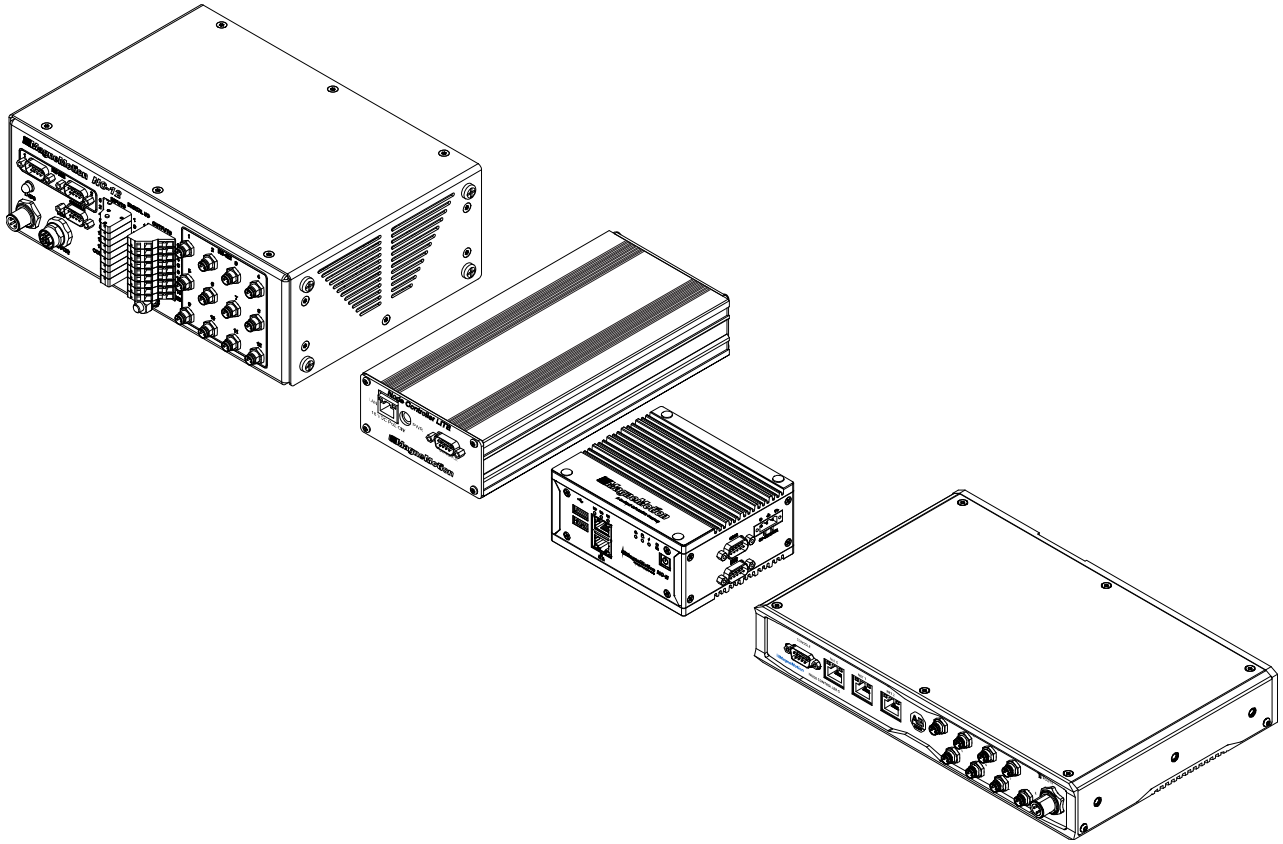
MagneMotion

A Rockwell Automation Company

# Node Controller Hardware
# User Manual



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# Contents

# Figures

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# Changes

## Overview

This manual is changed as required to keep it accurate and up-to-date to provide the most complete documentation possible for the MagneMotion® node controllers. This section provides a brief description of each significant change.

**NOTE:** Distribution of this manual and all addenda and attachments is not controlled. To identify the current revision, contact ICT Customer Support.

### Rev. A

Initial release.

