

BECKHOFF

EL2521控制步进电机 (NC篇)

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技术支持部



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步进电机及其驱动器相关参数配置

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实现NC控制EL2521的相关设置

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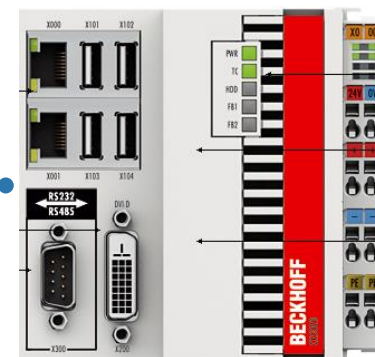
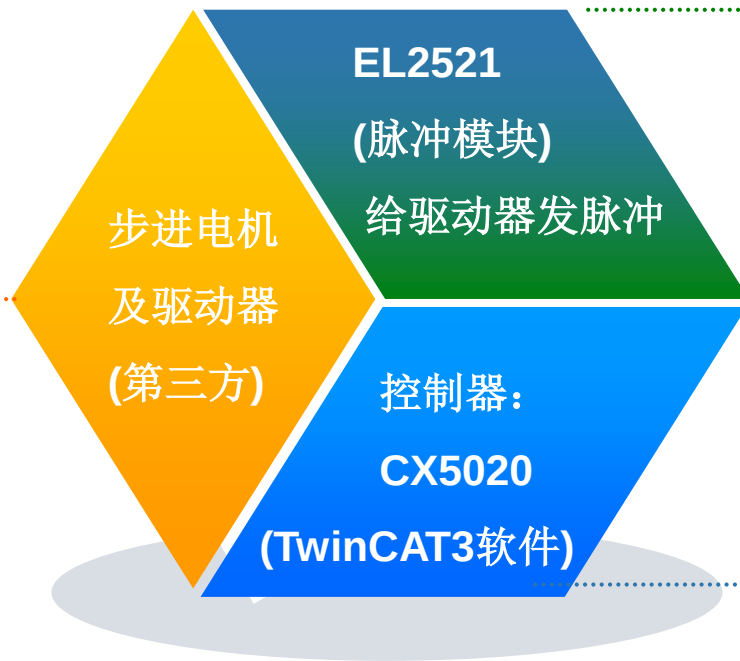
NC加减速功能



EL2521控制步进电机（PLC）

如何对步进电机进行定位

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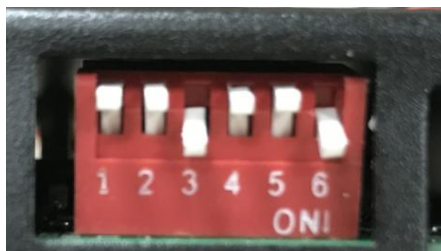




