

# Silent2209

## Product Introduction

---

![(images/2209v3.0.png)](image-20230508155154792)

The TMC2209 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. The integrated power MOSFETs handle motor currents up to 2A RMS with protection and diagnostic features for robust and reliable operation. 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. Step/Dir Drivers for Two-Phase Bipolar Stepper Motors up to 2.8A peak – StealthChop™ for Quiet Movement – UART Interface Option – Sensorless Stall Detection StallGuard4.

## Features

---

- 2-phase stepper motors up to 2.8A coil current (peak), 2A RMS
- STEP/DIR Interface with 8, 16, 32 or 64 microstep pin setting
- Smooth Running 256 microsteps by MicroPlyer™ interpolation
- StealthChop2™ silent motor operation
- SpreadCycle™ highly dynamic motor control chopper
- StallGuard4™ load and stall detection for StealthChop
- CoolStep™ current control for energy savings up to 75%
- Low RDSon, Low Heat-Up LS 170mΩ & HS 170mΩ (typ. at 25°C) t
- Voltage Range 4.75... 29V DC
- Low Power Standby to fit standby energy regulations
- Internal Sense Resistor option (no sense resistors required)
- Passive Braking, Freewheeling, and automatic power down

- Single Wire UART & OTP for advanced configuration options
- Integrated Pulse Generator for standalone motion
- Full Protection & Diagnostics