### Rev. B

Added the following:

- Added support for the NC-S node controller.
- In *Chapter 6, Maintenance*, added the *Repair* section with information on *Upgrading Node Controllers*.

Updated the following:

- In *Chapter 2, Safety*, updated the *Recycling and Disposal Information* section.
- In *Chapter 3, Node Controller Overview*, updated the *Node Controller Loading* section.
- In *Chapter 6, Maintenance*, updated the *Contact ICT Customer Support* section.

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# About This Manual

## Overview

This section provides information about the use of this manual, including the manual structure, related documentation, format conventions, and safety conventions.

### Purpose

This manual explains how to install and maintain the MagneMotion® node controllers that are used with MagneMover® LITE and QuickStick® transport systems. Node controllers are used to monitor vehicles and control the motors of a MagneMotion transport system based on the commands from the host controller.

This manual is not intended to provide a design guide or reference for the installation or operation of a MagneMotion transport system. Use this manual in combination with the other manuals and documentation that accompanies the transport system to install, configure, test, and operate a MagneMotion transport system. MagneMotion offers instructor-led training classes that provide additional instruction in the use of the node controllers.

### Audience

This manual is intended for all users of MagneMotion transport systems and provides information on how to install and maintain the node controllers in the transport system.

### Prerequisites

The information and procedures that are provided in this manual assume the following:

- Basic familiarity with general-purpose computers and with the Windows® operating system, web browsers, and terminal emulators.
- That full documentation for the transport system is available.
- All personnel operating the transport system are properly trained.

# MagneMotion Documentation

The documentation that is provided with the MagneMotion transport system includes this manual, which provides complete documentation for the installation of the node controllers. Other manuals in the document set, which is listed in the *Related Documentation* section, support design, installation, configuration, and operation of the transport system.

The examples in this manual are included solely for illustrative purposes. Because of the many variables and requirements that are associated with any LSM system installation, MagneMotion cannot assume responsibility or liability for actual use that is based on these examples.

## Manual Conventions

The following conventions are used throughout this manual:

- Bulleted lists provide information in no specific order, not procedural steps.
- Numbered lists provide procedural steps or hierarchical information.
- Keyboard keys and key combinations (pressing multiple keys at a time) are shown enclosed in angle brackets. Examples: <F2>, <Enter>, <Ctrl>, <Ctrl-x>.
- Dialog box titles or headers are shown in bold type, capitalized exactly as they appear in the software. Example: the **Open XML Configuration File** dialog box.
- Responses to user actions are shown in italics. Example: *Motion on all specified paths is enabled.*
- Selectable menu choices, option titles, function titles, and area or field titles in dialog boxes are shown in bold type and are capitalized exactly as they appear in the software. Examples: **Add to End...**, **Paths**, **Path Details**, **OK**.
- **Dialog Box** – A window that solicits a user response.
- **Click** or **Left-click** – Press and release the left mouse button*.
- **Right-click** – Press and release the right mouse button.
- **Double-click** – Press and release the left mouse button twice in quick succession.
- **Control-click** – Hold down <Ctrl> and press and release the left mouse button.
- **Click-and-hold** – Press down the left mouse button and hold it down while moving the mouse.
- **Select** – Highlight a menu item with the mouse or the tab or arrow keys.
- **Code Samples** – Shown in monospaced text. Example: `Paths`.

* Mouse usage terms assume typical ‘right-hand’ mouse configuration.

- **Data Entry** – There are several conventions for data entry:
  - **Exact** – The text is shown in single quotes. Example: Enter the name 'Origin' in the text field.
  - **Variable** – The text is shown in italics. Example: Save the file as *file_name*.xml.
- **Numbers** – All numbers are assumed to be decimal unless otherwise noted and use the US number format; that is, one thousand = 1,000.00. Non-decimal numbers (binary or hexadecimal) are explicitly stated.
  - **Binary** – Followed by $_2$, for example, 1100 0001 $0101_2$, 1111 1111 1111 $1111_2$.
  - **Hex** – Preceded by 0x, for example, 0xC15, 0xFFFF.
- **Measurements** – All measurements are SI (International System of Units). The format for dual dimensions is *SI_units* [*English_units*]; for example, 250 mm [9.8 in].
- Text in blue is a hyperlink. These links are active when viewing the manual as a PDF. Select a hyperlink to change the manual view to the page of the item referenced. In some cases, the item that is referenced is on the same page, so no change in the view occurs.