步距角: 1.8°
额定电流: 2.8A

电机转一圈所需步数

$$\frac{360^{\circ}/r}{1.8^{\circ}/step} = 200$$



设置细分倍数为**16**，可计算得出

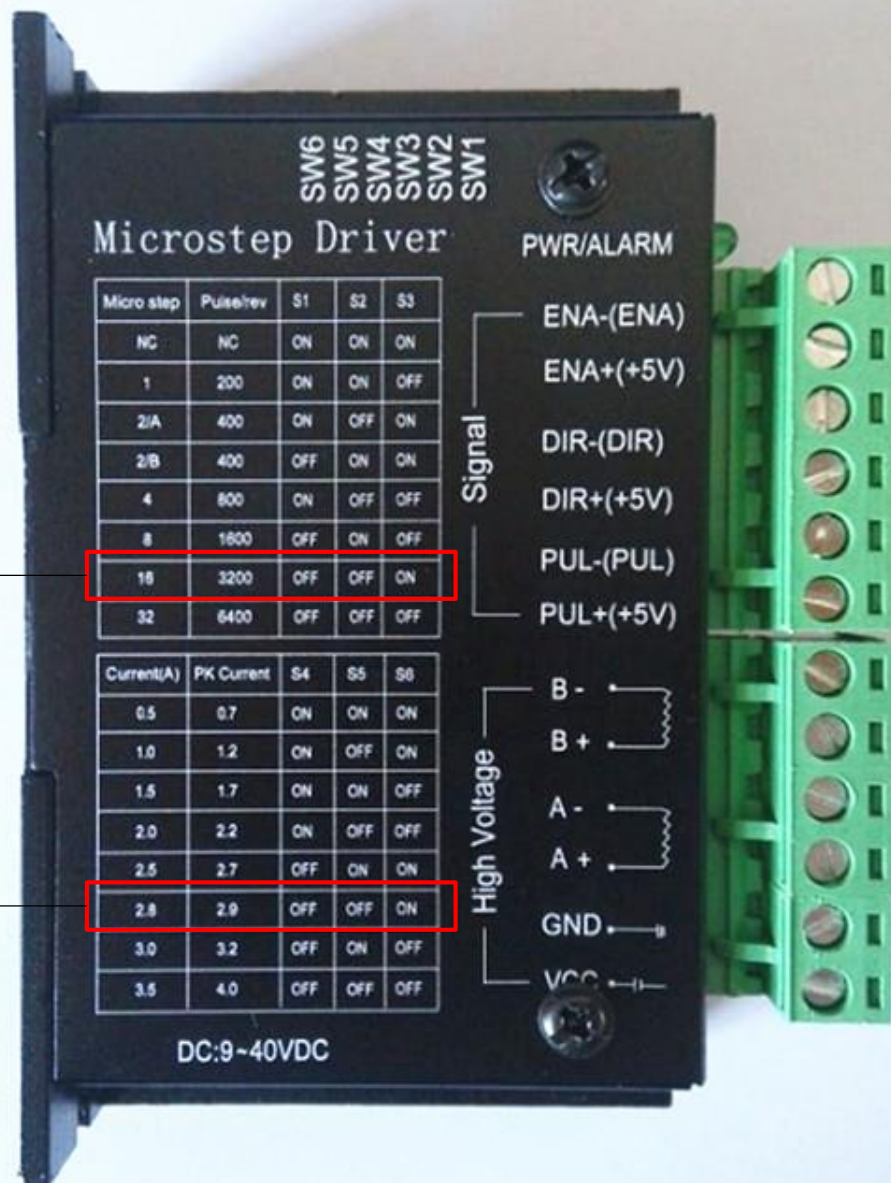
$$\frac{360^\circ/r}{1.8^\circ/step} \times \text{细分倍数} = 200 \times 16 = \mathbf{3200}$$

