AC Servo Motor Driver

SIDC SIA series

User's Manual

Thank you for purchasing 「SIDC SIA」 series.

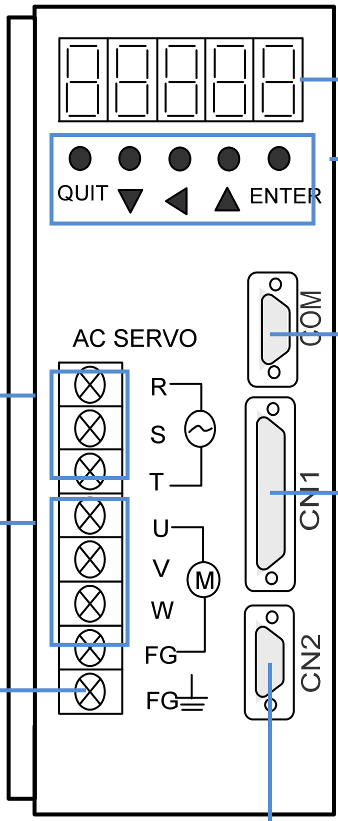
Please read this manual thoroughly before operating the servo system.

ver.080603E

NAMES & FUNCTION

Driver 【SIDC 650】

front



Displays 5 digit, 7-segment LED

Switch keys

QUIT cancel/exit
▲ up
◀ shift
▼ down
ENTER select/input

TB (terminal button)

Power Supply Line
Connect AC power supply line

Motor Connect Line
Connect the motor UVW cable

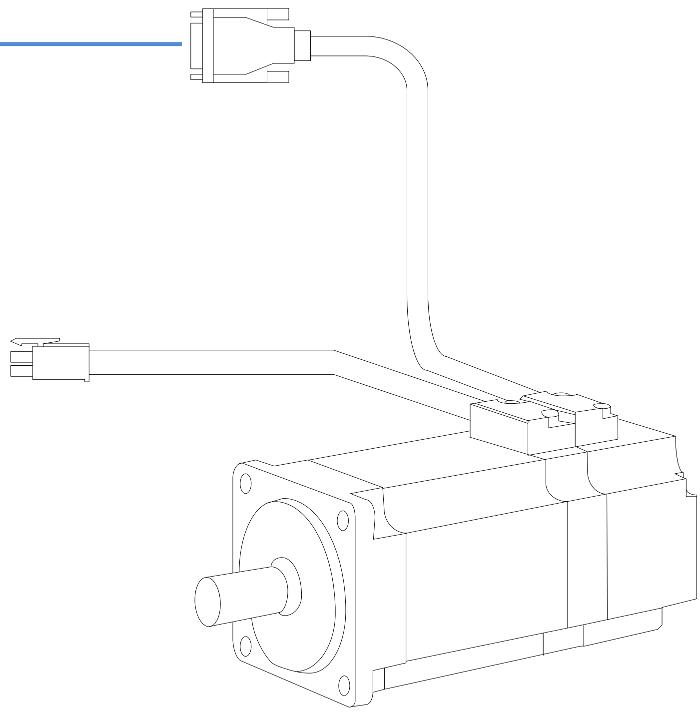
Ground

Communication for RS-232(COM)
Use for hyper terminal control.

Connector1(CN1)
Use to connect the controller.

Connector2(CN2)
Use for encoder cable.

Motor 【SIA Series】

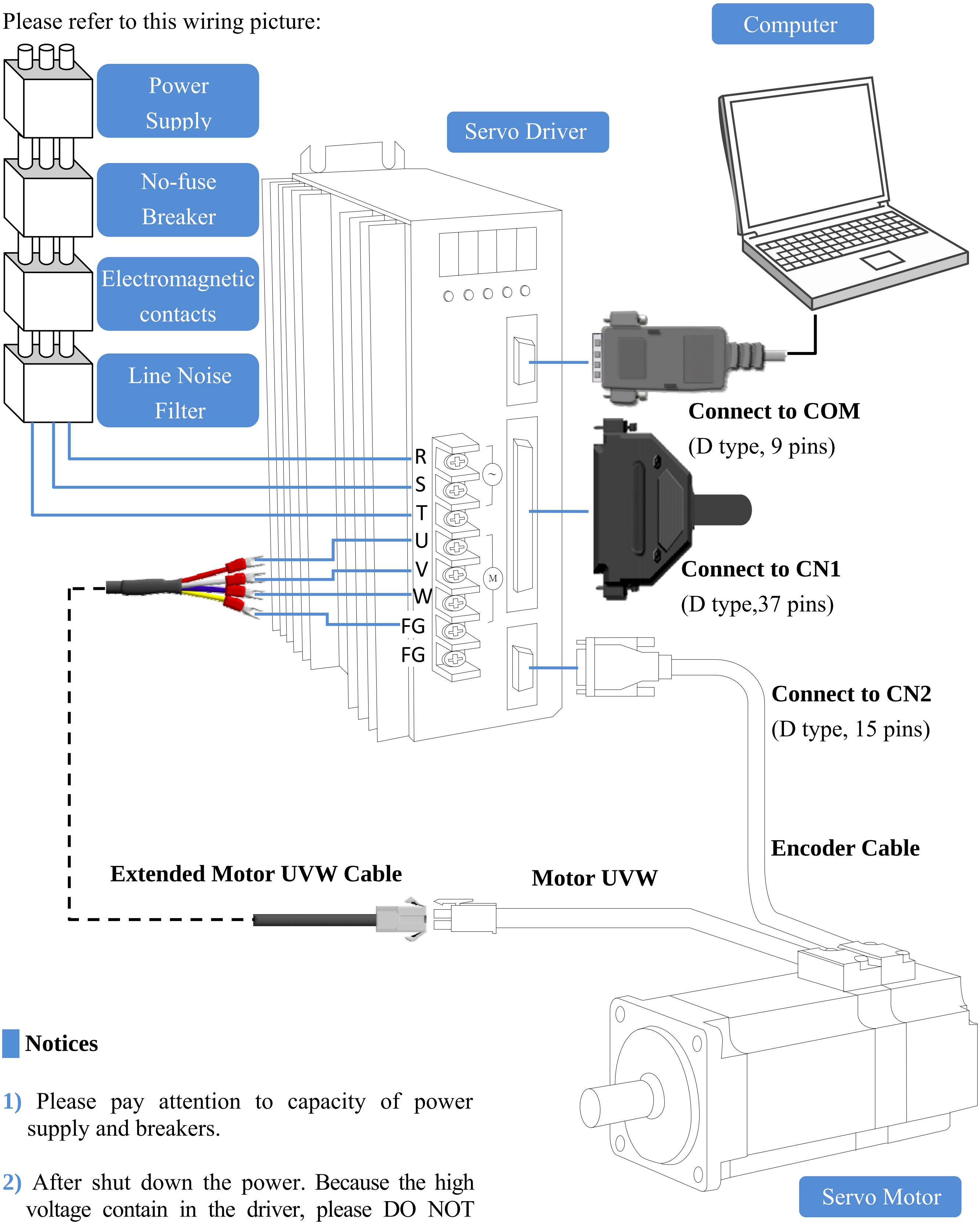


Encoder Cable

Motor UVW Cable

Wiring

Please refer to this wiring picture:

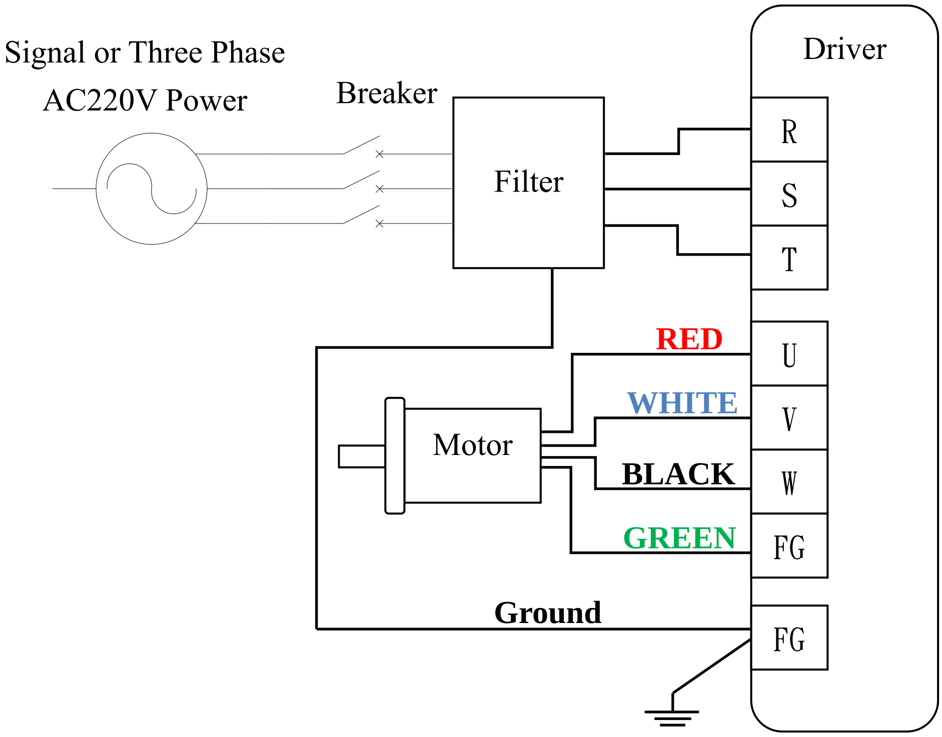


Notices

1) Please pay attention to capacity of power supply and breakers.

2) After shut down the power. Because the high voltage contain in the driver, please DO NOT touch the **TB** terminal(**R**、**S**、**T** and **U**、**V**、**W**) and encoder cable for safe. Please wait until the LED put out, user can touch the terminal button.

Connect the Power and the Motor to Driver (TB)



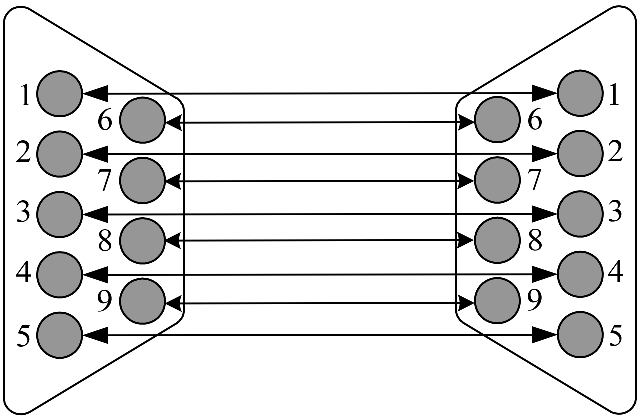
Notices

1) Please confirm the power line is AC 220V.
2) <u>If user connect the signal-phase AC220V, please connect the power lines to **R**、**S** terminal buttons and keep **T** terminal button empty.</u>
3) Please confirm the motor cable color and **U**、**V**、**W** terminal buttons.

Terminal Button(TB)

Name	Symbol	Description
Main circuit power supply	R	Connect to power supply (1-phase or three-phase AC220±15%)
	S	
	T	
Servo motor power	U	Connect the red motor cable
	V	Connect the white motor cable
	W	Connect the black motor cable
The earth terminal of motor	FG	Connect the green motor cable
The earth terminal of driver	FG	Connect to the earth terminal of the servo motor and to the protective earth (PE) of the control box to perform grounding.

COM (for communication)



NO.	Name	Direction	Description
Pin 1	CD		
Pin 2	TXD	SIDC650→PC	Transmit
Pin 3	RXD	PC→SIDC650	Receive
Pin 4	DSR		Data
Pin 5	GND		Ground
Pin 6	DTR		Data Terminal Ready
Pin 7	CTS		Clear To Send
Pin 8	RTS		Request To Send
Pin 9	RI		

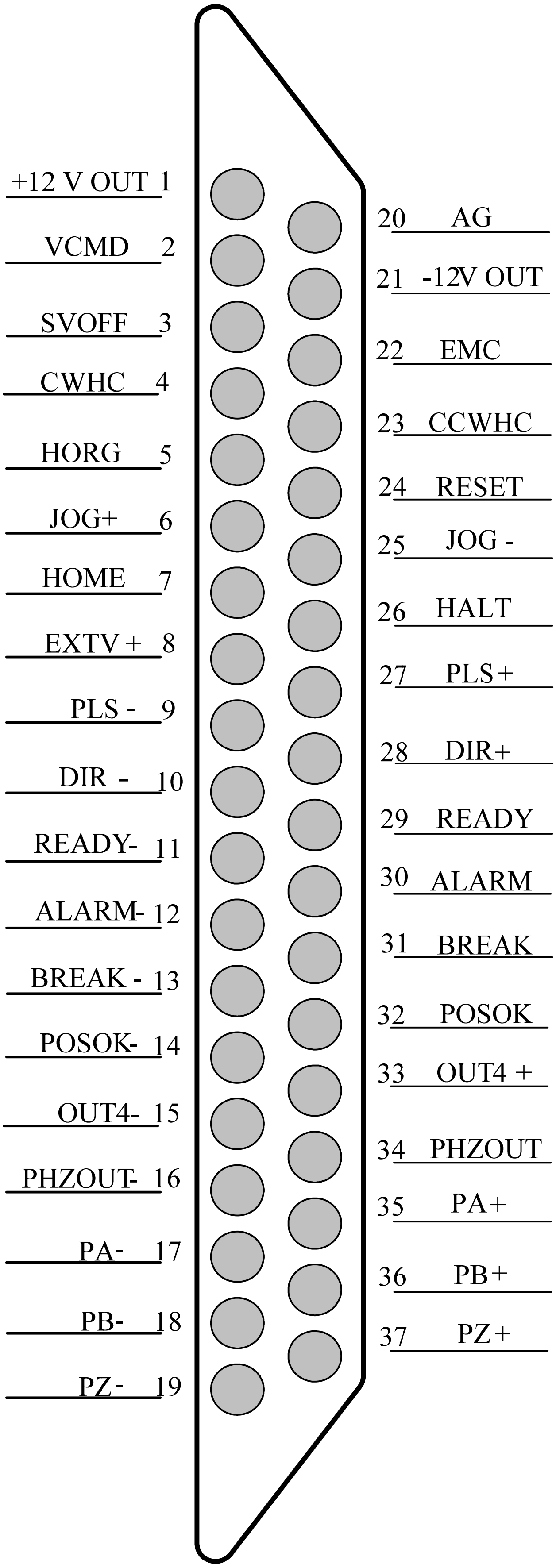
- The setting of COM port:

  Baud Rate: 9600

  Data Bits： 8 Check: None

  Stop Bits： 1 Flow Control: Hardware

CN1 Connector (for controller)



For each operation mode, please refer to the wiring between controller and CN1. (**DG** pin is the negative terminal of external power supply)

I/O Type

Please refer to I/O type at P.16

Suitable Mode

The column of suitable mode shows the applicative rage for control method. The meaning for each word please refer to Parameter **PN01** (**MD**).

