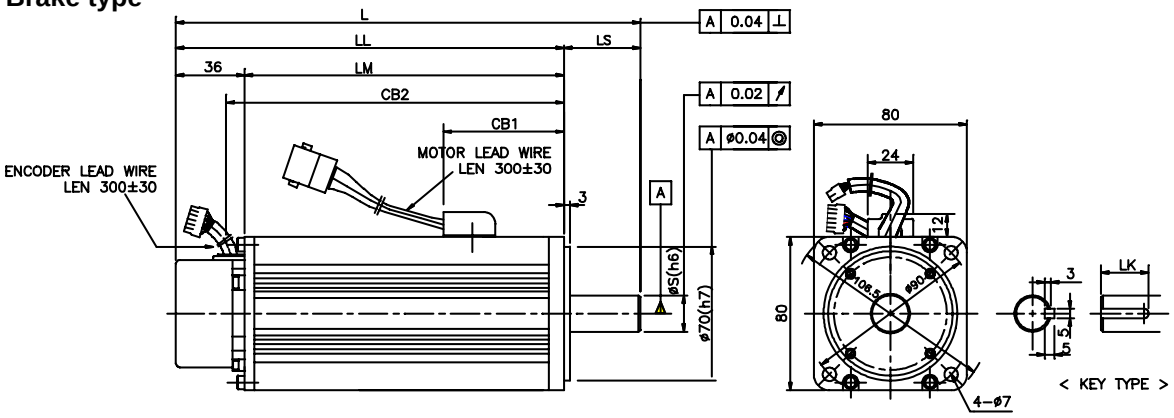
ENCODER CONNECTOR DIAGRAM

16.2.2 Flange 80 Series

Standard type

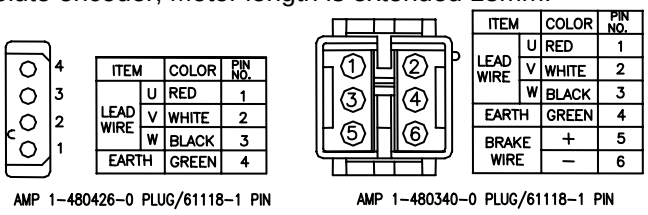


Brake type

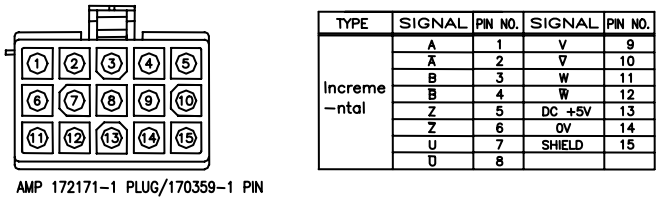


Model	External dementions					Key dimensions			Weight
	L	LL	LM	CB1	CB2	S	LS	LK	
CN04A, KN03	147(174)	112(139)	76(103)	(63)	(113)	14	35	20	2.1(2.9)
CN06, KN05	171(198)	131(158)	95(122)	(63)	(132)	16	40	25	2.6(3.3)
CN08, KN06	193(219)	153(179)	117(143)	(63)	(153)	16	40	25	3.1(3.9)
CN10, KN07	213(246)	173(206)	137(170)	(70)	(180)	16	40	25	3.7(4.6)

* Figures in ( ) indicate brake-attached type.
* Use DC 24V for brake input power supply.
* In case of applying absolute encoder, Motor length is extended 15mm.

