NX-Plasma Hardware Manual - NPN - Version 2026.5

NevexTech LTD

Contents

1 Introduction

Welcome to the NX-Plasma Hardware manual. This manual is designed to provide you with a comprehensive understanding of the NPN version of the NX-Plasma Motion Controller. Whether you are setting up a new plasma cutting system or upgrading your existing setup, this manual will guide you through the process of connecting, configuring, and utilizing the controller to its fullest potential.

The NX-Plasma Motion Controller represents a cutting-edge solution tailored specifically for managing plasma cutting tables. As an essential companion to the NX-Plasma CNC software, this controller takes charge of critical tasks such as controlling motor movements, managing input and output signals, and overseeing torch height adjustments during the cutting process.

To ensure you make the most of this manual, we recommend familiarizing yourself with the key features of the NX-Plasma Motion Controller, outlined in the next section. Whether you are an experienced professional or a newcomer to the world of CNC and plasma cutting, this manual aims to provide clear instructions and insights to empower you in achieving optimal performance and precision in your plasma cutting endeavors.

Please note that this manual is tailored to the NPN version of the controller. Therefore, we encourage you to verify that you have the correct version before proceeding with the installation and setup process. As you delve into the subsequent sections, you'll discover detailed information about connecting the controller, utilizing its various features, troubleshooting common issues, and understanding the warranty terms and limitations.

We are excited to embark on this journey of exploring the capabilities of the NX-Plasma Motion Controller with you. By the end of this manual, you'll be equipped with the knowledge and confidence to seamlessly integrate the controller into your plasma cutting workflow and unlock its full potential.

Let's dive in and begin your journey with the NX-Plasma Motion Controller!

1.1 What is the NX-Plasma Motion Controller?

The NX-Plasma Motion Controller is a specialized motion controller designed specifically for managing plasma cutting tables. It is meant to work in conjunction with the NX-Plasma CNC software, taking charge of tasks such as controlling motor paths, managing outputs, monitoring input signals, and overseeing torch height adjustment during the cutting process.

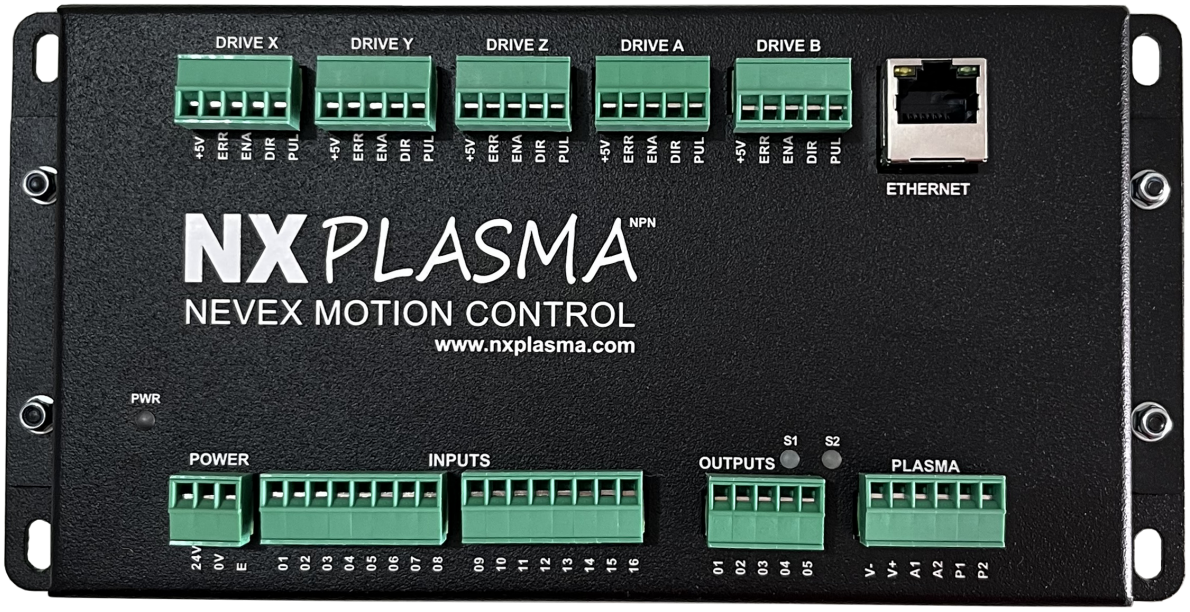


Figure 1: The NX-Plasma Motion Controller

1.2 Key Features

- Supports control for up to 5 axes (NPN signal).
- Integrated torch height control.
- Equipped with 16 optically isolated inputs (PNP).
- Features 5 solid-state relay outputs.
- Includes an analog input for plasma arc voltage.
- Built-in solid-state relay for initiating plasma cutting.
- Dedicated input for arc-ok signal.
- Step/Dir interface for servo or stepper drivers.
- Maximum frequency of 200 kHz.
- Operates with 24-volt inputs/outputs.
- Features a 10/100 Mbps Ethernet interface.

