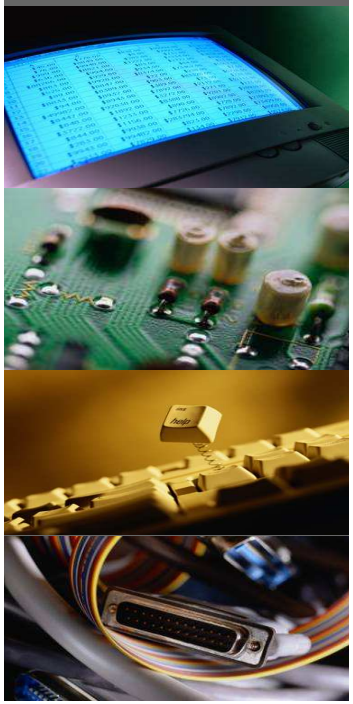
L7S Series Guidebook



09.Mar,2015

Technical support team

LS Mecapion

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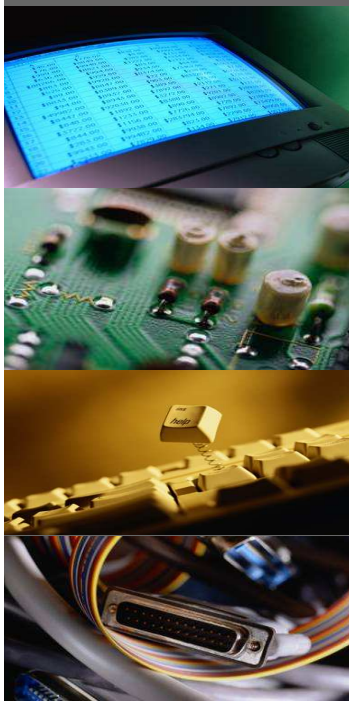


09.Mar,2015

Technical support team/Eric Son

LS Mecapion

Contents

Motor Model

Model Name

APM – FB 04 A M N 2

Servo Motor

Motor Shape
- S : Solid shaft
- H : Hollow shaft
- B : Assembly
- F : Flat
- L : L7 only

Flange Size
- A : 40 Flange
- B : 60 Flange
- C : 80 Flange
- D : 100 Flange
- E : 130 Flange
- F : 180 Flange
- G : 220 Flange
- H : 250 Flange
- J : 280 Flange

Motor Capacity
- R3 : 30[W]
- R5 : 50[W]
- 01 : 100[W]
- 02 : 200[W]
- 03 : 300[W]
- 04 : 400[W]
- 05 : 450[W]
- 06 : 550/600[W]
- 07 : 650[W]
- 08 : 750/800[W]
- 09 : 850/900[W]
- 10 : 1.0[kW]
- ⋮
- 150 : 15.0[kW]
- 220 : 22.0[kW]
- 300 : 30.0[kW]
- 370 : 37.0[kW]

Rated RPM
- A : 3000 [rpm]
- D : 2000 [rpm]
- G : 1500 [rpm]
- M : 1000 [rpm]

Shaft Cross-section
- N : Straight
- K:One-sided round key(Standard)
- D : D Cut
- T : Tapering
- R:Double-sided round key
- H : Hollow Shaft

Encoder Type

Quadrature(Pulse Type)
- A : Inc. 1024 [P/R]
- B : Inc. 2000 [P/R]
- C : Inc. 2048 [P/R]
- D : Inc. 2500 [P/R]
- E : Inc. 3000 [P/R]
- F : Inc. 5000 [P/R]
- G : Inc. 6000 [P/R]

Serial Biss (Communication Type)
- N : 19bit S-Turn Abs.
- M : 19bit M-Turn Abs.

(18bit SA M-Turn Abs)

Oil Seal and Brake

Non-existent :None included
- 1 : Oil Seal attached
- 2 : Brake attached
- 3 : Oil Seal, Brake attached

Drive Model

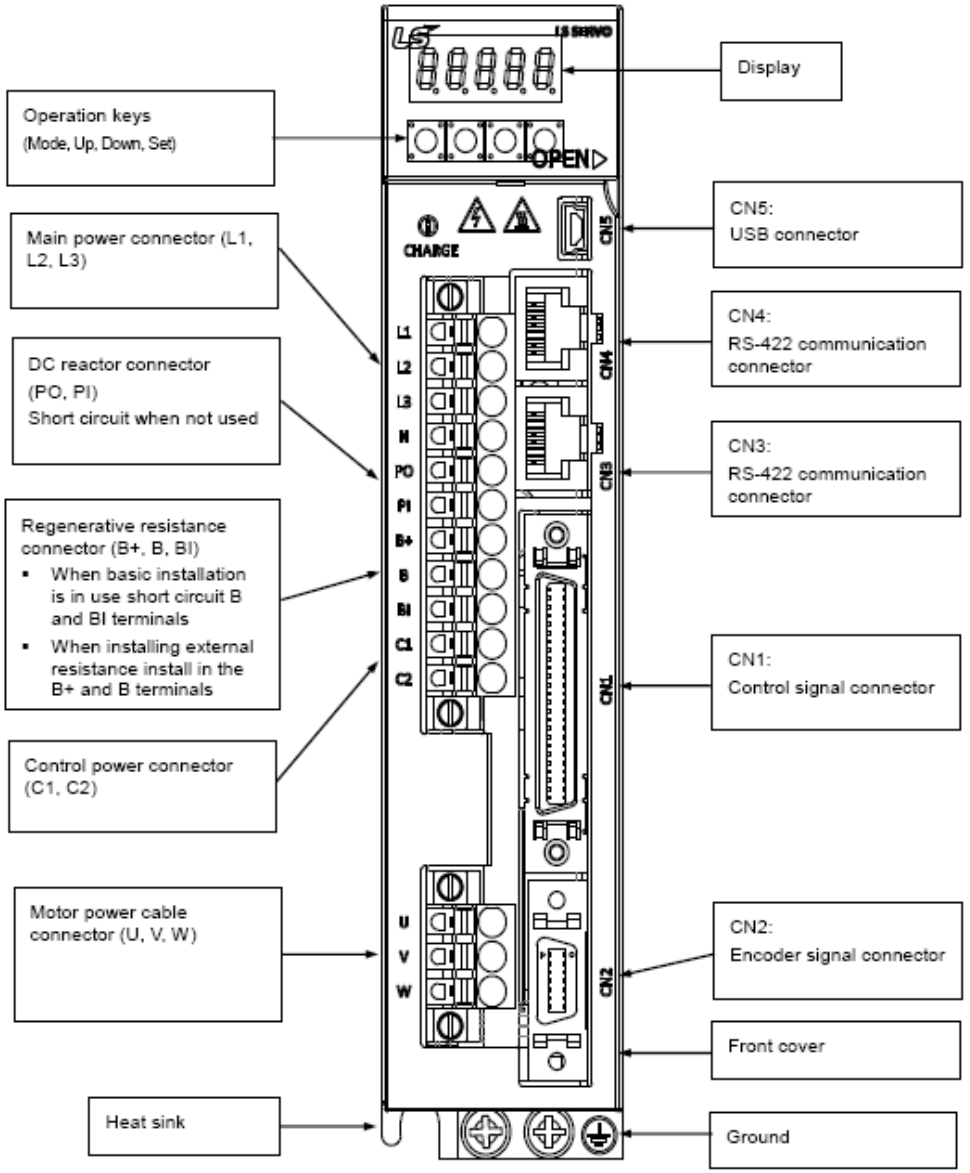
Model Name

L7 S A 004 B

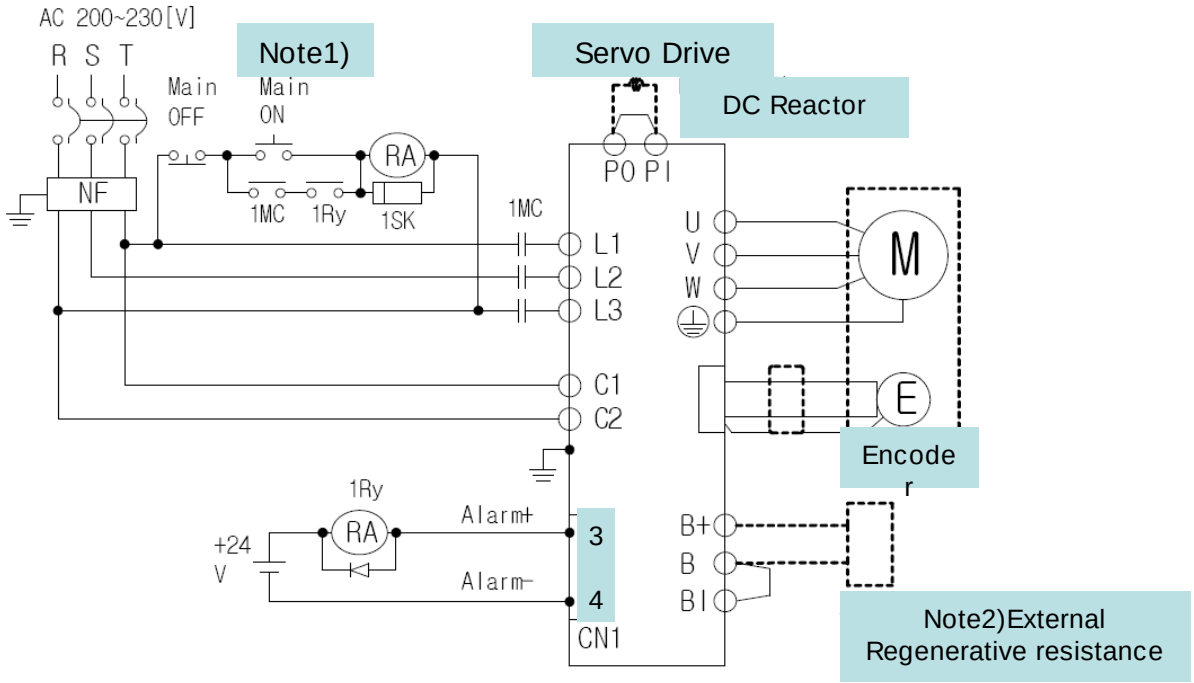
Series Name	Communication Type	Input Voltage	Capacity	Encoder Type
Servo Series L7 : L7 VS : VS VP : VP	S: Standard I/O Type N : Network Type	A : 220Vac B : 400Vac	001 : 100W 002 : 200W 004 : 400W 008 : 750W 010 : 1.0Kw 020 : 2.0kW 035 : 3.5Kw 050 : 5.0kW 150 : 15.0KW	A: Incremental B: Serial (Communication Type)

Drive part name

Part name



Power Supply Wiring

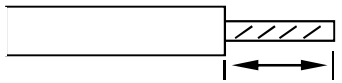


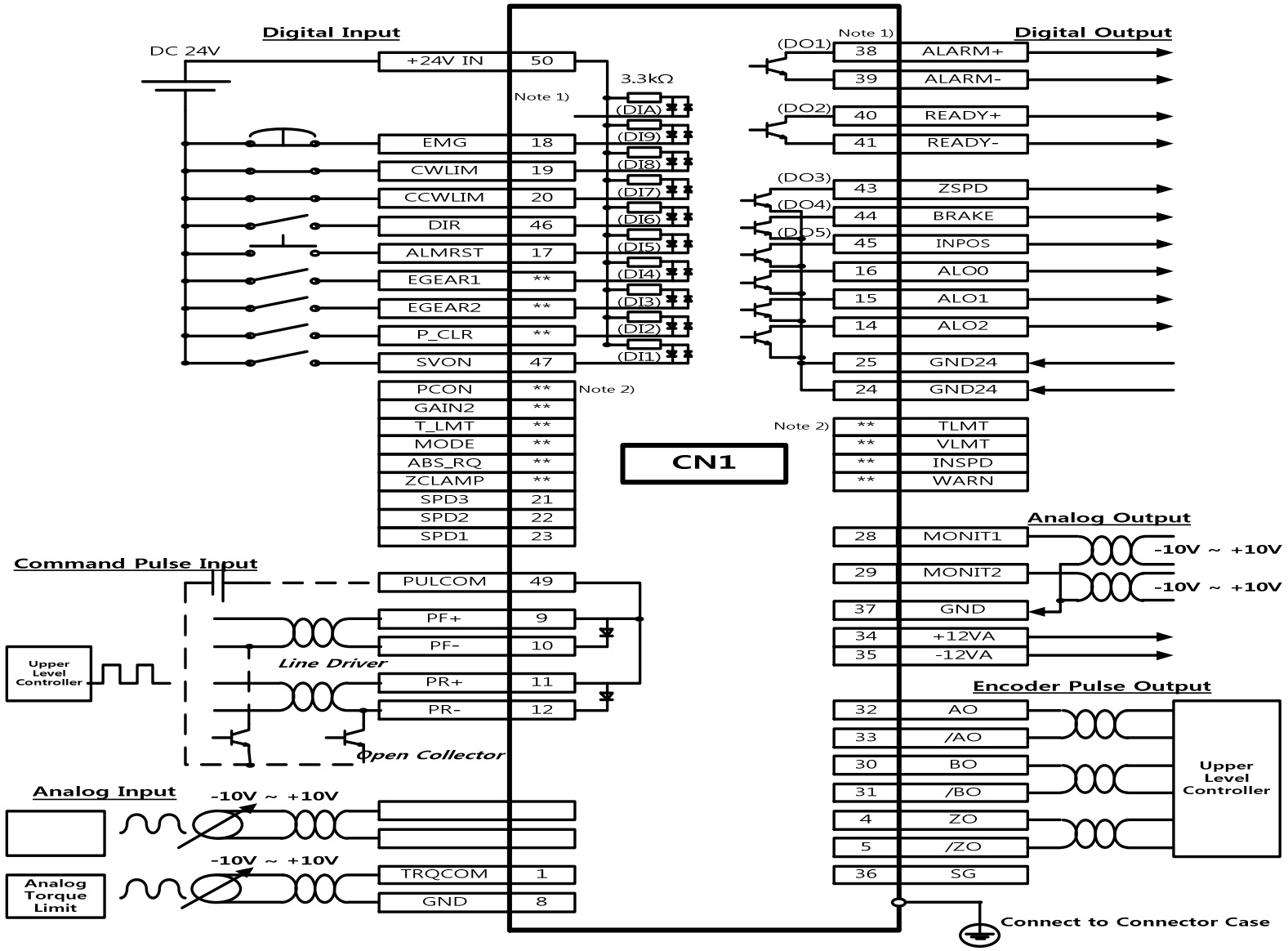
Note1) It takes approximately one to two seconds to output an alarm signal after turning on the main power(3Phase AC220V). Accordingly, press and hold the main power ON switch for at least two seconds.

Note2) Check the B and BI short-circuit terminals and the L7NA001B-L7NA004B (50 W, 100 Ω), L7NA008B ~ L7NA010B (100 W, 40 Ω), and L7NA020B ~ L7NA035B (150 W, 13 Ω) regenerative resistors before use. If the regenerative capacity is high because of frequent acceleration and deceleration, open the short-circuit pins (B , BI) and connect an external regenerative resistor to B and B+

주3) Remove approximately 7-10 ㎜ of the sheathing from the cables for the main circuit power and attach crimp terminals. (Maker : SEOIL)

100[W]~400[W] : UA-F1510, 800[W] ~400[W]: UA-F2010, 2[kW] ~3.5[kW]: UA-F4010

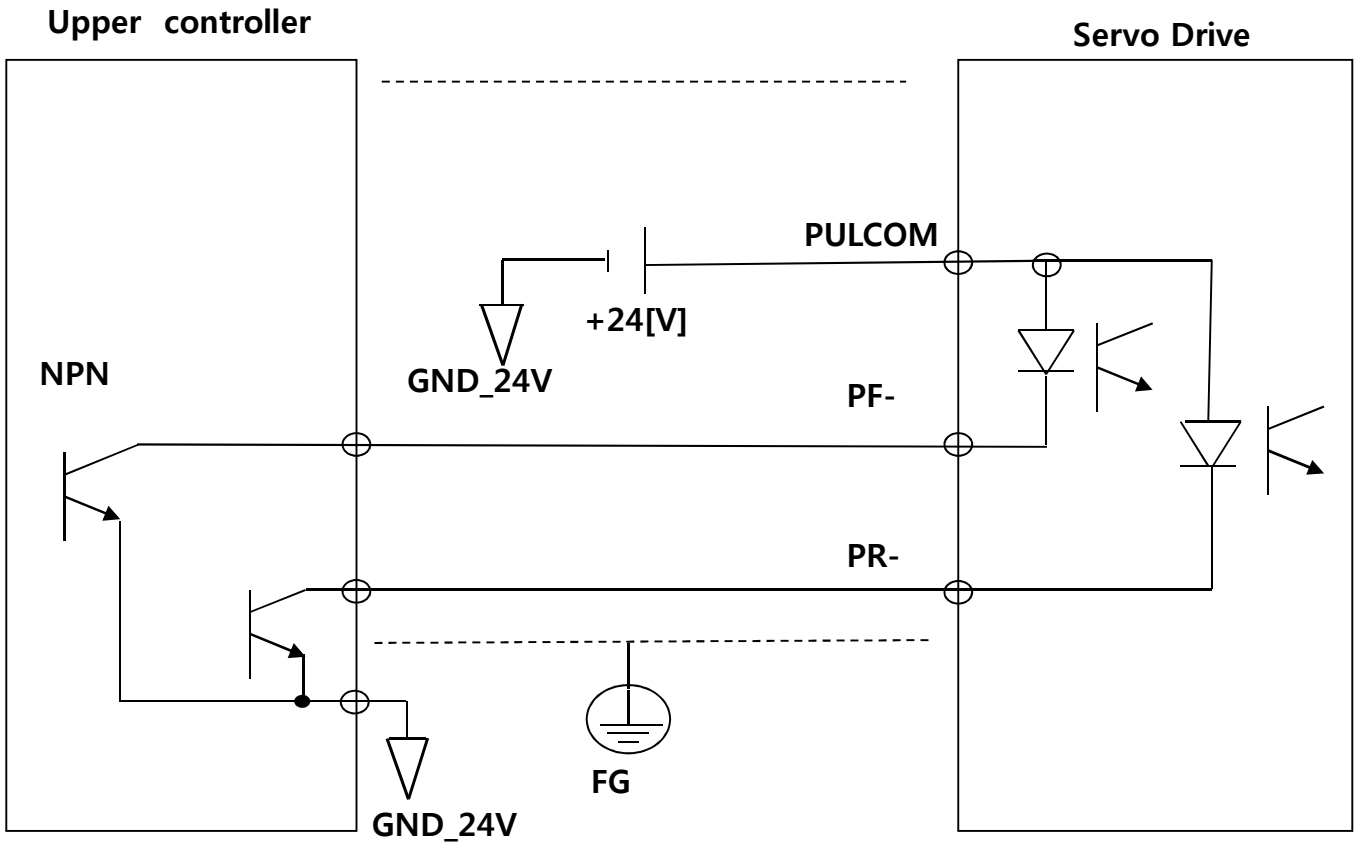




Note 1) Input signals DI1 to DIA and output signals DO1 to DO5 are default signals allocated by the factory.
Note 2) ** These are non-allocated signals. You can change their allocation by setting parameters. For more information, refer to "4.1.6 External Input Signal and Logic Definition" and "4.1.8 External Output Signal and Logic Definition."

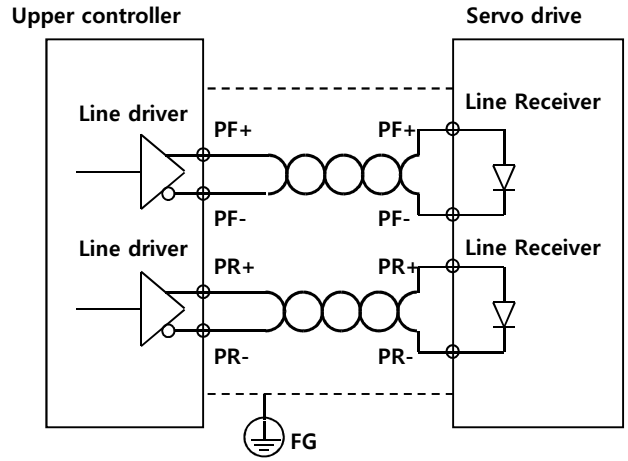
Pulse Input Wiring Diagram(1/2)

24V Open Collector



Pulse Input Wiring Diagram (2/2)

5V Line Driver

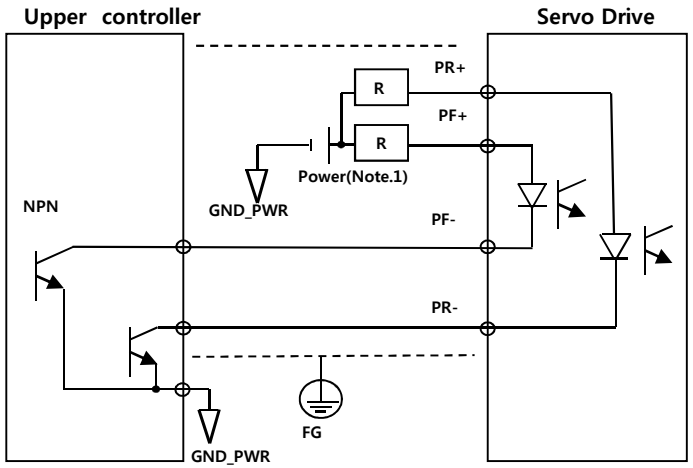


☞ Only using PF+,PF-,PR+,PR-

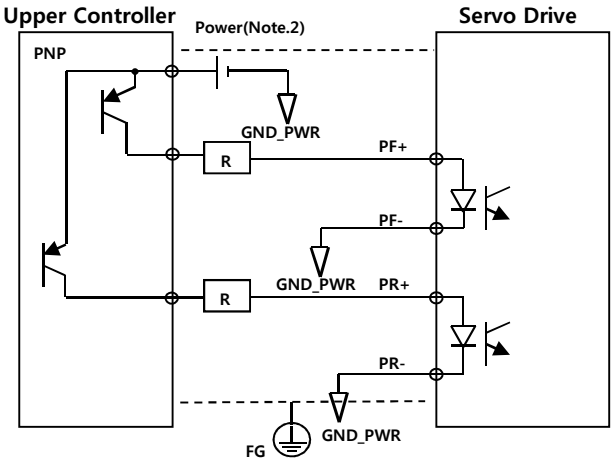
Nowadays, Mostly, using for Line Driver mode due to strong point for Noise

(Note.1, Note.2)
Power 24[V] : Resistor R = 1500 [Ω]
Power 12[V] : Resistor R = 560 ~ 680 [Ω]
Power 5[V] : Resistor R = 100 ~ 150 [Ω]

NPN Open Collector



PNP Open Collector



(Notice)

▶ In the case of wrong parameter set, Motor will rotate in high speed or vibrate. And, it causes burning of Motor

Motor ID [P0-00]

1. then motor constant can be automatically set
2. ID is displayed on Motor Label

Encoder Type [P0-01]

No.	Types	Signal Mode	Signal types	Remark
0	Incremental Parallel	A Phase Lead 15Lines	A,B,Z,U,V,W	
1	SingleTurn Absolute Serial	Biss Serial	Serial Type	
3	MultiTurn Absolute Serial	Biss Serial	Serial Type	

Encoder Pulse [P0-02]

