RTELLIGENT

Leading the Way with Intelligent Motion Control

USR2556 User Manual

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Revision History

Date	Version	Description
2024.05.22	V4.0	Version 4 product update
2024.08.03	V4.2	1. Modified the font and size of the entire text 2. Add manual version change record 3. Replacement port diagram for USR2556 4. Added wiring diagram of pulse & direction signals 5. Modified the wiring diagram of the alarm signal

1 Feature

- Low-speed vibration suppression algorithm
- Sensorless stall detection function
- Phase loss alarm function
- Independent 5V, 24V control signal interface
- Three pulse command forms: pulse + direction, double pulse, orthogonal pulse
- Isolated input and output
  - 3 isolated inputs
  - 1 isolated output
- DIP switches – two sets
  - 8 current levels
  - 16 pulse/revolution
  - Standby current
  - Pulse mode, bandwidth, running direction, command filtering and other extended parameters can be set by DIP switches

2 Product Comparison

Table 1 Product comparison

Feature	USR2556
Voltage range	18~50VDC
AC input	Not supported(1)
Current range	1.4~5.6A
Overcurrent self-recovery	Not supported
Debug interface	Serial Port TTL 3.3V
Extension DIP switch	2（SW1~SW8, K1~K8）
Alarm output	1
Pulse command voltage	5V、24V Independent interface
Pulse command form	PUL+DIR，CW+CCW，QEP
Pulse mode setting	DIP setting: PUL+DIR，CW+CCW
Pulse bandwidth setting	DIP setting: 200K、600K
Reverse direction	DIP setting
Stall detection	DIP setting
Phase loss detection	DIP setting
Pulse filtering	DIP setting

(1) The driver does not support AC input, connecting to AC power will damage the drive.

(2) Built-in resettable fuse to maximize the protection of the motor and driver.

(3) Through the debugging interface and debugging software, it can be set.

