

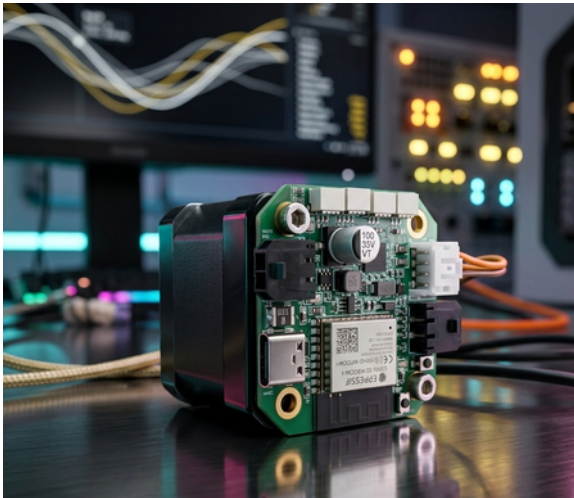


NEMA17 Closed Loop CAN Adapter Board

CANStepper

Product Brochure | Firmware V1.5 | docs.grafito.in

The CANStepper is a compact closed-loop stepper controller that mounts directly on the back of a NEMA 17 motor. Every board carries an ESP32-C3, a TMC2209 silent driver, an MT6701 14-bit magnetic encoder and a TCAN3413 CAN transceiver. Up to 31 boards daisy-chain on a single 1 Mbps CAN bus, and a host computer drives the whole machine in Python through the USB port of any node.



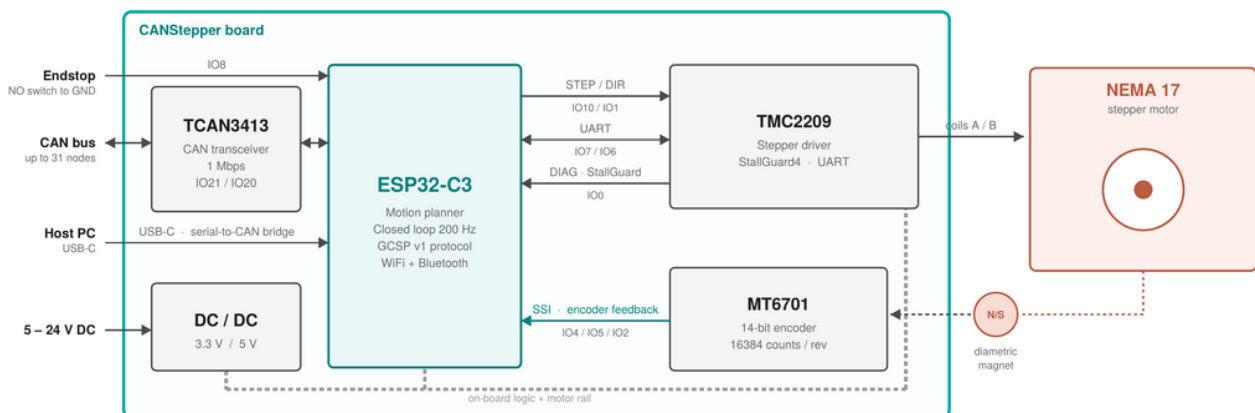
Features

- ESP32-C3 with WiFi and Bluetooth, USB-C programming
- TMC2209 silent driver, 2.0 A RMS / 2.8 A peak
- MT6701 14-bit magnetic encoder, $\sim 0.022^\circ$ resolution
- 200 Hz closed position loop, on the board itself
- Trapezoidal planning with velocity feedforward + PID
- Up to 31 nodes on one 1 Mbps CAN bus
- 5–24 V input, limit switch connectors included
- Latched E-stop per node, per group or bus-wide
- Endstop and StallGuard sensorless homing
- Python library, G-code layer and software simulator

Applications

- Robotics & Multi-Axis Arms
- CNC Machines
- 3D Printer Motion
- Industrial Automation
- Laboratory Automation
- Conveyor Systems
- Linear Actuators
- Smart Farming
- Home Automation

Simplified Block Diagram



1 Hardware

Oneboardpermotor. Every axis carries its own planner, driver, encoder and CAN node.

