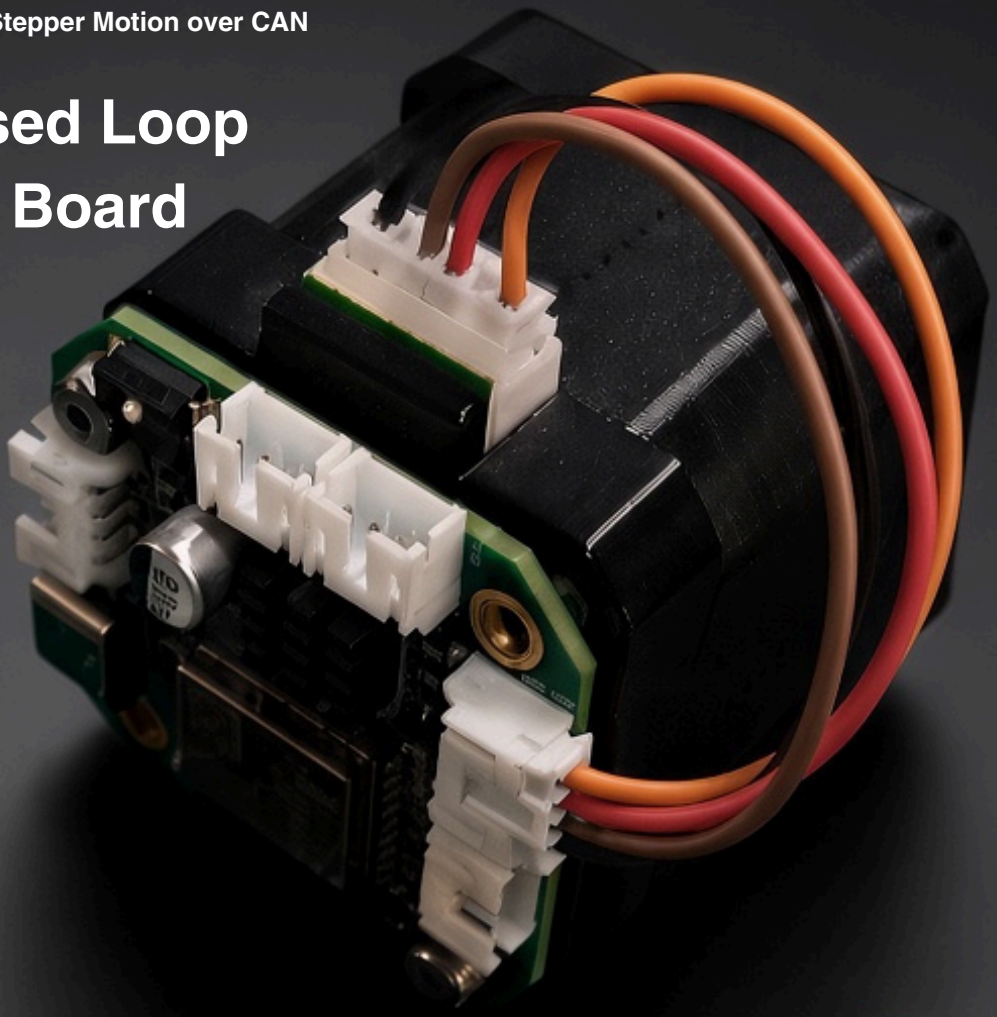
Grafito Innovations

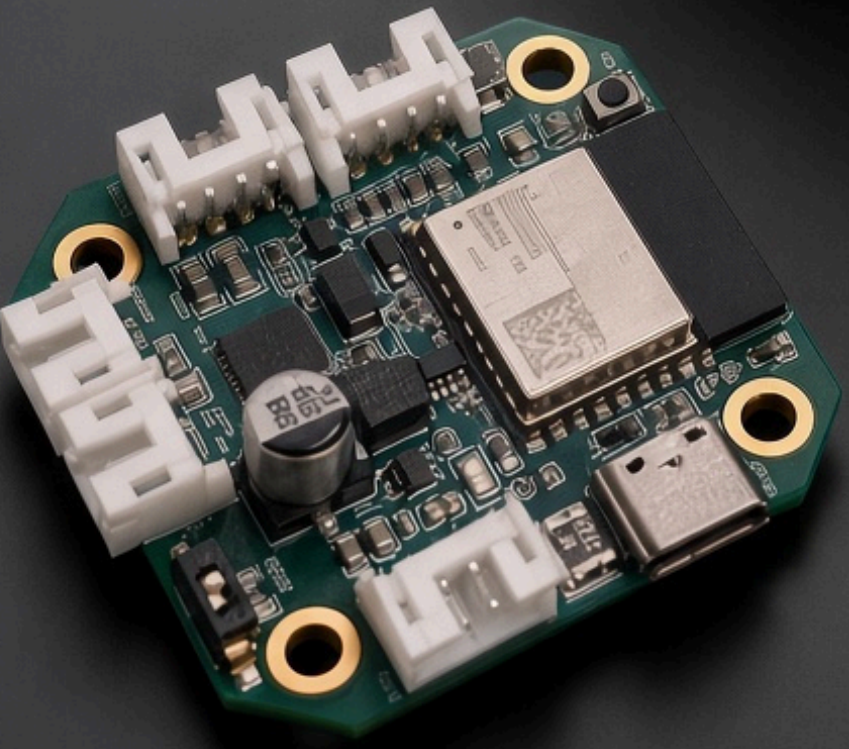
Closed-Loop Stepper Motion over CAN

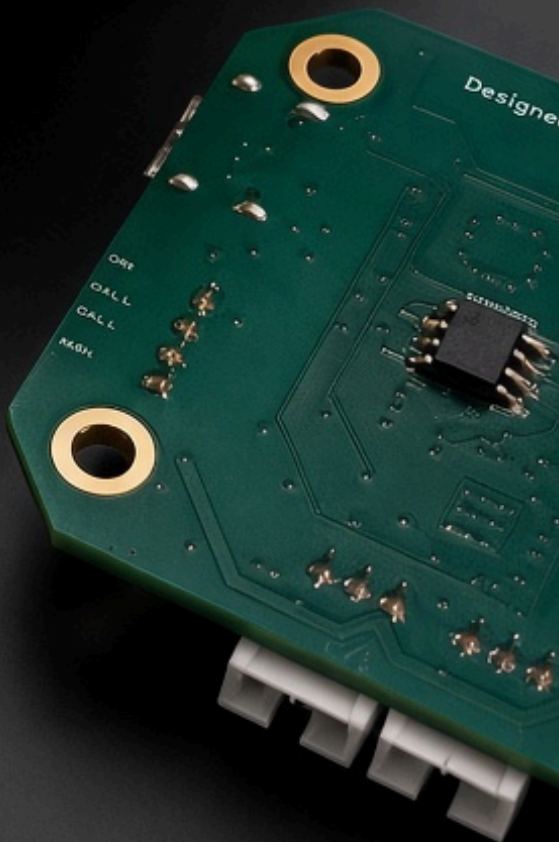
NEMA17 Closed Loop CAN Adapter Board

CANStepper

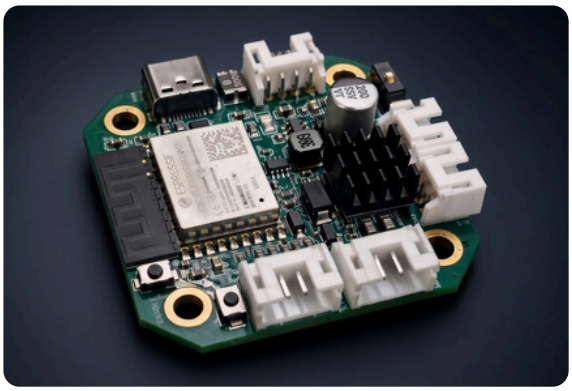
