



TNC-M34
Four Axes Motion Controller

Document: Operation Manual

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(Four Axis CNC Controller)

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This manual contains information for installing and operating the following product:

TNC-M34, Four Axes Offline CNC Motion Controller

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TNC-M34 Product Introduction

Thank you for your interest in our 4 Axis CNC Controller and for taking the time to read this manual.

The TNC-M34 is a cutting-edge 4-axis CNC controller designed for stepper and servo systems, embodying years of innovation in a compact, powerful package. Whether you're new to our products or upgrading from a previous model, you'll find the TNC-M34 intuitive to use, with this manual serving as your comprehensive guide. It is ideal for a wide range of CNC machines, including lathes, routers, mills, and pick-and-place systems, operating as a standalone unit without requiring a computer.

Key Features:

- Supports a comprehensive set of standard G/M codes for versatile programming compatibility across various CNC applications.
- Features a dual-core ARM processor for high-speed, efficient G-code processing and system responsiveness.
- Equipped with a 7-inch graphic display, providing vibrant visuals for clear monitoring and control.
- Includes a 36-key keypad with dual-purpose keys (function and numeric), designed for efficient and intuitive operation.
- Offers two USB ports for easy file transfers and peripheral connectivity, enhancing workflow flexibility.
- Incorporates an internal SD card, enabling storage of practically unlimited G-code file sizes for complex projects.
- Comes with a Manual Pulse Generator (MPG) pendant featuring its own display for precise manual control and real-time feedback.
- Upgradeable via firmware downloadable from <https://www.tinycontrols.com>
- Delivers exceptional precision and accuracy, with a reliable, user-friendly interface that can be mastered quickly.

Tiny Controls is committed to providing cutting-edge CNC solutions, and the TNC-M34 reflects our dedication to quality and innovation. With its robust feature set and adaptable design, this controller elevates your machining capabilities with ease and efficiency.

TNC-M34 Technical Specifications

1. **Inputs:** 16 opto-coupled NPN normally open (N/O) digital inputs, providing robust electrical isolation to ensure reliable signal detection from sensors, switches, or other devices.
2. **Open Collector Outputs:** 14 open collector 24V outputs, capable of sinking current up to 200mA each, ideal for driving external devices like LEDs, solenoids, or small relays.
3. **Relay Outputs:** 4 integrated relay outputs, offering isolated switching for higher-power applications such as coolant pumps or spindle motors, enhancing control flexibility.
4. **Stepper/Servo Outputs:** 8 differential outputs for precise control of stepper or servo motors, supporting up to 500 kHz interpolation pulse frequency per axis for smooth 4-axis linear and circular motion.
5. **Spindle Control:** Isolated 0-10V analog output for spindle speed regulation, with configurable PWM mode option, providing versatile compatibility with various spindle drives.
6. **Processor:** Dual-core ARM processor, delivering high-speed processing for real-time G-code execution and responsive user interaction, ensuring efficient standalone operation.
7. **Display and Interface:** 7-inch graphic display with vibrant visuals, complemented by a 36-key keypad for efficient navigation and input, combining functionality with a compact design.
8. **Power Supply:** Single 24VDC input at 0.5A, simplifying wiring and reducing setup complexity while powering both the controller and its I/O systems.
9. **Connectivity and Storage:** Two USB ports for file transfer and peripheral connection, plus an internal SD card supporting unlimited G-code file sizes, ensuring scalability for complex projects.
10. **MPG Pendant:** Includes a Manual Pulse Generator (MPG) pendant with its own display, enabling precise manual jogging and real-time position monitoring during setup or operation.
11. **Software and Hardware:** Ships with software version 1.01 (upgradeable via firmware from <https://www.tinycontrols.com>) and hardware version 1.0, offering a solid foundation with room for future enhancements.

The TNC-M34 is engineered to meet the demands of modern CNC operations, combining advanced technology with practical design to enhance your workshop's productivity and precision.

Controller Parts and Key Functions

The TNC-M34 4 Axis CNC Controller is designed for intuitive operation and precise control in a compact, robust package. This section outlines the main components of the controller and its Manual Pulse Generator (MPG) pendant, along with the functions of the keypad and other interface elements. Familiarizing yourself with these parts will help you operate the controller efficiently for a wide range of CNC applications.

