SD500 Quick Field Commissioning Guide

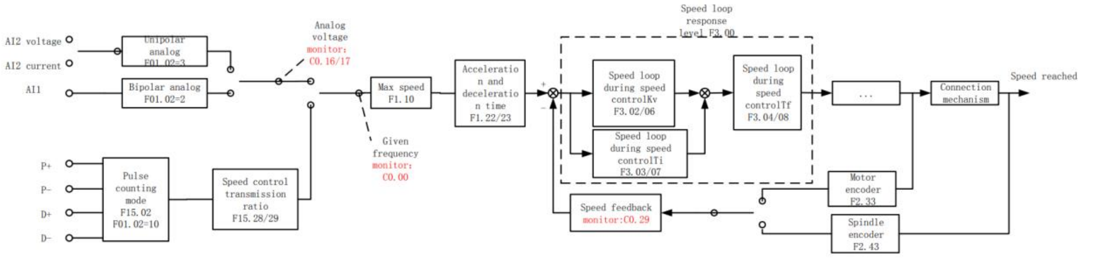
Note: This guide is only used as a supplementary guide for SD500 field commissioning, and is intended to facilitate quick field commissioning. It is referred to 《SD500 Commissioning Manual》, 《SD500 Spindle Servo Drive User's Manual》, 《SD500 Common Function Code Description (Being improved) 》. Before using the commissioning guide, it is best to read the appeal manual first, and it is recommended that the actual commissioning be carried out in combination with the 《SD500 Commissioning Manual》 in the field application.		
Version	Time	Modified by
V1.0	2020.12.26	Liu Shuai Tao

1. General Debugging Steps

In general, do not change the default value, if the machine is new for debugging, restore the factory settings (F00.03=22). Remember to disconnect the X terminal enable during initialization		
Rotate the self-learning a bit to let the drive recognize the encoder direction signal (to avoid the E.PST3 alarm), there is no need to modify the parameters on the interface of the upper computer rotation self-learning.		
If the parameters are copied from the upper computer, when importing parameters to the drive of different devices, remember to ensure that the number of encoder cable (F02.33) is the same, otherwise it will also report E.PST3, in this case you need to lift the alarm and set the correct number of encoder cable to re-rotate the self-learning. (Remember to disconnect the enable: disconnect the terminal cable or tap the emergency stop)		
1. Determine the frequency setting method		
Full pulse (F01.02=10)	Analog quantity (F01.02=3)	
Suitable for speed mode, position mode, and quasi-stop.	Only suitable for speed mode. (Refer to "SD500 Spindle Servo Drive Instruction Manual" for specific wiring and parameter setting)	
2. Check the wiring (combined with the SD500 Commissioning Manual for wiring check, especially pay attention to the site is a single closed loop or double closed loop)		
Many situations on the site are caused by the customer's wiring errors. It is necessary to check them first when arriving at the site		
3. Determine the control method (monitor C00.14 and check the X terminal conduction status)		
X1 terminal active	X3 terminal active	X4 terminal active
Speed mode (F15.35=0 adjust F03) (F15.35=1 adjust F15.33, F15.34)	Quasi-stop mode (adjust F24)	Position mode (adjust F15)
Note: The SD500 is in the enable state when the terminal is turned on, some parameters cannot be modified at this time. Remember to disable the X terminal when changing the parameters, especially when restoring the factory values		
If not, you can also see the system interface. If the spindle is displayed as C-axis, it is in position mode, otherwise it is in speed mode.		
4. Adjustment of gain		
For speed mode, there are two solutions:		
One is F15.35 = 1, adjust F15.33 and F15.34. (Do not add too much value when debugging.) In this case the speed loop gain is automatically given and the responsiveness is adjusted to F15.33 and F15.34. F15.33 is similar to the integration constant, the larger the value the better the stiffness and the better the response. F15.34 affects the value of the electronic inertia, the smaller the value the greater the electronic inertia and the less the overshoot, the better the response.		