2 Connecting the NX-Plasma Controller

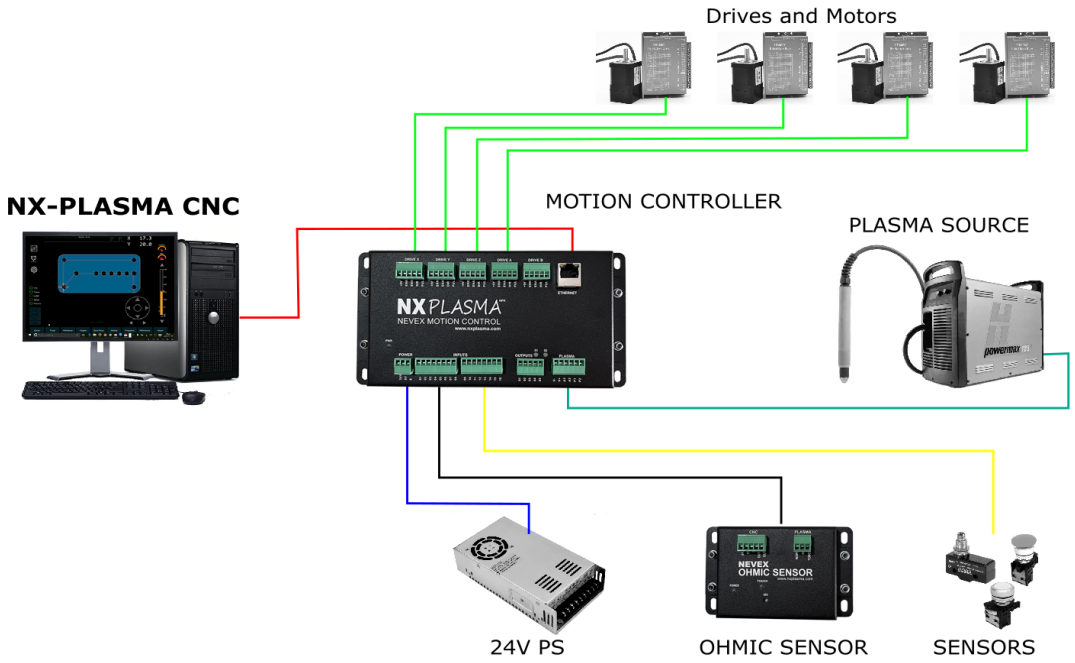


Figure 2: NX-Plasma CNC Overview

The NX-Plasma motion controller interfaces with the plasma cutting system through six different groups of connectors:

- Driver Connectors (X, Y, Z, A, B),
- Input Connectors,
- Output Connector,
- Plasma Source Connector,
- 24V Power Supply Connector,
- Ethernet Connector.

The **driver connectors** are **NPN open-collector type**. When active, the signal is pulled low to **0 V**.

The **input and output connectors** are **PNP type**. The inputs are activated by applying **24 V**, and the outputs supply **24 V** when active.

2.1 X, Y, Z, A, B Driver Connectors

The motion controller offers the capability to manage up to 5 axes, each equipped with a dedicated connector housing the necessary input and output lines to oversee a singular motor driver. Whether the driver is of the stepper or servo type, provided that it adheres to Step/Dir command logic, it can be controlled seamlessly. Notably, the output signals are of the NPN (open collector) variety, signifying that the controller will drive the output pin to zero volts upon activation. These outputs can handle voltages of up to 24 volts, with a current capacity of 10mA each.

The STEP signal is a series of rapid pulses that serve to advance the motor's position by one step, a fundamental unit of ovement. Each pulse corresponds to a discrete movement increment. On the other hand, the DIR (direction) signal governs the rotation direction of the motor. The DIR signal's state, either low or high, dictates whether the motor rotates in a clockwise or counterclockwise direction. In essence, the STEP signal triggers the motion, while the DIR signal determines the direction of rotation.

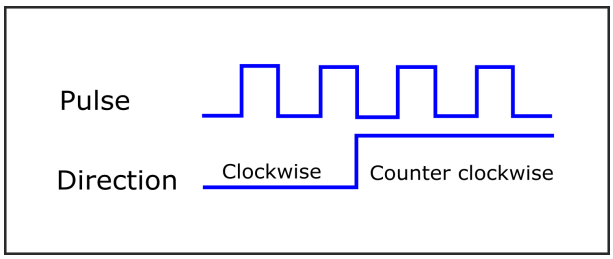


Figure 3: STEP / DIR Signals

For the driver to recognize a step pulse as valid, the pulse signal duration must meet the minimum pulse duration required by the driver. A typical value ranges between 1 microsecond and 5 microseconds. Refer to the driver's manual for the precise value. This parameter is adjustable in the NX-Plasma CNC software. The polarity of the direction signal is also adjustable to ensure motors rotate in the desired direction, either clockwise or counterclockwise.