Main Controller Components

1. 7-Inch Graphic Display:

Located at the top centre of the controller, the 7-inch graphic display provides a clear, vibrant interface for monitoring machine status, coordinates, and G-code execution. It displays real-time information such as axis positions, feed rates, spindle speed, and operational modes. The display also supports navigation through menus for file management, parameter settings, and more.

2. 36-Key Keypad:

Positioned below the display, the 36-key keypad is the primary input interface for controlling the TNC-M34. The keys are color-coded and labelled for specific functions, including axis control, jogging, operation modes, and system commands. The keys serve dual purposes as both function and numeric inputs, enhancing operational efficiency.

3. USB Ports:

Two USB ports are located on the right side of the display, labelled "USB." These ports allow for easy file transfer of G-code programs, firmware updates, and connection of external peripherals, ensuring seamless integration with your workflow.

Handheld Pendant Components and Functions

The TNC-M34 4 Axis CNC Controller comes equipped with a Manual Pulse Generator (MPG) pendant, designed to provide precise manual control over the machine's axes during setup, testing, or operation. The handheld pendant enhances user flexibility by allowing operators to jog axes, zero positions, and perform other functions without needing to interact directly with the main controller's keypad. This section details the components of the pendant, their functions, and their integration with the TNC-M34 system.

1. Monochrome Display:

Located at the top of the pendant, the small monochrome display provides real-time feedback on the machine's status. It shows the selected axis (X, Y, Z, or A), the current position of the selected axis, and the active scale setting (e.g., 1, 10, 100, 1000). This display mirrors the axis selection and scale indicators on the main controller in currently selected work coordinate (G54 .. G59), ensuring the operator has immediate access to critical information while away from the main screen.

2. Rotary Dial (Handwheel):

The large rotary dial, positioned centrally on the pendant, is the primary tool for manual axis jogging. The handwheel allows for fine, incremental movements of the selected axis, with each pulse corresponding to a specific distance based on the active scale setting (e.g., 1 micron, 10 microns, 100 microns, or 1000 microns per pulse). The dial provides tactile feedback, enabling precise positioning during setup or tool alignment. The scale setting is adjusted using the "Jog Scale" key on the main controller or on the pendant, which is reflected on both the main display and the pendant's display.

3. Jog Axis Selection Button:

Allows the operator to cycle through X, Y, Z, A to select the axis to jog. Activates the corresponding axis for manual movement via the rotary dial or through Jog buttons (Arrow Keys) on the main controller. The selected axis is indicated by a red LED on the main controller's display (labelled "Axis") and is also shown on the pendant's display for confirmation.

4. Jog Scale Selection Button:

Sets jogging increment, correspond to the scale settings on the main controller (e.g., 1 micron, 10 microns, 100 microns, or 1000 microns per pulse in step mode). In continuous mode, these settings adjust the jogging speed (e.g., slow, medium, fast). The active scale is indicated by a green LED on the main controller's display (labelled "Scale") and is also shown on the pendant's display.

5. Zero Buttons:

XYA Zero: Sets the currently selected axis to zero, establishing a reference point for current WCS (working coordinate G54 ... G59). This function is equivalent to the "X-Zero," "Y-Zero," "Z-Zero," and "A-Zero" keys on the main keypad.

Z Zero: Sets the Z axis to zero, establishing a reference point for current WCS (working coordinate G54 ... G59). This function is equivalent to the "Z-Zero" key on the main keypad.

6. Toggle Spindle Zero Button:

Toggles Spindle ON/OFF. This function is equivalent to the "Spin-T" key on the main keypad.

7. Start Cycle Button:

Starts the Cycle if not in running (Idle) state. While the machine is running these key acts as Pause/Resume key.

Note: Once cycle is started from pendant, it can be only paused and resumed from pendant, to Cancel/Stop the cycle use "Stop" key on the main controller.

Integration with Main Controller

- **Axis and Scale Synchronization:** The pendant's axis and scale selections are synchronized with the main controller. When an axis or scale is selected on the pendant, the corresponding LED indicators on the main display (e.g., "X," "Y," "Z," "A" for axis; "1," "10," "100," "1000" for scale) light up, ensuring consistency between the two interfaces.
- **Real-Time Feedback:** The pendant's display updates in real-time as the axes move, reflecting the same position data shown on the main 7-inch graphic display. This allows the operator to monitor axis positions while working at a distance from the controller.
- **Cable Connection:** The pendant is connected to the main controller via a cable, providing flexibility to move around the machine while maintaining a reliable connection. The cable connects to a port on the main controller (exact location to be specified in the "Wiring" section).

