

## The adjustment instructions of the control parameters of the Fardriver controller

Due to the wide variety of motors on the market, different motors have different working parameters.

### 1 Basic parameters:

**1.1 Maximum phase current:** the maximum phase line current of the working motor. Determines the maximum torque of the motor output from the standstill to the rated speed.

The maximum phase current has a maximum limit on the controller hardware, and the set value is not allowed to exceed the factory setting. Otherwise, the probability of the controller being burnt out will increase greatly.

Different types of motors will have different output torque performance under the same maximum phase current setting value. The torque version has a large motor output torque, the balance version has a slightly smaller output, and the speed version has the smallest motor output. A motor with a low constant speed has a large output torque, and a motor with a high constant speed has a small output torque.

**1.2 Maximum line current:** the maximum bus current of the controller's working battery. Determines the maximum power value of the motor output. Controller maximum input power = battery voltage \* maximum line current.

This value determines the maximum output power and thus the maximum speed.

**1.3 Rated voltage:** The maximum number of battery strings for different voltage Nanjing remote drive controllers is as follows:

	Lead-acid batteries	Ternary lithium battery	Lithium iron phosphate battery
48V	4series	13-14series	16 series
60V	5series	17series	20 series
72V	6series	21series	24 series
84V	7series	24series	28 series
96V	8series	28series	32 series
108V	9series	32series	35-36 series

### 1.4 Throttle Threshold:

The handlebars on the market are uneven, and the voltage value of different handles or accelerator pedals will be different.

	Idle voltage	Full hand voltage
Electric motorcycle handlebar	0.8V-0.9V	4.1-4.3V
Central control transfer	0.8V-0.9V	4.5-4.95V
12V Accelerator	0.0V-0.2V	4.6-4.8V

1.4.1 We set the low throttle threshold according to the idle voltage. Taking into account the voltage fluctuation of the steering handle, the low throttle threshold is generally set to be 0.2-0.3V higher than the idle voltage to ensure that the motor

works in an idle state when stopped.

For example, the low-throttle threshold of the electric friction handle will be set to 1.1V, and the low-throttle threshold of the 12V accelerator pedal will be set to 0.5V.

1.4.2 We set the high throttle threshold according to the full-handle voltage. In order to enable the controller to output full power in the full-handle state, we need to make the set value lower than the full-handle voltage. But here you have to pay attention not to set too low. In order to automatically detect whether the electronic throttle is damaged, we set a value 0.6V higher than the high throttle threshold as the alarm limit. Once exceeded, the handlebar is considered to be damaged, and the controller immediately stops the power output to prevent the vehicle from speeding and causing it. Security incident.

So when we set the high-throttle threshold, for example, when the steering wheel of an electric motorcycle is 4.1-4.3V, we will set 3.9V as the high-throttle threshold. For the high throttle threshold of the 12V accelerator pedal, we will set it at 4.3V.

## 2 Constant speed and weak magnetic field:

**2.1 Constant speed: the speed of the motor under the rated voltage, referred to as the rated speed, which is often called constant speed in the electric motorcycle industry.**

This constant speed determines the highest motor speed. Generally, ordinary controllers can drive the maximum speed of the motor to near the constant speed under the rated voltage state.

**2.2 Speed expansion:** The motor speed is pushed to a higher speed than the fixed speed, which is called speed expansion.

**Speed expansion method 1:** increase the working voltage, the higher the voltage, the higher the motor speed.

**Speed expansion method 2:** Do not increase the working voltage, and increase the motor speed through field weakening.

**2.3 Fardriver controller adopts weak magnetic speed expansion:** without changing the battery voltage, it directly increases the motor speed by controlling the current-limiting parameters.

**2.4 Maximum speed, backward speed: Limit the maximum speed of the motor.**

In the electric vehicle market, the maximum speed is generally not limited, but the maximum speed is limited by the following current limiting parameters. After the speed exceeds the fixed speed, it will automatically enter the field weakening state. The more the speed exceeds the fixed speed, the greater the depth of field weakening.

**2.5 Depth of field weakening:**

Depth of field weakening:  $(\text{maximum speed} - \text{fixed speed}) / \text{fixed speed} * 100\%$ .

Generally, the field weakening depth of in-wheel motors can reach 50%.

Some in-wheel motors have a field weakening depth of more than 100%.