The controller provides a connector for each axis, streamlining the driver's connection to the motion controller. The signals from this connector are NPN type, where the signal is low (0 volts).

Table 1: Driver connector pins

Pin:	Signal	I/O	Description
5	Step	Out	Step pulse signal
4	Direction	Out	Direction signal

Pin:	Signal	I/O	Description
3	Enable	Out	Enable signal
2	Error	In	Error indication
1	+5V	Out	+5V Voltage

Stepper motor drivers should be connected as depicted below:

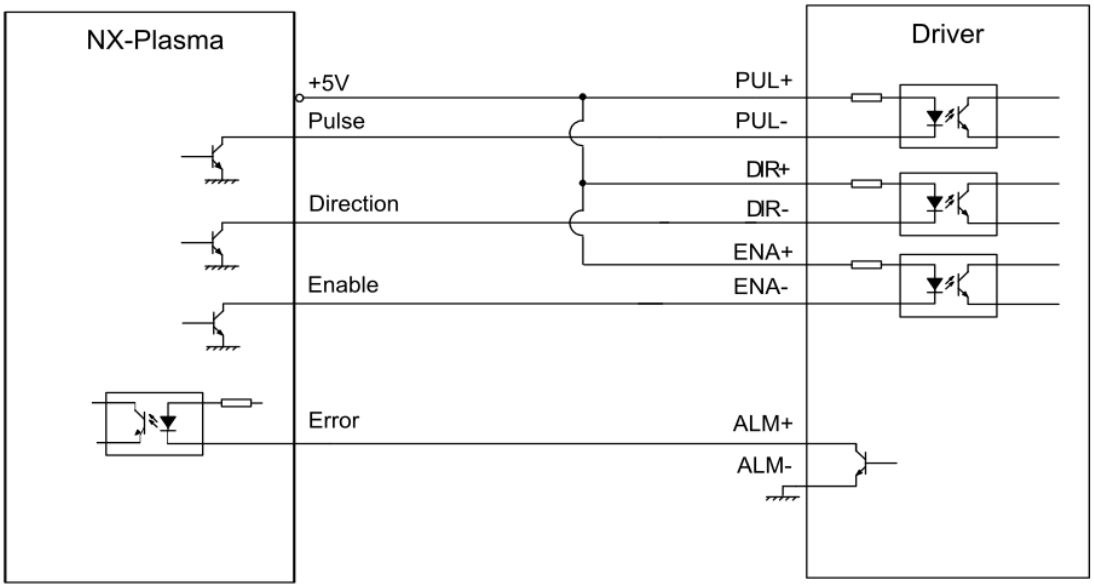


Figure 4: Driver Connection

The enable signal can be utilized to activate the motion drivers. If left unconnected, the default behavior of the drivers is to be enabled. Use this as a safety measure once the motors are functioning correctly. This signal is NPN. This signal is activated when virtual output 6 is activated.

The error signal is an input used in servo scenarios, where the servo generates a negative (NPN) signal to signify proper functioning. When the servo enters an alarm state due to a servo-related issue, the servo must deactivate the signal, and the controller will indicate the error.

Each axis error input is associated with a unique input pin number, as listed in the table below.

Table 2: Axis error input is associated with a unique input pin number

Axis:	Virtual Input
X	19
Y	20
Z	21
A	22
B	17

2.2 Input Connectors

The controller features 16 versatile general-purpose inputs meticulously crafted to facilitate sensor integration, including limit switches and emergency buttons, among other applications. These inputs are divided between two connectors, each boasting 8 inputs for convenient connectivity. Operating in adherence to the PNP principle, these inputs spring to action when a 24-volt signal is applied the input pin. The inputs are PNP type and are detected as active when 24 volts is applied.

Table 3: Pins for Input Connector 1

Pin	Description
1	Input 1
2	Input 2
3	Input 3
4	Input 4
5	Input 5
6	Input 6
7	Input 7
8	Input 8

Table 4: Pins for Input Connector 2

Pin	Description
1	Input 9
2	Input 10
3	Input 11
4	Input 12
5	Input 13
6	Input 14
7	Input 15
8	Input 16

IMPORTANT: To ensure safety, it is advised to consistently employ NC (normally closed) switches when wiring limit switches, reference switches, or emergency switches. This guarantees a continuous signal flow to the controller, and it's only when this signal is interrupted that the input gets triggered. This setup enables the CNC system to promptly detect wire breaks, thereby initiating an alarm.

