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Ver. 1.1

# OP-500 MANUAL

## BLDC Operator Series OP-500

Ver. 1.1

 SERVO INDUSTRIAL SYSTEMS CO., LTD.

# OP-500 MANUAL

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## 1. Introduction

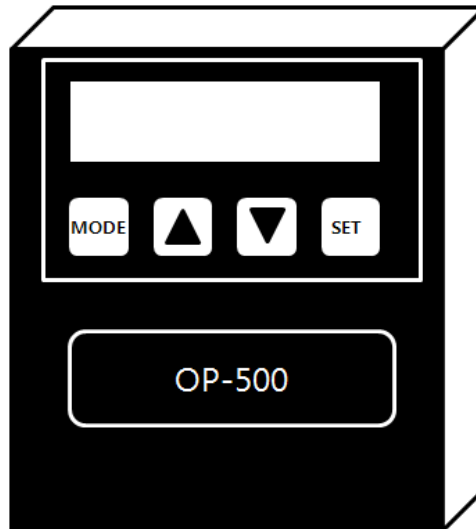


Figure 1. OP-500

OP-500 can be applied to standard digital driver model (400WD, 750WD), and this can display status, parameter setting, diagnostics, and alarm state by its display part, consists of six 7-segment LED display, also this can set various data through 4 button at the bottom of the display.

- ▶ Data through the switch operation, have stored, although the power is removed.
- ▶ Alarm history is remembered even if power off, and you can find its contents after power back on.

※ Notice : Attaching or detaching of OP-500, should be proceed after turn off the power.

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## 2. Operation flowchart of OP-500

### 2.1. Outline

Just after power-up, 7-segment LED displays the status mode, and converting mode is done by [MODE] button.

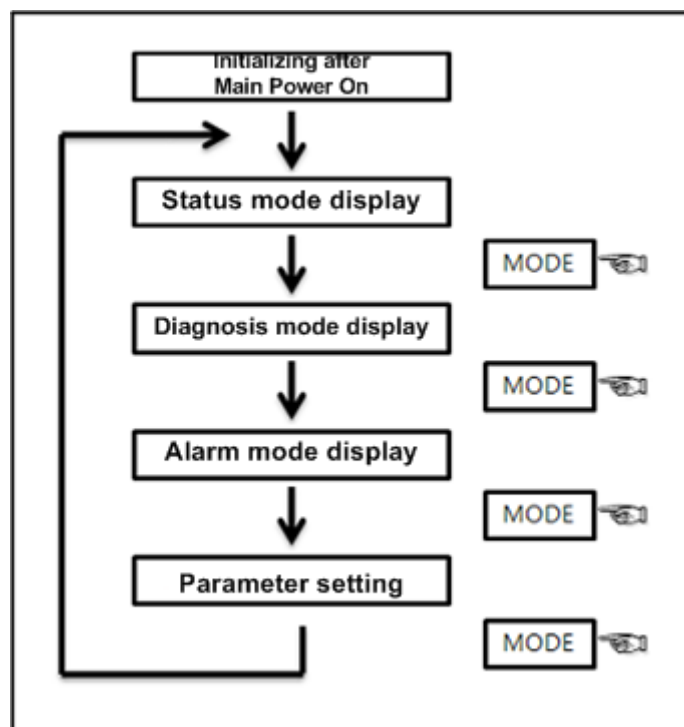


Figure 2. Flowchart for mode change

- ▶ When turn on the main power, 

b	L	d	C	#	#
---	---	---	---	---	---

 is displayed initially, and displays 

r		0	0	0	0
---	--	---	---	---	---

, which shows the motor speed.
- ▶ Increase or decrease the address/data is done by [UP][DOWN] button, and data storage and setting is operated by [SET] button.

Notice) "## " indicates Motor capacity, for example "10" means 100W , which increase and decrease by 100W unit.