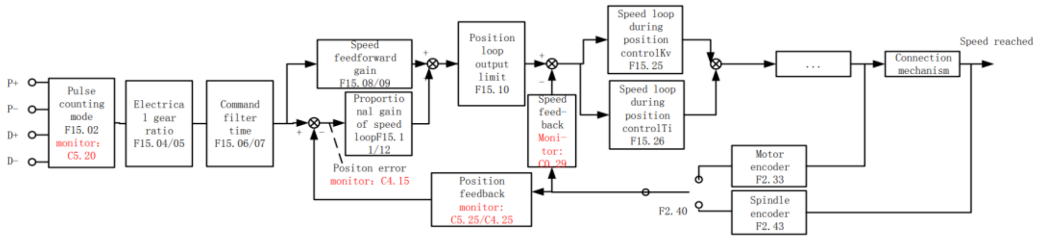
The other one is F15.35=0, adjust F03.02 to F03.09.

At this time, the speed loop gain is set by the PI parameter in the F03 group vector control parameters, and the P parameter is adjusted as high as possible if the response is high, and then the I integration time is adjusted down.Generally, if you want to have a good response when stopping, no shaking without rotation, you need to adjust the responsiveness of the second speed gain (F03.06,F03.07,F03.08) as high as possible. The filtering time is adjusted according to the field conditions, and the default value is generally used.



For position mode:

F15.35=1, to adjust the responsiveness, you only need to adjust the F15 group parameters, mainly the position loop and speed loop. Generally speaking, the speed and position loops can be adjusted by P. Mainly adjust F15.11, F15.25, F15.26



When increasing rigidity, F15.11, F15.25 should be increased, and F15.26 value should be decreased, but the jitter and sound issues need to be weighed. If jitter occurs when reaching the position, please reduce the above gain appropriately. To further improve the fast response, F15.08 speed feedforward gain can be added.

For Quasi-stop:

The rigidity of quasi-stop can be adjusted by F24.20~F24.24 parameters.

Set Home: Enter C04.00 (spindle position) to check the current value and keep pressing for 3 s. Exit the current value means the setting is successful

The Home parameter is set in F24.07 Spindle Indexing Offset (previous 65.10 software version). The 3 terminals X5~X7 (set as 81~83 respectively) can be combined with 8 stages of quasi-stop, and the required position can be set to F24.08~F24.15 by C04.26 (spindle encoder) or C05.26 (motor encoder) monitoring parameters.

Slow quasi-stopping speed: properly increase F24.21 and F24.24

2. General Problem Solutions

1. The transmission ratio or gear ratio corresponding to each mode		
Pulse speed control	Pulse position	General positioning encoder
F15.28, F15.29,	F15.04, F15.05	F02.35, F02.36

2. Motor vibration noise (first have to determine which is the problem between the drive, motor, transmission mechanism)

A	F01.00=0, let the motor running in VF mode. If the vibration and noise still exist, then it's excluded that it's a drive problem. If the vibration and noise disappear, then the drive gain is not set properly, directly follow the steps to adjust the gain and reduce the rigidity.

