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ZetaStar

PLASMA Torch Height Control



OPERATION MANUAL

ZETASTAR THC

PLASMA Torch Height Control | UP / DOWN / ON

Overview

ZetaStar measures the plasma arc voltage and controls torch height through output signals to a CNC or Z-axis motion system. The measured Plasma Voltage is compared with an adjustable Target Voltage to keep a stable cutting distance, even when the workpiece surface is not perfectly flat.

The 2.4-inch TFT display indicates measured voltage, the target reference, status icons and operating modes. The rotary knob is used to navigate the menu and adjust settings.

The 1:1, 1:50 and 1:100 plasma-voltage measurement inputs are photoelectrically isolated. Install and wire the system in accordance with all plasma-source safety instructions.

Technical Support

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Safety Warning — High Voltage

Electric shock can cause serious injury or death. Plasma cutting uses hazardous DC voltages; the torch, workpiece and other conductive parts may be live during cutting.

• Disconnect both the plasma source and CNC power before wiring, inspection or maintenance; follow the required isolation procedure and allow capacitors to discharge.

• Do not touch the torch, workpiece, arc-voltage terminals or exposed conductors while the system is energized.

• Use the plasma manufacturer’s divided-voltage output when available. Direct 1:1 connections must be treated as high voltage and require appropriately rated insulation and protection.

• Never connect raw 1:1 plasma voltage to the divided-voltage terminals.

• Installation and servicing must be performed by qualified personnel. Keep equipment dry and follow the plasma power-source grounding and safety guidance.



Technical Specifications

Supply Voltage	9-36 VDC typical; 48 VDC maximum
Current Draw	110 mA
Plasma Voltage Input	0-350 VDC typical; 600 VDC maximum
Plasma Voltage Interface	Photoelectric isolation
Control Outputs	Active-LOW, optically isolated
Supported Ratio	1:1 / 1:50 / 1:100
Display	2.4 inch TFT
Dimensions (L x W x H)	105 x 105 x 55 mm
Weight	230 g

TFT Display and Status Icons

The TFT display uses distinct icons to identify the voltage being shown and the current operating state.



USER — Target Voltage
Shows the operator-selected target reference. Rotate the knob to adjust it when local selection is enabled.



HIGH VOLTAGE — Plasma Voltage
When the plasma arc is active, the measured voltage appears. The reading updates approximately every 250 ms.



SD — Step/Direction
Identifies the STEP/DIR operating mode. The SPEED parameter controls correction pulse frequency.



AUTO PILOT
Indicates automatic capture of a stable measured arc voltage as a new Target Voltage after piercing.



HYSTERESIS — No-correction band
Displayed when the measured voltage is within the allowable band around the target and no height correction is necessary.



UP — Height Correction
Indicates that the THC is requesting an upward Z-axis correction.



DOWN — Height Correction
Indicates that the THC is requesting a downward Z-axis correction.

Turning the knob during an active arc can temporarily show Target Voltage in place of the measured value.

Target Voltage and Plasma Voltage

Target Voltage

Target Voltage is the reference arc voltage for the desired torch height. When the torch moves away from the metal, arc voltage normally rises. When it approaches the metal, arc voltage normally falls. During a stable straight cut, make small changes to the reference until the correct cutting height is achieved.

Plasma Voltage

Plasma Voltage is the value measured at the selected raw or divided input. The THC compares this measurement with Target Voltage to decide whether a Z-axis correction is required.

Direction and Adjustment

A measured voltage above the target normally indicates a greater torch-to-workpiece distance; a measured voltage below target indicates a smaller distance. The output direction and machine polarity must be verified with a controlled test before live cutting.

Do not adjust Target Voltage to compensate for an incorrect probe offset, improper pierce height, loose wiring or incorrectly configured Z-axis movement.

Menu Parameters

Press the rotary knob to enter the settings menu. Turn it to select and adjust each parameter. The names below match those displayed on the ZetaStar screen.

SPEED

SPEED determines the frequency of STEP pulses and therefore how quickly the Z axis responds to torch-height corrections in Step/Direction (SD) mode. In this mode the CNC STEP and DIR commands are routed through the THC to a compatible Z-axis stepper or servo driver. Increasing SPEED makes corrections faster; decreasing it produces gentler motion.

Start with conservative Z-axis speed, acceleration and travel limits. Check STEP/DIR polarity, driver signal levels and direction with the torch disabled. A reference starting value for the comparable pulse-frequency setting is 14; confirm the actual ZetaStar setting before use.