Product Brochure | Firmware V1.9 | docs.grafito.in







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.



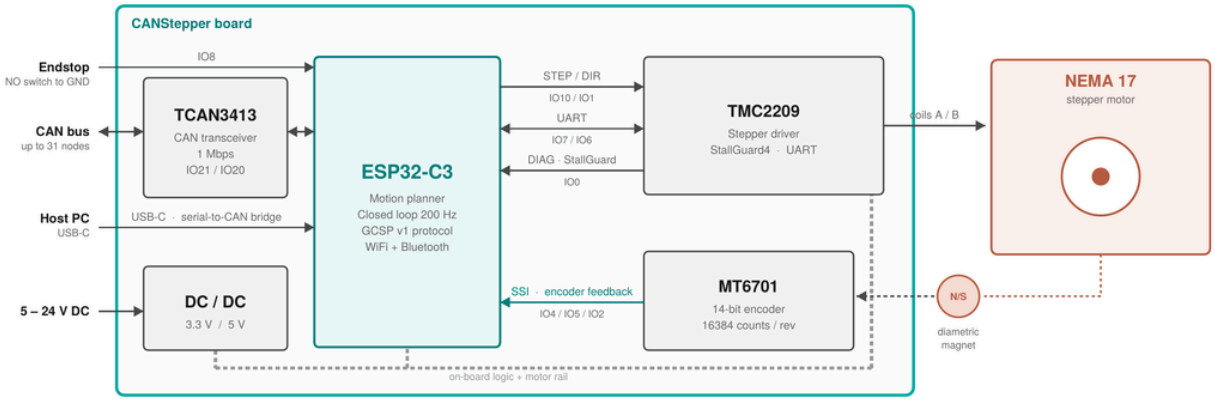
Features

- 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, ~0.022° 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