0：Position Control Mode

1：Position Control Mode with Buffer

2：Velocity Control Mode

3：Voltage Control Mode

4：Torque Control Mode

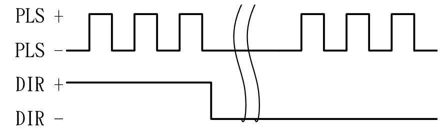
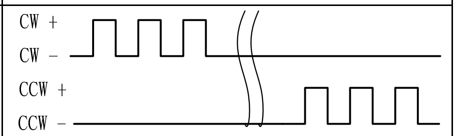
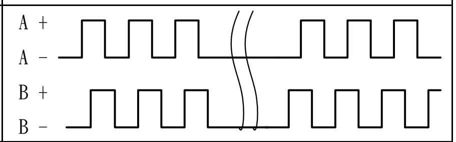
5：Hyper Terminal Control Mode

A：All Control Mode

Pin	Name	Symbol	I/O Type	Suitable Mode
1	**±12 V Output**	**＋12V**		
21		**－12V**		
Supply ±12VDC/10mA MAX output voltage.				
2	**Speed/Torque Input**	**VCMD**	**AI**	**2,3**
20		**AG**		
The speed and torque command can input **VCMD** pin, and **AG** is the analog ground. The Max torque and speed is corresponding to ±10V **VCMD** input voltage.				
3	**Servo off**	**SVOFF**	**SI**	**A**
	When open-circuit this pin and **DG** pin, driver will servo on. When short-circuit this pin and **DG** pin, driver will servo off. (Please refer to **PN04** parameter)			
22	**Emergency Stop**	**EMC**	**SI**	**A**
	When short-circuit this pin and **DG** pin, driver will immediately execute emergency stop and servo off. (Please refer to **PN04** parameter)			
4	**CW Drive Inhibit**	**CWHC**	**SI**	**A**
	When short-circuit this pin and **DG** pin, it means that travel-exceeding has happened. (Please refer to **PN05** parameter)			

23	**CCW Drive Inhibit**	**CCWHC**	**SI**	**A**
	When short-circuit this pin and **DG** pin, it means that travel-exceeding has happened. (Please refer to **PN05** parameter)			
5	**Home Signal**	**HORG**	**SI**	**1,5**
	When short-circuit this pin and **DG** pin, it means that mechanical home signal has inputted. (Please refer to **PN03** parameter)			
24	**Reset**	**RESET**	**SI**	**A**
	When short-circuit this pin and **DG** pin, it will reset the driver. (Reset driver can also remove the alarm.)			
6	**JOG Forward**	**JOG+**	**SI**	**1**
	When short-circuit this pin and **DG** pin, motor will jog forward.			
25	**JOG Backward**	**JOG-**	**SI**	**1**
	When short-circuit this pin and **DG** pin, motor will jog backward.			
7	**Homing**	**HOME**	**SI**	**1**
	When short-circuit this pin and **DG** pin (ON→OFF), motor will rotate back to the mechanical home.			
26	**Pulse Input Inhibit**	**HALT**	**SI**	**1**
	When short-circuit this pin and **DG** pin (ON→OFF), the input pulses will be invalid.			
8	**External +24V Power**	**+24V**		**A**
	User need to supply external +24V power for I/O.			
27	**Pulse Input**	**PLS+**	**PI**	**0,1**
9		**PLS-**		
28	**Direction Input**	**DIR+**		
10		**DIR-**		

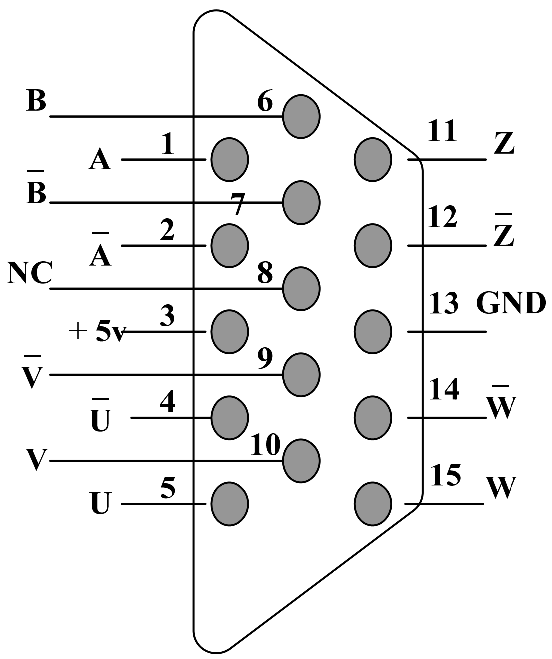
SIDC650 can accept three command types. (Please refer to **PN02**)：

Command Type	Pin Status	
	Forward	Backward
Pulse+Dir		
CW/CCW		
AB Phase		

29 11	**Servo Ready**	**READY**	**SO**	**A**
	After power on the driver without any alarms, **READY** signal will be ON. (Please refer to **PN07** parameter)			
30 12	**Alarm**	**ALARM**	**SO**	**A**
	If any alarm occurring, **ALARM** signal will be ON. (Please refer to **PN07** parameter)			
31 13	**Holding Break**	**BREAK**	**SO**	**A**
	When servo off, the **BREAK** pin will output ON. This pin can be used to control the relay of magnetic break.(Please refer to **PN06** parameter)			
32 14	**In Position**	**POSOK**	**SO**	**0,1**
	Please refer to **PN18** parameter			
33 15	**Output 4**	**OUT4**	**SO**	**A**
	This output pin is reserved by manufactory.			
34 16	**Z-phase Output**	**PHZOUT**	**SO**	**A**
	The **PHZOUT** pin signal is the same as the **PZ+** signal, and the type of this pin is open collector.			

35	Encoder A-Phase Output	PA	PO	A
17		$\overline{PA}$		
36	Encoder B-Phase Output	PB		
18		$\overline{PB}$		
37	Encoder Z-Phase Output	PZ		
19		$\overline{PZ}$		
Output the encoder signal which be inputted to driver. The A-phase leads B-phase 90 degrees, when view from the shaft end. The types of these pins are line-drive.				
	Shield	FG		A

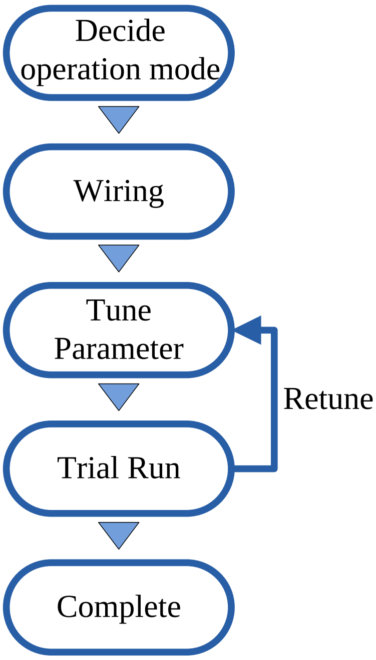
CN2 Connector (for encoder)



This chapter introduces the operation mode, various I/0 ports in SIDC650, and wiring so that the user can connect the controller to control the servo drivers.

How to Operate SIDC-SIA

User can follow the flow chart to set the driver:



1) Users can select one operation mode from the five ones in SIDC according to different application. (By setting system parameter **MD (PN01)**, user can decide which operation mode to be applied. Refer to P.27)

2) Wire the motor, power supply, and the driver. According to the selected operation mode, connect the wiring between controller and driver.

3) After wiring, please use the default parameters and operation mode to rotate the motor first. If alarm occurs or doesn't perform well, please adjust the parameter until it meets your requirements. (Please be sure to adjust your driver according to the description of P.43 so that it can achieve its performance.)

4) Please operate carefully.

After complete the installation, the driver can work well.

Operation Mode Description

There are five operation modes in SIDC 650 in total. The differences of the five modes are described thoroughly as follows:
(By setting the system parameter **MD (PN01)**, user can decide which operation mode to be applied. Refer to P.28)

Position Control Mode (MD=0)

In this mode, the rotations of motors are controlled directly by input pulses. As long as the driver receives pulses, the motor will instantly respond to it. Not only the position, but also velocity and acceleration are controlled by the input pulses from controller. (Motor is not controlled by parameter **VM** and **VA** in driver).

In this mode, whenever the driver receives pulse, the distance of rotation is decided by electrical gear ratio parameter **SC1** and **SC2**. There are three ways for pulse input, set by **PM** parameter. (For the definition of **SC1** and **SC2**, please refer to P.35 and P.29 for parameter **PM**).

Position Control Mode with Buffer (MD=1)

This mode is almost the same with the previous one. The distance of the rotation is decided by **SC1** and **SC2** parameter. But the input pulses only decides the final position. The velocity and acceleration of motor rotation is controlled by **VM** and **VA** parameter. (For the definition of **VM** and **VA**, please refer to P.34).

Velocity Control Mode (MD=2)

In this mode, the velocity and direction of motors are controlled by CN1 analog input port (**VCMD** and **AG** pin, please refer to P.5). Positive voltage, rotate forward; negative voltage, rotate backward. The higher the voltage, the faster the motor rotates. The relation between voltage and rotation velocity is determined by **VM** parameter. When the voltage of the input port is +/-10Volt, the corresponding rotation velocity of the motor is +/-**VM**. Besides, the proportion between **VM** and analog input voltage is set by **TSC** (the definition of **TSC** is in P.37). And the acceleration of the motor is limited by **VA** parameter).

In this mode, the velocity is controlled by close loop, and very stable. In other words, it will not be affect by the loading.

Voltage Control Mode (MD=3)

In this mode, the output voltage applied in motor is determined by the voltage of analog input port (**VCMD** and **AG**, please see P.5). The SIDC works as an amplifier. The higher the analog input is, the higher the output voltage will be. The proportion between the two is determined by **TSC** parameter (For the definition of **TSC**, please refer to P.37). Generally speaking, the rotation velocity of motor is proportioned to input voltage. But this mode is not like close loop control just like velocity control mode. Therefore, it is in fact influenced by loading, and is not always proportioned to input voltage.

In this mode, the current and the output torque are not directly controlled. The output current will increase along with the increase of loading. If it overloads, the actual output current and voltage will be limited by the rated current and the rated voltage of SIDC 650.

Torque Control Mode (MD=4)

Normally, the torque of motors is proportioned to current, so this mode is also named current control mode. In this mode, the torque and direction of torque can be controlled and commanded by the voltage of analog input port (**VCMD** and **AG** pin, please see P.5). If you input positive voltage, it will output positive torque; if you input negative voltage, it will output negative torque. The higher the voltage inputs, the larger the torque of the motor outputs. The proportion of analog input voltage and output torque is decided by parameter **TSC** (please see the definition of **TSC** in P.37).

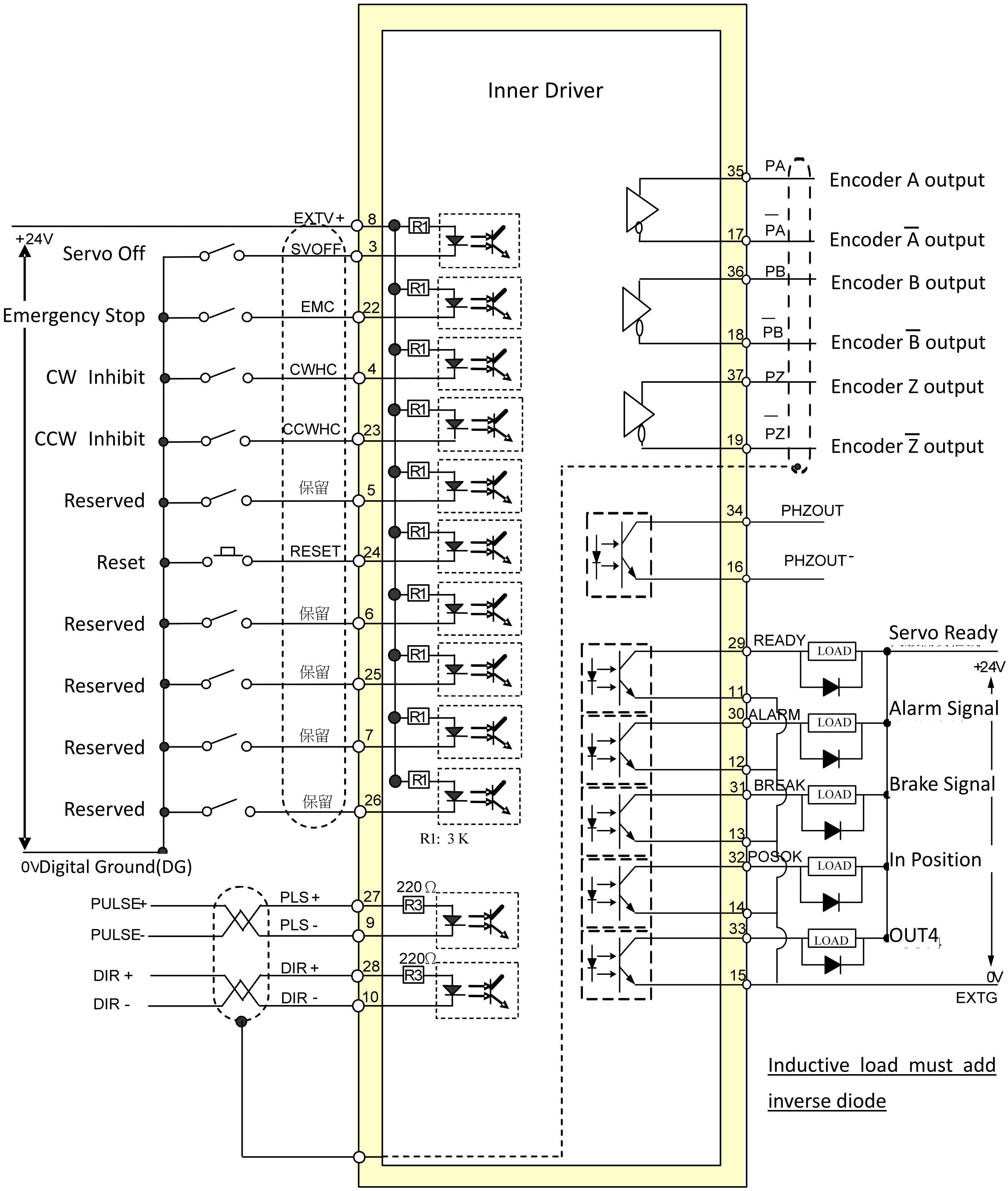
In this mode, the speed of motor rotation is not directly controlled, but parameter **VM** can control the speed limit (the definition of **VM** is in P.34). Please be careful with the increasing rotation speed when there is no loading applied on motor.

Hyper Terminal Control Mode (MD=5)

In this mode, all motor actions can be commanded by RS232 communication port in the front panel. Please see 「SIDC 650/850 Terminal Command」 in P. 49.

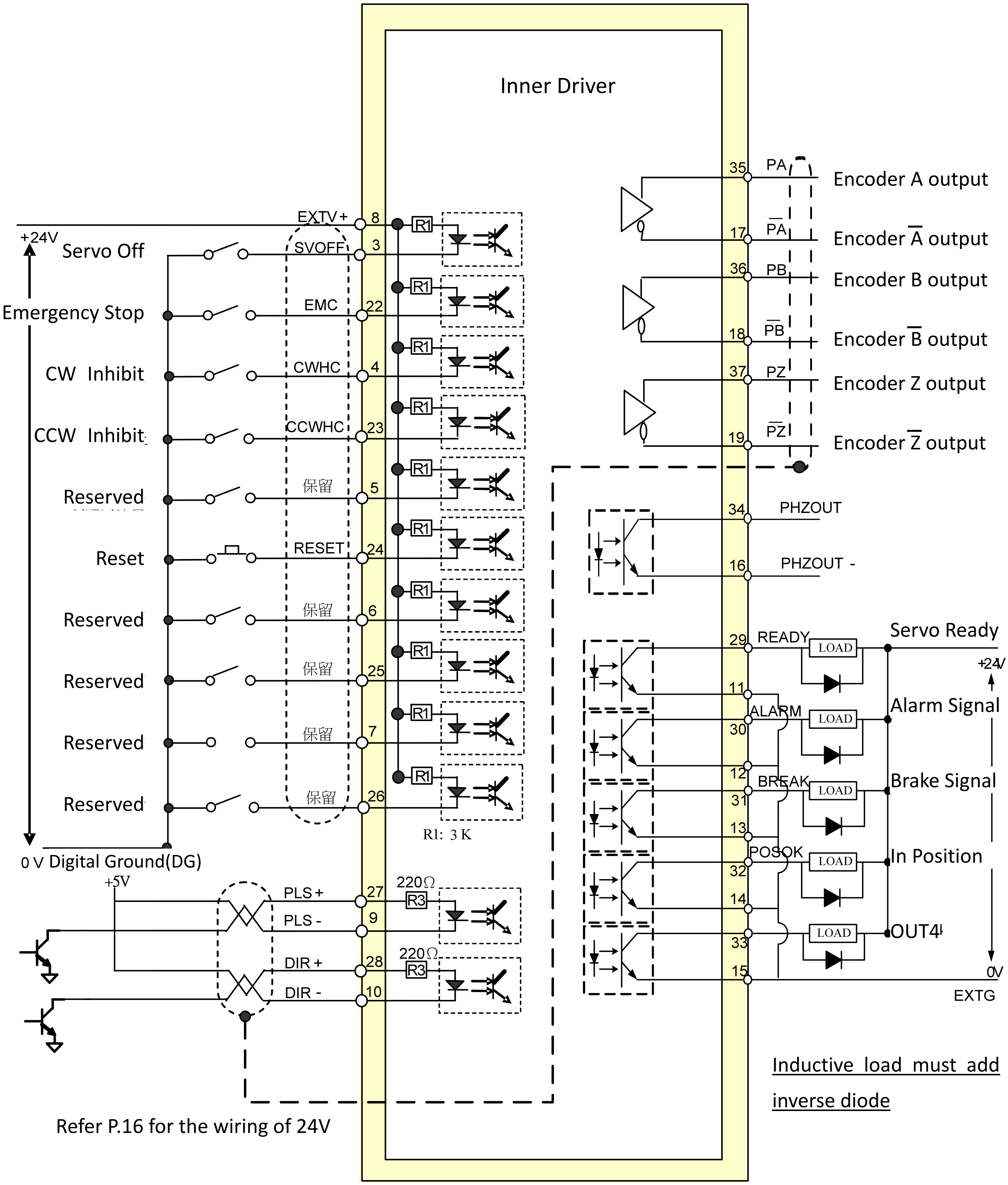
Position Pulse Control Mode （Line Drive、Mode MD=0）

