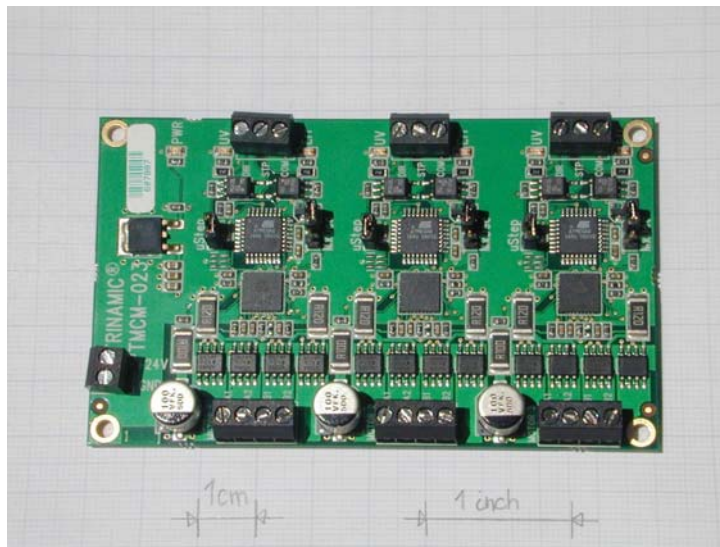


TMCM-023

Manual

**Triple step-/ direction driver module
for up to three motors
2A RMS / 28.5V**



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1 Features

The TMCM-023 is a very compact step- / direction three axis stepper motor controller and driver. With up to 2 A coil current it operates from a single 7 to 28.5V power supply. With jumpers for every axis mixed decay can be enabled. The micro step resolution of 4 or 8 steps can be chosen with jumpers also.

Applications

- Triple step-/ direction stepper driver for general decentralized applications
- Two LEDs for every axis for error diagnostics
- Optically decoupled input of step- /direction signals (24V, different voltage rating upon request)

Motor type

- Motor coil current 2A RMS (2.8A peak) (different rating upon request)
- 7V to 28.5V nominal supply voltage

Highlights

- Fully protected drive
- Possibility to individually select mixed decay mode with a jumper for every axis
- Two micro step resolutions for every axis available (4 and 8 microsteps, up to 24 upon request)
- Theoretical microstep frequency up to 250kHz

Other:

- RoHS compliant
- Size: 60x100mm²

Order code	Description
TMCM-023	3-axis step/direction driver module
Related products	TMCM-302

Table 1.1: Order code

2 Life support policy

TRINAMIC Motion Control GmbH & Co. KG does not authorize or warrant any of its products for use in life support systems, without the specific written consent of TRINAMIC Motion Control GmbH & Co. KG.

Life support systems are equipment intended to support or sustain life, and whose failure to perform, when properly used in accordance with instructions provided, can be reasonably expected to result in personal injury or death.

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Specifications subject to change without notice.