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## 2.2. State transition diagram

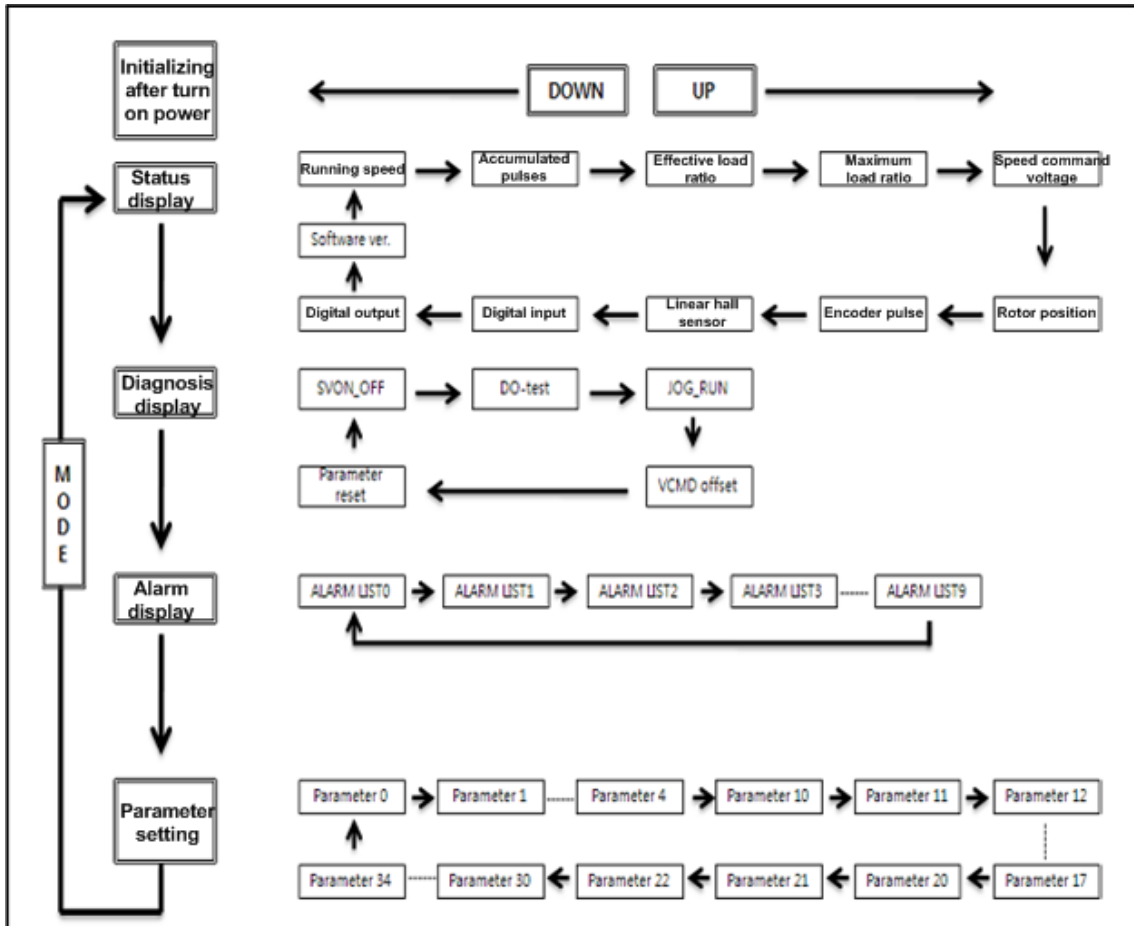


Figure 3. OP-500 State transition diagram

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## 3. Status display mode

### 3.1 Name and contents

Name	Symbol	Display range	content
Motor rotation speed	r	-9999~9999[RPM]	Display rotation speed of motor
Accumulated pulse of Hall sensor	b	-9999~9999[PULSE]	Count the value of Hall sensor to display the amount of rotation of the motor
※Effective load factor	L	-250~250[%]	Continuous rms current value is represented as a%
※ Max. load factor	H	-250~250[%]	Maximum effective current value display in %
Speed command voltage	U	0~5000[mV]	Displays analog external speed command voltage
Rotor position	P	1~6[STATOR]	Shows the value of the Hall sensors for each rotation angle of the rotor
Encoder pulse	E	-9999~9999[PULSE]	Indicates motor rotation amount by counting the encoder pulse
Liner Hall sensor	A	0~1023[ADC]	Output voltage of Liner Hall sensor is displayed by ADC value
Digital Input	dI.	---	On/Off state of digital input signal
Digital output	dO.	---	On/Off state of digital output signal
Software version	Soft.	1.0~	Version of driver software

Table 1. Contents for Status display mode

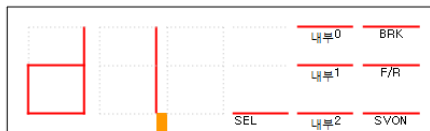
※Notice) In 400WD Driver

Effective load factor : Displays current value of currents by the value of the ADC, from 0 to 1023

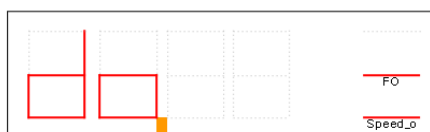
Maximum load factor : Displays maximum current value.