An added advantage is the ability to link multiple switches to a single input. For instance, you have the flexibility to connect all limit switches to one input and allocate another input for all reference switches. This approach not only conserves input resources but also opens up additional inputs for other essential functions.

2.3 Output Connector

The controller is equipped with 5 general-purpose outputs designed to activate relays and other low-current devices. These outputs are PNP and output 24 volts when active. The maximum output current is 50mA.

IMPORTANT: Subjecting an output to a short circuit can lead to its impairment or malfunction. A short circuit occurs when there's an unintended connection between the output terminal and a low-resistance pathway. In such cases, a significantly higher current than the output's designed capacity flows through the circuit. This excessive current can generate excessive heat, potentially causing components within the output to overheat or even fail. To prevent this, it's crucial to ensure that outputs are properly connected and not subjected to short circuits, as such occurrences can compromise the functionality and longevity of the output.

Table 5: Pins of the output connector

Pin	Description
1	Output 1
2	Output 2
3	Output 3
4	Output 4
5	Output 5

2.4 Plasma Power Source Connector

The controller utilizes three distinct signals from the plasma power source: arc voltage, arc OK, and plasma start signals.

All three signals must be connected to the controller for proper CNC system operation. These signals should be connected to the plasma power source connector on the motion controller.

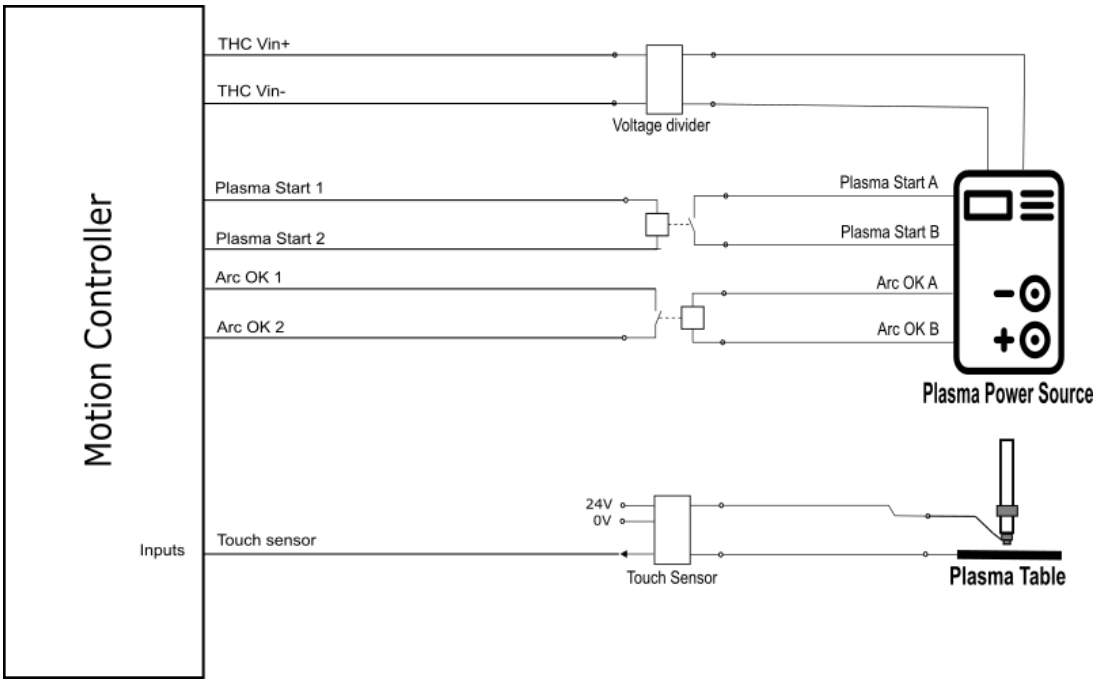


Figure 5: Plasma Power Source Connections

The connection diagram above shows the **Plasma Start** and **Arc OK** signals passing through external relays. This is not strictly necessary, because the controller already includes internal relays for these signals.

The advantage of using external relays is that they provide additional isolation between the controller and the plasma source.

The controller's internal relays are solid-state devices and are designed for low-current switching. Therefore, when using external relays, verify that they are also solid-state type relays and that their input current does not exceed **25 mA**.

Solid-state relays are recommended because they switch quickly and do not require diode protection circuits to suppress the high-voltage spikes generated when coil-type relays are switched off.

Arc Voltage Inputs - These two inputs should be connected to the arc voltage monitoring output of

the plasma power source. Most plasma power sources provide a voltage divided by 50, and that's the value to be used. The input voltage should range from 0V to 5V, corresponding to an arc voltage of 0V to 250V. Note that these inputs are polarized, and polarity must be respected; use a multimeter to check the polarity of the plasma power source signals.