Main Screen Layout

The TNC-M34 4 Axis CNC Controller features a 7-inch graphic display that serves as the primary interface for monitoring and controlling CNC operations. The main screen provides a comprehensive view of the machine's status, including axis positions, active G/M codes, feed rates, spindle speed, and more. This section details the layout and functionality of the main screen, helping users navigate and interpret the displayed information effectively.

The main screen is organized into several sections, each displaying critical information for machine operation. The layout is designed for clarity, with color-coded elements and intuitive labels to facilitate quick decision-making during setup and machining.

1. Top Section: Active G/M Codes and Status

- **Active G-Codes:** The top left displays the currently active G-codes, such as G54 (work coordinate system 1), G21 (metric units), G90 (absolute positioning), and G17 (XY plane selection). These codes indicate the controller's operational mode and settings.
- **Homing Required Indicator:** The "Homing Required" message in red at the top right signals that the machine needs to perform a homing sequence to establish a reference position for the axes. This is typically required after powering on or resetting the controller.

2. Axis Position Display (Center Right)

- The central right section shows the current positions of the X, Y, Z, and A axes in real-time:
 - **X: -3.400**
 - **Y: 104.400**
 - **Z: -1.400**
 - **A: 10**
- These values are displayed in the active unit system (e.g., millimeters if G21 is active, as shown). The positions update dynamically as the machine moves, providing immediate feedback during jogging or G-code execution.

3. Operational Parameters (Center Left)

- **Feed Rate (F):** Displays the current feed rate (F3: 840.000 units/min), which can be adjusted using the Feed-O key.
- **Spindle Speed (S):** Shows the spindle speed (S0: 1000 RPM), adjustable via the Spin-O key.
- **Tool Information:** Indicates the active tool number (Tool: 3) and tool length offset (ToolL: 0.000).
- **Units:** Confirms the active unit system (Units: MM).

- **Output Status:** Shows the state of digital outputs (Output: 0), which can be controlled via M62-M65 codes.
- **Coordinate Mode (Coord):** Displays the active coordinate system (e.g., G54).
- **Path Information:** Indicates the current G-code file path (e.g., /USB-DISC/TNC-M34).
- **File Name:** Shows the loaded G-code file (Name: 19072509.NC).
- **Line Information:** Displays the current line number (Line: 0) and total lines (N69).
- **Block Information:** Shows the current G-code block being executed (e.g., N69).
- **Tip:** Provides a brief tip or status message (e.g., "Z end").
- **Time:** Displays the current time (e.g., 19:01:25 PM).

4. Soft Keys (Left Sidebar, Green)

- The left sidebar contains soft keys (F1-F6) that correspond to context-sensitive functions, dynamically changing based on the active menu or mode:
 - **F1: Settings:** Accesses the settings menu for configuring parameters such as axis limits, feed rates, and system preferences.
 - **F2: Block Run:** Initiates a block run mode, allowing execution of specific G-code blocks for testing or partial program runs.
 - **F3: Block Delete Mode:** Enables block delete mode, where selected G-code blocks can be skipped during execution if marked with a specific identifier.
 - **F4: Auto Tool Zero:** Automates the tool zeroing process, setting the tool's reference position for accurate machining.
 - **F5: Start Program from Specific Line:** Allows the user to start G-code execution from a specified line number, useful for resuming or skipping sections of a program.
 - **F6: Set Date/Time:** Opens the date and time settings to configure the system clock, ensuring accurate timestamps for logs and operations.

5. Status Indicators (Top Bar)

- **Scale Indicators (Left):** Green LEDs labelled "1000," "100," "10," and "1" indicate the active jogging scale (e.g., 1 micron, 10 microns, etc.), corresponding to the Jog Scale key.
- **Axis Indicators (Right):** Red LEDs labelled "X," "Y," "Z," and "A" show the currently selected axis for jogging, controlled by the Jog Axis key.
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Functionality and Usage

- **Real-Time Monitoring:** The axis positions and operational parameters update in real-time, allowing users to monitor the machine's state during setup, jogging, or G-code execution.