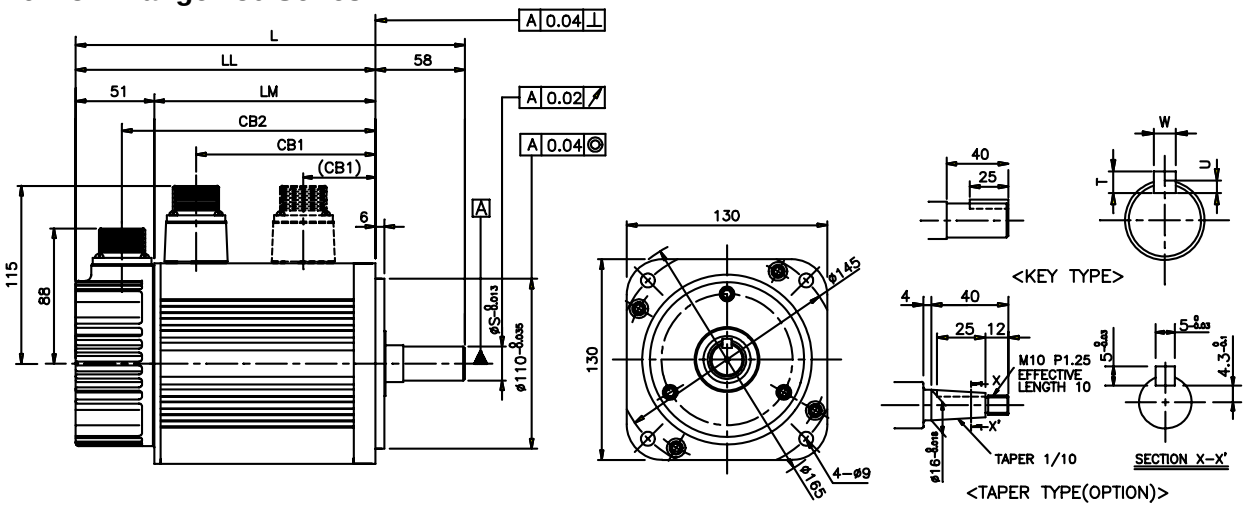


MOTOR CONNECTOR DIAGRAM



ENCODER CONNECTOR DIAGRAM

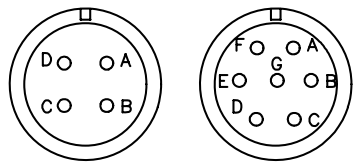
16.2.3 Flange 130 Series



(Dotted lines indicate position of brake-attached connectors)

Model				External dementions					Key dimensions				Weight
				L	LL	LM	CB1	CB2	S	T	U	W	
		TF05	LF03	269 (315)	211 (257)	160 (206)	132 (53)	180 (226)	19	5	3	5	8.2 (10.4)
	KF08			285 (325)	227 (267)	176 (216)	148 (53)	196 (236)	19	5	3	5	8.8 (11.0)
	KF10	TF09	LF06	325 (365)	267 (307)	216 (256)	188 (53)	236 (276)	19	5	3	5	11.6 (13.8)
	KF15	TF13	LF09	385 (425)	327 (367)	276 (316)	248 (53)	296 (336)	22	6	3.5	6	15.8 (18.0)
CN09	KN06A	TN05	LN03	207 (250)	149 (192)	98 (141)	70 (71)	118 (161)	19	5	3	5	5.5 (7.7)
CN15	KN11	TN09	LN06	231 (274)	173 (216)	122 (165)	94 (71)	142 (185)	19	5	3	5	7.0 (9.2)
CN22	KN16	TN13	LN09	255 (298)	197 (240)	146 (189)	118 (71)	166 (209)	22	6	3.5	6	8.5 (10.7)
CN30	KN22	TN17	LN12	279 (322)	221 (264)	170 (213)	142 (71)	190 (233)	22	6	3.5	6	10.0 (12.2)

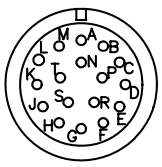
* Figures in ( ) indicate brake-attached type.
* Use DC 90V for brake input power supply.



MS3102A20-4P (STANDARD TYPE) MS3102A20-15P (BRAKE TYPE)