- Refer P.9 for「Operation Mode」
- Refer P.16 for Line Drive I/O Circuit



Position Pulse Control Mode （Open Collector、Mode MD=0）

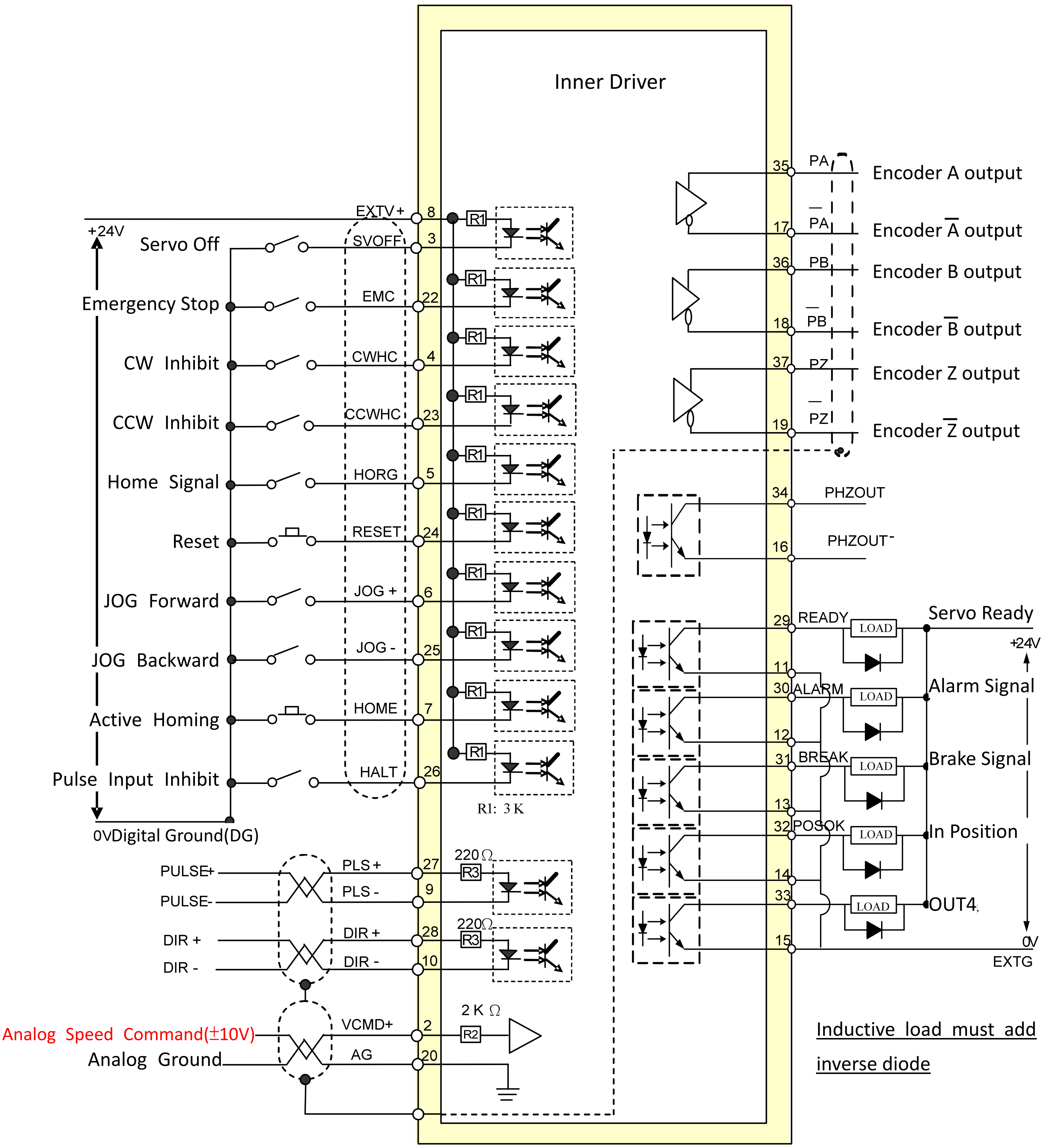
- Refer P.16 for Open Collector I/O Circuit



SIGNALS AND WIRING of CN1

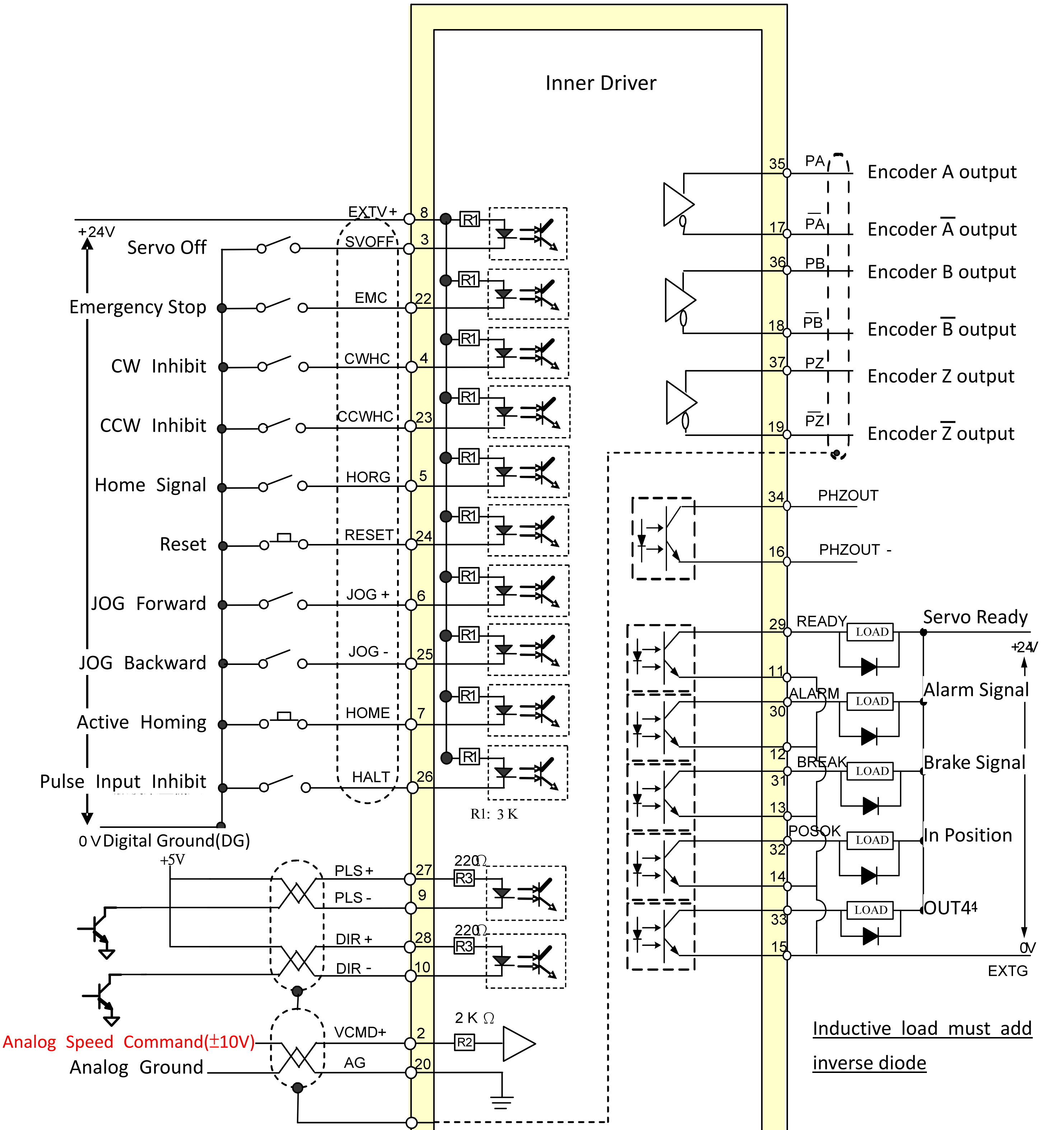
Position Pulse Control Mode （Line Drive、Mode MD=1）

（with Buffer and External Analog Input）



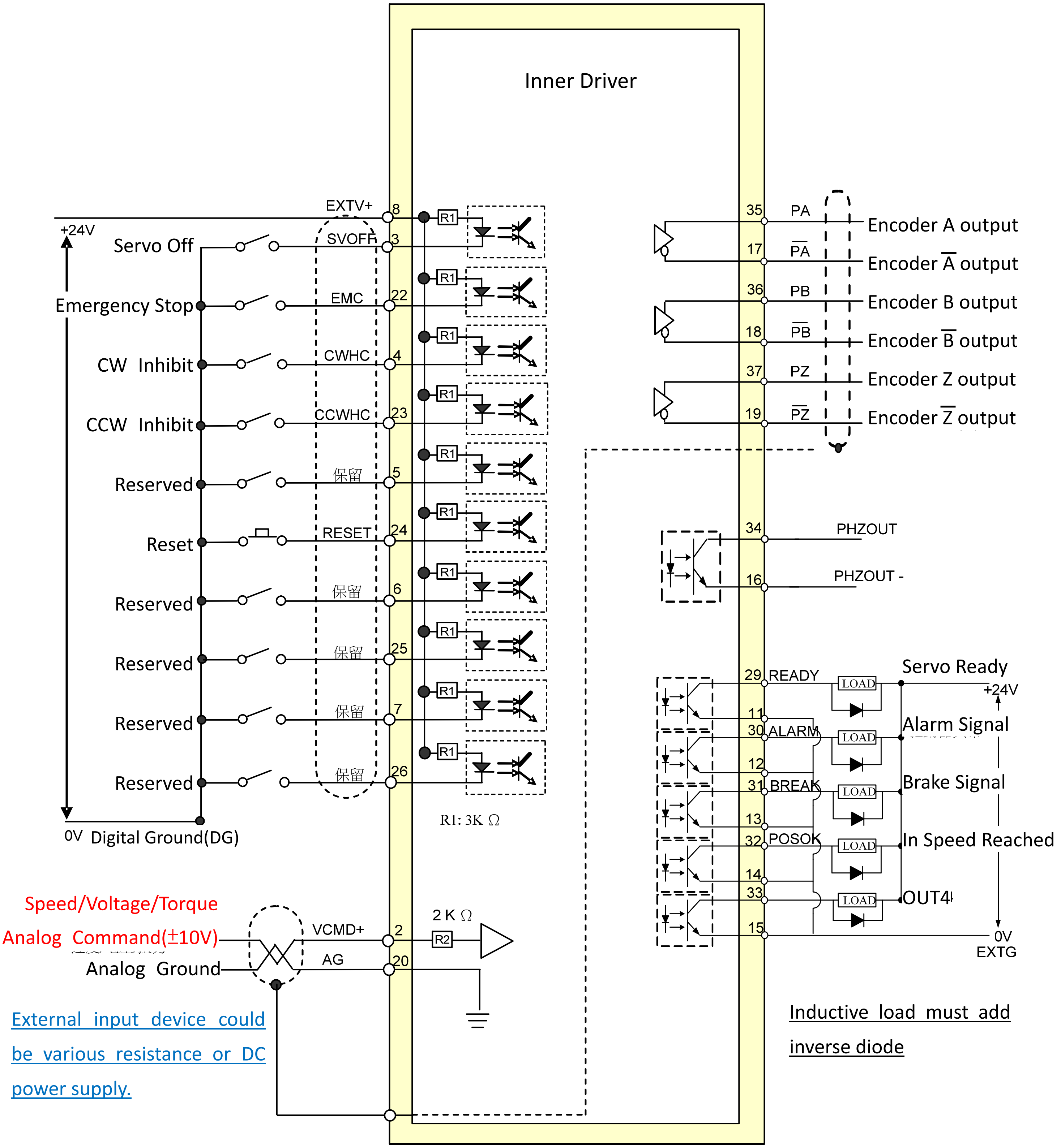
Position Pulse Control Mode （Open Collector、Mode MD=1）

（with Buffer and External Analog Input）



Refer P.16 for the wiring of 24V

Velocity/Voltage/Torque Control Mode（Mode MD=2、3、4）

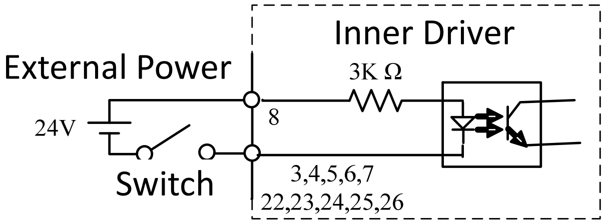


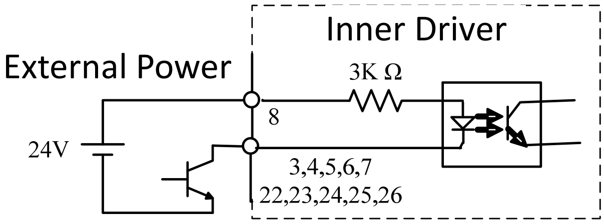
This page describes the I/O circuit of CN1.

Input Circuit

SI (Serial Signal Input)

Connect the external switches, relay, and open collector of transistor.



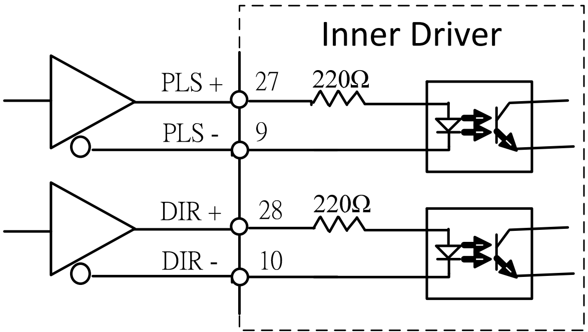


PI (Pulse Signal Input)

There are two interfaces of input position pulses.

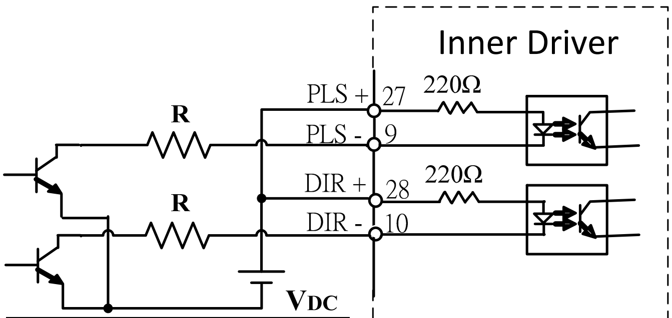
1 <u>Line Drive Input</u>

Recommend method for less noise.



2 <u>Open Collector Input</u>

Need to add the extra DC power supply and select resistance R for the current limit.



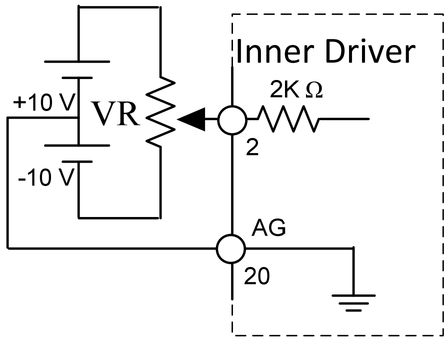
VDC	R value
5 V	None
12 V	1 KΩ 1/4 W
24 V	2.2 KΩ 1/4 W

$$\frac{V_{DC}-1.5}{R+220} \approx 10\text{mA}$$

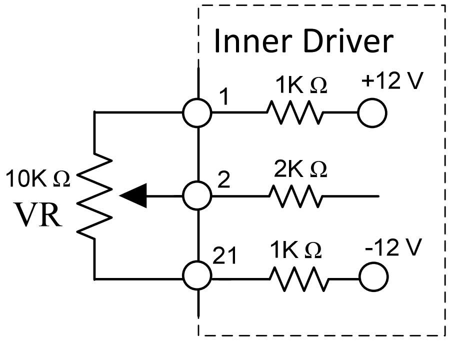
AI (Analog Signal Input)

User could use the external power supply or the 12V.output of CN1. The range of analog input is -10V～+10V.