- **Homing Requirement:** The "Homing Required" message prompts the user to press the Homing key to initialize the machine's reference position, ensuring accurate positioning.
- **Soft Key Navigation:** The F1-F6 keys provide quick access to essential functions, reducing the need to navigate through multiple menus. Their labels change depending on the context (e.g., file management, tool setup).
- **Operational Feedback:** Parameters like feed rate, spindle speed, and tool data help users verify that the machine is operating within desired settings, with overrides available via the keypad (e.g., Feed-O, Spin-O).
- **File and Program Status:** The file name, line number, and block information keep users informed about the progress of the G-code program, with options to pause, resume, or stop execution using the Start, Pause, and Stop keys.

Additional Notes

- **Customization:** The soft key functions (F1-F6) can be customized via firmware settings to suit specific user needs, as detailed in the "Software & Operation" section.
- **Error Handling:** Messages like "Homing Required" or other alerts (e.g., limit switch triggers) will appear in red to ensure they are not overlooked.
- **Units and Precision:** The display adheres to the active unit system (e.g., millimetres), with axis positions shown to three decimal places for precision.

The main screen of the TNC-M34 provides a user-friendly interface for managing CNC operations, combining essential information with intuitive controls. For detailed instructions on specific tasks, such as homing or file loading, refer to the "Software & Operation" section.

Keypad Layout and Functions

The keypad is divided into functional groups for ease of use. Below is a detailed breakdown of the keys and their primary functions, based on their visible labels:

- **F1 to F6:** These keys serve function keys for quick access to not so frequently used features as shown on the main screen.
- **X-Zero, Y-Zero, Z-Zero, A-Zero:** These keys set the respective axis (X, Y, Z, or A) to zero, establishing a reference point for current WCS (G54...G59) for machining operations.
- **Jog Axis:** Allows the operator to cycle through X, Y, Z, A to select the axis to jog. Activates the corresponding axis for manual movement via the rotary dial or through Jog buttons (Arrow Keys) on the main controller. The selected axis is indicated by a red LED on the main controller's display (labelled "Axis") and is also shown on the pendant's display for confirmation.
- **Jog Scale:** Sets jogging increment, correspond to the scale settings on the main controller (e.g., 1 micron, 10 microns, 100 microns, or 1000 microns per pulse in step mode). In continuous mode, these settings adjust the jogging speed (e.g., slow, medium, fast). The active scale is indicated by a green LED on the main controller's display (labelled "Scale") and is also shown on the pendant's display.
- **Rapid-O:** Adjusts rapid traverse override (speed for G0 moves).
- **Feed-O:** Adjusts feed rate override for G1-G3 moves.
- **Spin-O:** Controls spindle speed override.
- **Limit-O:** Toggles soft or hard limit overrides.
- **DryRun:** Enables dry run mode to simulate G-code execution without actual movement.
- **Shift:** Activates secondary functions for keys with dual purposes (e.g., numeric input).
- **Spin-T:** Toggles spindle on/off.
- **WCS-T:** Toggles coordinate display between current WCS and Absolute machine coordinates.
- **WCS:** Manage Work Coordinate Systems (e.g., G54-G59 selection).
- **Z-Inhibit:** Disables Z-axis movement while running G-code file, mostly for testing operations.
- **Homing:** Initiates the homing sequence for all axes.
- **Space/Bk-Spc:** Inserts a space during text input or menu navigation or deletes one line or value.
- **0-9, Decimal (.):** Numeric keys for entering values like coordinates, feed rates, or spindle speeds.
- **Start:** Begins G-code execution from start of file.
- **Stop:** Halts G-code execution and reset program to Line 1.
- **Pause:** Pauses the current operation, allowing for manual intervention.
- **Resume:** Resumes a paused operation.
- **Go-Zero:** Moves all axes to the zero position, Z moves first and then other Axes simultaneously.
- **File:** Accesses the file management menu for loading G-code programs.
- **Left/Right arrow keys:** Use for continuous jogging the selected axis enabling smooth, uninterrupted axis movement while the key is held, also for navigation in settings etc.
- **Up/Down arrow keys:** Use for precise step mode jogging the selected axis also for navigation in settings etc.
- **Del:** Deletes a selected entry or resets a value.
- **OK:** Confirms selections or saves settings.
- **ESC:** Exits a menu or cancels an operation.