Motor Cable Connector Diagram

Item	Lead Wire Marking	PIN No.
Motor	U	A
	V	B
	W	C
	Ground	D
Brake	+	E
	–	F



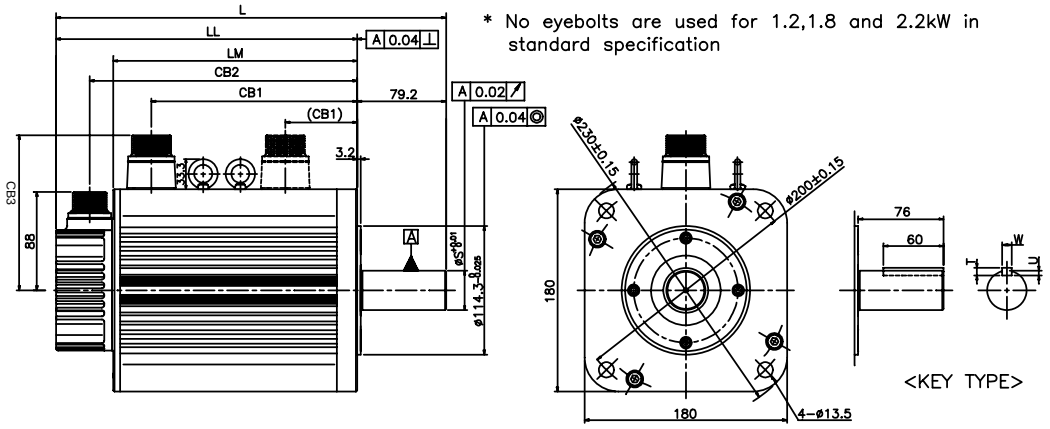
MS3102A20-29P

Encoder Signal	PIN No.	Encoder Signal	PIN No.
A	A	U	K
$\overline{A}$	B	$\overline{U}$	L
B	C	V	M
$\overline{B}$	D	$\overline{V}$	N
Z	E	W	P
$\overline{Z}$	F	$\overline{W}$	R
0V	G	SHIELD	J
+5V	H		

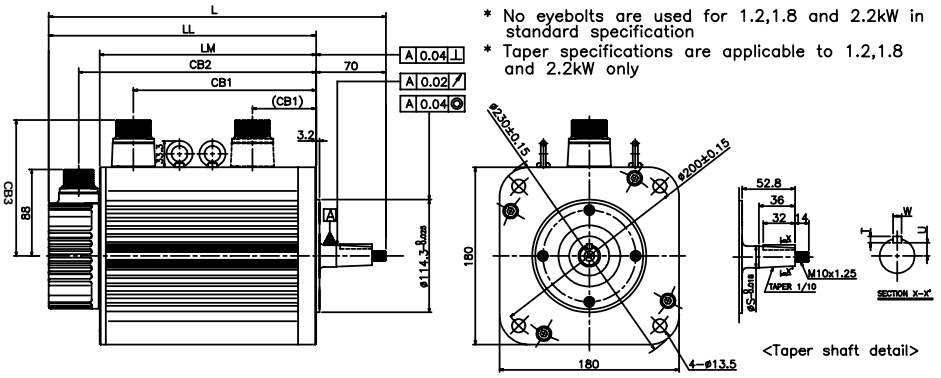
Encoder Cable Connector Diagram

16.2.4 Flange 180 Series

Straight Shaft(Standard) Type (Dotted lines indicate position of brake-attached connectors)

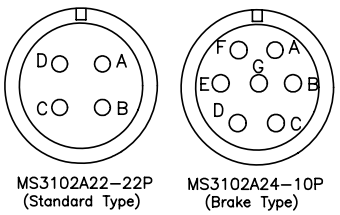


Taper Shaft(Standard) Type (Dotted lines indicate position of brake-attached connectors)



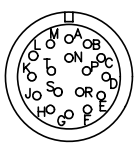
Model				External dementions						Key dimenstions				Weight
				L	LL	LM	CB1	CB2	CB3	S	T	U	W	
CN30A	KN22A	TN20	LN12A	265 (332)	186 (253)	135 (202)	102 (96)	156 (223)	138	24	5	3	5	12.9 (18.5)
	KN35	TN30	LN20	300 (367)	221 (288)	170 (237)	137 (96)	191 (258)	138	35	8	5	10	18.2 (24.0)
CN50A				310 (377)	231 (298)	180 (247)	147 (96)	201 (268)	138	35	8	5	10	19.9 (25.7)
	KN55	TN44	LN30	350 (417)	271 (338)	220 (287)	187 (96)	241 (308)	138	35	8	5	10	26.8 (32.5)
			LN40	410 (477)	331 (398)	280 (347)	247 (96)	301 (368)	138	35	8	5	10	36.1 (41.8)
		TN75		461 (527)	382 (448)	331 (397)	298 (96)	352 (418)	147	35	8	5	10	45.7 (51.4)
	KF22	TF20	LF12	347 (421)	268 (342)	217 (291)	181 (96)	238 (312)	138	35	8	5	10	17.2 (24.7)
	KF35	TF30	LF20	407 (476)	328 (397)	277 (346)	241 (96)	298 (367)	138	35	8	5	10	27.4 (34.9)
	KF50	TF44	LF30	507 (571)	428 (492)	377 (441)	341 (96)	398 (462)	138	35	8	5	10	38.3 (45.8)