3 Connections and Mechanical

3.1 Pinning

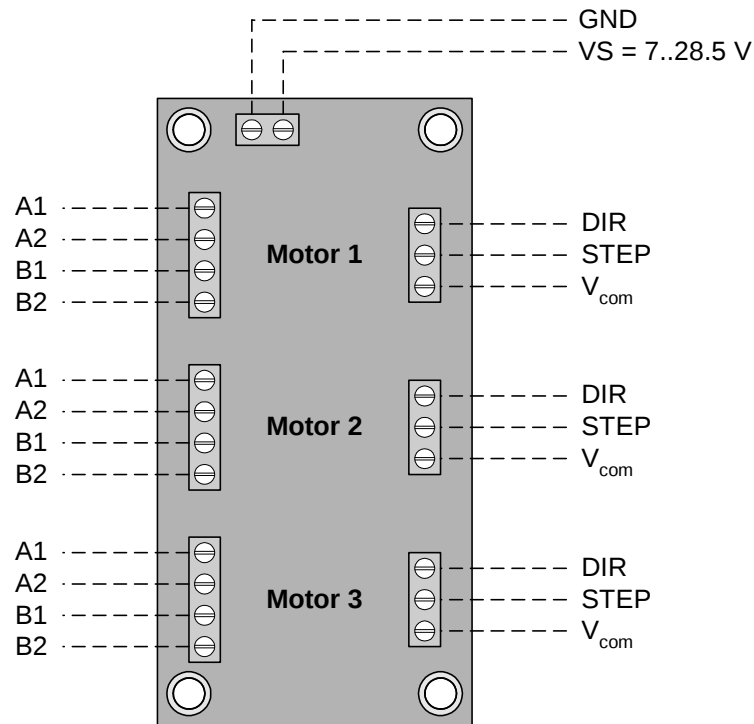


Figure 3.1: Pinning of TMCM-023

Pin	Function
VS	Positive power supply voltage
GND	GND, power
V_{COM}	Reference voltage for step-direction inputs. Positive optocoupler supply. Required for negative logic.
Dir	Direction: Tie to GND to inverse motor direction, leave open or at V_{COM} otherwise; optically isolated (Cathode of optocoupler)
Step	Step signal, optically isolated (Cathode of optocoupler)
A1	Connection for motor coil A
A2	Connection for motor coil A
B1	Connection for motor coil B
B2	Connection for motor coil B

Table 3.1: Pinning of TMCM-023

3.2 Dimensions

60mm*100mm*14mm (Height is measured by the highest part on PCB). The mounting holes are 3.2mm diameter.

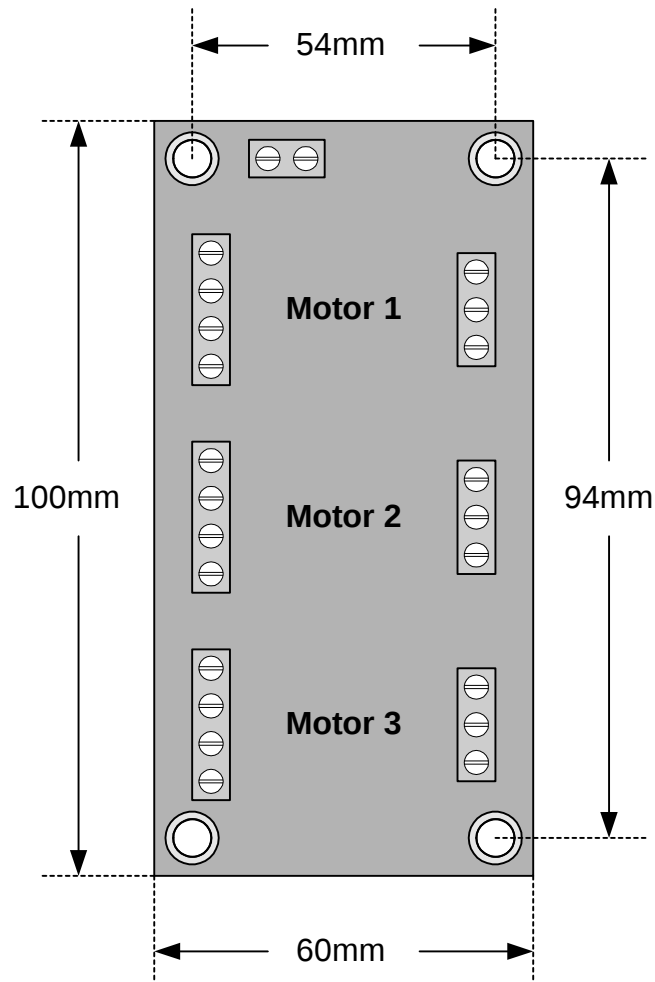


Figure 3.2: Dimensions for TMCM-023

4 Operational Ratings

The operational ratings show the intended / the characteristic range for the values and should be used as design values. In no case shall the maximum values be exceeded.

Symbol	Parameter	Min	Typ	Max	Unit
V_S	Power supply voltage for operation	7	12 .. 28.5	30	V
V_{SUV}	Undervoltage LED threshold		11		V
I_{CRUN}	RMS Motor coil current		2000		mA
$I_{CSTANDBY}$	Motor coil RMS current in standby (chopper regulated, standby mode 1 sec. after last step pulse)		$\frac{1}{4} I_{CRUN}$		mA
I_S	Power supply current motor running		$\ll I_{CRUN}$	$1.4 * I_{CRUN}$	A
V_{ISO}	Isolation voltage of optocouplers		± 42	± 100	V
V_{COM}	Supply voltage for step and direction; (inputs have negative logic)	18	24	27	V
f_{STEP}	Step frequency			245	kHz
t_{STEPLO}	Step impulse low time (opto coupler on)	1.0			μs
t_{STEPHI}	Step impulse high time (opto coupler off)	2.0			μs
$t_{DIRSETUP}$	Direction setup time to rising edge of step input	0			μs
$t_{DIRHOLD}$	Direction hold time after rising edge of step input	3.0			μs
T_{ENV}	Environment temperature for operation (forced cooling required at heavy duty cycle)	-25		70	$^{\circ}C$

Table 4.1: Operational Ratings

Never pull / plug motor connections during operation. This could damage the unit due to high-voltage discharge flowing into the power driver outputs. Always switch off the unit before connecting or disconnecting a motor.

