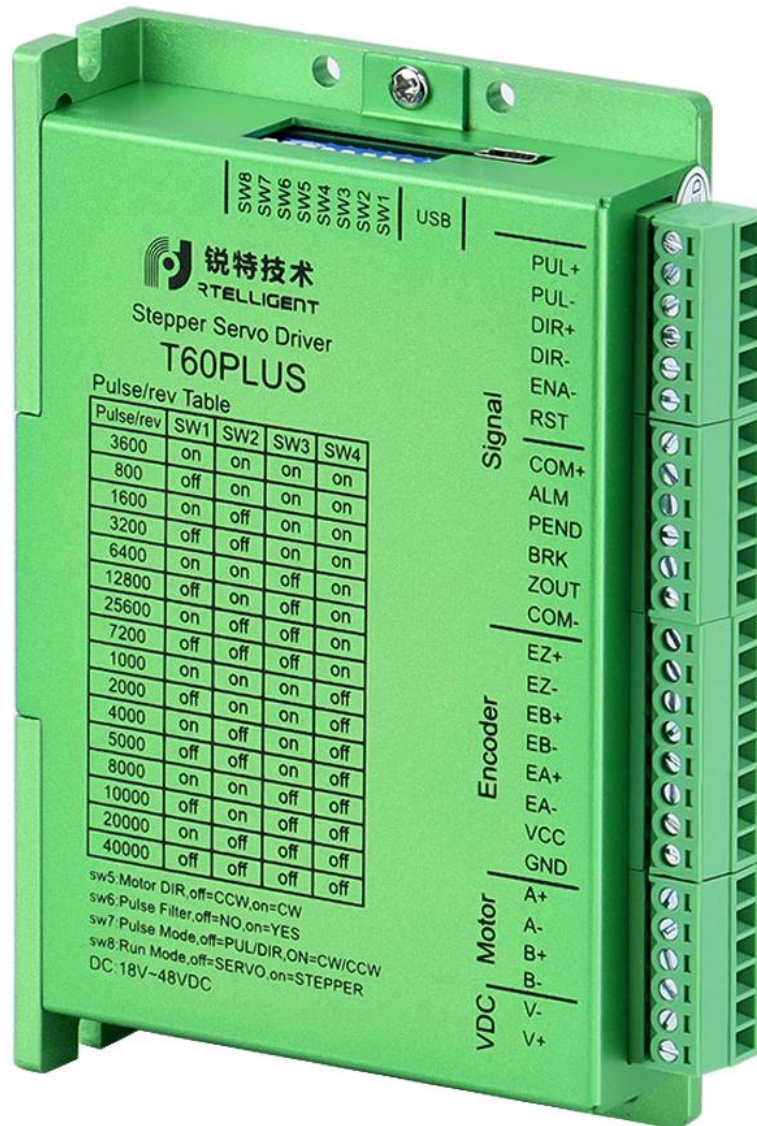# T60PLUS V3.0

# User Manual

# 1. Product Overview

Stepper servo is a stepper servo scheme with high-speed, high-torque, high-precision, low vibration, low-heat and no step loss, which is based on the ordinary open-loop stepper motor and combined with position feedback and servo algorithm. T series stepper servo drive is designed by using Field Oriented Control (FOC) and vector weakening control algorithm in servo drive, which has all-round performance beyond ordinary stepper.

◆ Built-in PID parameter adjustment function, so that the motor can better meet the application of different types of loads.

◆ The built-in field weakening control algorithm weakens the magnetic field characteristics of the motor at high speed and maintains the power.

◆ Built-in current vector control function, so that the motor has servo current characteristics and low heat generation.

◆ Built-in micro-step instruction algorithm to keep the motor stable and low vibration when running at various speeds.

◆ Built-in encoder feedback with 4000 pulse resolution improves positioning accuracy without losing steps.

In short, the servo control scheme combined with the characteristics of the stepper motor enables the T series stepper servo drive to better exert the performance of the stepper motor, can replace the servo application of the same power, and is a new choice for the best cost-effective automation equipment.