External Power



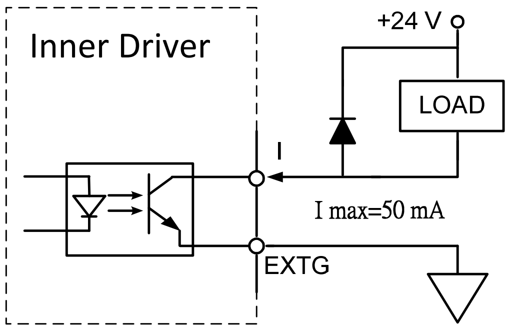
Internal Power



Output Circuit

SO (Serial Signal Output)

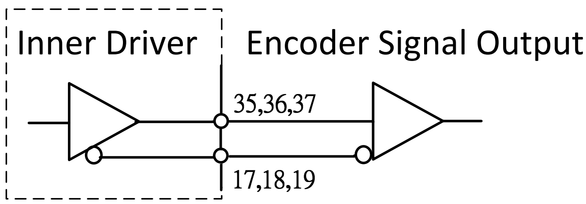
※The maximum output current is 50mA。



<u>Inductive load must add inverse diode</u>

PO (Pulse Signal Output)

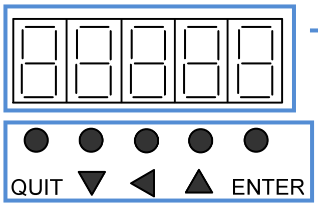
This is differential output of encoder signal.



OPERATE THE FRONT PANEL

In order to make good use of servo systems, the driver contains many parameters in need of adjustment; therefore, please be familiar with the operation of the front panel on the driver so as to monitor and set the parameter (the user doesn't need to connect the driver with computer.)

The Front Panel and Switch Keys



Displays 5 digits, 7-segment LED display

Switch keys

Symbols for Keys	Names of Keys	Functions of Keys
ENTER	Select & Input	Selecting or confirm the adjusting parameter.
▲	Up	Add 1 to the being adjusted parameter.
◀	Shift Cursor	Change the cursor position when editing.
▼	Down	Sub 1 from the being adjusted parameter.
QUIT	Cancel & Exit	Cancel the editing and return to the previous menu

Operate the Front Panel

The front panel of SIDC 650 offers the following operations:

you can press ▲▼ to select the operation you need. After selecting the required functions, press **ENTER** and you can get into the operation; in contrast, you can return to previous operation after you press **QUIT**.

【Status Display】 & 【Monitor Setting】

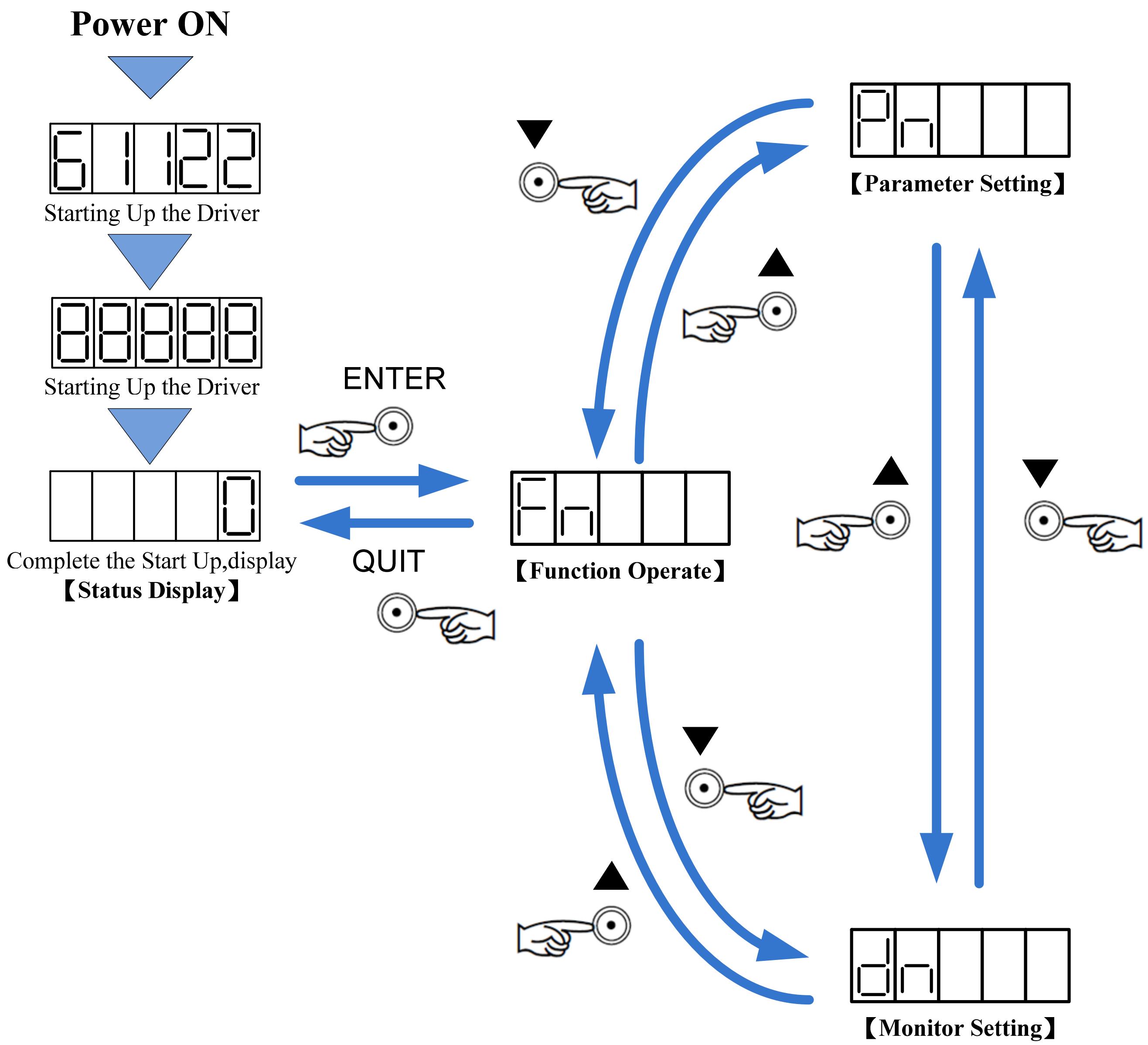
The setting of the DN parameter in **【Monitor Setting】** decides what the being monitored parameter is (see P35, "**SIDC 650 Monitoring Option List**"). Under **【Status Display】**, the 7 segment LED displays the monitored option.

【Parameter Setting】

Under **【Parameter Setting】**, user can adjust the system parameters (see P.26, "**System Parameters (PN) List of SIDC 650**").

【Function Operate】

Under **【Function Operate】**, user can execute some functions by using the front panel (see P35, "**System Parameters (PN) List of SIDC 650**").



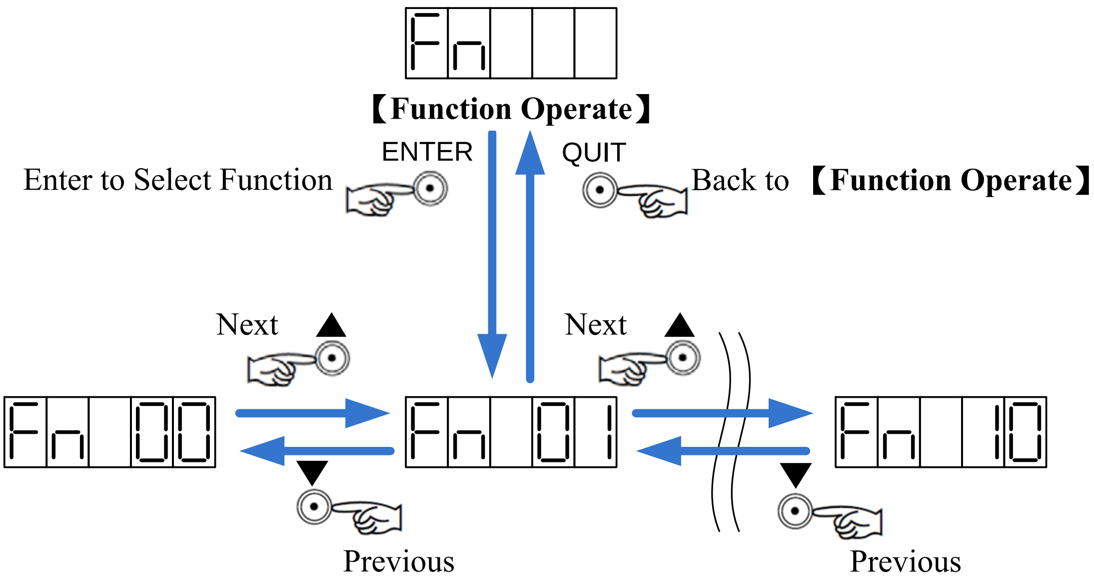
Power ON
Starting Up the Driver
Starting Up the Driver
Complete the Start Up,display
【Status Display】
ENTER
QUIT
【Function Operate】
【Parameter Setting】
【Monitor Setting】

FUNCTION OPERATE

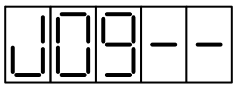
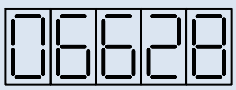
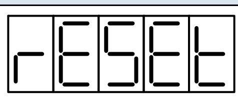
User can use 【**Function Operate**】 from front panel to adjust and test the servo system. Please read the following details for the specific function.

How to Select the Function

● After the front panel displays FN (【**Function Operate**】) and you press **ENTER**, you can select the functions which you want to operate by using ▼▲ buttons. SIDC 650 has 11 functions in total, ranging from “00” to”10”. After select the target function, you can press **ENTER** to start operating the selected function. In contrast, after you press **QUIT** you can give up operation and go back to previous display.



SIDC 650 Function (FN) List

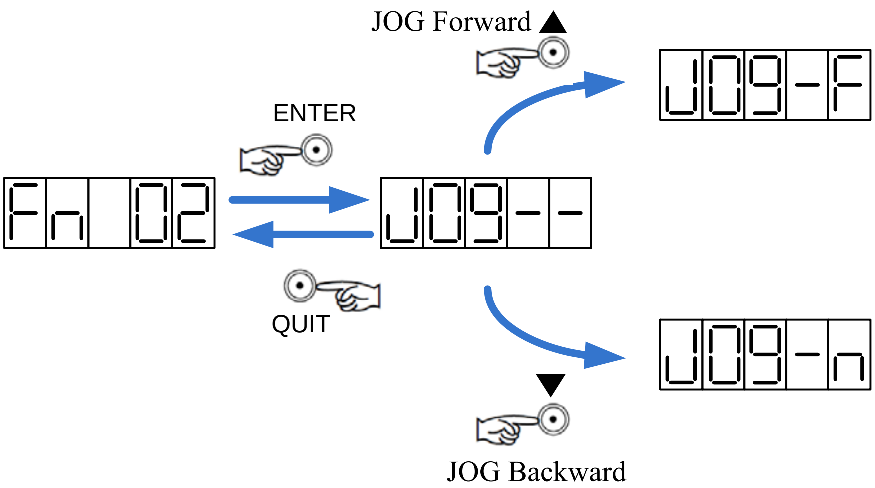
Fn	Function	Displays	Description	Notes
00	reserved by manufactory			
01	reserved by manufactory			
02	**JOG**		JOG Forward (press UP key) or JOG Backward (press DOWN key) with the speed set by **VJ** (**PN14**).	
03	**Firmware Version**		Display the version of Firmware.	
04	**RESET SYSTEM**		Reset the driver. This function is the same as the Pin24 **RESET** of CN1.	
05	reserved by manufacturer			
06	reserved by manufacturer			

07	reserved by manufactory			
08	**Calibrate Current Sensor**		After executing **FN09**, please execute this operation to calibrate current sensor.	Execute **FN10**,first
09	**Initialize Parameters**	P init	Initialize the parameters.(restore to default value from factory.)	Execute **FN10**,first
10	**Lock / Unlock Function**	UoLoc	Before executing **FN08**、**FN09**, user needs to execute "UNLOCK".	
11	**Motor Type**	2210	Display the motor type	

How to Operate Function

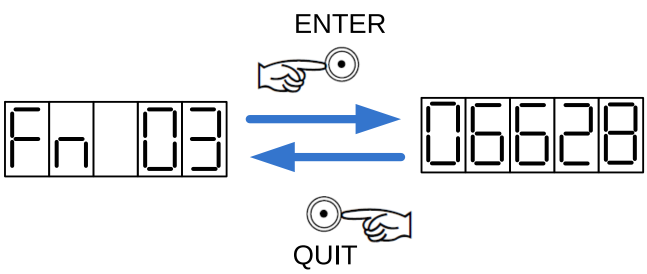
【JOG】(FN02)

● The speed of jog is decided by parameter **VJ** (**PN14**) and the acceleration is decided by parameter **VA** (**PN11**).



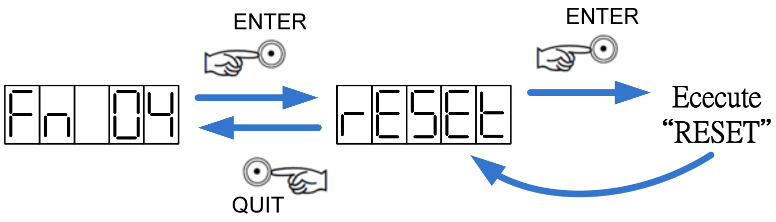
【Firmware Version】(FN03)

● This function just displays the firmware version of the driver.



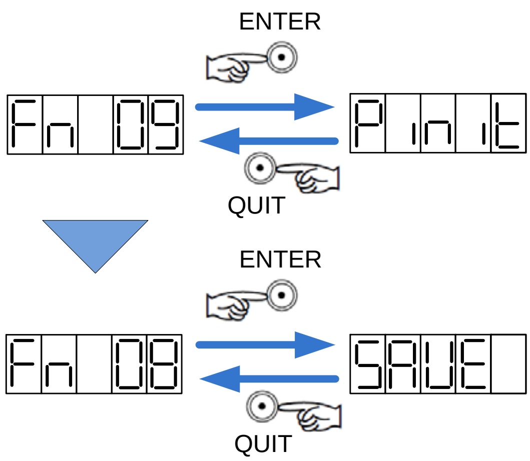
【RESET SYSTEM】(FN04)

- Reset the servo driver is like as soft-restart.
- User can reset the servo driver to clear the alarm.



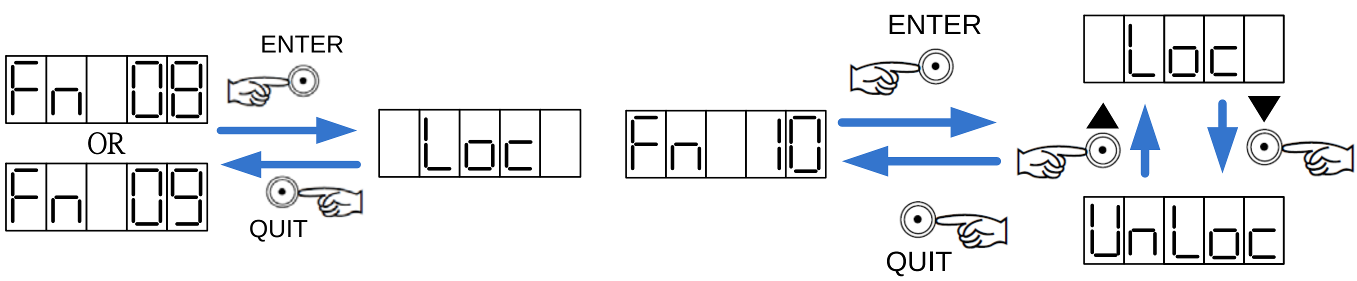
【Calibrate Current Sensor】&【Initialize Parameter】 (FN08、FN09)

- **【Initialize Parameter】** will restore all the parameter to the default value from manufactory.
- **【Calibrate Current Sensor】** will calibrate the current sensors built in driver. By calibrate the current sensors; driver could drive the motor well. This is the function that user need to execute first after executing the function **【Initialize Parameter】**.
- Function **FN10** exists for avoiding the mistake that execute this two function **【Calibrate Current Sensor】&【Initialize Parameter】** carelessly.