IMPORTANT: If your plasma power source doesn't have a voltage divider, you will need to add one between the plasma output and the controller input. Not using a voltage divider will damage the controller.

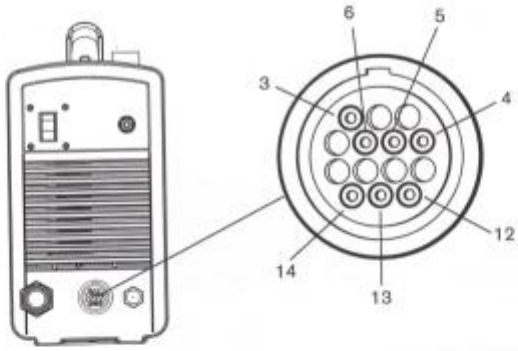
Arc OK - This signal is provided by the plasma power source when it detects that an arc has been created, indicating to the CNC controller to initiate the cutting operation. The two provided pins should be shorted (dry contact) to indicate that arc OK is active. Internally, they are connected to an opto-coupled input to provide electrical isolation, and when activated, virtual input number 18 is triggered.

Plasma Start - This signal is used to instruct the plasma power source to initiate the arc. Most plasma power sources provide two pins that, when shorted, will initiate the arc. The NX-Plasma motion controller features an internal solid-state relay for this purpose. This relay is a low-current relay and should not be used for any demanding current input. This relay is activated when virtual output number 7 is activated.

Table 6: Plasma Connector Pins

Pin	Signal	Type	Description
1,2	Arc Voltage	Input	Arc voltage divided by 50.
3,4	Arc OK	Input	Requires dry contact to activate. In an open circuit, presents 24V voltage at the arc OK terminals.
5,6	Plasma Start	Output	Normally open. Closed with a dry contact through a solid-state relay.

Plasma power source connectors may vary from supplier to supplier and from model to model. Refer to the plasma power source user manual for the correct pinout of the connectors. Below, we illustratively present an example of a plasma power source CNC connector:



Refer to the following table when connecting the Powermax45 to a torch height controller or CNC controller with a machine interface cable.

Signal	Start (start plasma)	Transfer (start machine motion)	Ground	50:1 voltage divider
Type:	Input	Output	Ground	Output
Notes:	Normally open. 18 VDC open circuit voltage at START terminals. Requires dry contact closure to activate.	Normally open. Dry contact closure when the arc transfers. 120 VAC/1 A maximum at the machine interface relay or switching device (supplied by the customer).		Divided arc signal of 50:1 (provides a maximum of 7 V).
Connector sockets	3, 4	12, 14	13	5, 6
Cable wires	Green, black	Red, black	Green/yellow	Black, red

Figure 6: Hypertherm CNC Connector

Table 7: Example connection with NX-Plasma controller

NX-Plasma	Plasma Power Source
Pin 1	Pin 5
Pin 2	Pin 6
Pin 3	Pin 12
Pin 4	Pin 14
Pin 5	Pin 3
Pin 6	Pin 4

2.5 24V Power Supply Connector

The NX-Plasma controller requires a 24-volt, 5-watt power supply to operate. This power supply is connected to the controller through the controller's power supply connector. For improved noise immunity, a separate power supply should be used for the controller and another for the motor drives.

Table 8: Power supply connector pins

Pin	Signal	Description
1	+24V	Positive 24V supply
2	0V	Return of power supply voltage
3	Ground	Earth ground connection

2.6 Ethernet Connector

For enhanced reliability in an industrial environment, the controller utilizes a network connection for communication with the CNC control software.

To ensure proper communication, the network adapter on the computer running the CNC control software needs to be configured to use a static IP address within the same subnet as the controller (192.168.0.*). Since the controller comes pre-configured with IP 192.168.0.100, we recommend setting the PC's IP to 192.168.0.2.

2.6.1 Configuring IP Address in Windows 10

- ☐ Open the Control Panel.
- ☐ Click on Network and Sharing Center.
- ☐ In the left panel, click on the Change adapter settings link.
- ☐ Right-click on your network adapter and select Properties.
- ☐ Select Internet Protocol Version 4 (TCP/IPv4).
- ☐ Click the 'Properties' button.