T60PLUS V3.0 drive can set subdivision and other parameters through DIP switch and debugging software. It has protection functions such as voltage, current and position. It adds alarm output interface, and its input and output signals adopt photoelectric isolation.

| | |
|---|---|
| Power supply | 18~48VDC |
| Control precision | 4000 Pulse/r |
| Pulse mode | Direction&pulse, CW/CCW double pulse, A/B quadrature pulse |
| Current control | Servo vector control algorithm |
| Subdivision setting | DIP switch setting, 15 options (or debugging software setting) |
| Speed range | Conventional 1200~1500rpm, up to 4000rpm |
| Resonance suppression | Automatic calculation of resonance point to suppress mid-frequency vibration |
| PID parameter adjustment | Debugging software to adjust motor PID characteristics |
| Pulse filter | 2MHz digital signal filter |
| Alarm output | Alarm output for overcurrent, overvoltage, position error, etc. |

We hope that our excellent performance products can help you complete the motion control project excellently. Please read this technical manual before using this product.

# 2. Application Environment & Installation

## 2.1. Application Environment Requirements

| Item | T60PLUS V3.0 |
|---|---|
| Installation environment | Avoid dust, oil, corrosive environment |
| Vibration | 0.5G (4.9m/s2) Max |
| Operating temperature / humidity | 0℃ ~ 45℃ / below 90%RH (no condensation) |
| Storage and transportation temperature | -10 ℃ ~ 70 ℃ |
| Cooling method | Natural cooling / keep away from heat source |
| Waterproof class | IP54 |