1. Set Encoder Pulse Number
2. Encoder Pulse Number is displayed on Motor Label

(Notice) Serial type : Set the number of bits per turn from Encoder
Incremental type : Set the number of Encoder pulse

(Note) Set Pulse Logic Parameter in Servo-off

Operation Mode [P0-03]	"2" (Position Mode) Set

Operation mode	Operation mode
0	Torque control operation
1	Speed control operation
2	Position control operation
3	MODE contacts ON : Speed control operation MODE contacts OFF : Position control operation
4	MODE contacts ON : Speed control operation MODE contacts OFF : Torque control operation
5	MODE contacts ON : Position control operation MODE contacts OFF : Torque control operation

(Note) Set Pulse Logic Parameter in Servo-off

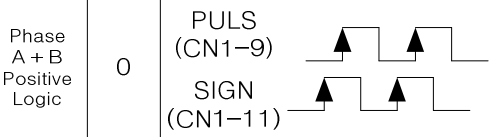
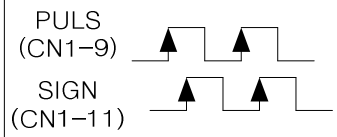
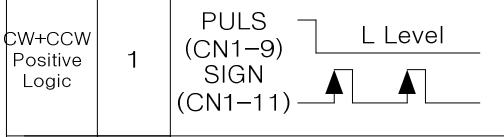
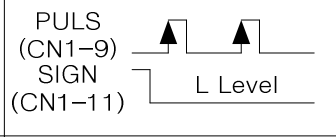
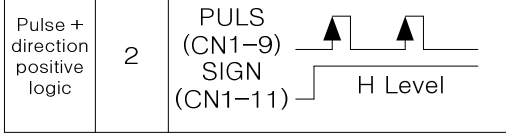
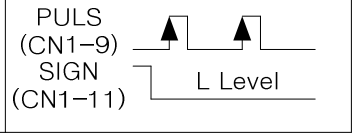
Pulse Logic Set(1/2)

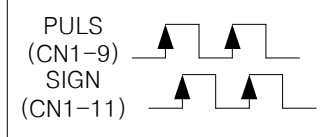
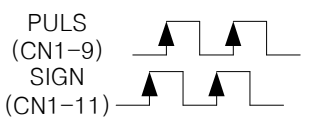
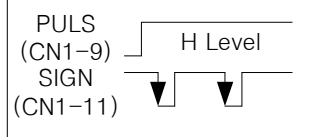
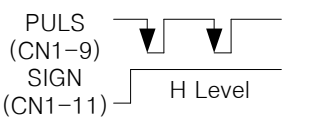
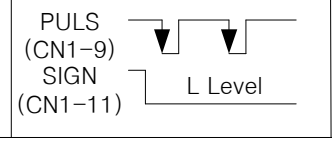
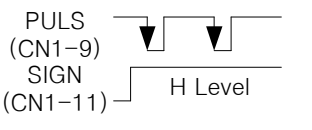
Input Pulse Logic Set [P4-00]

Logic Set as below

The Pulse output mode of Upper controller must match with Pulse input mode of Servo Drive

▶ Pulse Logics

PF + PR		Forward rotation	Reverse rotation
Phase A + B Positive Logic	0		
CW+CCW Positive Logic	1		
Pulse + direction positive logic	2		

PF + PR		Forward rotation	Reverse rotation
Phase A + B Negative Logic	3		
CW+CCW Negative Logic	4		
Pulse + direction negative logic	5		

(Note) Set Pulse Logic Parameter in Servo-off

Pulse Logic Set(2/2)

▶ Pulse Logic & Positioning Module Set

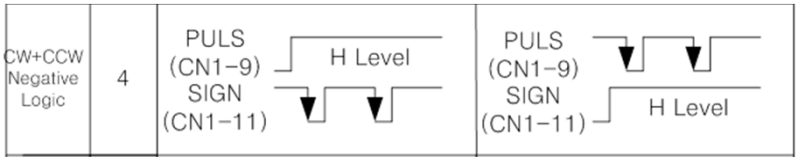
Positioning Module: XBF-PD02A (Line-Driver, 2-Axis)

	Item	X Axis	Y Axis
Basic Parameter	Pulse Output Level	0: Low Active	0: Low Active
	Pulse Output Mode	0: CW/CCW	0: CW/CCW
	MCode Output Mode	0: None	0: None
	Bias Speed	1 pls/s	1 pls/s
	Speed Limit	2000000 pls/s	2000000 pls/s
	ACC No.1	500 ms	500 ms
	DEC No.1	500 ms	500 ms
	ACC No.2	1000 ms	1000 ms
	DEC No.2	1000 ms	1000 ms
	ACC No.3	1500 ms	1500 ms
	DEC No.3	1500 ms	1500 ms
	ACC No.4	2000 ms	2000 ms
	DEC No.4	2000 ms	2000 ms
	S/W Upper Limit	2147483647 pls	2147483647 pls
	S/W Lower Limit	-2147483648 pls	-2147483648 pls
	Backlash Compensation	0 pls	0 pls
	S/W Limit Detect	0: No Detect	0: No Detect
	Pos. Comp. Condition	0: Dwell	0: Dwell
	Upper/Lower Limit	1: Use	1: Use
Home/ Manual Parameter	Home Method	0: DOG/HOME(OFF)	0: DOG/HOME(OFF)
	Home Direction	1: CCW	1: CCW
	Home Address	0 pls	0 pls
	Home High Speed	5000 pls/s	5000 pls/s
	Home Low Speed	500 pls/s	500 pls/s
	Home compensation	0 pls/s	0 pls/s
	Homing ACC Time	1000 ms	1000 ms

Position Parameter | X-Axis Data | Y-Axis Data

OK | Cancel

1. Pulse Output Level : Low Active
2. Pulse Output Mode : CW/CCW
=>
The positioning Module of the left picture is Pulse Logic No.4 on Servo Drive



■ Electronic Gear Set(1/2)

1. **Actual Pulse of Operating Motor = Command Pulse of Upper controller x (Electronic gear ratio numerator/Electronic gear ratio denominator)**

2. **When upper controller commands 1 pulse, The necessary Scale Factor to travel basic position For example, The scale factor to travel 1[um] Per 1 Pulse of command**

Electronic gear ratio numerator [P4-01]	Actual value set
Electronic gear ratio denominator [P4-05]	Actual value set

You need to know in order to set the Electronic Gear

No	List	Contents	Remark
1	Machine Spec	Ball screw type, Turn Table, Roller	Ball screw type : Pitch, Roller : Roller Diameter
2	Deceleration ratio	In the case of using of reducer	Pulley ratio in the case of Pulley
3	Encoder Pulse Number	Applied Encoder Pulse Number	19 bit Serial : 524288 (=2^19), Inc 3000 : 12,000 (= 3000 x 4)
4	Command unit	Travel per 1 Pulse	degree or mm

(Note) Set Pulse Logic Parameter in Servo-off

Electronic Gear Set (2/2)

Example for Electronic gear set

No	List	Machine Configuration		
		Ball Screw	Turn Table	Belt+Pulley
1	Machine Spec	Ball Screw Pitch : 5 [mm]	Degree per rotation : 360^0	Pulley Diameter : 100 [mm] (Pulley Circumference : 314 [mm])
2	deceleration ratio	1/1	1/100	1/50
3	Encoder Pulse	19bit (= 524,288)	19bit (= 524,288)	19bit (= 524,288)
4	Command Unit	0.001 [mm] (= 1 [um])	0.01^0	0.005 [mm] (= 5 [um])
5	Travel per rotation of load axis (= Machine spec / Command Unit)	5000 (= 5 / 0.001)	36000 (= 360 / 0.01)	62800 (= 314 / 0.005)
6	Electronic gear (= (Encoder Pulse number/Travel per rotation of load axis) * (1/deceleration ratio))	Electronic gear = (524288/5000)*(1/1)	Electronic gear = (524288/36000)*(100/1)	Electronic gear = (524288/62800)*(50/1)
7	Parameter Set	Electronic gear ratio numerator = 524,288 Electronic gear ratio denominator= 5,000	Electronic gear ratio numerator = 52,428,800 Electronic gear ratio denominator = 36,000	Electronic gear ratio numerator = 2,621,4400 Electronic gear ratio denominator = 62,800

(Tip) If Electronic gear ratio is 2, "2" = 100(numerator)/50(denominator) = 2(numerator)/1(denominator)

Position command frequency

1. Position command frequency = (*Encoder pulse number x Motor speed[r/min])/(60*Electric gear ratio)
   *Incremental Encoder = Encoder pulse number X 4
   *Serial Encoder = Actual Encoder pulse number (19bit = 524288)

- Input frequency of L7S Drive : 1Mpps.
- LSIS XGF-PO*H(Open collector) : Maximum output pulse 500kpps,
  XGF-PD*H(Line Driver) : Maximum output pulse 4Mpps

* In the use of Positioning module XGF-PD*H, Set as output pulse 1Mpps
When output pulse exceeds 1Mpps, Motor is operated abnormally. (The speed is too slow)

Ex) Encoder pulse :19bit Rated speed : 3000rpm. Not use electric gear ratio in the drive
=> Motor speed is operated below approximately 115rpm
*Motor speed = (position command frequency/Actual encoder pulse number)*60*Electric gear ratio

To operate rated seed 3000rpm, use electric gear ratio in the drive
Electric gear ratio numerator : 524288, Electric gear ratio denominator : 20,000
Position command frequency = (524288 x 3000)/(60*(524288/20000) = 1Mpps

Gain Tuning

1. In the case of Cascade type Controller, Inner Loop(Speed Control) -> Outer Loop(Position Control)

2. Proportional Gain -> Integral Gain -> Feedforward Gain

- **Proportional Gain (Controller BW)** : The Slope to reach command value

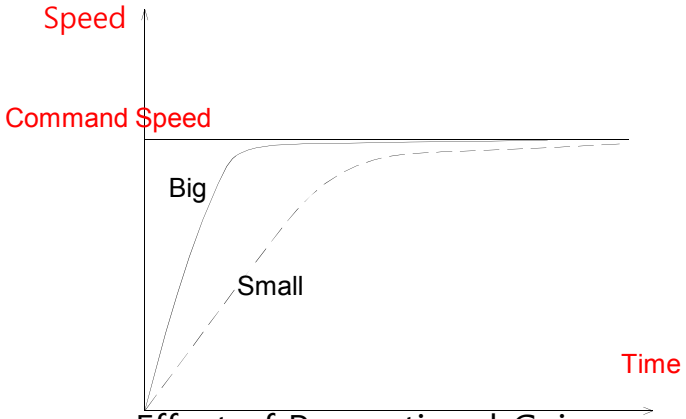
  If Proportional gain is big, the slope is steep.

  That's to say, response is fast.

- **Integral gain(Steady-state error, Overshoot occurrence)**

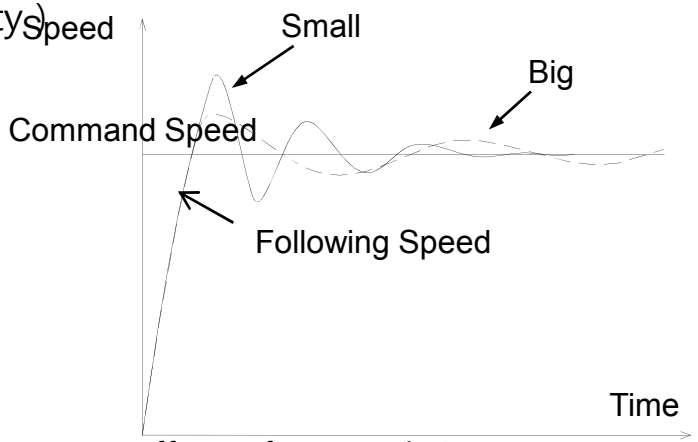
  Notice 1) For L7 series. Using Integral time constant instead of Integral gain. To increase Integral gain, decrease Integral time constant

- **Feedforward Gain**(Improvement of System Lag Quality)



< Effect of Proportional Gain>

If the proportional gain is low,
the slope corresponding to the command is slow



<Effect of Integral time constant>

If we reduced I tc, speed following characteristic can be improved as excessive response characteristic is improved. But if it is too small, overshoot would be occurred.

Set the gain as below ordering

1. Inertia : [P1-00]

- Using Auto tuning : [Cn-05]
- Manual Set : [P1-00]

2. Speed Proportional Gain : [P1-06]

- Increase step by step (Increase 50 per step)
- If noise or vibration occurs, decrease 50 per step from current value

3. Speed Integral Time Constant : [P1-08]

- Increase step by step (Increase 1 per step)
- After monitoring OverShoot and Steady-state error, if Oversh0oot occurs, increase 10per step.

Note) If overshoot occurs when Integral gain increase, using for P/PI Converstion Mode

4. Speed feedback filter : [P1-11]

- Using for reducing Vibration and Noise
- Increase step by step (Increase 1 per step) till no vibration

Set the gain as below ordering

1. Position Proportional Set : [P1-01]

- Increase step by step (Increase 10 per step)
- If noise or vibration occurs, decrease 10 per step from current value

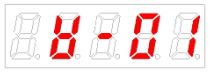
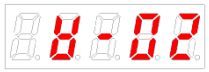
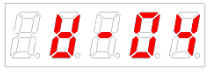
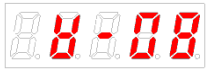
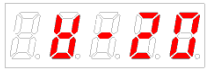
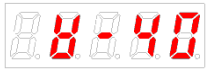
2. Position Feedforward Set : [P1-04]

- Increase step by step (Increase 10 per step)
- As monitoring Pulse Error(st-05), to set the value in order to be minimum value.

3. Position Command & Feedforward filter : [P1-03,05]

- Set the filter if noise occurs after you increase feedforward gain

8. Warning Alarm

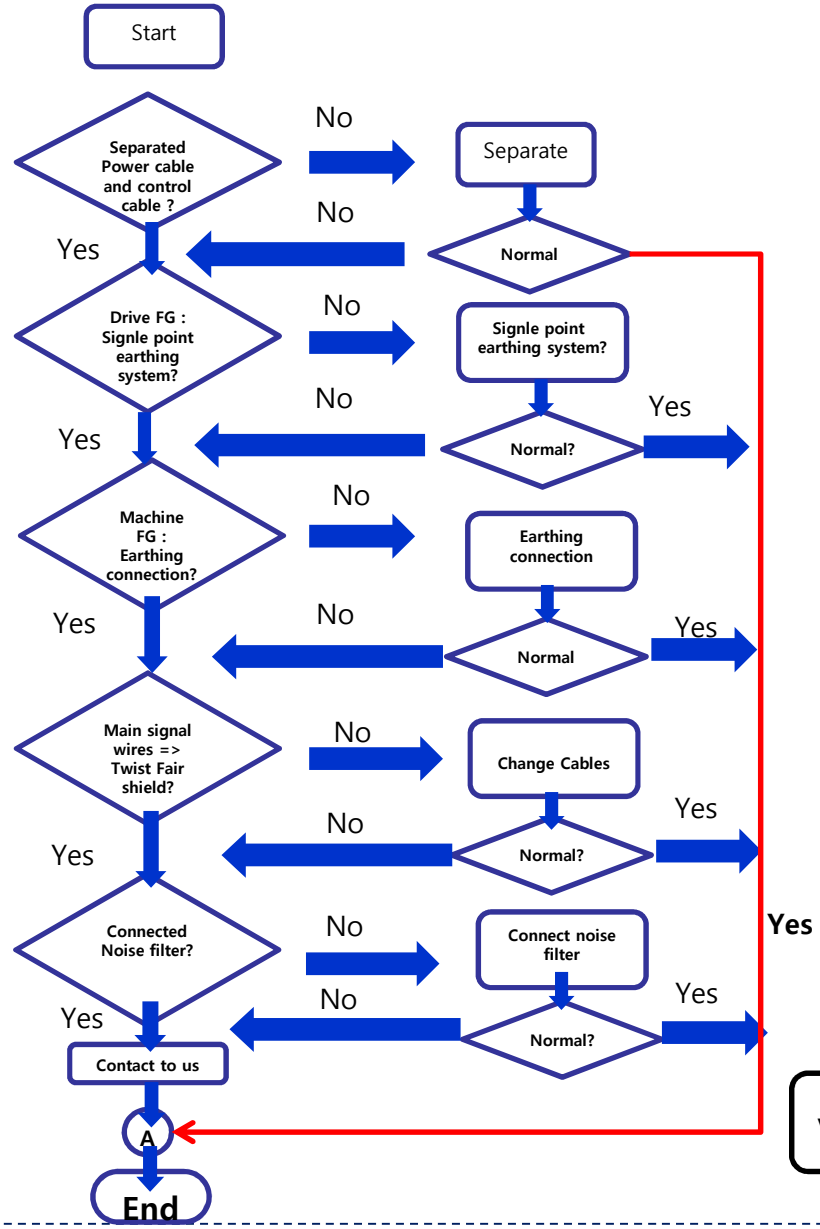
(CODE)	Name	Reason of Alarm	Checking Point
	RST_PFAIL	Open Phase of Main Power	When [P0-06]DIGIT2 is set as 1, Power is not applied
	LOW_BATT	Shortage of Battery	
	OV_TCMD	Over Torque Command	Input over torque command
	OV_VCMD	Over Speed Command	Input over speed command
	OV_LOAD	Warning for overload	Over the range of Max. Setting overload [P0-13]
	SETUP	Selection of Motor	Motor capacity is bigger than Drive
	UD_VTG	Warning for low voltage	When [P0-06] DIGIT2 is set as 1 DC-link voltage is lower than 190V
	EMG	EMG Conatact	I/O Wiring & [P2-09] setting checking

◆ Warning is not saved on History of L7 Drive. And when 2 kinds of warning alarm is occurred added value is displayed .

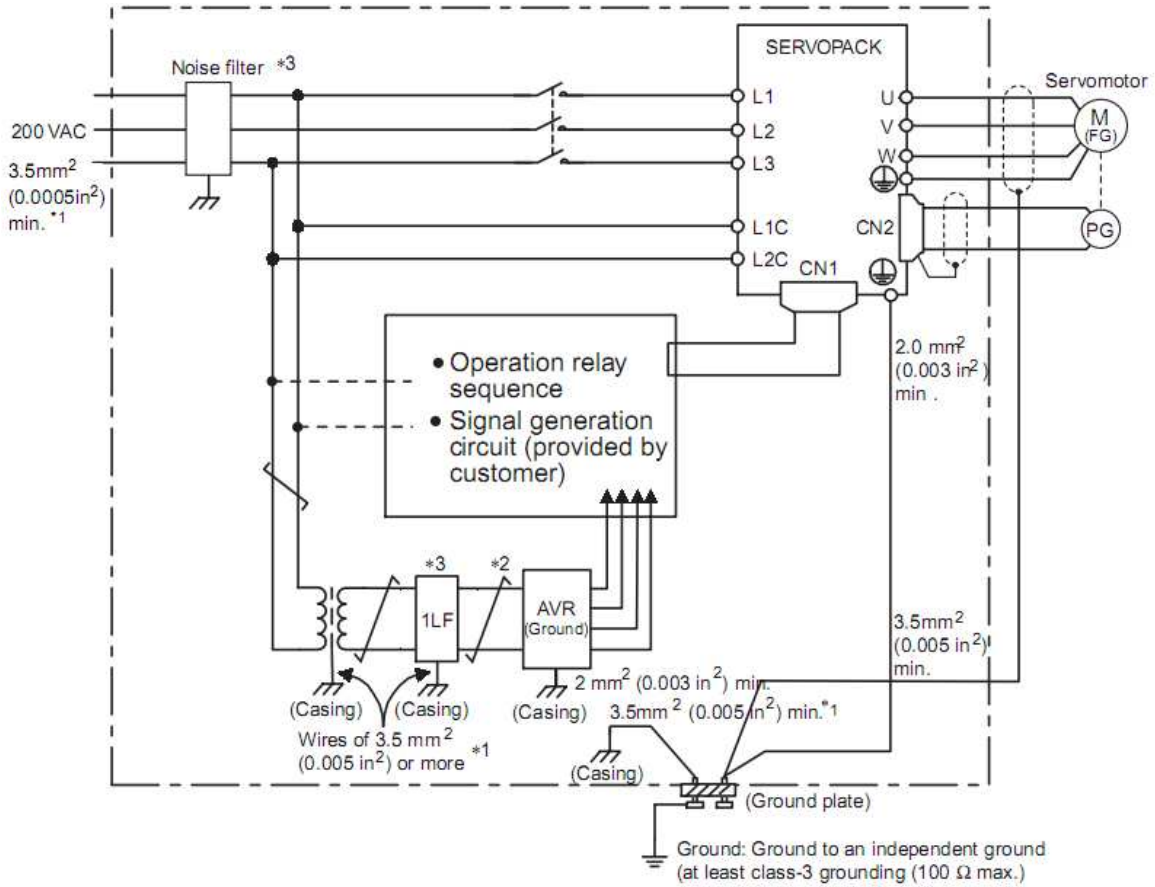
ex) [W-41] = [W-01] + [W-40] = Open phase of main power + Warning for Low voltage