B	If the VF mode vibration and noise are still present Disconnect the motor from the drive mechanism. If the noise disappears, it is a mechanical assembly problem (abnormal noise generated by belt or gear). If it still exists, it is a motor problem, try to change a motor to test it.
Abnormal noise caused by drive gain	
Specific situation	Solutions
Speed mode (Analog feed)	1. set F15.35 to 0, modify the gain parameter of F03 group, pull down the speed loop gain F03.02 (not less than 5) to reduce the rigidity, and increase F03.03 appropriately. 2. Increase the carrier frequency F01.40 (not too large, below 8k) 3. Slightly increase the feedback filtering F02.37 4. Again make sure the numerator denominator of the ratio is correct (fully closed-loop system can be measured by motor self-learning), check whether F03.00 (speed loop rigidity level) is 32, and whether F03.01 (speed loop rigidity mode) is 0
Speed mode (Full pulse)	1. When F15.35=0, the debugging procedure is the same as the analog setting (this method is preferred). 2. When F15.35=1, adjust F15.33 and F15.34 for responsiveness. pull down F15.33 and pull up F15.34, don't change the setting value too much. F15.33 is similar to the integration constant, the bigger the value the better the rigidity and the better the response. F15.34 affects the value of electronic inertia, the smaller the value the bigger the electronic inertia, the less overshoot and the better the response.
Position Mode (Full pulse)	1. Modify F15 group, reduce F15.11 (position loop gain), then reduce F15.25 ASR proportional gain, appropriately pull up the integration time, reduce the rigidity of the outer loop first after the inner loop (the rest of the parameters can also try to adjust, generally the gain can be improved after pulling down)
2. Large swing after indexing in place (bad rigidity, stopping with rebound, bad stopping effect)	
Speed Mode	It is necessary to adjust the responsiveness of the second speed gain (F03.06, F03.07, F03.08) as much as possible. The filtering time is adjusted according to the field conditions, usually using the default value is fine.
Position Mode	First increase the value of F15.25 (position control ASR proportional gain), and then adjust the value of F15.11 (position loop gain), the integration time can be appropriately extended, following the principle of adjusting the inner loop first and then the outer loop, the appropriate extension of the value of F15.07 (position given smooth filtering time) can reduce the oscillation of the increased gain. In high-speed rigid tapping, the position loop gain and position loop feedforward gain need to be increased, for different occasions need to adjust the different gain parameters.
3. Inaccurate running position (Customer feedback position running inaccurate, processing accuracy cannot be achieved)	
It may be the pulse number receiving error. Monitor C05.20 (command pulse), feedback pulse C04.25 (dual PG, using spindle encoder) or C05.25 (using motor encoder), and check whether their increments are consistent after operation (subtract the value before operation from the value after operation, because the two values are not necessarily equal, but the increments should be equal each time).	
1. If the increment is not consistent (consider using motor encoder and the transmission ratio is not 1:1), recalculate according to the electronic gear ratio *C05.20. If there is still a difference between the number of command pulses and the number of feedback pulses, it is necessary to determine whether the force is acting on the spindle, or whether the position loop gain is too small. (Also have to exclude the case of inaccurate gear ratio) 2. If the command pulse number and feedback pulse number increment value remain unchanged, excluding the drive problem, you need to determine whether the command pulse number sent by the system and the command pulse number C05.20 received by SD500 are the same. If it is the same, the pulse number is wrongly set on the machine system, if it is not the same, it can be determined that there is a fault or error in the system software setting or hardware circuit.	
Common problems when using pulse position control **Q1:** System enables but motor does not move **Monitoring:** C5.20 pulse command count	

Judgement: If C5.20 does not change, it may be a wiring error or a wrong pulse type

Q2: Position control does not reach the exact position

Monitoring: C5.20 pulse command count, C5.25 motor encoder pulse count (spindle encoder C4.25), C4.15 position error

Judgement: If the increase of C5.20 and C5.25 is the same, while C4.15 = 0, check if the system ratio and command are set correctly, otherwise you can increase the gain a little.

4. The expansion of problem 3, if the number of pulses sent by the machine system is correct, and the wiring problem is eliminated, but the spindle still cannot be rotated.

A	Check whether F15.02 (pulse counting mode) is set incorrectly, "AB" or "pulse + direction"
B	In special cases, there may be a problem with the terminal definition of the system spindle port (when the machine operating system is a Kainty system) Set the multimeter to the Hz gear (frequency gear) and connect it to the command pulse output terminal of the spindle port of the operating system. Let the system send the command pulse to see if there is a frequency value. If there is no frequency value, it means there is a problem in the definition of the system terminal
B (The correct definition of the terminal, it is best to check with the system supplier)	See table below

VEICHI with KND（凯恩帝）

CN1			X60/X64	
20	PA +	red	1	X64
5	PA -	red & white	9	
19	PB +	black	2	
4	PB -	black & white	10	
22	OA +	blue	8	X60
7	OA -	blue & black	7	
21	OB +	green	6	
6	OB -	green & black	5	
36	OZ +	yellow	4	
35	OZ -	yellow & black	3	
10	X4	blue & black	Spindle position	
11	X1	blue & black	Spindle enable	
12	24V			

5. Wrong direction of rotation

Enable forward rotation and observe whether the direction is correct. If the rotation direction is wrong, the pulse signal can be reversed by adjusting F15.02 pulse counting mode, and the analog signal can pass F07.05

6. During the operation of double PG mode, there is a slight deviation between the speed displayed by the system and the command, and the transmission ratio needs to be fine-tuned (usually self-learning will automatically measure and set)

During the operation of dual PG mode, if there is a small deviation between the system display speed and the command, fine adjustment can be made by F15.28 /F15.29 (after modification, forward and reverse rotation should be re-enabled).