## 2.2. Installation Dimension



Front

Side
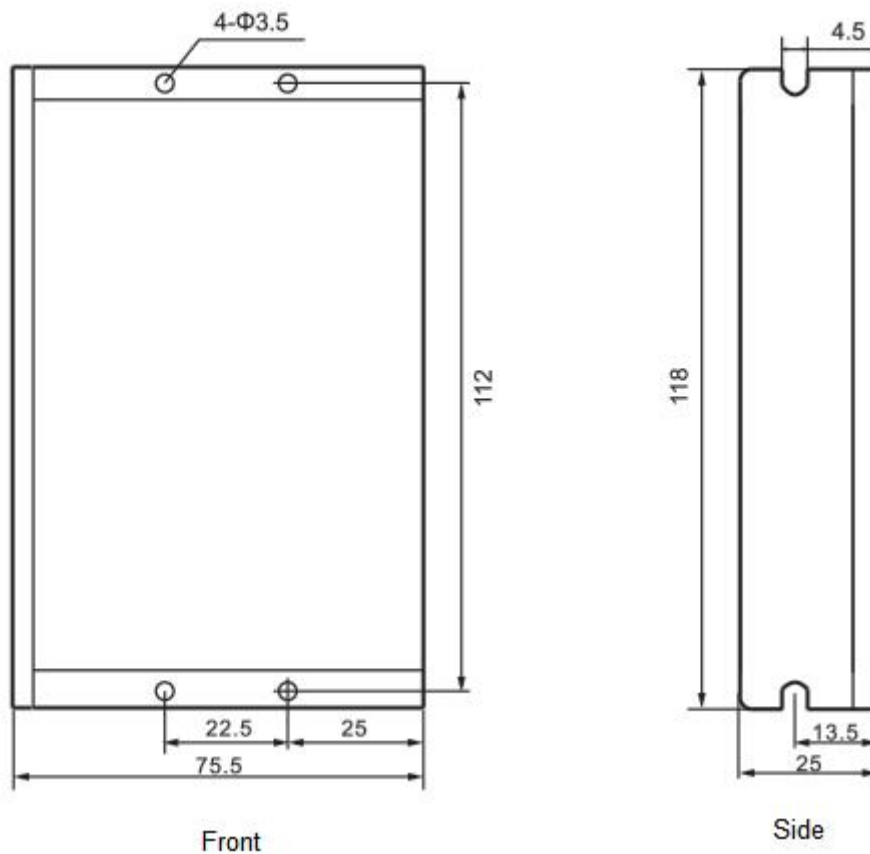
# 3. Drive Interface & Connection

## 3.1.   Interface Function Description

| Function | Grade | Definition | Remarks |
|---|---|---|---|
| Power supply | V+ | Input to the positive pole of the DC power supply | DC 18~48V |
| | V- | Input to the negative pole of the DC power supply | |
| Motor | B- | Negative terminal of phase B winding | Black |
| | B+ | Positive terminal of phase B winding | Green |
| | A- | Negative terminal of phase A winding | Blue |
| | A+ | Positive terminal of phase A winding | Red |
| Encoder | GND | Encoder working power 5V ground terminal | Blue |
| | VCC | Encoder working power 5V positive | Red |
| | EA- | Negative terminal of encoder phase A | White |
| | EA+ | Positive terminal of encoder phase A | Brown |
| | EB- | Negative terminal of encoder phase B | Yellow |
| | EB+ | Positive terminal of encoder phase B | Green |
| | EZ- | Negative terminal of encoder phase Z | Black |
| | EZ+ | Positive terminal of encoder phase Z | Grey |
| Control signal | PUL+ | Pulse input interface | When used for 5V control signal. |
| | PUL- | | |
| | DIR+ | Direction input interface | For 24V control signal, 24V is connected to COM+, pulse and direction are connected to PUL-, DIR- |
| | DIR- | | |
| | ENA+ | Enable control interface | 24V level, the motor can be enabled when it is not connected by default, when it is connected to 0V, the motor will turn off the output |
| | ENA- | | |
| | REST | Reserve | Reserve |
| | COM+ | Control signal 24V common | Control signal 24V common |
| | ALM | Alarm output interface | Optocoupler isolation, open collector output |
| | PEND | In position output | |
| | BRK | Brake control signal output | |
| | Z- | Encoder Z signal single-ended output | |
| | COM- | Output common negative | Control signal 0V common |

## 3.2.　Power supply

The power supply of the drive is DC power, and the input voltage range is between 18V~ 48V.

◆　Note: Do not mistakenly connect the power supply to the NC pin, and do not reversely connect the polarity of the input power!!!

**Power selection reference:**

**Voltage:**

The stepper motor has the characteristic of torque decreasing as the motor speed increases, and the voltage of the input power supply will affect the declining amplitude of the motor torque at high speed. Increasing the voltage of the input power supply appropriately can increase the output torque of the motor at high speed.

Stepper servos have higher revolution speed and torque output than ordinary steppers. Therefore, if the better high-speed performance is wanted, the power supply voltage of the drive is required to increase.

**Current:**

The work of the drive is to convert the input power supply with high voltage and low current to the low voltage and high current at both terminals of the motor winding.In actual application, the appropriate power supply is selected according to the motor mode and the torque of the load.

**The effects of regeneration voltage:**

When the stepper motor is working, it also keeps the characteristics of the generator. At deceleration, the kinetic energy accumulated by the load is converted into electric energy, which will be superimposed on the drive circuit and the input power. In application, attention should be paid to the setting of acceleration and deceleration time to prevent the protection of the drive or power supply.

When the drive is powered off, similarly, the drive LED indicator will be on if the load is increased to allow the motor to move

## 3.3.　Encoder Connection

The T60PLIUS V3.0 encoder is A/B differential output, which is connected in the corresponding order when used.

| EB+ | EB- | EA+ | EA- | VCC | GND |
|------|--------|-------|-------|-----|------|
| Green | Yellow | Brown | White | Red | Blue |

◆　Rtelligent also provides a certain length of special cables for encoders. Please purchase the extension cables of different lengths according to the installation needs.

## 3.4. Motor Connection

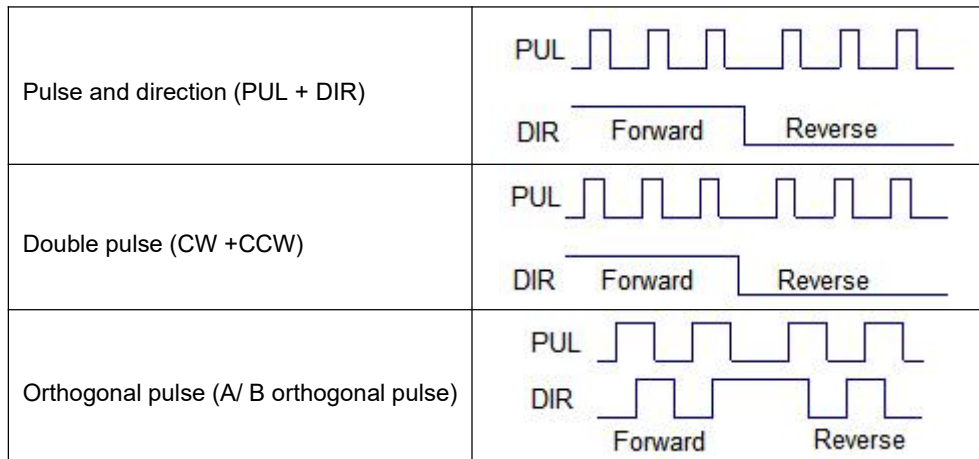| | Nema 23/24 motor |
|---|---|
| A+ | Red |
| A- | Blue |
| B+ | Green |
| B- | Black |
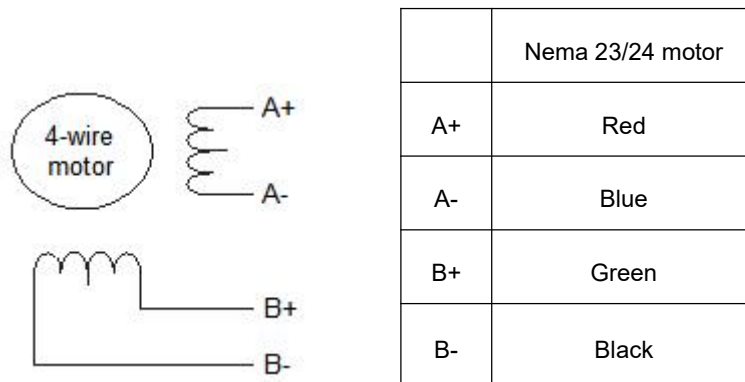
◆ The matching motor of the T60PLUS drive is the corresponding T series stepper servo motor, and its corresponding motor connection order is fixed and unique.