Check Process to solve out Noise

Action for abnormal situation

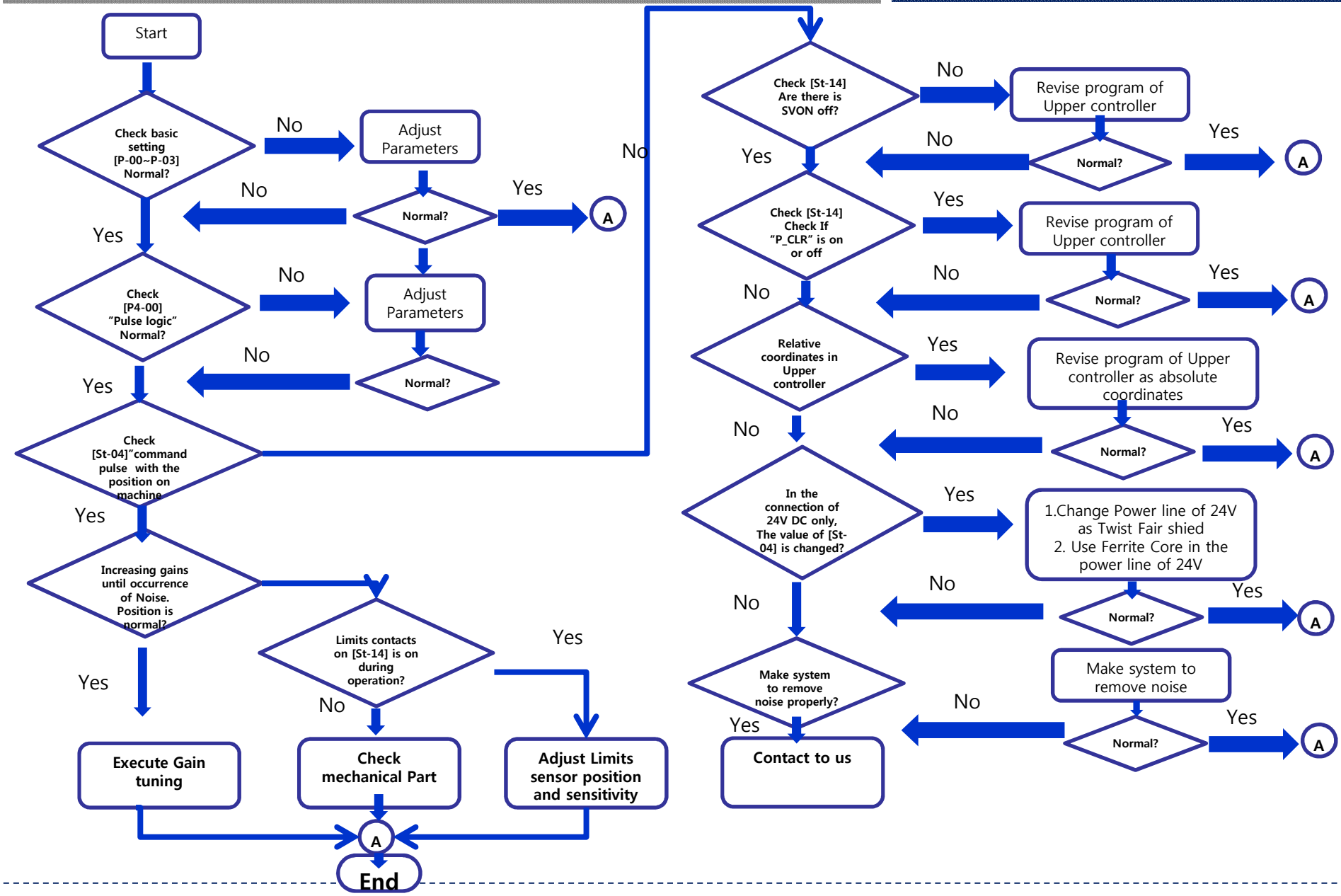


Main Signal: Voltage line, Pulse line



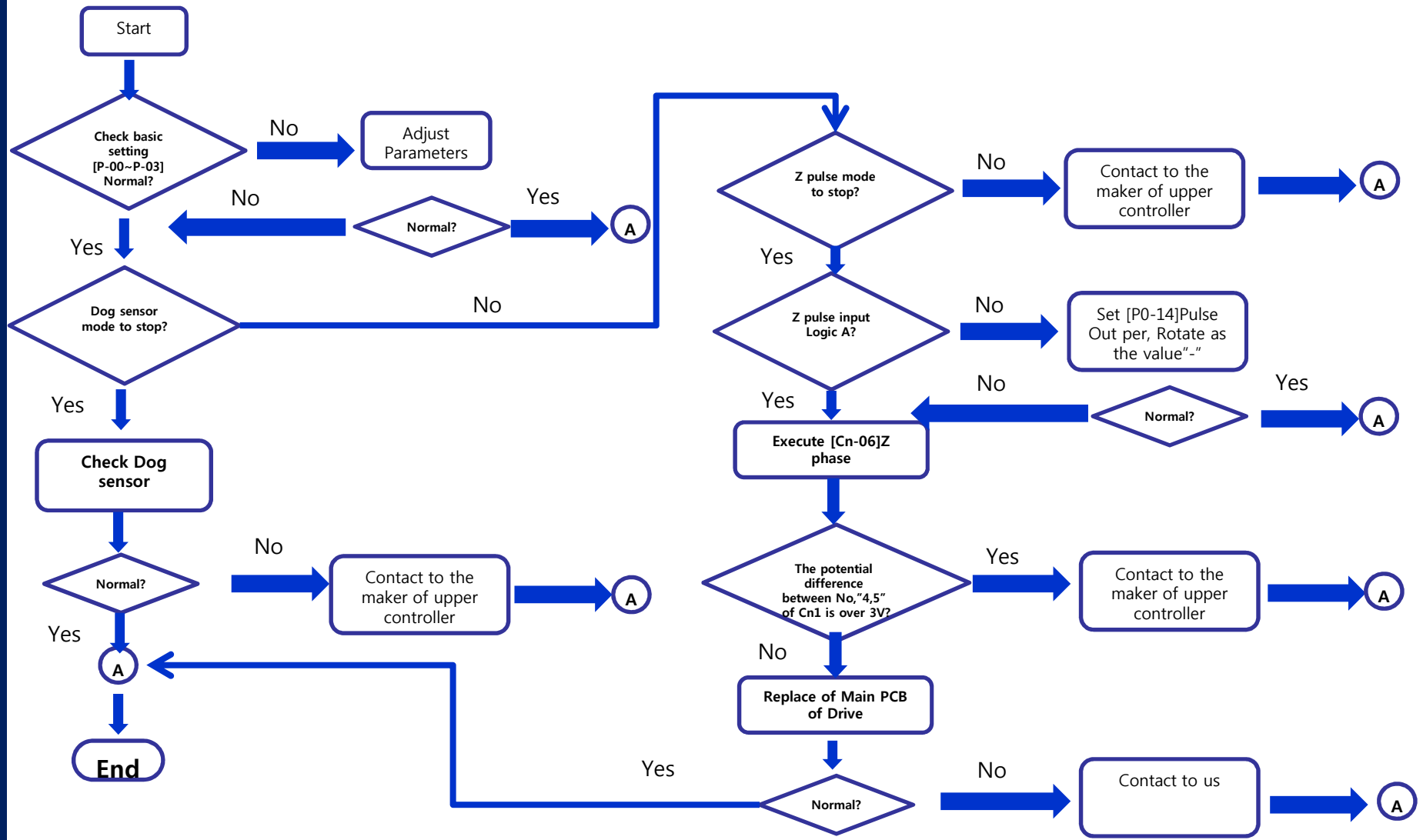
Check Process in the case of position Error

Action for abnormal situation



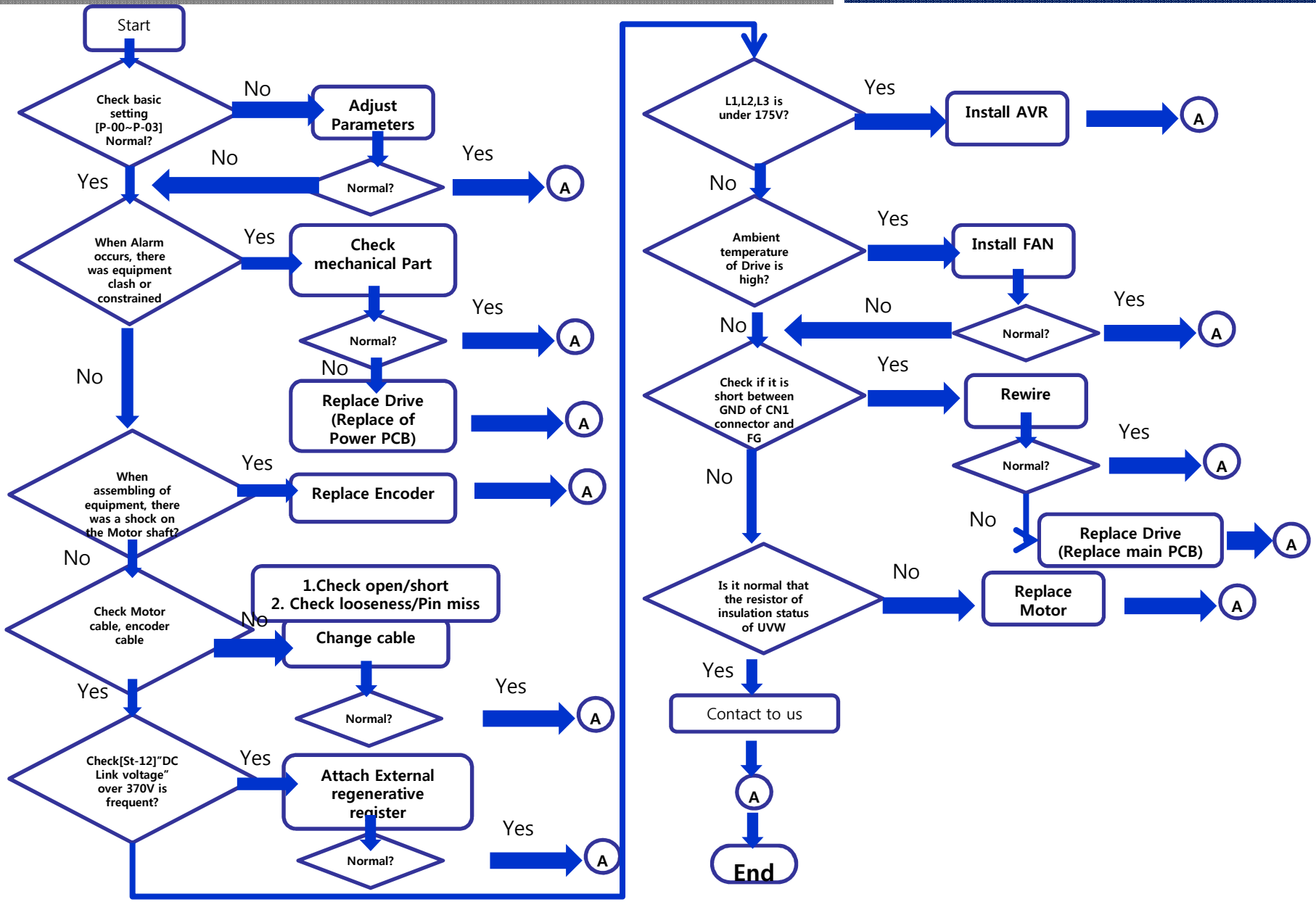
Check process in the case of abnormal origin operation

Action for abnormal situation



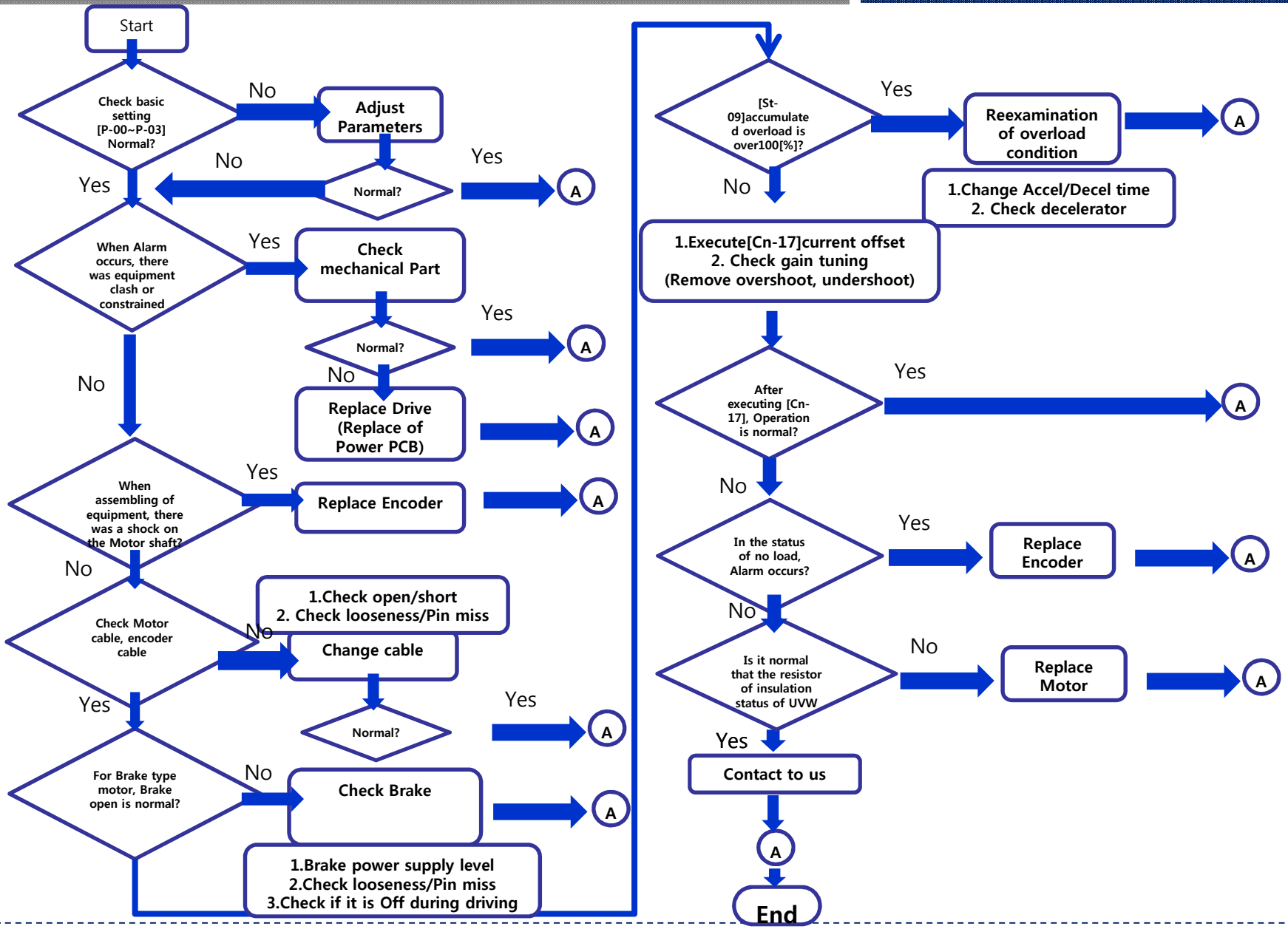
Check Process in the case of over current Alarm[AL-10,16,18]

Action for abnormal situation

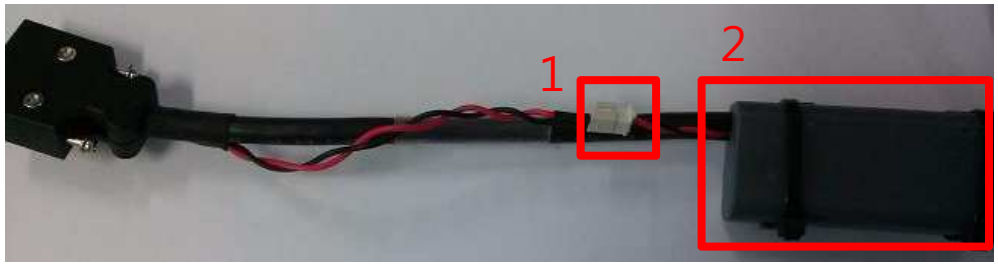


Check Process in the case of continuous overload[AL-21]

Action for abnormal situation



Replace of battery of Multi-turn encoder(1/2)



-The battery is connected with Encoder cable

- To replace battery,

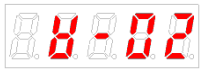
1) Disconnect the connection line as No.1

2) After Cut cable tie, Open battery case with pressing as No.3

- There is a battery (Toshiba ER6V) in the case
- Possible the battery to purchase the battery in electronic components store or Internet mall

Replace of battery of Multi-turn encoder(2/2)

- Replace of Battery FAQ –

1. The voltage Level that low voltage warning  occurs
   => 3.3V

2. Changing period after warning ?
   => it is recommended to replace as fast as possible when warning occurs. After warning occurs, possible to use approximately 20 days(in the case of 24 hours a day by Battery) But, it is estimated figure not guaranteed

3. The voltage level not possible to use battery
   => Under 3.0V

4. After disassembling battery, changing time?
   => within 20minutes. Without battery, possible to save position data because of Super capacitor on Encoder for 20 minutes

Brake Type Motor

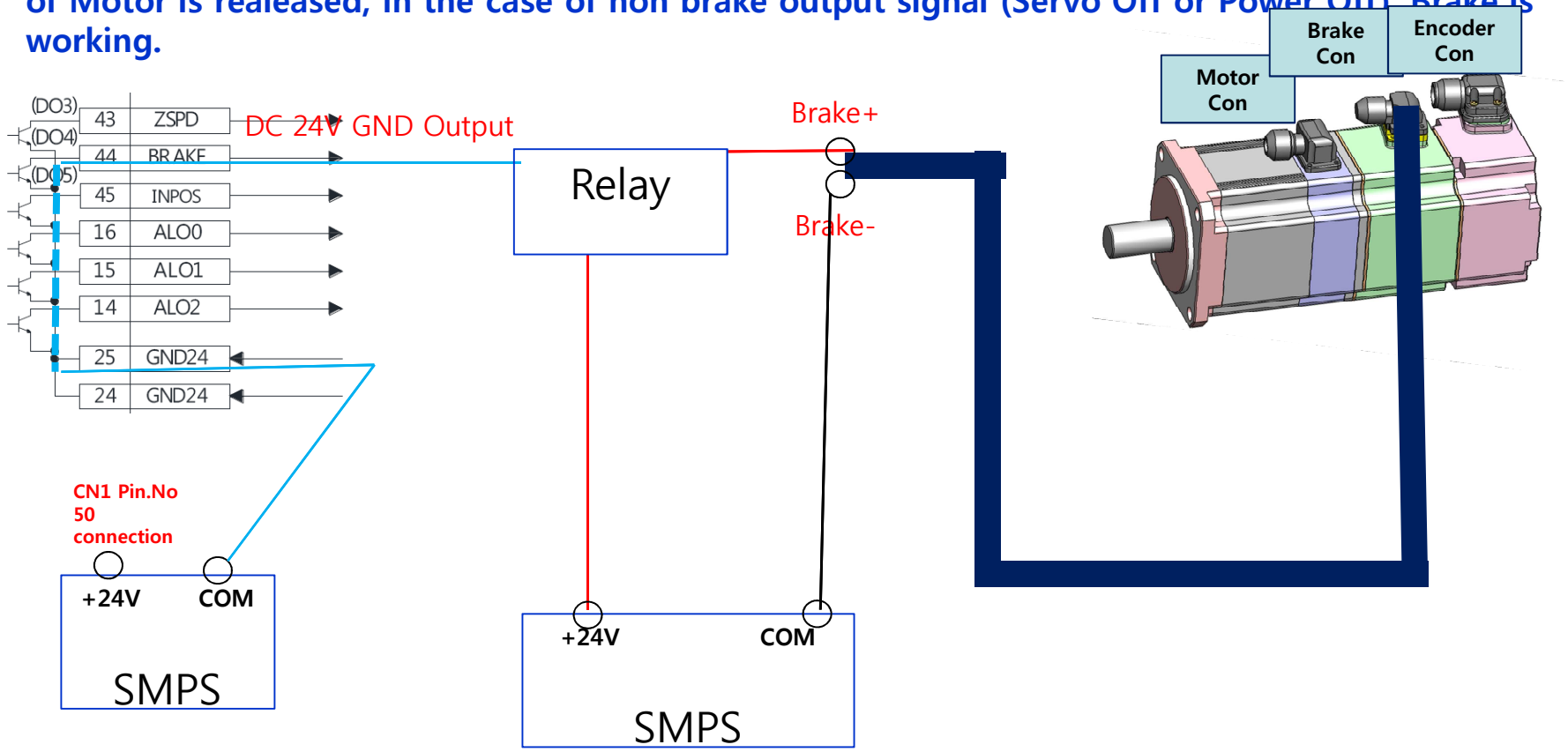
1. Brake Type Motor : Brake Type motor is to control vertical axis for fall protection (Servo Off or Power Off)

2. Wiring :

*Brake output signal (CN1-44) needs to be sure to indirect control through a relay (Not possible to control motor brake directly with Drive because Drive cannot be output high voltage and high current)

*Need to use SMPS for Brake motor only (Do not use the SMPS that is using for Interface)

3. Output contact : Default contact is B contact for Brake, In the case of Brake output signal, Brake of Motor is realeased, in the case of non brake output signal (Servo Off or Power Off), Brake is working.

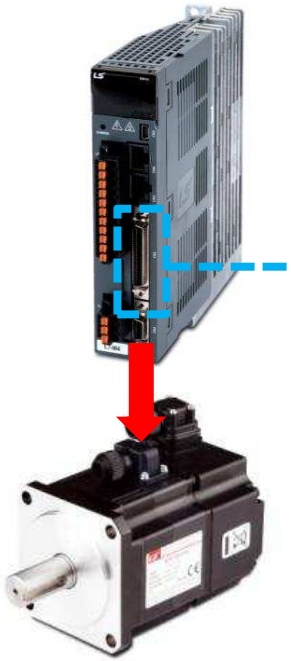


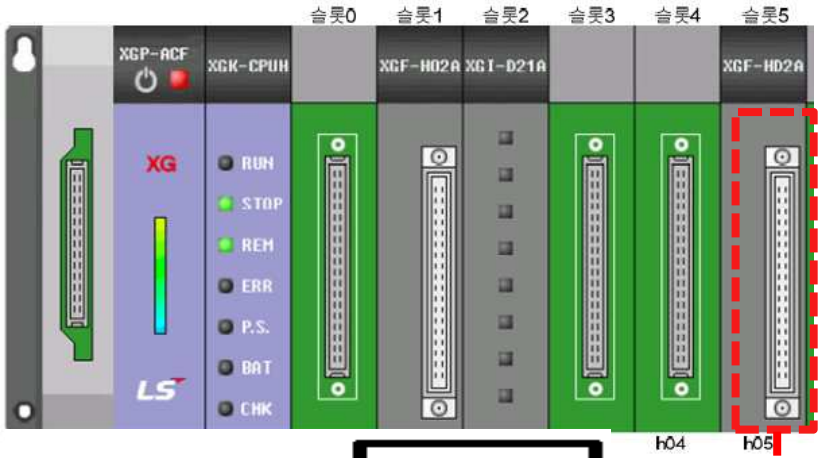
▶ High speed counter module setting

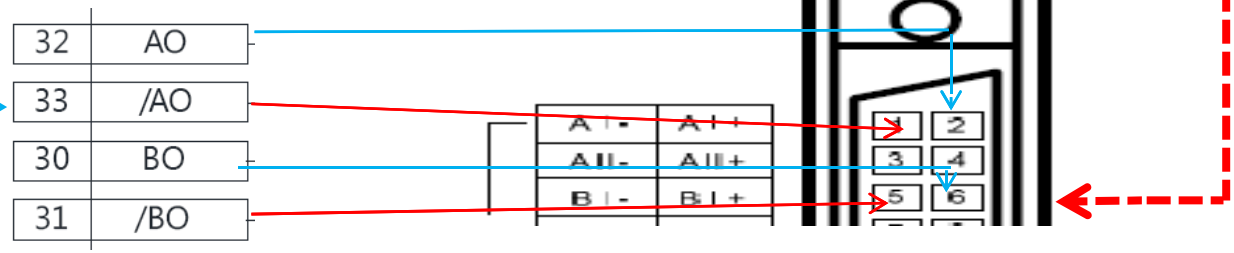
- After High speed counter module collects the pulse signals from Servo Drive and counts the pulses, Upper controllers obtains current position
- The wiring of XGF-HD2A(Line Driver) with L7S Drive

