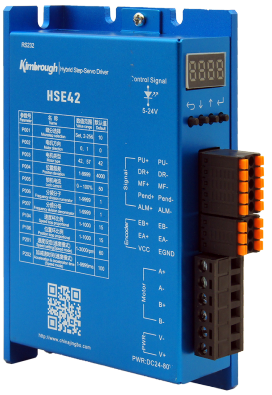
闭环步进电机驱动器
CLOSED-LOOP STEPPER MOTOR DRIVER

HSE42

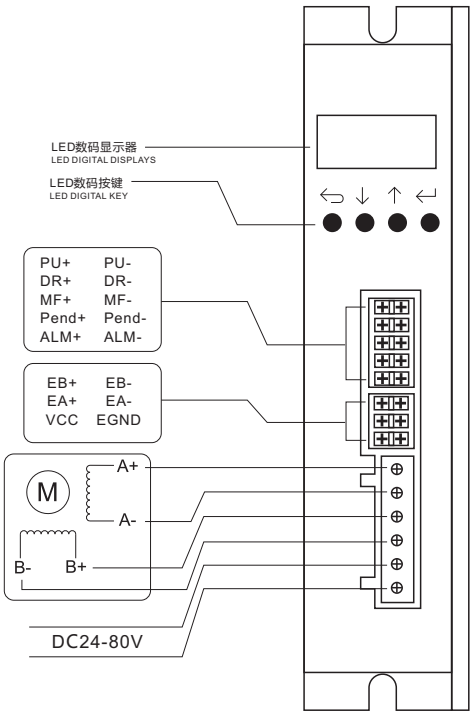
特点 (Feature)

- 采用全新 32 位电机控制专用 DSP 芯片
- 电流0-6.0A可以任意设置
- 适配驱动42、57和60两相闭环步进电机
- 脉冲响应频率最高可达200KHz
- 16档细分选择（200-51200脉冲/转）
- 电子齿轮模式（任意细分值）
- 具有过流、过热、过压和跟踪误差超差等保护
- 位置控制模式和速度控制模式可选
- 控制信号+5～+24V 均可驱动，高于+5V无需外接限流电阻
- 位置控制有两种模式可选

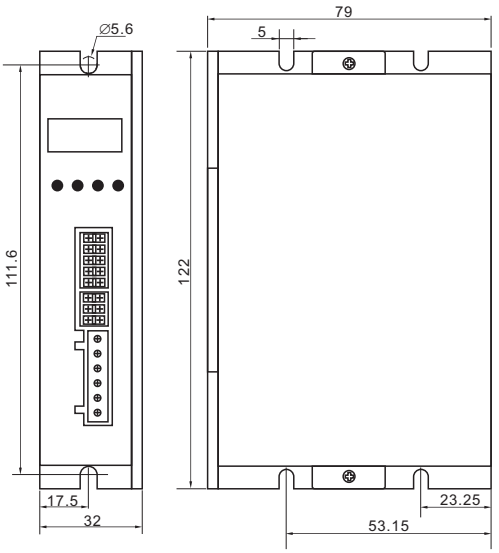
- 32 bit DSP control technology
- The current can be set arbitrarily (0-6.0A)
- Adaptable to drive 42, 57 and 60 series closed-loop stepper motors
- Pulse response frequency amounts to 200KHz
- Standard 16 channels microsteps selection (200~51200 Pulse/R)
- Electronic gear mode (any microstep value)
- Protection against overcurrent, overheating, overvoltage and tracking error deviation
- Position control mode and speed control mode are optional
- It can connect +5-+24V, no extra resistor is needed when it is over +5V
- There are two modes for position control



外形图 (Dimension)



安装尺寸 (Installation dimension drawing) Unit:mm



注意：保持驱动器的良好散热
(1)驱动器的可靠工作温度通常在60℃以内，电机工作温度为80℃以内；
(2)安装驱动器时请尽量采用直立侧面安装，远离热源，必要时在电气柜上安装散热风扇.
Note: Keep the driver cool
(1)The reliable operating temperature of the driver is usually within 60℃ ,and the motor operating temperature is within 80℃ ;
(2)When installing the driver, please install it on the upright side, keep away from the heat source. If necessary, please install a cooling fan on the electrical cabinet

电气指标 (Electrical index)