HYSTERESIS

HYSTERESIS creates a no-correction band around Target Voltage, reducing constant small UP/DOWN movements. A lower value gives a more sensitive response; a higher value reduces hunting but may decrease height accuracy. Typical adjustment range: 1–15 V; reference default: 1 V.

Example: Target Voltage 120 V with HYSTERESIS 2 V gives an approximately 118–122 V neutral region. Increase the value slightly if Z-axis motion oscillates repeatedly around the target.

PIERCE DLY

PIERCE DLY temporarily suspends automatic height correction while the plasma arc pierces the workpiece. During ignition and piercing the arc voltage may be unstable. Corrections resume after the set delay when the arc has settled. Typical adjustment range: 1–15 seconds; reference default: 1 second.

Increase PIERCE DLY if the torch attempts to move during piercing. Avoid unnecessarily long delays, as the THC cannot compensate for material variation while correction is suspended.

CALIBRATION

CALIBRATION corrects a consistent difference between the measured Plasma Voltage displayed by ZetaStar and an appropriately rated calibrated reference meter. First confirm the divider ratio and the wiring. Calibration aligns the displayed measurement; it does not change the physical arc voltage or plasma power-source output.

Only qualified personnel using suitable high-voltage measuring instruments may make measurements across an energized plasma circuit. If an external 0–10 V analog reference requires checking, verify it independently with a suitable meter; do not confuse analog reference readings with arc-voltage measurement.

AUTO PILOT

When AUTO PILOT is enabled, after the piercing phase and the selected timing interval, the stabilized measured Plasma Voltage is copied into Target Voltage. The stored reference stays in use until the next capture, reducing repeated manual adjustment when cutting materials of different thicknesses.

Use a correctly configured probe sequence and pierce height so that the recorded voltage represents stable cutting at the intended torch height.

LOW CUT

LOW CUT rejects readings below the valid plasma-voltage range. Low readings can occur when the plasma source is idle, while the arc is establishing, or because of residual leakage or electrical noise. Ignoring them prevents false UP/DOWN corrections.

Set LOW CUT above unwanted idle readings but below the normal cutting voltage. A reference default is 40 V; check the operating condition of the actual plasma source.

ANTI-DIVE

Near the end of a cut, at an edge or during a sudden change in arc conditions, Plasma Voltage may rise sharply. Without protection the THC could interpret this as excessive torch height and command an unwanted downward movement. ANTI-DIVE suppresses height corrections when measured Plasma Voltage exceeds Target Voltage plus the configured protection margin.

Condition: Plasma Voltage > Target Voltage + ANTI-DIVE

Choose a margin that ignores end-of-cut spikes without blocking corrections during a steady cut. If the torch dives toward the sheet at cut end, adjust the threshold gradually and verify the response in a controlled test.

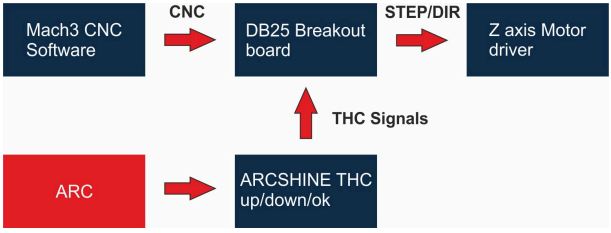
TEST Z AXIS

TEST Z AXIS produces a controlled test sequence of output commands so the installer can verify UP/DOWN signals, CNC input assignments, and physical Z-axis movement without a live plasma arc. Confirm output polarity and direction independently, with Z-axis travel restricted.

The SD indicator on the TFT identifies Step/Direction operation. SPEED is its motion-response parameter; this manual explains the SD control method in the SPEED section above.

Signal Path

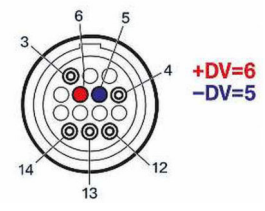
This diagram illustrates the relationship between the plasma arc, THC, CNC breakout board and Z-axis motor driver. Select wiring appropriate to the active control mode.



Arc-Voltage Connections

ZetaStar accepts raw 1:1 voltage or divided 1:50 / 1:100 inputs. Use the plasma source manufacturer's divided-voltage output when possible. Match the chosen ratio and never connect raw arc voltage to the divided terminals.