L7S	
No.32	AO
No.33	/AO
No.30	BO
No.31	/BO

XGF-HD2A	
No.2	AI+
No.1	AI-
No.6	B+
No.5	B-





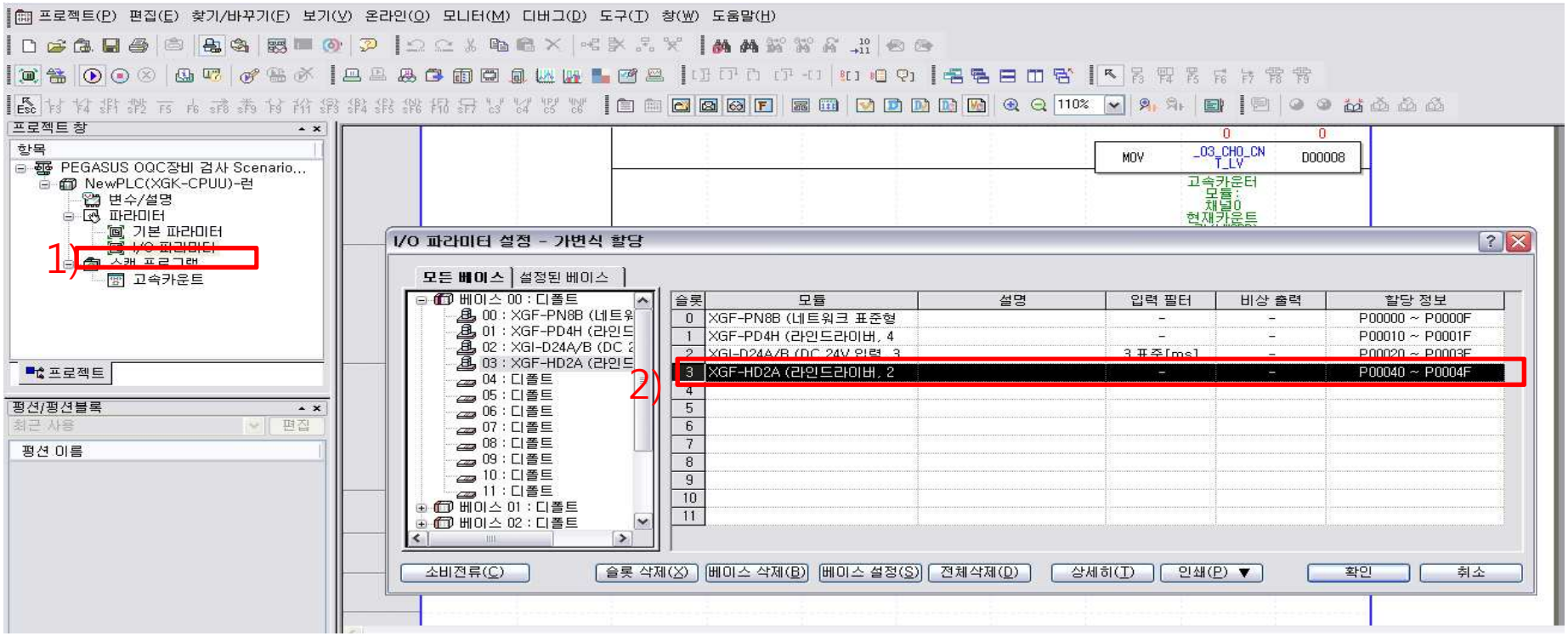


▶ Encoder pulse out per, rotate setting [P0-14]

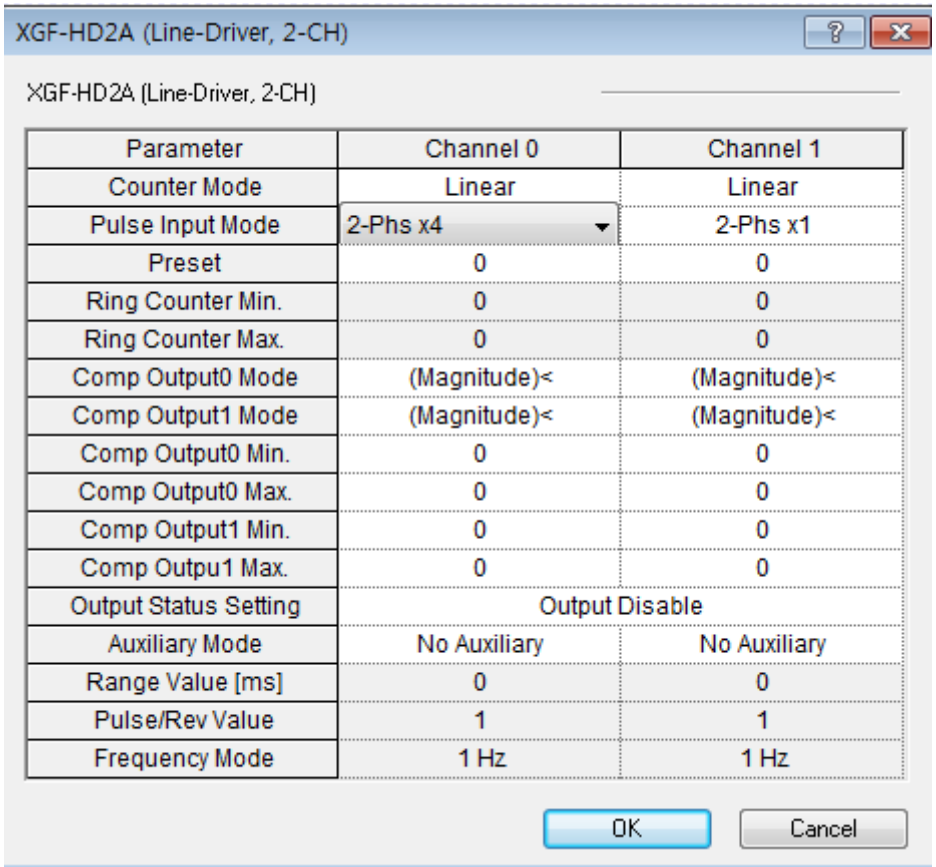
- Output pule numbers per rotation of Motor
- 4 multiplication need to be input. That is to say, to be 1000 pulses per rotation of motor, input 4000 in P0-14

▶ XG5000 setting

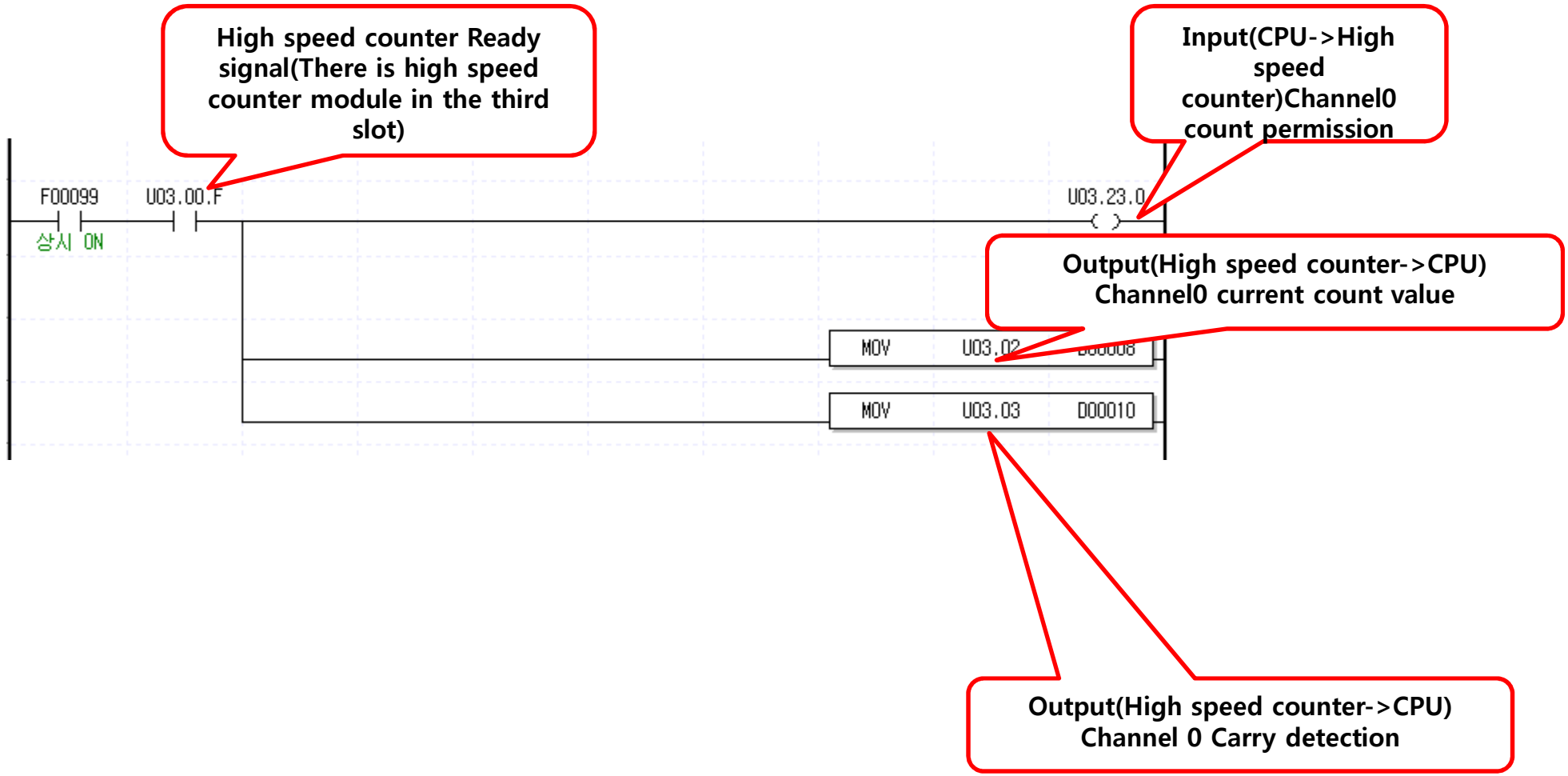
- I/O Parameter setting : Click as below 1)->2)



- As Click 2) on previous page, created the window as below
- Linear counter -> 2 phases 4 multiplication (If 2 phases 4 multiplication is set on the window as below, it does not need to set 4 multiplication on P0-14 on Drive)



▶ Ladder Program

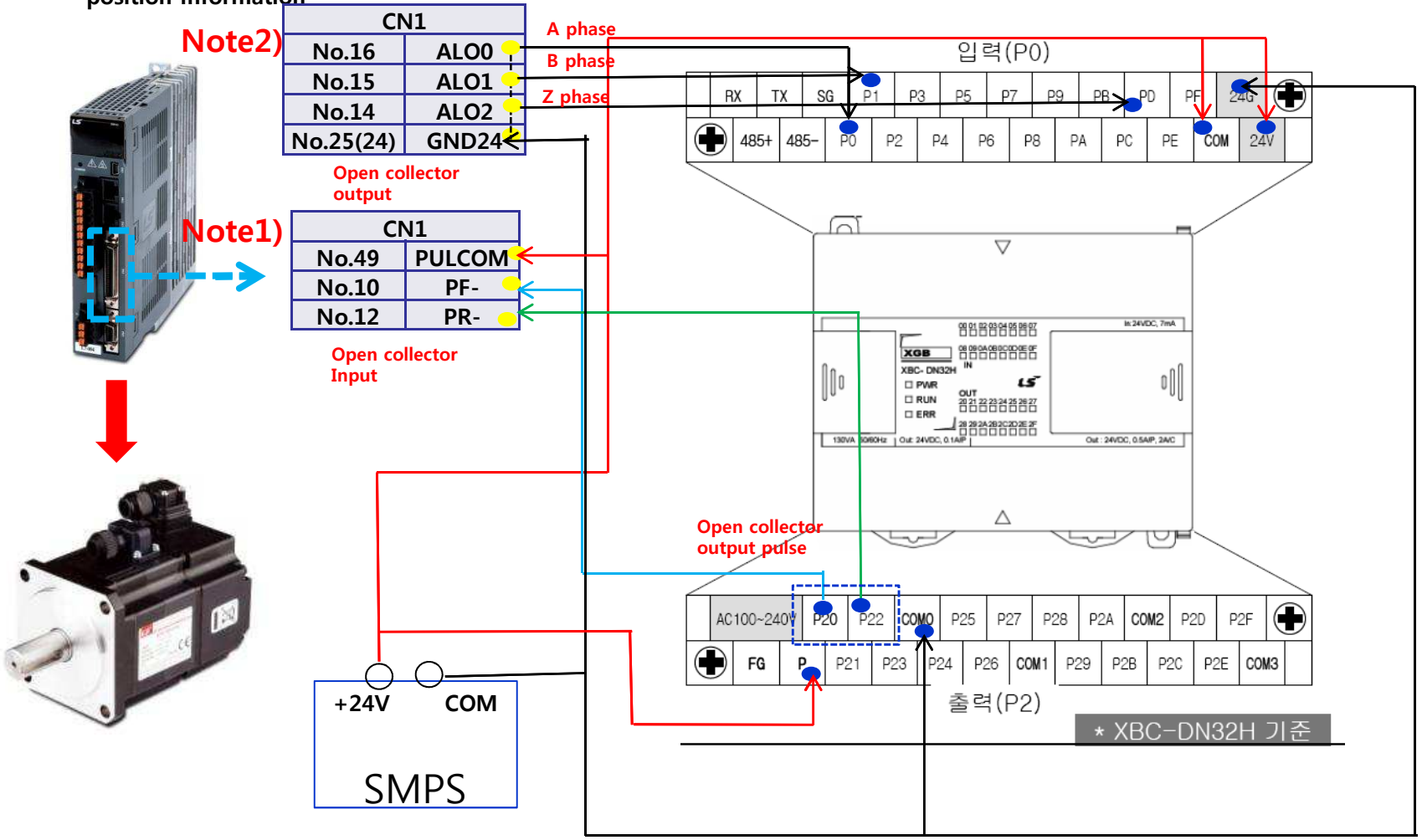


Wiring diagram for XGB PLC & L7S

▶ XGB PLC(At 1 axis of XBC-DN32H) & L7S Drive

Note1) Servo drive open collector pulse input : PULCOM(+24V connection), PF-(P20 connection), PR-(P22 connection)

Note2) Servo drive open collector pulse output : As Default setting of L7S drive is Line drive pulse mode output, need to be changed as open collector output mode. In order to change, Set P0-17(Basic function bit) Digit3, 0->1(Use open collector output)
Use home sensor with ALO2(Z phase). As open collector output mode with ALO0(A phase), ALO1(B phase), upper controller obtains current position information



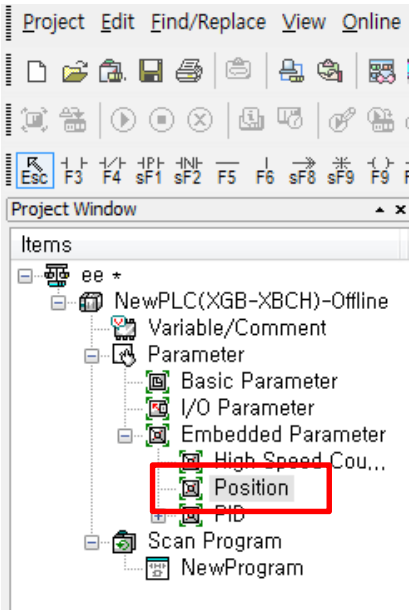
▶ Important setting

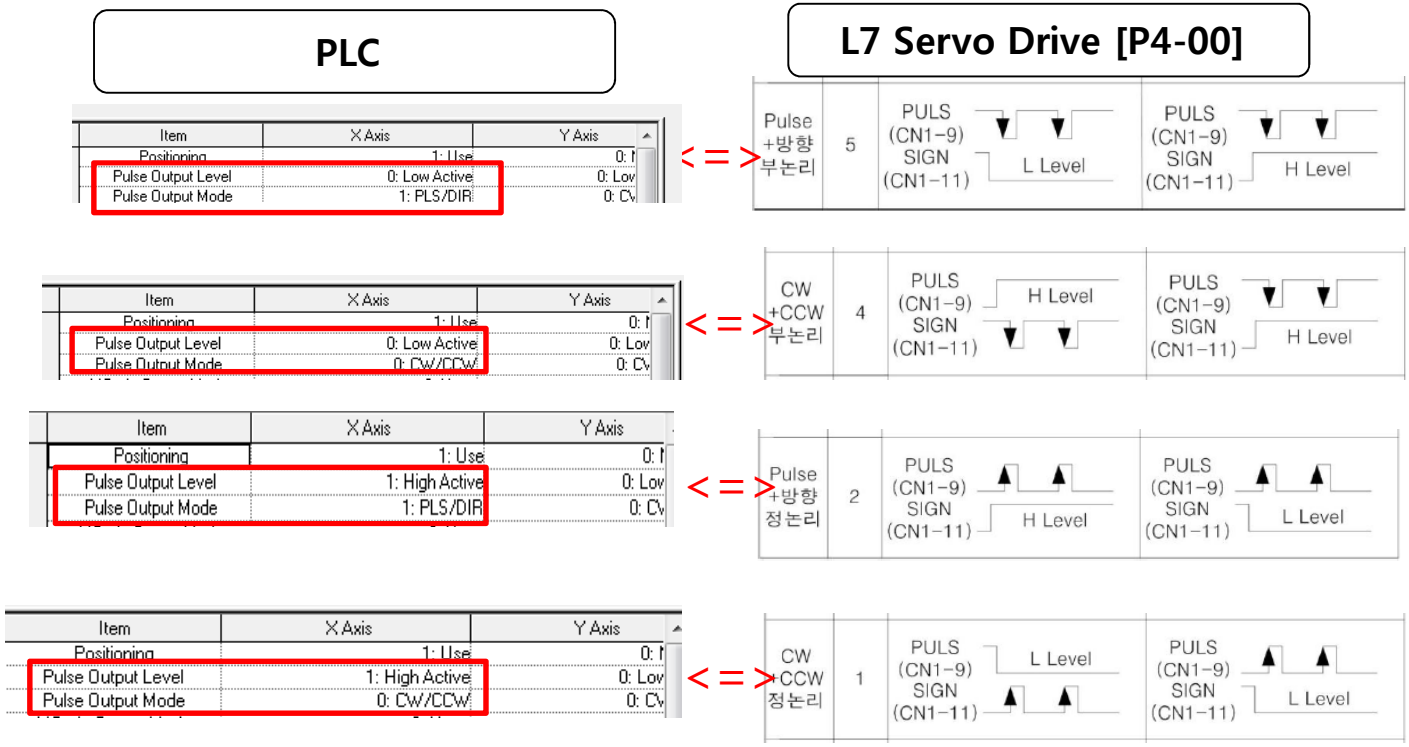
1) Electronic gear ratio setting

Need to set up electronic gear ratio in Servo Drive because there is no electronic gear setting function in XGB PLC

2) Input pulse logic setting

Click to positioning module in XG5000 as below. And, set the pulse output level and pulse output mode





▶ High speed counter & Encoder pulse out per, rotate setting

- High speed counter module is embedded in XGB PLC (Open collector input). ALO0(No.16) is A phase. and ALO1(No.15) is B phase. (Refer to 34Page)
- Encoder pulse out per, rotate: Set [P0-14] in Servo drive, and set 2 phase 4 multiplication in high speed counter module in PLC
- Note for Encoder pulse out per, rotate & open collector input frequency of PLC

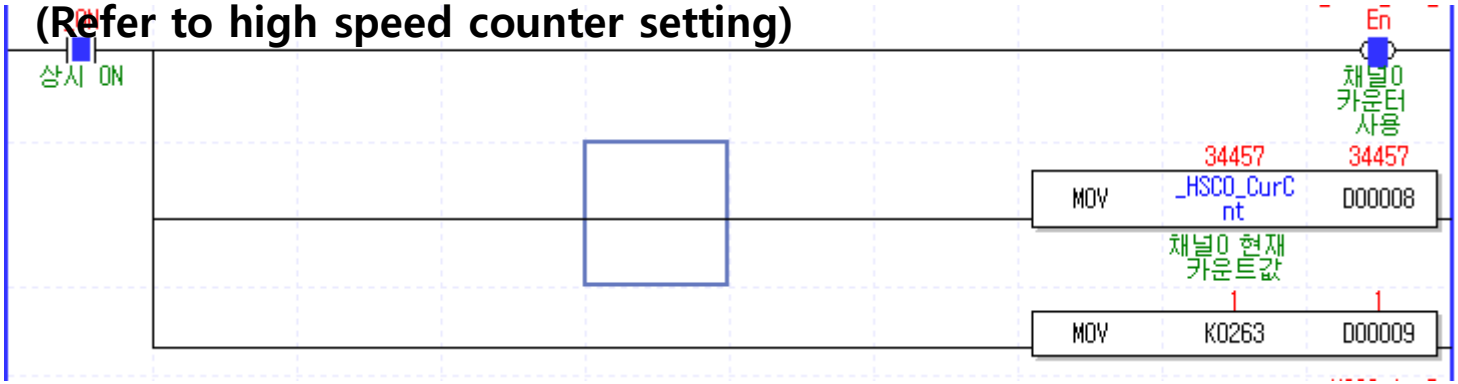
: Input frequency of open collector of XBC-DN32H is 50kHz

Ex) For 3000rpm, need to be set below 1000 in Encoder pulse out per, rotate

That is to say, 3000rpm = 3000/60rps and , 3000/60 * 1000(Encoder pulse out per, rotate) = 50kHz. If in Encoder pulse out per rotate is set by 2000,

3000/60 * 2000(Encoder pulse out per, rotate) = 100kHz, Upper controller misses the pulses.

▶ Example for High speed counter Ladder Program (Refer to high speed counter setting)



Analog Monitor Output Setting

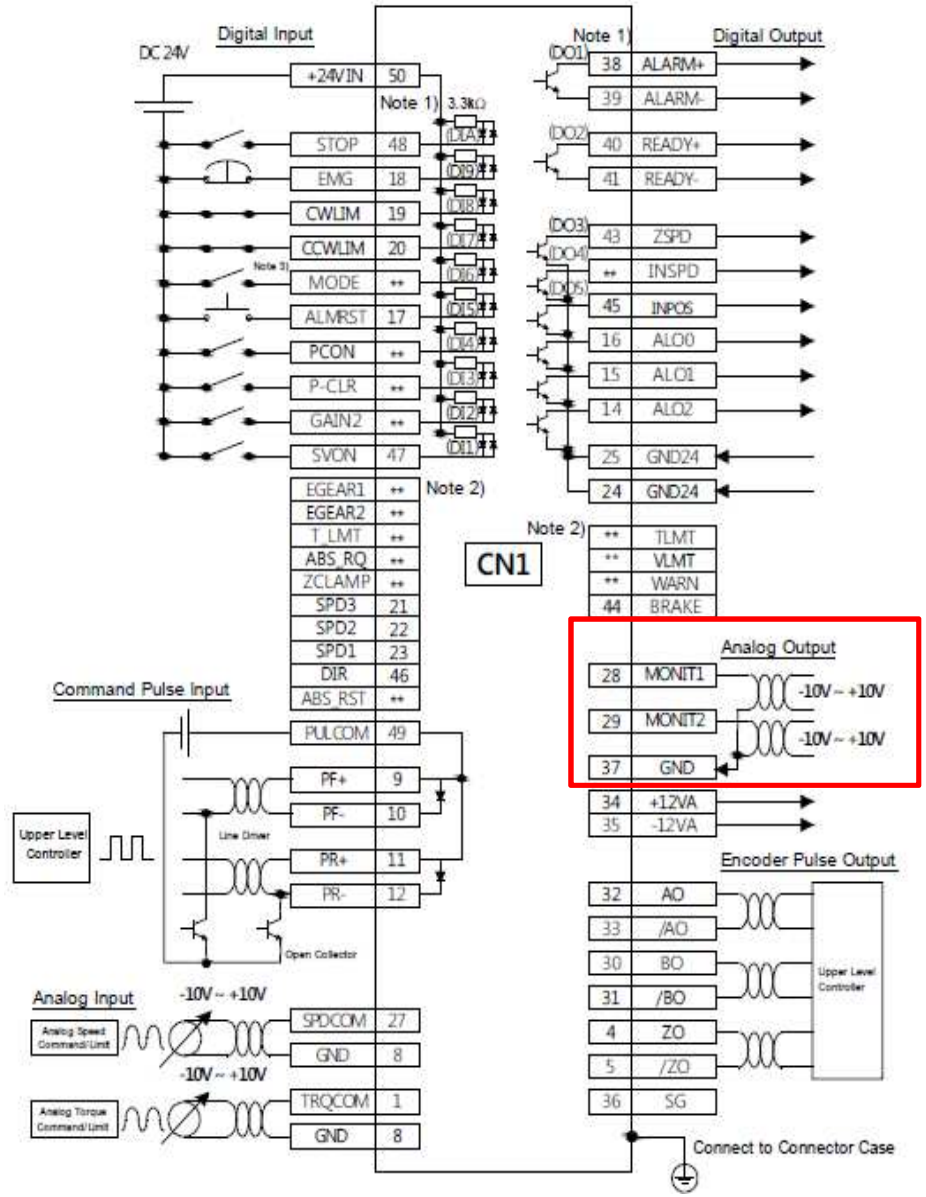
Analog Monitor Output

P0-18	DAC output mode	-	0x3210	Sets output mode for 1-2 analog output channels.	PST
	DAC mode (F)	0x0000	0xFFFF	Sets CH0-CH3 from the bottom, HEX Code, in order. ▪ Output CH0 and CH1 as MONIT1 and MONIT2. • 0 : Speed Feedback [RPM] • 1 : Speed Command [RPM] • 2 : Torque Feedback [%] • 3 : Torque Command [%] • 4 : Position Command Frequency [0.1 Kpps] • 5 : Following Error [pulse] • 6 : DC Link Voltage [V] • D: Speed command (User) [RPM] • E: Torque command (User) [%]	

▶As table above, Possible to set 9 kinds of output through MONIT1, MONIT2.

ex) The default value is 0x3210.
in CH0, SpeedFeedback is output through MONIT1.