参数 parameter	最小值 Minimum	典型值 Typical	最大值 Maximum	单位 unit
连续输出电流 Continuous output current	0	-	6.0	A
输入电压（直流） Input voltage (DC)	24	48	80	Vdc
逻辑输入电流 Logic input current	7	10	20	mA
脉冲频率 Pulse frequency	0	-	200	KHZ
绝缘电阻 Insulation resistance	500			MΩ
编码器电流 Encoder current			50	mA

使用环境及参数 (Use environment and parameters)

冷却方式 Cooling Method	散热片自然散热（如果环境温度过高，请外接散热风扇） The heat sink is naturally cooled (if the environmental temperature is too high, please use an external cooling fan)	
使用环境 Use Environment	使用场合 Use occasion	尽量避免粉尘、油雾及腐蚀性气体 Try to avoid dust, oil mist and corrosive gases
	温度 Temperature	-10℃-50℃
	湿度 Humidity	40-90%RH
	震动 Vibration	5.9m/s^2 Max
保存温度 Storage temperature	-20℃-+80℃	
重量 Weight	300g	

电机和电源输入端口(Motor and power input port)

端子号 Terminal number	符号 Mark	名称 Name
1	A+	A相 + A phase +
2	A-	A相- A phase -
3	B+	B相 + B phase +
4	B-	B相- B phase -
5	V-	电源输入(DC24~80V) Power input(DC24~80V)
6	V+	

注意： 闭环驱动器不能以互换绕组 +、- 改变电机运转方向，运转方向与给定方向不一致时，可更改P002里数值换向
Note: The closed-loop driver can not change the motor running direction by interchangeable motor winding +, - . If the motor running direction is not consistent with the given direction, please changethe value in parameter P002 to reverse.

编码器信号输入端口(Encoder signal input port)

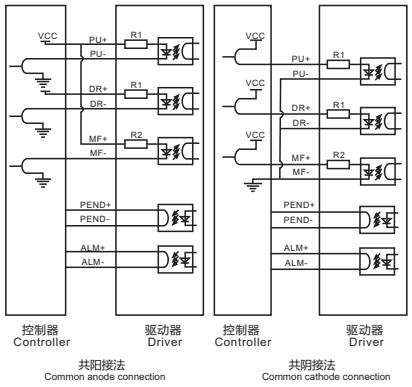
端子号 Terminal number	符号 Mark	名称 Name
1	EB+	编码器B相+ Encoder B phase +
2	EB-	编码器B相- Encoder B phase -
3	EA+	编码器A相+ Encoder A phase +
4	EA-	编码器A相- Encoder A phase -
5	VCC	编码器电源+5V Encoder power +5V
6	EGND	编码器电源地 Encoder power ground

控制信号端口(Control signal port)

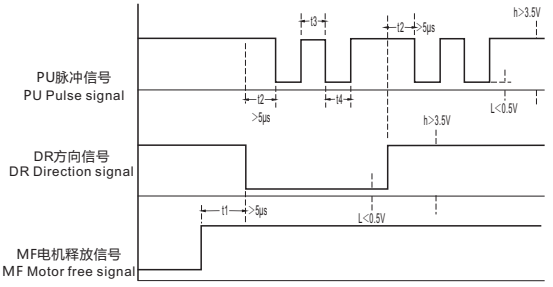
端子号 Terminal number	符号 Mark	名称 Name	说明 Description
1	PU+	脉冲+ Pulse input +	信号+5～+24V 均可驱动, 高于+5V无需外接限流电阻 It can connect +5-+24V, no extra resistor is needed when it is over +5V
2	PU-	脉冲- Pulse input -	
3	DR+	方向+ Direction input+	信号+5～+24V 均可驱动, 高于+5V无需外接限流电阻 It can connect +5-+24V, no extra resistor is needed when it is over +5V
4	DR-	方向- Direction input-	
5	MF+	电机释放信号+ Motor free signal +	该信号有效时电机处于自由状态 When the signal is valid, the motor is in a free state
6	MF-	电机释放信号- Motor free signal -	
7	Pend+	到位信号+ In place signal output +	电机到位后驱动器输出信号给上位机 After the motor is in place, the driver outputs signal to the host computer.
8	Pend-	到位信号- In place signal output -	
9	ALM+	故障信号+ Alarm signal output+	故障信号或刹车信号 Alarm signal output or Brake signal output
10	ALM-	故障信号- Alarm signal output -	

注：驱动器故障时, MF信号有效, 驱动器将清除所有故障。
Note: When a fault occurs, the MF signal is valid and the driver will clear all faults.