【Lock/Unlock】(FN10)

- User can use this function to lock or unlock the function **【Calibrate Current Sensor】** and **【Initialize Parameter】**. If the driver is in "Lock" status, user can't execute function **FN08** and **FN09**.



【Motor Type】(FN11)

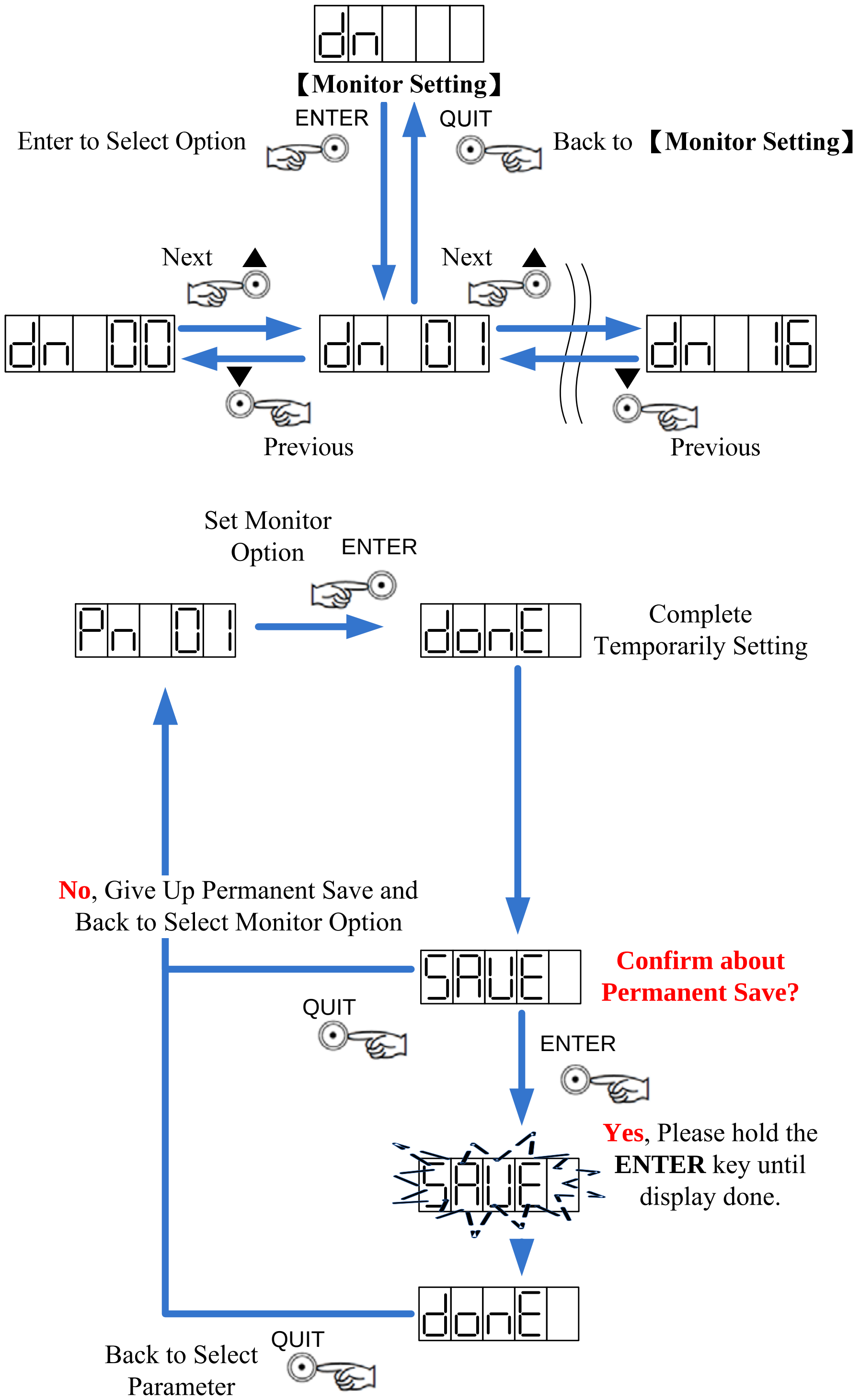
● User can confirm which kind of motor is suitable for this driver.

Display	Motor Type
2110	SIA-351□□□□A
2150	SIA-351□□□□B
2160	SIA-351□□□□C
2210	SIA-551□□□□A
2310	SIA-751□□□□A
3250	SIA-121□□□□B
3260	SIA-121□□□□C

User can use DNxx【**Monitor Setting**】to monitor the status of driver. This function also can help user to tune the driver.

How to Monitor the Target and Save Monitor Option

● After the front panel displays DN (【**Monitor Setting**】) and you press **ENTER**, you can select the options which you want to monitor by pressing ▼▲ buttons. SIDC 650 has 17 options in total, ranging from "00" to"16". After select the target options, you can press **ENTER** to setting the monitor target and press **ENTER** again to save setting. In contrast, after you press **QUIT** you can give up operation and go back to previous display.



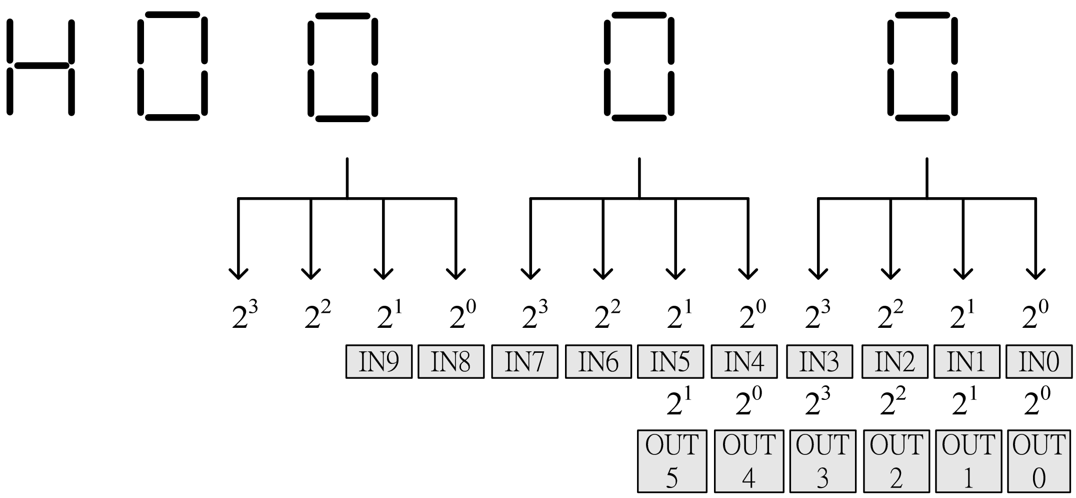
SIDC 650 Monitor Option (DN) List

DN	Target	Unit
00	Display nothing, 7-segments just shows"n".	
01	**Rotational Speed (right now)** (this is the average value in 0.1 sec)	RPM
02	**The differential pulses between the input pulse and the feedback pulses from encoder.**	pulse
03	**The Max. of the differential pulses (the monitor target of DN02)** (If this value is larger than system parameter **EL**, the alarm "**Follow Error**" will occur.)	pulse
04	**Input pulses**	pulse
05	**The feedback pulses from encoder**	pulse
06	**Output Current (right now)** For example: 180 means output current 1.8A	0.01A
07	**The Max. Output Current**	0.01A
08	**Output Torque (right now)** For example: 109 means output torque 10.9 kg*cm	0.1kg*cm
09	**The Max. Output Torque**	0.1kg*cm
10	**Power (right now)**	W
11	**The Max. of Power**	W
12	**The Analog Input Voltage in VCMD**	V
13	**Input Pin Status（Display in HEX Value）**	
14	**Output Pin Status（Display in HEX Value）**	
15	**UVW Output Monitor**	
16	**ABZ-Phase Monitor**	

※ Press **QUIT** will update the max. value.

How to Read the I/O status

The I/O status display in HEX values.



SIDC 650 I/O Map

NO.	I/O Name	CN1 pin No.
IN0	SVOFF	3
IN1	EMC	22
IN2	CWHC	4
IN3	CCWHC	23
IN4	HORG	5
IN5	RESET	24
IN6	JOG +	6
IN7	JOG -	25
IN8	HOME	7
IN9	HALT	26
OUT0	READY	11 、29
OUT1	ALARM	12 、30
OUT2	BREAK	13 、31
OUT3	POSOK	14 、32
OUT4	OUT4	15 、33
OUT5	PHZOUT	16 、34

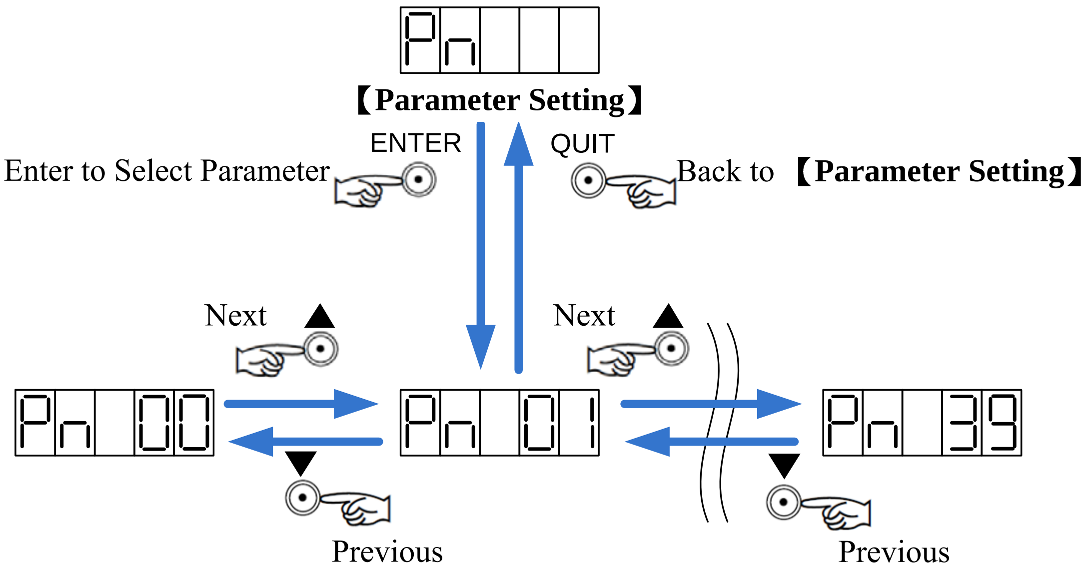
Example 1:
when the 7-segments displays ”**H0013**” at setting **DN=13**, it means that there are input from **IN0 、IN1 、IN4**.

Example 2:
when the 7-segments displays ”**H0023**” at setting **DN=14**, it means that there are output from **OUT0 、OUT1 、OUT5**.

The operation mode and performance of servo driver are decided by the setting of PN parameters which is called the system parameters. Please refer to "System Parameter (PN) List of SIDC 650" in P.28 for more detailed content.

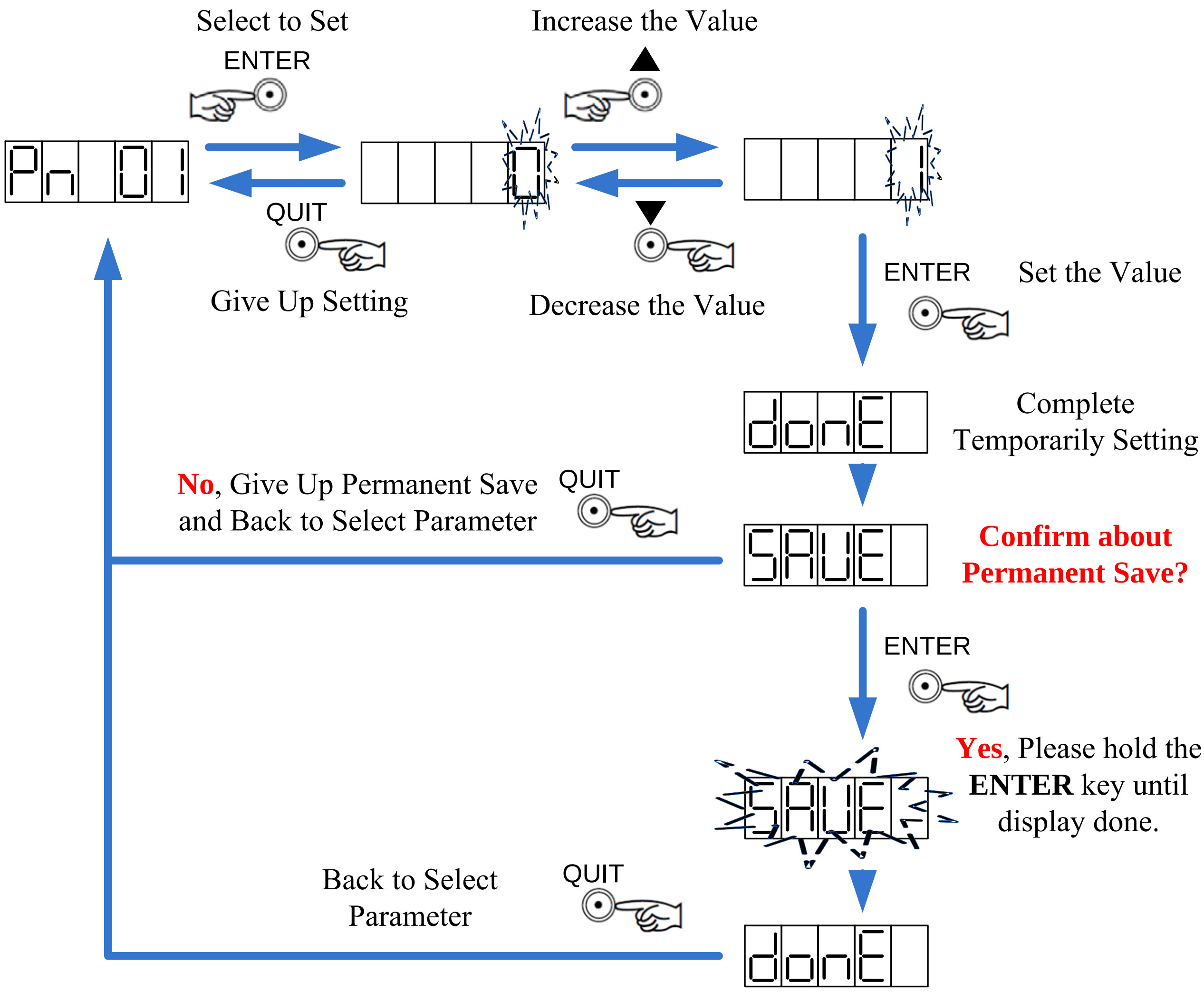
How to Select the PN Parameters

● After the front panel displays PN (【**Parameter Setting**】) and you press **ENTER**, you can select the parameter which you want to adjust by pressing ▼▲ buttons. SIDC 650 has 40 parameters in total, ranging from "00" to"39". After select the target parameter, you can press **ENTER** to set the parameter. In contrast, after you press **QUIT** you can give up adjusting parameters and go back to previous display.



How to Set and Save the PN Parameters

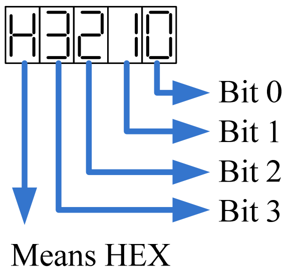
- Please refer to following drawing:



※ "Complete Temporarily Setting" means the new value of the selected parameter has been accepted by the driver and becomes effective instantly. But it is still not saved in EEPROM. If you turn off the power in this condition, the parameter will restore the older one.