To monitor Torque Command in CH0, Change the first bit as 3 in the parameter P0-18.



Analog Monitor Output Setting

P0-23	DAC output scale 1 (MONIT1)	[Unit/V]	500	Sets magnification for 1-2 analog output channels. Sets magnification as setting Unit/V. E.g.) Channel 1 scale 100 [RPM]: Output 100 [RPM] as 1 [V]. (Details: Refer to "4.4.1 System Parameter Setting.")	PST
	DAC scale1 (F) (MONIT1)	1	10000		
P0-24	DAC output scale 2 (MONIT2)	[Unit/V]	500		PST
	DAC scale 2 (F) (MONIT2)	1	10000		

▶ As table above, possible to set the scale of analog output channel 1~2

ex) In the case that CH0 is SpeedFeedback, when the output scale is set as 500, 1V is output per 500RPM. If 100 is set, 1V is output per 100RPM. When motor turns by 100RPM, 10V is output

In the case of Torque Command out, when output scale is 10, 1V is output per Torque value 10%. 3V is output when Torque Command is 30%

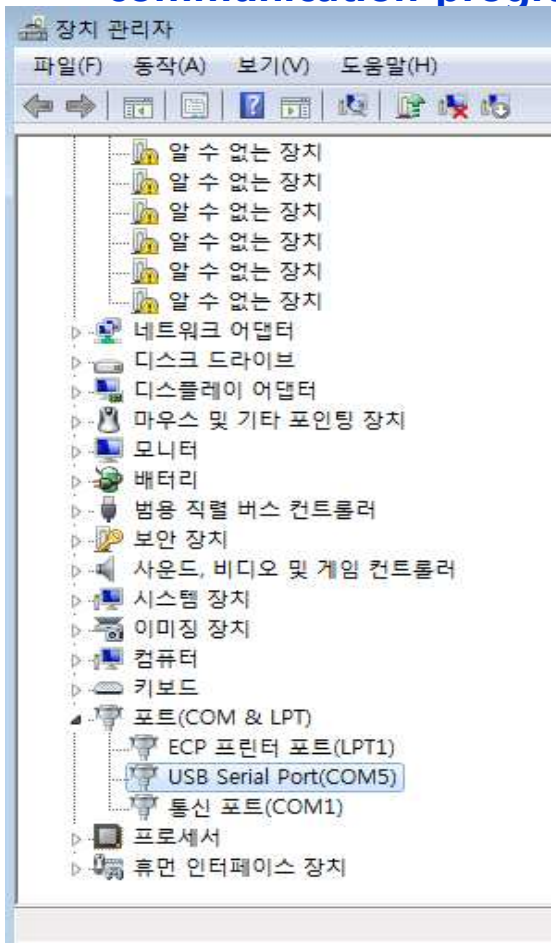
P0-19	DAC output offset 1 (MONIT1)	[Unit/V]	0	Sets offset for 1-2 analog output channels. • Speed: [RPM] • Torque: [%] • Position command frequency: [0.1 Kpps] • Position: [pulse] • DC Link: [V] • Offset (Details: Refer to "4.4.1 System Parameter Setting.")
	DAC output offset 1 (MONIT1)	-1000	1000	
P0-20	DAC output offset 2 (MONIT2)	[Unit/V]	0	
	DAC offset 2 (F) (MONIT2)	-1000	1000	

▶ As table above, possible to set the offset of analog output channel 1~2.
In the case that CH0 is SpeedFeedback, When output scale is 100 and motor turns as 100RPM, 10V is output.
And, when offset is 100, 9V is output because 1V is offset

Communication protocol overview

- L7 Servo drive uses RS-422 serial communication by connecting it to a PC or an upper controller. Need communication converter to use PC.
- You can also operate or handle communication of up to 32 axes by connecting multiple L7 servo drives via a multi-drop method.

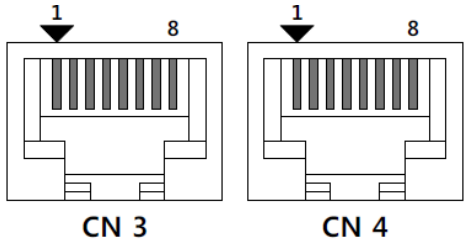
▶ In the case of using PC for upper controller, After checking Serial port at device manager, the Baud Rate (P0-04) & System ID(Node ID, P0-05) in Drive. Set it in communication program



▶ In the case of abnormal communication access,

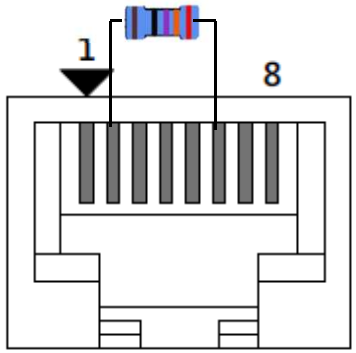
1) Check Serial Port
2) Baud rate(P0-04) of Drive
3) System ID(Node ID, P0-05)
4) Check wiring (When not connected GND, cannot be communication access by external noise)

Connection of CN3 and CN4 Connector Pins



Pin no	Pin Function
1	Not for use
2	Terminating resistance connection note
3	RXD+
4	TXD-
5	TXD+
6	RXD-
7	Not for use
8	GND

- The TXD and RXD in the above table are based on the servo drive
- Connect RXD(TXD) of Servo Drive to TXD(RXD) of Upper controller



- In the case of multi access connection, apply terminating resistance by connecting Pin 2 of the last drive to Pin 6(RXD-). Use 120Ω for terminal resistor

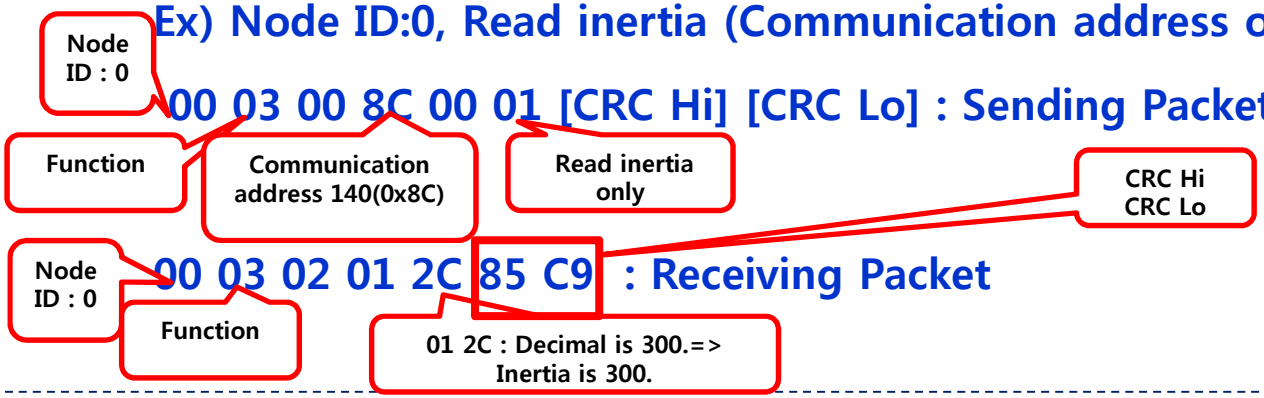
▶ Protocol command code

1) Read Single Register (0x03)

Sending Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x03
2	Starting Address Hi	0x00
3	Starting Address Lo	0x6B
4	Quantity of Register Hi	0x00
5	Quantity of Register Lo	0x01
6	CRC Hi	
7	CRC Lo	

Normal Receiving Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x03
2	Byte Count	0x02
3	Register Value Hi	0x02
4	Register Value Lo	0x2B
5	CRC Hi	
6	CRC Lo	

Ex) Node ID:0, Read inertia (Communication address of inertia : 140(0x8C))



▶ Protocol command code

1) Read Multi Register (0x03)

Sending Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x03
2	Starting Address Hi	0x00
3	Starting Address Lo	0x8C
4	Quantity of Register Hi	0x00
5	Quantity of Register Lo	0x03
6	CRC Hi	
7	CRC Lo	

Normal Receiving Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x03
2	Byte Count	0x06
3	Register Value Hi	0x01
4	Register Value Lo	0x2C
3	Register Value Hi	0x00
4	Register Value Lo	0x32
5	Register Value Hi	0x00
6	Register Value Lo	0x46
7	CRC Hi	
8	CRC Lo	

Ex) Node ID:0, Read inertia, Position P gain1, Position P gain2 (Reading three consecutive Data from 140(Decimal) of communication address)

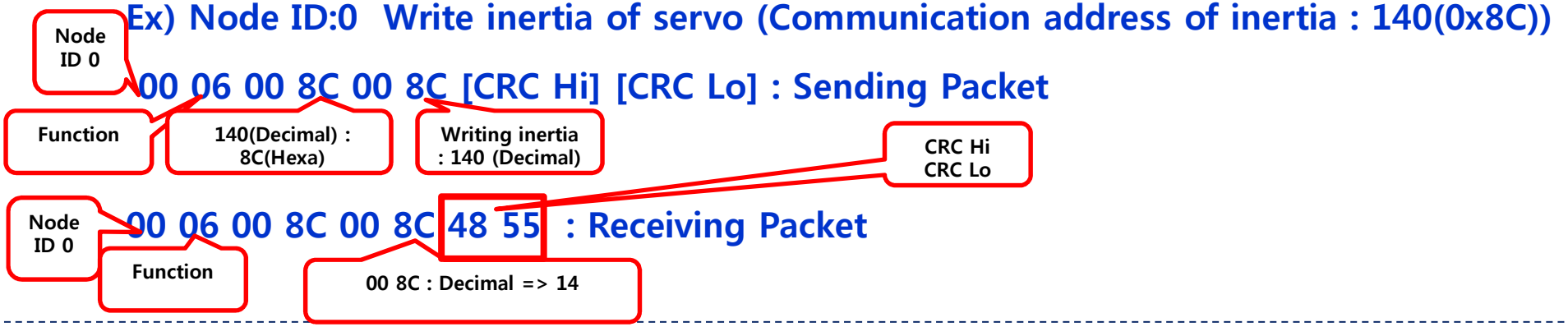
▶ Protocol command code

1) Write Single Register (0x06)

Sending Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x06
2	Register Address Hi	0x00
3	Register Address Lo	0x01
4	Register Value Hi	0x00
5	Register Value Lo	0x03
6	CRC Hi	
7	CRC Lo	

Normal Receiving Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x06
2	Register Address Hi	0x00
3	Register Address Lo	0x01
4	Register Value Hi	0x00
5	Register Value Lo	0x03
6	CRC Hi	
7	CRC Lo	

Ex) Node ID:0 Write inertia of servo (Communication address of inertia : 140(0x8C))



▶ Protocol command code

1) Write Multi Register (0x10)

Sending Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x10
2	Starting Address Hi	0x00
3	Starting Address Lo	0x01
4	Quantity of Registers Hi	0x00
5	Quantity of Registers Lo	0x02
6	Byte Count	0x04
7	Register Value Hi	0x00
8	Register Value Lo	0x0A
9	Register Value Hi	0x01
10	Register Value Lo	0x02
6	CRC Hi	
7	CRC Lo	

Normal Receiving Packet		
Byte	Content	Value
0	Node ID (P0-05)	0x00
1	Function	0x10
2	Starting Address Hi	0x00
3	Starting Address Lo	0x01
4	Quantity of Register Hi	0x00
5	Quantity of Register Lo	0x02
6	CRC Hi	
7	CRC Lo	

Ex) Node ID:0 Write inertia&Position P gain(Communication address of inertia : 140(0x8C))

00 10 00 8C 00 02 04 00 8C 00 1E [CRC Hi] [CRC Lo] : Sending Packet

Node ID 0 | Function | 140(Decimal) : 8C(Hexa) | The number of register | The number of Byte | Writing inertia 140(Decimal) | Writing PositionP1 30(Decimal

00 10 00 8C 00 02 81 F2 : Receiving Packet

Node ID 0 | Function | 00 8C : Decimal => 14 | The number of register | CRC Hi CRC Lo

■ The example of ladder program for communication protocol

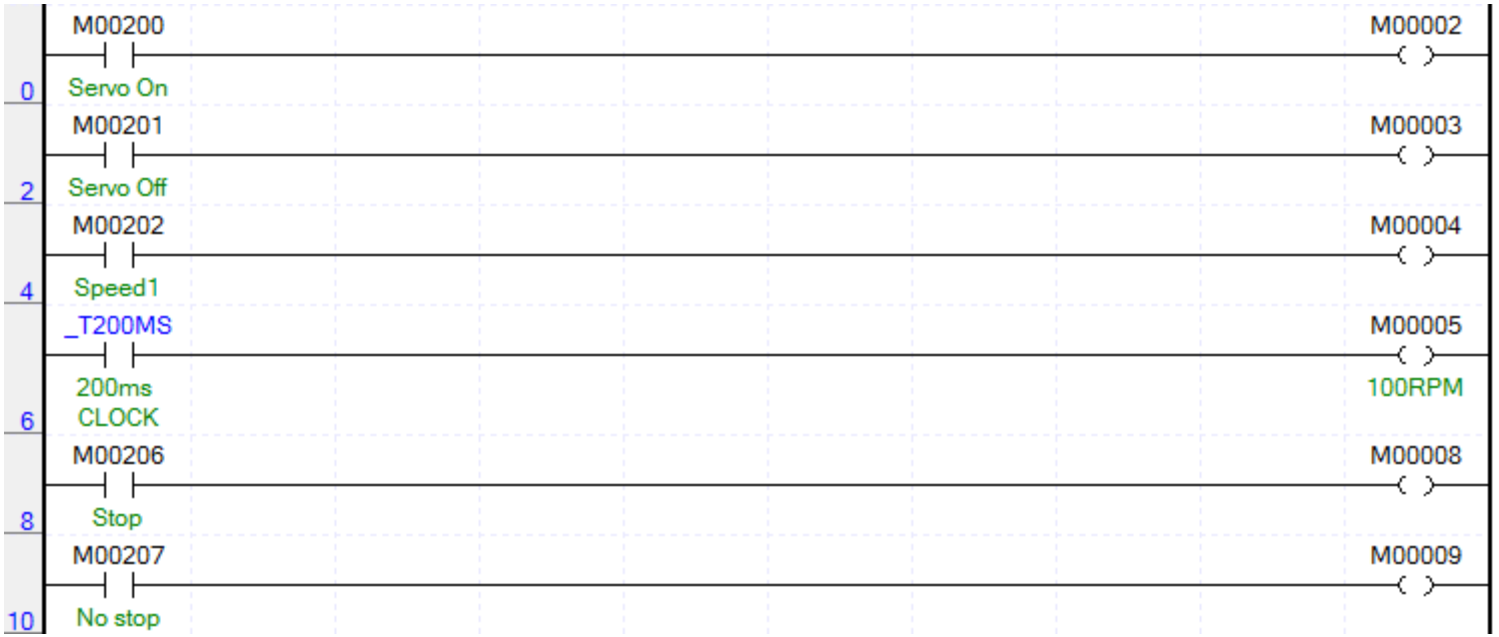
1) When M00002 and M00003 enables, Servo is On/Off

2) When M00004 enables, Motor runs as Digital speed1

3) As M00005 enables, 100rpm setting in digital speed1

4) When M00008 enables, Motor stops

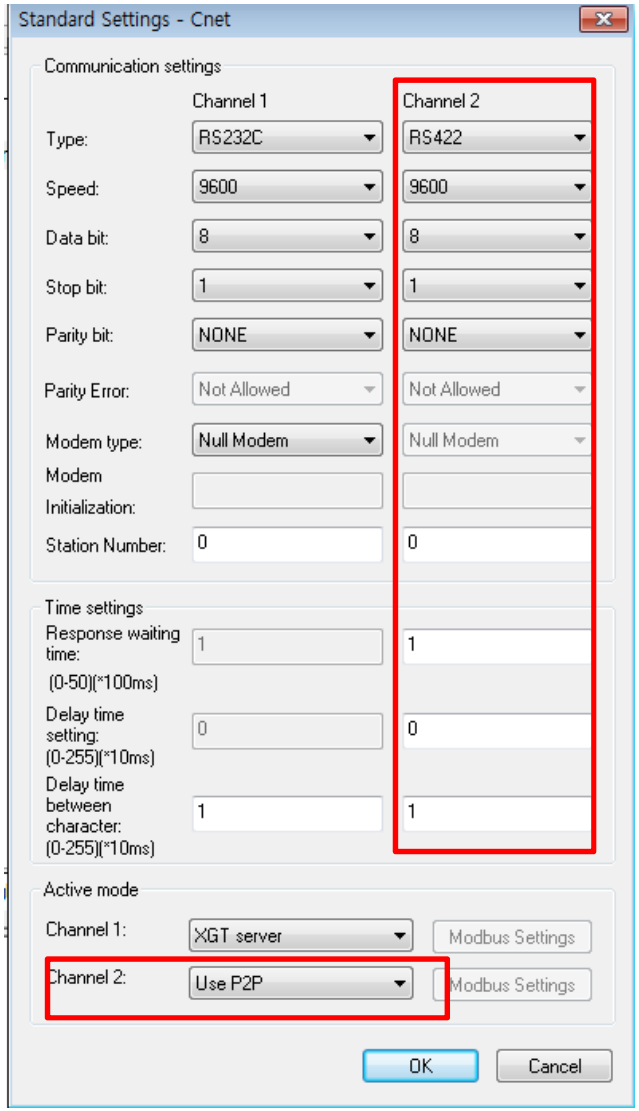
5) When M00009 enables, Motor runs



■ XG PD Setting : Standard setting - Cnet

1) Communication type, Communication speed
(Match with Communication speed of L7S Drive)
L7S communication Baud rate parameter : P0-04

2) Active mode : Use P2P setting(PLC : Master, Drive : Server)

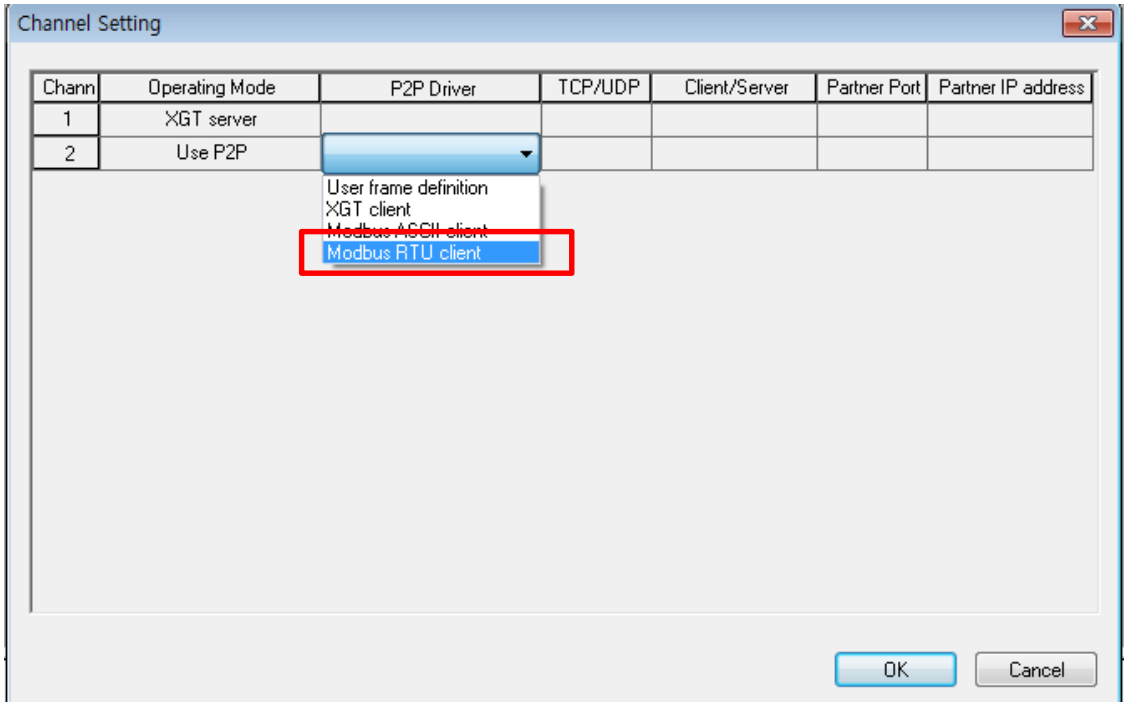


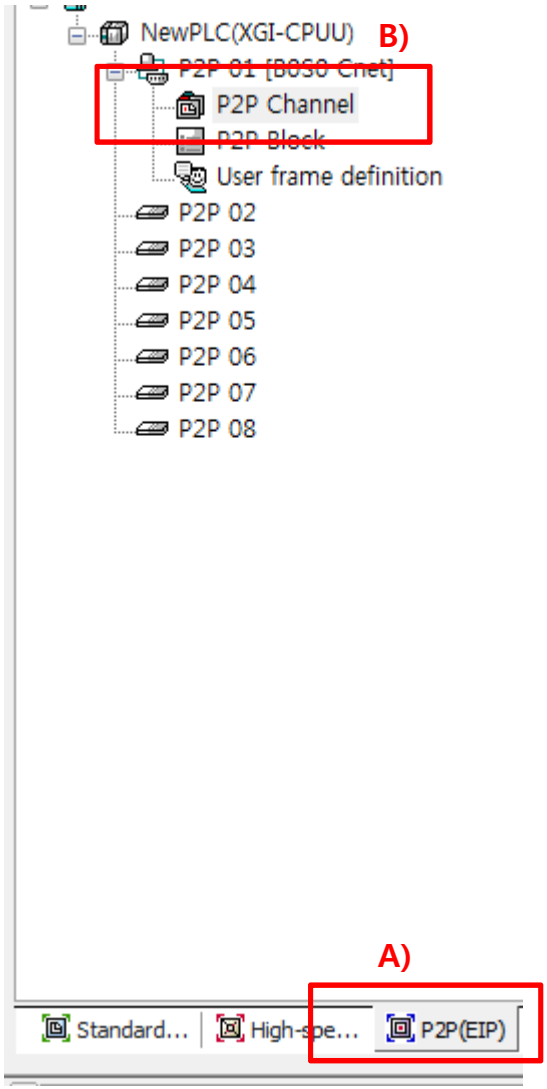
■ XG PD setting : P2P setting

1) Click P2P at (A)