7. Reporting encoder PG fault, self-learning report E.PG02 (or E.PST3 when running)

The motor encoder cable number is set incorrectly. Reset the correct number of encoder cable, then perform rotational self-learning. (Remember to disconnect the X terminal to disable drive enable)

In addition to the wrong setting of the number of encoder cable, PG faults can be:

1. The encoder power signal is not effective the shield is not grounded causing serious interference during operation.
2. Poor contact of encoder communication cable, loose contact of connection cable.

Solutions:

	Z pulse failure	Z pulse loss	Z logic failure	Cable disconnection fault
Fault Display	PG02/07	PG 10/11	PG 08/09	PG 05/06
Fault code	4402/4407	4410/4411	4408/4409	4405/4406
Occurrence probability	Low	High	High	Low
Encoder type		Magnetic ring encoder	Magnetic ring encoder	
Can be shielded or not	Unable to shield	Shieldable F2.46=0	Unable to shield	Shieldable (generally not shielded) F2.38=0
Cause of failure	Cable number setting error	The installation distance of encoder sensor is far , Z pulse width is too narrow	No self-learning, serious field interference, encoder installation	Encoder fault, cable not plugged in
Solution	Re-judge the number of encoder cable	F15.31=1100, otherwise shielded	Reinstall the sensor	Look for wiring and encoder itself problems

Note: 1. The above are incremental encoders; 2. The current faults are mostly magnetic ring encoders, which have a certain relationship with their installation and thickness.

3. Some Relevant Notes

1. Parameters to be set for three different applications (single motor encoder, single spindle encoder, dual encoder)

A	Single motor encoder	Suitable for 1:1 ratios

1. Set the number of encoder cables for the FO2.33 motor (no setting is required by factory default with VEICHI motors)
2. Set FO2.07 = 1 and press and hold SET for 1s to perform self-learning

B	Single spindle encoder	For non-1:1 ratios, manual setting of the ratio is required

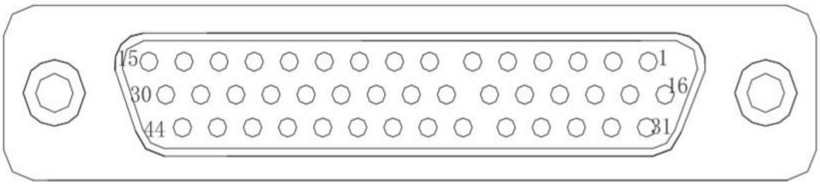
1. Set the number of encoder cables for the FO2.33
2. Set FO2.40 = 1 Positioning encoder selection
3. Set F02.07 = 1, then press and hold SET for 1s to perform self-learning (self-learning can be learned directly from the encoder ratio F2.35/36 and written into the parameters)

C	Dual encoder	Suitable for applications where high precision control of non-1:1 ratios is required

1. Setting FO2.33 Number of motor encoder cable (no factory default setting required if using VEICHI motors)
2. Set FO2.40 = 2, positioning encoder selected as spindle encoder
3. Setting FO2.43 Number of spindle encoder cable
4. Set FO2.45 bit = 1 to divide the frequency to output the spindle encoder signal
5. Set FO2.07 = 1 and press and hold the SET key for 1s to perform self-learning (with self-learning the encoder ratio F15.28/29 can be read out directly and written into the parameters)

