One、Introduction to basic application of servo driver

1、 The servo driver mainly has three working modes: position mode, speed mode and torque mode.

The position mode takes the motor target position as the control target. Position instructions can be set by external pulses, the number of pulses determines the final motor target position, and the pulse frequency determines the motor rotation speed. A position instruction can also be given by an internal position instruction program. The user sets the final target position, target speed, acceleration and deceleration time, and triggers the action through the input function bit.

Speed control takes motor speed as control target. Speed instructions can be set by analog voltage or parameters.

Torque control takes the output torque of the motor as the control target. Torque instructions can be set by analog voltage or parameters.

Each mode is controlled by the corresponding control parameter Pxx.xx and the corresponding input function bit INFnxxx. The running result will be output to the corresponding monitoring parameter Pxx.xx and the output function bit OUTFnxxx.

The control parameter Pxx.xx can be set by VECobserve, by modbus master, by keyboard, or by the PLC program assigned to Dxxx. The last setting prevails.

The input function bit INFnxxx can be bound to the entity input terminal DIx. The entity input terminal drives the input function bit.For example, P06.01=1: binds the input function bit INFn001 (enable) to DI1, and the input terminal DI1 drives INFn001.When DI1 is activated, INFn001 (enable) is activated.

For example, P06.02=1 binds the input function bit INFn001 (enable) to DI2. INFn001 is driven by input terminal DI2. When DI2 is activated, INFn001 (enable) is activated.

The INFn input bit cannot be bound to two DI terminals. If two DI terminals drive the same input bit, conflicts may occur.

The input function bit can also be operated directly through the PLC Mxxx. If an input bit is already bound to Entity DIx, the PLC cannot operate the input bit through Mxxx. That is, the entity terminal has the highest priority of the operation input bit.

The monitoring parameter Pxx.xx can be displayed on the panel or obtained by reading the PLC Dxxx.

The output function bit OUTFnxxx can be bound to the entity output terminal DOx and its effective state can be output by the entity output terminal, or its effective state can be obtained by Mxxx of PLC.

（1）Examples of simple application of speed mode.

If you want the motor to move at 500rpm. You need to set the following parameters:

P02.01=1(Select Speed Mode)

P04.01=0(The speed instruction is derived from the main speed instruction A)

P04.02=0(The main speed instruction A is derived from P04.03)

P04.03=500(Set the value of the main speed instruction A)

After activating the input function bit INFn001 (enable the motor), the motor will rotate at a speed of 500rpm. The real-time speed of the motor is shown in P09.09.

（2）Examples of simple application of location pattern.

If you want to trigger a signal to make the motor rotate 10 times forward, the rotation speed is 2000rpm. You need to set the following parameters:

P02.01=0(Select Position mode)

P03.01=1(Location instructions are derived from internally planned locations)

P03.08=0 P03.10=10000(Set 10000 position instruction units to make 1 turn of the motor)

P13.01=0(Stop after a single trigger motion)

P13.02=1(Run 1 segment position after triggering)

P13.05=1(Run in relative position mode)

P13.10=10 0000 （The position instruction is positive 10 turns, if negative set to -100000）

P13.12=2000 （Command speed is 2000rpm）

Then activate the input function bit INFn001 (enable motor). The rising edge triggers the INFn27 motor to rotate forward for 10 turns.

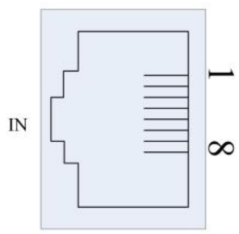
Two、Built-in PLC function description

Based on the general servo, VC600 series servo has added PLC function. PLC function is enabled by parameter P01.90=1. PLC program through GX Works 2 development download test. PLC support ladder diagram language programming. VC600 also supports the parsing of multiple formats of RS instructions. The data completed by parsing is placed in the parameters and provided to PLC for use. The function of RS instruction parsing is referred to "VC600 Introduction to RS Instruction Parsing".

The CN5 monitoring port (serial port 1) of the VC600 series servo can be used as the servo monitoring port to communicate with VECobserver, can also be used as the PLC download debugging port to communicate with GX Works2, and can also be used as the RS instruction receiving port to communicate with the RS upper computer, which can be selected by parameter P01.91. When connecting to the monitoring port (serial port 1) of CN5, you need to set P01.91 correctly to communicate with related software.

VC600 series servos add a RS232 interface (serial port 2) in the CN1 network port, which is used to realize the RS instruction communication with the machine tool. Run P01.94 to select the serial port from which the RS command originates. The signals of the CN1 network port are defined as follows:

PLC program operation, through the INFn171 control, the default parameter P06.04=171, by DI4 control PLC start and stop. P06.24=1, the DI level is reversed, so the system will run PLC by default when there is no connection.



CN1 Definition of signal

PIN	CN1 define	illustrate
1	CANH	High signal of CAN bus
2	CANL	Low signal of CAN bus
3	GND	Power supply ground
4	SG+	Signal positive of RS485
5	SG-	Signal negative of RS485
6	TXD	Send of serial port 2

7	RXD	Receiving of serial port 2
8	GND	Power supply ground

2.1、Explanation of PLC related parameters

Parameter No.	Parameter Description	Set Range	Default	Read and write mode	Effective method
P01.90	Enabling parameters of PLC functions	0~1	0	RW	immediately
	0-The PLC function is not enabled 1-Enable PLC function				
P01.91	Serial port 1 (micro usb) protocol type	0~2	0	RW	immediately
	0-VEC debugging software protocol 1-PLC program download protocol 2-RS instruction protocol				
P01.93	PLC non-standard function	0~1	0	RW	immediately
	0-Universal RS function 1-Non - standard RS instruction parsing function				
P01.94	Serial port source of RS instruction	0~1	0	RW	immediately
	0-Serial port 2 (RS232 inside the network port) 1-Serial port 1 (RS232 in the monitoring port)				

Special note: Drive default, P06.04 (DI4 function configuration) =171 (PLC operation DI function number), P06.24 (DI4 level) =1, DI level is inverted, so in the case of unconnected, the system default PLC operation.

2.2、Introduction of PLC software components

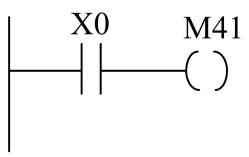
The content of this section is very important and relates to the programming of the built-in PLC. PLC contains the following soft components.

element	description	Internal start address of the drive	Drive internal end address	Common start address	common end address	Power-down save starting address	Power-down save end address
M	Auxiliary relay	0	511	512	3071	512	1535
C16 bit	Counter			0	199	100	199
C32 bit	High-speed counter			200	255	200	255
T	Timer			0	255	246	255
D	Data Register	0	2047	2048	7999	2048	3071
X	Input Relay			0	10		
Y	Output Relay			0	6		

2.2.1 X soft component, Y soft component, M soft component detailed introduction

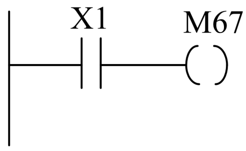
X0~X9 Valid status of the physical DI terminals DI1 to DI10 of the drive.
Y0~Y5 Valid status of the entity DO terminals DO1 to DO6 corresponding to the drive.
M0 to M511 are the input and output function bits inside the drive, which have specific functions.Among them, M41~M116 correspond to the servo input function bits INFn01~INFn76; The fixed offset address of the INFn is 40.
M141~M173 correspond to servo output function bits OUTFn01~OUTFn33; OUTFn has a fixed offset address of 140.
Other input function bits of M0~M511 are reserved for the servo.
The M512 to M1535 are universal M bits that can be maintained after power failure.
The M1536 to M3071 are universal M bits, which will be lost in a power failure.

（1）Application Example 1



After DI1 is activated, the servo drive is enabled.

（2）Application Example 2

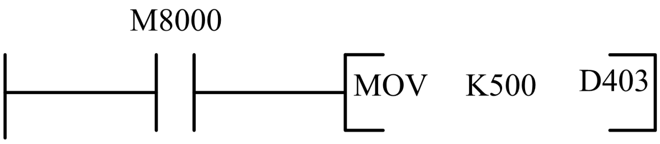


After DI2 is activated, internal location planning is triggered.

2.2.2 Introduction to Area D

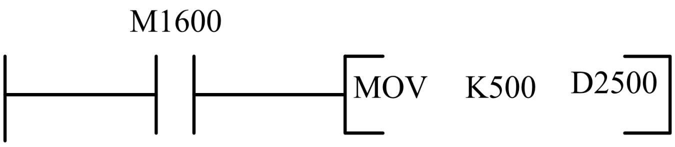
D0~D2047 Corresponding to servo parameters P00.00-P20.47, some parameters are not used, reserved for the servo.
D2048~D3071 It's the address of the power-off hold.
D3072~D7999 It's the address of the power failure.

（1）Application Example 1



Run the PLC program to automatically assign 500 to D403, that is, servo parameter P04.03=500.

（2）Application Example 2



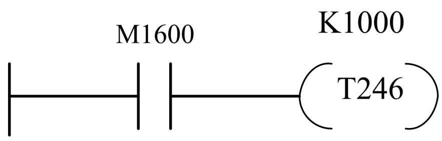
Run PLC program and close M1600, power off, power on again, D2500 value is still 500. Because the D2500 has power failure hold function.

2.2.3 Introduction to other soft components

T0~T245 It is a universal T bit, which will be lost in a power failure.
T246~255 Is the universal T bit, which will be retained after power failure.

100ms type 0.1~3276.7sec	10ms type 0.01~327.67sec	1ms Cumulative*4 0.001~32.767sec	100ms Cumulative*4 0.1~3276.7sec	1ms type 0.001~32.767sec
T0~T199 200 point For Subprogram T192~T199	T200~T245 46 point	T246~T249 For 4-point Execution Interrupt saving*4	T250~T255 6 points hold*4	T256~T511 256 point

（1）Application Example 1



Run PLC program and close M1600, and T246 starts counting. When the value reaches 1000, T246 is effective and remains at 1000. Generally, the counting value of T246 should be cleared within one cycle after the operation.

Three、 Engineering create and connect PLC download procedure steps

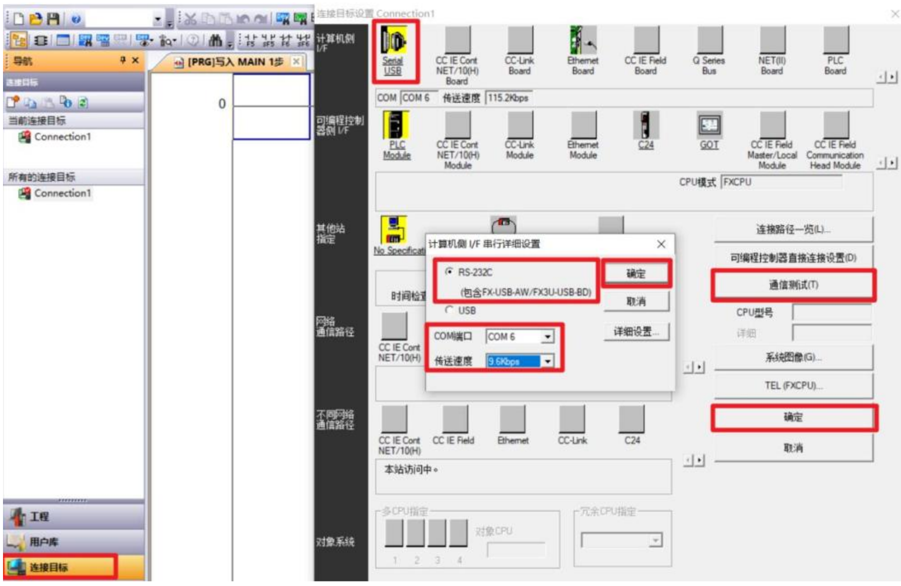
3.1 Creation of project

1、Click on Project and select New Project

2、 Choose simple engineering type, FXCPU for PLC series, and click "OK" after selecting ladder diagram for programming language

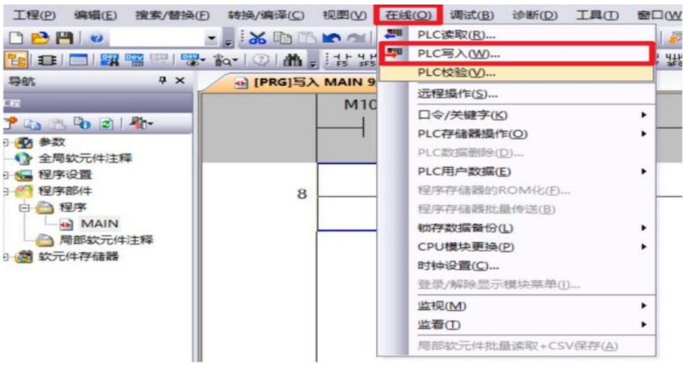
3.2 Connect the PLC to download the program

1、 Click "Connection Target" -> "Current Connection Target" in the left navigation window, double-click "Serial USB", select RS-232C mode, set the COM port number and baud rate as 9.6Kbps, press "OK" button, click communication test, click "OK" button after successful communication test. This indicates that the PLC is successfully connected.