控制信号接口电路图(Control signal interface circuit diagram)



输入信号波形时序图 (Input signal waveform timing diagram)



驱动器细分表 (P001参数值) Driver microstep table(P001 Parameter value)

细分数 Microstep	SET	2	4	5	8	10	16	20	25	32	40	50	64	100	128	200	256

注意 Note: 1.计算脉冲/ 转时，表格里细分数×200 When calculating Pulse/Revolution, the number of microstep in the table × 200

2.当P001里数值为SET时，驱动器采用电子齿轮变量 When the value in P001 is Set, the driver uses electronic gear variables

计算公式Calculation formula:

$$P \times G = N \times C \times 4$$

P：输入指令的脉冲数 Number of input command pulses　　G：电子齿轮比 Electronic gear ratio

$$G = \frac{\text{分频分子 Frequency division numerator}}{\text{分频分母 Frequency division denominator}}$$

N：电机旋转圈数 Number of motor revolutions

C：光电编码器线数/转，本系统 C = 1000 Photoelectric encoder line number / rev , this system C = 1000

如：当上位控制器输出指令脉冲为 6000，电机旋转 1 圈

For example:When the command pulse output by the host controller is 6000, the motor rotates 1 revolution.

$$G = \frac{N \times C \times 4}{P} = \frac{1 \times 1000 \times 4}{6000} = \frac{2}{3}$$

则参数 P006 设为 2，P007 设为 3，上面的结果通过数学约分计算得来，尽量取最小公约数。电子齿轮比推荐范围为：1/20≤G≤20

Then the parameter P006 is set to 2 and P007 is set to 3. The above result is calculated by mathematical gear, try to take the minimum common divisor. The recommended range of electronic gear ratio is:1/20≤G≤20

参数设定(Parameter setting)

操作面板由LED 数码显示器和 按键 “⮌ 🡓 、🡑 🡐 ” 组成，用来显示系统各种状态和参数设置等。
The driver's operation panel consists of LED digital display and 4 keys “⮌. 🡓. 🡑. 🡐 ”,it used to display various system status and parameter settings.

按键功能说明表Key function description table

按键 Key	功能说明 Function
⮌	退出，取消操作；用于返回上一页面，结束参数输入状态 Exit, cancel the operation; it is used to return to the previous page,end the parameter input status
🡓	下翻页、数值更改时用于调整当前位的数据大小 Page down, it is also used to adjust the current data when the value is changed
🡑	上翻页、数值更改时用于数据位的移位操作 Page up, it is also used for data digit shift operation when the value is changed
🡐	进入参数修改模式、参数修改确认，长按3秒 Enter parameter modification mode, parameter modification confirmation, please press it for 3 seconds

每次上电后显示当前版本号，3 秒后显示当前状态（待机运转速度 0，有故障时显示故障代码）。
进入工作模式时，显示当前电机转速（转/分钟），当电机反转时,数码管显示值最左边位闪烁；
When it is powered on, the current version number is displayed. After 3 seconds, it displays the current driver status (standby operation speed is 0, and a fault code is displayed when there is a fault).
When entering the work mode, it displays the current motor speed (rev / min) . When the motor rotates counterclockwise, the leftmost digit (highest digit) of the displayed value flashes.

参数功能说明(Parameter function description)

待机状态下，长按 “🡐” 键3秒进入P参数设置，默认显示P001，按 “🡓” 、 “🡑” 键翻页选择需要更改的参数类型。
例如，更改细分数值，在P001状态下，再次按一下 “🡐” 键，显示当前细分值，长按 “🡐” 键3秒后进入修改状态，此时当前细分数值闪烁，通过 “🡓” 、 “🡑” 键翻页选择细分值，长按 “🡐” 键 3 秒确认，数值停止闪烁，更改完成，按 “⮌” 键返回。
In standby state, press and hold the “🡐” key for 3 seconds to enter the P parameter setting. The default display is P001, press the “🡓” .“🡑” keys to select the parameter type to be changed.For example, to change the microstep value, in the P001 state, press the “🡐” key again to display the current microstep value, press and hold the “🡐” key for 3 seconds to enter the modification state. At this time, the current microstep value flashes, press the “🡓” “🡑” keys to select the desired microstep value, press and hold the “🡐” key for 3 seconds to confirm, the value stops flashing, the modification is completed, and press “⮌”key to return.