*) Figures in ( ) indicate brake-attached type. *) Use DC 90V for brake input power supply. *)In case of Taper shaft, shaft length is shorted 9.2mm.



Motor Cable Connector Diagram

Item	Lead Wire Marking	PIN No.
Motor	U	A
	V	B
	W	C
	Ground	D
Brake	+	E
	–	F



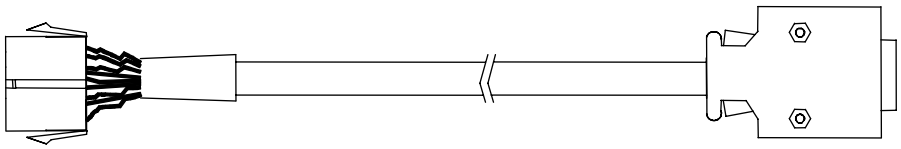
Encoder Signal	PIN No.	Encoder Signal	PIN No.
A	A	$\overline{U}$	K
$\overline{A}$	B	$\overline{U}$	L
B	C	V	M
$\overline{B}$	D	$\overline{V}$	N
Z	E	W	P
$\overline{Z}$	F	$\overline{W}$	R
0V	G	SHIELD	J
+5V	H		

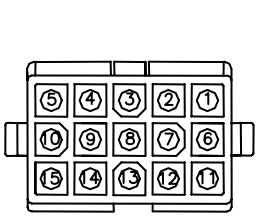
Encoder Cable Connector Diagram

17. Specifications of options

17.1 AC servo motor cable specifications

17.1.1 Encoder signal cable (Flange 60, 80 Series)

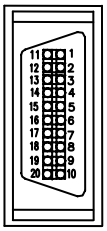




PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	A	9	V
2	$\overline{A}$	10	$\overline{V}$
3	B	11	W
4	$\overline{B}$	12	$\overline{W}$
5	Z	13	+5V
6	$\overline{Z}$	14	0V
7	U	15	SHIELD
8	$\overline{U}$		

AMP 172163-1 CAP/170361-1 PIN

<Motor side Connector>



PIN NO.	Encoder Signal	PIN NO.	Encoder Signal
1	W	11	$\overline{Z}$
2	$\overline{W}$	12	SHIELD
3	V	13	$\overline{B}$
4	$\overline{V}$	14	Z
5	U	15	$\overline{A}$
6	$\overline{U}$	16	B
7	–	17	–
8	–	18	A
9	0V	19	+5V
10	–	20	–

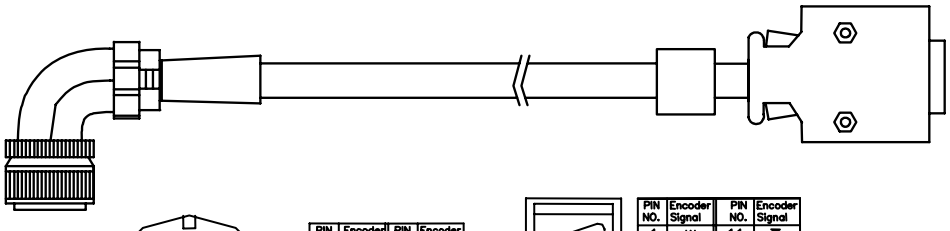
CONNECTOR 10120-3000VE 3M
CONNECTOR COVER 10320-52A0-008 3M