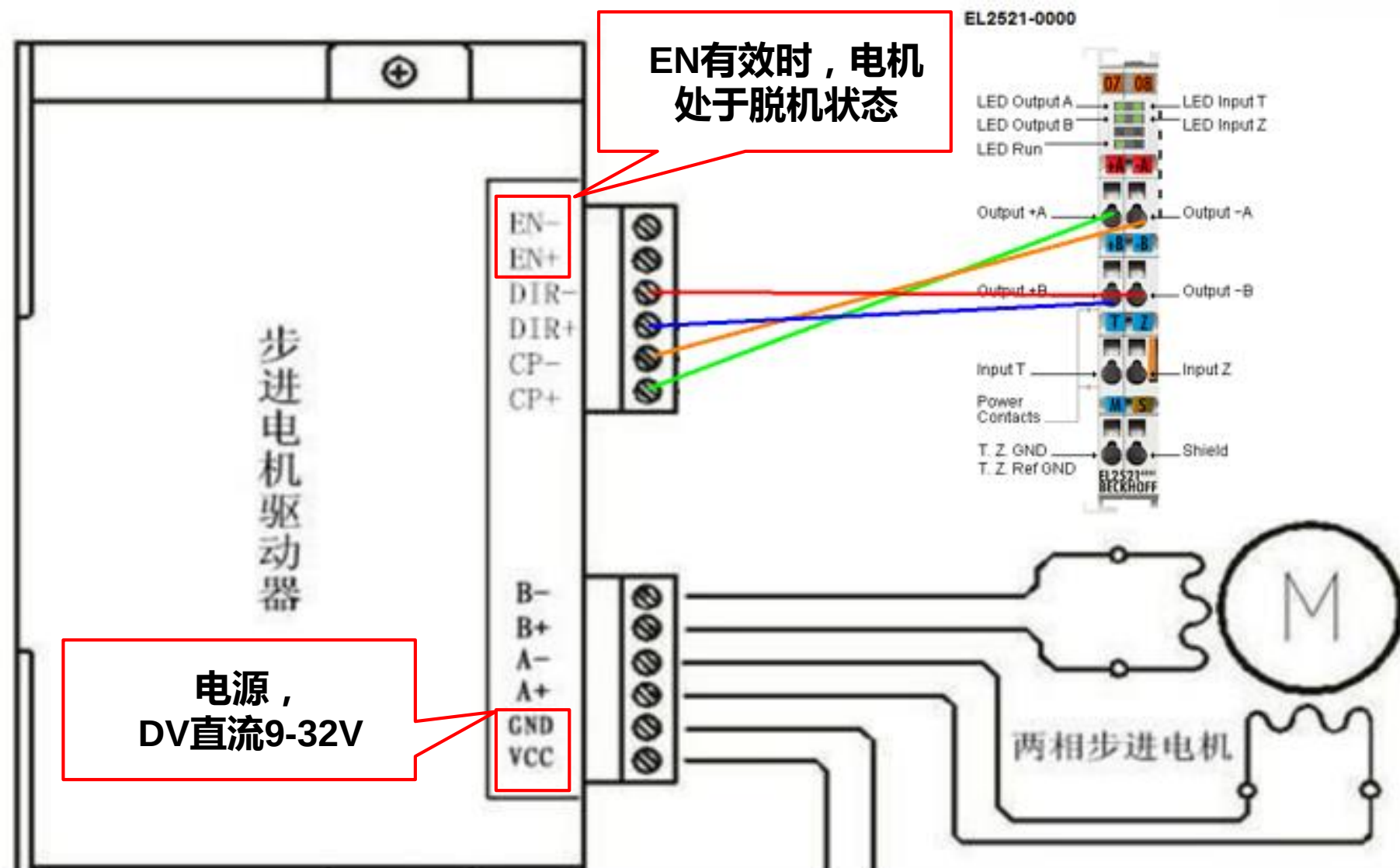
则脉冲数为**3200**，根据上述数据设置**S1~S3**

S1	S2	S3
off	off	on

根据电机的额定电流**2.8A**，设置**S4~S6**

S4	S5	S6
off	off	on





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NC加减速功能

step1

step2

step 3

确定步进电机采用的驱动方式——脉冲+方向 8000:0E为1

8000:0	Feature bits	RW	> 15
8000:02	Emergency ramp active	RW	FALSE
8000:03	Watchdog timer deactive	RW	TRUE
8000:04	Sign/amount representation	RW	FALSE
8000:05	Rising edge clears/sets counter	RW	TRUE
8000:06	Ramp function active	RW	FALSE
8000:07	Ramp base frequency	RW	10
8000:08	Direct input mode	RW	FALSE
8000:09	Users switch-on-value on wdt	RW	FALSE
8000:0A	Travel distance control active	RW	FALSE
8000:0B	Rising edge sets counter	RW	FALSE
8000:0E	Operating mode	RW	Pulse-dir. ctrl (1)
8000:0F	Negative logic	RW	FALSE

Set Value Dialog

Dec: 1 OK

Hex: 0x01 Cancel

Enum: Pulse-dir. ctrl
Frequency mod.
Pulse-dir. ctrl
Incremental enc.

Bool: ☐ 0 ☒ 1 New Edit...

Binary: 01 1

Bit Size: ☐ 1 ☒ 8 ☐ 16 ☐ 32 ☐ 64 ☐ ?

step1

step2

step 3

确定采用NC方式控制步进电机驱动器，关闭原有的斜坡功能8000:06 为0(false)

8000:0	Feature bits	RW	> 15 <
8000:02	Emergency ramp active	RW	FALSE
8000:03	Watchdog timer deactive	RW	TRUE
8000:04	Sign/amount representation	RW	FALSE
8000:05	Rising edge clears/sets counter	RW	TRUE
8000:06	Ramp function active	RW	FALSE
8000:07	Ramp base frequency	RW	10 Hz (0)
8000:08	Direct input mode	RW	FALSE
8000:09	Users switch-on-value on wdt	RW	FALSE
8000:0A	Travel distance control active	RW	FALSE
8000:0B	Rising edge sets counter	RW	FALSE
8000:0E	Operating mode	RW	Pulse-dir. ctrl (1)
8000:0F	Negative logic	RW	FALSE

step1

step 2

step3

设置EL2521基频，即电机转过一圈所需要的脉冲数8001:02成为3200

8001:0	User settings	RW	> 8 <
8001:01	Users switch-on-value	RW	0x0000 (0)
8001:02	Base frequency 1	RW	0x00000C80 (3200)
8001:03	Base frequency 2	RW	0x000186A0 (100000)
8001:04	Ramp time constant (rising)	RW	0x0064 (100)
8001:05	Ramp time constant (falling)	RW	0x0064 (100)
8001:06	Frequency factor (Digit x 10...	RW	0x0064 (100)
8001:07	Slowing down frequency	RW	0x01F4 (500)
8001:08	Ramp time constant (emergency)	RW	