### 3.2. Details

▶ Digital input  : Displays On/Off state of digital input signal



▶ Digital output  : Displays On/Off state of digital output signal.



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## 4. Diagnostic mode

In diagnostic mode, we can verify and set the system conditions and the system initialization etc.

### 4.1. Name and contents

#### 4.1.1 SERVO ON / OFF

This indicates ON/OFF state of driver ready.

r  d  -  o  F  F : When driver is not ready

r  d  -  o  n  : When driver is ready for running

#### 4.1.2 Digital Output Test

The driver output signal can be output arbitrarily.

You can select the desired output by SET button, and on/off signal by the UP/ DOWN button .

d  o  -  t  S  t

#### ▶ How to use

d  o  -  t  S  t

SET

S  P  -  o  F  F DOWN         S  P  -  O  n  - UP

SET

F  O  -  o  F  F DOWN         F  O  -  O  n  - UP

SET

d  o  -  t  S  t

SP (Speed\_out), F0 (Fault\_out) 2 modes exists, when oFF setting the corresponding output port are low, and when ON setting ,its output ports are high state.

When return to its original state return to their original values.

※ F0(Fault out) is depending on the value of the parameter 17, the level of signal can be inverted at the output port.

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## 4.1.3 JOG RUN

Depending on the manual speed command set, JOG operation is carried out.

**J 0 9. r u n**

### ▶ How to use

**J 0 9. r u n**

SET□□

**J r 0 0 0 0 0** : Becomes driver ready state.

UP□□ : While holding the UP button, rotate counter-clockwise by the JOG speed.

**J r 0 1 0 0 0**

DOWN□□ : While holding the DOWN button, rotate clockwise by the JOG speed.

**J r 0. 1. 0. 0.**

**J r 0 0 0 0 0** : When releasing the button, the motor stops.

SET□□

**J 0 9. r u n** : Becomes driver not ready state.

### ※ How to change the rotation speed during JOG operation

**J r 0 0 0 0 0**

Press and hold [MODE] and [UP] buttons simultaneously, increasing the rotation speed.

**J r 0 1 0 0 0** ⇒ **J r 0 2 0 0 0**

**J r 0 0 0 0 0**

Press and hold [MODE] and [DOWN] buttons simultaneously, decreasing the speed.

**J r 0 1 0 0 0** ⇒ **J r 0 0 5 0 0**



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## 4.1.4 VCMD offset

The offset of the analog speed command voltage is automatically adjusted.

U - o F S t

### ▶ Using Method

U - o F S t : press the [SET] button 3 seconds

- - - - - : Initial display.

U - o F S t : Display after 3 second.

The analog speed command voltage value at this point, is recognized as 0V and its value is stored at the parameter 16.

ex) If setting the offset when applied speed command is 1V in the case of 1000rpm, motor rotates 0 rpm at 1V, 500 rpm at 3V, 1000 rpm at 5V, etc.

## 4.1.5 Parameter Reset

Each parameter value, which is stored in the driver memory, is initialized to the default values.

P A r A - -

### ▶ How to use

P A r A - - : SET□□

0. 0. 0 4 0 0 : Initialise the 0-34 parameters.  
~ ((values of the 6.2.1 table)

3. 4. 1 0 0 0

P A r A - - : A display after initialization is completed.