※ After the user permanently saves the new parameter, the new value will be saved into EEPROM. Even the user turns off the power and restart the driver, the newly-set value will not restore the older one.

System Parameters (PN) List of SIDC 650



Suitable Mode

The column of suitable mode shows the applicative rage for control method. The meaning for each word please refer to Parameter **PN01** (**MD**).

※ The value of【 】is the default value.

※ The value in this table is suitable for SIDC650 driver & SIA-551 motor.

<table>
<tr><th>No.</th><th>Name</th><th>Range 【Default】</th><th>Suitable Mode</th></tr>
<tr><td rowspan="2">PN00</td><td>DN</td><td>0~16【1】</td><td></td></tr>
<tr><td colspan="3">Monitor Option Select（corresponding to “Monitor Setting”）refer to P.23</td></tr>
<tr><td rowspan="2">PN01</td><td>MD</td><td>0~5【1】</td><td></td></tr>
<tr><td colspan="3">Operation Mode Select(Please refer to “Operation Mode” in P.8
<table><tr><td>0</td><td>Position Control Mode</td></tr><tr><td>1</td><td>Position Control Mode with Buffer</td></tr><tr><td>2</td><td>Velocity Control Mode(Closed Loop)</td></tr><tr><td>3</td><td>Voltage Control Mode(Open Loop)</td></tr><tr><td>4</td><td>Torque Control Mode</td></tr><tr><td>5</td><td>Hyper Terminal Control Mode</td></tr></table></td></tr>
<tr><td rowspan="2">PN02</td><td colspan="3">Command Setting</td></tr>
<tr><td>DI</td><td>H000【0】</td><td>A</td></tr>
</table>

	Bit 0		

The Rotational Direction of Motor	
0	Clockwise rotate (viewed from mounting side) when input positive command
1	Counter Clockwise rotate (viewed from mounting side) when input positive command

PM	H00【0】0	**0,1**

Bit 1

Position Command (refer to P.6)	
0	PLS/DIR (pulse + direction)
1	CW/CCW command
2	A/B phase command

	H【0】000	**5**

Bit 3

Execute Program Automatically	
0	**Disable** Auto-Start
1	**Enable** Auto-Start

※This parameter is only valid in the controller version of SIDC650 or SIDC850.

PN03

Homing Setting & Baud Rate

HM	H000【0】	**1,5**

Bit 0

Home Direction	
0	Short connection of **HOME** pin & **DG** pin, motor will home in **backward** direction. The action of homing is triggered by **shorting CCWHC** pin & **DG** pin.
1	Short connection of **HOME** pin & **DG** pin, motor will home in **forward** direction. The action of homing is triggered by **shorting CWHC** pin & **DG** pin.
2	Short connection of **HOME** pin & **DG** pin, motor will home in **backward** direction. The action of homing is triggered by **shorting HORG** pin & **DG** pin.
3	Short connection of **HOME** pin & **DG** pin, motor will home in **forward** direction. The action of homing is triggered by **shorting HORG** pin & **DG** pin.
4	Short connection of **HOME** pin & **DG** pin, motor will home in **backward** direction. The action of homing is triggered by **opening CCWHC** pin & **DG** pin.
5	Short connection of **HOME** pin & **DG** pin, motor will home in forward direction. The action of homing is triggered by **opening CWHC** pin & **DG** pin.
6	Short connection of **HOME** pin & **DG** pin, motor will home in **backward** direction. The action of homing is triggered by **opening HORG** pin & **DG** pin.

BAUD	H0【0】00	1,5

Bit 2

RS232 Baud Rate	
0	9600
1	19200
2	38400

	H【0】000	1,5

Bit 3

Echo responds to RS232	
0	**Enable** Echo from terminal
1	**Disable** Echo from terminal

PN04

SERVO OFF & EMC Setting

	H010【1】	A

Bit 0

The Setting of SVOFF Pin	
0	The pin of **SVOFF** is **invalid**.
1	**Short** connection of **SVOFF** pin & **DG** pin, driver will SERVO OFF immediately.
3	**Open** connection of **SVOFF** pin & **DG** pin, driver will SERVO OFF immediately.

	H01【0】1	A

Bit 1

Brake Method of Servo Off	
0	When servo off, motor will immediately **decelerate speed**. (the deceleration decided by **VA** parameter) After motor stop, driver will shut down the output current.
1	When servo off, driver will immediately shut down the output current. The motor will **free run**.

	H0【1】01	A

Bit 2

The Setting of EMC Pin	
0	After **EMC** occur, **ALARM** pin and **BREAK** pin will be invalid.
1	**Short** connection of **EMC** pin & **DG** pin will **enable** EMC(emergency stop), and motor will immediately stop.
3	**Open** connection of **EMC** pin & **DG** pin will **enable** EMC(emergency stop), and motor will immediately stop.

	H【0】101	A

Bit 3

Brake Method of Emergency	
0	When EMC occurs, motor will immediately **decelerate speed**. (the deceleration decided by **VA** parameter) After motor stop, driver will shut down the output current.
1	When EMC occurs, driver will immediately shut down the output current. The motor will **free run**.

PN05

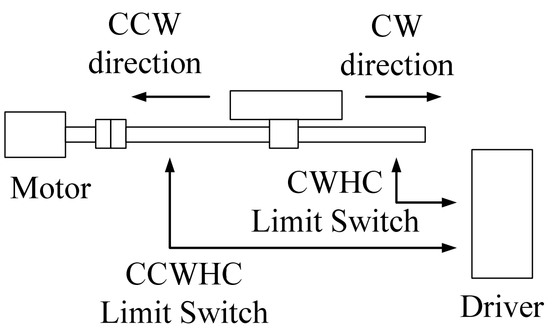
The Limit Switch of CW & CCW

	H010【1】	A

Bit 0

The Setting of **CWHC** Pin	
0	The **CWHC** pin will be invalid.
1	**Short** connection of **CWHC** pin & **DG** pin will **enable** CWHC (inhibit clockwise rotation).
3	**Open** connection of **CWHC** pin & **DG** pin will **enable** CWHC (inhibit clockwise rotation).

Make use of two safe limit switches to trigger **CWHC** pin and **CCWHC** pin so that the motor can prevent from exceeding the work range.



	H01【0】1	A

Bit 1

Brake Method of CWHC	
0	When CWHC occurs, motor will immediately **decelerate speed**. (the deceleration decided by **VA** parameter) After motor stop, driver will shut down the output current.
1	When CWHC occurs, driver will immediately shut down the output current. The motor will **free run**.

	H0【1】01	A

Bit 2

The Setting of **CCWHC** Pin	
0	The **CCWHC** pin will be invalid.
1	**Short** connection of **CCWHC** pin & **DG** pin will **enable** CCWHC (inhibit counter- clockwise rotation).
3	**Open** connection of **CCWHC** pin & **DG** pin will **enable** CCWHC (inhibit counter- clockwise rotation).

	H【0】101	**A**

Bit 3

Brake Method of CCWHC	
0	When CCWHC occurs, motor will immediately **decelerate speed**. (the deceleration decided by **VA** parameter) After motor stop, driver will shut down the output current.
1	When CCWHC occurs, driver will immediately shut down the output current. The motor will **free run**.

PN06

About the Holding Brake (Magnetic Brake behind the motor)

	H100【1】	**A**

Bit 0

The Setting of **BRAKE** Pin	
0	The **BRAKE** pin will be invalid.
1	After servo ready, output of the **BRAKE** pin will be **OFF**.(short)
3	After servo ready, output of the **BRAKE** pin will be **ON**.(open)

	H10【0】1	**A**

Bit 1

Time Delay of BREAK ON, After Servo On	
0~F	After servo on, the holding brake behind motor will be released after X time delay.(unit of X: 100 msec)

	H1【0】01	**A**

	Bit 2		
	Time Delay of BREAK OFF, After Servo Off 0~F: After servo off, the holding brake behind motor will lock motor after X time delay.(unit of X: 100 msec)		
		H【1】001	**A**
	Bit 3		
	Dynamical Brake Setting 0: **Disable** dynamical brake 1: **Enable** dynamical brake		
PN07	**Setting of Output Signal**		
		H111【1】	**A**
	Bit 0		
	The Setting of READY Pin 0: The **READY** pin will be invalid. 1: After servo ready, the **READY** output pin will be **ON**. 3: After servo ready, the **READY** output pin will be **OFF**.		
		H11【1】1	**A**
	Bit 1		
	The Setting of ALARM Pin 0: The **ALARM** pin will be invalid. 1: After alarm occurs, the **ALARM** output pin will be **ON**. 3: After alarm occurs, the **ALARM** output pin will be **OFF**.		
		H1【1】11	**0,1**
	Bit 2		
	The Setting of POSOK Pin 0: The **POSOK** pin will be invalid. 1: After motor rotates to command position, the **POSOK** output pin will be **ON**. 3: After motor rotates to command position, the **POSOK** output pin will be **OFF**.		
		H【1】111	**A**
	Bit 3		
	The Setting of PHZOUT Pin 0: **Disable** output the Z phase signal of encoder. 1: **Enable** output the Z phase signal of encoder.(this signal is the same as **PZ+**)		
PN08	**The Setting of Selecting External or Internal Speed**		
		H000【0】	**1**

Bit 0

The Selection of Normally Rotation Speed	
0	Use **internal speed** setting **PN10 (VM)** as rotation speed.
1	Use **external analog VR input** as rotation speed. The maximum speed is **PN19 (VF)**.

	H00【0】0	**1**

Bit 1

The Selection of JOG speed	
0	Use **internal speed** setting **PN14 (VJ)** as manual JOG speed.
1	Use **external analog VR input** as manual JOG speed. The maximum speed is **PN19 (VF)**.

※When setting Bit0 or Bit1 be 1, driver will convert the voltage detected from analog input to speed (RPM) value and write this value to **PN10 (VM)** or **PN14 (VJ)**.

PN09

Sequence of Switching Control Mode		
	H000【0】	**A**

Bit 0

Sequence of Switching Control Mode	
0	When changing the control mode by setting MD (PN01), driver will **SERVO OFF**.
1	When changing the control mode by setting MD (PN01), driver will **STILL SERVO ON**.

PN10

VM	1~5000【3000】	**12345**

Rotational Speed (Unit: RPM)

- At mode **<u>PN01 (MD) =1</u>** (the position control mode with buffer), this parameter **VM** sets the maximum speed of motor. If the rate of input command pulses is higher than **VM**, the maximum rotational speed will be **VM**. But the final position determined by input pulses will not be affected by the **VM**.
- At mode **<u>PN01 (MD) =2</u>** (the velocity control mode) or **<u>PN01 (MD) =3</u>** (the voltage control mode), this parameter **VM** determines the rotational speed in inputting +10V analog voltage. For example, if you set **VM** to 3000, you will get 3000 RPM when you input +10V to analog input port and you will get -1500 RPM when you input -5V.
- At mode **<u>PN01 (MD) =4</u>** (the torque control mode), this parameter **VM** is used to limit the rotational speed for safe protection. In torque control mode, SIDC650 will output the constant torque. If the load is removed from the motor, the rotational speed of motor will increase. When the speed is over **VM**, SIDC650 will decrease the output torque to avoid over speed.
- At mode **<u>PN01 (MD) =5</u>** (hyper terminal control mode), **VM** means the maximum speed of **MA** instruction and **MR** instruction.

※ The rotation speed of mode **<u>PN01(MD)=0</u>** (the position control mode) is not controlled by **VM**.

	※ This default value 【】 is different from set to set.(a set here means a motor and a driver)		
PN11	VA	1~1000【250】	**1,2,5**
	Acceleration (Unit: RPS²) ● This parameter decides the maximum acceleration and deceleration of rotation. The unit is revolution per sec². For example: If **PN10(VM)**=3000，**PN11(VA)**=250. The unit of **VM** in SIDC650 is RPM, 60RPM=1RPS. Therefore, the total time of starting to 3000 RPM from station needs =(**VM**/60)/**VA**=0.2 sec. ●The setting of **VA** is closely related with the torque and load. The formula is $\boxed{A = T / Im}$ A is angular acceleration, unit: rad/sec² T is the output torque of motor, unit: Nt*m Im is the total inertia of motor and load , unit: Kg*m² ● If mode **PN01 (MD) =1** (the position control mode with buffer), **VA** decides the maximum acceleration of the motor. If the rating of the input pulse is smaller than **VA**, the motor will follow the input pulse. But if the rating of input pulse is over **VA**, the motor will follow the command with acceleration of **VA**. The buffer will save the excessive amount of the input pulse, and release them when the rating of input command becomes small. To sum up, the final steady state of the motor speed and position will not be influenced by **VA**. ●If mode **PN01 (MD) =2** (the velocity control mode), **VA** decides the maximum acceleration and deceleration of the motor. ● If mode **PN01 (MD) =5** (the terminal mode). When you execute the instructions of **MA**、**MR**、**JGF**、**JGR**、**H**, **VA** decides the acceleration and deceleration of the motor. ● In all modes, **VA** decides the acceleration of JOG in the front panel.(**Execute FN02**) ※The acceleration of mode **PN01 (MD) =0,3,4** is not controlled by **VA**.		
PN12	SC1	1~9999【1】	**0,1**
	Electric Gear Ratio Numerator ● **SC1** and **SC2** parameter is used for position pulse control(**MD**=0 or **MD**=1). The unit of		

<table>
<tr><td></td><td colspan="3">motor moving is EC(Encoder Count)，corresponding to the resolution of encoder. In position pulse control mode, SIDC650 will drive motor rotate
$\left(\text{input pulses} \times \frac{PN12}{PN13}\right)$EC. For example:
When SIDC650 received 2000 pulses, and user sets SC1=5 , SC2=10，the motor will rotate 2000*5/10=1000 EC.(1000 EC is 1/10 revolution of 2500 lines encoder, because one revolution of 2500 lines encoder is 4*2500=10000 EC.)
● SC1 and SC2 must be set in positive integral, but SC1÷SC2 could be set arbitrarily.

For example:
User can set SC1=2 and SC2=3 (SC1÷SC2=0.6666…EC). User won’t be worried about the position error ，SIDC650 will deal with the error and let the final position error be less than 1 EC.

● The range of SC1÷SC2 is 9999 to 1/9999。
● We recommend user to use the position pulse control mode with buffer (MD=1), when the value of SC1 is much bigger than SC2. Because the bigger electric gear ratio was set, motor moves more rapidly with per input pulse. But if use MD=1 and tune the parameter VA, motor will move smoothly.

※SC1 and SC2 is only valid in MD=0 or MD=1.
※The variation of this parameter is valid after driver being reset.</td></tr>
<tr><td rowspan="2">PN13</td><td>SC2</td><td>1~9999【1】</td><td>0,1</td></tr>
<tr><td colspan="3">Electric Gear Ratio Denominator
Please refer to parameter PN12.
※The variation of this parameter is valid after driver being reset.</td></tr>
<tr><td rowspan="2">PN14</td><td>VJ</td><td>1~5000【3000】</td><td>A</td></tr>
<tr><td colspan="3">JOG Speed (Unit：RPM)
● VJ is the speed of motor rotation when user operates the front panel.（Execute FN02）
● VJ is also the speed of command JGF and JGR.</td></tr>
<tr><td>PN15</td><td>V0</td><td>-200~200【0】</td><td>2,3,4</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">The Zero Offset of Analog Input (Unit: 0.01V)
● The range of analog input is ±10V，and 0V is the zero point. Sometime the zero point of analog input is not the same zero point of driver, so user could use this parameter to calibrate the zero point of driver.
● The method of calibration:
1) Set DN=12, LED will display the real time analog input voltage.
2) Set V0 to 0.
3) Set the voltage of external device to zero.
4) If the value of LED display is not zero, set the inverse value to V0.(ex: LED display -24，set V0 to 24)
5) SAVE the new value of V0 to EEPROM when need.</td></tr>
<tr><td rowspan="2">PN16</td><td>VZ</td><td>0~99【0】</td><td>2,3</td></tr>
<tr><td colspan="3">The Deadzone (inactivity) of Analog Input (Unit: 0.01V)
● This parameter is mainly applied in speed/voltage/torque control mode(MD=2,3,4), or position mode with external analog speed input(MD=0,1).