2、Once you've written the program, you need to convert it

3、After conversion, you can download the program to the PLC

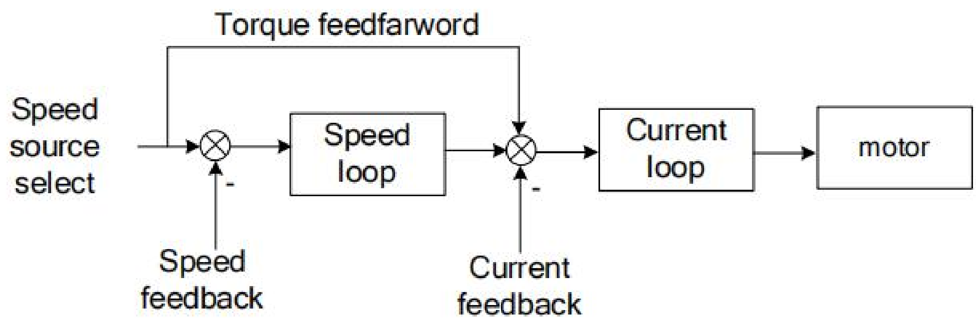


Then wait for PLC program download can be completed.

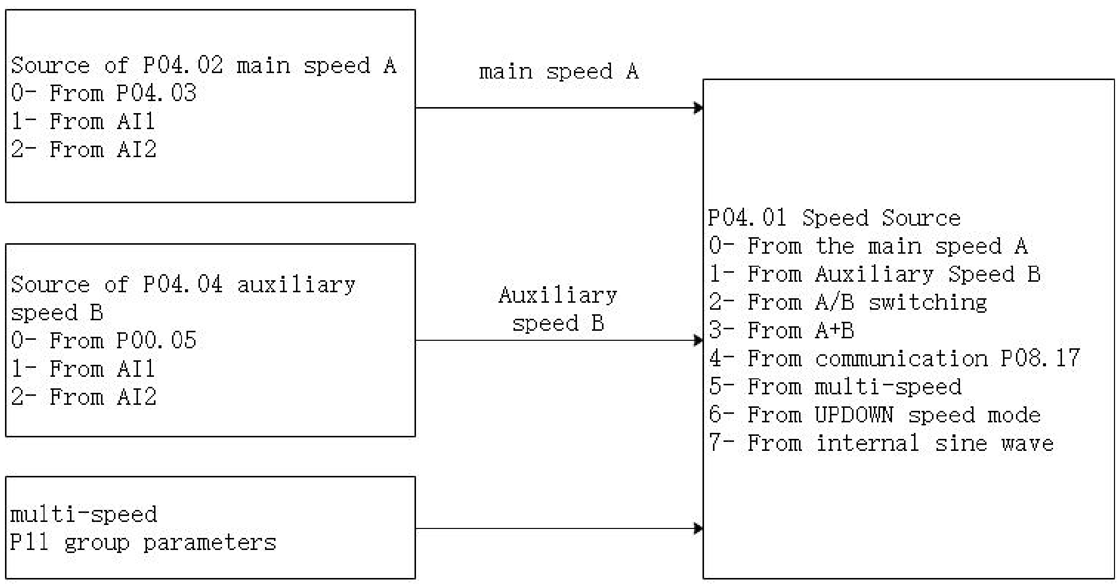
Four、 The built-in PLC servo motor is used to drive the fixed speed

4.1 Servo speed mode is briefly introduced

Speed mode is a control mode with motor speed as the control target. It is often used for driving the spindle. The speed command can be set by simulating voltage or parameters. The implementation of the speed mode is shown below.



The servo has two speeds to choose from, the main speed A and the auxiliary speed B, which can be superimposed on each other or switched between each other. Both primary velocity A and secondary velocity B have multiple sources of velocity. This is shown in the figure below.



By default P04.01=0, P04.02=0, size of speed instruction (rpm) set by P04.03, positive P04.03, positive turn, negative P04.03, reverse.

Related parameters are as follows:

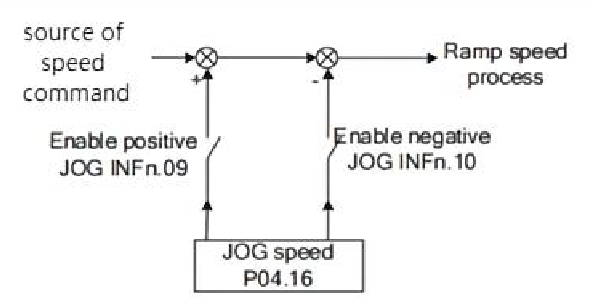
Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P04.01	Source of velocity	0~7	-	any time	immediately	0	RW
	Select the source of the speed instruction. 0- Main velocity A 1- Auxiliary velocity B 2- Perform A/B switchover using INFn.12 3- A+B 4- communication 5- Multiple segment velocity 6- UP/DOWN speed mode 7- Internal sine wave						
P04.02	The source of the primary velocity A	0~4	-	any time	immediately	0	RW
	Set the speed instruction source for the main speed instruction A source 0- Source from P04.03 1- Derived from AI1 2- Derived from AI2 ~~3- Derived from AI3~~(AI3 is not supported on hardware) 4- Derived from pulse rate						
P04.03	The set value of the main velocity A	-32767~32767	rpm	any time	immediately	500	RW
	Set the speed instruction value via P04.03 when the main speed A source selects the number given source.						
P04.04	Auxiliary velocity B source	0~4	-	any time	immediately	0	RW
	Set the speed instruction source for secondary speed instruction B. 0- Derived from P04.05 1- Derived from AI1 2- Derived from AI2 ~~3- Derived from AI3~~(AI3 is not supported on hardware) 4- Derived from pulse rate						
P04.05	The set value of the auxiliary speed B	-32767~32767	rpm	any time	immediately	500	RW

	Set the speed instruction value via P04.05 when the auxiliary speed B source selects the number given source.						
P08.17	Speed communication given	-32767~32767	rpm	any time	immediately	0	RW
	In speed control mode, the source of speed instruction is communication timing, and the value of speed instruction is set.						

When the speed instructions come from AIx, see "6.3.1 Simulated Input AI" in the VEC VC210 servo manual for details.

4.2This section describes the click function

The dot function is widely used in the field. Operators often use the dot function in trial operation or when they want to manually make the material run to a certain position. There are two kinds of point-moving, namely forward point-moving and reverse point-moving, which are respectively controlled by INFn.09 and INFn.10. When INFn.09 or INFn.10 is in effect with servo drive enabled, the speed output will overlay a point speed P04.16 over the current speed instruction.



4.3 Commonly used input function bits

bits	Bit description
INFn.01	Enable servo controller after activation, otherwise disconnect enable
INFn.02	The rising edge resets the servo controller
INFn.09	The speed output will overlay a forward point speed P04.16 on top of the current speed instruction
INFn.10	The speed output will overlay a reverse point speed P04.16 on top of the current speed instruction
INFn.11	The speed command is reversed from the original.
INFn.13	The speed command is zeroed directly.

XX in INFn.XX is the parameter value of the sixth DIX function control register

4.4 Commonly used output function bits

bits	Bit description
OUTFn.01	OUTFn.01 is valid when the servo controller is enabled
OUTFn.02	When the absolute value of the actual output speed P04.21 is greater than the speed arrival threshold P04.23, the speed arrival signal OUTFn.02 is effective.
OUTFn.05	The zero speed signal OUTFn.05 is valid when the amplitude of the actual output speed P04.21 is less than the zero speed threshold P04.25.
OUTFn.07	When the actual output speed P04.21 is greater than the zero speed threshold, the forward turn signal OUTFn.07 is effective
OUTFn.08	When the actual output speed P04.21 is less than the negative zero speed threshold, the reversal signal OUTFn.08 is effective
OUTFn.32	When the difference between the actual output speed P04.21 and the speed given instruction is less than the speed consistency threshold P04.24, the speed consistency signal OUTFn.32 is effective

XX in OUTFn.XX is the parameter value of DOX function control register in group 6

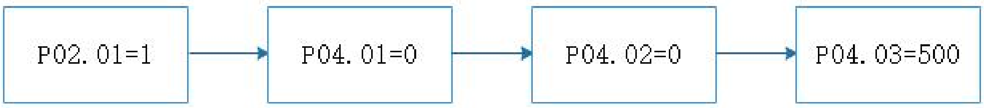
4.5 Common control parameters

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P04.03	The set value of the main velocity A	-32767~32767	rpm	any time	immediately	0	RW
	Set the speed instruction value via P04.03 when the main speed A source selects the number given source.						
P04.16	JOG speed	0~32767	rpm	any time	immediately	20	RW
	When using the DI jog function, set the jog speed command value.						
P04.17	Acceleration time	0~32767	ms	any time	immediately	500	RW
	The time when the speed is commanded to accelerate from 0 to rated speed.						
P04.18	deceleration time	0~32767	ms	any time	immediately	500	RW
	The time when the speed is commanded to decelerate from the rated speed to 0.						

4.6 Commonly used monitoring parameters

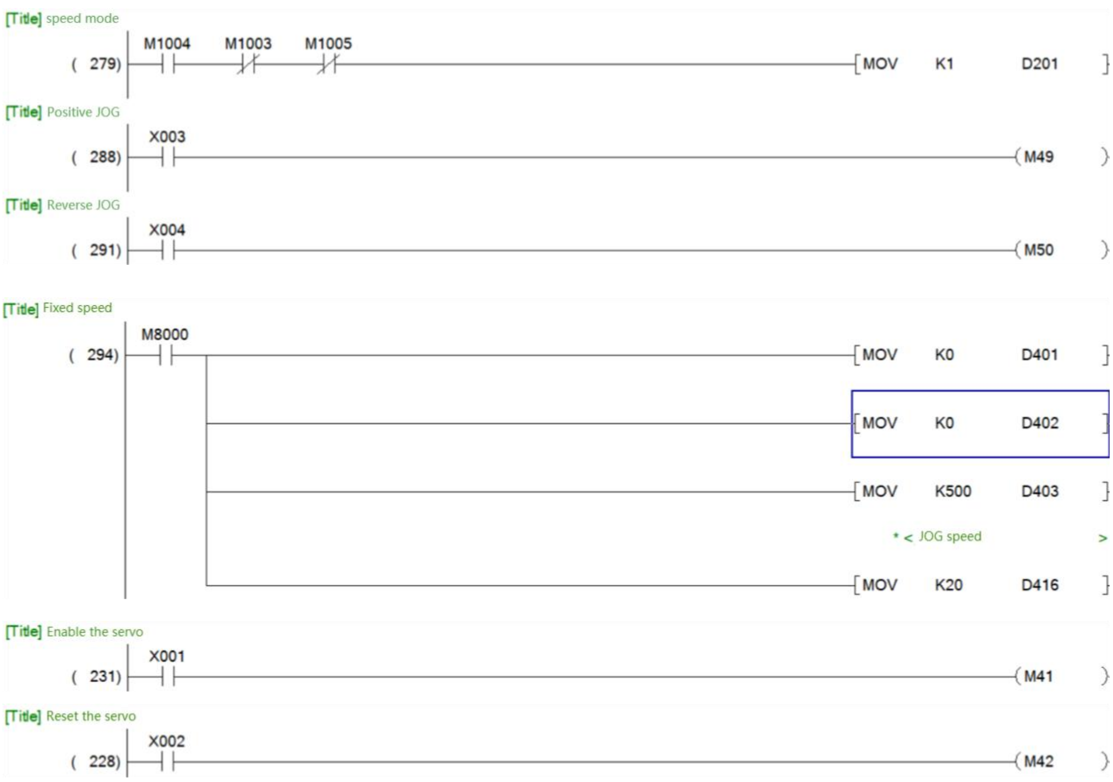
Parameter number	description of parameter	Set range	Unit	Reading and writing mode
P04.21	Displays the filtered value of the speed.	0~32767	rpm	RO
P09.09	Real-time speed monitoring	0~32767	rpm	RO

4.7 Servo mode parameter setting process



This flowchart means that the driver control mode selects the speed mode, and the speed comes from the main speed A, which comes from P04.03

4.8 Mitsubishi programming case.



Case Notes:

Set the drive control mode to speed mode, speed from speed A, speed A from P04.03,P04.03 set to 500, that is, the motor will run at the speed of 500rpm/min after enabling. There is also a JOG function, when INFn.09 or INFn.10 is effective, the speed output will overlay a point speed P04.16 on top of the current speed instruction.