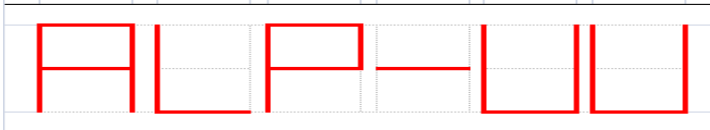
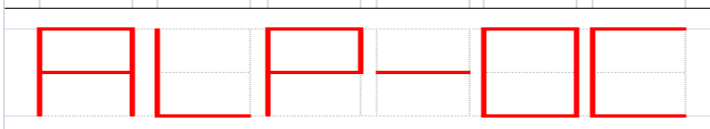
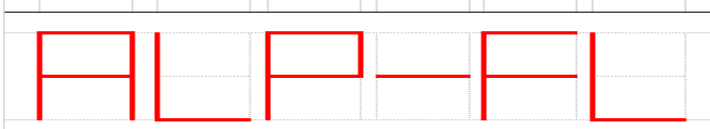

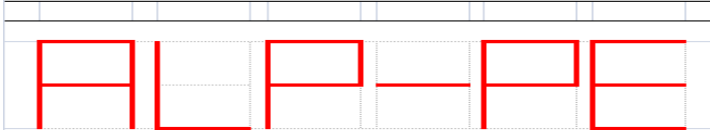
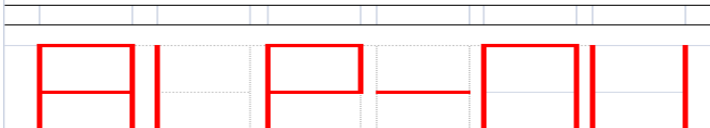
※ Before initializing the parameters of the driver, please stop driving.

Operation of each button is ignored during the initializing parameter.

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## 5. Alarm display mode

### 5.1.1 Alarm display

	: No Error
	: Under Voltage * This alarm is not stored in the memory.
	: Over Current
	: Feedback Loss (Hall sensor fault)
	: Over Load (When Over load sustained)
	: Parameter Error
	: Over Voltage

### 5.1.2 Alarm History

Alarm contents occurred in the past can be checked, this alarm history can also be initiated.

Alarm history can be confirmed the alarm state earlier raised, which is the more recent activity near number zero.

Maximum nine previous alarm history can be stored in memory.

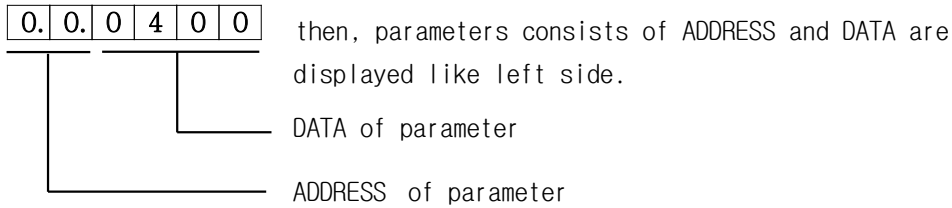
It can be checked by using the UP/DOWN buttons, and when you press the "SET" button for more than three seconds, stored alarm history is initialized.

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## 6. Use parameter mode

### 6.1 Setting method

1. Press the MODE□□ button



2. Select parameter number by UP/DOWN buttons.

ex) 

0.	2.	0	0	0	1
----	----	---	---	---	---

 : in the case of choosing ADDRESS 2

When you press the [SET] button, a part of DATA is blinked, and it turns into changeable state.

3. When display flicker state, DATA can be changed by UP/DOWN key.

ex) 

0.	3.	1	0	0	0
----	----	---	---	---	---

 ⇒ 

0.	3.	2	0	0	0
----	----	---	---	---	---

 : When data changes to 2000

0.	3.	1	0	0	0
----	----	---	---	---	---

 ⇒ 

0.	3.	1.	0.	0.	0.
----	----	----	----	----	----

 : When data changes to -1000

When you press the [SET] button after selecting the desired DATA, DATA flickering stop, and data setting is completed.

- ※ Press the button once turns the data by one, and keeping the button pressed, the more quickly the data can be changed.

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## 6.2 Contents of parameter

Before entering the operation, depending on the system configuration and operating information, the parameter settings is required.