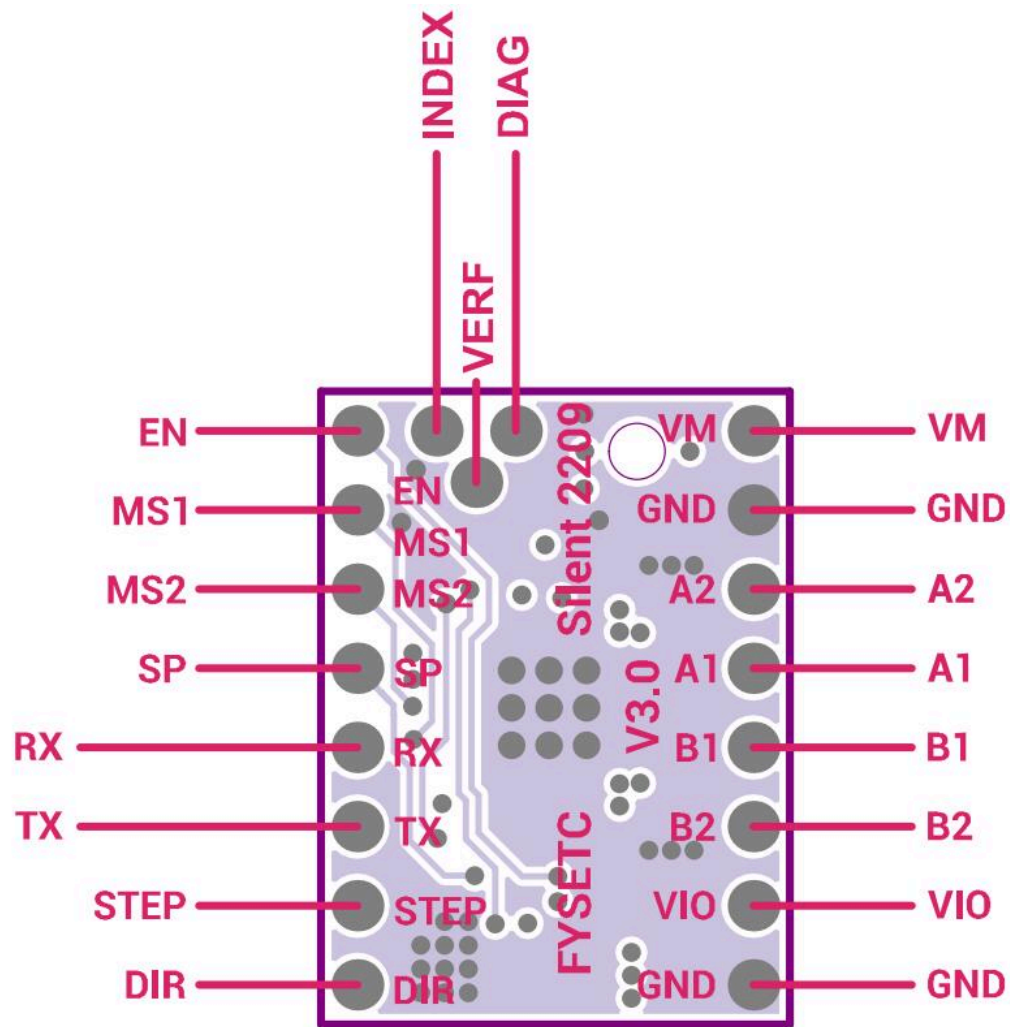
## Technical Specifications

Model	TMC2209
Interface	Step/Dir
Configuration	CFG Pins or UART
Native Microsteps	up to 1/256
microPlyer Microsteps	1/256
Logic Voltage (VIO)	3-5V
Motor Voltage (VM)	5.5-28V
Motor Phase Current max	2A RMS, 2.8A Peak
Internal V- Regulator	enabled
RDSon	0.1 Ohm (HV 0.2 Ohm)
stealthChop (quiet)	yes
spreadCycle	yes
coolStep	yes
stallGuard	yes
dcStep	yes