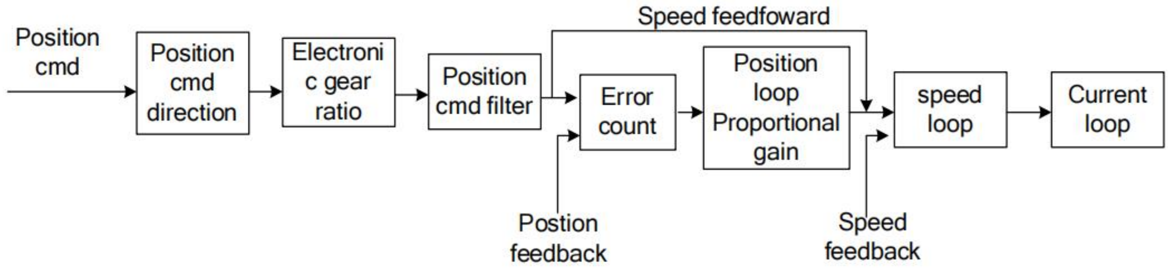
This PLC programming case is based on the "servo speed mode parameter setting process" to write. You can press Un000 on the panel to check whether the speed is correct.

M1004	This command is used to set the driver control mode to speed mode	M8000	Used to set speed mode parameters
X001	Used to enable a servo driver	X002	Reset servo driver (Can also reset the fault)
X003	Positive JOG button	X004	Reverse JOG button

Five 、 use the built-in PLC servo control motor for positioning control

5.1 Brief introduction of servo position mode

Position mode is a control mode in which the motor target position is taken as the control target and is often used to achieve high precision positioning. Position instructions can be set by external pulses, the number of pulses determines the final motor target position, and the pulse frequency determines the motor rotation speed. A position instruction can also be given by an internal position instruction program. The user sets the final target position, target speed, acceleration and deceleration time, and triggers the action by inputting function bit INFn27. The implementation of the location pattern is shown below.



The position instructions in the figure above can be derived from pulse instructions or internal planning position instructions. Only instructions from internal location planning are introduced here. That is to say, the user sets the user position instruction size, instruction speed, acceleration and deceleration time. After the trigger position is executed, the motor will act according to the setting. After the action is completed, the signal of positioning completion is output.

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P03.01	Source of position instruction	0~6	-	any time	immediately	0	RW
	0- Derived from the external pulse instruction 1- Derived from internal multi-segment position planning (internal planned position Directive) 2~6 Refer to the detailed instructions						

There are two kinds of internal planning position instruction: absolute position instruction and relative position instruction, both of which are called user position instruction.

The absolute position instruction refers to the position relative to the zero. Before the absolute position instruction, it must be returned to zero to calibrate the zero of the absolute position, while the relative position instruction refers to the position relative to the current position.

For example, if three absolute position instructions are run, the size of the first position instruction is set to 10000, the second position instruction is set to 20000, and the third position instruction is set to 0. First, the zero return operation is carried out, and then the position of 3 sections is triggered. The motor first goes forward 10000, then forward 10000, then reverse 20000, and finally returns to zero.

For example, if the relative position instruction is taken for 3 sections, the position instruction of the first section is set to 10000, the position instruction of the second section is set to 20000, and the position instruction of the third section is set to -10000. After triggering the multi-section position, the motor first goes forward 10000, then forward 20000, then reverse 10000.

The locating action is triggered by INFn27. OUTFn13 takes effect after the locating is complete. The output condition can be set by P03.45.

The parameters set by the internal planning location directive are shown in the following table.

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P13.01	Multi-segment location (internal planning location) working mode	0~2	-	Stop to set	immediately	0	RW
	0- Stop after a single run 1- Run in cycles 2- The DI switches and reads the values of INFn.31, INFn.30, INFn.29, and INFn.28 as segment numbers						
P13.02	Total number of segments	1~16	-	any time	immediately	16	RW
P13.03	Idle waiting time unit	0~1	-	any time	immediately	1	RW
	0- ms 1- s						
P13.05	Absolute or relative position instruction Settings	0~1	-	any time	immediately	1	RW
	0- Absolute position instruction 1- Relative position instruction						
P13.10	Number of 1st segment position commands	-2147483647 ~ 2147483647	User unit	any time	immediately	10000	RW
P13.12	Running speed of the first segment position	0~32767	rpm	any time	immediately	500	RW
P13.13	The acceleration time of the first position run	0~32767	ms	any time	immediately	500	RW
P13.90	The deceleration time of the first	0~32767	ms	any time	immediately	500	RW

	position operation						
P13.14	The free time in the first position (Usually set to 0)	0~32767	ms(s)	any time	immediately	1	RW

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P03.45	Locate the completed output condition	0~3	-	any time	immediately	0	RW
	In the position control mode, when the servo is running, when the absolute value of position error P03.17 is within the set value of P03.46(positioning completion threshold) and keeps P03.49 (positioning completion/approaching time threshold), the servo can output the positioning completion signal. The output condition of the positioning completion signal can be set through P03.45. 0-If the position error is less than the threshold of positioning completion, the output will be cleared; 1-When the position error is less than the threshold of positioning completion and the speed instruction P03.95 in position mode is zero, the output will be cleared otherwise; 2-When the position error is less than the positioning completion threshold and the filtered speed instruction P03.96 is zero in position mode, otherwise the output will be cleared; 3-If the position error is less than the positioning completion threshold and the speed instruction P03.95 is zero in position mode, the output will be cleared if the speed instruction P03.95 is not zero in position mode						
P03.46	Positioning completion threshold	0~32767	0.0001 circle	any time	immediately	10	RW
	Set the threshold value of the absolute value of the position deviation when the servo driver outputs the positioning completion signal. (The positioning completion signal is only valid when the servo driver is in the position control mode and in the running state)						

5.2 Introduction to electronic gear ratio

The electronic gear ratio is used to convert the user's position command unit to the motor encoder's position unit. It has two settings.

（1）The first is to set how many user position commands are required to make the motor rotate for 1 circle, or how many user position commands are required to make the motor rotate for 1 circle. Set P03.08=0, P03.10 value is the user position command value to make the motor rotate for 1 turn.

（2）The second is to directly set the numerator and denominator of the electronic gear ratio. I.e

$$\text{User position command} \times \frac{\text{Electronic gear ratio numerator}}{\text{Electronic gear ratio denominator}} = \text{Location of motor encoder}$$

For example, assuming that the pulse tracking mode is used, the user PLC sends XY pulses to the servo driver, which stipulates that a pulse motor must travel 1 micron, but the actual motor needs to rotate 100 pulses to travel 1 micron, then the electronic gear ratio (numerator ratio denominator) is 100.

If the numerator of the electronic gear ratio is set to 0, then how many pulses the motor needs to make one revolution depends on the denominator.

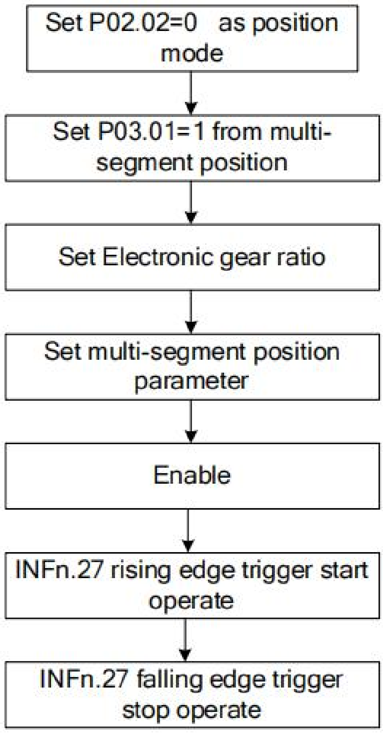
For example, the encoder resolution of the motor is 10000, and the denominator of P03.10 electronic gear ratio 1 is set to 5000. When the motor receives 10000 pulses, the motor rotates twice.

If the numerator of the electronic gear ratio is not 0, the motor encoder position is calculated according to the above formula.

The system has two sets of electronic gear ratios to choose from, and Related parameters are as follows.

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P03.08	Electronic gear ratio 1 numerator	1~2147483647	-	anytime	Immediately	0	RW
	A molecule that sets the first set of electronic gear ratios for the position instruction to divide/double the frequency.						
P03.10	Electronic gear ratio 1 denominator	1~2147483647	-	anytime	Immediately	1000	RW
	Sets the denominator of the Group 1 electronic gear ratio for the position instruction sub/double frequency						

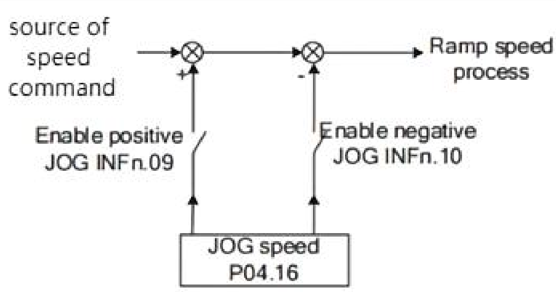
5.3 Positioning function parameter setting process



5.4 Function Description of JOG

In the speed mode, there are two kinds of forward jog and reverse jog, which are controlled by INFn.09 and INFn.10 respectively. When INFn.09 or INFn.10 is valid, the speed output will superimpose a jog speed P04.16 on the basis of the current speed command. As shown below.

(The point function in position mode is a little different from that in speed mode, that is, if the multi-segment position mode is used in position mode, the point function does not need to consider the speed command when enabled.)