The contents of the available parameters are as follows:

No	Name	Range (default)	class	Comment
0	Motor capacity	200~2000(용량)	C	[W]
1	Motor poles	2~10(4)	C	[POLE]
2	Encoder pulse	0~9999(0)	B	[PULSE]
3	Motor rotation direction	0/1(0)	A	
4	Rated speed	0~9999(3000)	B	[RPM]
5	PWM mode	0/1(1)	B	0: square wave 1: sine wave
6	Control mode	0/1(0)	B	0: Close Loop 1: Open Loop
7	.	.	.	.
8	.	.	.	.
9	.	.	.	.
10	Current limit	50~250(200)	B	[%]
11	Speed command scale	0~5000(5000)	B	[mV]
12	Accel/Deceleration time	1~9999(100)	A	[Adjust Variable register and scale]
13	Overload time	0~9999(10)	A	[Adjust variable register and scale]
14	Speed limit	0~9999(3000)	B	[RPM]
15	Zero clamp	0~5000(200)	B	[mV]
16	Speed command offset	0~5000(0)	B	[mV]
17	Alarm signal type	0/1(0)	B	0: Close 1: Open
18	.	.	.	.
19	.	.	.	.
20	Internal speed 0	0~9999(1000)	A	[RPM]
21	Internal speed 1	0~9999(2000)	A	[RPM]
22	Internal speed 2	0~9999(3000)	A	[RPM]
23	.	.	.	.
24	.	.	.	.
25	.	.	.	.
26	.	.	.	.
27	.	.	.	.
28	.	.	.	.
29	.	.	.	.

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No	Name	Data limit(default)	class	Note
30	Velocity loop P gain	0~9999(700)	A	
31	Velocity loop I gain	0~9999(7)	A	
32	Current loop P gain	0~9999(100)	D	
33	Current loop I gain	0~9999(50)	D	
34	Position loop P gain	0~9999(100)	D	
35	.	.	.	.
36	.	.	.	.
37	.	.	.	.
38	.	.	.	.
39	.	.	.	.
40	.	.	.	.

※ With respect to parameter modification is classified as follows,

Group	Remark
A	The parameter can be modified under the SERVO ON state
B	The parameter can be modified under the SERVO OFF state
C	Changed parameter is taken effect after driver- restart
D	The parameters cannot be modified by the user.

## 6.2.1 Details

### No.0 Motor Capacity

- ▶ According to the motor capacity, the rated current is set.

### No.1 Motor Poles

- ▶ It should be set to match the motor's poles.  
Incorrectly set with the poles of the motor, rotation speed may be changed.  
ex) Motor with 4 pole : set 4.

### No.2 Encoder pulse

- ▶ Encoder A phase, B phase pulses are output 2000 pulses per revolution, respectively.  
At the time of forward direction, rotating counterclockwise(CCW) when viewing the motor shaft, B-phase is preceded than the A-phase pulse by 90°.

### No.3 Rotation Direction

- ▶ Origin pulse (Z-phase) is output 1 pulse per motor 1 revolution.  
You can change the direction of rotation of the motor.  
ex) The current parameter value is zero, the motor rotates in the forward direction(CW),  
when the parameter value is set to 1, the motor direction is reversed to CCW.

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## No.4 Rated Speed

- ▶ Set the rated motor speed.

ex) If you want to set the motor rated speed to 3000rpm, set 3000.  
and although you set the rated speed more than the speed limit(parameter No. 14),  
speed limit parameter value is set to the rated speed.

## No.10 Current Limit

- ▶ Set the motor current limit as percent value (%).

ex) If you set 100%, the current over the 100% is limited as 100%

## No.11 Velocity Limit

- ▶ Depending on set value (mV), when motor is rotating at rated speed, the voltage of rotation can be changed.

ex) When the rated speed of 3000rpm,  
parameter 5000 setting, motor rotated as 3000 rpm at 5V applied.  
parameter 2500 setting, motor rotated as 3000 rpm at 2.5V.

## No. 12 Acceleration / Deceleration Time

- ▶ It is the required time to reach the target speed.

Adjustable by the VR3 of the driver, and the accel/decel time is more faster as  
closer to value 1, more slower as closer to value 9999.

## No. 13 Over-Load Time

- ▶ It is the setting time to cause the overload alarm, when continuous load is more  
than allowed value.

Adjustable by the VR4 of the driver and, as closer to 0 in the parameter causes  
overload alarm faster, as closer to 9999 alarm time to occur is slow.