4.1 Power supply requirements

The power supply should be designed in a way, that it supplies the nominal motor voltage at the desired maximum motor power. In no case shall the supply value exceed the upper / lower voltage limit. The stepper motor unit uses a chopper principle, i.e. the power supply to the motor is pulsed at a frequency of 36kHz. To ensure reliable operation of the unit, the power supply has to have a sufficient output capacitor and the supply cables should have a low resistance, so that the chopper operation does not lead to an increased power supply ripple directly at the unit. Power supply ripple due to the chopper operation should be kept at a maximum of a few 100mV.

Therefore we recommend to

- a) keep power supply cables as short as possible
- b) use large diameter for power supply cables
- c) if the distance to the power supply is large (i.e. more than 2-3m), use a robust 2200μF or larger additional filtering capacitor located near to the motor driver unit.

An effect the power supply has to cope with, is, that the motors can feed back current into the power supply if the motors are operated at very high velocity! Precautions have to be taken, to limit the supply voltage to within the operational limits. Normally a large power supply capacitor is sufficient for this.

4.2 Temperature range

The module generates heat when operated. The temperature range in the power stage has to be kept well below 150°C. This is guaranteed, when operating within the following limits:

Temperature	duty cycle of motors	forced air flow	PCB mounted
$T < 45^{\circ}\text{C}$	100%	no	horizontally or vertically
$45^{\circ}\text{C} < T < 70^{\circ}\text{C}$	50%	no	horizontally or vertically
$45^{\circ}\text{C} < T < 70^{\circ}\text{C}$	100%	yes	horizontally or vertically

Table 4.2: Cooling requirements at different settings and conditions

However, a higher component temperature decreases live time of the product. It is not advised to operate the unit near the limits for an increased period of time.

5 Functional Description

The TMCL-023 module is able to control up to three stepper motors autonomous with its step-/direction interface. Mixed decay can be switched on and off via jumpers. Also the micro step resolution can be changed from 4 to 8 steps.

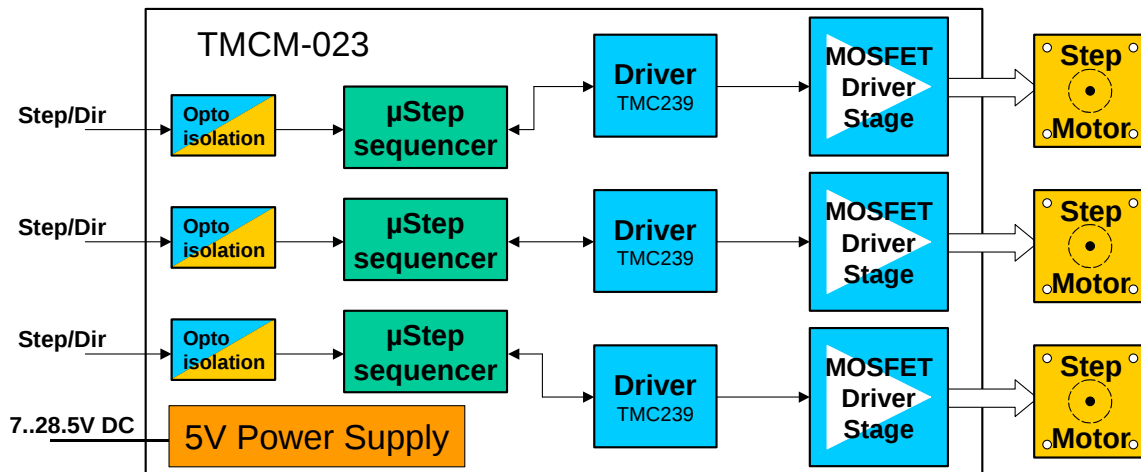


Figure 5.1: Main parts of the TCM-023

5.1 Step-Direction Interface

The Step-Direction controls are as follows:

Motor	Velocity	Acceleration	Rotate right	Rotate left
Control	Step frequency	Increase or decrease of Step frequency	Direction open wired or connected to V_{COM}	Direction connected to Ground

Table 5.1: External signals and motor reactions

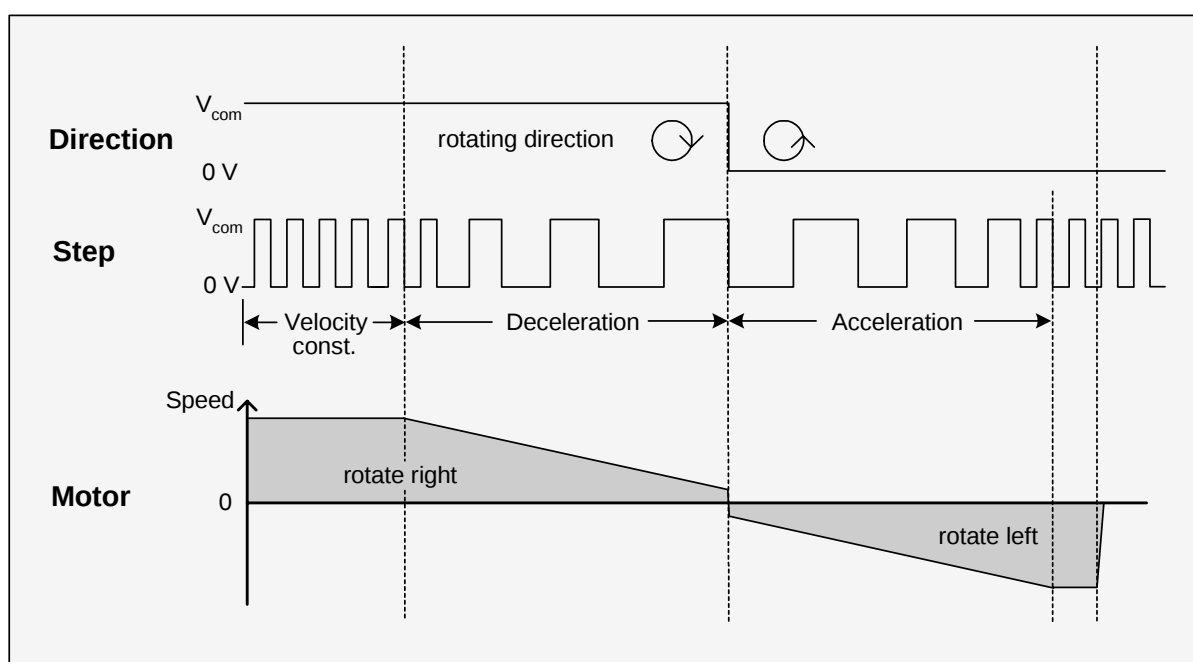


Figure 5.2: Step-Direction signals and motor reactions

5.1.1 Direction

Description: The Direction signal changes the motors rotation from clockwise (CW) to counterclockwise (CCW) and vice versa.

Function Table:

GND	open wire	$V_{COM} = 24V$
motor CW	motor CCW turn	

5.1.2 Step

Description: The Step signal controls the velocity and acceleration of the motor. The velocity depends on the frequency, the acceleration on the change of the frequency. One step impulse represents one microstep.

Calculation of rotations per second:

$$v[\text{rotations / s}] = \frac{\text{Step input frequency}}{\text{Fullsteps} \cdot \text{Microstep resolution}} [\text{rotations / s}]$$

Frequency: The maximum Step input frequency is 245 kHz, aligned to the Direction signal. The minimum logic "0" time is 1 μs and the minimum logic "1" time is 3 μs . A step is triggered by the positive going edge of the signal (switching off of opto coupler).