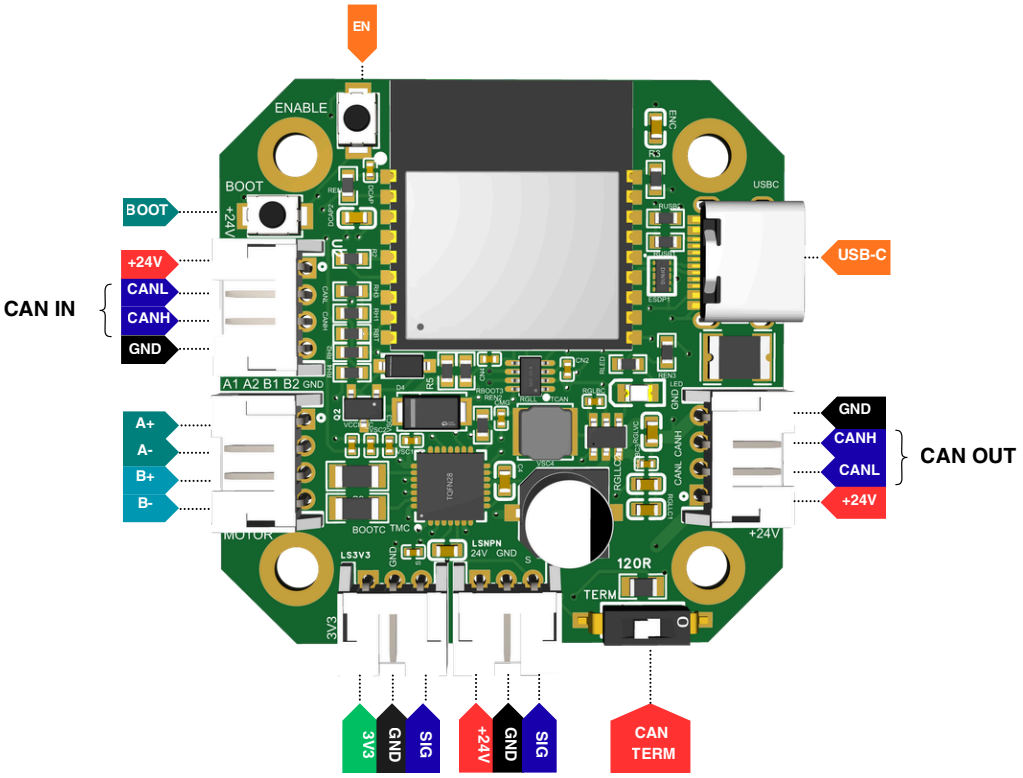
Applications

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

Simplified Block Diagram



Pinout



1 Hardware

One board per motor. Every axis carries its own planner, driver, encoder and CAN node.