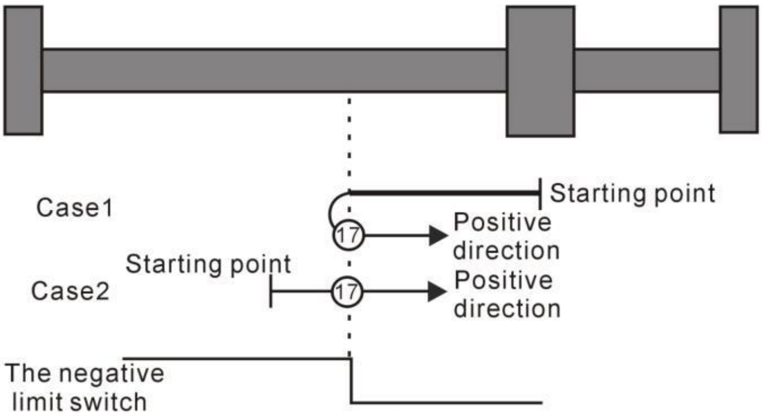
5.5 This section describes the return to zero function

In some applications, it is often necessary to set an origin. You need to return to zero during the first power-on. When zero is returned, the position of origin switch, reverse operation limit switch or forward operation limit switch can be calibrated, or the current position can be calibrated. For a variety of applications, our servo developed a variety of back to zero mode. The zero-back mode is set by P03.51. Commonly used are return to zero mode 17, return to zero mode 18, return to zero mode 35. The return to zero action is triggered by INFn26. OUTFn15 is set after the return to zero. The user position P03.90 after the return to zero is equal to the return to zero offset P03.55. The following describes the three common return to zero modes.

（1）Homing method 17：Origin return depending on the reverse operation limit switch

Case 1: When the user triggers the execution of homing, if the negative position limit switch state is in the low level, the axis starts to move in the reverse direction at the first speed. When the negative limit switch is in the high level, the moving direction changes and starts to move at the second speed; the position when the negative limit switch state is in the low level is the zero point position.

Case 2: When the user triggers the execution of zero return, if the state of the reverse operation limit switch is at a high position, the axis starts to move forward at the second speed, and the position when the reverse operation limit switch state is at a low position is the origin position.

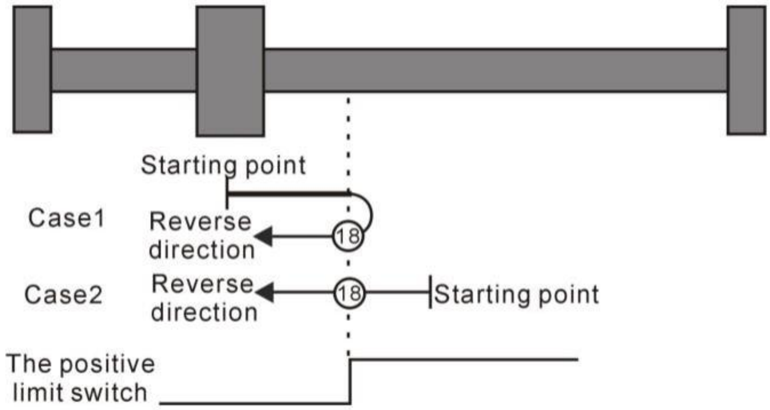


Homing method 17: Homing on the negative limit switch

（2）Homing method 18:Homing on the positive limit switch

Case 1: When the user triggers the execution of homing, if the positive position limit switch state is in the low level, the axis starts to move forward at the first speed, and when the positive position limit switch is in the high level, the moving direction changes and starts to move at second speed, and the position at the time when the positive limit switch state is at the low level is the zero point position.

Case 2: When the user triggers the execution of the zero return, if the forward running limit switch state is at a high position, the axis will directly start reverse movement at the second speed, and the position when the forward running limit switch state is at a low position is the origin position.



Homing method 18: Homing on the positive limit switch

（3）Homing method 35：depends on current location

In mode 35, when the user triggers the home return, the axis does not move, and the current position of the axis is considered to be the home position.

For details of the zero-back mode, please refer to the 5.2.10 "Zero-Back Function of Origin" section of "VC210 Servo Manual".

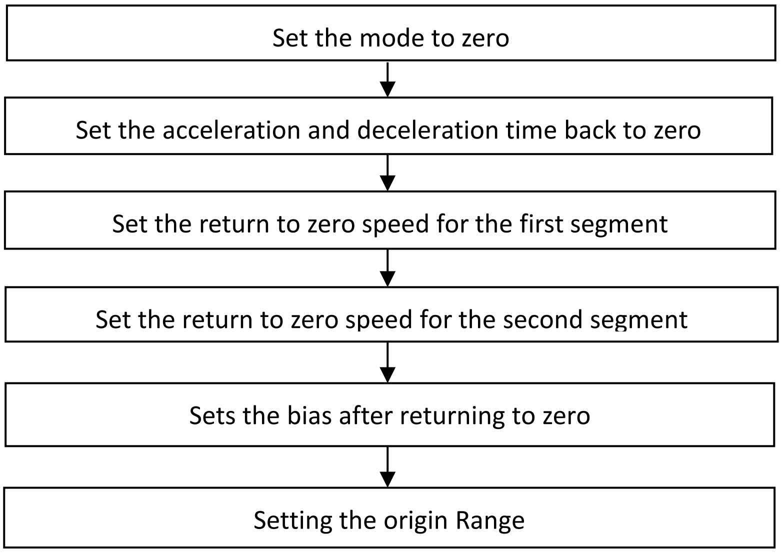
Note: When using the origin return to zero mode with operating limit switch (limit switch), before using the origin return to zero function, it is necessary to set P03.73 to 0 or 2. When setting to 1, the positive and negative limit will trigger the servo motor directly into the fault protection state and cannot continue to complete the return to zero operation.

Related Parameters

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P03.51	Return to zero mode Set the origin back to zero mode and trigger signal source.	0~99	-	Stop to set	Immediately	0	RW
P03.52	Acceleration and deceleration time back to zero	0~32767	ms	any time	Immediately	500	RW
	Set the time for the motor to accelerate from 0 to the rated speed when the origin returns to zero. Therefore, when the origin runs back to zero,						

	the actual acceleration time of the motor t = P03.53/ rated speed *(P03.52)						
P03.53	The return to zero velocity of the first segment	0~32767	rpm	any time	Immediately	500	RW
	Also called high speed return to zero speed, set the origin return to zero, search deceleration point signal when the motor speed.						
P03.54	The second segment returns to zero velocity	0~32767	rpm	any time	Immediately	100	RW
	Also known as low speed return to zero speed, set the origin return to zero, search the origin signal when the motor speed.						
P03.55	Bias it back to zero Set the absolute position value of the motor after the origin returns to zero.	-2147483647~2147483647	User unit	any time	Immediately	0	RW
	When BIT9 of P01.46 is set to 1, the motor does not go to the offset position after the origin is found, and the origin is directly set to the offset position. When BIT9 of P01.46 is set to 0, after the origin is found, take the origin as zero and the motor moves to an offset position.						
P03.57	Range of origin	0~32767	0.0001 circle	any time	Immediately	5	RW
	When the position of the motor encoder is within the origin range, and the speed is given P09.89=0 in the position ring mode, and P03.49 time is maintained, the output is returned to zero completion signal.						

5.6 Process for setting the return to zero function



5.7 Travel limit function

In position mode, the servo has the software limit function. When the software limit is enabled, the position value of the encoder is detected to be less than the lower limit value of the software limit (P03.74) and the motor moves in the negative direction, and the software limit fault (Er207) is reported. When the position value of the encoder is detected to be greater than the upper limit of the software limit (P03.76) and the motor moves in the positive direction, the software limit fault (Er207) is reported.

In position mode, the servo also has hardware limit function. After hardware limit is enabled, set INFn.43 and INFn.44 to a certain DIx. When the DIx is valid and the speed is greater than or less than zero (see INFn.43 and INFn.44 below), a hardware limit fault Er208 is reported.

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P03.73	The software and hardware limits are enabled 0-Software and hardware limits are not enabled 1-The hardware and software limits are directly enabled during	0~2	-	any time	Immediately	0	RW

	power-on 2-Enable the software and hardware limits after the value is returned to zero						
	The software/hardware limit function and the way to enable the software/hardware limit function						
P03.74	Software limit lower limit	-2147483647~2147483647	User unit	any time	Immediately	-10000000	RW
	Set the lower limit of the software limit						
P03.76	Upper limit value of software limit	-2147483647~2147483647	User unit	any time	Immediately	10000000	RW
	Set the upper limit of software limit						

The relevant input function bits are as follows.

bits	Bit description
INFn. 43	Under the position mode, the forward hardware limit switch will report hardware limit fault when the speed is greater than zero and INFn. 43 is valid
INFn. 44	Reverse hardware limit switch in position mode, when the speed is less than zero and INFn When 44 is valid, hardware limit fault is reported

XX in INFn.XX is the parameter value of the sixth group of DIX function control registers

5.8 Common input function bits

bits	Bit description
INFn.21	The position command is prohibited. When it is valid, the position command is prohibited to be input into the servo. It can be used for emergency stop operation.
INFn.22	The position command is reversed. If it is valid, the reverse position command is input into the servo.
INFn.26	Trigger return to zero
INFn.27	Trigger multi segment position command The rising edge triggers the execution of the multi segment position command, and the falling edge stops the execution of the multi segment position command, or only the rising edge triggers the execution of the multi segment position command, and the falling edge does not act. Refer to P13.92 for details
INFn.34	Zero return origin switch input
INFn.43	Position mode forward operation limit switch (forward limit switch)
INFn.44	Position mode reverse operation limit switch (reverse limit switch)

XX in INFn.XX is the parameter value of the sixth DIX function control register

5.9 Commonly used output function bits

bits	Bit description
OUTFn.1	Servo enabled, output effective signal
OUTFn.13	Positioning complete output, positioning complete when valid
OUTFn.15	Return the origin to zero to complete the output. When the encoder position of the motor is within the origin range, and the speed is given P09.89=0 in the position loop mode, and P03.49 time is maintained, the output is returned to zero to complete the signal.

XX in OUTFn.XX is the parameter value of DOX function control register in group 6

5.10 Common Setting Parameters

Parameter No.	Parameter Description
P03.01	Used to select the source of the position instruction.
P03.02	Used to select the pulse instruction count mode.
P03.06	Set the position to a given median filtering time constant
P03.07	Set the position for a given low pass filter time constant
P03.08	Electronic gear ratio is 1 molecule
P03.10	Electronic gear ratio 1 denominator
P03.45	Set the output condition for positioning completion
P03.46	Set the positioning completion threshold