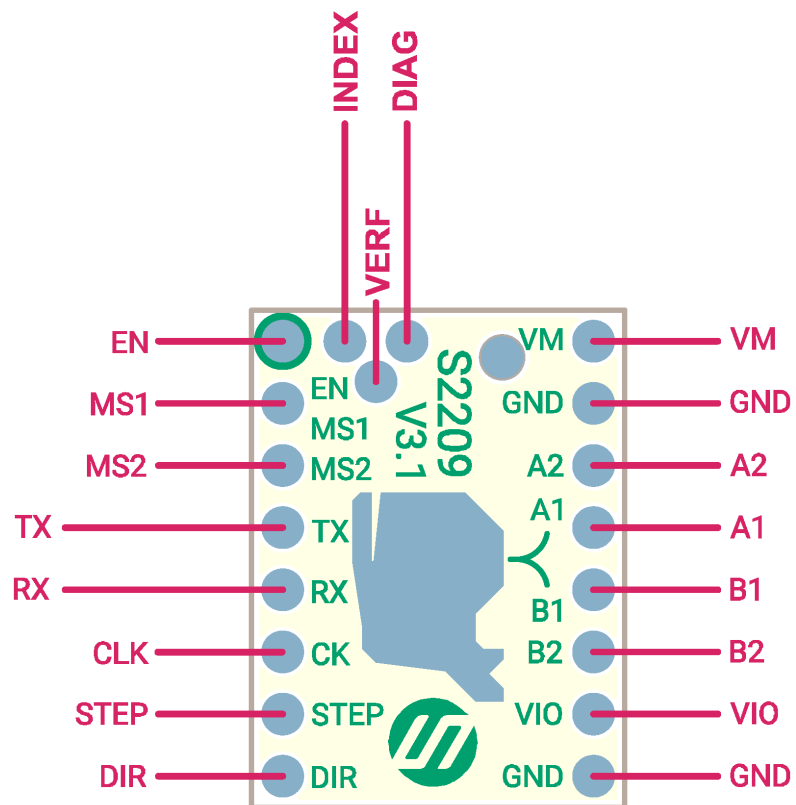
## Pin Functions

---

V3.0

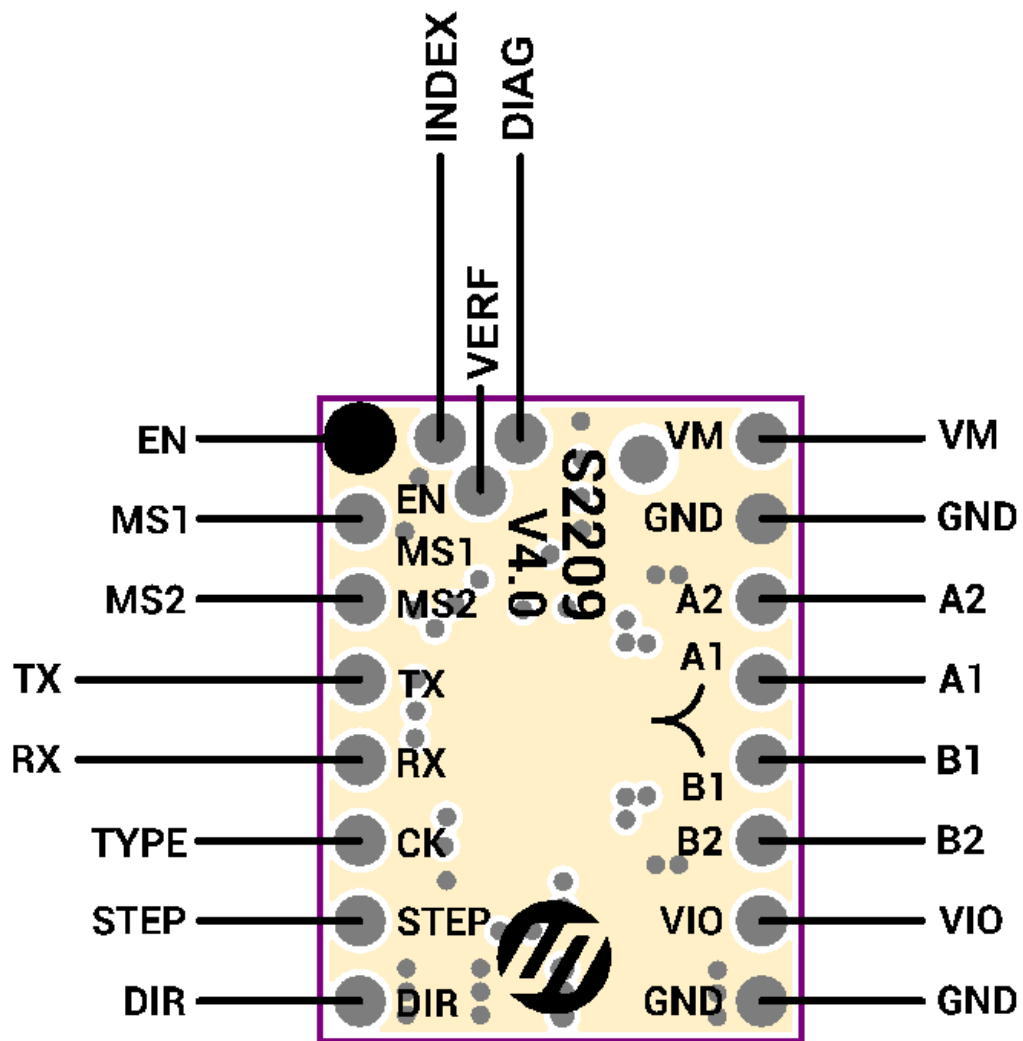


V3.1



![[image-20230508160723032]]

V4.0