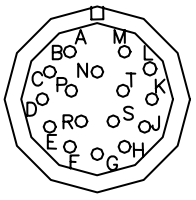
<Driver side Connector>

Order side(FCA_□□□□□)

Flange	Operating type				Non-operatig type			
	3m	5m	10m	20m	3m	5m	10	20m
60,80	EA03F	EA05F	EA10F	EA20F	EA03N	EA05N	EA10N	EA20N

17.1.2 Encoder singal cable (Flange 130,180 Series)

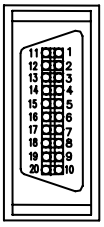




PIN No.	Encoder Signal	PIN No.	Encoder Signal
1	A	9	V
2	$\overline{A}$	10	$\overline{V}$
3	B	11	W
4	$\overline{B}$	12	$\overline{W}$
5	Z	13	+5V
6	$\overline{Z}$	14	0V
7	U	15	SHIELD
8	$\overline{U}$		

MS 3108B20-29S

<Motor side Connector>



PIN NO.	Encoder Signal	PIN NO.	Encoder Signal
1	W	11	$\overline{Z}$
2	$\overline{W}$	12	SHIELD
3	V	13	$\overline{B}$
4	$\overline{V}$	14	Z
5	U	15	$\overline{A}$
6	$\overline{U}$	16	B
7	–	17	–
8	–	18	A
9	0V	19	+5V
10	–	20	–

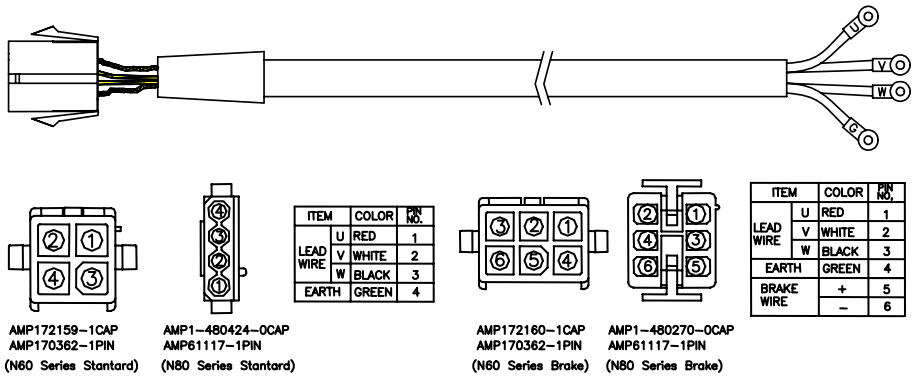
CONNECTOR 10120-3000VE 3M
CONNECTOR COVER 10320-52A0-008 3M

<Driver side Connector>
(FDA 5000 Series)

Order code(FCA_□□□□□)

Flange	Operating type				Non-operating type			
	3m	5m	10m	20m	3m	5m	10	20m
130,180	FC03F	FC05F	FC10F	FC20F	FC03N	FC05N	FC10N	FC20N

17.1.3 Power cable for motor (Flange 60,80 Series)

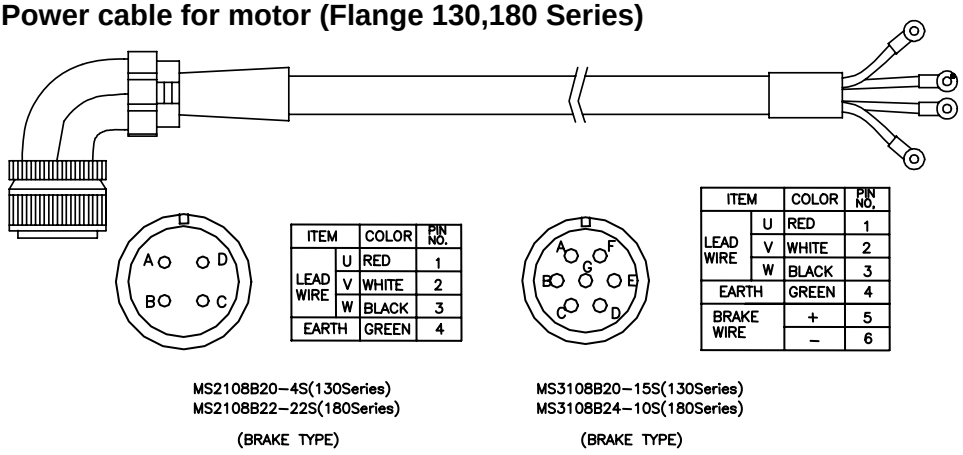


Motor Cable Connector Diagram

Order code(FCA–□□□□□)