参数号 Parameter number	名称 Name	数值范围 Value range	说明 Description	默认值 Default value
P000	控制参数 Control parameter		设定特定值将对应特定功能，详见P000设置说明 Setting a specific value will correspond to a specific function, see P000 setting instructions for details.	0000
P001	细分 Microstep	Set，2-256	16 档通用细分，1档任意电子齿轮 16 channels general microstep,1 channel any electronic gear	10
P002	电机运行方向 Motor running direction	0、1	0：正向 Forward 1：反向 Reverse	0
P003	电机类型 Motor type	42、57	42=42mm 57=57/60mm	42
P004	位置超差限定值 Position deviation limit	1-9999	设置为0时，系统关闭位置超差检测 When it is set to 0, the system closes position deviation detection	4000
P005	锁机电流百分比 Lock current percentage	0～100%	待机状态电流 Standby current	50%
P006	电子齿轮分频分子 Electronic gear frequency division numerator	1-9999	该值不能设为 0 This value cannot be set to 0	1
P007	电子齿轮分频分母 Electronic gear frequency division denominator	1-9999	该值不能设为 0 This value cannot be set to 0	1
P020	输入脉冲数低 4 位 Low 4 digits of input pulses number	~	用于显示外部输入脉冲累计总数，分开查看高低8位 Used to display the cumulative total of external input pulses, and view the high and low 8 digits separately	
P021	输入脉冲数高 4 位 High 4 digits of input pulses number	~		
P100 *	运行电流百分比 Operating current percentage	10-120%		100%
P101	电流环比例系数 Current loop proportional coefficient	1-1000	出厂设置，禁止修改 Factory setting,modification prohibited	
P102	电流环积分系数 Current loop integral coefficient	1-1000	出厂设置，禁止修改 Factory setting,modification prohibited	
P103	电流环阻尼系数 Current loop damping coefficient	1-1000	出厂设置，禁止修改 Factory setting,modification prohibited	
P104 *	速度环比例系数 Speed loop proportional coefficient	1-1000	值越大，增益越高，刚性越大。 The larger the value, the higher the gain and the greater the rigidity.	15
P105 *	速度环积分系数 Speed loop integral coefficient	1-1000	值越小，积分速度越快，抵抗偏差越强，刚性越大，但太小容易超调。 The smaller the value, the faster the integration speed, the stronger the resistance deviation, the greater the rigidity. But if the value is too small, it is easy to overshoot.	
P106 *	位置环比例系数 Position loop proportional coefficient	1-1000	值越小，增益越高，刚性越大，位置跟踪越快。但数值太小可能会引起电机振荡或超调 The smaller the value, the higher the gain, the greater the rigidity, and the faster the position tracking. But if the value is too small, it may cause the motor to oscillate or overshoot.	15
P107 *	速度环前馈系数 Speed loop feedforward coefficient	1-100	值越大，响应外部脉冲速度越快，刚性越大，最大值为100 The larger the value, the faster the response to external pulses and the greater the rigidity. The maximum value is100.	

参数号 Parameter number	名称 Name	数值范围 Value range	说明 Description	默认值 Default value
P108 *	驱动器内部使能 Driver internal enable	0、1		
P109 *	速度环阻尼系数 Speed loop damping coefficient	1-100		
P110	输入输出电平设置 Input and output level setting	0/1	详见P110设置表 See P110 setting table for details.	
P111*	定位精度 Positioning accuracy	1-50	定位误差为± 脉冲数。数值越大，定位误差越大；负载过重时数值大，可以抑制共振。 The positioning error is ±the number of pulses. The larger the value, the greater the positioning error; when the load is too heavy, the value is large, which can suppress resonance.	1
P112 *	共振系数 Resonance coefficient	1-12	默认值为6，相同刚性下，数值越小定位时间越短，但容易发生共振；数值越大定位时间越长，不易发生共振。 The default value is 6. Under the same rigidity, the smaller the value, the shorter the positioning time, but resonance is easy to occur;the larger the value, the longer the positioning time, the less prone to resonance.	6
P200	运行模式选择 Operating mode selection	0、1、2	0:全闭环位置模式 Fully closed loop position mode 1:速度模式 Speed mode PU和DR接+5~+24V高电平PU=CW， DR=CCW，（也可通过修改P002值改变电机运行方向）； Connect PU and DR to +5~+24V high level PU = CW, DR = CCW, (the motor running direction can also be changed by modifying the value of P002) 2:功角闭环位置模式 Power angle closed loop position mode （详见下页说明）(see the description on the next page for details)	0
P201	速度设定 Speed setting	1-3000	速度模式下电机转速（RPM） Motor speed in speed mode(RPM)	60RPM
P202	加减速时间 Acceleration and deceleration time	1-9999	速度模式下加减速时间(ms) Acceleration and deceleration time in speed mode(ms)	100ms
P203	刹车延时释放 Brake delayed release	0-9999	详见下页P203设置 See P203 settings on the next page for details	0
P204	报警后控制模式 Control mode after alarm	0、1、2	详见下页P204设置 See P204 settings on the next page for details	0