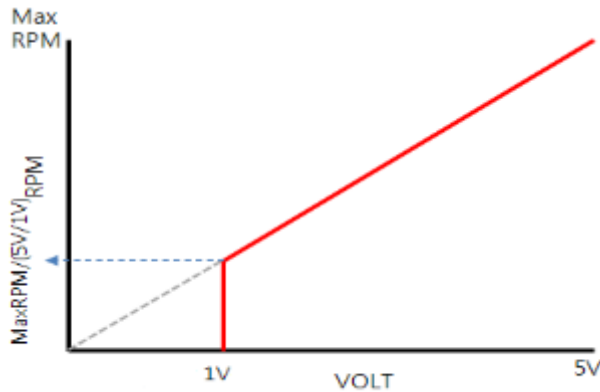
## No. 14 Velocity Limit

- ▶ Set this parameter when you desire to limit motor speed, at the time of motor  
driving.

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## No. 15 Zero Clamp

- ▶ Reference voltage to set the zero clamp.



Ex)

When the clamp\_zero is set to 1V, motor speed is recognized to 0 RPM until 1V.

When voltage is 1V or more, the speed depends on the results of the expression below.

$$RPM = MaxRPM \times \frac{x}{5V}$$

\* x = Speed command voltage

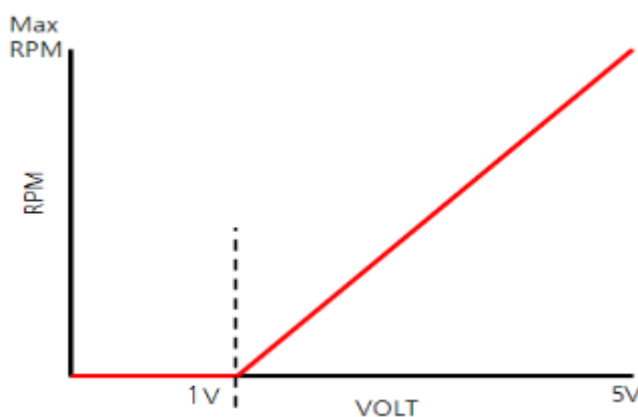
Motor can not be driven in the range of this value, and only driven over the range of zero clamp speed. Associated with the lowest RPM of the motor.

## No. 16 Speed Command Offset

- ▶ you can set the offset of speed command at this parameter, which behave same function as that of diagnostic mode.

It's just different that the former is manually operated, on the other hand, the latter automatically set.

Speed command only works over the set offset voltage.



Ex)

When setting the speed reference offset 1V, recognized to 0 RPM until the input 1V

In the case of 1V or more, speed is as follows.

$$RPM = MaxRPM \times \frac{x-1V}{5V-1V}$$

\*x = speed command voltage

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### No. 17 Alarm signal type

- ▶ In the case of an alarm in the driver, determine the output signal type.  
if 0 is set: signal output is shorted when normal operation,

output is opened when alarm state.

if 1 is set: signal output is opened when normal operation,  
output is shorted when alarm state.

### No. 20~22 Internal Speed 0~2

- ▶ Sets the internal speed command.

If the corresponding internal rate terminal of CN1 connector and internal speed selection (pin 15) are short-circuited with 24G (pin 11), the motor is running with its internal speed.

※ Not yet applied in 400W Driver, will applied since 750W Driver REV3.0 model.

### No. 30 Speed control P gain

- ▶ Speed control P gain is the parameter to determine the speed control response. Characteristics appearing externally, determines the strength of stiffness. As P-gain increase, stiffness grows stronger.

However, the P gain value over which setting may cause the vibration and hunting. Therefore, It is recommended that the P gain is set as large as possible, within the instability does not occur.

### No. 31 Speed control I gain

- ▶ This is the element of compensation to reduce the steady-state error and to increase stiffness.

As I-gain larger, get higher rigidity, but if too large, the vibrations may cause the system to be unstable.

### No. 32 Current Control P gain

- ▶ Factory-tuned, and the user can not change.

### No. 33 Current Control I gain

- ▶ Factory-tuned, and the user can not change.

### No. 34 Position Control P gain

- ▶ P gain for position control is parameter to determine the response of the position control.

Increasing this value, better responsiveness, but larger value may cause more shock, applied to motor at the time of running or stopping.



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On the other hand, less setting cause delayed response, and increase the amount of error pulse can cause the position error.