Technical Specifications

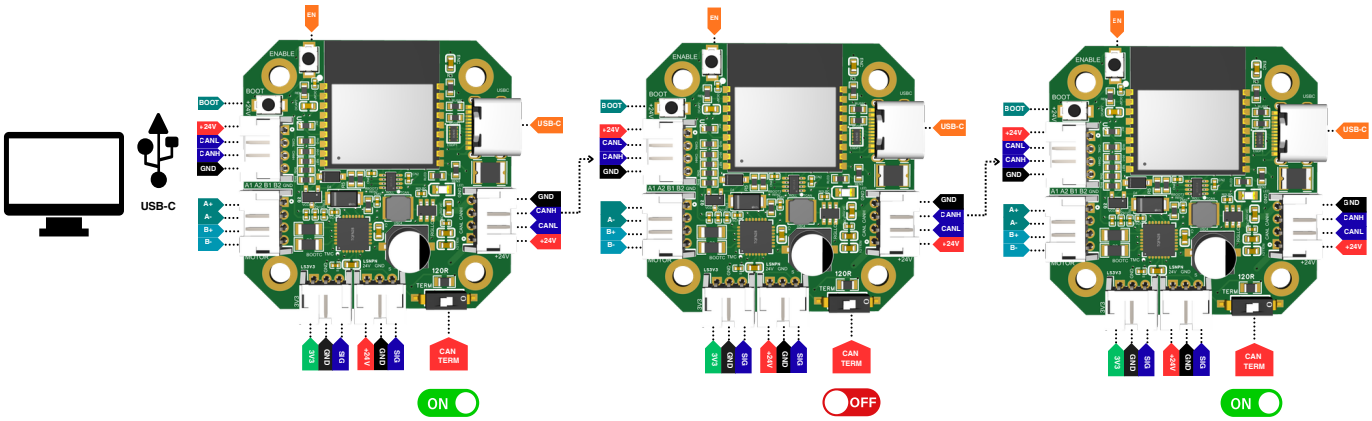
Parameter	Value
Supported motor	NEMA 17 stepper motor
Control mode	Closed loop with magnetic encoder feedback TMC2209, UART
Motor driver	configured, StallGuard4
Encoder	MT6701, 14-bit magnetic, 16384 counts/rev
Angle resolution	~0.022° per step
Input voltage	5–24 V (24 V rail recommended for full speed/torque) 2.0 A RMS /
Motor current	2.8 A peak Prefer ~70% run current for long high-speed duty
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

CAN Bus Multi-Axis Architecture

A host computer communicates with CANStepper nodes through USB-C. Each node controls one NEMA17 motor axis. The CAN bus is wired as a linear daisy chain.



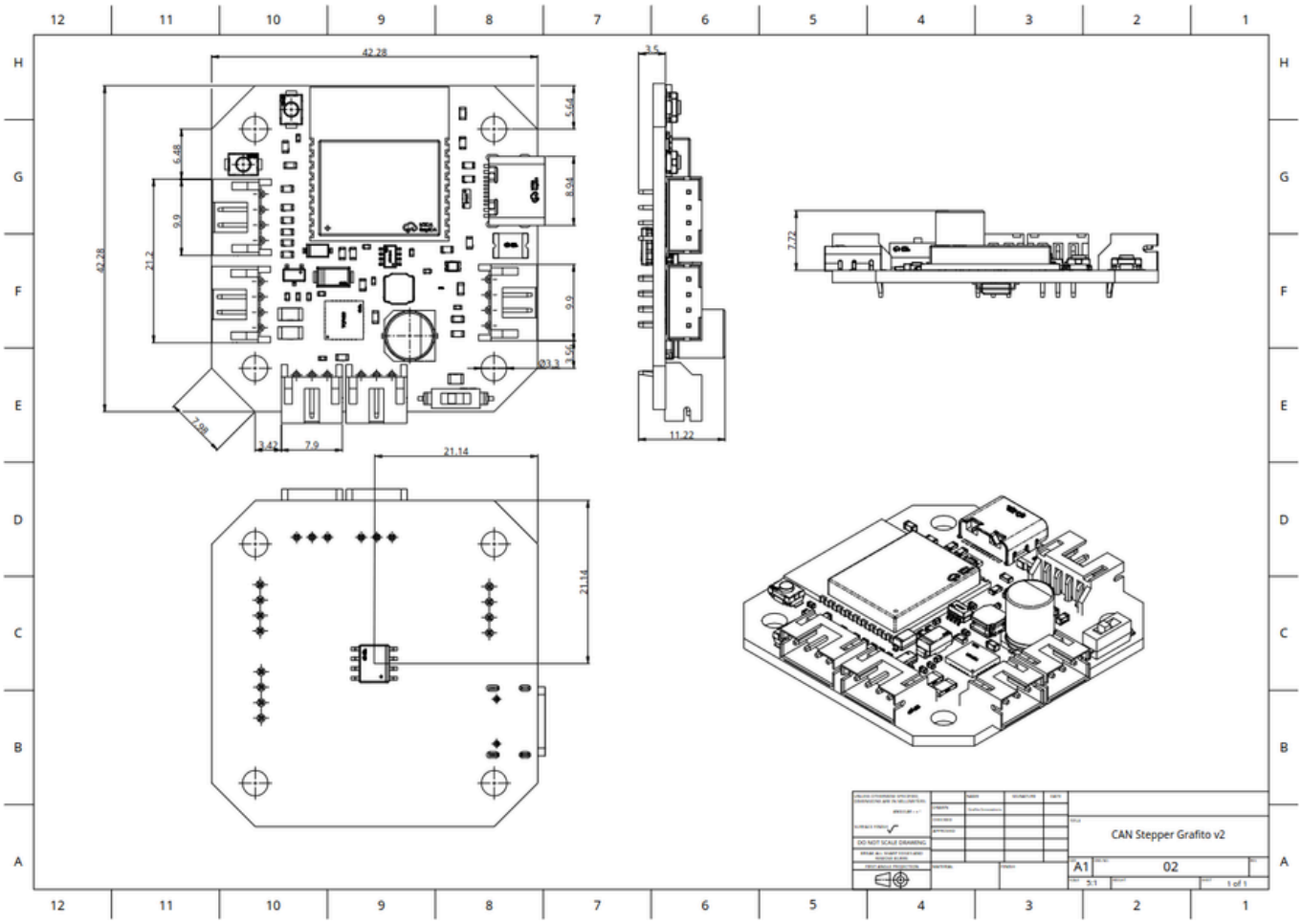
CAN Termination & Power: The onboard DIP switch allows CAN termination to be enabled or disabled at each node. For reliable CAN communication, enable termination only at the two physical ends of the bus and disable it on intermediate nodes. A 24 V DC bus supply is recommended to power the connected CANStepper nodes.