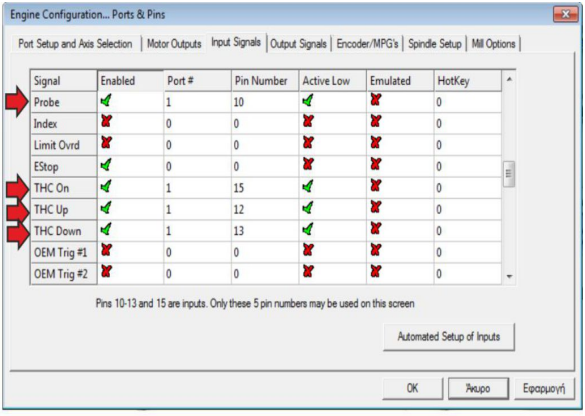
Example: Hypertherm Powermax45



Illustrative 1:50 connector assignment: +DV pin 6 and −DV pin 5. Verify the exact cutter connector and hardware revision before wiring.

Mach3 Input Configuration

In Mach3, open Config > Ports and Pins > Input Signals. Enable the THC signals and assign the correct port, pin number and active state for your breakout board.

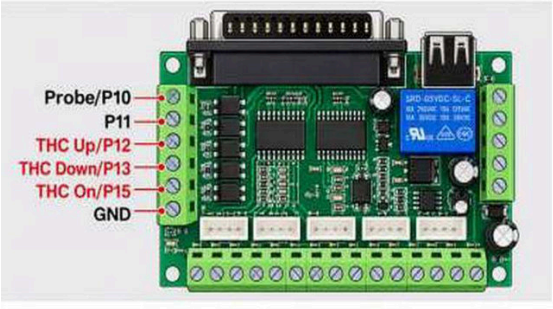


Example Input Assignments

Probe	P10
THC Up	P12
THC Down	P13
THC On	P15

These pin numbers are examples. Actual assignments depend on breakout-board wiring and the CNC controller.

Breakout Board and Z Axis



THC Travel Limits

Mach3 uses minimum and maximum THC correction limits to restrict total Z-axis travel during automatic height control. Limits that are too narrow may stop correction; excessive limits may allow unwanted movement.



The example changes THC Max from +5 to +50 and THC Min from −3 to −50. These are sample values, not recommended settings. Select appropriate limits and verify the result with a dry run.

Profile configuration

In some Mach3 versions, the THC travel-limit settings are stored in the active CNC profile XML. The example below shows the THCMax and THCMin entries in Plasma.XML.

If the XML file must be edited, first back up the profile and close Mach3. Use the settings available in Mach3 itself wherever possible.

Example: Mach3 profile XML

Plasma.XML

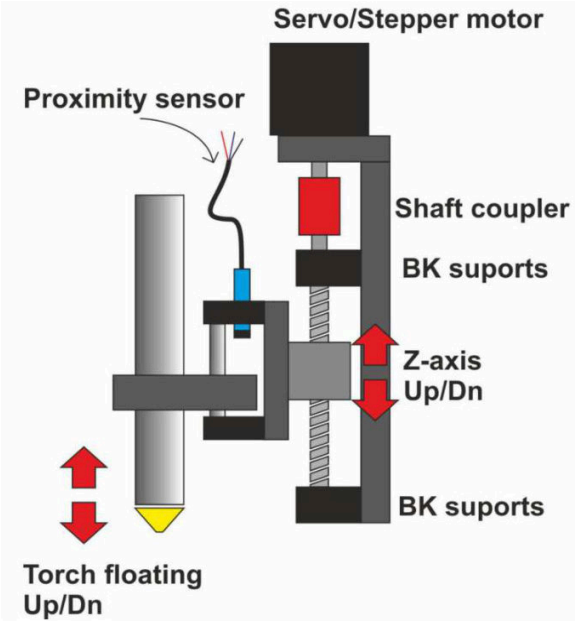
```
            <BacklashOn>0</BacklashOn>
            <PathMode>2</PathMode><ThrottleFunc>2</ThrottleFunc>
<JoyOn>0</JoyOn>
            <PWMBase>5000</PWMBase><JogSpeed>100.</JogSpeed>
<m_SafeZ>0.</m_SafeZ>
            <JogInc>100.</JogInc><JogSlide>0.1</JogSlide>
            <THCMax>5.</THCMax><THCMin>-3.</THCMin><RadiusA>0.
</RadiusA>
            <RadiusB>0.</RadiusB><RadiusC>0.</RadiusC>
<LaserXGrid>0.</LaserXGrid>
            <LaserYGrid>0.</LaserYGrid><JogInc0>100.</JogInc0>
```

The screenshot shows sample limit values only. Set values appropriate to the actual Z-axis travel, units and torch clearance; excessively large limits may allow unwanted movement.

After any change, reopen Mach3 and verify the limits with a controlled dry run before live cutting.