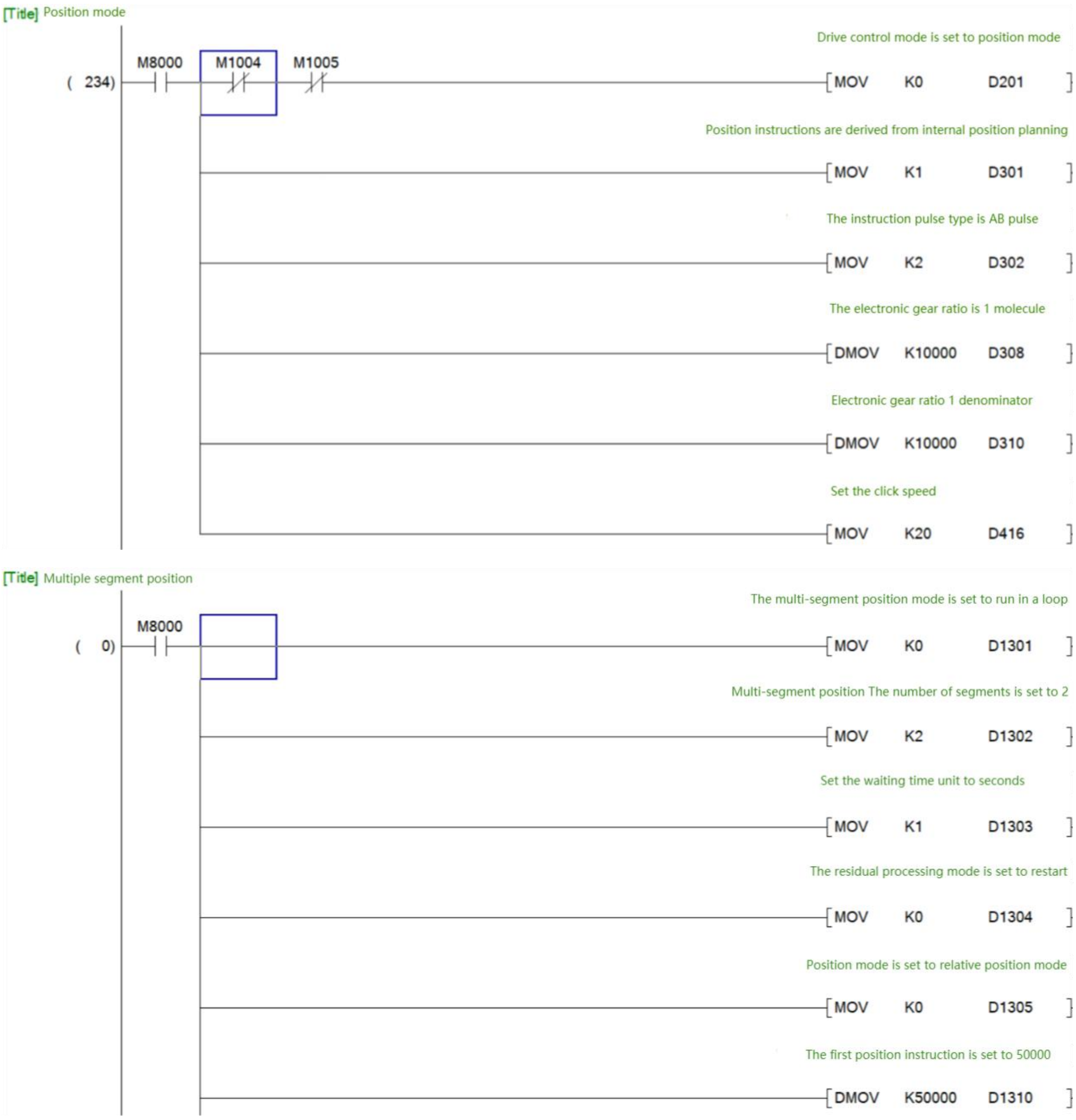
P03.49	Set the positioning completion/approach time threshold
P03.51	Set the mode to zero
P03.52	Set the acceleration and deceleration time back to zero
P03.53	Set the speed of the first segment back to zero
P03.54	Set the speed of the second segment to zero
P03.55	Set bias back to zero
P03.57	Setting the origin Range
P03.73	The software and hardware limits are enabled
P03.74	Software limit lower limit
P03.76	Software upper limit
P13.XX	Set the multi-segment location mode parameters

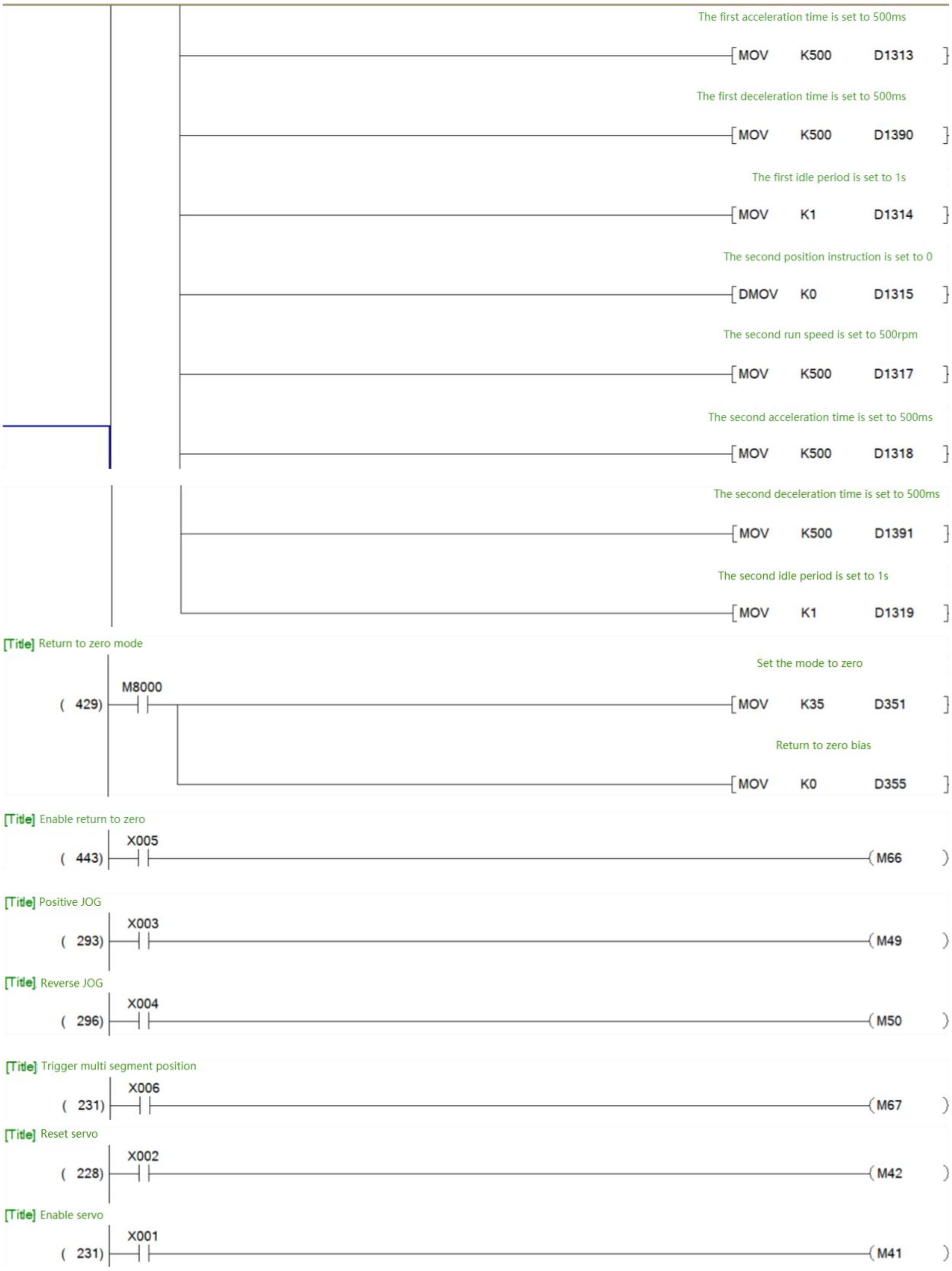
5.11 Common monitoring parameters

Parameter No.	Parameter Description
P00.13	View motor encoder position (encoder unit)
P03.04	View the number of instruction pulses received
P03.17	Position error monitoring (unit: 0.0001 turn)
P03.90	Mechanical position (user position unit)
P03.95	Speed command monitoring in position mode
P03.96	Speed instruction monitoring after filtering in position mode
P09.09	Real-time speed monitoring

5.12 Mitsubishi PLC programming case

5.12.1 Positioning case (2500 line incremental encoder motor)





Case Notes:

The driver control mode is set as the position mode, the position instruction comes from the internal multi-segment position, the pulse type is AB pulse, the electronic gear ratio is set as 1(10000/10000), the multi-segment position is the relative position mode (if it is the absolute position mode, it should be returned to zero before starting, pay attention to whether the return to zero is successful, To converge P03.90 to the value of P03.55(back to zero bias), first turn forward 5 times at the speed of 500rpm/min and then reverse 5 times at the speed of

500rpm/min. In this way, the acceleration and deceleration time is 500ms, and there is 1s idle time in the middle of the two positions. In position mode, the point function can also be performed. When INFn.09 or INFn.10 is effective with servo enabled, the speed output will overlay a point speed P04.16 on the basis of the current speed instruction

X001	Enable servo driver	X002	Reset servo driver (can be used to reset fault)
X003	Positive jog button	X004	Reverse jog button
X005	Enable return to zero	X006	Trigger multi segment position

Six、 Gain adjustment

6.1 Control loop gain adjustment

There are three sets of loop gains to be adjusted inside the servo, namely current loop gain, speed loop gain and position loop gain. The current loop gain generally does not need to be adjusted. There are six gain adjustment methods (adjustment modes) for speed loop and position loop.

P07.20=0, the first set of gain is used for fixation. In this mode, the user can manually modify the three values of P07.03, P07.04 and P07.05 to optimize the control performance.

P07.20=1, gain switching. Similar to type 0, it can be used for gain switching.

P07.20=2 or P07.20=3, the gain is automatically calculated according to the set rigidity level and load inertia. P07.20=2 is generally used for normal mode, and P07.20=2 is generally used for positioning mode.

P07.20=4, the gain is automatically calculated by setting the speed loop bandwidth P07.03 and the position loop bandwidth P07.05.

P07.20=5, no adjustment function. The gain is calculated automatically according to the adjustment free parameter P07.78.

When using the 2/3/4/5/6 gain adjustment method, the motor rated current P00.01, motor rated torque P00.25, motor rotor inertia P00.27, load inertia ratio 07.29, and driver rated current P01.03 must be set.

The characteristics and adjustable parameters of different gain adjustment modes are as follows:

Adjustment mode	Adjustable speed ring/position ring parameters
P07.20=0 Gain adjustment High adjustability, the best performance that can be adjusted, and high requirements for user professionalism。	P07.03 （Speed loop proportional gain） P07.04（Speed loop integral gain） P07.05（Position loop proportional gain） P07.08 P07.10（Torque feedforward） P07.09 P07.11 （Speed feedforward）
P07.20=1 Gain switching adjustment High adjustability, the performance that can be adjusted is the best, and the user's professional level is highly required.	P07.03 P07.04 P07.05P07.08 P07.09 P07.10 P07.11（First set gain） P07.21 P07.22 P07.23 P07.24 P07.25 P07.26 P07.27（Second set of gain）
P07.20=2/3 Adjustment of rigidity grade Low adjustability, can only meet the general application needs, and has low requirements for users' professional level.	P07.28（Rigidity class） P07.29（Load inertia ratio） P07.08 P07.10 P07.41（Torque feedforward） P07.09 P07.11 （Speed feedforward）
P07.20=4 Bandwidth adjustment High adjustability, the performance that can be adjusted is the best, and the user's professional level is highly required.	P07.29（Load inertia ratio） P07.03（Speed loop bandwidth） P07.04（Speed loop integral gain） P07.05（Position loop bandwidth） P07.08 P07.10 P07.41（Torque feedforward） P07.09 P07.11 （Speed feedforward）
P07.20=5 No adjustment The lowest adjustability can only meet the general application needs, with low requirements for users' professionalism.	P07.78 （Adjustment free parameters） P07.11 P07.09（Speed feedforward）

6.1.1 P07.20=0 Gain adjustment method

Adjust parameters	Adjustment method
Speed loop proportional gain P07.03	When the response is slow, very soft, low frequency oscillation, and the speed is unstable, increase the value. Reduce this value in case of abnormal noise and high frequency vibration. It is generally adjusted within the range of 200 to 5000.
Speed loop integral P07.04	The response is slow and very soft. Increase the value. In case of low frequency jitter, decrease the value.

	It is generally adjusted in the range of 20 to 500.
Position ring proportional gain P07.05	The response is slow and very soft. Increase the value. In case of low frequency jitter, decrease the value. It is generally adjusted in the range of 20 to 500.
Torque feedforward filter P07.08 Torque feedforward coefficient P07.10	P07.08 is set to 10, which is generally not adjusted. P07.10 The greater the inertia, the greater the value. This value can be adjusted in a wide range. Generally, it is set to 0. Increasing this value will speed up the response, but may cause noise problems.
Speed feedforward filter P07.09 Speed feedforward coefficient P07.11	P07.09 is set to 10, generally not adjusted. When the follow-up error is required to be 0, P07.11 must be set to 100%, otherwise it can be set to 0% to 50%. Generally, no adjustment is made. The higher the value is, the faster the position response will be, which is easy to cause position overshoot. Adjust within the range of 0-100%.