Set Value Dialog

Dec: 3200

Hex: 0x00000C80

Float: 4.4841551e-042

Bool: 0 1

Binary: 80 0C 00 00 4

Bit Size: ☐ 1 ☐ 8 ☐ 16 ☒ 32 ☐ 64 ☐ ?

OK Cancel Hex Edit...

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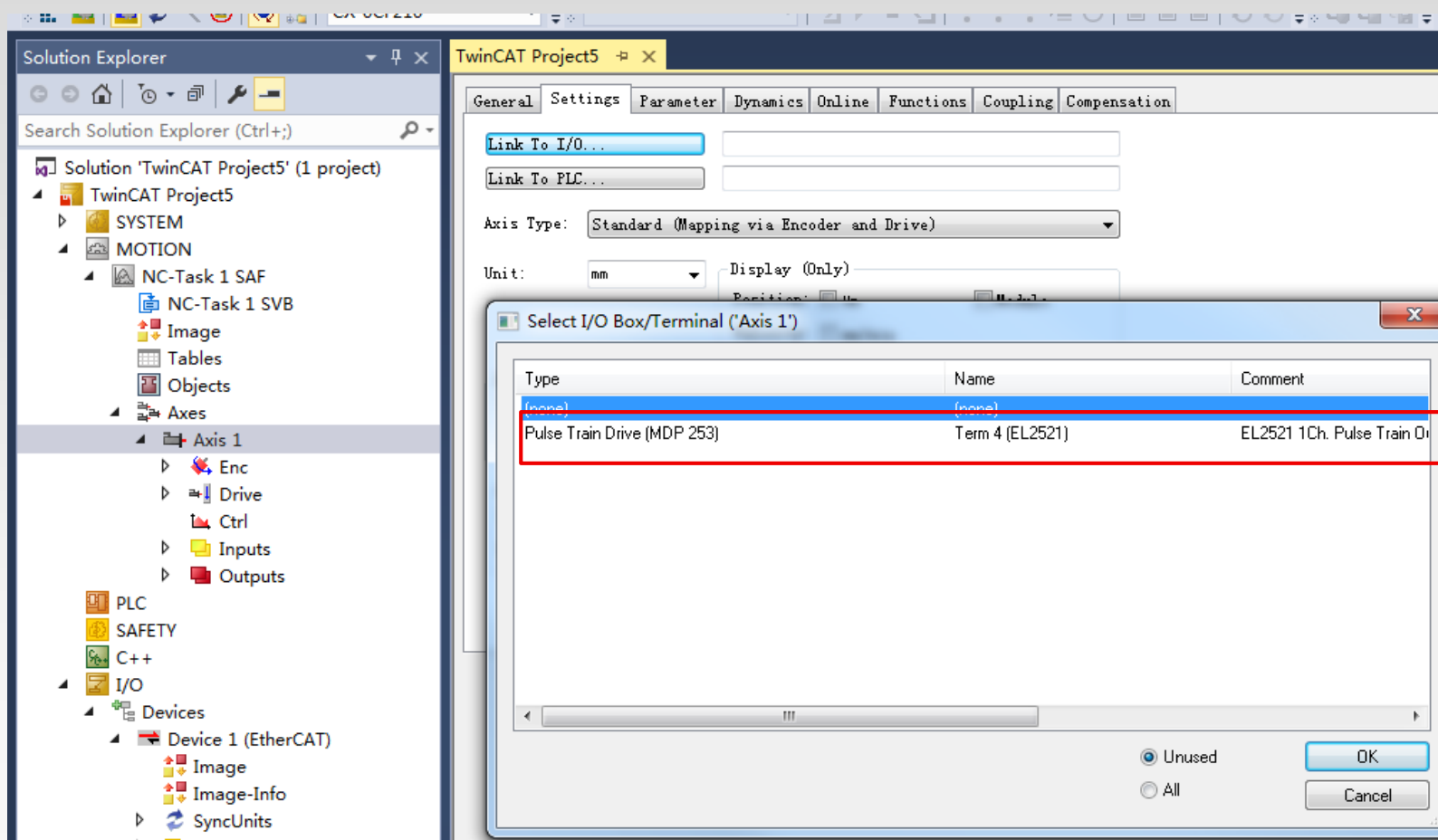