## Notes, Safety Notices, and Symbols

Notes, Safety Notices, and Symbols that are used in this manual have specific meanings and formats. Examples of notes, the different types of safety notices and their general meanings are provided in this section. Adhere to all safety notices provided throughout this manual to achieve safe installation and use.

### Notes

Notes are set apart from other text and provide additional or explanatory information. The text for Notes is in standard type as shown in the following example.

**NOTE:** A note provides additional or explanatory information.

### Safety Notices

Safety Notices are set apart from other text. The color of the panel at the top of the notice and the text in the panel indicates the severity of the hazard. The symbol on the left of the notice identifies the type of hazard (see *Symbol Identification* on page 32 for symbol descriptions). The text in the message panel identifies the hazard, methods to avoid the hazard, and the consequences of not avoiding the hazard.

Examples of the standard safety notices that are used in this manual are shown in the following examples. Each example includes a description of the hazard level indicated.

**DANGER**

*Danger* indicates a hazardous situation which, if not avoided, will result in death or serious injury.

**WARNING**

*Warning* indicates a hazardous situation which, if not avoided, could result in death or serious injury.

**CAUTION**

*Caution* indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.

***NOTICE***

*Notice* indicates practices that are not related to personal injury that could result in equipment or property damage.

## Manual Structure

This manual contains the following chapters:

- *Introduction*: Provides an overview of the node controllers, which are used to monitor vehicles and control the motors in a MagneMotion LSM transport system.
- *Safety*: Identifies safety concerns and requirements for the node controllers and the personnel operating and servicing them where they are installed.
- *Node Controller Overview*: Provides an overview of the types of node controllers available for use in the transport system.
- *Specifications and Site Requirements*: Provides specifications and the requirements for installation of the node controllers in a transport system.
- *Installation*: Provides complete installation procedures for the node controllers.
- *Maintenance*: Provides tools for identifying and resolving problems with the node controllers, their meaning, and how to clear them.

- *Appendix*: Provides additional information that is related to the node controllers and MagneMotion transport systems.
- *Glossary*: Provides a list of terms and definitions for the transport system and its components.
- *Index*: A cross-reference to this manual organized by subject.

### Related Documentation

Before configuring or running the transport system, consult the following documentation:

- *MagneMover LITE Configurator User Manual*, 990000558.
  or
  *QuickStick Configurator User Manual*, 990000559.
- *Node Controller Interface User Manual*, 990000377.
- *NCHost TCP Interface Utility User Manual*, 990000562.
- *Host Controller TCP/IP Communication Protocol User Manual*, 990000436,
  *Host Controller EtherNet/IP Communication Protocol User Manual*, 990000437,
  or
  *Mitsubishi PLC TCP/IP Library User Manual*, 990000628.
- *MagneMover LITE User Manual*, 990000410,
  *QuickStick 100 User Manual*, 990000460,
  or
  *QuickStick HT User Manual*, 990000496.
- *Node Controller Hardware User Manual*, 10004903067 (this manual).
- *LSM Synchronization Option User Manual*, 990000447.
- *Virtual Scope Utility User Manual*, 990000759.

**NOTE:** Distribution of this manual and all addenda and attachments is not controlled. Changes to the document set or the software can be made at any time. To identify the current revisions or to obtain a current version, contact ICT Customer Support.

# Contact Information

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# Introduction 1

## Overview

This chapter provides an overview of the MagneMotion® node controllers and the transport system hardware and software. The basic set of tasks for using the node controllers with a MagneMotion transport system are also described.

Use this manual to install the node controllers for proper transport system operation. Some procedures may vary based on the transport system configuration, communications, and other variables.

This manual supports:

- MagneMover® LITE transport systems.
- QuickStick® transport systems.

Included in this chapter are overviews of:

- The transport system components.
- The transport system software.
- Getting started with the node controller.