6.1.2 P07.20=4 Gain adjustment method

Adjust parameters	Adjustment method
Speed ring band width P07.03	When the response is slow, very soft, low frequency oscillation, and the speed is unstable, increase the value. Reduce this value in case of abnormal noise and high frequency vibration. It is generally adjusted in the range of 10 to 500. The larger the machine, the smaller the value. The greater the inertia, the smaller the value.
Speed loop integral P07.04	When the response is slow and soft, increase the value. When low-frequency oscillation occurs, reduce this value. It is generally adjusted in the range of 1 to 50.
Band width of position ring P07.05	When the motor response is slow and soft, increase the value. When low-frequency oscillation occurs, reduce this value. It is generally adjusted in the range of 5 to 200. Load inertia ratio P07.29
Load inertia ratio P07.29	Learned from or roughly evaluated. The general setting is 1-50.
Torque feedforward filter P07.08 Torque feedforward	P07.08 is set to 10, which is generally not adjusted. P07.10 Not set, automatically calculated according to inertia ratio, motor parameters and driver parameters.

coefficient P07.10 Torque feedforward percentage P07.41	The torque feedforward percentage P07.41 is generally set to 0.
Speed feedforward filter P07.09 Speed feedforward coefficient P07.11	P07.09 is set to 10, generally not adjusted. P07.10 When the follow-up error is required to be 0, it must be set to 100%, otherwise it can be set to 0% to 50%. Generally, no adjustment is made. The higher the value is, the faster the position response will be, which is easy to cause position overshoot. Adjust within the range of 0-100%.

6.1.3 P07.20=2/3 Gain adjustment method

First, use Fn007 to self-learning inertia, and the operation steps are as follows.

(1)Press the MODE key to switch the mode to the functional operation mode. At this time, the first two digits of the nixie tube display Fn;

(2)Set the display value of the nixie tube to Fn007 by pressing three keys: "▲" (increase), "◄◄" (shift) and "▼" (decrease);

(3)Click SET to display SEL4; (Self-Learn 4)

(4)Press the "◄◄" (shift) key to start self-learning. The servo enters the state of automatically learning inertia, and the learned inertia will be automatically displayed on the panel.

(5)Press "▲" to rotate the motor forward for 2 cycles, and press "▼" to rotate the motor backward for 2 cycles. The load inertia value will be updated to the panel once every revolution. Press repeatedly until the inertia is stable. The inertia at this time is the learned load inertia. After stabilization, long press "◄◄" (shift) to save the learned value to the servo.

be careful:

- When the driver is enabled, this function is invalid.
- When the load inertia is very large, the self-learning may have low-frequency oscillation. You need to manually increase P07.03 and reduce P07.04 before self-learning.
- When the load inertia is small, reduce the inertia self-learning acceleration and deceleration time P07.33.
- When the machine shakes, it is necessary to reduce the position loop gain P07.05
- If the overcurrent Er.100 is reported in the learning process, P07.01 (proportional gain of current loop), P07.02 (integral gain of current loop), P07.03 (proportional gain of speed loop) and P07.04 (integral gain of speed loop) can be appropriately reduced.
- If the load inertia is large, low frequency oscillation may occur during self-learning. At this time, it is necessary to manually increase P07.03 and decrease P07.04 before self-learning.

Second, use Fn006 to self-learn the rigidity level. The operation steps are as follows.

(1) Press the MODE key to switch the mode to the functional operation mode, and

the first two digits of the nixie tube will display fn;

(2)Combine ▲ (increase), ▼ (shift) and ▼ (decrease) to set the display value of the digital tube to Fn006; ;

(3)Click SET to display the value of rigidity grade P07.28;

(4)Press the ""(shift) key, and the motor starts to rotate forward and backward;

(5)Press "▲" or "▼" to gradually increase or decrease the value of the rigidity level until the rigidity of the servo meets the practical application. In general, the rigidity level can be gradually increased until the motor makes abnormal noise, and then the rigidity level can be reduced by 1-2.

(6)After the rigidity of level modulation reaches an appropriate value, press and hold the "◀◀"(Shift) key to save the adjusted rigidity level into the servo.

note:

- This function is not valid when the drive is enabled.
- Every time the rigidity level is adjusted, the parameters will not be automatically saved into the servo. If the adjustment is completed, the user needs to manually press and hold the ""(Shift) key to save the adjusted rigidity level into the servo.

6.1.4 P07.20=5 gain adjustment method

When P07.20=5, the load inertia ratio is invalid. All gains are invalid. Torque feedforward is invalid.Adjust P07.78 online. P07.78 is A.B format.

A represents the stiffness, and the setting range is 0-7. The greater the value, the greater the stiffness, generally set below 4.

B represents the load inertia, and the setting range is 0-7. The greater the load inertia, the greater the value to be set.

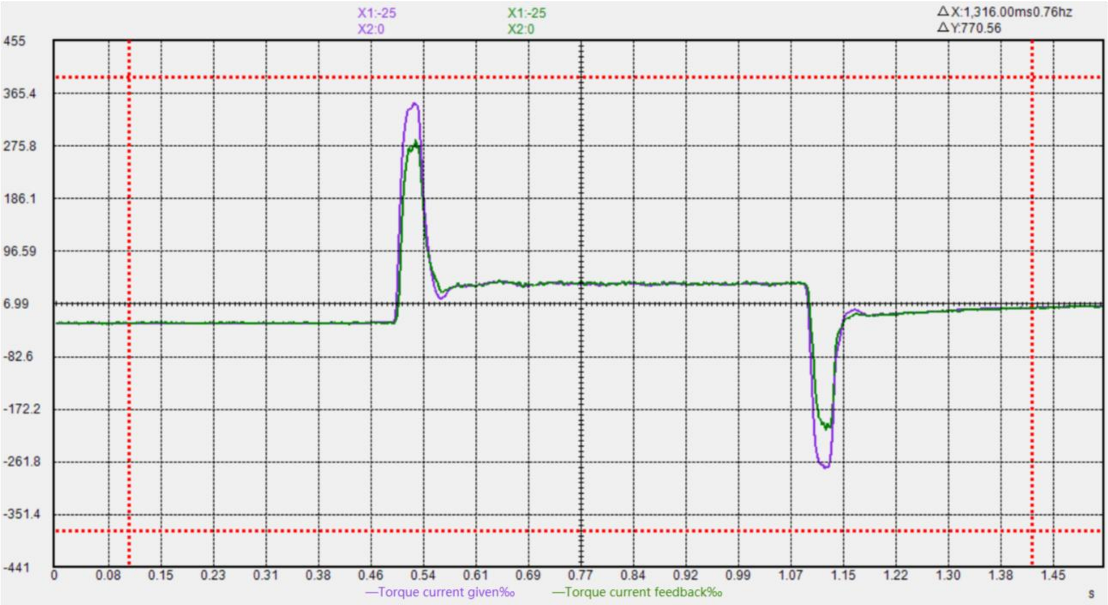
6.1.5 P07.20=0 adjustment example

In many cases, the gain adjustment is carried out in the position mode, and there are several important indicators of the movement in the position mode. 1. Whether the speed can meet the requirements; 2. Whether the positioning time (that is, the time from the position instruction to the position error converging to zero) meets the requirements; 3. Whether the whole movement time (that is, the time from the position instruction to the position error converging to zero) meets the requirements; 4. Judging whether it meets the requirements according to the customer's or the actual site requirements.

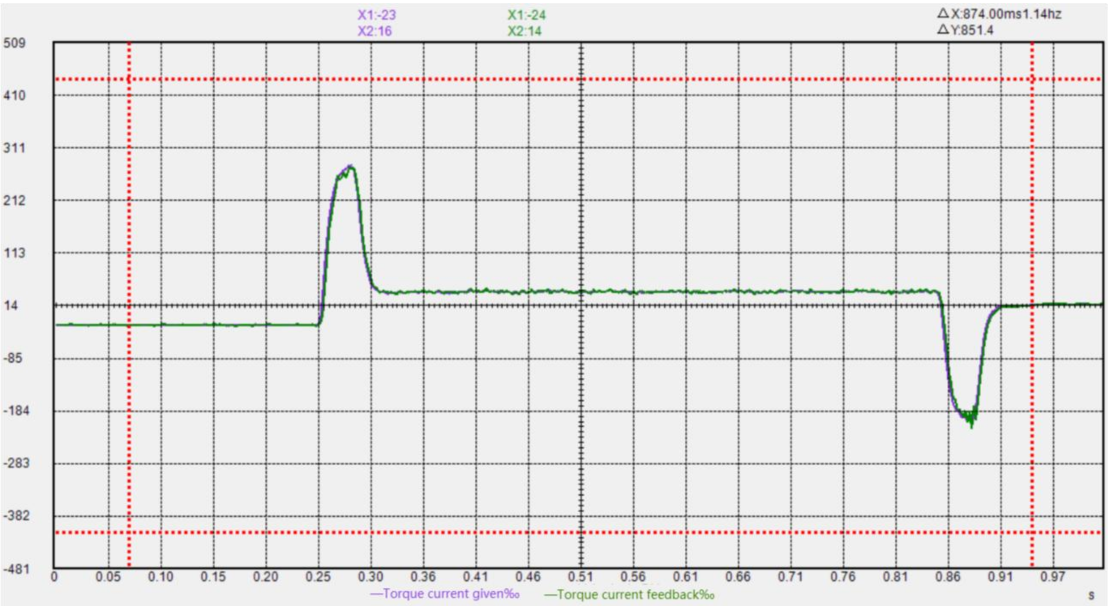
The three loops for adjusting the gain are generally the current loop first, then the speed loop and finally the position loop, but they should also be flexible. In many cases, the three loops have to be adjusted together until the action meets the site requirements.

Here we will briefly explain the gain adjustment process with the first set of gain. (The test condition is that the motor rotates forward and backward for 10 cycles, the speed is 1000 rpm/min, and the acceleration and deceleration time is 100 ms)