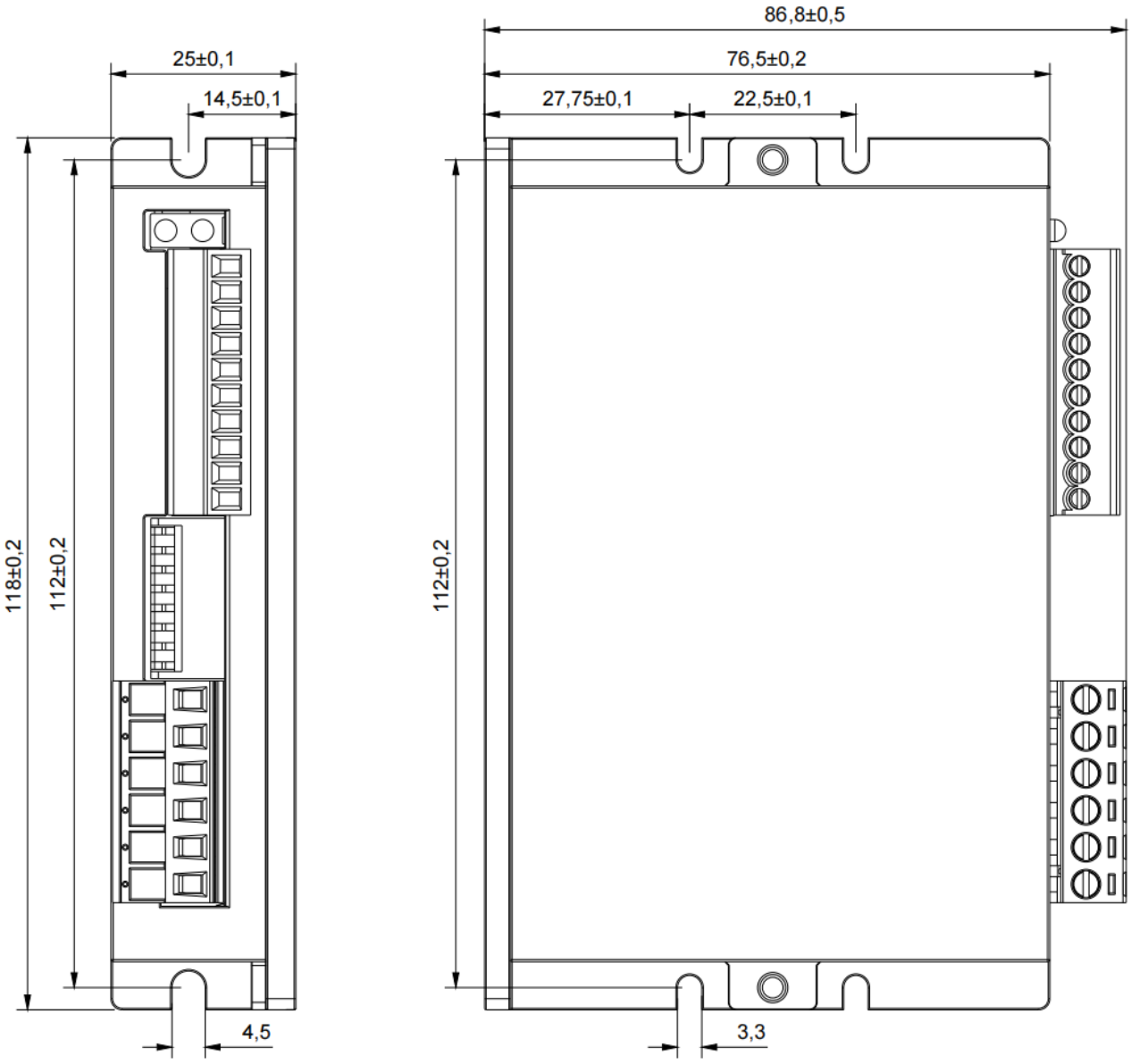
3 Installation

3.1 Installation Requirements

- When installing, please place the driver vertically or horizontally, with the front facing forward and the top facing upward to facilitate heat dissipation.
- During assembly, be careful to prevent drilling shavings and other foreign matter from falling into the driver.
- Please use M3 screws to fix during installation.
- When there is a vibration source near the installation (such as a punching and drilling machine, etc.), please use a vibration absorber or add an anti-vibration rubber gasket
- When multiple drivers are installed in a control cabinet, please note that there must be enough space for adequate heat dissipation. If necessary, a cooling fan can be configured to ensure good heat dissipation conditions in the control cabinet.

3.2 Installation Dimensions

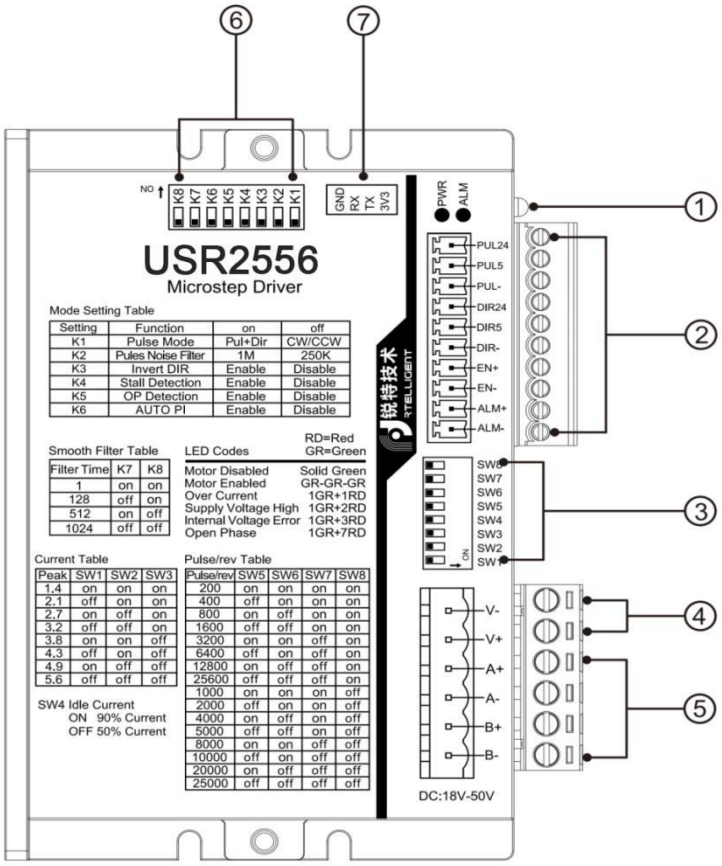
3.2.1 USR2556



4 Port, Wiring & Setting

4.1 Port Function Description

4.1.1 USR2556



Mode Setting Table

Setting	Function	on	off
K1	Pulse Mode	Pul+Dir	CW/CCW
K2	Pules Noise Filter	1M	250K
K3	Invert DIR	Enable	Disable
K4	Stall Detection	Enable	Disable
K5	OP Detection	Enable	Disable
K6	AUTO PI	Enable	Disable

Smooth Filter Table

Filter Time	K7	K8
1	on	on
128	off	on
512	on	off
1024	off	off

LED Codes (RD=Red GR=Green)

Motor Disabled	Solid Green
Motor Enabled	GR-GR-GR
Over Current	1GR+1RD
Supply Voltage High	1GR+2RD
Internal Voltage Error	1GR+3RD
Open Phase	1GR+7RD

Current Table

Peak	SW1	SW2	SW3
1.4	on	on	on
2.1	off	on	on
2.7	on	off	on
3.2	off	off	on
3.8	on	on	off
4.3	off	on	off
4.9	on	off	off
5.6	off	off	off