2) Click at (B)

3) After clicking P2P channel, select Modbus RTU client

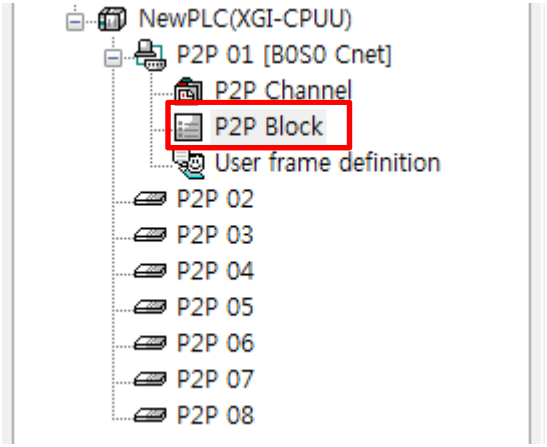




■ XG PD Setting : P2P Setting

1) As the picture right, Click P2P block

2) Set as the picture below, In the case of Servo On,
When M00002 is enable,
the value of M0120 is saved in 0xEC (address) of Servo Drive

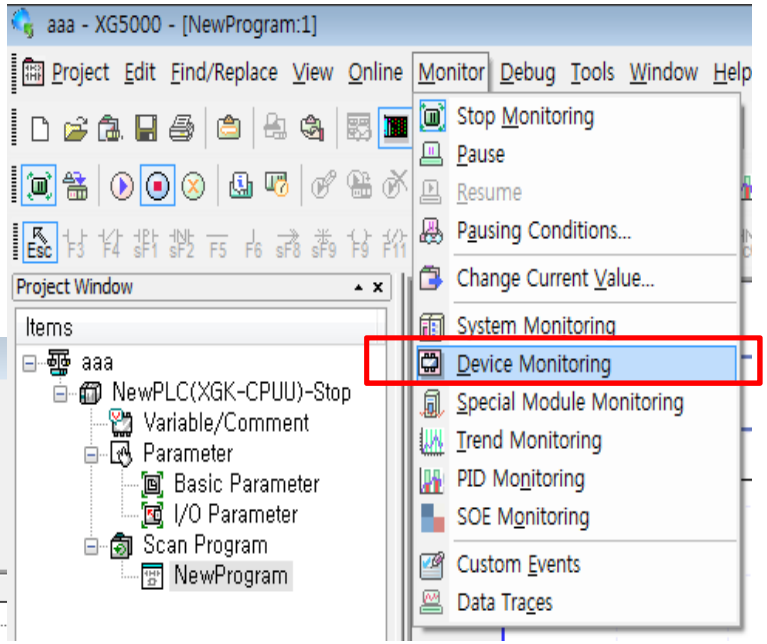


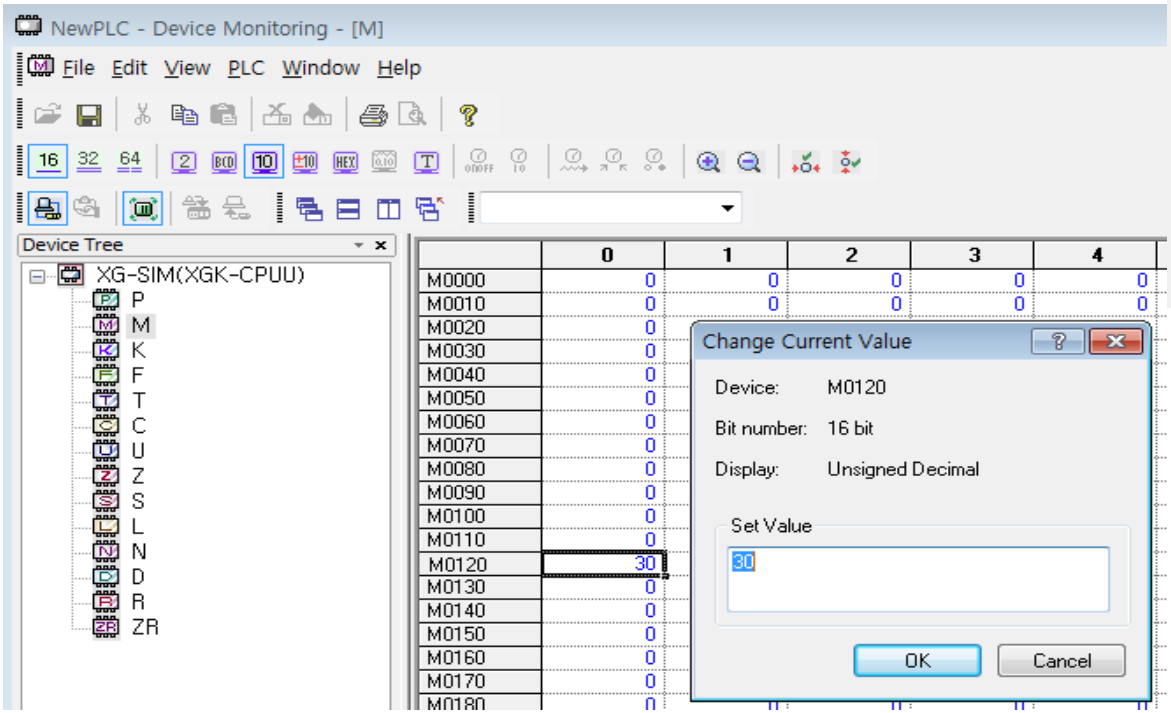
Index	Ch.	Driver Setting	P2P function	Conditional flag	Command type	Data type	No. of variables	Data size	Destination station	Destination station number	Frame	Setting	Variable setting contents
0	2	Modbus RTU client	WRITE	M00002	Single	WORD	1		☑	0		Setting	Number :1 READ1:M0120,SAVE1:0x400EC
1	2	Modbus RTU client	WRITE	M00003	Single	WORD	1		☑	0		Setting	Number :1 READ1:M0130,SAVE1:0x400EC
2	2	Modbus RTU client	WRITE	M00004	Single	WORD	1		☑	0		Setting	Number :1 READ1:M0140,SAVE1:0x400EC
3	2	Modbus RTU client	WRITE	M00005	Single	WORD	1		☑	0		Setting	Number :1 READ1:M0150,SAVE1:0x40118
4	2	Modbus RTU client	WRITE	M00008	Single	WORD	1		☑	0		Setting	Number :1 READ1:M0180,SAVE1:0x400EE
5	2	Modbus RTU client	WRITE	M00009	Single	WORD	1		☑	0		Setting	Number :1 READ1:M0190,SAVE1:0x400EE

■ Device monitor

1) As the picture right, Click device monitor.

2) As input the value '30'(Decimal, Binary : 11110) in M0120,
Writing the value to the address 0xEC of Servo Drive



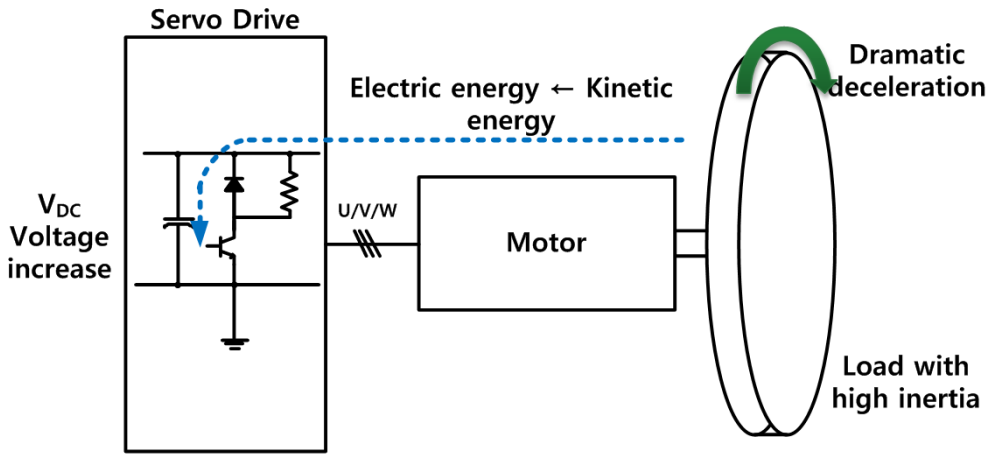


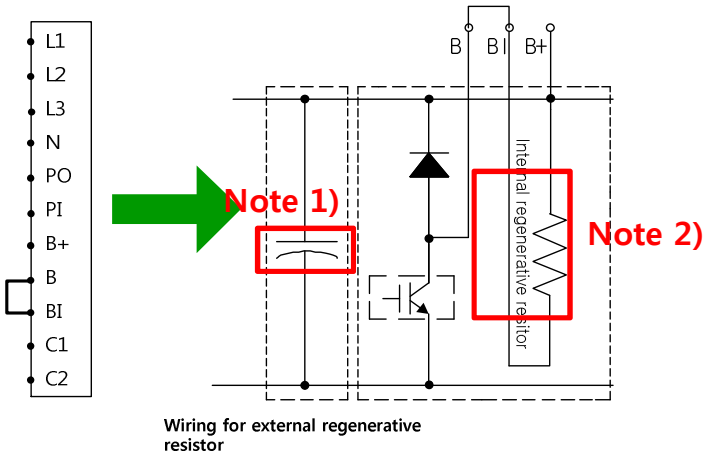
Regenerative braking resistor

▶ The purpose of regenerative braking resistor :

Regeneration is the phenomenon which converts motor's kinetic energy to electric energy that is back to the drive when motor decelerates dramatically or runs the load with high inertia. Regenerative resistor is used for preventing a damage of drive by repressing internal voltage of drive from increase.

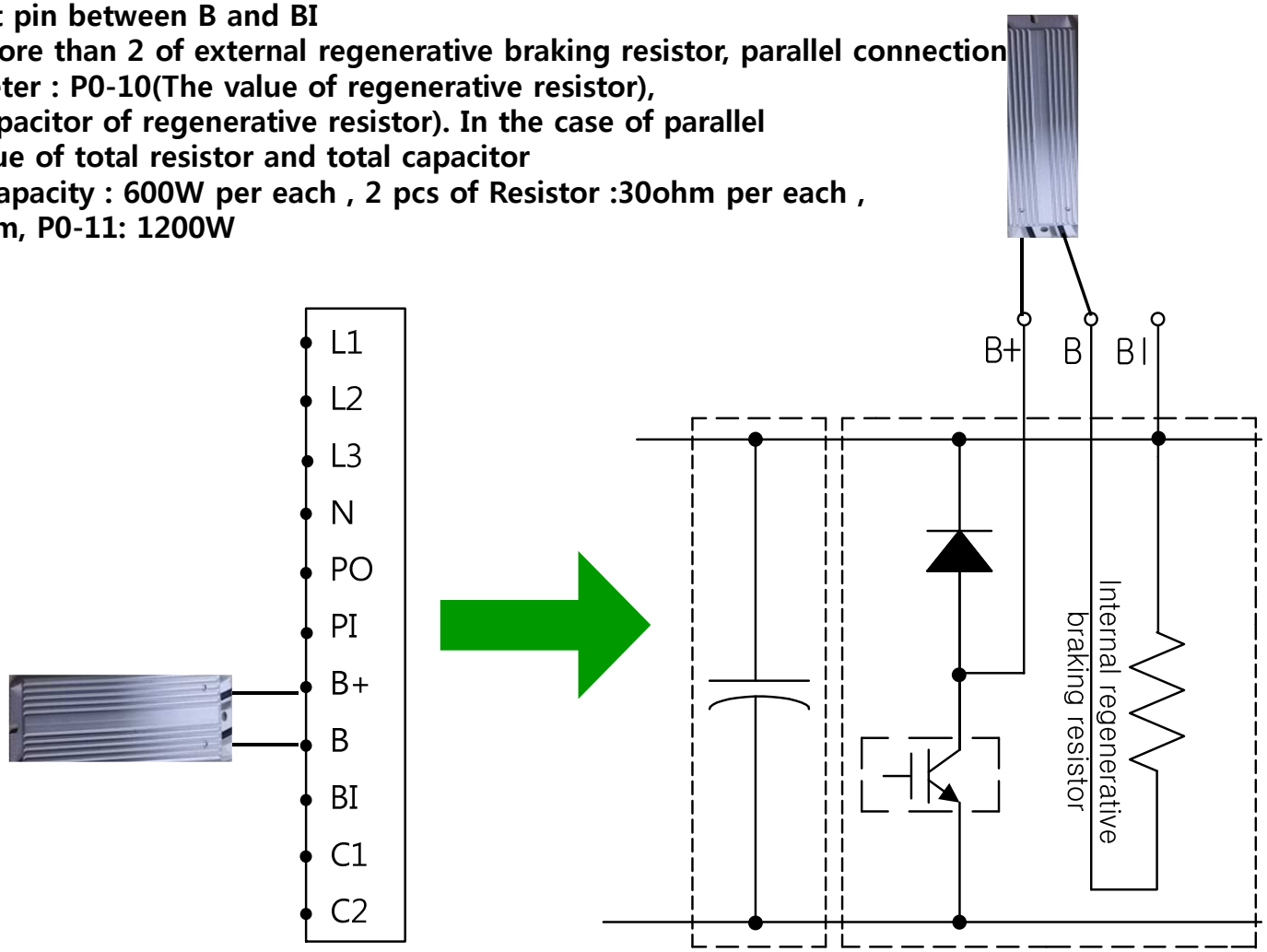
Note 1) Regenerative energy from Motor is stored in Capacitor first
Note 2) When the capacity of capacitor is full, Regenerative energy is consumed





External regenerative braking resistor setting :

1) Remove short pin between B and BI
2) To connect more than 2 of external regenerative braking resistor, parallel connection
3) Servo parameter : P0-10(The value of regenerative resistor),
   P0-11(The capacitor of regenerative resistor). In the case of parallel
   Input the value of total resistor and total capacitor
   Ex)2 pcs of Capacity : 600W per each , 2 pcs of Resistor :30ohm per each ,
   P0-10 : 15ohm, P0-11: 1200W

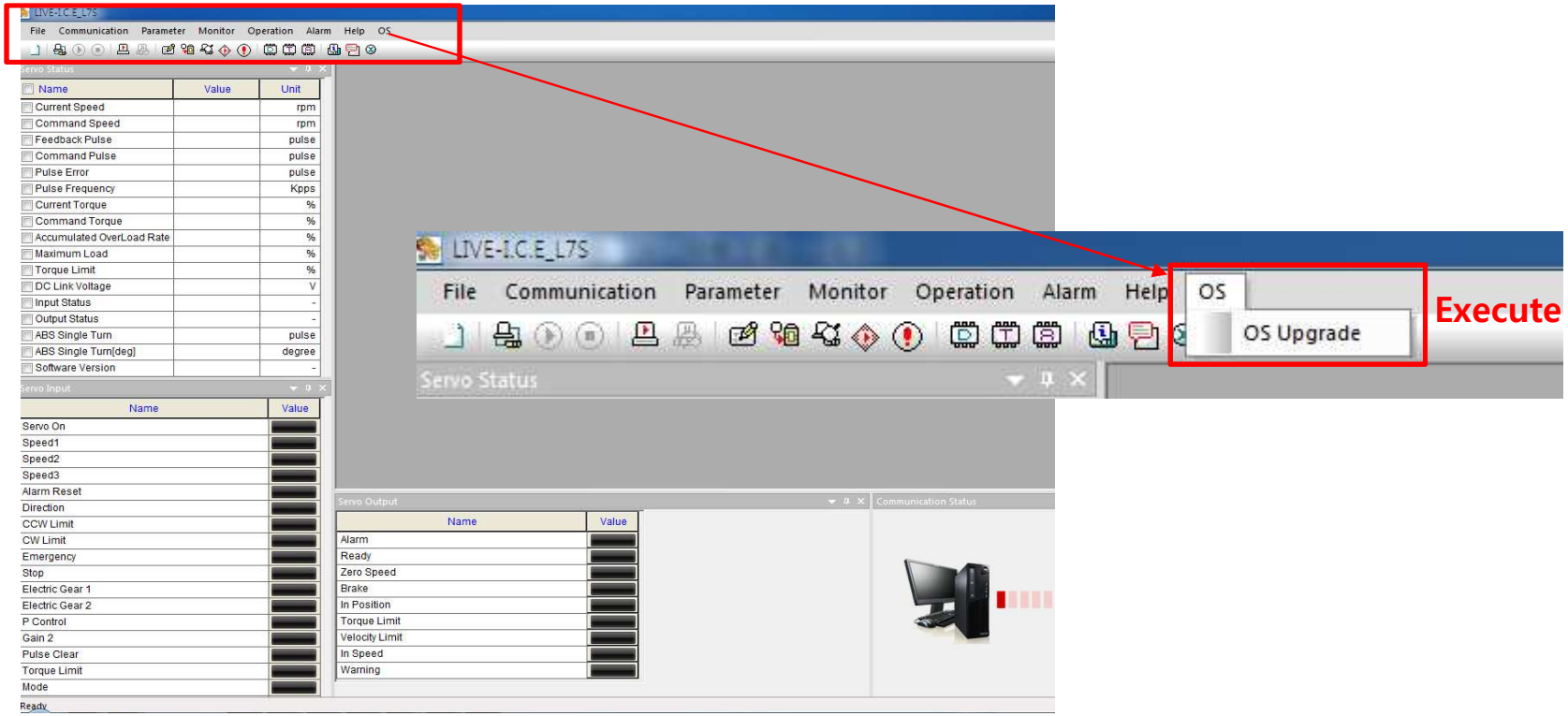


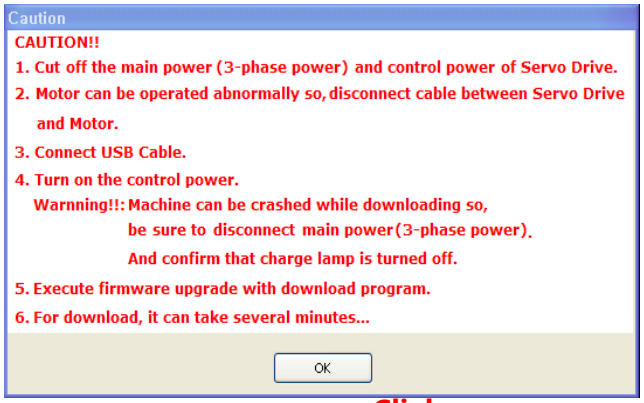
Wiring for external regenerative resistor

L7S Ver1.29 OS Download

1. If current version is 1.28, need to upgrade 1.29 version

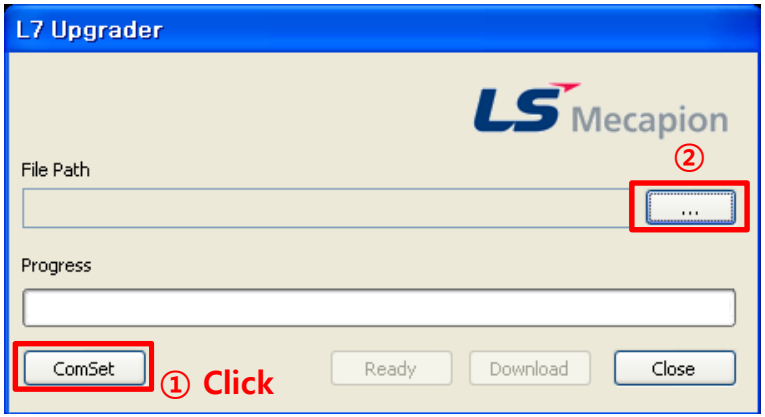
*** Execute OS with upgrader in Live-I.C.E**

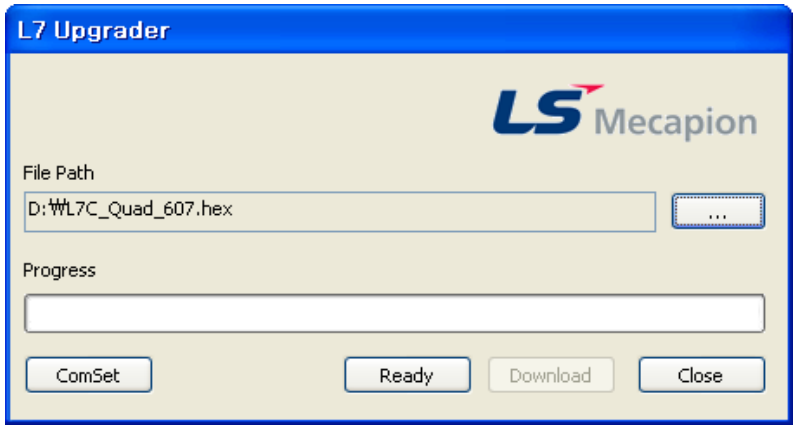




Click

1. ① Connect Port
2. ② Load the.Hex file that is downloading
3. ③ When loading Hex file, Ready button is activated. When Ready button is clicked, Download button is activated

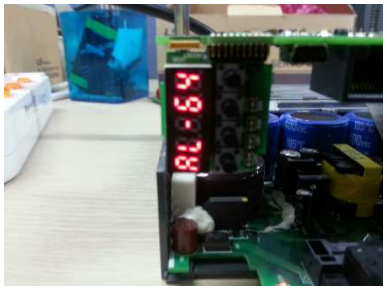




L7S Ver1.29 OS Download

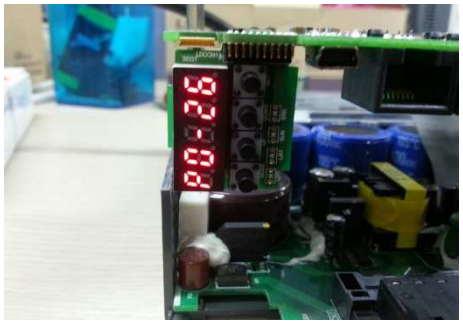
Use the multi-turn encoder as single-turn

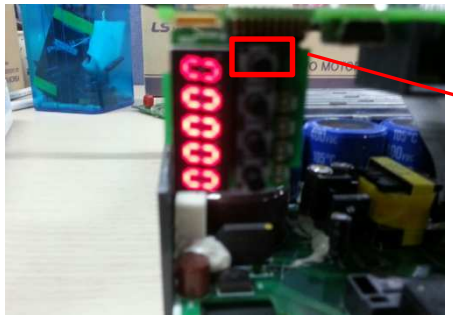
1. When downloading Ver1.29 in current OS, AL-64 occurs



2. After saving 0 in [P0-26], Power off/on

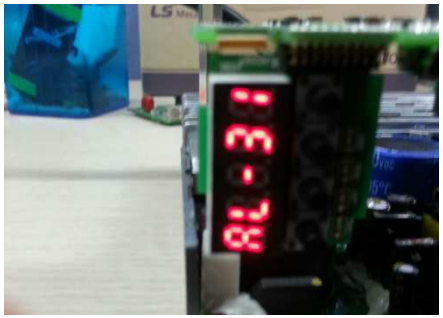
(The value of P0-26 is already 0. But, you have to save the value in EEPROM by set key because it was not save in EEPROM))