# Node Controller Interface Overview

The node controllers are used to monitor vehicles and control the motors of a MagneMotion transport system as commanded by the host controller. Each node controller provides both a web interface and a console interface (see the *Node Controller Interface User Manual*). These interfaces are used to configure and administer both the node controller and the transport system.

The transport system is a configuration of linear synchronous motors that are placed end-to-end to form long chains, or paths. These chains move vehicles with integral magnet arrays in a controlled manner at various acceleration/deceleration and velocity profiles while carrying a wide range of payloads with high precision.

The transport system consists of the following components at a minimum:

- MagneMover LITE or QuickStick motors.
- Node controllers.
- Vehicles with magnet arrays.
- Paths and nodes.
- User-supplied host controller.

# Transport System Components Overview

This section identifies the components of a MagneMotion transport system as shown in Figure 1-1 and described after the figure.

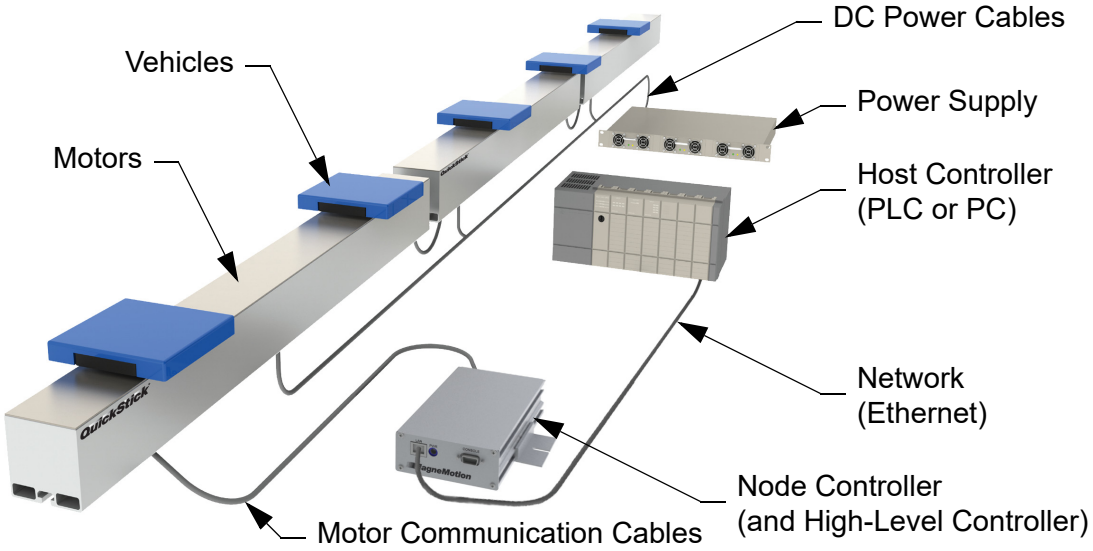



*Figure 1-1: Simplified View of the MagneMotion Transport System Components*

- **DC Power Cables and Communication Cables** – Distributes DC power to the motors and carries communications between the components of the transport system.
- **High-Level Controller** (HLC) – Software application that is enabled on one node controller. This application handles all communication with the user-supplied host controller and directs communication as appropriate to individual node controllers.
- **Host Controller** – Provides user control and monitoring of the MagneMotion transport system. User-supplied, it can be either PC-based or a PLC.
- **Motor** – Refers to a MagneMotion linear synchronous motor (LSM).
- **Network** – Ethernet network providing communications (TCP/IP or EtherNet/IP™) between the host controller and the HLC (TCP/IP is used between node controllers).
- **Node Controller** (NC) – Coordinates motor operations and communicates with the HLC. Three types of node controllers are available:
  - **NC-12** (not shown) – Provides one network port, two RS-232 ports, 12 RS-422 ports, 16 digital inputs, and 16 digital outputs.
  - **NC LITE** – Provides one network port and four RS-422 ports.
  - **NC-E** (not shown) – Provides one active network port, four digital inputs, and four digital outputs. For Ethernet motor communications only.
  - **NC-S** (not shown) – Provides one active network port and eight RS-422 ports.
- **Power Supply** – Provides DC power to the motors.
- **Vehicle with Magnet Array** – Carries a payload through the MagneMotion transport system as directed. The magnet array is mounted to the vehicle and interacts with the motors, which moves each vehicle independently.