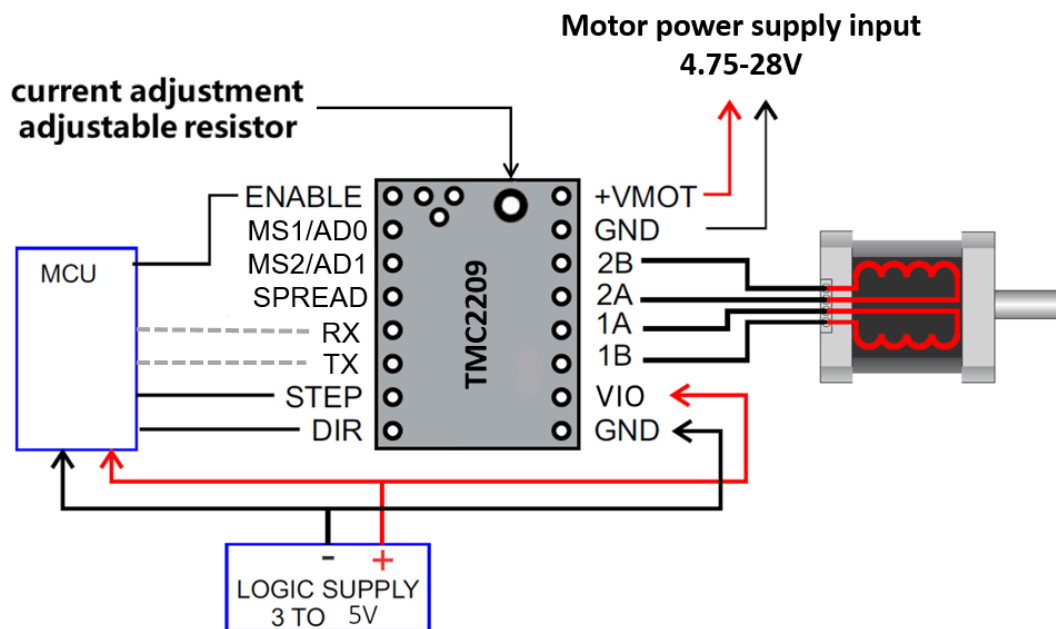
Pin	Function
<b>Power Supply</b>	
GND	Ground
VM	Motor Supply Voltage
VIO	Logic Supply Voltage
<b>Motor Outputs</b>	
M1A	Motor Coil 1
M1B	Motor Coil 1