step1

step2

step 3

创建NC轴，同时将该轴关联EL2521模块所带的外部硬件轴



step1

step2

step 3

设置scaling factor

Scaling factor Numerator = 进给量 = 360°

Scaling factor Denominator = 脉冲数/圈 = $3200/r$

General NC-Encoder Parameter Time Compensation Online

	Parameter	Offline Value	Online Value
-	Encoder Evaluation:		
	Invert Encoder Counting Direction	FALSE	FALSE
	Scaling Factor Numerator	360.0	360.0
	Scaling Factor Denominator (default: 1.0)	3200.0	3200.0
	Position Bias	0.0	0.0

step1

step 2

step3

设置reference velocity、maximum velocity、homing velocity等，使得NC命令与脉冲量相匹配

reference velocity = 进给量 × 电机额定转速 = $360^{\circ}/r \times 60r/min = 360^{\circ}/s$

maximum velocity = ***reference velocity*** × 120% = $360^{\circ}/s \times 120\% = 432^{\circ}/s$

其他速度根据实际使用情况进行设置。

Parameter	Offline Value
Maximum Dynamics:	
Reference Velocity	360.0
Maximum Velocity	432.0
Homing Velocity (towards plc cam)	30.0
Homing Velocity (off plc cam)	5.0
Manual Velocity (Fast)	200.0
Manual Velocity (Slow)	50.0

实例：轴以 $90^\circ/\text{s}$ 的速度由 0° 到 360° 转一圈

The screenshot displays the Microsoft Visual Studio environment with the el2521_nb project open. The main window shows the TwinCAT RT (x86) interface, specifically the 'General' tab for 'Axis 1 Continuous Axis'. The interface includes a 'Setpoint' field set to 0.0000, an 'Actual Velocity' field set to 0.0000, and a 'Target Position' field set to 360. Below these fields are various status indicators and control buttons (F1-F9). The 'Error List' at the bottom indicates 0 errors and 0 warnings. The 'Properties' window on the right shows the 'Misc' and 'Persistent' properties for the axis, including the name 'Axis 1', item type '22', and path name 'TINC^NC-Task 1 SAF^Axes^Axis 1'.

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功能替换

实现加减速

Ramp
Function

Dynamic

8000:0	Feature bits	RW	> 15 <
8000:02	Emergency ramp active	RW	FALSE
8000:03	Watchdog timer deactive	RW	TRUE
8000:04	Sign/amount representation	RW	FALSE
8000:05	Rising edge clears/sets counter	RW	TRUE
8000:06	Ramp function active	RW	FALSE
8000:07	Ramp base frequency	RW	10 Hz (0)
8000:08	Direct input mode	RW	FALSE
8000:09	Users switch-on-value on wdt	RW	FALSE
8000:0A	Travel distance control active	RW	FALSE
8000:0B	Rising edge sets counter	RW	FALSE
8000:0E	Operating mode	RW	Pulse-dir. ctrl (1)
8000:0F	Negative logic	RW	FALSE

General Settings Parameter Dynamics Online Functions Coupling Compensation

☒ Indirect by Acceleration Time

Maximum Velocity (V max): 432 mm/s

Acceleration Time: 3 s

Deceleration Time: ☒ as above 3 s

Acceleration Characteristic: smooth stiff

Deceleration Characteristic: smooth stiff

☐ Direct

Acceleration: 145.44 mm/s²

Deceleration: ☒ as above 145.44 mm/s²

Jerk: 4896.48 mm/s³

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轴从0走到2000，当设置成下图的动态速度时，

General Settings Parameter **Dynamics** Online Functions Coupling Compensation

☐ Indirect by Acceleration Time

Maximum Velocity (V max): 432 mm/s

Acceleration Time: 10 s

Deceleration Time: ☒ as above 10 s

smooth stiff

Acceleration Characteristic:

Deceleration Characteristic:

a (t)

v (t)