# Transport System Software Overview

Several software applications are used to configure, test, and administer a MagneMotion transport system as shown in Figure 1-2 and described after the figure. See *Related Documentation* on page 17 for the reference manuals for these applications.

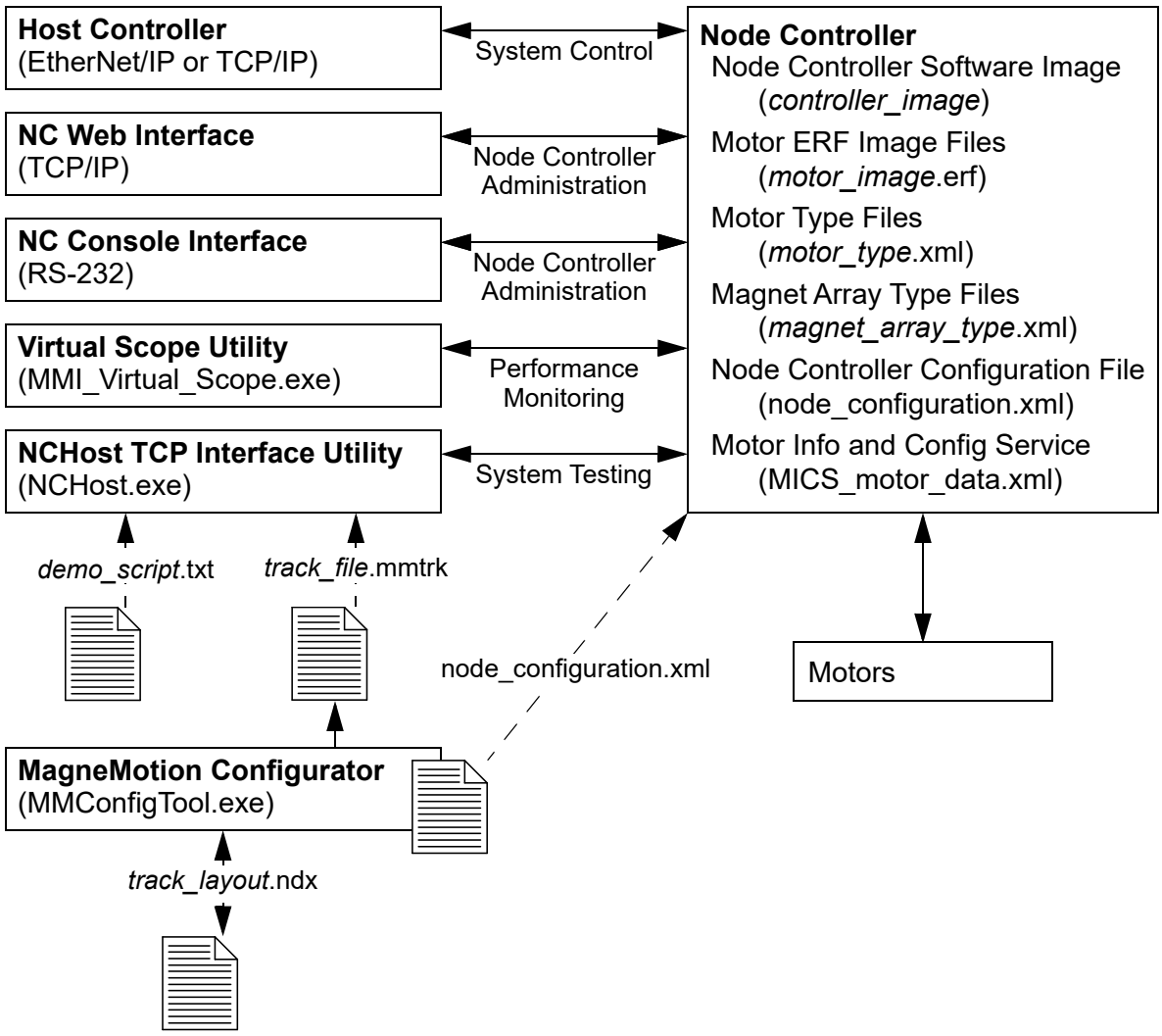



*Figure 1-2: Simplified View of Transport System Software Organization*

- **NC Web Interface** – A web-based software application that is supplied by MagneMotion, resident on the node controllers, for administration of the transport system components.
- **NC Console Interface** – A serial communication software application that is supplied by MagneMotion, resident on the node controllers, for administration of the node controller.
- **NCHost TCP Interface Utility** – A Windows® software application that is supplied by MagneMotion to move vehicles for test or demonstration purposes. This application supports system testing without the host controller to verify that vehicles move correctly before integrating a transport system into a production environment.

- **MagneMotion Configurator Utility** (Configurator) – A Windows software application that is supplied by MagneMotion to create or change the Node Controller Configuration File. It is also used to create or change the Track file and Track Layout file for MagneMover LITE transport systems, without editing the files directly.
- **Virtual Scope Utility** – A Windows software application that is supplied by MagneMotion to monitor and record the change of motor performance parameters. These parameters are displayed as waveforms to analyze the performance of the motors.
- **Demo Script** – Text files (*demo_script*.txt) uploaded to the NCHost TCP Interface Utility to move vehicles on the transport system for test or demonstration purposes.
- **Node Controller Software Image File** (IMG file) – The software file for the node controllers (controller_image), includes the node controller and HLC applications. The Node Controller Software Image file is uploaded to all node controllers in the transport system.
- **Motor ERF Image Files** (ERF file) – The software files for the MagneMotion motors (*motor_image*.erf). The Motor ERF Image files are uploaded to all node controllers in the transport system and then programmed into all motors.
- **Restricted Parameters Files** – XML files (*restricted_parameters*.xml) that provide access to restricted configuration elements for specific transport systems. The Restricted Parameters file is uploaded to HLC. Contact ICT Customer Support for the development of a custom Restricted Parameters file for a specific transport system.