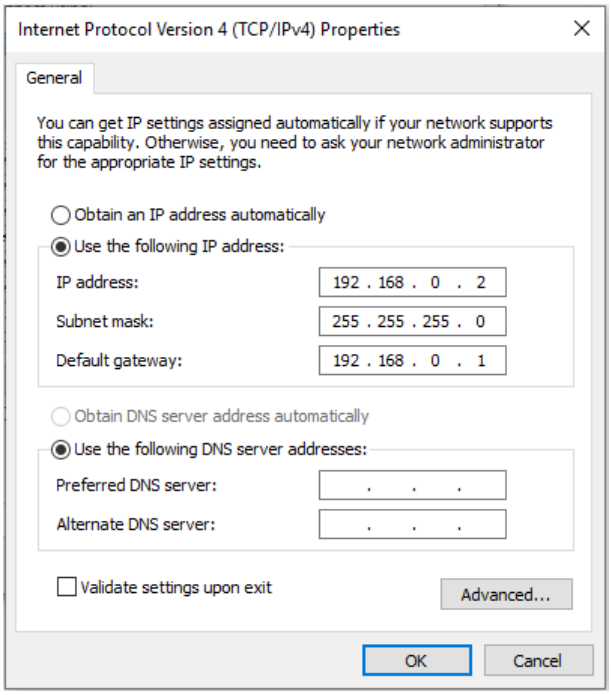


Figure 7: Network Adapter Settings

- ☐ Choose the option Use the following IP address.
- ☐ Set the IP address to 192.168.0.2.
- ☐ Set the Subnet mask to 255.255.255.0.
- ☐ Set the Default gateway to 192.168.0.1.
- ☐ Click OK. To verify communication with the controller, use the Ping command (in the command prompt window) to the controller's default IP address, 192.168.0.100.

```
C:\>ping 192.168.0.100

Pinging 192.168.0.100 with 32 bytes of data:
Reply from 192.168.0.100: bytes=32 time<1ms TTL=128
Reply from 192.168.0.100: bytes=32 time<1ms TTL=128
Reply from 192.168.0.100: bytes=32 time=1ms TTL=128
Reply from 192.168.0.100: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.0.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Figure 8: Ping Command Results

Ensure that no packets are lost during the test. Packet loss indicates unreliable communication and

should not be used for controlling CNC equipment. Also, ensure that the maximum response times are below 5ms.

2.7 Mounting Diagram

The NX-Plasma controller is mounted using four screws, and the mounting dimensions are depicted below:

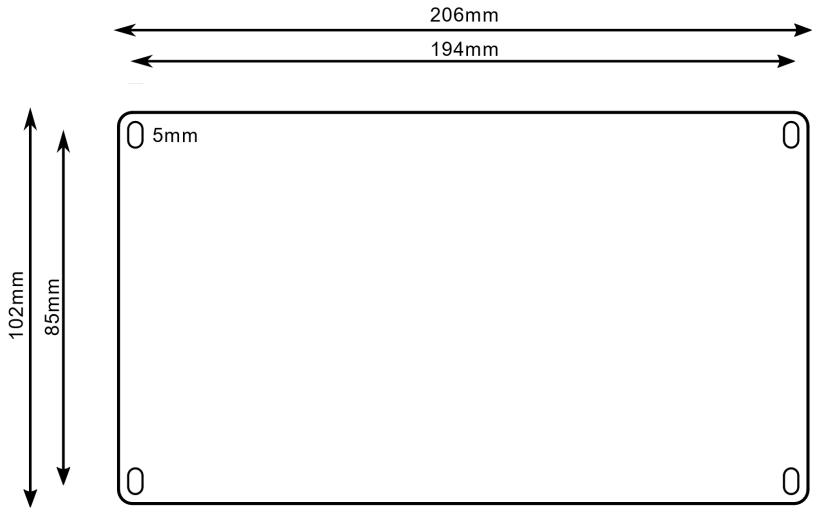


Figure 9: Mounting Diagram

3 Ohmic Sensor

Figure 10: Ohmic Sensor

In plasma cutting, accurately determining the height of the metal plate being cut is crucial. This is achieved through a process known as a “touch sequence.” During this sequence, the CNC (Computer Numerical Control) system lowers the cutting torch until it contacts the plate’s surface. This contact is essential for CNC controller to sense the correct cutting height.

To detect when the torch tip touches the metal plate, most cutting torches are equipped with a feature called a sensing cup located at the tip. The interaction between the sensing cup and the plate is monitored by an Ohmic sensor. This sensor is responsible for measuring the electrical resistance between the sensing cup and the grounded metal plate.

When the torch tip contacts the plate, the resistance measured by the Ohmic sensor drops below a predetermined threshold. This decrease in resistance triggers the Ohmic sensor to send an output signal to the CNC controller. The reception of this signal by the CNC controller indicates that the torch tip has made contact with the plate. Consequently, the controller records this position as the height of the plate.

The sensitivity of the Ohmic sensor plays a vital role, especially when cutting thin metal sheets. These sheets can deform under the pressure of the torch tip. If the Ohmic sensor is not sensitive enough, the plate may be pushed down before the CNC receives the signal, leading to an inaccurate height measurement due to the plate’s deformation. Conversely, if the sensor is overly sensitive, it might

falsely trigger due to water on the cutting table or a dirty nozzle.

To address false triggers caused by water in the nozzle, a quick solution is to briefly fire the torch. This action generates enough heat to evaporate the water inside the nozzle. However, if the issue is a dirty nozzle, it requires a more hands-on approach. This involves disassembling the nozzle consumable and either cleaning or replacing it to ensure accurate and efficient plasma cutting performance.

You can adjust the sensitivity of the touch sensor using the adjustment potentiometer with a small Philips screwdriver.

3.1 Connecting the Ohmic sensor

The Ohmic sensor requires the following connections:

1. **24-Volt Power Supply Connection**:
    - This involves connecting two wires from the Ohmic sensor to the 24-volt power source.
    - One wire connects to the 24-volt line, and the other wire connects to the 0-volt or ground line of the power source.
2. **Output Signal Connection to the CNC Controller**:
    - This connection is crucial for signaling the CNC controller when the Ohmic sensor detects contact between the torch tip sensing cup and the metal plate.