SW4 Idle Current
ON 90% Current
OFF 50% Current

Pulse/rev Table

Pulse/rev	SW5	SW6	SW7	SW8
200	on	on	on	on
400	off	on	on	on
800	on	off	on	on
1600	off	off	on	on
3200	on	on	off	on
6400	off	on	off	on
12800	on	off	off	on
25600	off	off	off	on
1000	on	on	on	off
2000	off	on	on	off
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
25000	off	off	off	off

Number	Part Name	Description
①	Status indicator	LED lights are used to display the operating status and fault status of the driver
②	Control signal interface	Interface for pulse, direction, enable signal input and alarm signal output
③	Motor operation parameter DIP switch	Used to set current and pulse/revolution parameters
④	Power supply input interface	Input DC voltage 18~50V
⑤	Motor cable interface	Connect A+, A-, B+, B- phases
⑥	Extended parameter DIP switch	Used to set pulse mode, command smoothing and other common extension parameters
⑦	Debug interface	Used to connect to the debugging software for parameter debugging

4.2 Power Supply & Motor

4.2.1 Power Polarity

For USR2556 drivers, please do not connect the input power polarity in reverse! Connect the positive lead of the power supply to the V+ of the drive and the negative lead of the power supply to the V- of the driver.

4.2.2 Power Supply Voltage

The stepper motor has the characteristic that the torque decreases as the motor speed increases, and the input power voltage will affect the magnitude of the motor's high-speed torque decrease. Properly increasing the input power voltage can enhance the torque output of the motor when running at high speed.

- **Pay attention to check the operating voltage range of each driver!**

4.2.3 Regeneration Voltage

When the stepper motor is working, it also retains the characteristics of a generator. When decelerating, the kinetic energy accumulated by the load will be converted into electrical energy through the driver circuit. This part of energy will be superimposed on the driver circuit and input power supply, causing the protection of the driver circuit and power supply.

When setting the motor operation command, pay attention to the setting of the acceleration and deceleration time.

In addition, when the driver is powered off, the driver LED indicator will light up when the load is pulled to make the motor move. This phenomenon is also related to the above reasons.

4.2.4 Power Supply Current

The driver works by converting the input high voltage and low current power into low voltage and high current at both ends of the motor winding. Therefore, the current of the power supply will be lower than the current value output by the driver to the motor.

In actual use, select a suitable power supply based on factors such as motor model and load torque.

4.2.5 Motor Wiring

- Please follow the instructions provided with the motor to make the connections.
- Verify that unused motor leads are not short-circuited to other objects.
- Do not unplug/plug the motor or power cable when powered on.

4.3 Control Signal Wiring

4.3.1 Wiring Requirements

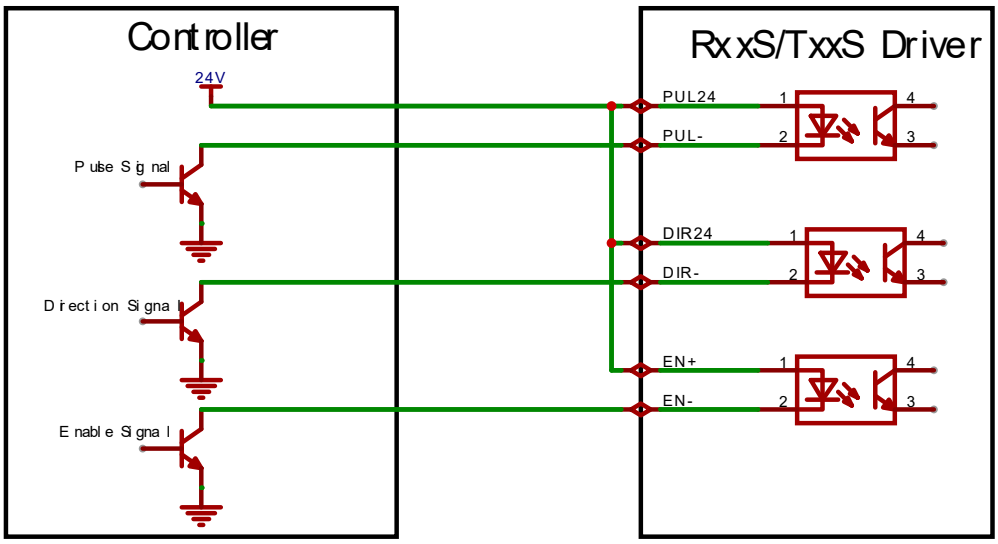
- In order to prevent the driver from being interfered, it is recommended to use shielded cables for control signals, and short-circuit the shielding layer and the ground wire. Except for special requirements, the shielding wire of the control signal cable is grounded at one end: the host computer end of the shielding wire is grounded, and the driver end of the shielding wire is left hanging.
- Only one point of grounding is allowed in the same machine. If it is not a real grounding wire, serious interference may occur. In this case, the shielding layer is not connected.
- The pulse and direction signal cables are not allowed to be wrapped side by side with the motor cables. It is best to separate them by at least 10cm. Otherwise, the motor noise will easily interfere with the pulse direction signals, causing inaccurate motor positioning, system instability and other faults.