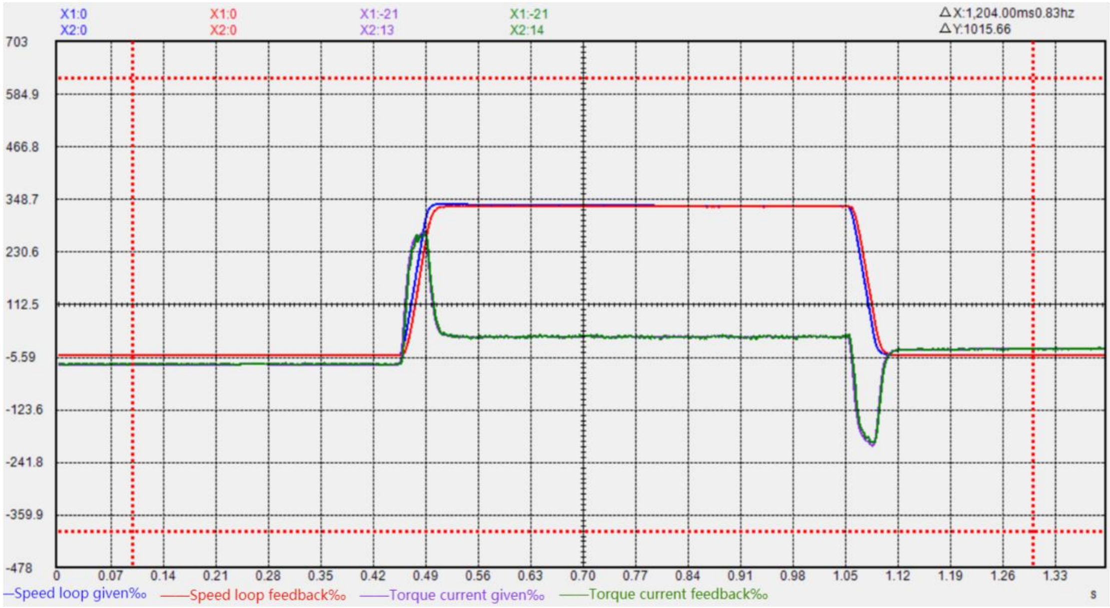
(1) Commissioning current loop



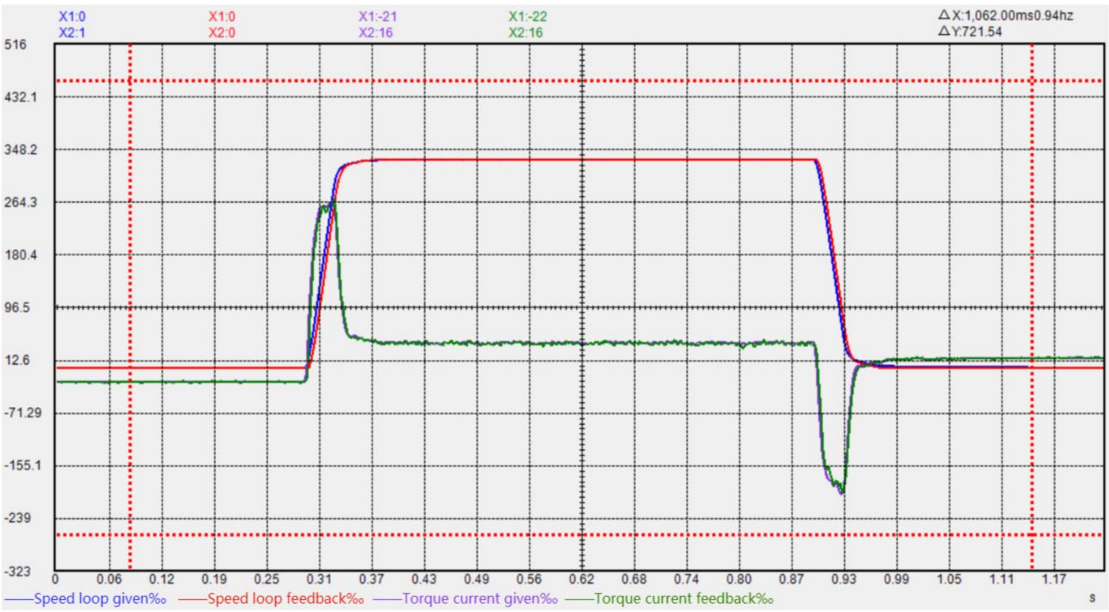
It can be seen from the above figure that the current setting and feedback deviation is large when the motor is starting and decelerating, and it is OK when the motor is running at a constant speed. In this case, due to the weak gain of the current loop, the current loop proportion (P07.01) and integral (P07.02) can be increased. After increasing the proportion and integration of the current loop, as shown in the figure below, the deviation between the current setting and feedback is reduced a lot, and the acceleration and deceleration are in an overlapping state. In the process of debugging, if howling occurs, reduce the value of the current loop ratio.



（2）Commissioning speed ring



It can be seen from the above figure that the speed loop feedback lags behind the given speed loop, and it takes a long time for the speed loop feedback to coincide with the given speed loop at a constant speed. At this time, it is necessary to increase the speed loop ratio (P07.03) and integral gain (P07.04). After increasing the proportion and integral gain of the speed loop, as shown in the figure below, the curves given by the speed loop are basically consistent with those fed back by the speed loop. It should be noted that the proportion and integral cannot be added too much or there will be howling or vibration.

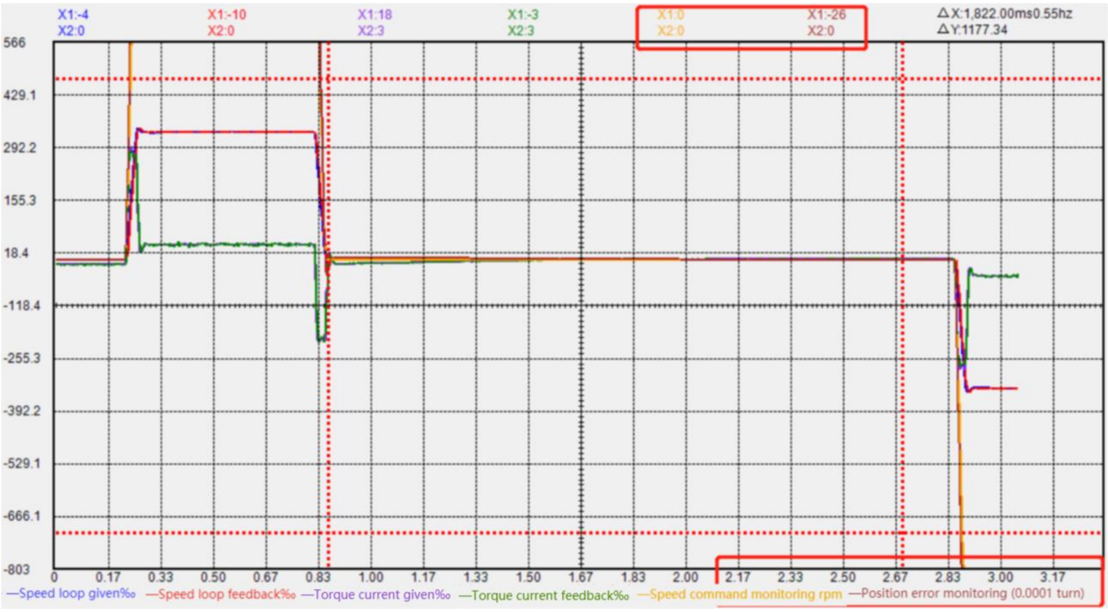


（3）Commissioning position ring

The adjustment of position loop gain involves whether the motor can reach the specified position, whether it can reach the specified position within the specified positioning time, and whether it can overshoot after the position command is issued. At this time, it is not only possible to adjust the gain of the position loop. For point-to-point position control, the real-time process is generally not required, and filtering can be added (for some cases of large inertia, the filtering time of P03.06 and P03.07 should be increased more), When the position loop gain is adjusted to the point where the motor overshoots or the position error does not converge to zero for a long time, the position loop gain should be reduced and the gains of the speed loop and current loop should be increased on the original basis until a suitable gain is found.

Addres	Description	Value
701	Current loop proportional gain	90
702	Current loop integral gain	60
703	Speed loop proportional gain	700
704	Speed loop integral gain	20
740	Speed loop differential gain	0
741	Torque feed forward percentage	0
742	Speed loop proportional gain percentage	0
705	Position loop proportional gain	200
706	Position loop maximum output speed perce...	0
707	Output voltage filtering time	0
708	Torque feedforward filter time constant	0
709	Speed feedforward filter time constant	0
710	Torque feed forward coefficient	90
711	Speed feedforward coefficient	60
712	Torque filter type	0
713	Torque low pass filter time constant	3
714	Notch filter 1 notch frequency	0
715	Notch filter 1 notch depth	10
716	Notch filter 1 notch width	50
717	Notch filter 2 notch frequency	0
718	Notch filter 2 notch depth	10
719	Notch filter 2 notch width	50
720	Gain adjustment mode	0
721	Second set of speed loop proportional gain	0

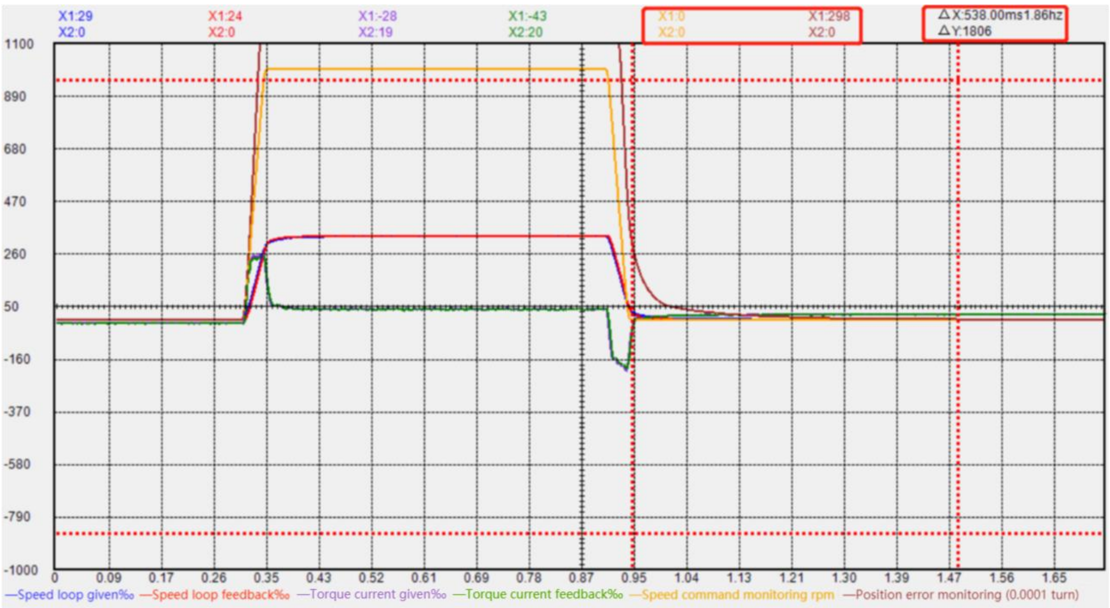
The above figure shows the gain parameters after adjusting the current loop and speed loop gain, and the waveform obtained is as follows:



The figure above shows the waveform obtained by increasing the proportional gain of the position loop after adjusting the current loop and the speed loop before. From the waveform (orange font stands for "speed command monitoring rpm", that is, position command, and brown font stands for "position error monitoring"), it can be seen that the position error converges to 0 after 1822ms after the position command is issued. Obviously, this does not meet the requirements of most sites and the motor has overshoot (when the position command is issued, the position error has a negative value).

07-control loop related parameters

Addres	Description	Value
701	Current loop proportional gain	90
702	Current loop integral gain	60
703	Speed loop proportional gain	1000
704	Speed loop integral gain	50
740	Speed loop differential gain	0
741	Torque feed forward percentage	0
742	Speed loop proportional gain percentage	0
705	Position loop proportional gain	100
706	Position loop maximum output speed percentag	100
707	Output voltage filtering time	0
708	Torque feedforward filter time constant	10
709	Speed feedforward filter time constant	10
710	Torque feed forward coefficient	90
711	Speed feedforward coefficient	60
712	Torque filter type	0
713	Torque low pass filter time constant	3
714	Notch filter 1 notch frequency	0
715	Notch filter 1 notch depth	10
716	Notch filter 1 notch width	50
717	Notch filter 2 notch frequency	0
718	Notch filter 2 notch depth	10
719	Notch filter 2 notch width	50
720	Gain adjustment mode	0
721	Second set of speed loop proportional gain	0
722	Second set of speed loop integral gain	0

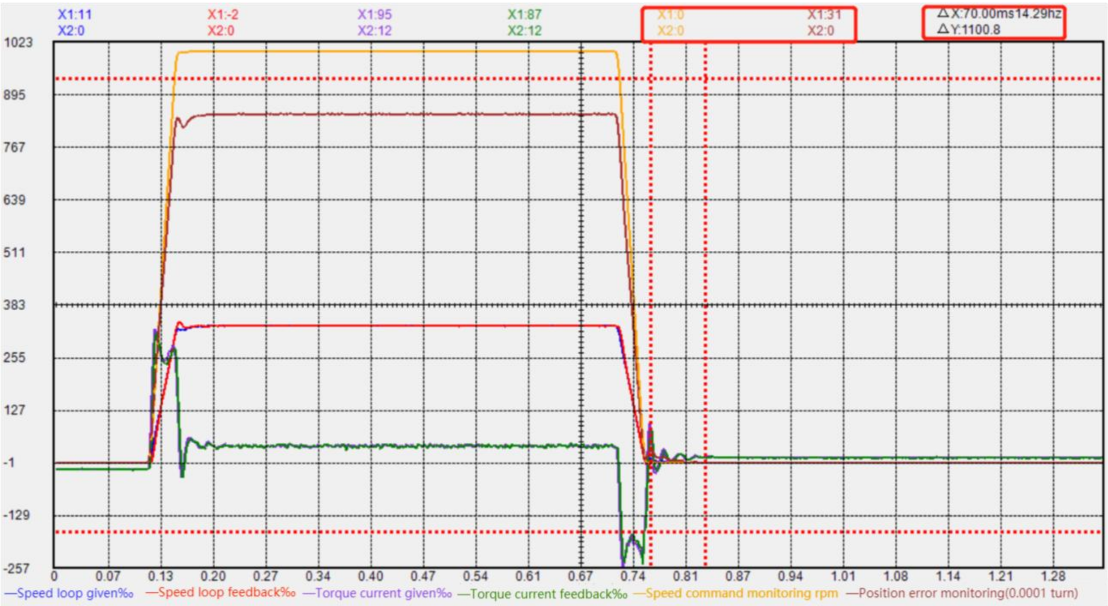


As shown in the figure above, the convergence time of position error is greatly reduced and no overshoot occurs after the ratio of position loop is reduced first, then the ratio of speed loop is increased to 1000 and the integral is increased to 50. However, this situation still can't meet most site requirements, and the positioning time is still relatively long, generally within 100ms.