    - You have options for the output signal mode: either NPN or PNP mode. The choice between these modes depends on the requirements of your CNC controller and the sensor's compatibility. For use with the NX-Plasma controller, the "Out+" signal should be connected to 24 Volts, and the "Out-" signal should be connected to one of the controller's 16 inputs. The touch function input of the NX-Plasma CNC must be configured to reflect the used input number, and the polarity should be set to positive.
3. **Torch Tip Sensing Cup and Ground Connection**:
    - This connection involves linking the torch tip sensing cup to the metal plate.
    - It is also imperative to ensure a good ground connection to the metal plate for the system to function correctly.

In summary, when connecting an Ohmic sensor, you need to establish a power supply connection, configure the output signal to the CNC controller correctly (considering the mode and voltage), and ensure a proper connection between the torch tip sensing cup and the metal plate with a good ground. Always refer to the specific sensor and CNC controller manuals for detailed instructions and safety precautions.

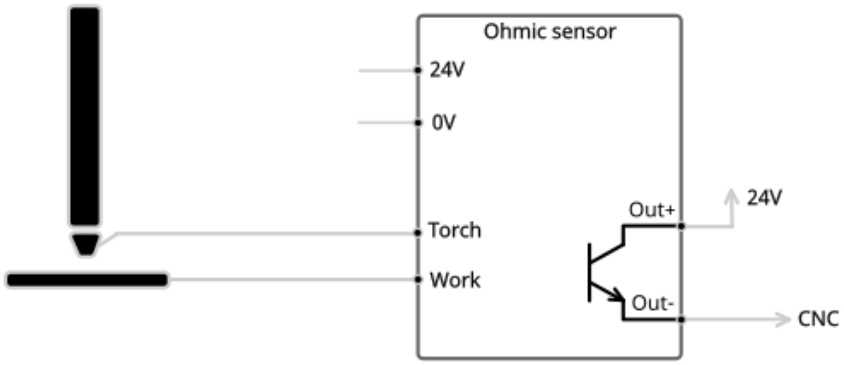


Figure 11: Connection Diagram

Table 9: Ohmic Sensor Connection

Signal	Description
+24V	Positive 24V supply
0V	Return of power supply voltage
GND	System ground
Out+	Positive opto-isolated output
Out-	Negative opto-isolated output

Table 10: Torch and Table Connection

Signal	Description
Work	Plasma table ground
NC	Not connected
Torch	Torch touch sensor

4 Technical Support

4.1 Motors Not Turning

- Check the wiring.
- Verify the step pulse duration configuration. Some stepper motor drivers ignore values below 3us.

4.2 Motors Only Turn in One Direction

- Check the wiring of the direction signal. Without a direction signal, drivers can only be commanded to turn in one direction.

4.3 Technical Support

If you encounter issues or have any questions regarding the installation or operation of this product, please contact NevexTech's technical support department via email at support@nxplasma.com.

5 Hardware License Agreement

Effective Date: 01/01/2024

This Hardware License Agreement ("Agreement") is entered into by and between **Nevex Tecnologia Ltda.**, a company organized under the laws of Brazil, with its principal mailing address at **P.O. Box 24913, CEP 80410-170, Curitiba, Paraná, Brazil** ("Manufacturer"), and the purchaser or end user ("User") of the NX-Plasma CNC Controller and related hardware ("Hardware").

By installing, connecting, or operating the Hardware, the User agrees to be bound by the terms of this Agreement. If the User does not agree to these terms, the Hardware must not be used and should be returned in unused condition within 14 days for a refund, subject to the return policy.

5.1 1. DEFINITIONS

1.1 Hardware: Refers to the NX-Plasma CNC Controller, THC (Torch Height Control), optional 24V Ohmic Sensor, and any physical components or electronic boards provided by Manufacturer. **1.2 Software**: Refers to any firmware, configuration tools, or companion software required for operation of the Hardware.

5.2 2. LICENSE AND USAGE RIGHTS

2.1 Limited License: Manufacturer grants the User a non-exclusive, non-transferable right to use the Hardware solely for the purpose of controlling CNC plasma or oxy-fuel cutting systems. **2.2 Restrictions**: User may not resell, modify, reverse engineer, tamper with safety mechanisms, or repurpose the Hardware for unrelated or unauthorized industrial or commercial applications without prior written permission from the Manufacturer.

5.3 3. SAFETY AND ASSUMPTION OF RISK

3.1 Risk Acknowledgment: The User acknowledges that CNC plasma and oxy-fuel cutting systems inherently involve high voltages, open flame, extreme temperatures, and automated mechanical motion, all of which present serious safety hazards.

3.2 Assumption of Risk: The User accepts full responsibility for ensuring the safe installation, integration, and operation of the Hardware within their specific machine environment. The User assumes all risks associated with physical injury, death, fire, explosion, property damage, or financial loss arising from the use or misuse of the Hardware.

3.3 No Liability for Damages: To the fullest extent permitted by law, the Manufacturer shall not be liable for any direct, indirect, incidental, special, consequential, or punitive damages, including but not limited to bodily injury, death, machine damage, or lost productivity, resulting from the use of the Hardware.