4.3.2 Pulse & Direction Signal

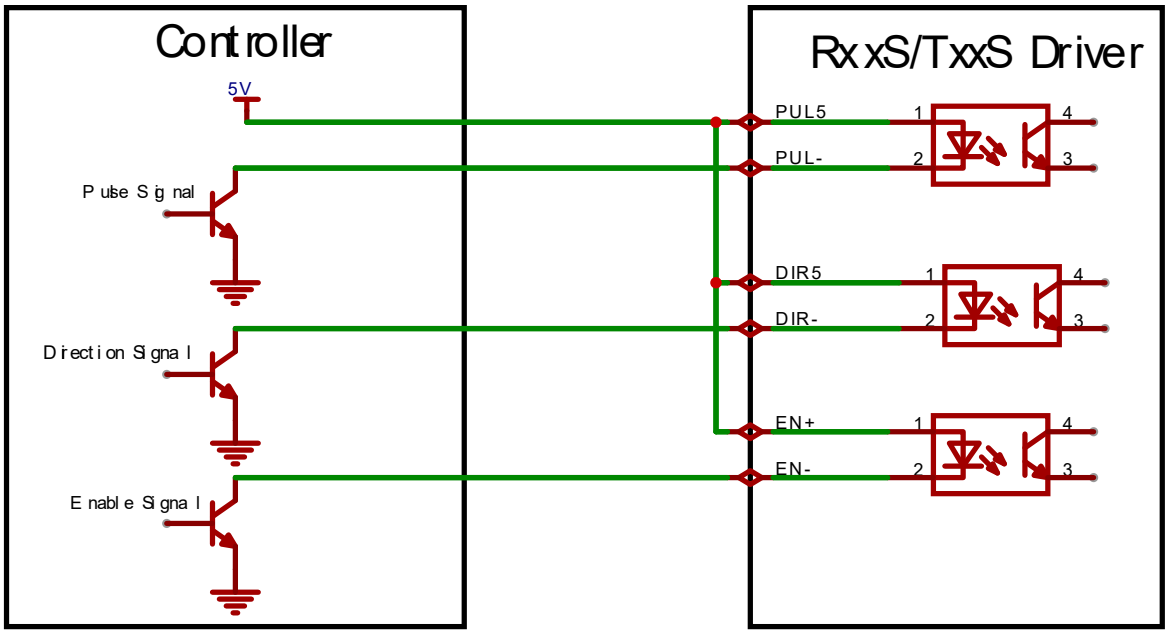
Different from the 5~24V pulse control signal interface circuit or single 5V or single 24V control signal interface used in previous stepper drivers, the USR2556 series drivers use independent 5V and 24V pulse control signal interfaces to match most control systems on the market, while avoiding the trouble of additional current limiting resistors.

When the running direction of the motor is inconsistent with the system design, it can be adjusted by extending the DIP switch K3

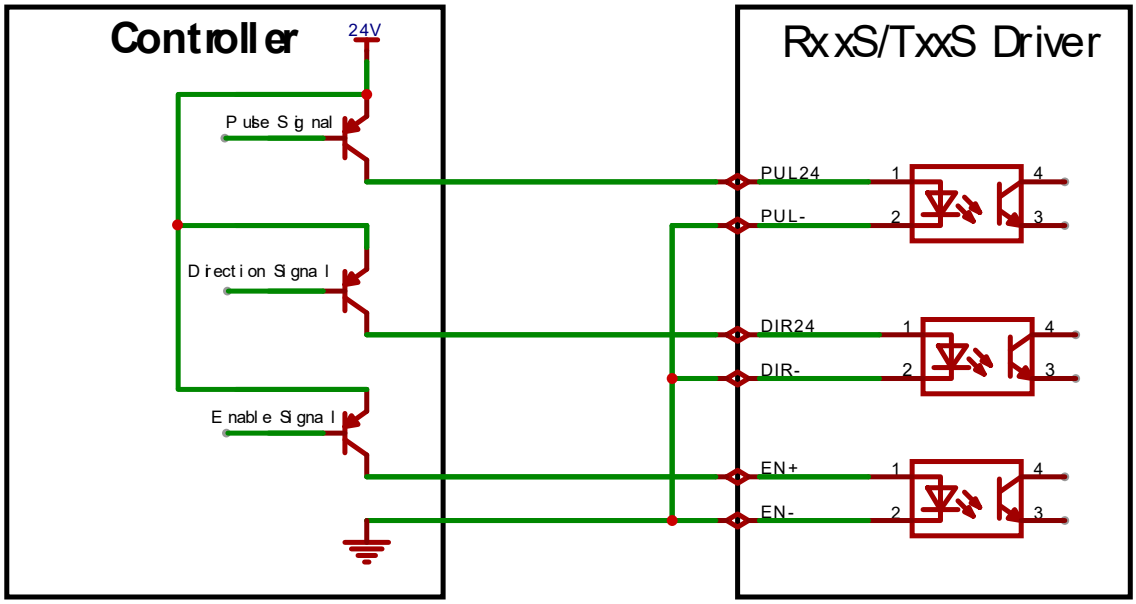
(1) NPN single-ended 24V common anode connection