Technical Specifications

Parameter	Value
Supported motor	NEMA 17 stepper motor
Control mode	Closed loop with magnetic encoder feedback
Motor driver	TMC2209, UART configured, StallGuard4
Encoder	MT6701, 14-bit magnetic, 16384 counts/rev
Angle resolution	~0.022° per step
Input voltage	5–24 V (24 V rail recommended for full speed/torque)
Motor current	2.0 A RMS / 2.8 A peak
MCU	ESP32-C3 with WiFi and Bluetooth
Communication	CAN daisy-chain, USB-C, WiFi, Bluetooth
CAN bit rate	1 Mbps, up to 31 nodes on one bus
Limit switches	2 connectors supported

Pin Map

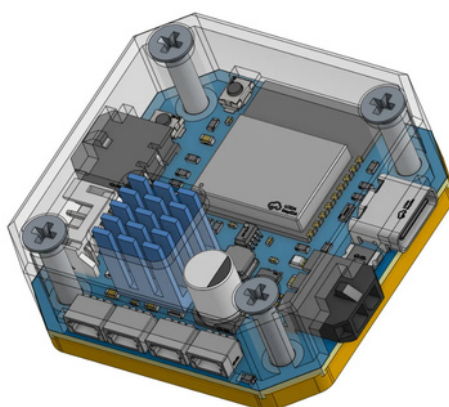
Signal	GPIO	Notes
CAN TX / RX	IO21 / IO20	to TCAN3413
TMC EN	IO3	LOW = driver energized
STEP / DIR	IO10 / IO1	hardware pulse generator
TMC DIAG	IO0	StallGuard trigger, rising edge
TMC UART	IO7 / IO6	single-wire PDN_UART
Encoder CLK / DO / CS	IO4 / IO5 / IO2	MT6701 SSI
Endstop (HOME)	IO8	internal pull-up, active-low by default

Power

- 5–24 V input; logic generated on-board
- 24V motor rail recommended for full speed and torque
- USB can power the logic for flashing and configuration, but the motor will not hold or move without the motor rail
- Prefer ~70% run current for long high-speed duty