Flange	Type	Operating type				Non-operating type			
		3m	5m	10m	20m	3m	5m	10	20m
60	Standard	SA03F	SA05F	SA10F	SA20F	SA03N	SA05N	SA10N	SA20N
	Brake	BA03F	BA05F	BA10F	BA20F	BA03N	BA05N	BA10N	BA20N
80	Standard	SB03F	SB05F	SB10F	SB20F	SB03N	SB05N	SB10N	SB20N
	Brake	BB03F	BB05F	BB10F	BB20F	BB03N	BB05N	BB10N	BB20N

17.1.4 Power cable for motor (Flange 130,180 Series)



Motor Cable Connector Diagram

Order code(FCA–□□□□□)

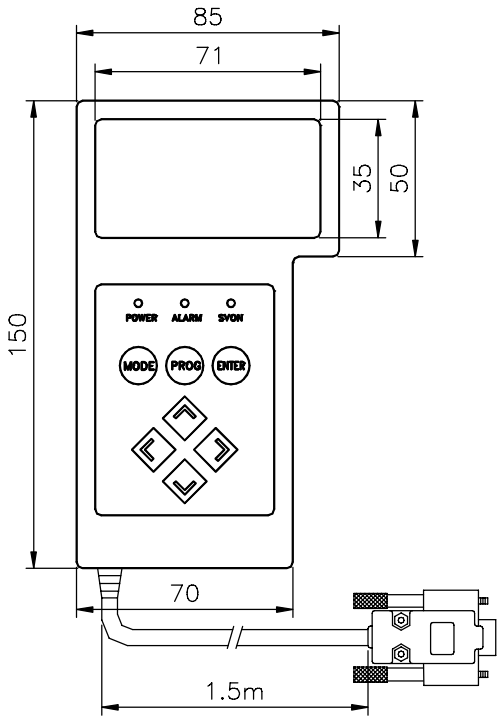
Flange	Type		Operating type				Non-operating type			
			3m	5m	10m	20m	3m	5m	10	20m
130	Standard		SC03F	SC05F	SC10F	SC20F	SC03N	SC05N	SC10N	SC20N
	Brake		BC03F	BC05F	BC10F	BC20F	BC03N	BC05N	BC10N	BC20N
180 (5.5Kw)	Standard	①	SD03F	SD05F	SD10F	SD20F	SD03N	SD05N	SD10N	SD20N
		②	SE03F	SE05F	SE10F	SE20F	SE03N	SE05N	SE10N	SE20N
180 (7Kw~)	Standard	③	SF03F	SF05F	SF10F	SF20F	SF03N	SF05N	SF10N	SF20N
180	Brake	①	BD03F	BD05F	BD10F	BD20F	BD03N	BD05N	BD10N	BD20N
		②	BE03F	BE05F	BE10F	BE20F	BE03N	BE05N	BE10N	BE20N

Note) Application ①:1.2~3.5kW , ②:4.4~5.5Kw, ③:7Kw~

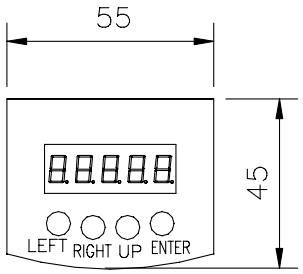
Power cable model for above 7Kw : MS3108B32-17S