注意:出厂默认的电流环参数，速度环参数，位置环参数为配套电机最佳参数,一般不需要修改,如应用环境特殊可以在专业人员指导下修改带* 参数 。
Note: The factory default current loop parameters, speed loop parameters, and position loop parameters are the best parameters for the supporting motor, and generally do not need to be modified. If the application environment is special, the parameters with * can be modified under the guidance of professionals.

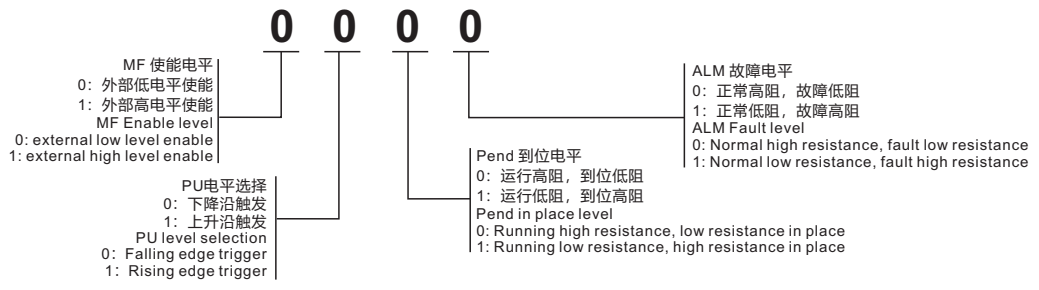
P000参数说明(P000 parameter description)

P000 为控制参数，设定特定值将对应特定功能，驱动器上电参数默认为“0000”，下表列出设定特定数值对应的功能。
P000 is the control parameter. Setting a specific value will correspond to a specific function.The driver power-on parameter defaults to "0000". The following table lists the functions corresponding to setting a specific value.

P000 参数设定值 P000 Parameter setting	功能说明 Function description
“1111”	驱动器恢复出厂设置 Driver factory reset
“0101”	显示电机实时速度 Display real-time motor speed
“0102”	实时显示驱动器内部直流母线电压 Real-time display of the internal DC bus voltage of the driver
“0103”	实时显示驱动器内部温度值 Real-time display of the internal temperature value of the driver
“0104”	实时显示位置误差 Real-time display of position error
“0105”	查询驱动器生产日期 Check the driver production date
“0106”	查看驱动器历史故障，1 号为最新故障 View historical faults of the driver, No.1 is the latest fault
“0200”	驱动器进入自测模式，默认速度60 转/分钟，“↓”、“↑”键可以减、增速度，速度范围-300～+300 转/分钟，实时显示电机转速，“⮌”键取消测试模式。 The driver enters self-test mode, the default speed is 60 rpm. The " ↓ " and " ↑ " keys can decrease or increase the speed, the speed range is -300 ~ +300rpm.The motor speed is displayed in real time, and the " ⮌" key can cancel the test mode

P110参数说明(P110 parameter description)

P110 为输入输出IO口电平设置，默认值“0000”
P110 is the input and output IO port level setting,the default value is "0000"



P203参数说明(P203 parameter description)

使用刹车电机时，刹车信号由ALM报警输出引脚来控制，P203控制刹车释放延时。
When the brake motor is used, the brake signal is controlled by the ALM alarm output pin, and P203 controls the brake release delay.