Function Table:

Extern	GND	open wire	$V_{COM} = 24V$
Intern	HIGH	LOW	

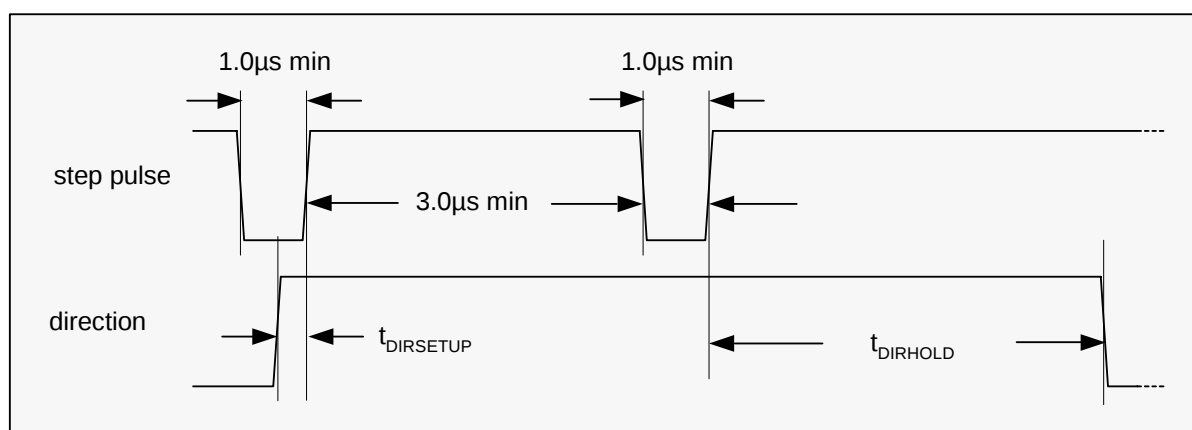


Figure 5.3: Step and Direction Signal

5.2 Mixed Decay

With the jumper "MxDec" the mixed decay mode can be switched on (jumper set) and off (jumper open). With mixed decay on, the motor steps more smoothly, especially in medium frequency range. This is the standard setting. With mixed decay off, power consumption is reduced.

5.3 Micro Step Resolution

With the jumper “uStep” the micro step resolution can be switched between 4 (jumper open) and 8 (jumper set) steps.

5.4 LEDs

There is a power supply LED plus two status LEDs for each driver.

Symbol	Parameter	Description
PWR	Power LED	Identifies power on (12...28.5 V)
UV	Under Voltage LED	Lights, when supply voltage is below 11 volts
Err	Error LED	Lights upon a short circuit condition or overheating of the units power stage. The LED flashes shortly upon power on. If the LED is on during operation, please switch off the unit and check motor cabling

Table 5.2: LED indication

5.5 Hardware changes for 5V Step-Direction control

The TMCM-023 operates with Step-Direction signals of nominally 24V. By a simple hardware change / addition this voltage can be lowered to 5V (3.3V to 7V) to operate the three drivers with e.g. a TMCM-302 Step-Direction controller.

Substitute the 2.4k ohms type 1206 resistors at each Step and Direction entrance with 330 Ohms resistors (or bypass the 2.4k with a 390 ohms resistor) to lower the switching voltage to 5V. This has to be done for each driver to be controlled by 5V signals. Be careful not to use 24V signals on modified inputs.