Settings Menu

The TNC-M34 4 Axis CNC Controller provides a detailed settings menu, accessible via the F1 soft key labelled "Settings" on the main screen. This menu allows users to configure a wide range of parameters to customize the controller's behaviour for specific machining tasks. The settings menu is organized into a hierarchical structure with main categories, subcategories, and individual parameters, ensuring users can easily adjust general settings, axis behaviour, I/O configurations, tool settings, and more. This section outlines the menu structure, the available parameters, and how to navigate and adjust them using the controller's keypad and display.

Accessing the Settings Menu

To access the settings menu:

1. From the main screen, ensure the controller is in a stopped or idle state (not running a G-code program).
2. Press the **F1** soft key (labeled "Settings").
3. The 7-inch graphic display will switch to the settings menu, displaying the main menu categories.

Settings Menu Structure

The settings menu is divided into main categories, with subcategories and parameters nested within them. Users can navigate through the menu using the keypad's **Up** and **Down** keys to scroll, the **OK** key to select an option, and the **ESC** key to return to the previous menu or exit. The structure and parameters are as follows:

Main Menu

1. **General Settings**
 - **STEP Pulse Width:** Sets the duration of the step pulse for motor control (e.g., 2 μ s), ensuring compatibility with stepper or servo drives.
 - **STEP Pulse Delay:** Defines the delay between step pulses (e.g., 1 μ s), optimizing motor performance and reducing jitter.
 - **Junction Deviation:** Adjusts the deviation tolerance for junction points in G-code paths (e.g., 0.01 mm), affecting path smoothing during high-speed moves.
 - **Arc Tolerance:** Sets the tolerance for arc approximation (e.g., 0.002 mm), ensuring accurate circular interpolation (G2/G3).
 - **Default Settings:** Restores factory default settings for all parameters, resetting the controller to its initial configuration.
2. **Axis Settings**
 - **X-AXIS SETTING**

- **Invert Dir Pin:** Toggles the direction pin polarity for the X-axis (e.g., Enable/Disable), reversing the motor direction if needed.
- **Flip Jog Key:** Inverts the X-axis jogging direction for the Jog keys (e.g., Enable/Disable), aligning with user preference.
- **Steps Per mm:** Sets the number of steps per millimetre for the X-axis (e.g., 1000 steps/mm), defining the resolution of movement.
- **Max Feedrate:** Defines the maximum feed rate for the X-axis (e.g., 5000 mm/min), ensuring safe operation.
- **Max Acceleration:** Sets the maximum acceleration for the X-axis (e.g., 500 mm/s²), controlling speed ramp-up.
- **Max Travel Limit:** Specifies the maximum travel limit for the X-axis (e.g., -100 to 100 mm), preventing over-travel.
- **Y-AXIS SETTING**
 - **Invert Dir Pin:** Toggles the direction pin polarity for the Y-axis (e.g., Enable/Disable).
 - **Flip Jog Key:** Inverts the Y-axis jogging direction for the Jog keys (e.g., Enable/Disable).
 - **Steps Per mm:** Sets the number of steps per millimetre for the Y-axis (e.g., 1000 steps/mm).
 - **Max Feedrate:** Defines the maximum feed rate for the Y-axis (e.g., 5000 mm/min).
 - **Max Acceleration:** Sets the maximum acceleration for the Y-axis (e.g., 500 mm/s²).
 - **Max Travel Limit:** Specifies the maximum travel limit for the Y-axis (e.g., -100 to 100 mm).
- **Z-AXIS SETTING**
 - **Invert Dir Pin:** Toggles the direction pin polarity for the Z-axis (e.g., Enable/Disable).
 - **Steps Per mm:** Sets the number of steps per millimetre for the Z-axis (e.g., 1000 steps/mm).
 - **Max Feedrate:** Defines the maximum feed rate for the Z-axis (e.g., 3000 mm/min).
 - **Max Acceleration:** Sets the maximum acceleration for the Z-axis (e.g., 400 mm/s²).
 - **Max Travel Limit:** Specifies the maximum travel limit for the Z-axis (e.g., -50 to 50 mm).