## 3.5. Control Signal Connection

### 3.5.1. PUL, DIR Port: Connection for Pulse Command

The signal interface of standard T series drive is pulse-shaped, and the T60PLUS V3.0 can receive three types of pulse command signals.

The upper controller can be the pulse signal generating device, such as PLC, MCU, control card and controller.

| Pulse and direction (PUL + DIR) | PUL ___ DIR Forward Reverse |
|---|---|
| Double pulse (CW +CCW) | PUL ___ DIR Forward Reverse |
| Orthogonal pulse (A/ B orthogonal pulse) | PUL DIR Forward Reverse |

### 3.5.2. ENA Port: Enable/Disable

When the default optocoupler is off, the drive outputs the current to the motor. When the internal optocoupler is on, the drive will cut off the current of each phase of the motor so that the motor is in a free state, and the stepper pulse can not be responded.

When the motor is in the wrong state, the port enables automatic disconnection. The level logic of the enable signal can be set to the opposite.

### 3.5.3. ALM Port: Alarm Output

The ALM port is used to output the drive operating status to the external control circuit. ALM outputs different optocoupler levels respectively when the drive is in wrong state and normal operation state.

### 3.5.4. PEND: In Position Output

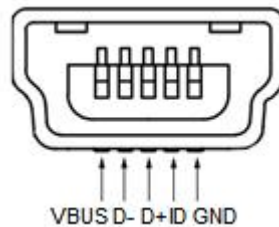The PEND port is used to indicate whether the motor is within the set accuracy.

### 3.5.5. BRK Port: Brake Signal

Open collector output, control relay, and then control brake.
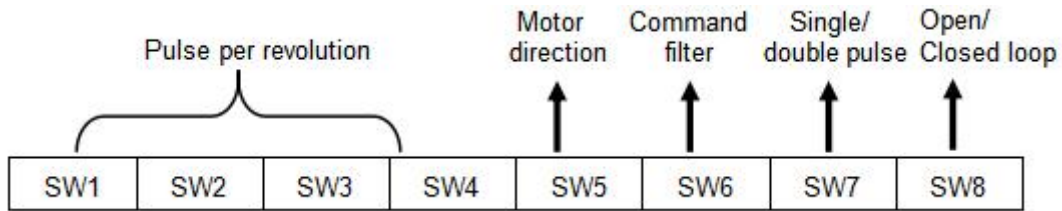
### 3.5.6. Z Signal Output

The encoder Z signal is photoelectrically isolated and output by the collector.

### 3.5.7. USB Serial Port



The USB is a Mini-USB connection port, and a USB drive needs to be installed.

# 4. DIP Switch & Operation Parameter Setting



## 4.1. Pulse per Revolution Setting

| Pulse/rev | SW1 | SW2 | SW3 | SW4 | Remarks |
|---|---|---|---|---|---|
| 3600 | on | on | on | on | |
| 800 | off | on | on | on | |
| 1600 | on | off | on | on | |
| 3200 | off | off | on | on | |
| 6400 | on | on | off | on | |
| 12800 | off | on | off | on | |
| 25600 | on | off | off | on | The DIP switch is turned to the 3600 |
| 51200 | off | off | off | on | state and the debugging software can |
| 1000 | on | on | on | off | freely change other micro-stepping level |
| 2000 | off | on | on | off | number |
| 4000 | on | off | on | off | |
| 5000 | off | off | on | off | |
| 8000 | on | on | off | off | |
| 10000 | off | on | off | off | |
| 20000 | on | off | off | off | |
| 40000 | off | off | off | off | |

DIP SW1, SW2, SW3, SW4 are used to set the required number of pulses per revolution of the motor.