Probing and Floating Z Axis

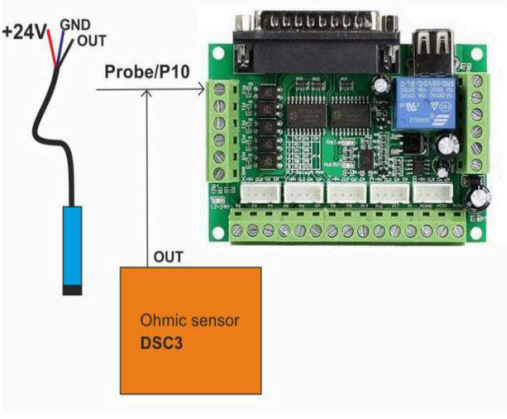
Before piercing, the CNC can probe the material surface to establish the correct starting position. A floating Z axis allows a small relative movement of the torch carriage to activate a switch or proximity sensor.



Configure the probe offset and pierce height in the CAM post-processor or CNC control software. Confirm correct retract movement before cutting.

Ohmic Probing and Z-Axis Design

Ohmic probing detects electrical contact between the torch and workpiece, which can improve surface location on thin sheet metal. A floating or proximity probe may remain an independent reference.



Shared Probe Input

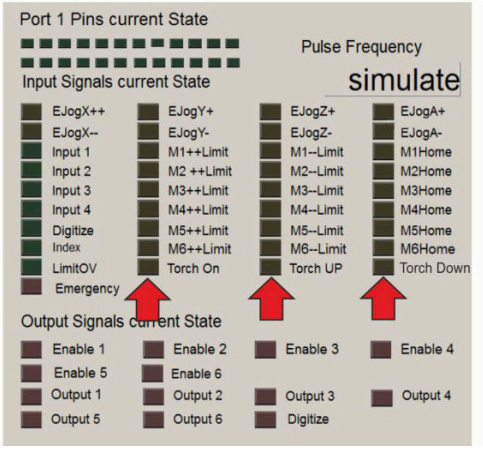
A proximity sensor and ohmic module may share a probe input only when their output types, reference wiring and electrical isolation are compatible. Do not connect unlike outputs without checking the electrical design.

Z-Axis Responsiveness

Responsive height control requires suitable Z-axis mechanics and correctly tuned motor-drive settings. Adjust Steps per Unit, speed and acceleration to match the ballscrew lead and motor-driver pulse configuration.

Testing and Commissioning

After all connections are checked, use TEST Z AXIS to activate UP and DOWN outputs and verify that the CNC receives the intended signals. Test without a live plasma arc.



Open Mach3 Diagnostics and observe the Torch On, Torch Up and Torch Down indicators. Confirm signal polarity and independently verify the Z-axis direction.

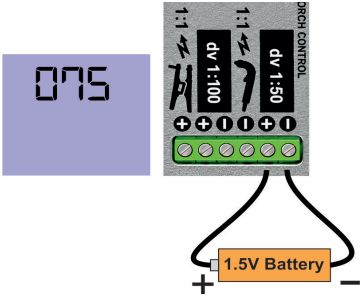
Troubleshooting

If a signal does not respond, check terminal wiring, breakout-board input assignment, common/reference and active-LOW configuration. Check driver pulse settings separately in SD mode.

Voltage Readings and Calibration

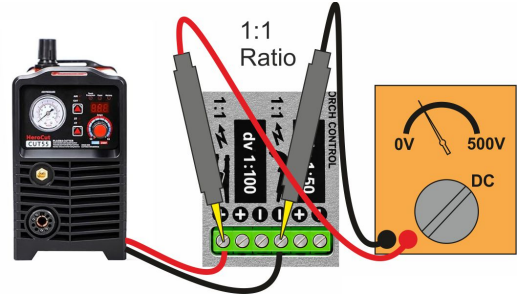
Illustrated 1:50 Reference Check

The example applies a 1.5 V battery to a 1:50 measurement input. At that ratio the display corresponds to approximately 75 V. This is a low-voltage illustration; never apply raw arc voltage to a divided input.



CALIBRATION — Display Correction

If a properly rated external reference meter and the displayed Plasma Voltage disagree consistently, CALIBRATION can align the displayed measurement. It does not alter the physical arc voltage or torch-height control mechanism.



Quick Setup and Troubleshooting

Incorrect Target Voltage

Confirm the selected control source (rotary knob or external analog reference) and make small changes only during a stable cut.

Oscillating Z Axis

Increase HYSTERESIS slightly and verify stable arc voltage. Reduce SPEED if Z-axis response is excessively abrupt. Avoid values that make corrections too slow or inaccurate.