- **MagneMotion Information and Configuration Service (MICS) Files** – XML files (*MICS_motor_data*.xml) that contains the network topology parameters for the transport system when using Ethernet communication with the motors. The file includes the MAC address of each motor and the location of each motor on a Path. The MICS file is uploaded to all node controllers in the transport system.
- **Motor Type Files** – XML files (*motor_type*.xml) that contain basic information about the specific MagneMotion motor types being used. The Motor Type files are uploaded to all node controllers in the transport system.
- **Magnet Array Type Files** – XML files (*magnet_array_type*.xml) that contain basic information about the specific MagneMotion magnet array type that is used on the vehicles in the transport system. The Magnet Array Type file is uploaded to all node controllers in the transport system.
- **Node Controller Configuration File** (Configuration file) – XML files (node_configuration.xml) that contain all parameters for the components in the transport system. The Node Controller Configuration File is uploaded to all node controllers in the transport system.
- **Track Layout File** – XML files (*track_layout*.ndx) that contain all parameters for the graphical representation of a MagneMover LITE transport system. The Track Layout file is used by the Configurator to generate the Node Controller Configuration File and the Track file for MagneMover LITE systems.
- **Track File** – Text files (*track_file*.mmtrk) that contain graphical path and motor information about the transport system. The Track file is used by the NCHost TCP Inter-

face Utility to provide a graphical representation of the transport system to monitor system operation. The Track file is created for MagneMover LITE transport systems using the MagneMover LITE Configurator. Contact ICT Customer Support for the development of a Track file for QuickStick transport systems.

**NOTICE**

Modifications to the Image or Type files could cause improper operation of the transport system.

# Getting Started with the Node Controllers

Use this manual as a guide and reference when installing or servicing the node controllers. Follow the steps in this section to get the node controllers operational quickly with the aid of the other MagneMotion manuals (see *Related Documentation* on page 17).

**NOTE:** Make sure that all components and complete design specifications, including the physical layout of the transport system, are available before starting to install or test transport system operation.

To get started quickly with the node controllers:

1. Save the files and folders from the MagneMotion transport system software package to a folder on a computer for user access.