Pin	Function
M2A	Motor Coil 2
M2B	Motor Coil 2
<b>Control Inputs</b>	
STEP	Step-Signal Input
DIR	Direction-Signal Input
<b>TMC2209</b>	
EN	Enable Motor Outputs: GND=on, VIO=off
MS1	Microstep resolution configuration (internal pull-down resistors)
MS2	MS1: 00: 1/8, 01: 1/2, 10: 1/4 11: 1/16 For UART based configuration selection of UART Address 0...3
SP	Chopper mode selection: Low/pin open=StealthChop, High=SpreadCycle
CLK	CLK input. Tie to GND using short wire for internal clock or supply external clock.
<b>TYPE</b>	<b>The V4.0 version replaces the original CLK pin with a module type identification pin, which is mainly used for spider king.</b>
TX	UART TX, Connected to the PDN via a 1K resistor on board
RX	UART RX, Directly connected to the PDN
DIAG	Diagnostic and StallGuard output. Hi level upon stall detection or driver error. Reset error condition by ENN=high.
INDEX	Configurable index output. Provides index pulse.
VREF	Analog Reference Voltage

## Interface Resources

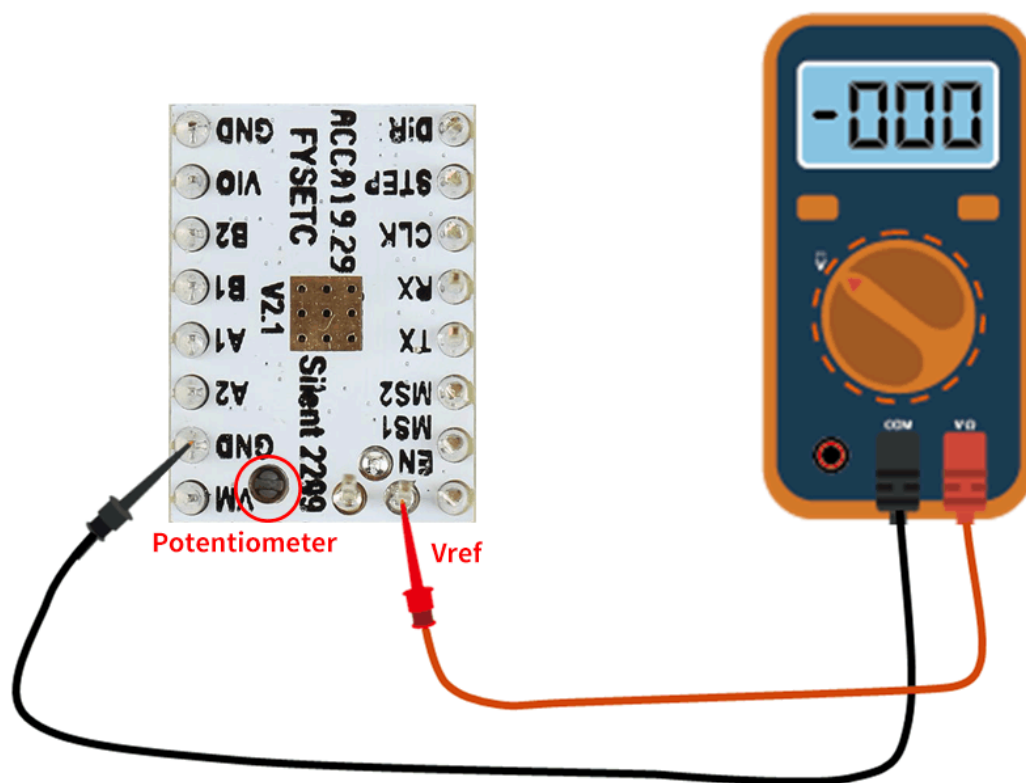
---

### Wiring Diagram



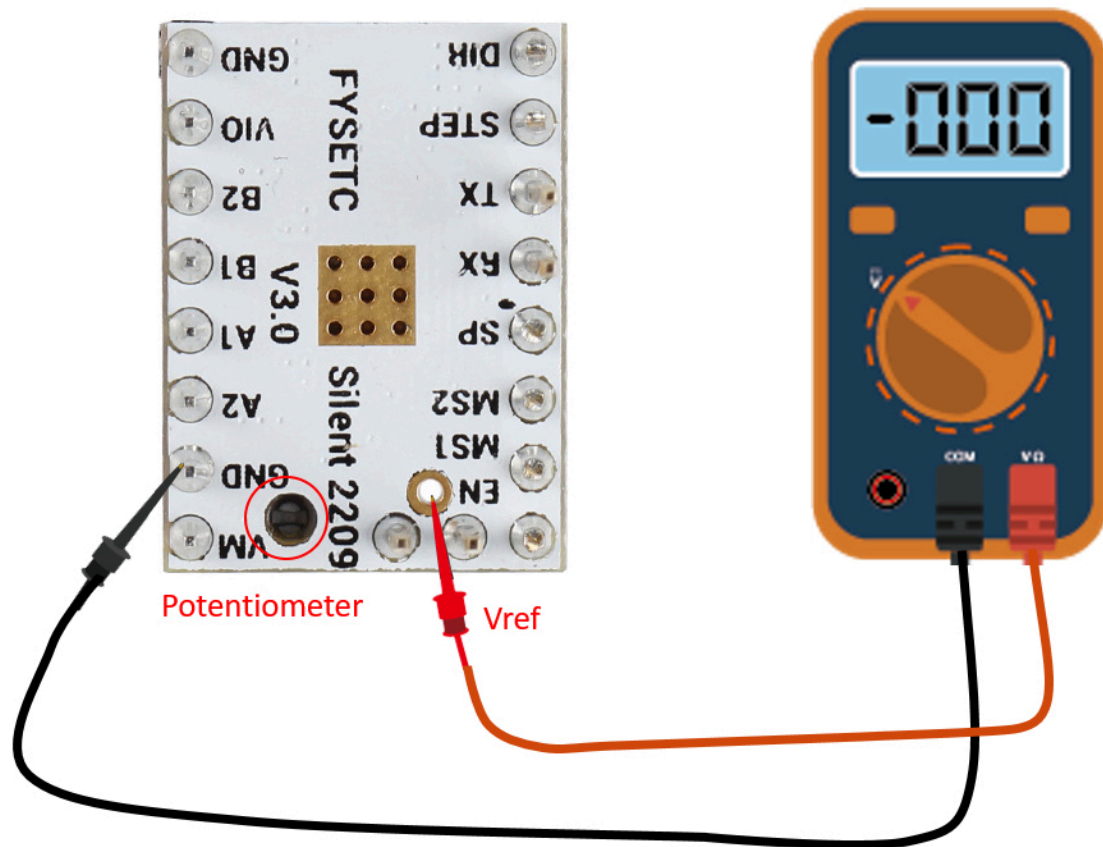
### Motor Current Setting

Below V2.1:



V3.0&3.1





The best way to set the motor current is by measuring the voltage on the Vref pin (0...2.5V) and adjusting the voltage with the potentiometer. The maximum settable motor current is 1.77A RMS (0.11Ohm sense resistors), but the SilentStepSticks can only be used up to 1.2A RMS.

$$I_{rms} = (V_{ref} * 1.77A) / 2.5V = V_{ref} * 0.71$$

$$V_{ref} = (I_{rms} * 2.5V) / 1.77A = I_{rms} * 1.41 = I_{max}$$

Vref -> Voltage on Vref pin

I<sub>rms</sub> -> RMS (Root Mean Square) current per phase ( $I_{rms} = I_{max} / 1.41$ )

I<sub>max</sub> -> Maximum current per phase ( $I_{max} = I_{rms} * 1.41$ )

#### Note

1. Vref measures Gnd and the voltage at the middle of the potentiometer.
2. Do not connect the motor when measuring the voltage, otherwise it is easy to burn the driver.
3. Power should be connected when measuring voltage, do not just connect USB power supply.
4. **Please pay special attention to directions!**