CAN Bus

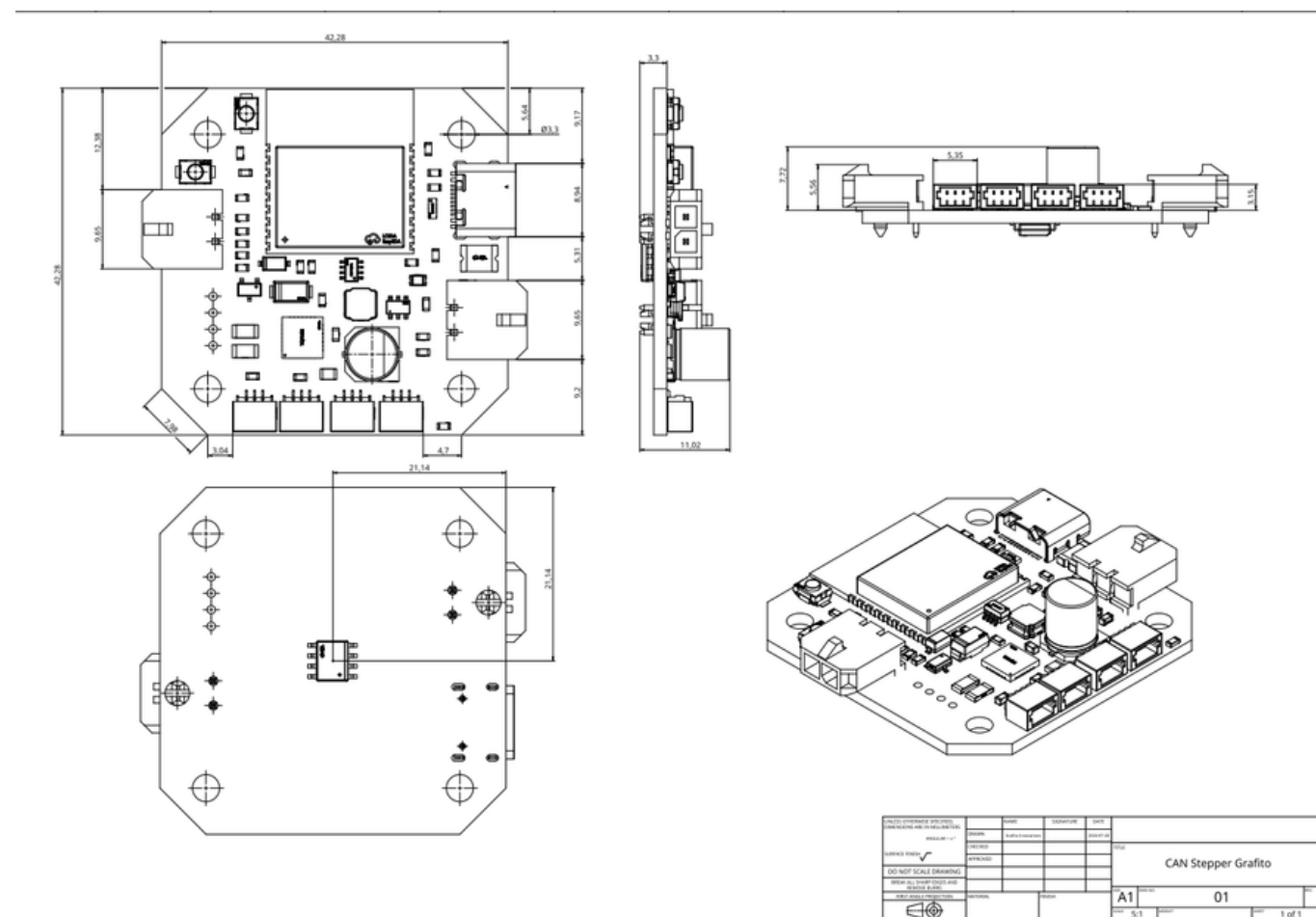
- Linear daisy-chain, 120 Ω termination at both ends
- Twisted pair for CANH / CANL, keep stubs short
- All nodes run 1 Mbps — no configuration needed
- A node powered alone enters bus-off and recovers once a second node appears



CANStepper V1 — 3D Model

2 Mechanical

The board mounts on the back of the NEMA 17 and ships with a 3D-printed protective casing. All dimensions as drawn.



CANStepper V1 — mechanical drawing

Mounting Notes

- Mounts directly on the back of a NEMA 17 / 42 mm motor
- The diametric magnet must sit **centred over the MT6701** with roughly **1–2 mm air gap**
- Poor magnet placement is the single most common cause of noisy angle readings
- A TMC2209 heat sink is included and is strongly recommended for production or continuous high-speed duty
- Leave space around the driver; avoid sealed, hot enclosures Keep
- The board free of metal particles — the magnet attracts them

2 Closed-Loop Performance

Lost steps are corrected, not silently accumulated.

Stalls are detected — a blocked axis faults instead of grinding.

Position telemetry is truth, measured at the shaft, not assumed.

Every board plans a rest-to-rest trapezoidal move, reads its encoder 200 times per second, and tracks the plan with velocity feedforward plus a light PID. Closed loop is on by default and can be disabled per node for classic open-loop stepping.

Measured Speed

Mode	deg/s	RPM
Open-loop continuous run()	~7200	~1200
Closed-loop cruise (max proven)	~6000	~1000
Closed-loop production default	4800	800

Measured on a PR42HS40-1204AF-02 NEMA 17 (1.8°, 1.2 A, 3.2 mH, 4.2 kg·cm) at 24.0 V, firmware 1.2. Your ceiling will differ with load, supply and motor inductance.