Motor speed = command pulse frequency / pulse per revolution

Motor stroke = number of command pulses / pulse per revolution

## 4.2. Motor Direction Selection

DIP SW5 is used to set the running direction of the motor under the initial pulse.

The "off" means that the motor direction is counterclockwise when inputting the initial pulse;

The "on" means that the motor direction is clockwise when inputting the initial pulse.

◆ The initial pulse is the testing pulse used when developing the drive software; Please refer to the actual running direction of the motor.

## 4.3. Pulse Filter Function Selection

DIP SW6 is used to set the pulse filter function of drive.

The "off" means the pulse filter function is off;

The "on" means the pulse filter function is on.

◆ The pulse filter function is the filter action by the drive upon the input commands. When the filter function is on, the drive will smoothen the input pulse command to make the acceleration and deceleration of motor softer, but this will also cause certain delay of the pulse command.

◆ Filter time setting: The default time of filtering function is 6.4ms, and the software can change the time below the 25.6ms.

## 4.4. Pulse Mode Selection

DIP SW7 is used to set the drive pulse command mode.

The "off" means pulse + direction (single pulse) mode;

The "on" means double pulse mode.

◆ When you need to set the drive pulse mode to A/B quadrature pulse mode, you need to set the pulse mode check function to A/B quadrature pulse mode in the debugging software and set SW7 to on.

## 4.5. Open/closed Loop Selection

DIP SW8 is used to set the control mode of the drive.

The "off" means the normal closed-loop mode of the input;

The "on" means that the input drive works in open-loop mode and can be used to test the motor.

◆ The above parameters are set for the DIP switch. For other parameters, please refer to application Instructions of debugging software

# 5. Drive Working Status LED Indication

| LED status | | Drive status |
|---|---|---|
| 🟢 | Green indicator is on for long time | Drive not enabled |
| 🟢🟢 | Green indicator is flickering | Drive working normally |
| 🟢🔴 | 1 Green, 1 Red | Drive overcurrent |
| 🟢🔴🔴 | 1 Green, 2 Red | Drive input power overvoltage |
| 🟢🔴🔴🔴 | 1 Green, 3 Red | The internal voltage of the drive is wrong |
| 🟢🔴🔴🔴🔴 | 1 Green, 4 Red | Tracking error exceeds limits |
| 🟢🔴🔴🔴🔴🔴 | 1 Green, 5 Red | Encoder phase error |

# 6. Common Problems & Countermeasures

| Phenomenon | Possible situation | Solution |
|---|---|---|
| The motor does not rotate | The power light does not light up | Check the power supply circuit, normal power supply |
| | The motor locks the shaft but does not rotate | The pulse signal is weak, and the signal current is increased to 7-16mA |
| | Speed is too small | Choose the right segment |
| | Drive is protected | Eliminate the alarm and power on again |
| | Enable signal problem | Pull the enable signal high or not connect |
| | Command pulse is wrong | Check whether the upper computer has pulse output |
| Wrong direction of motor | The motor turns in the opposite direction | Adjust DIP switch SW5 |
| | There is an open circuit in the motor wire | Check if the connection is bad |
| | The motor has only one direction | Wrong pulse mode or damaged DIR port |
| The alarm indicator is on | Wrong connection of motor wire | Check motor wiring |
| | Wrong connection of motor encoder wire | Check the encoder line sequence |
| | The voltage is too high or too low | Check power |
| Position or speed error | Signal is interfered | Eliminate interference, reliable grounding |
| | Command input error | Check the host computer instructions to ensure correct output |
| | Wrong setting of pulse per revolution | Check the status of the DIP switch and connect it |
| | Encoder signal is abnormal | Replace the motor, contact the manufacturer |
| Drive terminal burned out | Short circuit between terminals | Check power supply polarity or external short circuit |
| | Too much internal resistance between terminals | Check whether excessive solder is added to the connection between the wire and the wire to form a tin mass |
| Motor reported out of tolerance | Acceleration and deceleration time is too short | Reduce the command acceleration or increase the filter parameters of the drive |
| | Motor torque is too small | Choose high torque motor |
| | The load is too heavy | Check the load weight and quality, adjust the mechanical structure |
| | Power supply current is too small | Replace with a suitable power supply |