Calculator

RMS Current (A): 0.1

Reference Voltage (V): 0.14

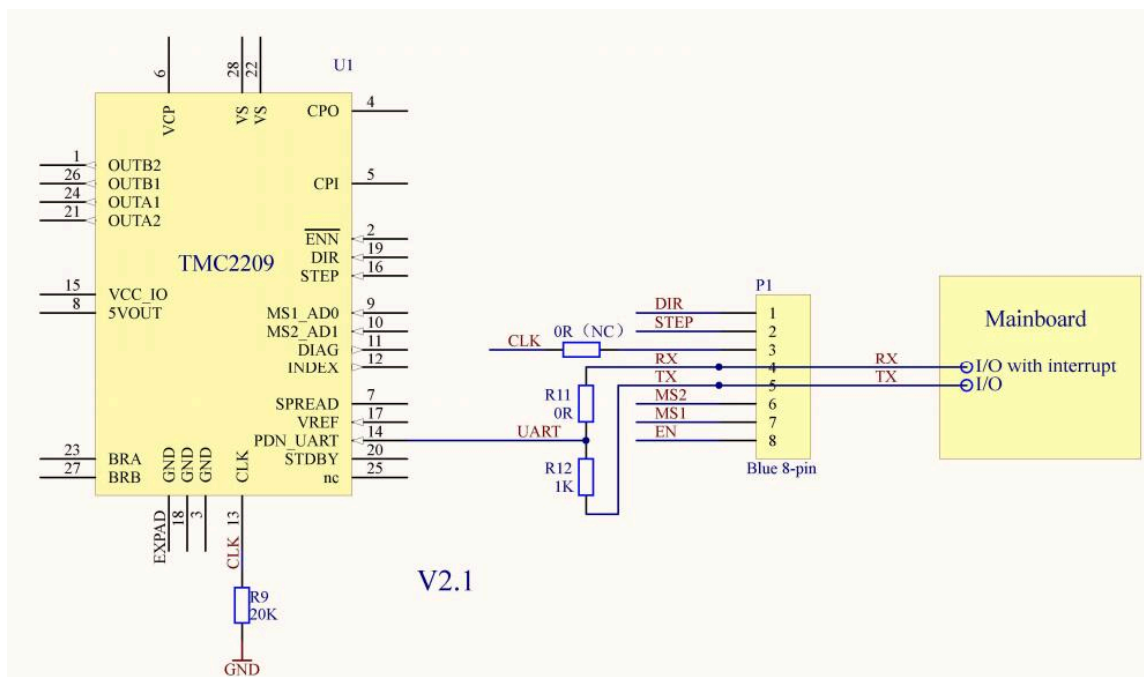
calculate

## Micro-stepping

MS2(-)	MS1(-)	Steps(-)	Interpolation(-)	Mode(-)
GND	VIO	$1/2$	$1/256$	stealthChop2
VIO	GND	$1/4$	$1/256$	stealthChop2
GND	GND	$1/8$	$1/256$	stealthChop2
VIO	VIO	$1/16$	$1/256$	stealthChop2