<Save by Set Key>

3. AL-31 occurs after Power off/on



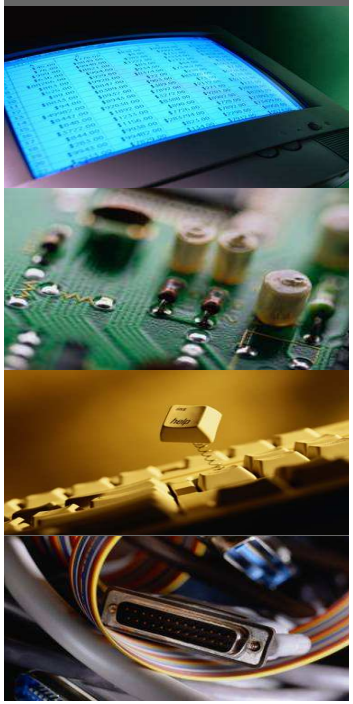
■ Use the multi-turn encoder as single-turn

■ Use the multi-turn encoder as single-turn

1) Input 0 in P0-26 (Use multi-turn)

2) Input 1 in P0-26 (Use single-turn)

Guide Book for L7S Series Speed Mode



09.Mar,2015

Technical support team/Eric Son

LS Mecapion

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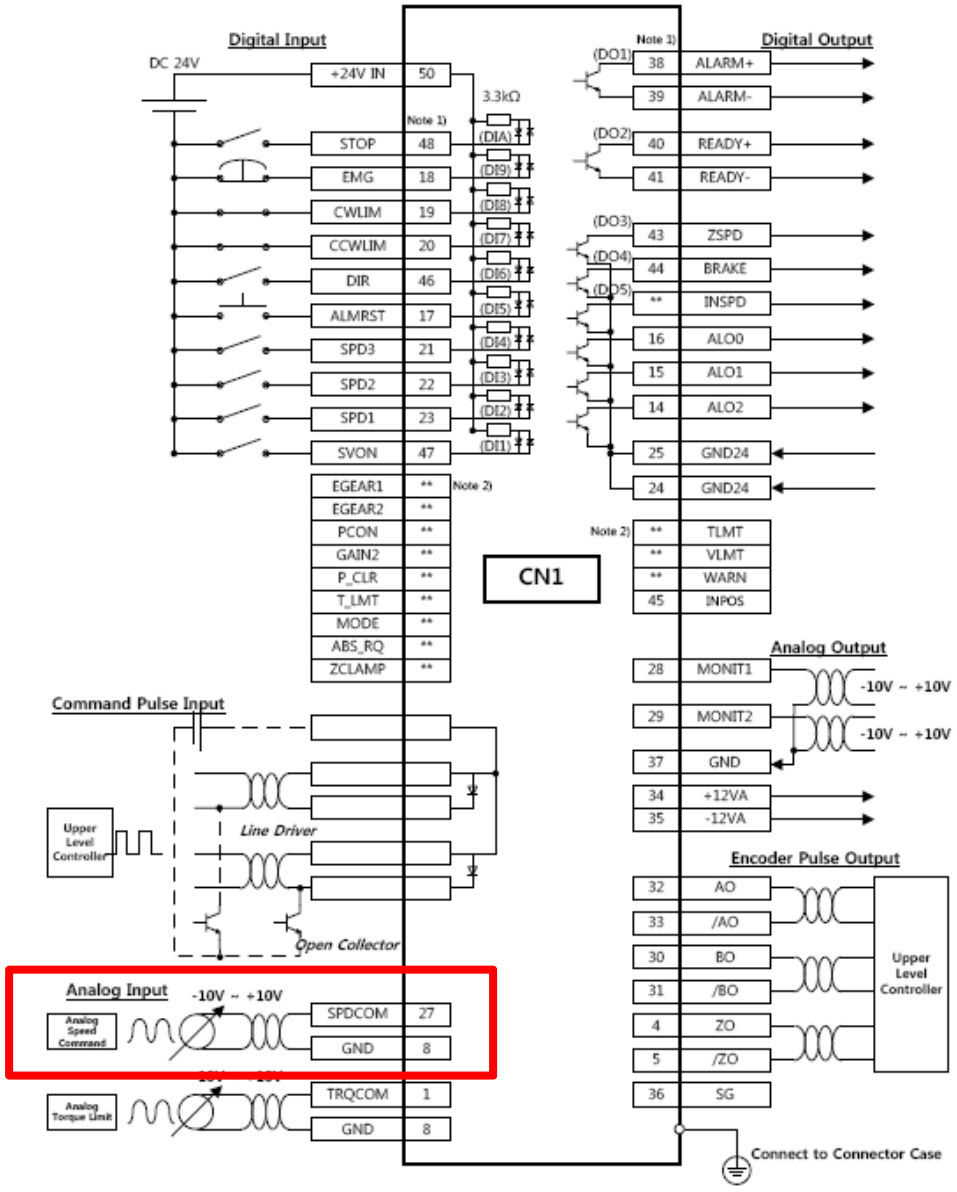

Digital Input
DC 24V
+24V IN 50
3.3kΩ
Note 1)
STOP 48 (DI1A)
EMG 18 (DI9)
CWLIM 19 (DI8)
CCWLIM 20 (DI7)
DIR 46 (DI6)
ALMRST 17 (DI5)
SPD3 21 (DI4)
SPD2 22 (DI3)
SPD1 23 (DI2)
SVON 47 (DI1)
EGEAR1 ** Note 2)
EGEAR2 **
PCON **
GAIN2 **
P_CLR **
T_LMT **
MODE **
ABS_RQ **
ZCLAMP **
Digital Output
Note 1)
(DO1) 38 ALARM+
39 ALARM-
(DO2) 40 READY+
41 READY-
(DO3) 43 ZSPD
(DO4) 44 BRAKE
(DO5) ** INSPD
16 ALO0
15 ALO1
14 ALO2
25 GND24
24 GND24
Note 2) ** TLMT
** VLMT
** WARN
45 INPOS
CN1
Analog Output
28 MONIT1
-10V ~ +10V
29 MONIT2
-10V ~ +10V
37 GND
34 +12VA
35 -12VA
Encoder Pulse Output
32 AO
33 /AO
30 BO
31 /BO
4 ZO
5 /ZO
36 SG
Upper Level Controller
Command Pulse Input
Upper Level Controller
Line Driver
Open Collector
Analog Input
-10V ~ +10V
Analog Speed Command
SPDCOM 27
GND 8
Analog Torque Limit
TRQCOM 1
GND 8
Connect to Connector Case

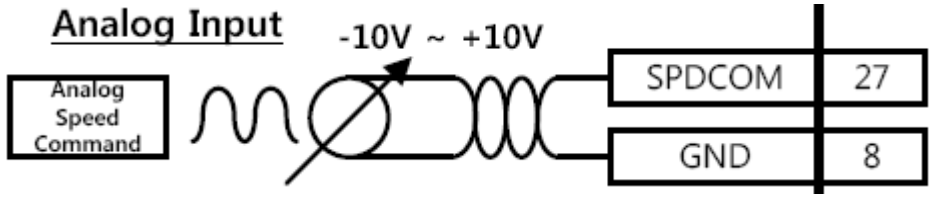
Outline for speed mode

▶ Set as below ordering

1. Wiring on CN1
   - Analogue speed command : CN1, No.27(SPDCOM), No.8(GND) Wiring
2. Basic parameters setting
   - Motor ID->Encoder type->Encoder pulse numbers->Operation mode
3. Motor operation test as increase gradually Analogue speed command voltage
4. Check speed command(rpm) and speed feedback(rpm)
5. When ordering 0V, if motor is rotated, adjust not to rotate motor as using speed offset function
6. Accel/Decel time setting when necessary
7. Use Zero clamp function to reduce offset of command from upper controller
8. Adjust Drive according to load condition

▶ Speed command

Analogue speed command input signal : I/O pin no.27, no8



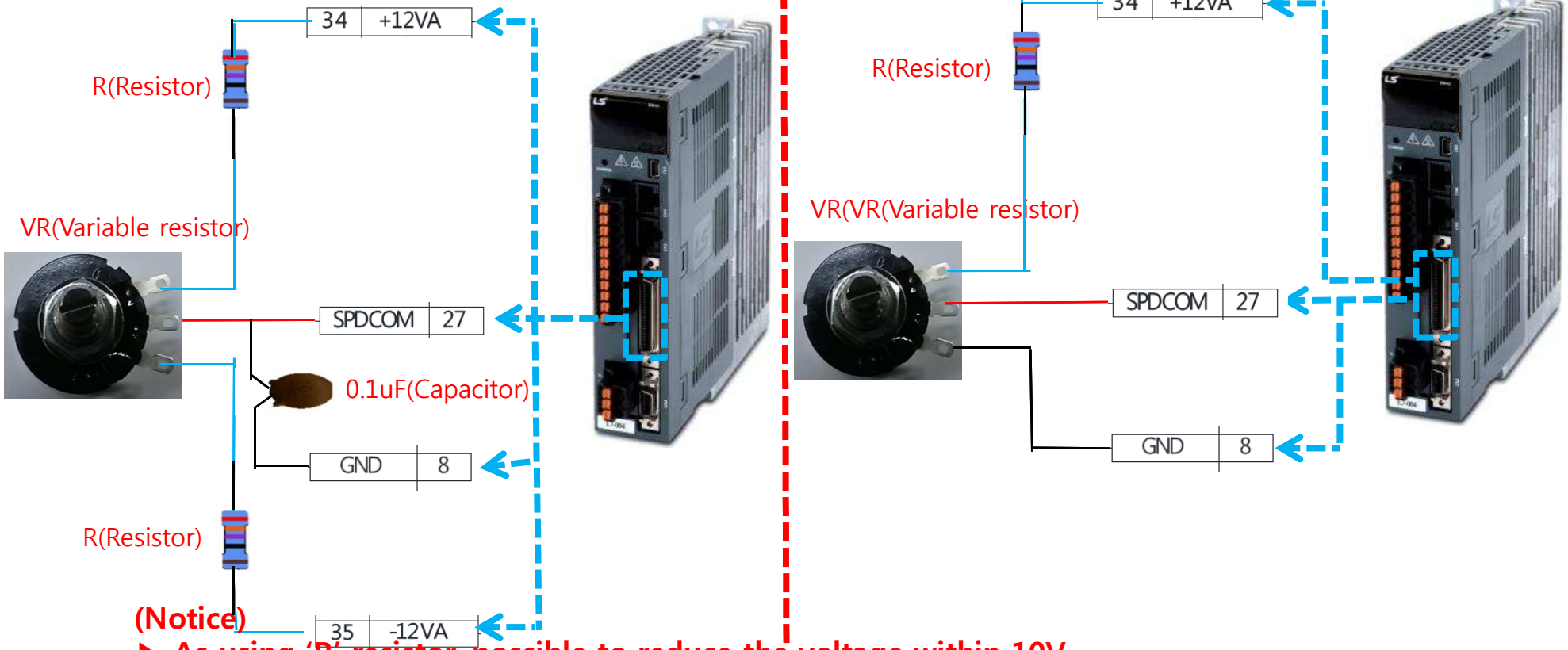
Analog speed scale setting [P2-17] : Sets speed scale when the analog speed command is 10 [V].
The maximum value is the maximum motor speed

If input value is 2000, when 10V, motor is rotated at 2000rpm

Analog speed command by using variable resistor

▶ Analog input adjustment by using variable resistor with using power supplied by the drive

Division	VR	R
selection1	10[kΩ]	660[Ω]
selection2	5[kΩ]	330[Ω]
selection3	2[kΩ]	132[Ω]



(Notice)

▶ As using 'R' resistor, possible to reduce the voltage within 10V.

▶ In the case of one side polarity only like right picture, Motor is rotated one direction only

▶ Analog speed scale[P2-17] :

Set the analog speed command of 10 [V] in the unit of [RPM].

The maximum value is the maximum motor speed. If input value is 2000, when 10V, motor is rotated at 2000rpm

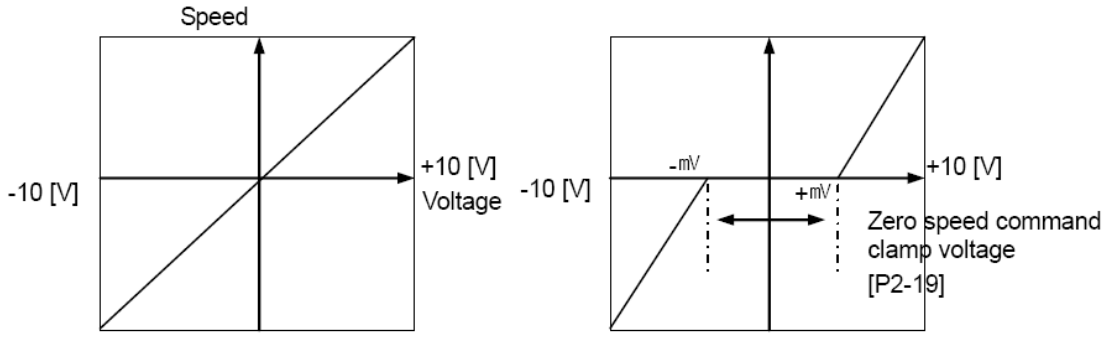
▶ Analog speed offset [P2-18]:

There are cases where a certain level of voltage remains on the analog signal access circuit, even at the 0 speed command. In this case, you can compensate it by setting the voltage as offset. The unit is [mV].

▶ Zero speed clamp voltage [P2-19]:

The voltage command under the zero speed clamp level[P2-19] is ignored

When speed command over the level inputs, motor is rotated by command value

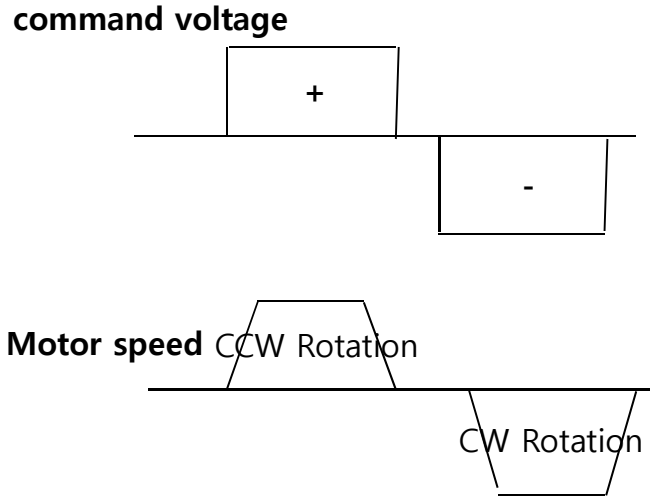


Zero speed command clamp voltage"
[P2-19] = 0

Zero speed command clamp voltage
[P2-19] = Not 0 [mV]

▶ Input of direction change :

In speed mode, motor direction is changed by polarity of voltage



If Input contact DIR(No.46) is On, Motor direction is changed as speed command is reversed

▶ STOP input :

After Servo-On, If speed command voltage is input after Servo-On, Motor is rotated

Input contact STOP(No.48) is on, Motor will be stopped.

▶ Soft operation setting :

As setting Accel/Decel and S-curve operation, possible for softer operation to reduce shock that can occur when Accel/Decel

▶ Acceleration/Deceleration Time :

Acceleration Time[P3-08]: Set the time required for the motor to reach the rated motor speed from zero speed in [ms] units

Deceleration TimeP3-09]: Sets the time required for the motor to stop after running at the rated

▶ S-Curve operation[P3-11]

You can set acceleration/deceleration operation as an S-curve pattern for smooth acceleration/deceleration.

0: Trapezoidal -> Set acceleration/deceleration time [P3-08] and [P3-09].

1: Sinusoidal -> Set acceleration/deceleration time [P3-08] and [P3-09] + S-curve time [P3-10].

(Notice)

▶ Without Acceleration/Deceleration setting, S-curve operation is not available. To use S-Curve operation, set Acceleration/Deceleration in advance.

▶ Before setting acceleration/deceleration time, if operation time is 20S, total operation time is => 20Second+Acceleration/Deceleration Time[P3-08],[P3-09]+S-Curve time[P3-10]

▶ Servo lock setting :

1) Servo-Lock : In speed mode, even if the speed command input is 0, the position of servo is not locked. If Servo-Lock function is set(P0-17), the position of servo is locked

If Servo-Lock function is used, it controls the position of the time that speed command input is 0

2) Servo lock setting[P0-17]:

DIGIT2 of Parameter [P0-17] -> "0" : Not use

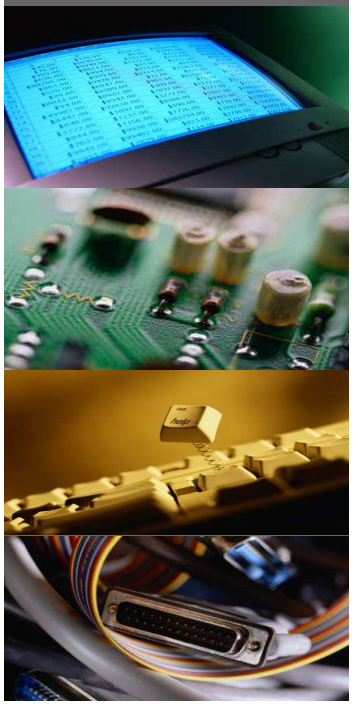
"1" : Use

▶ Digital speed command(P3-00~P3-06) :

It is operated by drive internal speed as using input signals SPD1(No.23), SPD2(No.22), SPD3(No.21) not using external analog input voltage.

SPD1	SPD2	SPD3	Speed control
OFF	OFF	OFF	Analog speed command
ON	OFF	OFF	Digital speed command1
OFF	ON	OFF	Digital speed command2
ON	ON	OFF	Digital speed command3
OFF	OFF	ON	Digital speed command4
ON	OFF	ON	Digital speed command5
OFF	ON	ON	Digital speed command6
ON	ON	ON	Digital speed command7

Guide Book for L7S Series Torque Mode



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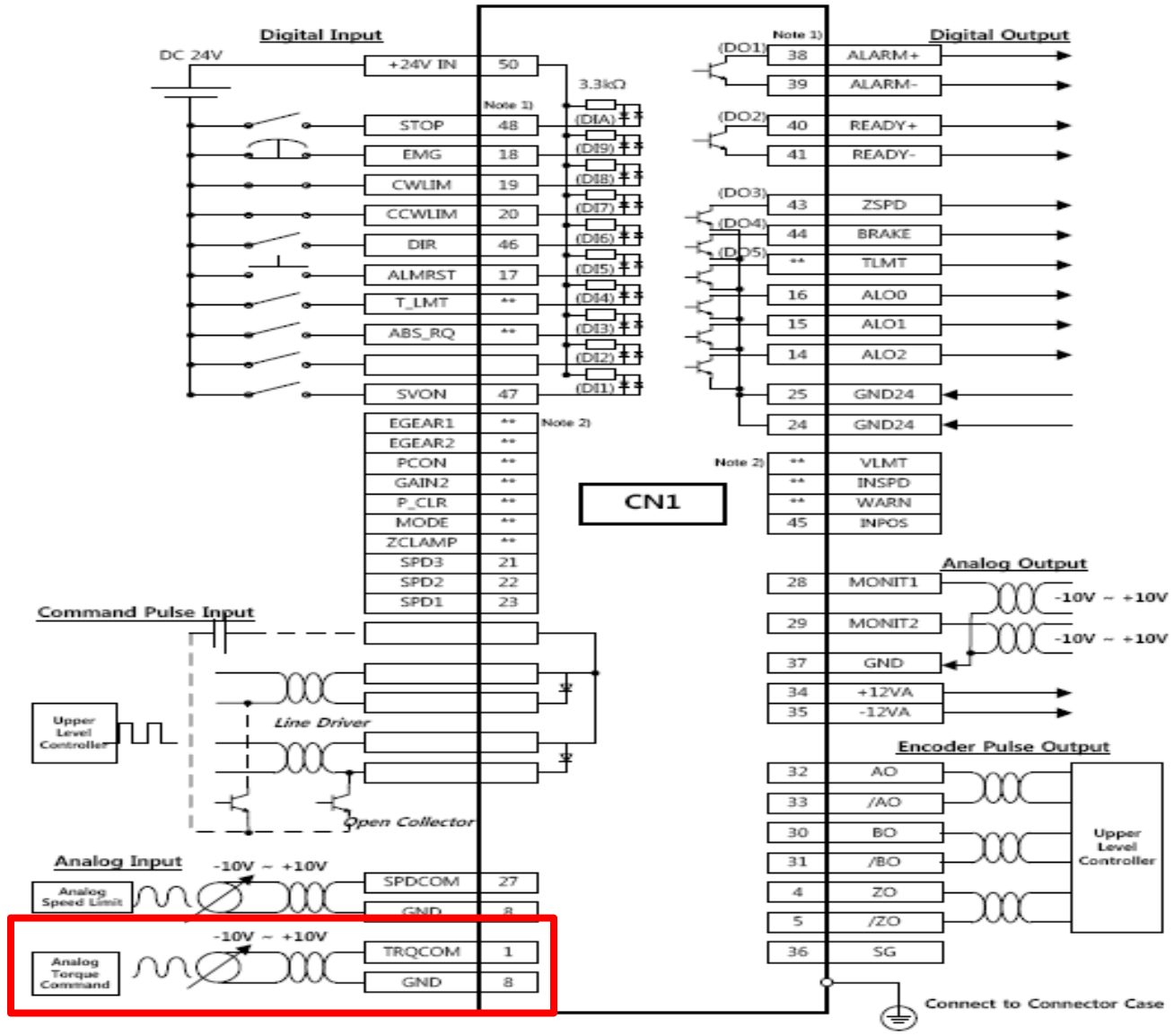
Contains

1. Wiring diagram
2. Outline
3. Parameter settings
4. Torque command
5. Gain Tuning


Digital Input
DC 24V
+24V IN 50
3.3kΩ
Note 1)
STOP 48
EMG 18
CWLIM 19
CCWLIM 20
DIR 46
ALMRST 17
T_LMT **
ABS_RQ **
SVON 47
(DI1)
(DI2)
(DI3)
(DI4)
(DI5)
(DI6)
(DI7)
(DI8)
(DI9)
(DIA)
EGEAR1 **
EGEAR2 **
PCON **
GAIN2 **
P_CLR **
MODE **
ZCLAMP **
SPD3 21
SPD2 22
SPD1 23
Note 2)
CN1
Digital Output
Note 1)
(DO1)
ALARM+ 38
ALARM- 39
(DO2)
READY+ 40
READY- 41
(DO3)
ZSPD 43
(DO4)
BRAKE 44
(DO5)
TLMT **
ALO0 16
ALO1 15
ALO2 14
GND24 25
GND24 24
Note 2)
VLMT **
INSPD **
WARN **
INPOS 45
Analog Output
MONIT1 28
MONIT2 29
-10V ~ +10V
-10V ~ +10V
GND 37
+12VA 34
-12VA 35
Encoder Pulse Output
AO 32
/AO 33
BO 30
/BO 31
ZO 4
/ZO 5
SG 36
Upper Level Controller
Connect to Connector Case
Command Pulse Input
Upper Level Controller
Line Driver
Open Collector
Analog Input
-10V ~ +10V
Analog Speed Limit
SPDCOM 27
GND 8
-10V ~ +10V
Analog Torque Command
TRQCOM 1
GND 8

Outline for torque mode

▶ **Outline:** Torque mode is to use for controlling tension and pressure of machine.