- **A-AXIS Settings**

- **Invert Dir Pin:** Toggles the direction pin polarity for the A-axis (e.g., Enable/Disable).
- **Flip Jog Key:** Inverts the A-axis jogging direction for the Jog keys (e.g., Enable/Disable).
- **Steps Per mm:** Sets the number of steps per degree for the A-axis (e.g., 100 steps/degree, assuming rotary axis).
- **Max Feedrate:** Defines the maximum feed rate for the A-axis (e.g., 3600 degrees/min).
- **Max Acceleration:** Sets the maximum acceleration for the A-axis (e.g., 300 degrees/s²).
- **Max Travel Limit:** Specifies the maximum travel limit for the A-axis (e.g., 0 to 360 degrees).

3. I/O Settings

- **Homing Settings**

- **Enable X Home:** Enables/disables homing for the X-axis (e.g., Enable/Disable).
- **Enable Y Home:** Enables/disables homing for the Y-axis (e.g., Enable/Disable).
- **Enable Z Home:** Enables/disables homing for the Z-axis (e.g., Enable/Disable).
- **Enable A Home:** Enables/disables homing for the A-axis (e.g., Enable/Disable).
- **Invert X Dir:** Inverts the X-axis homing direction (e.g., Enable/Disable).
- **Invert Y Dir:** Inverts the Y-axis homing direction (e.g., Enable/Disable).
- **Invert A Dir:** Inverts the A-axis homing direction (e.g., Enable/Disable).
- **Search Cycle:** Sets the number of search cycles for homing (e.g., 2 cycles) to ensure accuracy.
- **Home Debounce:** Defines the debounce time for home switches (e.g., 10 ms) to filter noise.
- **Sensor Clear:** Sets the distance to clear the home sensor after detection (e.g., 2 mm).
- **Home Feedrate:** Sets the initial homing feed rate (e.g., 2000 mm/min).
- **Home Seekrate:** Sets the fine seek rate for homing (e.g., 500 mm/min).
- **Z Safe Height:** Defines a safe Z-axis height during homing (e.g., 50 mm) to avoid collisions.

- **X Axis Pulloff:** Sets the pulloff distance for the X-axis after homing (e.g., 5 mm).
- **Y Axis Pulloff:** Sets the pulloff distance for the Y-axis after homing (e.g., 5 mm).
- **Z Axis Pulloff:** Sets the pulloff distance for the Z-axis after homing (e.g., 5 mm).
- **A Axis Pulloff:** Sets the pulloff distance for the A-axis after homing (e.g., 5 mm).
- **Limit Settings**
 - **Hard Limit:** Enables/disables hard limits using physical limit switches (e.g., Enable/Disable).
 - **Soft Limit:** Enables/disables soft limits based on travel limits (e.g., Enable/Disable).
- **Tool Settings**
 - **Tool Zero Sensor:** Enables/disables the tool zero sensor (e.g., Enable/Disable) for auto tool zero (F4 soft key).
 - **Tool Change Mode:** Sets the tool change mode (e.g., Manual/Auto), defining behaviour during tool changes.
- **Sensor Settings**
 - **Invert Home-X:** Inverts the X-axis home sensor polarity (e.g., Enable/Disable).
 - **Invert Home-Y:** Inverts the Y-axis home sensor polarity (e.g., Enable/Disable).
 - **Invert Home-Z:** Inverts the Z-axis home sensor polarity (e.g., Enable/Disable).
 - **Invert Home-A:** Inverts the A-axis home sensor polarity (e.g., Enable/Disable).
 - **Invert Limit:** Inverts the limit switch polarity (e.g., Enable/Disable) for all axes.
- **Spindle Settings**
 - **SPINDLE ON DELAY:** Sets the delay after turning on the spindle (e.g., 2 seconds) to allow it to reach speed.
 - **SPINDLE:** Type of spindle control (e.g., 0-10V or PWM).
 - **MIN RPM:** Sets the minimum spindle speed (e.g., 0 RPM) for the 0-10V output.
 - **MAX RPM:** Sets the maximum spindle speed (e.g., 24,000 RPM) for the 0-10V output.
 - **PWM FREQ:** Sets the PWM frequency for spindle control (e.g., 1000 Hz) if using PWM mode.
 - **PWM MIN DUTY:** Sets the minimum PWM duty cycle (e.g., 5%) for the lowest speed.

- **PWM MAX DUTY:** Sets the maximum PWM duty cycle (e.g., 95%) for the highest speed.