Connector and termination interface

Connector	What it is
4-position JST PH 2.0	+24V / CANL / CANH / GND
3-position JST PH 2.0	Micro Switch / Proximity or Inductive Switch input
DIP switch	CAN termination ON / OFF
USB-C	Programming and configuration

2 Mechanical

The board mounts on the back of the NEMA 17. All dimensions are in millimeters



CANStepper V2 — 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

3 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

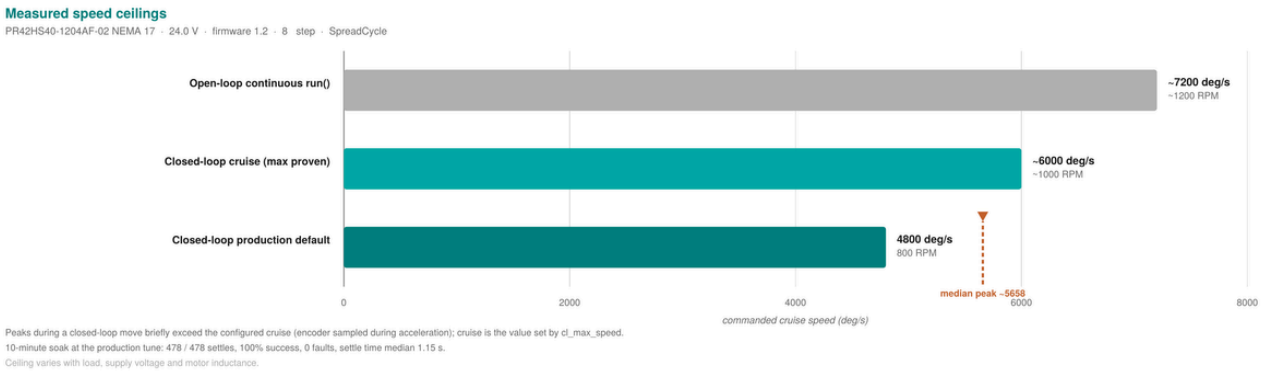
Measured on a PR42HS40-1204AF-02 NEMA 17 (1.8°, 1.2 A, 3.2 mH, 4.2 kg·cm) at 24.0 V, firmware 1.2. Your ceiling will differ with load, supply and motor inductance.

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°



4 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` — `pip install grafito-canstepper`
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	Per group	Bus-wide
Stop one axis and latch it	Stop a logical set of axes	One broadcast frame stops everything

E-stop latches until explicitly re-enabled.

5 Ordering

NEMA17 Closed Loop CAN Adapter Board

₹2,499 introductory (MRP ~~₹3,500~~)

NEMA17 Closed Loop CAN Adapter Board with Stepper Motor

₹3,499 introductory (MRP ~~₹4,500~~)

Free shipping across India · 15-day returns

Order at **grafito.in/shop** or on **Amazon.in** (ASIN B0H8XZ6V99)

Scan for the shop page

Included in the Box

- TMC2209 heat sink
- 6 X 4 way JST PH 2.0mm connector
- 2 × 3 way JST PH 2.0mm connector
- 4 X M3 40.0mm socket head screws
- Encoder magnet
- 4 X 3mm spacers
- 1 X CANStepper-to-motor connector

Grafito Innovations Private Limited
Cheruvathoor House, Choondal PO, Thrissur, Kerala 680502, India
+91 90740 56134 · hello@grafito.in · grafito.in · docs.grafito.in