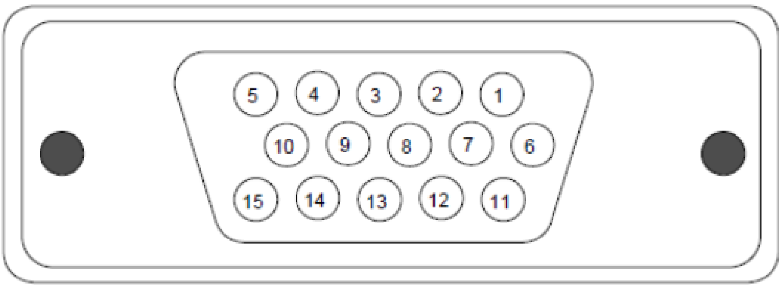
2. Pin definitions and wiring diagrams

Control loops CN1 Control Terminal pins



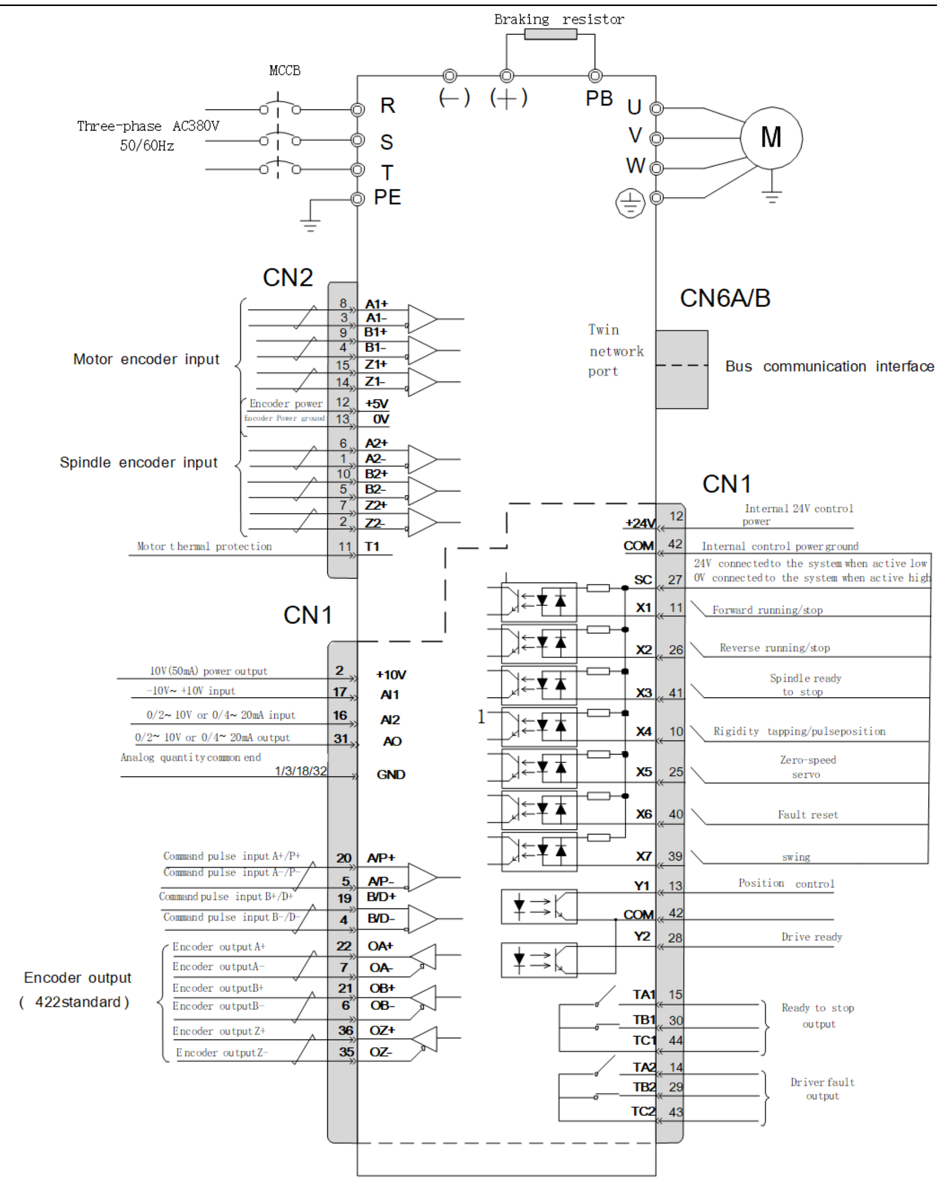
Function	PIN No.	Signal	Function description	Function	PIN No.	Signal	Function description
Analogue signal input	16	AI2	0~10V Input	SC is the common terminal of the I/O, 24V and SC are shorted (NPN connection method)	42	COM	24V Power ground
	16	AGND	Analogue GND		12	24V	Internal 24V+
Pulse signal (AB quadrature, pulse + direction, CW + CCW)	20	PULS +	Pulse command +		27	SC	I/O common terminal
	5	PULS -	Pulse command -	DI input (AGND and COM shorted if the analog and digital inputs of the CNC are grounded together)	11	X1	Forward
	19	SIGN +	Command Direction +		26	X2	Reversal
	4	SIGN -	Command Direction -		41	X3	Quasi-stop back to 0
Crossover output to system encoder interface	22	OA +	Crossover output OA +		10	X4	Speed position switching
	7	OA -	Crossover output OA -	DO output: Y1 and COM form a loop	15	TA1	Home return arrival signal
	21	OB +	Crossover output OB +		44	TC1	
	6	OB -	Crossover output OB -		14	TA2	Fault alarm signals
	36	OZ +	Crossover output OZ +		29	TB2	
	35	OZ -	Crossover output OZ -		43	TC2	
					13	Y1	Speed and position switching completion signal output
X5~X7 are not marked							