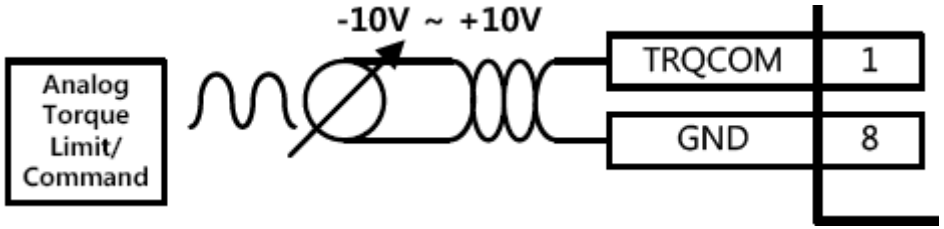
Input the voltage required from upper controller

▶ Set as below ordering

1. Wiring on CN1
   - Analog Torque command : No.1(TRQCOM), No.8(GND)
2. Basic parameters setting
   - Motor ID->Encoder type->Encoder pulse numbers->Operation mode
3. Motor operation test as increase gradually Analogue Torque command voltage
4. Check analog torque command scale and current command torque[St-08]
5. When ordering 0V, if motor is rotated, adjust not to rotate motor as using torque offset
6. Torque limit setting
7. Use Zero clamp function to reduce offset of command from upper controller
8. Adjust Drive according to load condition

▶ Torque command

Analogue Torque command input signal : I/O pin no.1, no8



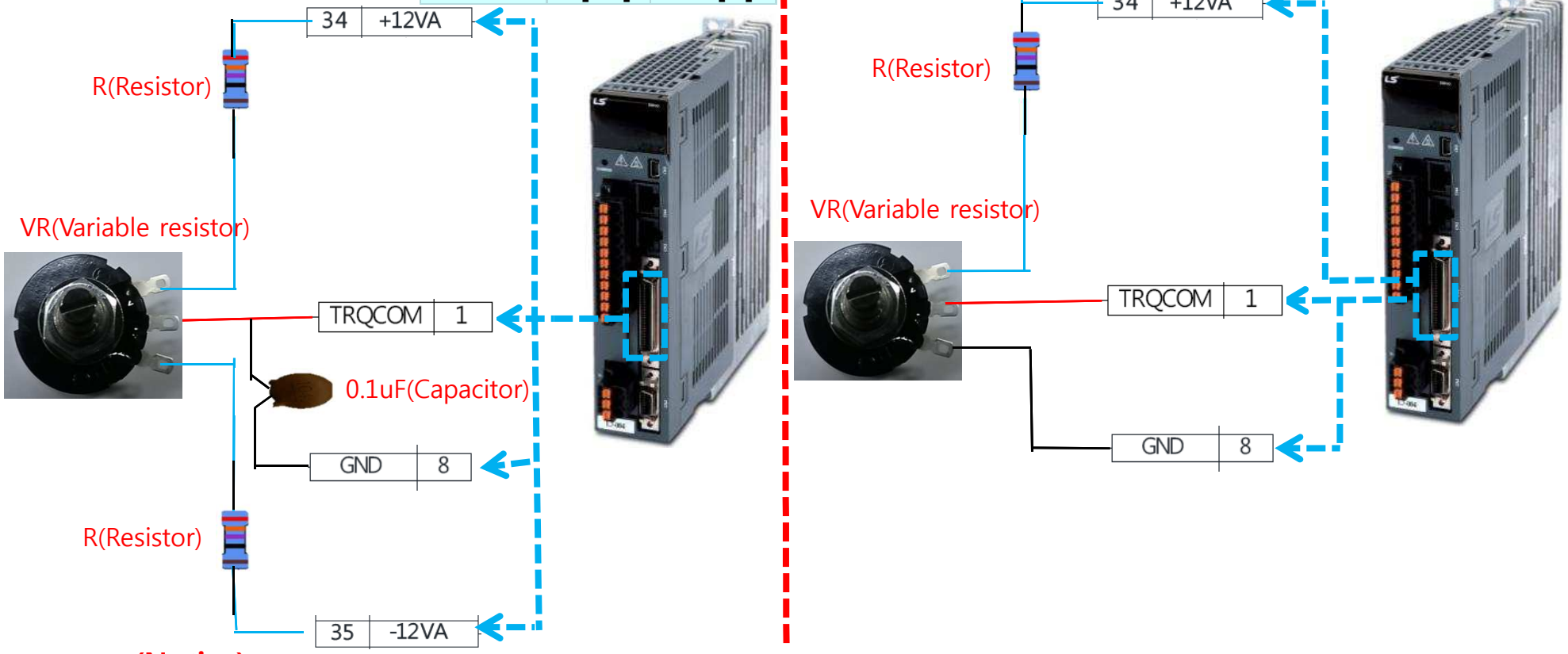
*Current operation torque (St-07) : Displays the current load factor against the rated load factor
(Displays the load currently output by the servo motor as a percentage against the rated output)

*Current command torque (St-08) : Displays the command load factor against the rated load factor
(Displays the load currently output by the servo motor as a percentage against the rated output)

■ Analog Torque command by using variable resistor

▶ **Analog input adjustment by using variable resistor with using power supplied by the drive**

Division	VR	R
selection1	10[kΩ]	660[Ω]
selection2	5[kΩ]	330[Ω]
selection3	2[kΩ]	132[Ω]



(Notice)

- ▶ **As using 'R' resistor, possible to reduce the voltage within 10V.**
- ▶ **In the case of one side polarity only like right picture, Motor is rotated one direction only**

▶ Analog Torque Scale Setting[P2-20] :

Set the analog torque command of 10 [V] as a percentage of the rated torque. The setting should be within the torque limit [P1-13] and [P-14] of system parameter setting.

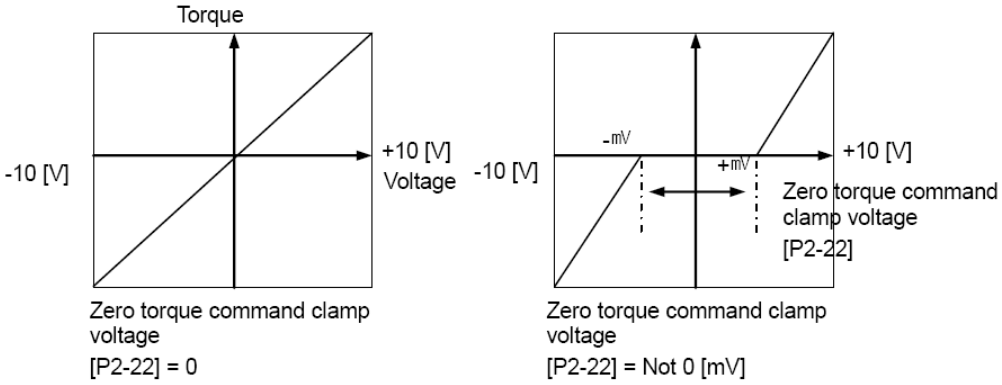
▶ Torque command offset[P2-21]:

There are cases in which a certain level of voltage remains on the analog circuit, even at the 0 torque command, because of problems with the circuit. You can compensate this by setting the voltage as offset. The unit is [mV].

▶ Zero Torque clamp voltage[P2-22]:

The voltage command under the zero speed clamp level[P2-22] is ignored

When speed command over the level inputs, motor is rotated by command value



▶ **Velocity limit in torque mode :** This function is to limit velocity for protection machine. In Torque mode, Servo motor is controlled by command torque but velocity is not controlled. Therefore, When over torque command is set, the velocity of motor is over machine torque and over speed occurs. For that case, possible to use velocity limit

▶ **Velocity limit switch :** Sets speed limit mode during torque control

* 0: Limit to [P1-23]. 1: Maximum motor speed 2: Analog speed command
  3: Limited to the smaller value between the value of [P1-23] and the analog speed command.

* Sets speed limit when speed limit mode [P1-22] is 0 during torque control

▶ **STOP input :**

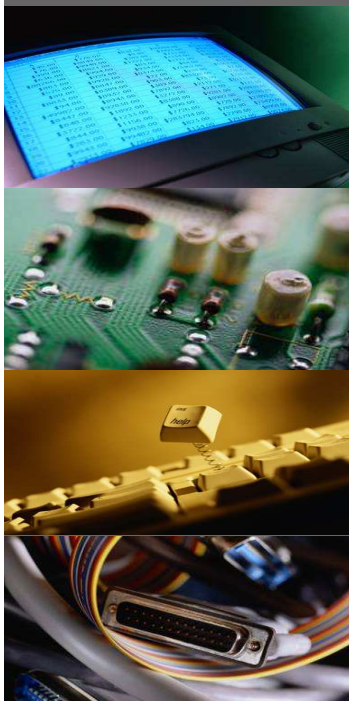
After Servo-On, If speed command voltage is input after Servo-On, Motor is rotated

Input contact STOP(No.48) is on, Motor will be stopped.

(Notice)

▶ **The setting of Acceleration/Deceleration Time and S-curve operation is available for Speed mode, only. It is not available for Torque mode**

L7S 400V



09.Mar,2015

Technical support team/Eric Son

LS Mecapion

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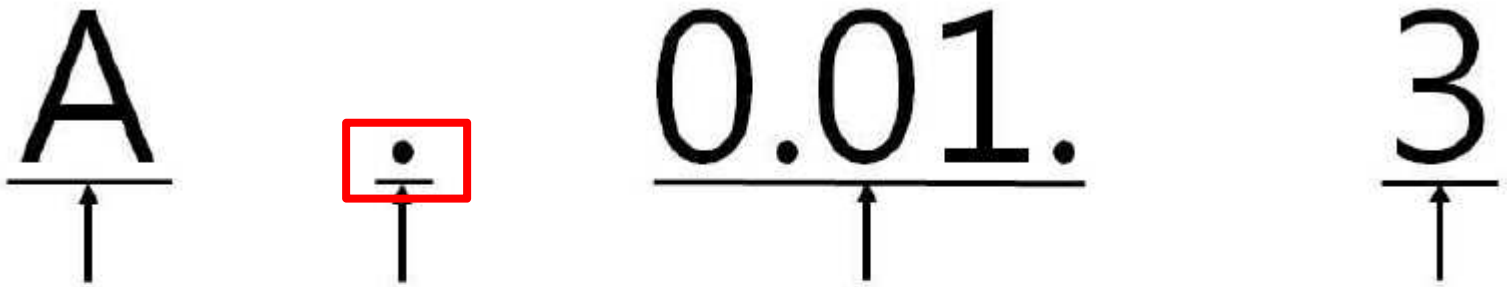
▶ Configuration difference between 400V Drive & 220V Drive

	Configuration difference	
Drive Specification	220V	400V
Input Power	200V ~ 230V	380V ~ 480V
Dimensions for Power circuit electrical parts	Reference for Related pages	
Basic parameter setting (Motor ID, Encoder type, Encoder pulse setting)	Same	
DC Link Voltage (ST-12)	0~500V	0~900V
Other parameters	Same	

Software version display



Character	Encoder Type
A	Quad
B	Serial

Display	Rated Voltage Type
Dot	400V
None	200V

Number	Drive Capacity
0	Default
1	100 [W]
2	200 [W]
3	400 [W]
4	750 [W]
5	1 [kW]
6	2 [kW]
7	3.5 [kW]
8	5 [kW]
9	7.5 [kW]
A	15 [kW]

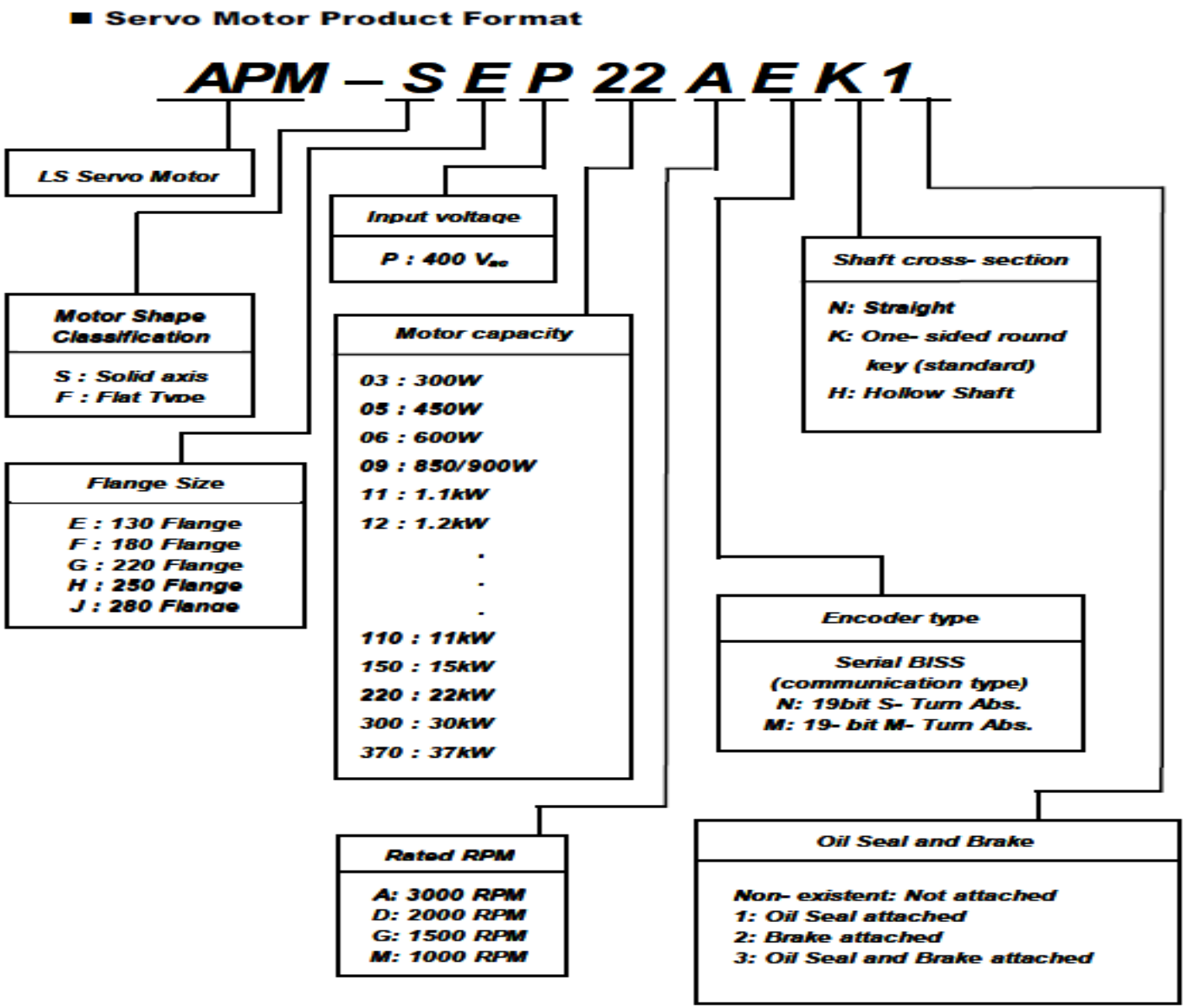
Servo Drive Product Format

■ The Servo Drive Product Format

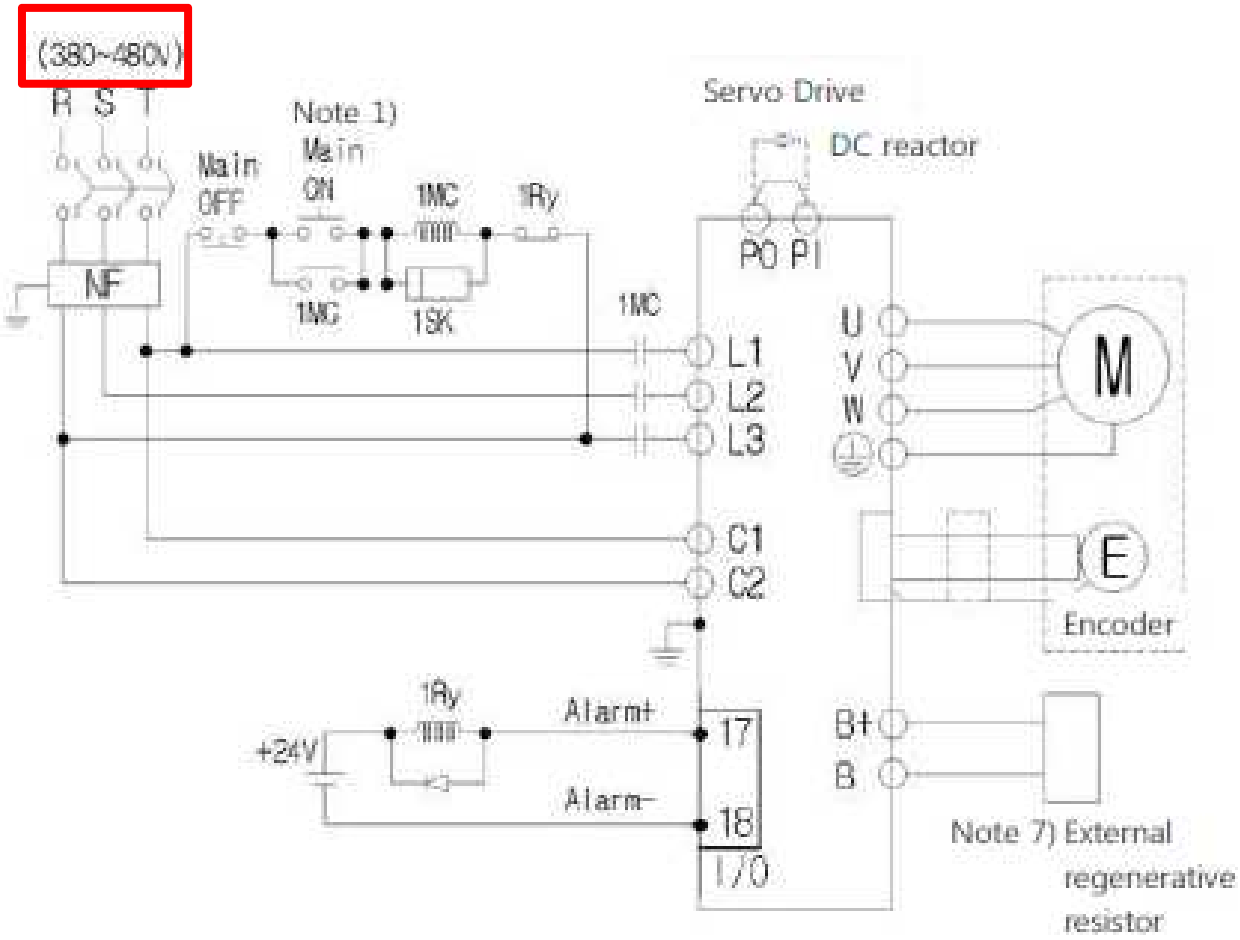
L7	S	B	010	B	AA
Series Name	Communication Type	Input voltage	Capacity	Encoder Type	Option
The Servo Series	S: Standard I/O type	B: 400 VAC	010: 1.0kW 020: 2.0kW 035: 3.5kW 050: 5.0kW 075: 7.5kW 150: 15.0kW	B: Serial only (communication type)	Exclusive Option

▶ Serial encoder type motor is supported only for 400V drive

Servo Motor Product Format



▶ **Input power : 380~480V, (For 220V Drive, Input 200~230V)**



▶ Dimensions for power circuit electrical parts

● 400V

Name		L7SB010□	L7SB020□	L7SB035□	L7SB050□	L7SB075□	L7SB150□
MCCB		30A Frame 10A (ABE33b/10)	30A Frame 20A (ABE33b/20)		30A Frame 30A (ABE33b/30)	30A Frame 30A (ABE33b/30)	50A Frame 50A (ABE53b/50)
Noise Filter (NF)		TB6-B010LBEI (10A)	TB6-B020NBDC (20A)		TB6-B030NBDC (30A)	TB6-B040A (40A)	TB6-B060LA (60A)
DC reactor		10 A	20 A		30A	30 A	50 A
MC		9A / 550V (GM□-12)	18A / 550V (GM□-22)		28A / 550V (GM□-40)	26A / 550V (GM□-40)	38A / 550V (GM□-50)
Wire Note 1)	L1, L2, L3 PO, PI, N B+, B U, V, W	AWG14 (2.08 ㎟)			AWG10 (5.5 ㎟)		AWG8 (8.0 ㎟)
	C1, C2	AWG14 (2.08 ㎟)					
Crimp terminal		UA-F4010, SEOIL (10 mm Strip & Twist)			GP110028 KET	GP110028 KET	GP110732 KET
Regenerative resistor (Default)		100 W 100 Ω	150 W 40 Ω		120 W 27 Ω	240 W 27 Ω	
Connector (Default)		BLZ 7.62HP/3/180LR SN OR BX SO BLZ 7.62HP/11/180LR SN OR BX SO					

● 220V

Name		L7SA001□	L7SA002□	L7SA004□	L7SA008□	L7SA010□	L7SA020□	L7SA035□	L7SA050□
MCCB(NFB)		30A Frame 5A (ABE33b/5)		30A Frame 10A (ABE33b/10)	30A Frame 15A (ABE33b/15)		30A Frame 30A (ABE33b/30)		50A Frame 40A(ABE53b /40)
Noise Filter (NF)		TB6-B010LBEI (10A)					TB6-B030NBDC(30A)		TB6-B040A(40A)
DC reactor		HFN-10 (10 A)			HFN-15 (15 A)		HFN-30 (30 A)		HFN-40(40A)
MC		11A / 240V (GM□-9)			18A / 240V (GM□-18)		32A / 240V (GM□-32)		50A / 240V (GM□-50)
Wire	L1,L2,L3 PO,PI,N, B+,B,BI U,V,W	AWG16 (1.5 ㎟)			AWG14 (2.5 ㎟)		AWG12 (4.0 ㎟)		AWG10 (6.0 ㎟)
	C1 C2	AWG16(1.5 ㎟)			AWG16(1.5 ㎟)		AWG16(1.5 ㎟)		AWG16(1.5 ㎟)
Crimp terminal		UA-F1510, SEOIL (10 mm Strip & Twist)			UA-F2010, SEOIL (10 mm Strip & Twist)		UA-F4010, SEOIL(10 mm Strip & Twist)		GP110028 KET
Regenerative resistance (Provided by default)		50 [W] 100 Ω			100 [W] 40 Ω		150 [W] 13 Ω		120[W] 6.8Ω
Connector (L1,L2...U,V,W)		• BLF 5.08/03/180F SN BK BX • BLF 5.08/11/180F SN BK BX					• BLZ7.62HP/03/180LR SN BK BX SO BLZ7.62HP/11/180LR SN BK BX SO		

DC Link Voltage

▶ **DC Link voltage :**

- **In 380V power, DC Link voltage is approximately 537V**
- **In 380V Power, Max allowed voltage is 800V**
- **If there is either too much regenerative energy or too little regenerative resistance capacity, Alarm[AL-41] triggers because DC Link voltage threshold is exceeded**
- **The normal DC link voltage in the regenerative section is 747V or below**