   **NOTE:** The minimum requirements for running MagneMotion software applications are a general-purpose computer (PC) running Microsoft® Windows® 7 with .NET 4.0, an Ethernet port (web interface), and an RS-232 port (console interface).

2. Install the MagneMotion Configurator on a computer for user access (see either the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual*).

   A. For MM LITE™ systems, create the Track Layout File (*track_layout*.ndx) to define the motors and paths graphically and their relationships in the transport system.

   B. For all transport systems, create the Node Controller Configuration File (node_configuration.xml) to define the components and operating parameters of the transport system.

3. Set the IP address for each node controller and specify the node controller to be used as the high-level controller. Upload the configuration, image, and type files to each node controller using the node controller web interface (see the *Node Controller Interface User Manual*).

   Once configured, the node controllers can be used to simulate the transport system. See the *MagneMover LITE User Manual*, the *QuickStick 100 User Manual*, or the *QuickStick HT User Manual*.

4. Install the components of the MagneMotion transport system as described in either the *MagneMover LITE User Manual*, the *QuickStick 100 User Manual*, or the *QuickStick HT User Manual*.

5. Install the node controllers as described in *Chapter 5, Installation*.

6. Test and debug the transport system by using the NCHost TCP Interface Utility and Demo Scripts (see the *NCHost TCP Interface Utility User Manual*). NCHost provides

an easy method to verify proper operation and make adjustments such as refining the control loop tuning.

**NOTE:** The NCHost TCP Interface Utility is for test and verification trials only. The host controller must be used to control the transport system after verification of functionality.

7. Configure the host controller (either a general-purpose computer or PLC) to control the transport system as required to meet the material movement needs of the facility where the system is installed. See the *Host Controller TCP/IP Communication Protocol User Manual* or the *Host Controller EtherNet/IP Communication Protocol User Manual*.

# Safety 2

## Overview

This chapter describes safety guidelines for the MagneMotion® node controllers and their use in a transport system. All personnel that are involved in the installation, operation, or maintenance of the transport system must be familiar with the safety precautions that are outlined in this chapter.

**NOTE:** These safety recommendations are basic guidelines. If the facility where the node controllers are installed has additional safety guidelines, they must be followed along with the applicable local and national safety codes.

If any additional safety-related upgrades or newly identified hazards that are associated with the node controllers are identified, the ICT Customer Support group notifies the owner of record.

Included in this chapter are:

- Regulatory compliance information.
- Personnel and equipment safety guidelines.
- Symbol identification.
- Label identification and locations.
- Identification of electrical hazards.
- Recycling and disposal Information.

# Regulatory Compliance

The MagneMotion node controllers are CE-compliant. To determine if a specific node controller is CE-compliant, check for the CE marking on the component. If necessary, request the official Declaration of Conformity (DoC) from MagneMotion.

The MagneMotion node controllers are UL Recognized in Canada and the United States. To determine if a specific node controller is UL Recognized, check for the UL Recognized Mark on the component. Some examples of the Mark may not display the ‘C’ and ‘US’.

Other sections of this manual may include additional regulatory information. These components comply with the regulations from the organizations that are indicated in Table 2-1.

*Table 2-1: Regulatory Information*

| Organization | Regulations |
|---|---|
| CE (Conformité Européenne) – The European safety requirements | • Machinery Directive<br>• Low Voltage Directive<br>• EMC Directive |
| UL | • 61010-1 |

**NOTICE**

It is the responsibility of the end user/third party integrator to make sure that the installed node controllers comply with the appropriate facility, local, and national regulations.

## Equipment Regulatory Guidelines

The following regulatory guidelines are provided to aid in the use and service of the MagneMotion node controllers in a transport system.

- ICT Customer Support issues Technical Advisories to notify the owners of record of any field retrofits.
- Contact ICT Customer Support for information regarding repair and maintenance service policies, both during the production of the node controllers and after production is discontinued.
- Any user-caused damage during integration of the node controllers into their equipment is the responsibility of the user.

- Responsibility for work that MagneMotion authorized technicians has performed or for equipment that the owner of record transports or resells, is determined on a case-by-case basis by ICT Technical Support.
- Any parts being returned to MagneMotion must be packaged according to the instructions provided in the *Packing Procedure* on page 126.
- MagneMotion provides training for the node controllers as integrated into a transport system. Any personnel that are performing service procedures on the node controllers must be properly qualified and trained. Damage that results from improperly performing a procedure or not following cautions is not covered under warranty or service agreements.