For example:
If user wants motor to be maintained station state in speed control mode, user must input zero voltage critically. But it is rather difficult to achieve this event. So user could use this parameter to set a deadzone (inactivity) of analog input, motor will not rotate when input any voltage within the deadzone.</td></tr>
<tr><td rowspan="2">PN17</td><td>TSC</td><td>1~32【10】</td><td>2,3,4</td></tr>
<tr><td colspan="3">Torque/Speed Scale
● In velocity control mode(MD=2), this parameter set the scale between analog input voltage and parameter VM.
● In voltage control mode(MD=3), this parameter set the scale between analog input voltage and output voltage of driver.
● In torque control mode (MD=4), this parameter set the scale between analog input voltage and output torque of motor.</td></tr>
<tr><td rowspan="2">PN18</td><td>EP</td><td>1~999【5】</td><td>0,1</td></tr>
<tr><td colspan="3">In Position Range (Unit: EC)
● This parameter decides the timing of output <u>POSOK</u> signal. When the difference between the command position and the actual position is less than the value of EP, driver will output the <u>POSOK</u> signal.</td></tr>
<tr><td>PN19</td><td>VF</td><td>1~6000【4000】</td><td>A</td></tr>
</table>

	Maximum Rotational Speed (Unit: RPM) ● This parameter decides the maximum limit of rotational speed. Please refer to **PN08**. ※ When detect the rotational speed exceeding **VF**, alarm "**Over Speed**" (**Err-10**) will happen.		
PN20	AVA	0~32000【1000】	**2,3,4**
	● When using external VR(variable resistor), the acceleration of motor rotation is decided by this parameter.		
PN21	Reserved by Manufactory		
PN22	Reserved by Manufactory		
PN23	VH	1~5000【300】	**1,5**
	Homing Speed (Unit: RPM) ● After the user triggers the **<u>HOME</u>** input pin or executes the instruction **H (**from hyper terminal), motor will run back to the mechanical home (the **<u>HORG</u>** input pin) with the speed of **VH** and exceeding the home. Then, motor run back again to the mechanical home with speed of **VH**/64 and stop in the mechanical home.		
PN24	HP	0~65535【0】	**1,5**
	After homing, the offset value of the position coordinate ● HP value x 4 = actual position offset		
PN25	EL	20~4000【400】	**A**
	Position Error Limit (Unit: EC) ● The follow error of motor means the error between practice position and command position. There are some factors (overloading, parameter setting fault) leading to bad performance and then the following error will become greater. In order to protect the servo system, the driver will be automatically turned to servo off. The fore-mentioned situation is called "**Follow Error**" (**Err-04**). For example： When we use the encoder with 500 pulse per count (500*4=2000 EC) and **EL**=400, we will meet alarm "**Follow Error**" (**Err-04**) in the moment of follow error over 400. (In other words, the moment of follow error over 1/5 count) ※ This parameter different from set to set.(a set here means a motor and a driver)		
PN26	LL	50~300【550】	**A**

	Load Limit (Unit: Watt) ● This parameter decides the rated power capacity of motor. If the load applied on motor is large than the rated power capacity, alarm "**Over Load**" (**Err-02**) will not happen immediately. The timing of alarm "**Over Load**" (**Err-02**) happening is according to the excess and the time. ※ This parameter is not adjustable, just for view.		
PN27	IL1	【900】	**A**
	Current Limit (Unit: 0.01 AMP) ● This parameter decides the maximum limit of peak current. Once the peak current of motor is larger than this value, alarm "**Over Current**" (**Err-03**) will immediately occur. ※ In general, DO NOT change this value to avoid from damaging the driver and motor. ※ This default value 【】 is different from set to set.(a set here means a motor and a driver)		
PN28	IL2	【300】	**A**
	Rated Current (Unit: 0.01 AMP) ● This parameter decides the rated current of motor. If the load applied on motor is large than the rated power capacity, alarm "**Over Rated Current**" (**Err-12**) will not happen immediately. The timing of alarm "**Over Rated Current**" (**Err-12**) happening is according to the excess and the time. ※ In general, DO NOT change this value to avoid from damaging the driver and motor. ※ This default value 【】 is different from set to set.(a set here means a motor and a driver)		
PN29	Reserved by Manufacturer		
PN30	KP	1~20000【5000】	**All modes**
	Proportional Gain of PID controller Please refer to the drawing of P.47.		
PN31	KD	1~32000【0】	**All modes**
	Differential Gain of PID controller Please refer to the drawing of P.47.		
PN32	KI	0~50【5】	**A**
	Integral Gain of PID controller Please refer to the drawing of P.47.		
PN33	DM	0~99【0】	**A**
	Virtual Damper ● In order to decrease the overshoot of PID control, user can decrease the **VA** parameter. But decreasing **VA** will lead to lower the performance of servo system. So we have another way to decrease the overshoot by increasing the damper of the system. ※ The disadvantage of adding the damper is that the load of motor will become more		

	larger. Please refer to “Servo Tune”, P.44.		
PN34	Reserved by Manufacturer		
PN35	FFV	0~9999【3221】	**A**
	Forward Velocity Compensation Please refer to “Servo Tune”, P.48. ※ This default value 【 】 is different from set to set.(a set here means a motor and a driver)		
PN36	FFB	-99~99【0】	**A**
	Unbalance Compensation (generally used for Z-axis movement) Please refer to “Servo Tune”, P.48.		
PN37	Reserved by Manufacturer		
PN38	Reserved by Manufacturer		
PN39	Reserved by Manufacturer		

Descriptions of Driver Alarms

- When 7 segment display shows Err, it means that alarm occurs and the driver cannot be operated.
- Please solve the problem according to the following procedure.

Alarm List

Display	Causes	Solutions
Err01	**Over Voltage** ● The voltage of DC bus is over 360V. ● AC voltage is over 255V. ● The circuit for detecting voltage is breakdown.	● Use multi-meter to measure whether the input voltage is more than the rated voltage. ● Check if the input voltage conforms to the spec of the driver.
Err02	**Over Load** ● Overloading, the actual torque exceeds rated torque for long time. ● The load of the motor exceeds the system parameter of **PN26** (**LL**). ● The servo system is unstable and vibrates. ● The wiring of motor and encoder are wrong.	● Extend acceleration and deceleration time, or increase the capacity of motor. ● Adjust the system parameter **PN30** (**KP**) or other gain value. ● Decrease the load or increase the power capacity of motor. ● Wire the cables correctly according to these instructions.
Err03	**Over Current** ● The output current from driver exceeds the setting value of parameter **PN27** (**IL1**). ● The output of driver short- circuits (circuit or IGBT has break down.) ● The relay for dynamic brake has been damaged by high temperature.	● Adjust the system parameter **PN30** (**KP**). ● Check if U,V,W cable short-circuit and if they are correctly connected. ● First, disconnect the motor. Second, power on the driver. If the alarm still occurs, replace the driver with another one. ● Replace the driver, and DO NOT use the SVOFF instruction to stop the motor
Err04	**Follow Error** ● The input pulse subtracts encoder feedback pulse exceeds the value of **PN25(EL)** . ● Velocity or acceleration command from the controller is too huge. ● The value of parameter **PN30(KP)** is too small. ● The motor did not follow the command.	● Add up the protect value of parameter **PN25(EL)**. ● Increase acceleration/deceleration time or reduce load. ● Add up the value of **PN30(KP) and PN31(KI)** to speed up the response of motors. ● Check if the motor and driver are compatible with each other.

Err05	**Encoder Error** ● The encoder breakdown. ● The encoder cable has noise. ● The communication between encoder and driver breaks down.	● Please tighten the connector of the cable between encoder and driver. ● Check if there is short circuit between the connector of encoder and something. ● Check if the input power of encoder is DC+5V, especially when the encoder cable is too long.
Err06	**Under Voltage** ● The input voltage of driver is lower than AC170V. ● DC bus is lower than 240V.	● Use multimeter to measure if the input voltage is lower than rated voltage. ● Check the input voltage of the driver.
Err07	**I Trip** ● The output of driver short-circuits or breaks down (circuit or IGBT breaks down). ● The relay for dynamic brake is damaged by high temperature. ● After **Err04** occurs, the user still input pulse command. In order to protect the system, the driver will start **I trip**.	● Check if U,V,W cable short-circuit and if they are correctly connected. ● First, disconnect the motor. Second, power on the driver. If the alarm still occurs, replace the driver with another one. ● Replace the driver. Don't use SVOFF to stop the operation. ● Before reset the system, please make sure there is no other pulse command inputting.
Err08	**V Trip** ● The voltage of DC bus is over 360V. ● Regenerative resistance is broken. ● The circuit for detecting voltage is breakdown.	● Use multi-meter to measure whether the input voltage is more than the rated voltage. ● Check if the input voltage conforms to the spec of the driver.
Err09	**Over Pulse Rate** ● The input pulse frequency is over 500 KHz.	● Please decrease the frequency of input pulse which comes from the outer controller.
Err10	**Over Speed** ● The velocity of the motor is over the setting of **PN19** (**VF**).	● Increase parameter **PN19**, or decrease the input pulse frequency that comes from the outer controller.
Err11	**EMC** ● The **EMC** pin has been inputted.	● After confirm that there is no other alarm or warning, short-circuit **Pin22** (**EMC**) and **DG** and then reset the system.

Err 12	**Over Rated Current** ● The output current is over the setting of parameter **PN28** (**IL2**) for a short time. ● Poor mechanism, which leads to malfunction. ● The output of driver short-circuits or breaks down (circuit or IGBT breaks down).	● Set parameter **PN11** (**VA**) properly. ● Check if U, V, W cable short-circuit and if they are correctly connected. ● First, disconnect the motor. Second, power on the driver. If the alarm still occurs, replace the driver with another one. ● Check if there is no obstacle in the travel route.
Err 14	**Memory Error** The data stored in memory is wrong.	● Please turn off the power and then press **ENTER** and **QUIT** key in the front panel at the same time to turn on the power. If the user does it correctly, the 7 segment LED display will show “dF dd”. Afterwards, first execute **FN09【Initialize Parameter】** and then execute **FN08【Calibrate Current Sensor】**.

※ If you sill can’t solve the problem, please contact the manufacturer to get further solution.

※ DC bus designates high DC voltage circuit in driver used to drive the motor.

The Other Alarm

Hc-F	**CW Drive Inhibit (CWHC)**
Hc-r	**CCW Drive Inhibit (CCWHC)**

● These two alarms are triggered by the limit switches which are connect to **CWHC** and **CCWHC** pin each other.

How to remove alarms

After user removes the causes of the alarm, short-circuit **Pin24** (**RESET**) and **DG** pin of CN1 to execute the system reset. But some alarms can be only removed by re-power on the driver.

● We strongly suggest our user to take the action that re-power on the driver to avoid the harmful action from driver after user removes the causes of the alarm.

● After removing the alarm and before operating, please check the following items.

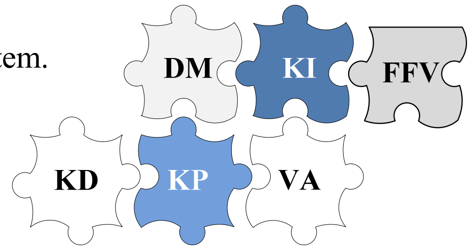
1) Check whether there is no command send to the driver.

2) Check whether all the alarms have been removed (alarm may be more than one) to avoid damage the driver again.

※When **Err-07** or **Err-03** occurs, be sure to turn off the power and restart the driver again so that no alarms will occur again.

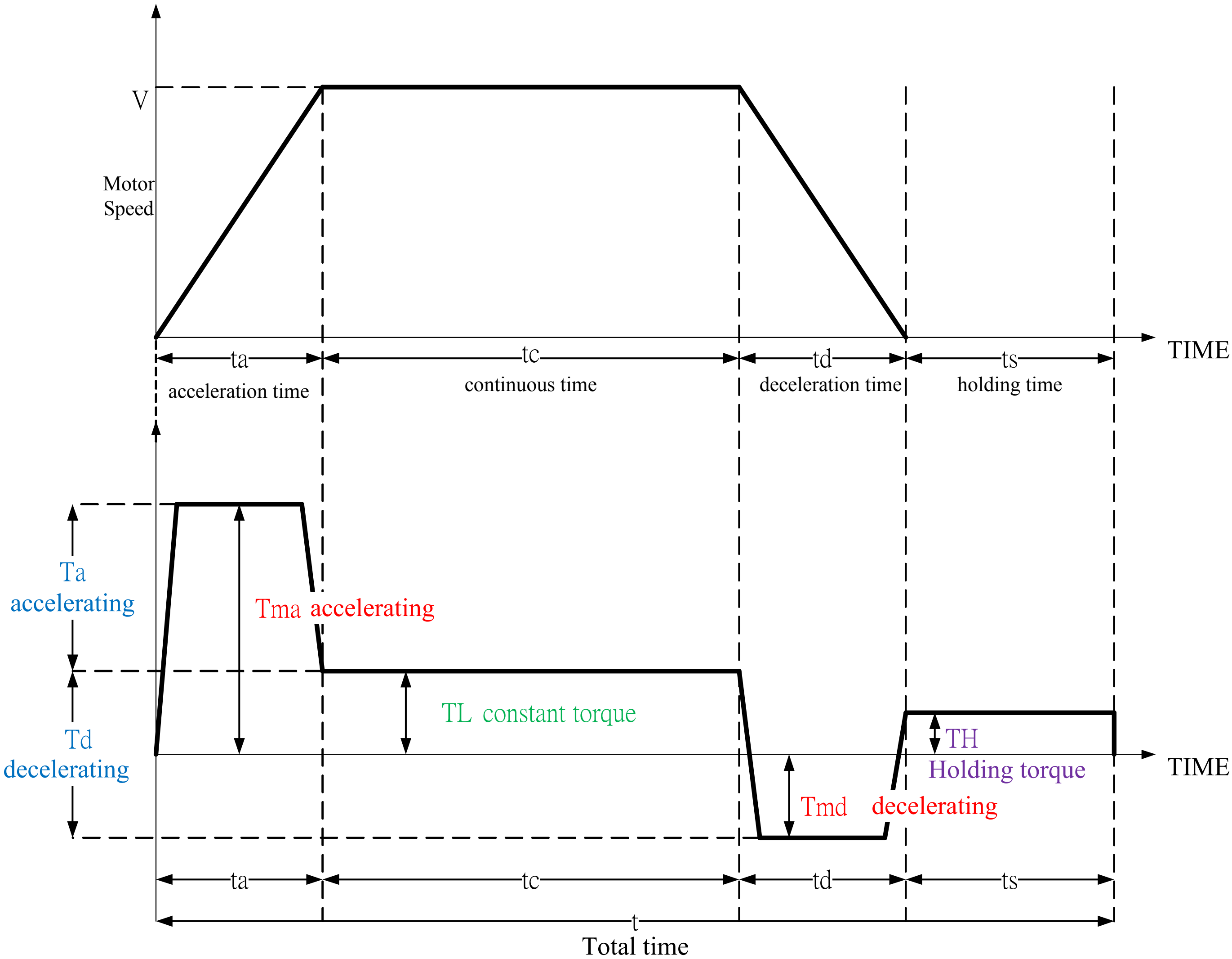
This chapter is extremely important. In order to make good use the servo system, the user needs to adjust some parameters.

Here we will talk about some important concept about the servo system.



The Power Capacity of Servo Motor

Before selecting motor, one should consider the following two factors. (as shown at the bottom)



Tma and Tmd must be less than the maximum torque of motor

the maximum torque of motor ≧ Tma＝Ta＋TL

the maximum torque of motor ≧ Tmd＝Td－TL

Continuous Tr must be less than the rated torque of motor

the rated torque of motor ≧ Tr

$$\left(Tr = \sqrt{\frac{Tma^2 \cdot ta + TL^2 \cdot tc + Tmd^2 \cdot td + TH^2 \cdot ts}{t}} \right)$$

If you meet these two basic factors, the motors can make better use of them. If possible, please select the motors whose power capacity is larger than you had thought so as to make sure the motors are stable when operating.

Adjustment of Rotation Acceleration VA (PN11)

If the user hopes to use the motor with highest efficiency, the user should follow the following instructions and incidentally check whether the capacity of the motor is appropriate or not.

1) Install the motor on the machine, add load, and set
VA (**PN11**) to 1 (minimum),
KP (**PN30**) to 1000,
KI (**PN32**) to 0.