4. Tool Zero Settings

- **Sensor Height:** Sets the height of the tool zero sensor (e.g., 10 mm) for accurate measurement.
- **BackOff:** Defines the backoff distance after tool zeroing (e.g., 2 mm) to clear the sensor.
- **Distance:** Sets the total distance to move during tool zeroing (e.g., 50 mm).
- **Feed Rate:** Sets the feed rate for the initial tool zero approach (e.g., 100 mm/min).
- **Seek Rate:** Sets the fine seek rate for tool zeroing (e.g., 20 mm/min).
- **Pulloff Rate:** Sets the pulloff rate after tool zeroing (e.g., 50 mm/min).

5. Auto Measure Offset

- **Tool0_Reference:** Sets the reference offset for Tool 0 (e.g., 0 mm), used as the baseline for other tools.
- **Tool1_Offset:** Sets the offset for Tool 1 (e.g., 50 mm).
- **Tool2_Offset:** Sets the offset for Tool 2 (e.g., 52 mm).
- **Tool3_Offset:** Sets the offset for Tool 3 (e.g., 48 mm).
- **Tool4_Offset:** Sets the offset for Tool 4 (e.g., 55 mm).
- **Tool5_Offset:** Sets the offset for Tool 5 (e.g., 53 mm).
- **Tool6_Offset:** Sets the offset for Tool 6 (e.g., 51 mm).

6. Manual Edit Offset

- **Tool Offset Table**
 - **ToolR mm:** Sets the reference tool offset (e.g., 0 mm).
 - **Tool1 mm:** Sets the offset for Tool 1 (e.g., 50 mm).
 - **Tool2 mm:** Sets the offset for Tool 2 (e.g., 52 mm).
 - **Tool3 mm:** Sets the offset for Tool 3 (e.g., 48 mm).
 - **Tool4 mm:** Sets the offset for Tool 4 (e.g., 55 mm).
 - **Tool5 mm:** Sets the offset for Tool 5 (e.g., 53 mm).
 - **Tool6 mm:** Sets the offset for Tool 6 (e.g., 51 mm).

7. TFT_LCD BackLight

- Adjusts the brightness of the 7-inch graphic display (e.g., 0-100%), allowing users to optimize visibility.

8. Pendant BackLight

- Adjusts the brightness of the MPG pendant's monochrome display (e.g., 0-100%), ensuring readability in various lighting conditions.

9. Hardware Version

- Displays the hardware version of the TNC-M34 (e.g., V1.0), for reference during troubleshooting or updates.

10. Firmware Version

- Displays the current firmware version (e.g., 1.01), with an option to check for updates via USB from <https://www.tinycontrols.com>.

RTC Menu

The Real-Time Clock (RTC) settings are accessible within the settings menu, typically under a "System" or "General Settings" category, or directly via the F6 soft key ("Set Date/Time").

• RTC SETTING

- **YEAR:** Sets the current year (e.g., 2025).
- **MONTH:** Sets the current month (e.g., 03 for March).
- **DATE:** Sets the current day (e.g., 19).
- **MINUTES:** Sets the current minutes (e.g., 01).
- **HOURL:** Sets the current hour (e.g., 07 for 7 PM).
- **AM/PM:** Selects AM or PM for the 12-hour clock format (e.g., PM).

Navigating and Adjusting Settings

1. Navigation:

- Use the **Up** and **Down** keys to scroll through the list of categories, subcategories, or parameters.
- Press **OK** to enter a category/subcategory or select a parameter for editing.
- Press **ESC** to return to the previous menu or exit the settings menu.

2. Editing Parameters:

- Once a parameter is selected, use the numeric keys (0-9, decimal) to enter a new value.
- Press **OK** to accept the new value, or **ESC** to cancel changes.
- For toggle options (e.g., Invert Dir Pin: Enable/Disable), use the **Left / Right** keys to cycle through available choices.

3. Saving Changes:

- After adjusting parameters, press Function key as displayed on the screen. Or to cancel and exit without saving the changes.
- Some changes may require a controller restart to take effect, indicated by a prompt on the display.

Additional Notes

- **Default Values:** The "Default Settings" option under "General Settings" allows users to restore factory defaults, resetting all parameters to their initial values.
- **Firmware Updates:** The "Firmware Version" option provides a way to check for updates, directing users to <https://www.tinycontrols.com> for the latest firmware.
- **Safety Considerations:** Adjusting parameters like "Max Feedrate," "Max Travel Limit," or "Hard Limit" should be done with caution to avoid exceeding the machine's mechanical limits. Always test changes in a safe environment (e.g., using DryRun mode).
- **Tool Offsets:** The "Auto Measure Offset" and "Manual Edit Offset" options provide flexibility for tool management, supporting up to 7 tools (ToolR and Tools 1-6).