## Setting Method

### V2.1 Hardware Connection

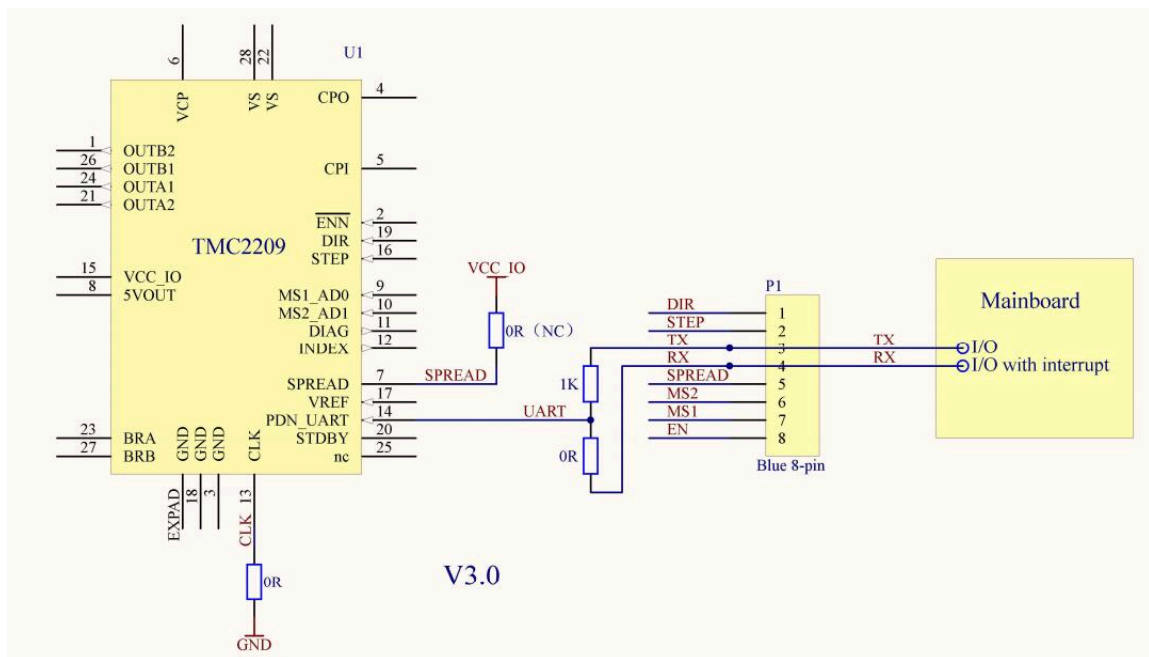


You can use every RS232 serial adapter with 0-5V logic levels (e.g. FTDI-Breakout) and the SilentStepStick Tester/Programmer can be used as connection adapter.

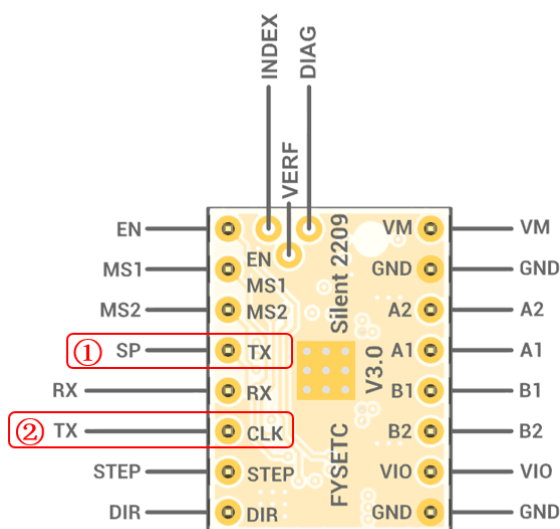
## Tip

The FYSETC TMC2209V2.1 version has been set with jumpers, and the TX and RX pins are lengthened for easy wiring. You only need to follow the silk screen to wire and use.

## V3.0 Hardware Connection



## Note



### Change log V3.0:

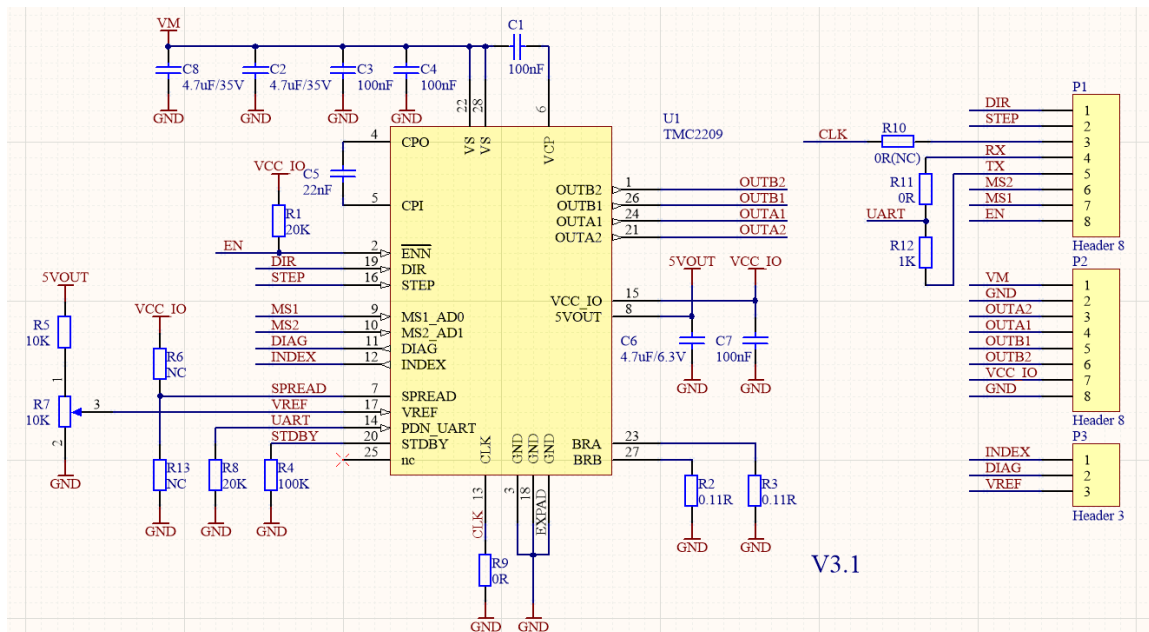
Adjust the pin define, Exchange the position of INDEX and VREF, add "spread" pinout for chopper mode selection