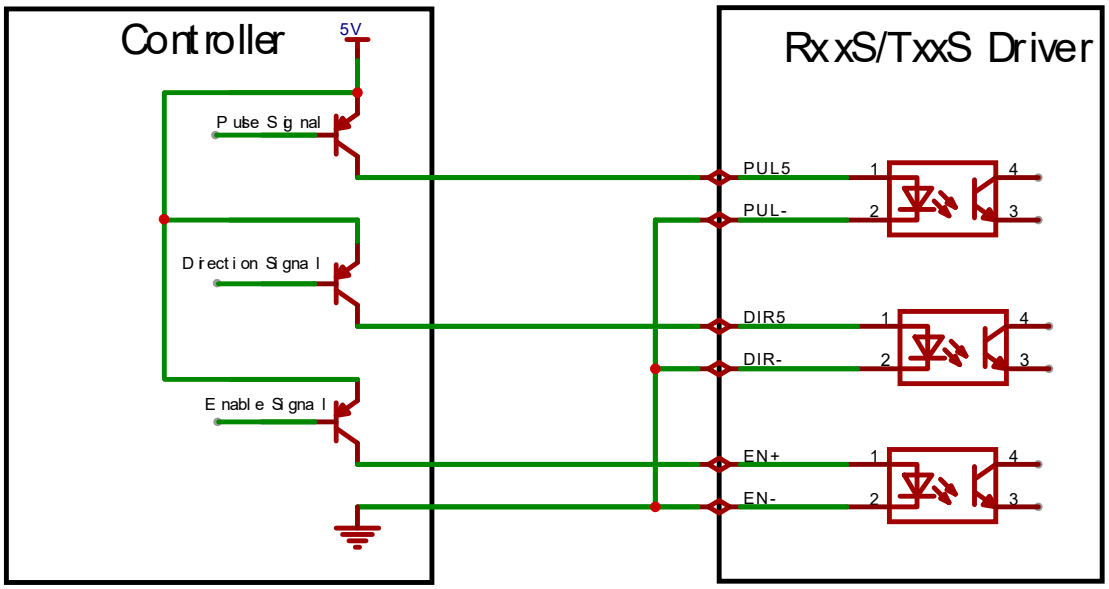
(2) NPN single-ended 5V common anode connection



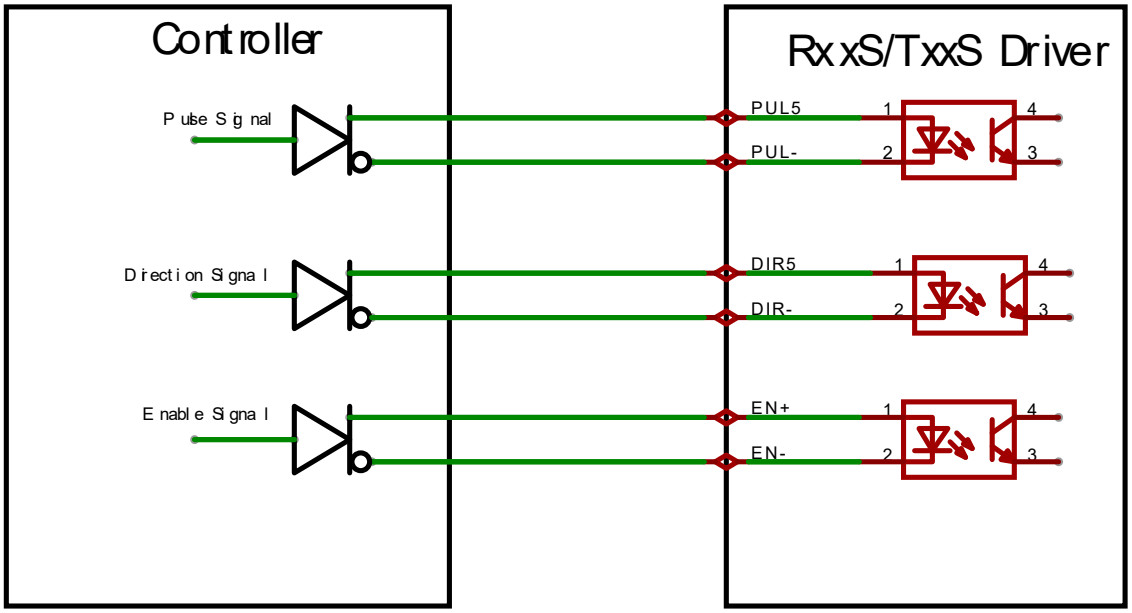
(3) PNP single-ended 24V common cathode connection



(4) PNP single-ended 5V common cathode connection



(5) Differential connection



4.3.3 Enable Signal

USR2556 have this interface.