The settings menu of the TNC-M34 provides extensive customization options, allowing users to tailor the controller to their specific machine and application needs. For detailed operational procedures, such as running a G-code program after configuration, refer to the "Software & Operation" section.

Supported G/M Codes

The TNC-M34 4 Axis CNC Controller supports a wide range of standard G and M codes, enabling precise control over motion, spindle operation, and auxiliary functions. These codes are compatible with common CNC workflows and are processed efficiently by the dual-core ARM processor. This section outlines the primary G and M codes supported by the TNC-M34, ensuring versatility for milling, routing, and other 4-axis applications. For the latest firmware updates and additional code support, refer to <https://www.tinycontrols.com>.

The TNC-M34 interprets these codes in real-time, supporting up to 500 kHz pulse frequency per axis for smooth operation. It includes acceleration management with look-ahead planning to optimize velocity and minimize jerk during complex motions. While the controller supports core motion and operational commands, advanced features like macro variables or arithmetic operations are not included, as these are better handled by external CAM software or GUIs.

Supported G Codes

- **G0**: Rapid positioning move to specified coordinates at maximum speed.
- **G1**: Linear interpolation move at the programmed feed rate (e.g., F value).
- **G2**: Clockwise circular interpolation (arc or helix) using I, J, K offsets or R radius.
- **G3**: Counterclockwise circular interpolation (arc or helix) using I, J, K offsets or R radius.
- **G4**: Dwell (pause) for a specified time (e.g., P value in seconds or milliseconds).
- **G17**: Select XY plane for circular interpolation (default plane).
- **G18**: Select XZ plane for circular interpolation.
- **G19**: Select YZ plane for circular interpolation.
- **G20**: Set units to inches.
- **G21**: Set units to millimetres.
- **G28**: Return to predefined home position (machine zero or intermediate point if specified).
- **G30**: Return to secondary predefined position (similar to G28).
- **G38.2**: Probing cycle toward workpiece, stops on contact, reports position (probe must be connected).
- **G40**: Cancel cutter compensation (default state).
- **G43.1**: Tool length offset applied dynamically (requires tool data).
- **G49**: Cancel tool length offset.
- **G53**: Move in machine coordinate system (non-modal, overrides work offsets).
- **G54-G59**: Select work coordinate system 1 through 6 for offset positioning.

- **G90:** Absolute distance mode (coordinates relative to origin).
- **G91:** Incremental distance mode (coordinates relative to current position).
- **G92:** Set temporary coordinate system offset (resettable).
- **G93:** Inverse time feed mode (feed rate based on time per move).
- **G94:** Units per minute feed mode (standard feed rate).

Supported M Codes

- **M0:** Program pause (stops execution until resumed manually).
- **M1:** Optional program pause (stops if configured, otherwise ignored).
- **M2:** Program end (stops execution without reset).
- **M3:** Spindle on, clockwise rotation (requires S value for speed).
- **M4:** Spindle on, counterclockwise rotation (requires S value for speed).
- **M5:** Spindle off.
- **M7:** Mist coolant on (if equipped and configured).
- **M8:** Flood coolant on (if equipped and configured).
- **M9:** Coolant off.
- **M30:** Program end and reset (returns to initial state).
- **M62-M66:** Digital I/O control and input waiting:
 - **M62:** Turns on a specified output in sync with motion (e.g., M62 P0 turns on output 0; supports up to 14 open collector outputs).
 - **M63:** Turns off a specified output in sync with motion (e.g., M63 P0 turns off output 0).
 - **M64:** Turns on a specified output immediately, independent of motion (e.g., M64 P0 turns on output 0).
 - **M65:** Turns off a specified output immediately, independent of motion (e.g., M65 P0 turns off output 0).
 - **M66:** Waits for a specified input to reach a defined state inputs (e.g., M66 P0 L1 waits for input 0 to go high).
Supports remaining NPN unused, that are not used as limit/homing/start-stop, probing etc.
- **Relay Output Control:** The 4 integrated relay outputs are controlled by M3, M4, M5, M7, M8, and M9, controlling high-power devices like spindle motors and coolant pumps.