

The image displays 18 circuit diagrams for stepper motor driver connections, organized into three groups of six. Each group corresponds to a different axis: X, Y, and Z. The diagrams show the power supply (3.3V and 24V), the motor driver IC (BSS138), the motor windings (X\_Step, X\_Dir, X\_Enable, etc.), and the connection to the motor driver IC (CN10, CN11, CN12, etc.).

**Group 1: X Axis**

- X\_Step:** 3.3V supply, 10k resistor (R35), 24V supply, 10k resistor (R36), BSS138 MOSFET (Q15), X\_STEP, X\_STEP\_COM, X\_Step\_24.
- X\_Dir:** 3.3V supply, 10k resistor (R41), 24V supply, 10k resistor (R39), BSS138 MOSFET (Q16), X\_DIR, X\_DIR\_COM, X\_Dir\_24.
- X\_Enable:** 3.3V supply, 10k resistor (R42), 24V supply, 10k resistor (R43), BSS138 MOSFET (Q17), X\_EN, X\_EN\_COM, X\_En\_24.
- Motor Driver IC:** CN10 X\_Driver, pins 6, 5, 4, 3, 2, 1, GND.

**Group 2: Y Axis**

- Y\_Step:** 3.3V supply, 10k resistor (R47), 24V supply, 10k resistor (R46), BSS138 MOSFET (Q18), Y\_STEP, Y\_STEP\_COM, Y\_Step\_24.
- Y\_Dir:** 3.3V supply, 10k resistor (R44), 24V supply, 10k resistor (R45), BSS138 MOSFET (Q19), Y\_DIR, Y\_DIR\_COM, Y\_Dir\_24.
- Y\_Enable:** 3.3V supply, 10k resistor (R38), 24V supply, 10k resistor (R37), BSS138 MOSFET (Q20), Y\_EN, Y\_EN\_COM, Y\_En\_24.
- Motor Driver IC:** CN11 Y\_Driver, pins 6, 5, 4, 3, 2, 1, GND.

**Group 3: Z Axis**

- Z\_Step:** 3.3V supply, 10k resistor (R48), 24V supply, 10k resistor (R49), BSS138 MOSFET (Q21), Z\_STEP, Z\_STEP\_COM, Z\_Step\_24.
- Z\_Dir:** 3.3V supply, 10k resistor (R51), 24V supply, 10k resistor (R50), BSS138 MOSFET (Q22), Z\_DIR, Z\_DIR\_COM, Z\_Dir\_24.
- Z\_Enable:** 3.3V supply, 10k resistor (R52), 24V supply, 10k resistor (R53), BSS138 MOSFET (Q23), Z\_EN, Z\_EN\_COM, Z\_En\_24.
- Motor Driver IC:** CN11 Z\_Driver, pins 6, 5, 4, 3, 2, 1, GND.

**Group 4: A Axis**

- A\_Step:** 3.3V supply, 10k resistor (R61), 24V supply, 10k resistor (R62), BSS138 MOSFET (Q24), A\_STEP, A\_STEP\_COM, A\_Step\_24.
- A\_Dir:** 3.3V supply, 10k resistor (R64), 24V supply, 10k resistor (R63), BSS138 MOSFET (Q25), A\_DIR, A\_DIR\_COM, A\_Dir\_24.
- A\_Enable:** 3.3V supply, 10k resistor (R65), 24V supply, 10k resistor (R66), BSS138 MOSFET (Q26), A\_EN, A\_EN\_COM, A\_En\_24.
- Motor Driver IC:** CN13 A\_Driver, pins 6, 5, 4, 3, 2, 1, GND.

**Group 5: B Axis**

- B\_Step:** 3.3V supply, 10k resistor (R59), 24V supply, 10k resistor (R58), BSS138 MOSFET (Q27), B\_STEP, B\_STEP\_COM, B\_Step\_24.
- B\_Dir:** 3.3V supply, 10k resistor (R56), 24V supply, 10k resistor (R57), BSS138 MOSFET (Q28), B\_DIR, B\_DIR\_COM, B\_Dir\_24.
- B\_Enable:** 3.3V supply, 10k resistor (R55), 24V supply, 10k resistor (R54), BSS138 MOSFET (Q29), B\_EN, B\_EN\_COM, B\_En\_24.
- Motor Driver IC:** CN12 B\_Driver, pins 6, 5, 4, 3, 2, 1, GND.