The EN input enables or shuts down the power section of the driver. The signal input is opto-isolated and can accept 5~24VDC single-ended or differential signals, with the signal up to 28V.

When the EN signal is hanging or at a low level (the optocoupler is not conducting), the driver is in the enabled state and the motor runs normally;

When the EN signal is high (the optocoupler is turned on), the driver power part is turned off and the motor is not excited.

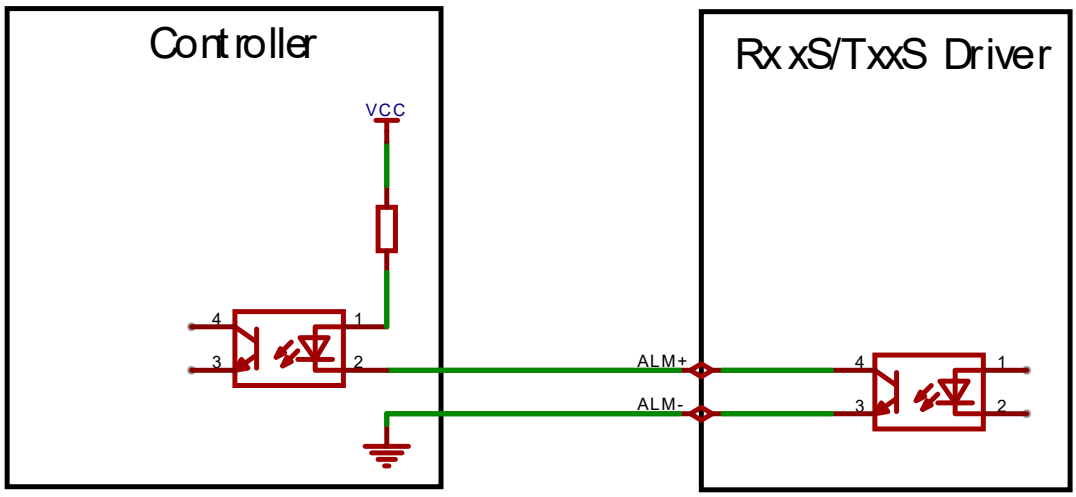
When the motor is in an error state, the EN input can be used to restart the driver. First, eliminate the existing fault from the application system, and then input a falling edge signal to the EN terminal. The driver can restart the power section and excite the motor to run.

4.3.4 Alarm Signal

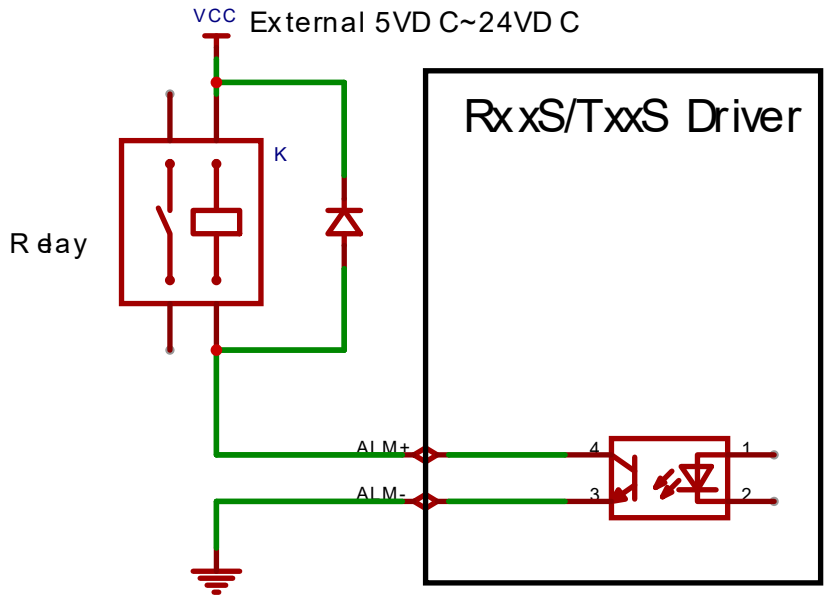
USR2556 have this interface.

The ALM port is a photoelectrically isolated OC output with a maximum withstand voltage of 30VDC and a maximum saturation current of 100mA. When the driver is working normally, the output optocoupler is not conducting.