**2.6 Current limiting parameter: Adjust the maximum speed by adjusting this parameter.**



视图	参数	标定	保护	限流	控制	通信					
500rpm	30	2000rpm	90	3500rpm	30	5000rpm	30	6500rpm	30	8000rpm	30
1000rpm	100	2500rpm	30	4000rpm	30	5500rpm	30	7000rpm	30	8500rpm	30
1500rpm	30	3000rpm	70	4500rpm	30	6000rpm	30	7500rpm	30	9000rpm	30

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Let me talk about the conversion of 500RPM, 1000RPM, ...8500RPM, 9000RPM in the current limit. These speeds are the speeds of the mid-mounted motor. The corresponding parameter is also the parameter of the central motor. For in-wheel motors, a conversion is required. Usually the number of pole pairs of the in-wheel motor is 16, 20, 24, 28, 30 pairs of poles. Usually the central motor has 4 pairs of poles.

**Pole pair ratio of hub motor and mid-mounted motor**

<b>Number of pole pairs of hub motor</b>	<b>16</b>	<b>20</b>	<b>24</b>	<b>28</b>	<b>30</b>
<b>And mid-mounted motor pole pair ratio</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>7.5</b>

After we obtain the pole pair value of a hub motor, we can set the current limiting parameters according to the speed requirements. For example, the pole pair number of the hub motor is 16, divided by 4 to get the pole pair ratio= $16/4=4$ . Then

- The actual speed of the 16-pole hub motor corresponding to 500RPM is 125RPM.
- The actual speed of the 16-pole hub motor corresponding to 1000RPM is 250RPM.
- The actual speed of the 16-pole hub motor corresponding to 4000RPM is 1000RPM.
- The actual speed of the 16-pole hub motor corresponding to 5000RPM is 1250RPM.
- The actual speed of the 16-pole hub motor corresponding to 5500RPM is 1375RPM.
- The actual speed of the 16-pole hub motor corresponding to 6000RPM is 1500RPM.
- The actual speed of the 16-pole hub motor corresponding to 6500RPM is 1625RPM
- The actual speed of the 16-pole hub motor corresponding to 8000RPM is 2000RPM.

### 2.7 Magnetic field weakening limit: gradually increase current limit parameters

The current limit value we set should be considered according to actual needs. For a motor with a constant speed of 1000RPM, consider the field weakening depth of 50%. The maximum speed is also considered at 1500RPM, and it is hoped that the motor will not work above 1625RPM. Therefore, the current limit value is set to 30% at 6000RPM, and the speed at 6500RPM and above is set to 5%. This ensures that the motor will weaken the field by 50% when it is idling. It will not cause the motor to shake or even burn control due to excessive field weakening.

For many motors, the field weakening depth can reach 100%, and a 1000RPM motor can work at a high speed of 2000RPM. For this kind of motor, in order to exert higher performance, the current limiting coefficient can be continuously expanded. The current limiting parameter within 8000RPM can be set at the normal value above 70, 8500 is set at 30, and 9000RPM is set at 5.

The setting of the current limit value starts from a safe value and gradually increases the speed. It is necessary to ensure that the field weakening cannot be excessive. Once it is found that the idling speed is unstable or even out of the MOE or OVER protection, it indicates that the speed is too high, the field weakening is excessive, and the parameter needs to be changed back.

### 3 Control parameters:

**3.1 Acceleration sensitivity:** Electric vehicles and electric motorcycles have very different requirements for accelerator acceleration.

An electric car is generally an accelerator pedal, while an electric motorcycle is an accelerator lever or a central control.

The response of electric vehicles to the throttle is moderate, while the requirements of electric motorcycles are different. Some customers require lightness, slowness, and stability, and some customers require quick response and trigger.

Acceleration sensitivity refers to the speed of throttle response. This parameter is between 16~224. The higher the number, the more sensitive the accelerator will accelerate.

16 is already very slow. It is generally appropriate to set around 32 on electric vehicles, and rarely exceed 64.

For electric motorcycles, in addition to setting it at 32, many users prefer to respond quickly, so set it at 64, 128. The track race is even set at 224.

### **3.2AN: AN value of the motor body characteristic, the parameter range is 0~16.**

Standard surface mount motor AN=0

Standard I PM motor AN=16.

This parameter setting must conform to the characteristics of the motor.

Hub motor, surface mount mid-mounted motor, AN is not greater than 8.

The AN value of the embedded central motor is not less than 8.

The encoder mid-mounted motor and the automobile permanent magnet synchronous motor matched with FarDriver all adopt AN=16.

All hub motors on the market are surface mount motors, and the AN value is generally set to 0 and not more than 4.

Incorrect setting of AN value will result in low starting efficiency and even MOE/OVER protection.