2) Execute one complete operation (can use the developed program or **JGF**, **JGR** instructions). If alarm or **Err-04** occurs, please check whether the connection of driver between encoder and motor are well connected or not and increase **KP** (only increase 100 each time). If **KP** is in its maximum (20000) but **Err-04** still occurs, please increase **EL** (**PN25**). If the driver still displays **Err-04**, the user probably needs to select the motor of lager power capacity.
※ If possible, please increase **KP** first before you increase **EL**.

3) After the user determines **KP**, and it can operate one complete travel, please switch the monitor parameter to **DN09** to view the peak value of torque (the unit is 0.01kg*cm), and increase **VA** to execute repeated operation. Remember at the same time to view **DN09**. Once **DN09** is larger than the peak torque, an alarm of **Err-03** would occur. After conducting many tests, the user can decide the maximum acceleration **VA** in normal conditions according to the value of **DN09**.
※ Please let the motor operate many times with the chosen **VA** and don't let the **DN09** get too close to the peak torque of the motor. Otherwise, once the motor is affected by other factors, the driver is likely to give alarms or servo off.

4) After the user chooses the value of **VA**, please operate the motor repeatedly. If alarm **Err-12** occurs after the repeated rotation, it means the long term continuous torque Tr is larger than the rated torque of the motor. The solution is to lower the value of **VA**. And an alternative way is to change the rated current of the motor—to increase **IL2** (**PN28**). But the second solution is to force the motor to operate with exceeding current. Long term operation may cause high temperature. But if the rotation is not going to last long, it is an alternative.
※ Demagnetization will occur if the motor is operating at high temperature, which is a permanent damage to the motor. The manufactory will not be responsible for this operation.

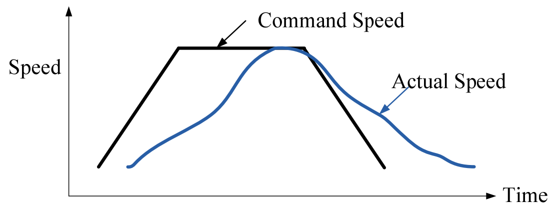
Torque of each Motor

Motor Type	Rated Torque kg*cm	Max. Torque kg*cm
SIA-121	3.9	11.7
SIA-151	4.9	14.6
SIA-351	11.4	34.1
SIA-551	17.9	53.6
SIA-751	24.3	73.0

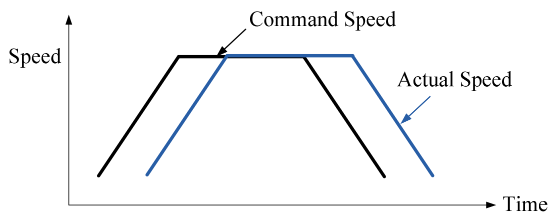
Roughly speaking, the process of adjusting is from **VA**=1. Increase **VA** and at the same time don't let the value of **DN09** get too close to the peak torque of the motor. After choosing the most important element—the value of **VA**, the user can optimize the servo system by following the following instructions in the next step.

The Purpose of Servo Driver

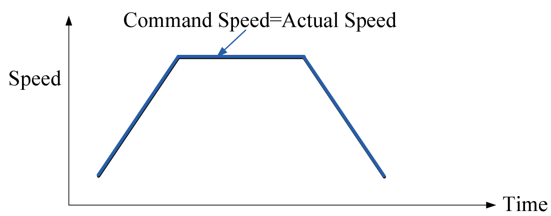
The purpose of adjusting the servo system is to minimize the level of inaccuracy of the servo motor when operating under instructions and also shorten the time of travel. Doing so needs to adjust gain parameter and compensation parameter. The following drawing of the speed curve and command speed explains the differences before and after adjusting gain parameter and compensation parameter.



From the above drawing we can know if we don't set gain parameter appropriately, the actual speed is not equilavent to the command speed, so we need to adjsut these three parameters — **KP** (**PN30**),**KD**(**PN31**) and **KI**(**PN32**) to achieve the status of following drawing.



The user also needs to add forward velocity compensation parameter **FFV**(**PN35**) to achieve the folloing drawing. (If it is unnecessary, **FFV** (**PN35**) and **KD** (**PN31**) don't need to be adjusted.)



Gain Parameter

Gain parameter is an important parameter that affects the performance of servo system. It includes **KP** (**PN30**), **KD** (**PN31**) and **KI** (**PN32**). Because SIDC 650 drivers use the PID control, **KP** means proportion gain and **KD** means differential gain and **KP** means integral gain.

※ According to the theory of PID control, user needs to set **KI** and **KP** to eliminate the steady state error.

Proportional Gain (KP)

The output of proportion controller is a proportion of position error. The equation is $\boxed{PWp=KP*FLE}$

PWp= the output of the proportion controller

KP= proportional gain

FLE= position error

Small **KP** value will lengthen the time for positioning, but large **KP** value leads to overshooting and vibrations.

※ Exceeding **KP** will cause too many vibrations so that it cannot be used.

Differential Gain (KD)

The output of differential controller is a proportion of the alteration of position error.

The equation is $\boxed{PWd=KD*(dFLE/dt)}$

PWd= the output of the differential controller

KD= the differential gain

FLE= position error

Increasing **KD** can decrease the overshooting of **KI**. Appropriate value of **KD** can at the same time shorten the time of positioning and decrease overshooting.

※ Exceeding **KD** will lengthen the time for positioning. (Meanwhile inhibits overshooting.)

Integral Gain (KI)

The output of proportion controller is a proportion of integral of position error.

The equation is $\boxed{PWi=\int FLEdt*KI}$

PWi= the output of integral gain

KI= integral gain

FLE= position error

The main function of integral gain is to eliminate the steady state error. Increasing **KI** can help eliminate the error when positioning but will become more unstable because of integral. If the steady state error is not really important, the user can set **KI** to 0. On the other hand, if steady state error matters, please set **KI** to at least 1.

※ Like **KP**, exceeding **KI** will cause too many vibrations so that it cannot be used.

Compensation Parameter

Compensation parameter also affects the performance of servo system, including **FFV** (**PN35**), and **FFB** (**PN36**).

Forward Velocity Compensation

Many applications in industry such as CNC, the system not only needs to be accurate in positing but also in traveling, which means the Follow Error (FLE) should be as few as possible. The most basic way of minimize FLE is to increase **KP**. As mentioned before, **KP** is in inverse proportion to FLE. If you increase **KP**, FLE will decrease. Please don't set **KP** too large because the system will become unstable.

In fact, it is impossible to solve the problem of Follow Error by using **KP**. Because there must be errors first, then comes following. No error, no rotation for motors. It is impossible to achieve controlling without errors.

In order to reduce FLE and stabilize the system, SIDC 650 not only compensates position errors, but also compensates velocity in advance. This is the function of **FFV** parameter. In general applications, the default value of **FFV** doesn't need to be changed. If the user need to adjust of reset **FFV**, the procedure is as follows:

1. Repeat the travel and change the monitor parameter into DN03, and then observe the peak of follow error.

※ The error in forward direction is "＋"; the error in backward direction is "－".

2. Adjust the value of **FFV** (**PN35**) repeatedly, until the 7-segment displays the minimum number of **DN03**. (Press **QUIT** in the front panel can update the newest peak)
3. If the user need to save the value, please execute **SAVE**.

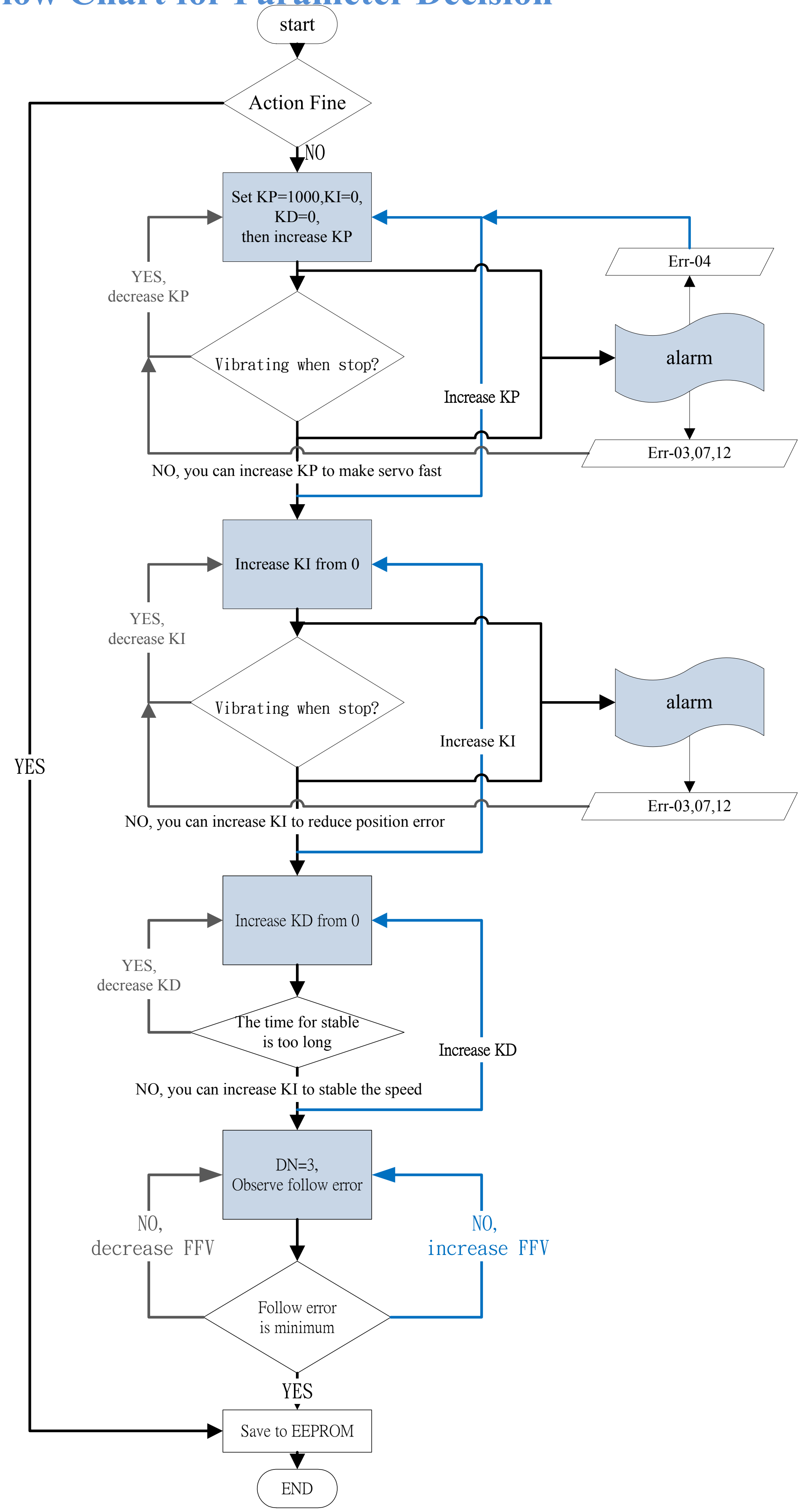
The Compensation of Unbalance (FFB)

When the servo motor is applied in Z-axis movement, the load of the motor in ascending is larger than the load in descending. As a result, one parameter is hard to give consideration to both two situations. We need another parameter to compensate the unbalance. The function of this parameter is to compensate the fixed load of one direction. The user can adjust or set **FFB** by following the instructions:

1. Enter Hyper Terminal Mode (**MD**=5), re-power on the driver.
2. Unlock brakes and add load to the motor. Command the motor to ascend a little bit and then stop it. When the motor stops, set **KI** to 0, and decrease **KP** adequately. (The purpose of decreasing **KP** is to emphasize FLE. But the value of **KP** cannot be too small, or the driver of alarm may occur.)
3. Reset **DN=2** to monitor FLE. When monitoring FLE, the user needs to adjust **FFB** and set FLE to 0. After doing so, the **FFB** is optimal right now.
4. Restore **MD**, **KP, KI** and **DN**, and execute **SAVE**. The setting of **FFB** is done.

※ When the value of **FFB** is negative, the direction of compensation is inverse.

The Flow Chart for Parameter Decision

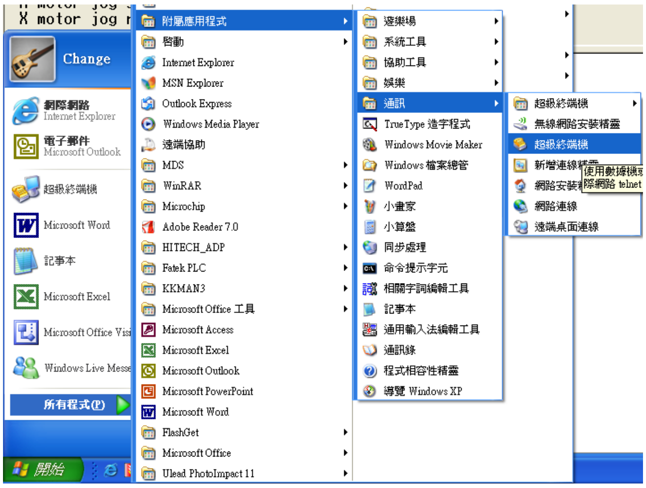


SIDC 650/850 can use Hyper Terminal to communicate with WINDOWS though RS-232 COM. Users can set parameter and try operating the motor.

How to Set the Connection

The procedure of connecting to computers is as follows:

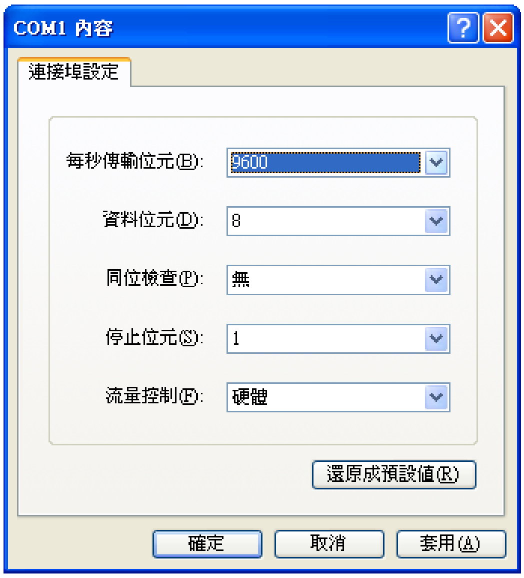
1) 「Program Files」→「Application Utilities」→「Communication」→「Hyper Terminal」



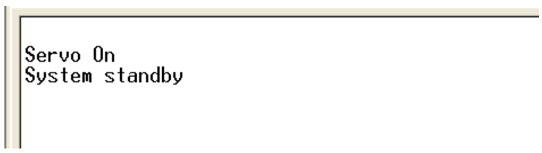
2) Name the icon. In the example, we name this SIDC 650.

3) Please refer to the following picture to set the port.

4) Set the baud rate to 9600, and flow control to hardware.



5) Now turn on the power of SIDC 650/850. If the installment is successful, we can see “Servo On”, ”System standby”.



Hyper Terminal Commands of SIDC 650/850

Here we offer some basic commands that users can use to position the motor and control I/O.

Command Instruction Chart

Type	Instruction	Range of Parameters	Functions
Movement Instruction	CS 0		Redefine the original of coordinates
	PZ		Suspend motor in the halfway of movement
	REDO		Restore to the movement status before PZ
	H		Homing
	MA m	$-2^{27} \le m \le 2^{27}$	Rotate the motor to the position of m×SC1 in absolute coordinates.
	MR m	$-2048 \le m \le 2047$	The motor rotate with the distance of m×SC1 in relative coordinates.
I/O Control	SET Po	650:$0 \le o \le 5$ 850:$0 \le o \le 2$	Set the output port Po to ON.
	CLR Po	650:$0 \le o \le 5$ 850:$0 \le o \le 2$	Set the output port Po to OFF.
JOG Movement Instruction	JGF		Rotate forward continuously.
	JGR		Rotate backward continuously.
	JG0		Stop rotations.
System Command	RESET		Reset the system alarm, restart the motor.
	HOFF		SERVO OFF
	Press ESC on keyboard		Emergent SERVO OFF
Parameter Setting	DF		Set all system parameter to default value
	SI		Calibrate the current sensors.
	SAVE		Save all system parameter to Flash Rom.
	SRn=XX		Instruction: “SR01=2” means PN01=2. Set system parameter. Please see P.28.