Corrections during piercing

Increase PIERCE DLY until automatic movement remains suspended while the pierce completes and the arc stabilizes.

Low or residual voltage

Set LOW CUT above unwanted idle readings but below normal cutting voltage. Verify wiring and the selected divider ratio.

Torch dive at cut end

Adjust ANTI-DIVE so end-of-cut voltage spikes are ignored without interfering with normal cutting.

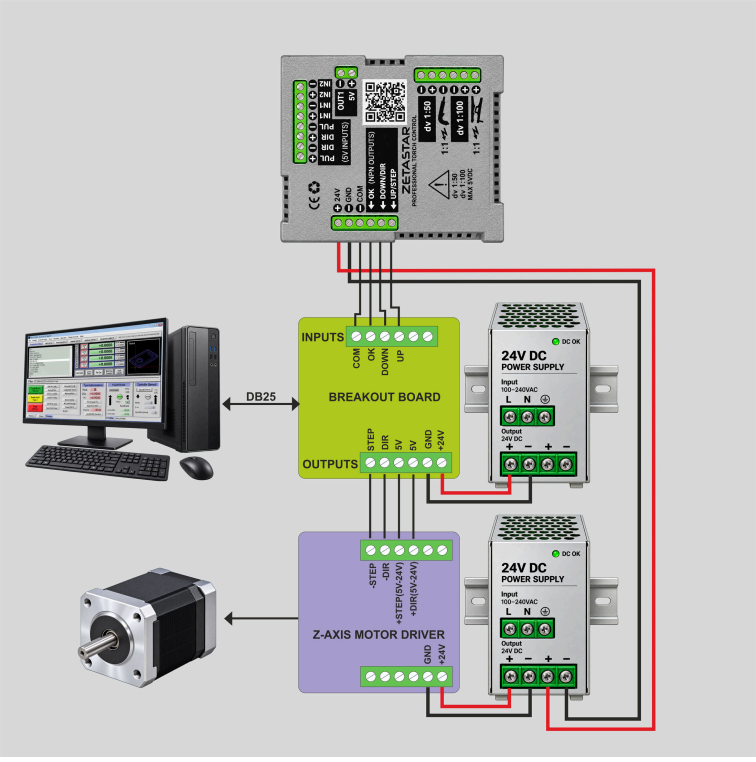
AUTO PILOT not updating

Confirm AUTO PILOT is enabled and that a valid stable plasma reading is available when the capture interval ends.

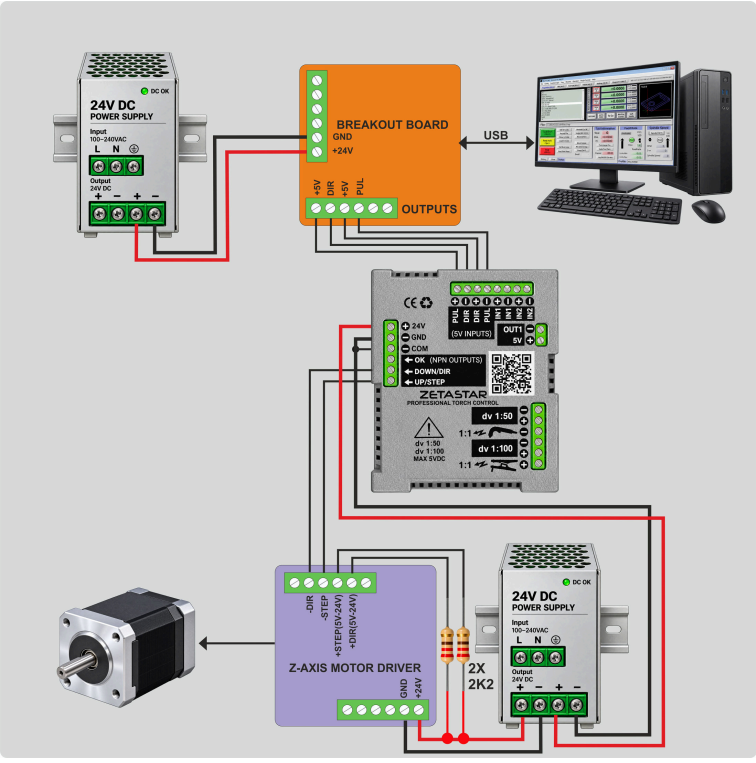
SD direction incorrect

Test STEP/DIR polarity and Z-axis direction at restricted travel. Check the CNC and motor-driver settings.

Up/Down/Ok interface & DB25 Breakout board



Step/Direction interface & USB Breakout board





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