### **3.3LM: Vehicle motor acceleration matching parameter, this value is used to adjust the smoothness of the motor running on the vehicle.**

The default setting is 22. The value used by most motors and vehicles on the market.

However, there are individual motor types that are poorly matched to the whole vehicle. At low speeds and medium speeds, you will feel obvious resonance and jitter. Adjusting the LM value will improve

Start at 22. If the jitter is accelerated in the low-speed range, reduce the LM. Start to test the effect from 16, 14, 12, 11, 8, and 5. The middle numbers will also work. Generally, it is better to be larger and try not to be too small. If it is too small, the current cannot be controlled, causing MOE/OVER protection and even burning control. Therefore, the LM value after the jitter disappears is the best parameter, so don't adjust it down.

Some motors and the whole vehicle are very smooth when LM=22, but it will cause jitter after changing the size. Therefore, it should be noted that there is no problem when LM=22 and this parameter should not be adjusted.

Or after the jitter resonance is found, the LM value is changed from 22 to 16,14. . . Even 5 doesn't have much effect, it means it has nothing to do with this parameter. At this time, you must change it back to the maximum value, such as 22, instead of keeping a random number in the controller.

### **3.4 PID parameters: Start KI, Mid KI, Max KI/Start KP, Mid KP, Max KP.**

The default parameters Start KI=4, Mid KI=8, Max KI=12/Start KP=40, Mid KP=80, Max KP=120.

The greater the motor power and the higher the voltage, the smaller the PID. PID parameters cannot be filled in casually, otherwise it will cause abnormal operation or even burn control. The following are the commonly used PID setting parameter values. There are 9 sets in total. Choose one set of parameters to match the motor vehicle and modify it under the guidance of professionals.

	StartKI	MidKI	MaxKI	StartKP	MidKP	MaxKP	
1	16	16	24	160	160	240	
2	8	16	24	80	160	240	
3	8	8	12	80	80	120	
4	4	8	12	40	80	120	Medium power default
5	4	4	6	40	40	60	
6	2	4	6	20	40	60	High power default
7	2	2	3	20	20	30	
8	1	2	3	10	20	30	
9	1	1	1	10	10	10	Surfboard default

Note: That improper PID parameter settings will cause the system to work abnormally, or even MOE\OVER\PHASE failures, etc., too large a difference will cause burning control, pay special attention

#### 4 Three-speed, electronic brake, power display, undervoltage protection parameters:

##### 4.1 Three-speed control: high-speed gear, middle-speed gear, and low-speed gear.

The current ratio is adjusted by 4 parameters.



High-speed gear: D is displayed on the mobile phone APP/computer. The power is fully open, working at the **maximum line current and maximum phase current**.

Mid-speed gear: DM is displayed on the mobile APP/computer. When the power is turned on, the phase current affects the starting acceleration, and the line current affects the maximum speed. Generally, the ratio of the medium-speed phase current is 75% of the maximum phase current, and the ratio of the medium-speed line current is 50% of the maximum line current.

Low-speed gear: DL is displayed on the mobile phone APP/computer. When the power is turned on, the phase current affects the starting acceleration, and the line current affects the maximum speed. Generally, the low-speed phase current ratio is 50% of the maximum phase current, and the low-speed line current ratio is 25% of the maximum line current.

**4.2 The electronic brake is controlled by two parameters: stop reflux, maximum reflux: charging current limit during reverse charging.**



For the electronic brake function, when braking, the vehicle will give a braking signal to the controller. After the controller detects the braking signal, it will perform electronic braking with the current that stops the return flow, and the braking current does not exceed the maximum return value.

Note that when you want to use the electronic brake function, you must **select the electronic brake in the follow item to enable this function**. And set the return current. Note that when setting parameters, the maximum reflux is generally 25%~50% larger than the stop reflux.

**4.3 Power factor: 0 power factor, full power factor: calibration power display parameters.**

The controller itself can estimate the battery power, and a more accurate power display can be obtained by adjusting the zero power factor and the full power factor.

When the battery is full, adjust the full power factor so that the display capacity is exactly 100%.

When the battery power is dead, adjust the zero power factor to make the displayed capacity and power basically match. For example, when there is 10% power remaining, adjust the zero power factor so that the power display is exactly 10%.

**4.4 Under-voltage protection: protection measures to extend battery life when power is lacking.**

When the battery voltage is close to the undervoltage protection point, the controller reduces the power output so that the battery will not be damaged due to excessive discharge. The general battery undervoltage setting is as follows:

Rated voltage	48V	60V	72V	84V	96V	108V
Undervoltage protection point	42V	52.5V	63V	73.5V	84V	94.5V

(to be continued)