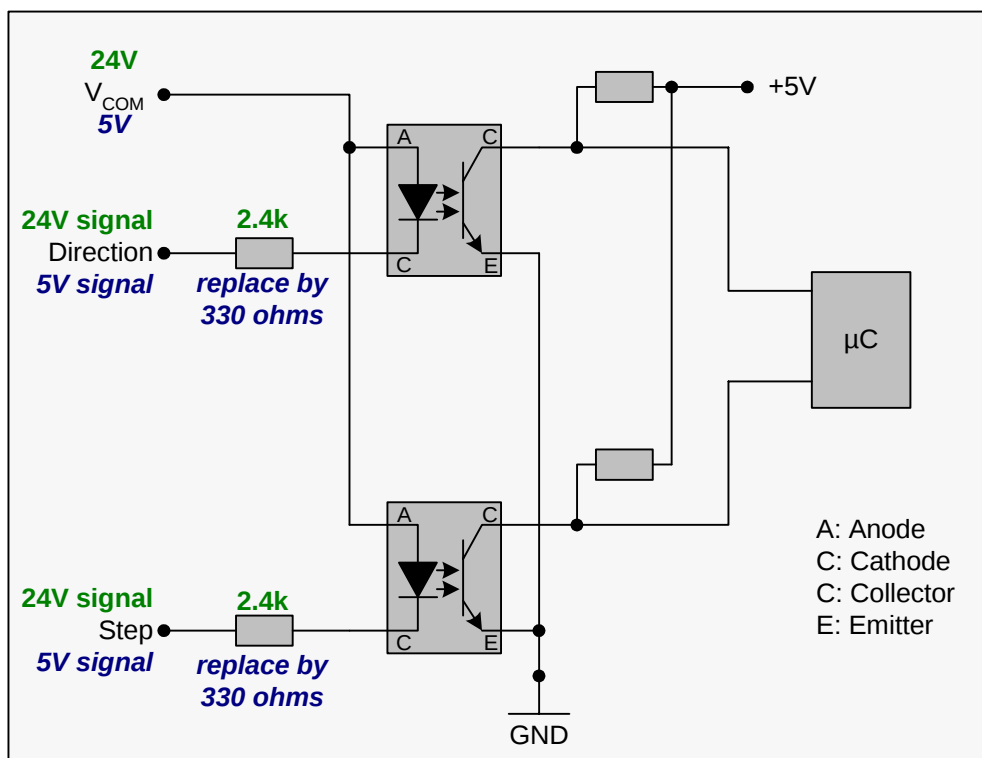


Figure 5.4: Step-Direction input with 5V signal replacement info

5.6 Application with 3 - Axis Control Module TMCM-302

The TMCM-302 Step-Direction 3-axis motion controller module is perfect to control the TMCM-023 driver module. Only 5V inputs are required. For modifications refer to 5.5 Hardware changes for 5V Step-Direction control.

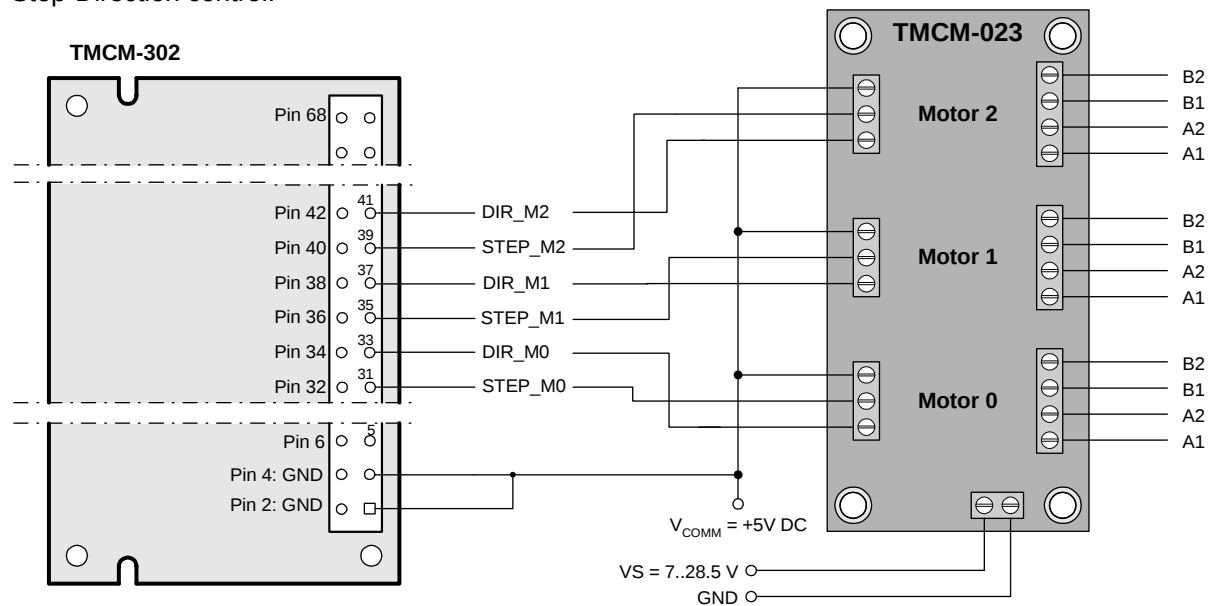


Figure 5.5: Application with TMCM-302 (5V inputs required, please see 5.5 for modifications)

6 Revision History

6.1 Documentation Revision

Version	Comment	Description
1.00	First Release	Full functionality for Firmware V1.05
1.20		Some updates
1.21	Updates	Order code, Step/Dir Timing, 5V Step-Dir signal inputs, TMCM-302 Info

Table 6.1: Documentation Revisions

7 References

[TMCM-302]

TMCM-302 manual (see <http://www.trinamic.com>)