3.4 No Medical, Life-Critical, or Safety-Critical Use: The Hardware is not designed or certified for use in medical, life-support, aerospace, or safety-critical systems. Any such use is strictly prohibited.

5.4 4. INSTALLATION AND MAINTENANCE

4.1 Qualified Personnel: Installation and wiring of the Hardware must be performed by qualified technicians familiar with industrial automation, electrical safety standards, and applicable national regulations. **4.2 Compliance**: The User is solely responsible for complying with all applicable local, national, and international safety and regulatory standards.

5.5 5. WARRANTY AND LIMITATIONS

5.1 Limited Hardware Warranty: Manufacturer warrants that the Hardware will be free from material defects in workmanship for a period of **three (3) months after installation** or **one (1) month from shipment**, whichever occurs first. **5.2 Delivery Terms**: Hardware is delivered as a standard product. Manufacturer is not responsible for application-specific adjustments or on-site testing. **5.3 Warranty Exclusions**: This warranty does not cover:

- Damage due to improper storage, mishandling, accidents, or unauthorized software/hardware designs
- Modifications made without the Manufacturer's written consent
- Usage outside the stated specifications
- Normal wear and tear

5.4 Remedies: The Manufacturer's sole obligation under this warranty is to repair or replace defective Hardware at its discretion. This is the exclusive remedy. Repair services or replacement parts outside warranty may be subject to service fees.

5.5 Precautions: These products are not designed for use in systems related to human life (e.g., nuclear, aerospace, medical, passenger transport). Contact Manufacturer for approval prior to such applications. Users must implement appropriate safety mechanisms where product failure could cause significant harm.

5.6 6. LIMITATION OF LIABILITY

6.1 Exclusion of Certain Damages: To the extent permitted by law, Manufacturer shall not be liable for any direct, indirect, incidental, special, or consequential damages, including but not limited to loss of profits, business interruption, or data loss, even if advised of the possibility.

6.2 Maximum Liability: In no event shall Manufacturer's total liability exceed the purchase price of the Hardware. This applies regardless of the legal theory (contract, tort, negligence, etc.).

6.3 Information Accuracy: Manufacturer disclaims any liability for errors or omissions in documentation or materials. User must verify product suitability for their application.

6.4 Acknowledgment of Limitations: The above limitations are fundamental terms of this Agreement. Some jurisdictions may not allow full exclusion of liabilities; specific rights may vary.

6.5 Legal Counsel Advised: By using the Hardware, User acknowledges and accepts these limitations and is advised to consult legal counsel before employing the product in critical applications.

5.7 7. GOVERNING LAW AND DISPUTE RESOLUTION

7.1 Governing Law: This Agreement shall be governed by the laws of Brazil. **7.2 Jurisdiction**: All disputes arising out of or in connection with this Agreement shall be submitted to the exclusive jurisdiction of the courts located in Curitiba, Paraná, Brazil. **7.3 Mediation Clause**: Prior to filing any legal action, the parties agree to attempt to resolve the matter through mediation or arbitration when applicable.

5.8 8. GENERAL PROVISIONS

8.1 Entire Agreement: This Agreement constitutes the entire agreement between the parties regarding the Hardware and supersedes all prior or contemporaneous agreements. **8.2 Severability**: If any provision of this Agreement is found to be invalid, the remaining provisions will continue in full force and effect. **8.3 No Waiver**: Failure to enforce any part of this Agreement shall not constitute a waiver of any rights.

5.9 ACCEPTANCE

By using the Hardware, the User acknowledges that they have read, understood, and agreed to be bound by this Hardware License Agreement.