# Limit Switches

The schematic diagram illustrates the internal circuitry of the Raspberry Pi RP2040 Core board. Key components include:

- U1 (LM4040)**: Precision centigrade centimeter.
- U2 (RP2040)**: The main microcontroller unit.
- U3 (W25Q128JVSIGTR)**: 128Kbit SPI Flash memory.
- U4 (750R)**: Resistor network.
- U5 (670688000)**: USB-to-UART bridge chip.
- X1 (12MHz)**: Crystal oscillator.
- X2 (12pf)**: Capacitors for the crystal oscillator.
- R1-R12**: Various resistors for pull-up/pull-down and timing.
- C1-C12**: Various capacitors for decoupling and timing.
- LED1-LED2**: Status LEDs.
- H1-H2**: Headers for debugging and expansion.
- USB1**: USB connector.

The diagram shows the connections between these components and the RP2040 core, including power supply rails (VDD, VREF, L1V), ground connections, and signal lines (GPIOs, I2C, SPI, UART, USB).

# Power Management

The schematic diagram illustrates a power management system with the following components and connections:

- Power Sources:**
  - CN2 POWER:** A 4-pin connector providing 12V, 5V, and GND.
  - USB\_5V:** A 5V USB power source.
  - COM\_5V:** A 5V common power source.
  - 12V:** A 12V power source for the L7805CD2T-TR regulator.
  - 24V:** A 24V power source for the L78M12ABDT-TR regulator.
- Regulators:**
  - U30: L7805CD2T-TR:** A 5V linear voltage regulator.
  - U6: L78M12ABDT-TR:** A 12V linear voltage regulator.
- Microcontroller:**
  - U3: AP2112K-3.3TRG1:** A 3.3V microcontroller.
- LEDs:**
  - LED5:** A red LED connected to the USB\_5V source.
  - LED6:** A red LED connected to the 5V source.
- Passive Components:**
  - Capacitors:** C23 (10uF), C24 (0.1u), C1 (10uF), C2 (10uF), C21 (0.33u), C22 (0.1u), C16 (0.33u), C17 (0.1u), C4 (10uF).
  - Resistors:** R21 (330r), R20 (330r).
- Grounding:** Multiple GND connections are shown throughout the circuit.

### AUX 24v RP2040 Actuators

The diagram illustrates the wiring for two 24V actuators (CN16 and CN17) and two LEDs (LED9 and LED10) connected to the RP2040's AUX pins. The circuit uses two NPN transistors (Q11 and Q12, MMBT2222A) to switch the 24V supply. The base of Q11 is connected to AUX24\_OUT0 through a 10k resistor (R86), and the base of Q12 is connected to AUX24\_OUT1 through a 10k resistor (R87). The emitters of both transistors are grounded. The collectors of Q11 and Q12 are connected to the actuators and LEDs through a 100k resistor (R10). The actuators are labeled AUX\_24\_Out1 and AUX\_24\_Out0. The LEDs are labeled LED10 and LED9. The circuit is powered by a 24V supply and grounded.

# Safety Controls

The diagram illustrates the wiring for safety controls. It consists of two main sections: CN5 DOOR and CN6 Controls.

**CN5 DOOR:** A red box labeled 'CN5 DOOR' contains a terminal block with four pins. Pin 2 is connected to a blue wire labeled 'Safety\_door'. Pin 1 is connected to a green wire labeled '3.3V'. Pins 3 and 4 are unconnected.

**CN6 Controls:** A red box labeled 'CN6 Controls' contains a terminal block with five pins. Pin 4 is connected to a blue wire labeled 'Cyclostart'. Pin 3 is connected to a blue wire labeled 'feedhold'. Pin 2 is connected to a green wire labeled 'e-stop'. Pin 1 is connected to a green wire labeled '3.3V'. Pin 5 is unconnected.

[illegible]