☒ Direct

Acceleration: 43.632 mm/s²

Deceleration: ☒ as above 43.632 mm/s²

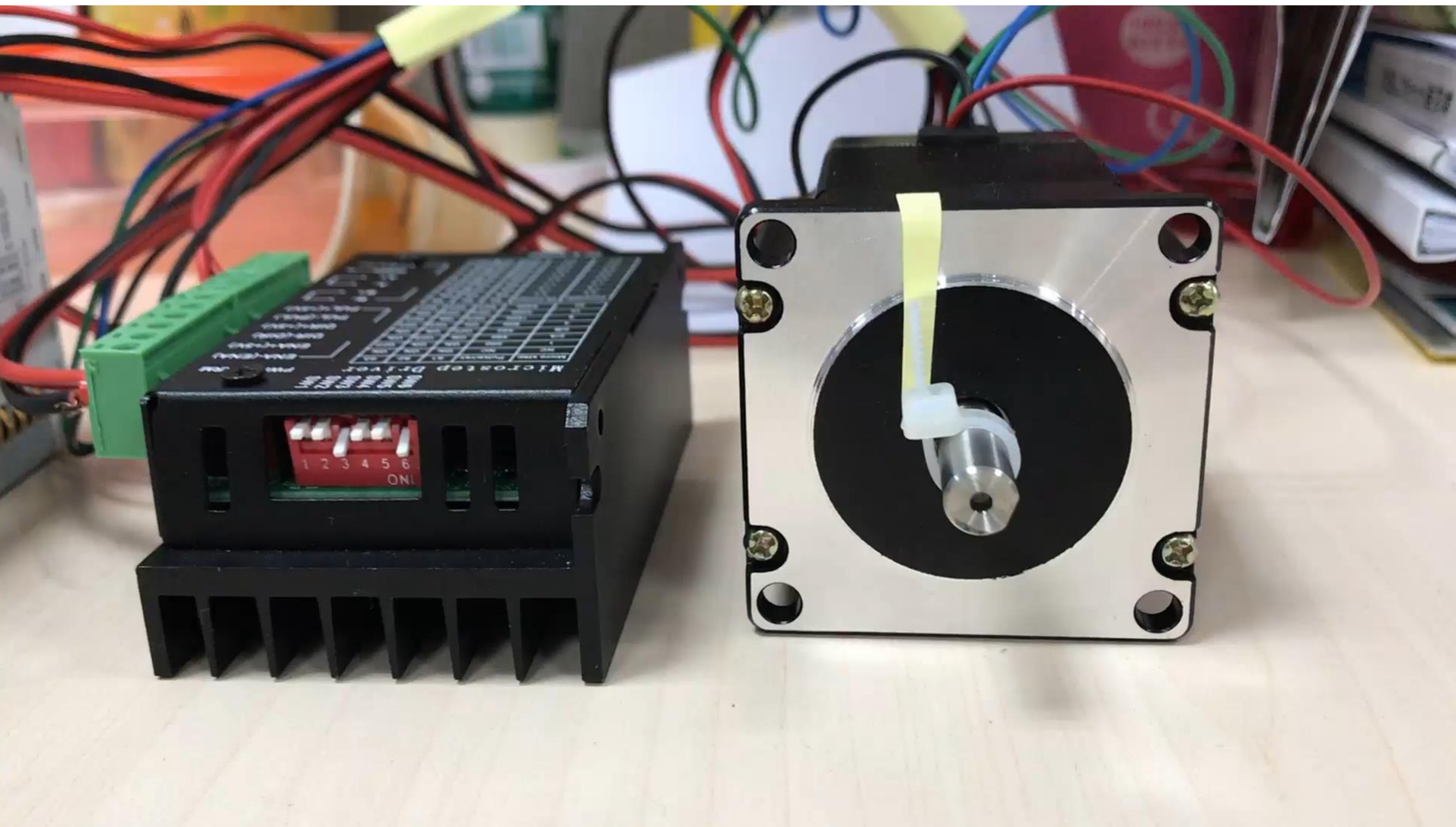
Jerk: 440.683 mm/s³

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NC加减速功能

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轴从0走到2000，当设置成下图的动态速度时，

General Settings Parameter Dynamics Online Functions Coupling Compensation

☐ Indirect by Acceleration Time

Maximum Velocity (V max): 432 mm/s

Acceleration Time: 1 s

Deceleration Time: ☒ as above 1 s

smooth stiff

Acceleration Characteristic:

Deceleration Characteristic:

a (t)

v (t)

☒ Direct

Acceleration: 660.96 mm/s²

Deceleration: ☒ as above 660.96 mm/s²

Jerk: 1908.05 mm/s³

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