10-Minute Closed-Loop Soak

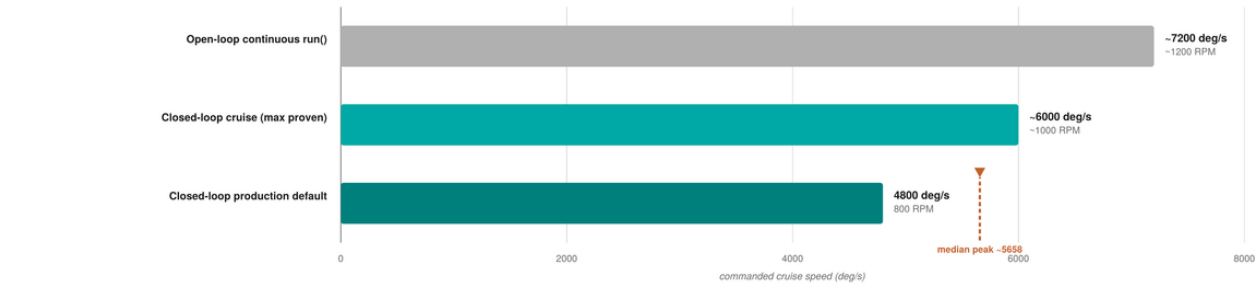
Item	Result
Tune	70% current, 4800 deg/s, 8 μstep
Pattern	0° → 1440° → 0°
Full cycles	239
Settles	478 / 478
Success rate	100%
Faults / timeouts	0 / 0
Settle time (median)	1.15 s
Final error (med / max)	0.11° / 0.46°
MCU temperature	41.4 → 61.4 °C

Production Tune

Parameter	Value
cl_max_speed	4800 deg/s (800 RPM)
cl_max_accel	19200
run_current	70%
microsteps	8
stealthchop	0 (SpreadCycle)
pid_kp / ki / kd	12 / 0.3 / 0.10
pid_tolerance	0.35°

Measured speed ceilings

PR42HS40-1204AF-02 NEMA 17 · 24.0 V · firmware 1.2 · 8 step · SpreadCycle



Peaks during a closed-loop move briefly exceed the configured cruise (encoder sampled during acceleration); cruise is the value set by cl_max_speed.
10-minute soak at the production tune: 478 / 478 settles, 100% success, 0 faults, settle time median 1.15 s.
Ceiling varies with load, supply voltage and motor inductance.

3 Software Stack

Layer	What it is
Firmware	GrafitoCANStepper_C3 — motion, closed loop, homing and safety on the board
Protocol	GCSP v1 — compact CAN frames with a documented wire format
Python library	grafito-canstepper — <code>pip install grafito-canstepper</code>
Simulator	The full protocol in software, for tests and development without hardware

Python in Practice

```
from canstepper import CANStepperBus

with CANStepperBus.serial("/dev/ttyACM0") as bus:
    print(bus.discover())          # {1: '1.0', 2: '1.0', ...}
    node = bus.node(1)
    node.set_run_current(40).enable()
    node.move_to(360.0, blocking=True)
    bus.estop_all()                # one broadcast frame
```

Built for Real Machines

- Millimetre units via `rotation_distance`
- Declarative `machine.toml` configuration
- Endstop and sensorless homing
- Dual-motor gantries coupled on-bus
- CoreXY and Cartesian kinematics
- Klipper-style G0 / G1 / G28 / M112
- Time-synchronized coordinated moves
- Live TMC2209 diagnostics over CAN

Safety in Three Scopes

Per node Stop one axis and latch it	Per group Stop a logical set of axes	Bus-wide One broadcast frame stops everything
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E-stop latches until explicitly re-enabled.

4 Ordering

NEMA17Closed Loop CAN Adapter Board

■ **3,499** introductory (MRP ■4,000)

NEMA17Closed Loop CAN Adapter Board with Stepper Motor

■ **4,000** introductory (MRP ■4,500)

Free shipping across India · 30-day returns

Order at grafito.in/shop or on [Amazon.in](https://amazon.in) (ASIN B0H8XZ6V99)

Included in the Box

- TMC2209 heat sink
- 4× CAN connectors
- 2× limit switch connectors
- 2× Micro-Fit connectors
- Encoder magnet
- 3D-printed casing
- CANStepper-to-motor connector



Scan for the shop page

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