CN2 encoder terminal pin



CN2 encoder interface					
PIN	Signal name	Function	PIN	Signal name	Function
1	U -	Spindle encoder signals A -	8	A +	Motor encoder signals A +
2	W -	Spindle encoder signals Z -	9	B +	Motor encoder signals B +
3	A -	Motor encoder signals A -	10	V +	Spindle encoder signals B +
4	B -	Motor encoder signals B -	11	T1	Motor overheating
5	V -	Spindle encoder signals B -	12	5V	Encoder power 5V
6	U +	Spindle encoder signals A +	13	0V	Encoder power 0V
7	W +	Spindle encoder signals Z -	14	Z -	Motor encoder signals Z -
Casing	Shield	/	15	Z +	Motor encoder signals Z +

Whether motor encoder or spindle encoder, if only one encoder is connected please connect the motor encoder signal, the signal name is different from the following diagram, please refer to the pin definition

Basic wiring diagram	 Note: Represents double twisted shield
3. Functional overview of the ADRC controller (functional description of hidden parameters F15.35, F15.34, F15.33)	
ADRC：F15.32~35（ADRC is used to replace the PI controller in the speed loop）	
F15.35 The default is 1 and this function is switched on by default. For normal scenes, this function is turned on to obtain a high level of stiffness and response. However, some machines can be noisy and the gain and other relevant parameters should be modified in this case by referring to the previous two summaries.	
Application	1. Single motor mode
	2. Double PG (better results with large inertia loads)
Advantages	1. Higher rigidity can be obtained
	2. Electronic inertia adjustment F15.34

Disadvantages	1. Higher default gain, zero speed, F15.33 reduction required at low speeds 2. High dependence on encoder, so automatic switch to PI controller when no PG vector is available

F15.35 Effect of parameter values on the speed loop control mode in each mode

F15.35	Speed mode	Position mode	Quasi-stop
F15.35=0	PI controller	PI controller	PI
F15.35=1	ADRC	PI controller	ADRC
F15.35=1	ADRC	ADRC	ADRC

In general, the main adjustments are F15.33 and F15.34.

F15.33 is equivalent to the integral gain (1/Ti) in PI control, the higher the value the more rigid it is, currently the default value is 100, which is already a rigid state and needs to be reduced when the encoder is not rigidly connected to the motor, otherwise it is prone to vibration. In the F2.40=1 single spindle mode, it is automatically set to 30.

F15.34 can be interpreted as an inertia adjustment, its normal adjustment range is 32 to 10, the smaller the value, the greater the electronic inertia being adjusted at this point. As the equivalent inertia becomes larger, the response can be achieved without overshooting and with greater immunity to interference. However, as this is the equivalent inertia generated by the electromagnetic torque, the smaller the F15.34, the greater the inertia and the more likely to cause vibration.

F15.32 (0x0F20)	adrc observer gain β1	V/F SVC FVC PMVF PMSVC PMFVC For improved system response and rigidity	10000 （0～20000）	RUN
F15.33 (0x0F21)	adrc observer gain β2	V/F SVC FVC PMVF PMSVC PMFVC For improved system response and rigidity	100 （0～200）	RUN
F15.34 (0x0F22)	ADRC input coefficient b	V/F SVC FVC PMVF PMSVC PMFVC For improved system response and rigidity	32 （1～200）	RUN
F15.35 (0x0F23)	adrc switch	V/F SVC FVC PMVF PMSVC PMFVC adrc and pi switch	1 （0～1）	STOP

PI variable gain mode

F3.01=0001 F3.00 rigidity level, adjusts Kp according to load size, can be switched on for large inertia loads, improves response at unterminated indexing.