In this case, the speed loop integral and the position loop proportional gain can be appropriately increased. To increase these two parameters, generally increase the speed loop integration (adjustment step: 50) until the positioning time of the speed loop integration has not changed. At this time, reduce the speed loop integration by 100 and then increase the position loop gain appropriately (adjustment step: 50). When the positioning time is close to 100ms, fine tune (adjustment step: 10) the integral of speed loop and the proportion of position loop.

The waveform obtained from the final gain adjustment is as follows

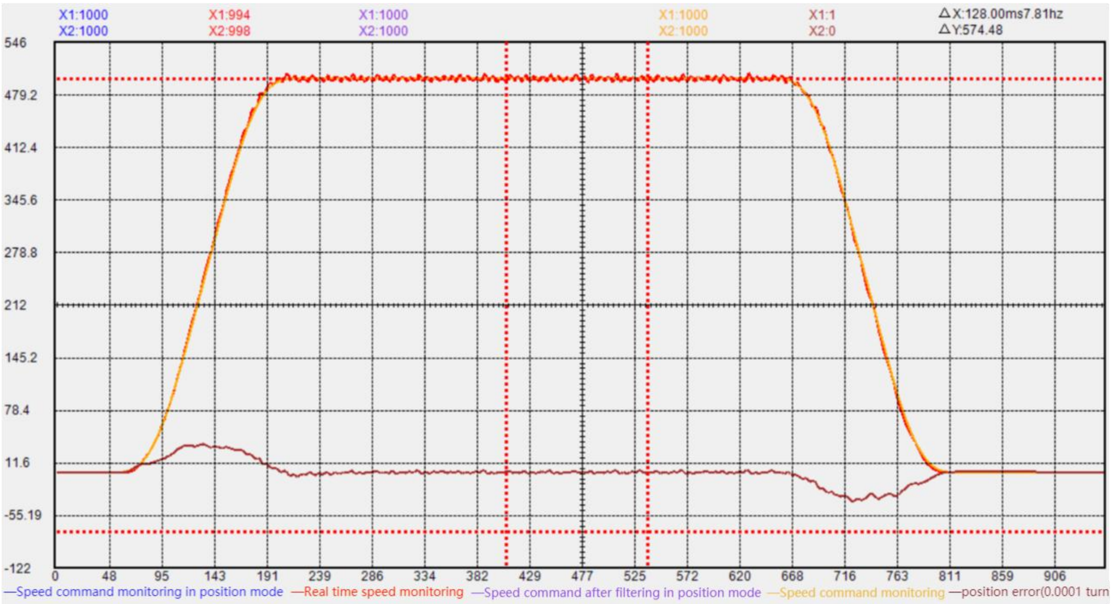
Addres	Description	Value
701	Current loop proportional gain	90
702	Current loop integral gain	60
703	Speed loop proportional gain	1050
704	Speed loop integral gain	300
740	Speed loop differential gain	0
741	Torque feed forward percentage	0
742	Speed loop proportional gain percentage	0
705	Position loop proportional gain	350
706	Position loop maximum output speed percentag	100
707	Output voltage filtering time	0
708	Torque feedforward filter time constant	10
709	Speed feedforward filter time constant	10
710	Torque feed forward coefficient	90
711	Speed feedforward coefficient	70
712	Torque filter type	0
713	Torque low pass filter time constant	3
714	Notch filter 1 notch frequency	0
715	Notch filter 1 notch depth	10
716	Notch filter 1 notch width	50
717	Notch filter 2 notch frequency	0
718	Notch filter 2 notch depth	10
719	Notch filter 2 notch width	50
720	Gain adjustment mode	0
721	Second set of speed loop proportional gain	0
722	Second set of speed loop integral gain	0



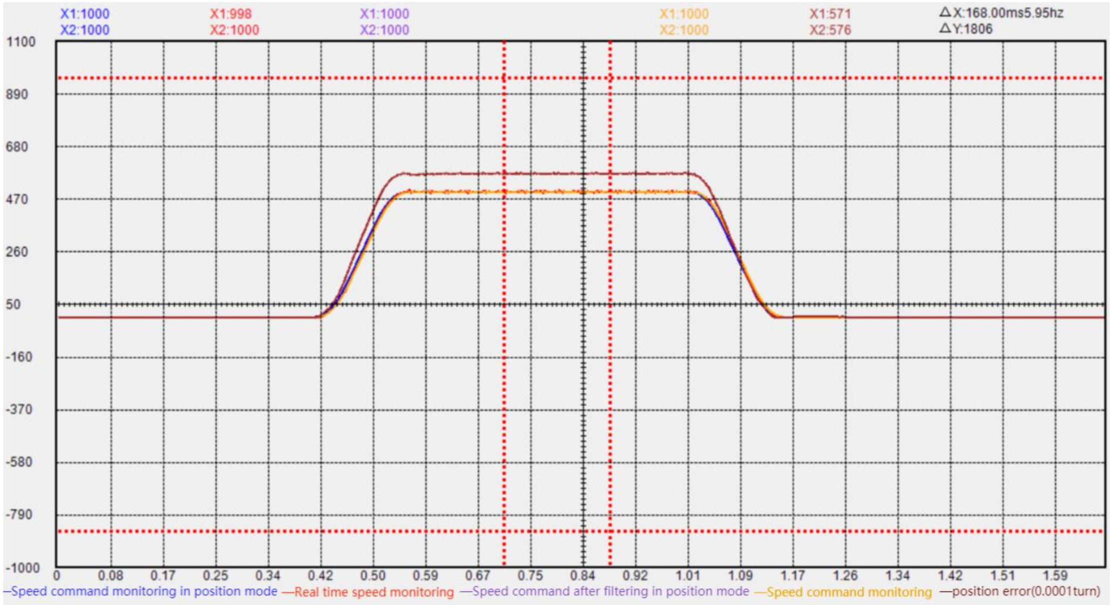
It can be seen from the waveform above that after adjusting the gain parameters, there is no overshoot and the positioning time is less than 100ms.

6.1.6 The use of position instruction filtering

The filtering of P03.06 and P03.07 is to make the position curve softer. It is usually used in the positioning function. For real-time tracking, P03.06 and P03.07 should be set to 0 and P07.11 should be set to 100.



The above figure shows the waveform with P03.06 and P03.07 set to 0 and P07.11 set to 100. It can be seen that the position error of the motor is equal to 0 when the speed is constant.



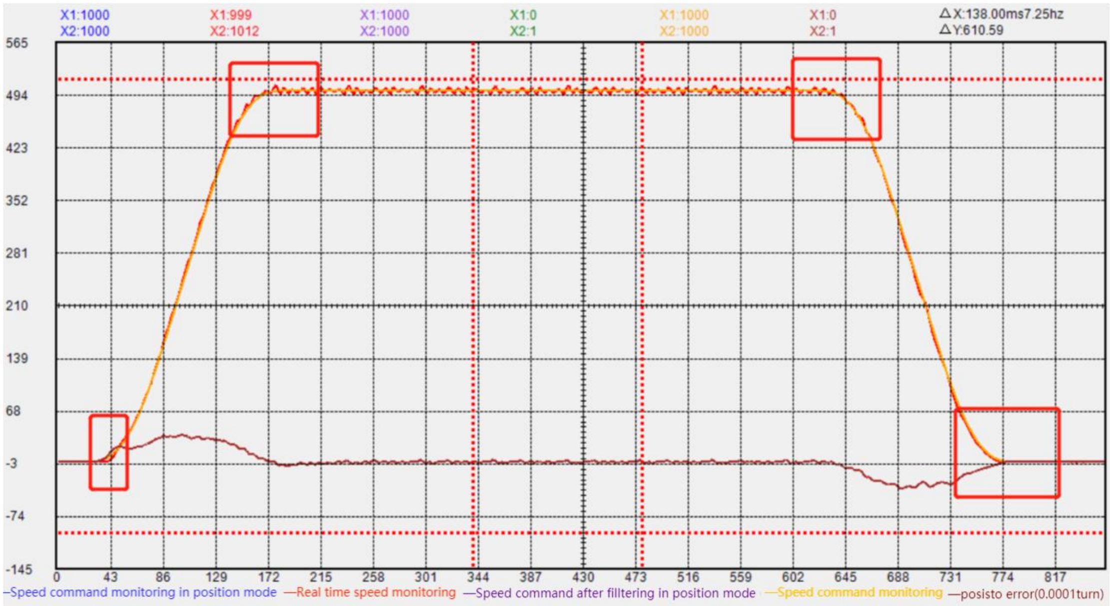
The above figure shows the waveform of P03.06 and P03.07 set to 5 and P07.11 set to 100. It can be seen that the position error of the motor is not 0 when the motor is at a constant speed. This is because the actual position lags behind the target position after filtering. We think that the position curve is relatively soft.

6.1.7 Function of 4th power position curve

Generally speaking, the trapezoidal speed curve is used for position planning in the servo system. The trapezium speed curve has a certain impact on the machine. In order to reduce the impact of the trapezium speed curve on the machine, the position curve function of the fourth power can be enabled. After enabling, the position curve is planned with a fourth power curve, which can greatly reduce the impact on the mechanical system.

Parameter No.	Parameter Description	Set Range	unit	Set Mode	Effective method	Default	Read and write mode
P03.82	Enable 4th power curve planning 0- Adopt trapezoidal speed curve 1- Use the 4th power curve	0~1	-	Stop to set	Immediately	1	RW
	Set the method of position curve planning, which can be modified only when it is disabled.						

The above figure shows the T-shaped speed curve for position planning. It can be seen from the waveform that the turning point is at the same angle. In this case, there will be fluctuations at the turning point, which will have a little impact on the mechanism.



The above figure shows the position planning of the 4th power speed curve. It can be seen from the waveform that the curve is an arc when turning. In this case, it is relatively soft when turning, and the impact on the mechanism is greatly reduced.

6.2 Common setting parameters for gain adjustment

Parameter No.	Parameter Description
P03.06	Set the given median filter time constant of position command
P03.07	Set the given low-pass filter time constant of the position command

P03.82	Set the method of position curve planning
P07.01	Set current loop proportional gain
P07.02	Set integral gain of current loop
P07.03	Set speed loop proportional gain
P07.04	Set speed loop integral gain
P07.05	Set position loop proportional gain
P07.10	Set torque feedforward coefficient
P07.11	Set speed feedforward coefficient
P07.20	Set gain adjustment mode
P07.28	Set Rigidity Level
P07.29	Load inertia, obtained through inertia self-learning

6.3 Common monitoring parameters for gain adjustment

Parameter No.	Parameter Description
P03.17	Check the position error (unit: 0.0001 circle)
P03.96	Speed command monitoring after filtering in position mode (this parameter is equivalent to "speed command monitoring")
P09.09	Real time speed monitoring
P09.20	Check the given speed loop
P09.21	Check speed loop feedback
P09.30	Check the current loop setting
P09.31	Check current loop feedback

When adjusting the gain, you can record relevant waveforms in the following places: