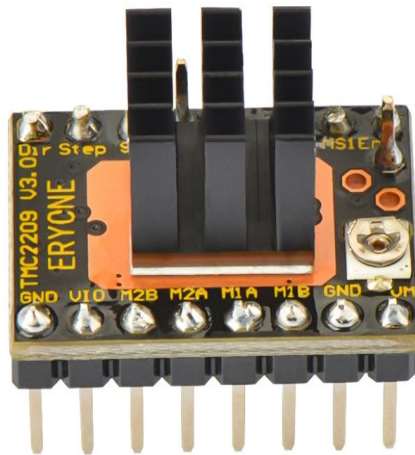


# Eryone TMC2209 V3.0

## User Manual



# Contents:

- 1. Notes . . . . . 2
- 2. Product introduction . . . . . 2
- 3. Product function . . . . . 3
- 4. Product advantages . . . . . 3
- 5. TMC2209V3.0 specification . . . . . 4
- 6. Pin description . . . . . 4
  - 6.1 Pin distribution description . . . . . 4
  - 6.2 Pin function definition . . . . . 5
- 7. TMC2209V3.0 Vref adjustment method . . . . . 6
- 8. Working mode configuration . . . . . 7
  - 8.1 Default mode (step/dir mode)configuration . . . . . 7
  - 8.2 UART mode configuration . . . . . 8
  - 8.3 Description of stealthchop and spreadcycle . . . . . 9
  - 8.4 Sensorless homing configuration . . . . . 10

# 1. Note

- 1) Before installing the driver, be sure to disconnect the power supply to prevent the driver from burning out;
- 2) Please confirm the pin of the driver before installation and insert it into the correct port;
- 3) Do not hotplug the drive module to avoid damage;
- 4) For install the heat sink, please be careful to prevent short circuit;
- 5) When using the driver, be sure to add the heat sink for it.

## 2. Product introduction

- ☐ The TMC2209 V3.0 is an ultra-silent motor driver IC for two phase stepper motors. TMC2209 pinning is compatible to a number of legacy drivers as well as to the TMC2208. TRINAMICs sophisticated StealthChop2 chopper ensures noiseless operation, maximum efficiency and best motor torque.
- ☐ Its fast current regulation and optional combination with SpreadCycle allow highly dynamic motion while adding. StallGuard for sensorless homing.
- ☐ A simple to use UART interface opens up tuning and control options. Store application tuning to OTP memory. Industries' most advanced STEP/DIR
- ☐ Stepper motor driver family upgrades designs to noiseless and most precise operation for cost-effective and highly competitive solutions.
- ☐ Suitable for replace A4988
- ☐ Suitable for replace DRV8825
- ☐ Suitable for replace TMC2100
- ☐ Suitable for replace TMC2208

# 3. Product function

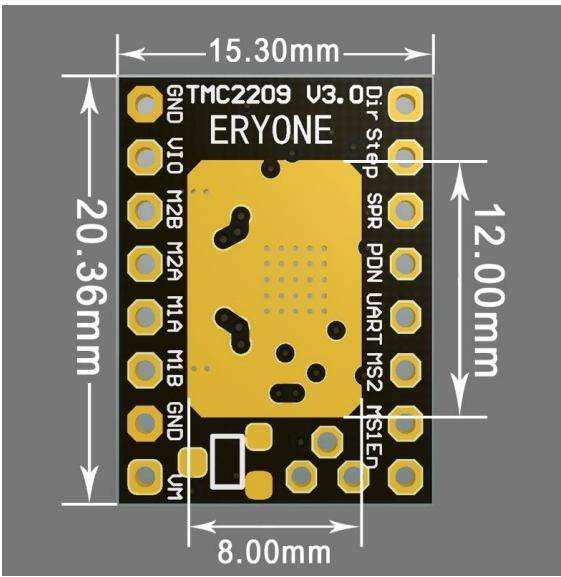
Product Name	Version	Date	Author
TMC2209	V3.0	2019/12/10	Jason.xin

Funtion	Description
StealthChop2™	silent motor operation
StallGuard4™	load and stall detection for StealthChop (sensorless homing)
SpreadCycle™	highly dynamic motor control chopper
CoolStep™	current control for energy savings up to 75%
Voltage Range	4.75... 29V DC
UART mode	for advanced configuration options
Smooth Running	256 microsteps by MicroPlyer™ interpolation
STEP/DIR Interface	with 8, 16, 32 or 64 microstep pin setting
Low Power Standby	to fit standby energy regulations

# 4. Product advantages

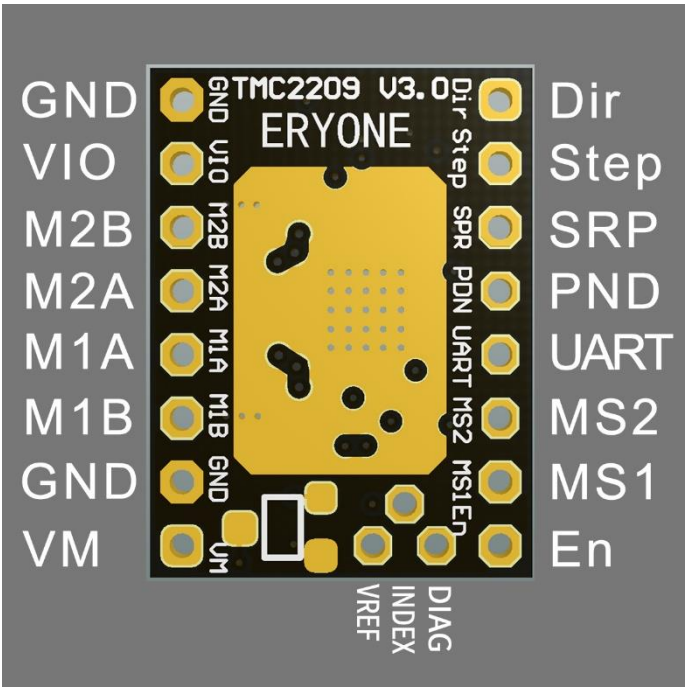
- 1. A lower chance of appearing stepper motor lost steps than TMC2208 and a higher energy consumption ratio means lower heat generation;
- 2. Continuing the advantages of maintaining low noise during TMC2208 operation;
- 3. Support sensorless homing config, which means you can abandon the traditional logic limit switch;
- 4. Supports STEP / DIR and UART modes, which means it is easy to config and use;
- 5. Smart burnout protection function (Protects TMC2209 and motherboard from burnout due to inverse direction plugged, but you need to pay attention that it cannot prevent burnout caused by hotplug)

# 5. TMC2209V3.0 specification



# 6. Pin description

## 6.1 Pin distribution description



# 6.2 Pin function definition

Number	PIN	Function	Number	PIN	Function
1	(EN)	Enable not input. The power stage becomes switched off (all motor outputs floating) when this pin becomes driven to a high level.	9	(VM)	Motor supply voltage. Provide filtering capacity near pin with shortest possible loop to GND pad.
2	(MS1)	Microstep resolution configuration (internal pull-down resistors) MS2, MS1: 00: 1/8, 01: 1/32, 10: 1/64 11: 1/16 For UART based configuration selection of UART Address 0...3	10	(GND)	GND. Connect to GND plane near pin.
3	(MS2)		11	(M1B)	Motor coil B output 1
4	(UART)	UART	12	(M1A)	Motor coil A output 1
5	(PDN)	PDN	13	(M2A)	Motor coil A output 2
6	(SPR)	Chopper mode selection	14	(M2B)	Motor coil B output 2
7	(STEP)	Step input	15	(VCC_IO)	3.3V to 5V IO supply voltage for all digital pins.
8	(DIR)	DIR input (internal pull-down resistor)	16	(GND)	GND. Connect to GND plane near pin.
DIAG		Diagnostic and StallGuard output. Hi level upon stall detection or driver error. Reset error condition by EN=high.			
VREF		Analog reference voltage for current scaling or reference current for use of internal sense resistors (optional mode)			
INDEX		Configurable index output. Provides index pulse.			

# 7. TMC2209V3.0 Vref adjustment method

## Driver current $I_{RMS}$ calculation formula

STANDALONE MODE RMS RUN CURRENT CALCULATION:

$$I_{RMS} = \frac{325mV}{R_{SENSE} + 20m\Omega} * \frac{1}{\sqrt{2}} * \frac{V_{REF}}{2.5V}$$

RMS CURRENT CALCULATION WITH UART CONTROL OPTIONS OR HOLD CURRENT SETTING:

$$I_{RMS} = \frac{CS + 1}{32} * \frac{V_{FS}}{R_{SENSE} + 20m\Omega} * \frac{1}{\sqrt{2}}$$

## Voltage regulation instructions:

Before installation, you need to prepare these kits to adjust the stepper motor driver board.

Here is the list:

- 1) Multimeter
- 2) Slotted screwdriver

Adjustment instructions:

Vref voltage reference range: 0.2 ~ 2.2V

Adjustment method:

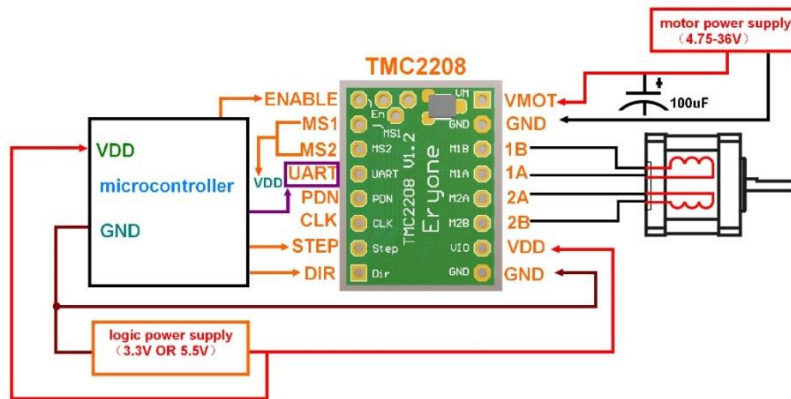
**Turn the potentiometer to reduce the Vref voltage**  
(refer to the picture on the right);

**Turn the potentiometer to increase the Vref voltage**  
(refer to the picture on the right)

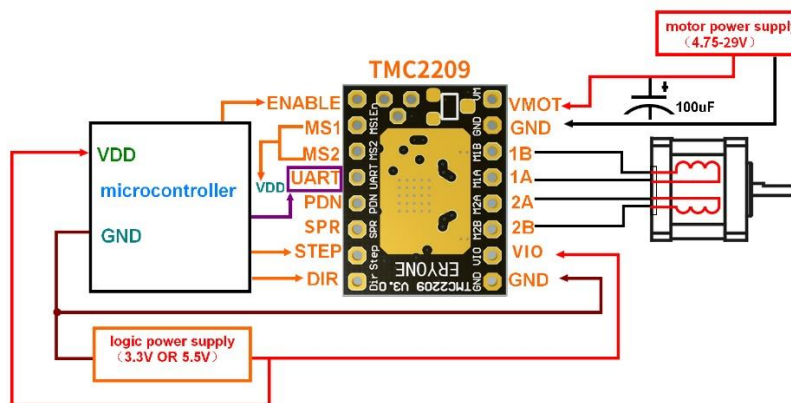


# 8. Working mode configuration

## 8.1 Default mode (step/dir mode)configuration



(Compare the TMC2208 and TMC2209)



1) The hardware configuration steps are as follows:

☐ Remove the old stepper driver board (if your motherboard is a new motherboard then skip this step)

☐ Jumper cap setting:

For how to set up the subdivision with jumper caps on the motherboard, you need to refer to your motherboard user manual.

You can use a multimeter and a slotted screwdriver to adjust the Vref (potentiometer) of the TMC2209 V3.0.

Power on your PSU Check the Vref of TMC2209 V3.0 → Use a slotted screwdriver to adjust the potentiometer of TMC2209 V3.0

## Control the stepper motor and test it

If you find that the direction of the stepper motor is incorrect. You can refer to these methods to set it to the correct direction

☐ Invert the stepper motor cable(We don't suggest you try this method if you are not familiar with hardware)

☐ Change it in the firmware, refer to the following modification instructions



## 2) Firmware configuration for default mode (Step / Dir)

☐ Change the firmware configuration.h

Open the firmware with Arduino IDE → Change the default value to the opposite value

eg:

Default value

```
#define INVERT_X_DIR true
```

After:

```
#define INVERT_X_DIR false
```

```
861 // Invert the stepper direction. Change (or reverse the motor connector) if an axis goes the wrong way.
862 #define INVERT_X_DIR true
863 #define INVERT_Y_DIR false
864 #define INVERT_Z_DIR false
865
866 // @section extruder
867
868 // For direct drive extruder v9 set to true, for geared extruder set to false.
869 #define INVERT_E0_DIR true
870 #define INVERT_E1_DIR false
871 #define INVERT_E2_DIR false
872 #define INVERT_E3_DIR false
873 #define INVERT_E4_DIR false
07A
```

Then save it and upload it to your printer and it will work.

## 8.2 UART mode configuration

Before this section, you need to check the motherboard first. If your motherboard supports UART then continue. If your motherboard doesn't support it, please use the default mode. As for the hardware require, the TMC2209 V3.0 UART mode is the same as the TMC2208.

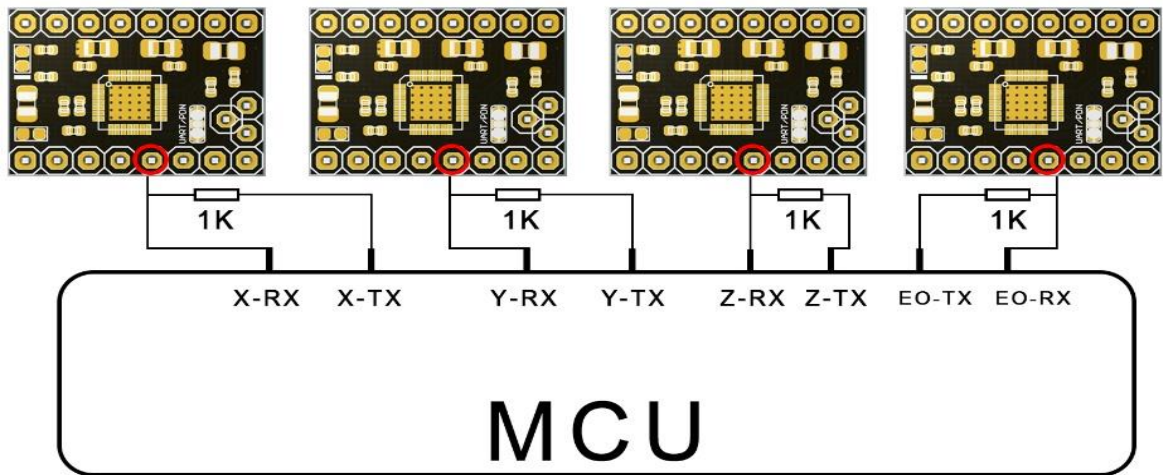
### 1) UART mode hardware configuration

For hardware, you need the following tools:

☐ Wire and 1kΩ resistance \* n (depending on the number of TMC2209 you need to configure)

Please check your motherboard datasheet at first. If you are not sure, please contact the technical support of the motherboard manufacturer you purchased from.

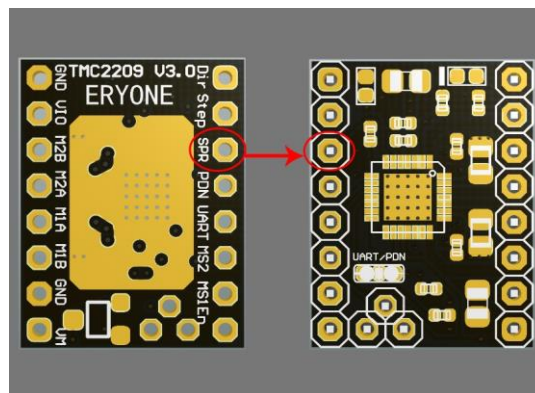
## UART mode wiring diagram



\* The factory default TMC2209 V3.0 uses UART mode. If you need to switch to PDN mode, please remove the resistance of the UART solder joint and solder the PDN contact with reference to the figure below:



## 8.3 Description of stealthchop and spreadcycle



\*If you want to check more info about stealthchop and spreadcycle, you can check it from this link:

<https://www.trinamic.com/products/integrated-circuits/details/tmc2209-la/>

## 8.4 Sensorless homing configuration

### Software

#### M914 TMC Bump Sensitivity (Lowest:0 Highest:255)

Some TMC stepper drivers can detect when they bump into something that causes them to stop moving. This feature is so sensitive that it can actually take the place of traditional endstops. Use this command to set the bump sensitivity for the X, Y, and Z stepper drivers.

The values of it based on your board.

\*If you want to use the feature, we suggest you enable the UART mode for TMC2209.

### Hardware

**You can use the DIAG pin to connect to the signal pin of the endstop port.**

If you have any questions, please feel free to contact with us via email:

[technical@eryone.com](mailto:technical@eryone.com)