### Here are two silkscreen errors in V3.0:

①: TX, The correct one should be "spread" pin, used for chopper mode selection: Low=StealthChop, High=SpreadCycle

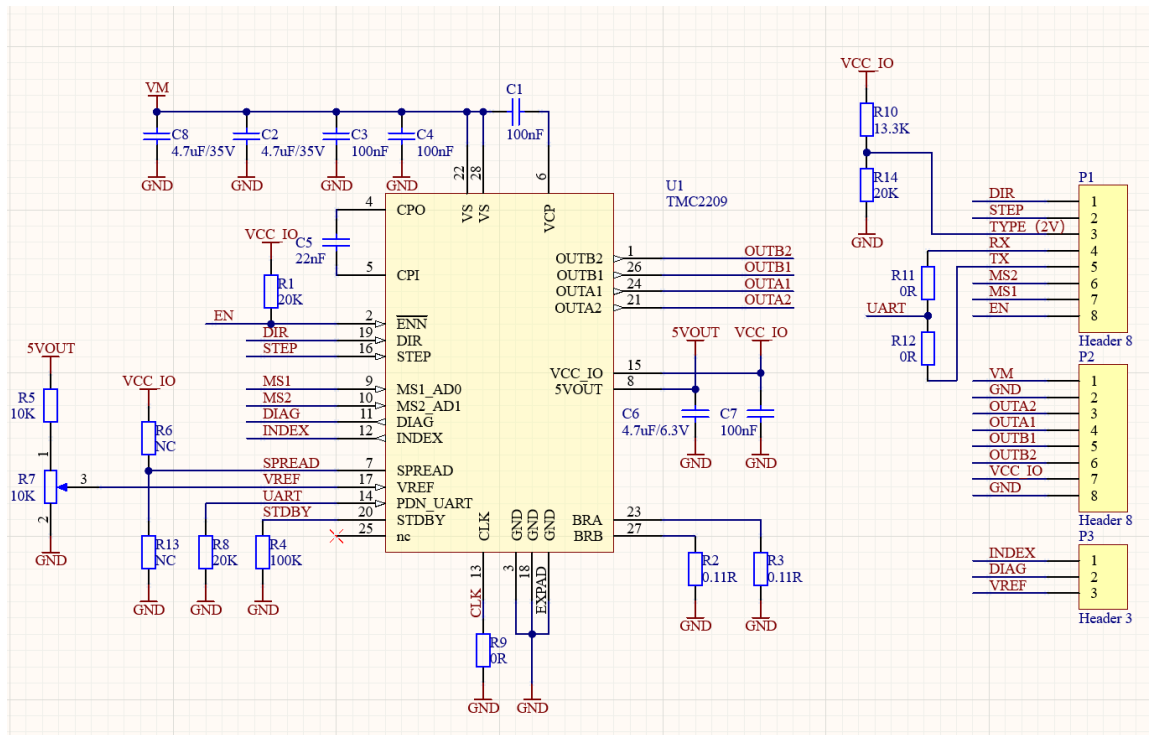
②: CLK, The correct one should be TX pin, used for wiring UART mode, F6 no need this pin

## V3.1 Hardware Connection



1. add CLK pin , not connect in default, tie to GND via 0R
2. SPREAD pin is floating. Reserve pull-up and pull-down resistors.
3. Move TX from 3 to 5
4. UART mode is compatible with F6,S6,SKR series and MKS series motherboards.

## V4.0 Hardware Connection



## Shop

---

- [TMC2209](#)

## Tech Support

---

Please submit any technical issue into our [forum](#)