17.2 AC servo driver

17.2.1 Digital loader (Order code No.: FDA500004S)

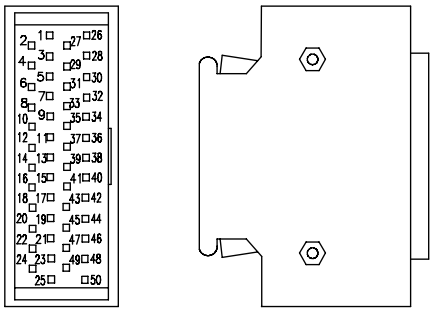


17.2.2 Mount loader (Order code No.: FDA500005S)



17.2.3 CN1 Connector (Order code No.: FDACON50P-3M)

Item No.: 10150-3000VE,10350-52A0-008,Maker:3M



17.2.4 Noise Filter

AC Servo drive	FDA-5001~5005	FDA-5010	FDA-5015	FDA-5020	FDA-5030	FDA-5045	FDA-5075
NOISE FILTER	NFZ-4030SG					NFZ-4040SG	NFZ-4050SG

17.2.5 Power unit for brake

Item No.: BPU-109A

Input: Singal phase AC200~220[V]

Output: DC24[[V](60,80 Series), DC90[V](130,180 Series)

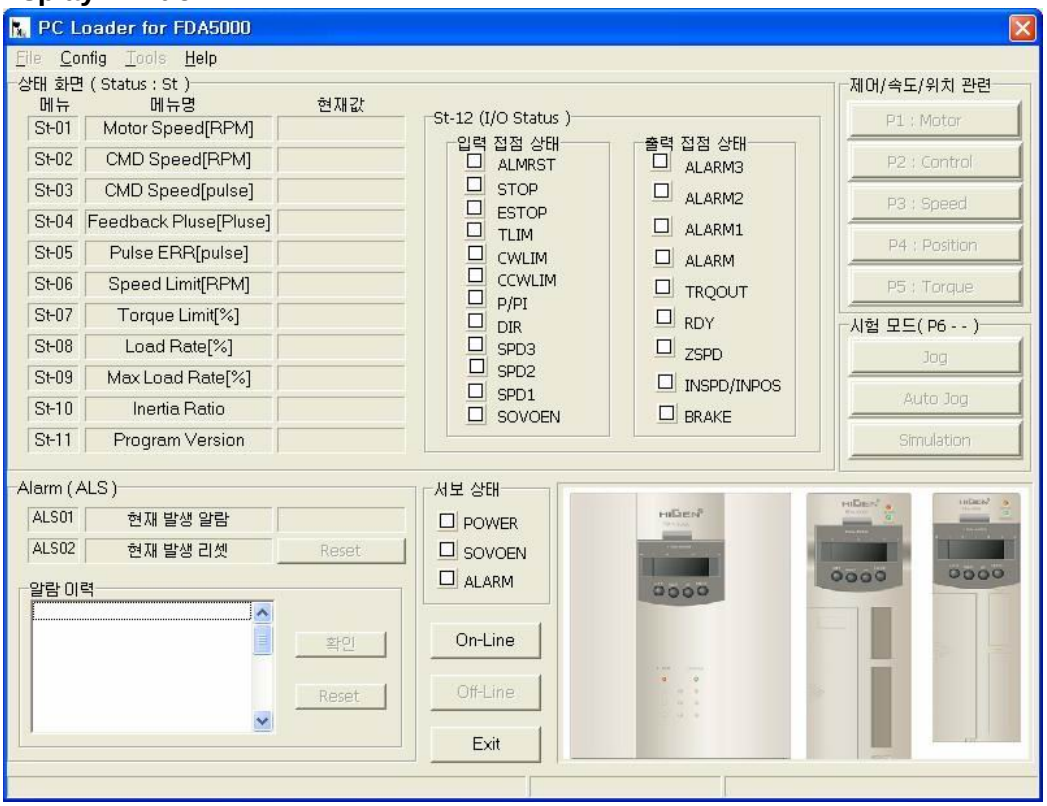
17.2.6 PC Loader (RS232C PC Communication Software)

Order code No : FDA500007S)

☞ **Main Features**

① **Current status display function(motor speed, load rate, etc.)**
② **Alarm status display function**
③ **I/O status display function**
④ **Convenient mode change and parameter change**
⑤ **Auto jog test function**

☞ **Display Window**



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Order NO : 702003121