(1) Optocoupler connection



(2) Relay Connection



4.4 Running Parameters Setting

The USR2556 series driver contains two sets of DIP switches, which are used to set the operating parameters of the stepper motor. SW1~SW8 are used to set the pulse/revolution and current parameters.

SW1	SW	SW3	SW4	SW5	SW6	SW7	SW8
Running current			Idle Current	pulse/revolution			

K1~K8 are used to set common extended parameters

K1	K2	K3	K4	K5	K6	K7	K8
Pulse Mode	Pulse bandwidth	Running direction	Stall detection	Phase loss detection	Automatic tuning	Command smoothing filter	

4.4.1 Current Setting SW1~SW3

The DIP switches SW1, SW2, and SW3 are used to set the current value that the driver outputs to the motor.

Normally, the current is set to the rated current of the motor. If your system has high requirements for heat generation, you can reduce the current appropriately to reduce the heat generation of the motor, but the output torque of the motor will also be reduced. If you do not require the motor to run continuously, you can increase the operating current appropriately to obtain a greater torque, but be careful not to exceed 1.5 times the rated current of the motor.

Factory setting: minimum current.

Running current (peak)/A USR2556	SW1	SW2	SW3
1.4	on	on	on
2.1	off	on	on
2.7	on	off	on
3.2	off	off	on
3.8	on	on	off
4.3	off	on	off
4.9	on	off	off
5.6	off	off	off

4.4.2 Idle Current SW4

The running current of the driver can be automatically reduced when the motor stops. SW4 sets the idle current as a percentage of the operating current.

When a high torque output is required, the 90% setting is most effective. To reduce the heat of the motor and driver, it is recommended to reduce the idle current as much as possible.

SW4=ON: 90% running current

SW4=OFF: 50% running current

4.4.3 Pulse/revolution Setting SW5~SW8

The driver sets the pulse/revolution value through SW5, SW6, SW7 and SW8 DIP switches, with 16 options.

Pulse/revolution USR2556	SW5	SW6	SW7	SW8
200	on	on	on	on
400	off	on	on	on
800	on	off	on	on
1600	off	off	on	on
3200	on	on	off	on
6400	off	on	off	on
12800	on	off	off	on
25600	off	off	off	on
1000	on	on	on	off
2000	off	on	on	off
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
25000	off	off	off	off

4.4.4 Pulse Mode Setting K1

Set DIP switch K1 to select pulse mode. When DIP switch K1 is set to on, it is pulse & direction mode, and when it is set to off, it is dual pulse mode. After changing the pulse mode, please power on the driver again for the setting to take effect.

K1=on: Set to single pulse mode (factory default).

K1=off: Set to double pulse mode.

4.4.5 Stepper Noise Filter K2

The pulse command signal input port has a built-in digital signal filter, and the setting DIP switch K2 sets the filter frequency of the digital signal filter inside the driver.

K2=on: filtering frequency is 1MHz.

K2=off: filtering frequency is 250KHz (factory default).

4.4.6 Running Direction Setting K3

Without changing the stepper motor winding connection and control signal settings, the motor's running direction can be changed by setting K3 to on or off.

he factory default is off.

4.4.7 Stall Detection Enable K4

Stalling means that the stepper motor cannot rotate normally due to external reasons. This situation will cause the stepper motor to overload, even burn out and damage the mechanical parts of the equipment.

The USR2556 series products collect the current feedback of the motor in real-time, estimate the load torque change of the motor through the observer, and then determine whether the motor is blocked. Once the motor is blocked, corresponding protection measures can be taken.

Sensorless technology is used for stall detection. The accuracy of the detection depends on the identification of motor parameters and the correct setting of related observer parameters. The default parameter identification of the driver is usually capable of this task. When misjudgment occurs in actual test applications, users can turn off this function.

K4=on: Enable the stall detection function (factory default).

K4=off: Disable the stall detection function.

When a stall is detected, the driver will stop running even if the controller continues to send commands to the driver, but the motor will remain in full flow state and the shaft will be locked. At the same time, the red alarm indicator will be on and the alarm output port will output an alarm signal. When the user stops sending pulses, the driver will automatically clear the alarm state and respond to subsequent command signals.

4.4.8 Phase Loss Detection Enable K5

Phase loss means that there is an abnormality in the stepper motor winding, such as the motor winding wire is broken.

The USR2556 series products use the current detection circuit to monitor whether the motor winding is normal and feedback the corresponding current to monitor the motor winding status. When a phase loss alarm occurs, the driver shuts down the power output and the motor is in a free state.

In some cases, the phase loss cannot be detected. For example, when the driver is powered on for the first time, the current reference value of the B-phase winding is zero. If the B-phase winding is broken, the current detected by the driver is also zero, and the driver cannot give an alarm signal. If a command is sent to make the motor run for more than 2 full steps, the driver can determine the phase loss state of the B-phase winding.

K5=on: Enable phase loss detection function (factory default).

K5=off: Disable the phase loss detection function.

4.4.9 Auto-tuning Function K6

The USR2556 series driver can automatically identify the driver's voltage and motor winding parameters during the first power-on phase and calculate the appropriate current loop control parameters. In actual applications, different current loop parameters can optimize the motor's noise, vibration and torque performance. When the automatically identified parameters are not suitable, the user can turn off this function and optimize them through the debugging software.

K6=on: Motor power-on auto-tuning function (factory default).

K6=off: Disable the power-on auto-tuning function.

4.4.10 Command Smoothing Filtering K7~8

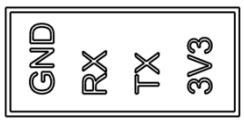
The USR2556 series driver has a built-in mean filter to smooth pulse commands.

Filtering setting	K7	K8
1	on	on
128	off	on
512	on	off
1024	off	off

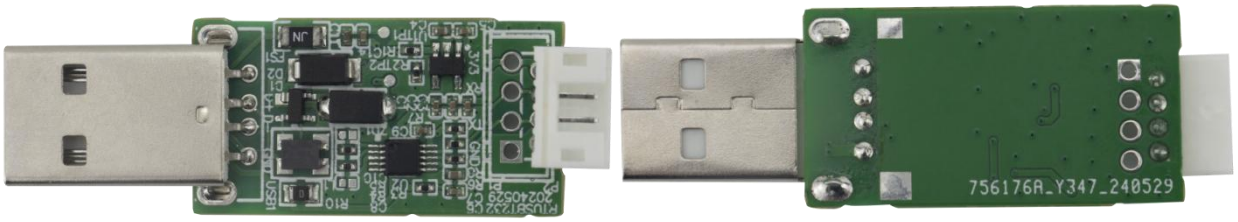
Actual command filtering time = setting value * 50us

4.5 Debugging Interface

The driver is uniformly equipped with a 3.3V level, 4-pin 2.0mm spacing UART communication interface for parameter debugging. Connect to the PC through a common USB to 232 TTL tool, and use the debugging software to set and save some parameters. The interface definition is as follows:

Icon	Marking	Description
	3V3	When the driver is operating normally, this 3V3 port must not provide power to the outside, otherwise it will affect the motor's running performance and reliability.
	TX	Need to connect the RXD port of the value debug cable
	RX	Need to connect the TXD port of the value debug cable
	GND	Need to connect the GND port of the value debugging cable

Common USB to 232 TTL tools are shown below:



◆ Note: Do not unplug or plug the serial port cable when the driver is powered on.

4.6 Status Indicator PWR ALM

he driver uses two LED lights (red---ALM, green---PWR) to display status and errors.

When the motor is in the enabled state, the green indicator light flashes slowly, and when the green light is on, the motor is disabled.

If an error occurs while the red LED is flashing, the error is indicated by a combination of red and green flashing lights, as follows:

Indicator status	Driver Status	Description
Green light flashing	The driver is working properly	---
Green light is on	The driver is not enabled	EN port has high level input
Red light is on	Motor stall	Insufficient current, excessive load, abnormal cable
1 Green, 1 Red	Driver overcurrent	Motor wiring error, poor contact or driver failure
1 Green, 2 Red	Driver input power overvoltage	Supply voltage is too high
1 Green, 3 Red	Driver internal voltage error	Driver failure
1 Green, 7 Red	Phase loss alarm	The motor wire is not connected properly
1 Green, 8 Red	Undervoltage alarm	The supply voltage is too low

5 Common Problems and Solutions

Phenomenon	Possible Situations	Solution
The motor only runs in one direction	Weak direction signal	Check wiring and level
	Wrong level access causes damage to the internal isolation device of the driver	
	Pulse mode mismatch	When the driver is set to PUL+DIR, and the command sent by the controller is CW+CCW mode, the motor runs when the CW direction is jogged, and the motor does not move when the CCW direction is jogged; When the driver is set to CW+CCW and the instruction sent by the controller is PUL+DIR mode, the controller sends forward and reverse instructions, and the motor will move in one direction.
Alarm indicator light on	-	Refer to 4.6 Status Indicator PWR ALM
Driver terminal burnt out	Short circuit between terminals	Check the power polarity or external short circuit
	The internal resistance between terminals is too large	Check whether excessive solder is added to the connection between the wires to form a tin mass.
Motor stall	Acceleration and deceleration time is too short	Reduce command acceleration or increase driver filter parameters
	The motor torque is too small	Choose a high torque motor
	The load is too heavy	Check load weight and quality, adjust mechanical structure
	Too little current	Check the DIP switches and increase the output current of the driver

SUPPORTS

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