参数 parameter	参数值 Parameter value	参数说明 parameter description
P203	0	ALM引脚仅定义为报警输出（不接刹车） The ALM pin is only defined as an alarm output (no brake).
	200	ALM引脚接刹车信号，驱动器PWM输出正常以后，再释放刹车。延时设定数值，再响应外部脉冲。（200代表：200Ms） The ALM pin is connected to the brake signal, and the brake is released after the driver's PWM output is normal. Delay the set value, and then respond to the external pulse.(200 means: 200Ms)

P204参数说明(P204 parameter description)

驱动器报警后控制模式设置，默认值为0，说明如下：
The control mode setting after the driver alarms, the default value is 0, the description is as follows:

参数 parameter	参数值 Parameter value	参数说明 parameter description
P204	0	默认值，报警以后，驱动器关闭PWM输出，不对电机进行控制 The default value, after the alarm, the driver turns off the PWM output and does not control the motor.
	1	驱动器报警以后，以恒定电流输出PWM控制电机，3S以后电流开始逐步减小，0.3S后停止PWM输出。防止报警时工件由于惯性撞击到设备。 After the driver alarms, it outputs PWM with constant current to control the motor. After 3 seconds, the current starts to gradually decrease, and 0.3 second later, the PWM output is stopped to prevent the workpiece from hitting the equipment due to inertia when the alarm is alarmed.
	2	驱动器报警以后，以恒定电流输出PWM控制电机，3S以后系统清除故障，重启。清除2次以后，若仍有故障将不再重启。 After the driver alarms, it outputs PWM with constant current to control the motor. After 3 seconds, the system clears the fault and restarts. After clearing twice, if there are still faults, it will not restart.

故障代码表(Fault code table)

发生故障报警时，显示相应故障代码，若多个故障报警时，将轮流闪烁相应故障代码
When a fault alarm occurs, the corresponding fault code is displayed. If multiple fault alarms occur, the corresponding fault code will flash in turn.

报警代码 Alarm code	报警名称 Alarm name	报警内容 Alarm content
Er 01	过流 Overcurrent	电机电流过大 The motor current is too high
Er 02	超速 Overspeeding	电机速度超过最大限制值(最大3000 转/分钟) The motor speed exceeds the maximum limit(maximum 3000 rpm)
Er 03	位置超差 Position deviation	位置偏差计数器的数值超过设定值，设置为0时，系统关闭位置超差检测 The value of the position deviation counter exceeds the set value, When it is set to 0, the system closes position deviation detection
Er 04	驱动器过热 Driver overheating	驱动器温度超过设定值（最高 80℃） Driver temperature exceeds the set value(up to 80 ° C)
Er 05	过压 Overvoltage	电源电压过高 The power supply voltage is too high
Er 06	EPROM 错误 EPROM error	EPROM 读写时错误 EPROM error when reading and writing
Er 07	编码器故障 Encoder fault	编码器接线错误或断线 Encoder wiring error or leads broken
Er 08	电机故障 Motor fault	电机接线错误或断线 Motor wiring error or leads broken

功角闭环模式(Power angle closed loop position mode)

P200设置为"2"时，驱动器运行功角闭环模式。在该模式如下参数有差异。
When P200 is set to "2", the driver operates in power angle closed loop position mode. The following parameters are different in this mode.

参数号 Parameter number	名称 Name	说明 Description
P104	速度环比例系数 Speed loop proportional coefficient	默认值为10，数值越大，位置环响应速度慢，刚性越弱。 The default value is 10. The larger the value, the slower the response speed of the position loop and the weaker the rigidity.
P105	速度环积分系数 Speed loop integral coefficient	功角闭环模式时，该参数未使用。 In power angle closed loop position mode, this parameter is not used.
P106	位置环比例系数 Position loop proportional coefficient	默认值为25，数值越大，位置环响应速度慢，刚性越弱。 The default value is 25. The larger the value, the slower the response speed of the position loop and the weaker the rigidity.
P107	速度环前馈系数 Speed loop feedforward coefficient	功角闭环模式时，该参数未使用。 In power angle closed loop position mode, this parameter is not used.

全闭环模式、功角闭环模式，P104、P105、P106、P107使用相同的参数标号，参数分开存储，模式切换互相不受影响。恢复默认参数都会被恢复出厂值
In full closed loop position mode and power angle closed loop position mode, P104, P105, P106, P107 use the same parameter label, the parameters are stored separately, and the mode switching will not affect each other. Restore default parameters will be restored to factory values.