# Safety Considerations

## Personnel Safety Guidelines

MagneMotion node controllers can provide several direct safety hazards to personnel if not properly installed or operated. General safety guidelines are provided in this section, specific cautions are provided as needed (see *Electrical Hazards* on page 37).

- Personnel operating or servicing the node controller must be properly trained.
- The following safety equipment, used according to the instructions provided by the manufacturer, must be donned before installing, testing, or servicing components from MagneMotion:
  - Eye protection
    Breaking material can produce flying shards. When running a setup or test procedure, always wear protective eyewear to guard against possible eye injuries.
  - Foot protection
    Always wear shoes with protective toes to help protect feet from falling tools or parts.
- It may be recommended that the use of hazardous materials, such as cleaning fluids, be used during routine maintenance procedures. Read and understand the hazardous materials policies for the facility and the SDS (provided by the manufacturer) for each substance.
- Make sure that the node controllers are properly decontaminated before performing any service by following the decontamination procedures at the facility. Follow all facility, local, and national procedures for the disposal of any hazardous materials.
- Ergonomic hazards can exist with certain installation or service operations that are related to the node controllers.

## Equipment Safety Guidelines

The following safety considerations are provided to aid in the placement and use of the MagneMotion node controllers.

- If hazardous materials are to be present, proper safety precautions must be observed. Make sure that all materials that are used are compatible with the materials from which the node controllers are fabricated.
- If the node controllers are to be installed in an earthquake prone environment, install the equipment appropriately.
- Do not place the power and communications cables for the node controllers where they could cause a trip hazard.

- Do not place the node controllers in a location where they can be subject to physical damage.
- Make sure that all electrical connections to the node controllers are made in accordance with the appropriate facility, local, and national regulations.
- Make sure that the node controllers receive proper airflow for cooling.
- Do not remove safety labels or equipment identification labels.
- Turn OFF power supplies before inserting or removing the node controller power cables.
- Use of the node controllers for any purpose other than as controllers for a linear transport system is not recommended and can damage the node controllers or the equipment they are connected to.
- Keep cables and connectors away from heated surfaces.
- Do not modify the connectors or ports.

# Symbol Identification

Symbols are used in this manual to identify hazards, mandatory actions, and prohibited actions. The symbols that are used in this manual and their descriptions are provided in the following tables.

*Table 2-2: Hazard Alert Symbol Identification*

| Symbol | Description |
|---|---|
|  | **General Hazard Alert** – Indicates that failure to follow recommended procedures can result in unsafe conditions, which could cause injury or equipment damage. |
|  | **Automatic Start Hazard** – Indicates the possibility of machinery automatically starting or moving, which could cause personal injury. |
|  | **Hazardous Voltage** – Indicates that a severe shock hazard is present that could cause personal injury. |
|  | **Pinch/Crush Hazard** – Indicates that there are exposed parts that move, which could cause personal injury from the squeezing or compression of fingers, hands, or other body parts between those parts. |

*Table 2-3: Mandatory Action Symbol Identification*

| Symbol | Description |
|---|---|
|  | **Lockout Required** – Indicates that all power must be disconnected using a method that helps prevent accidental reconnection. |

# Label Identification and Location

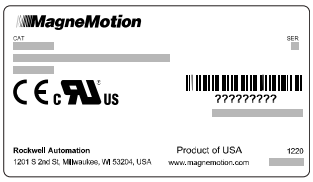
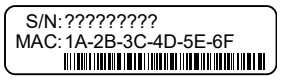
Identification labels are placed on the node controllers. These labels provide operators and service personnel with information about the node controllers at the point of use. This section describes each label and identifies its location.

**NOTE:** Label images are representational only. Actual labels include all appropriate regulatory symbols and can differ in appearance.

Label placement can cause labels to be visible only during maintenance operations.

The following tables list the labels that are affixed to the node controllers. The figure after each table shows the location of each label that is identified in the table. To replace a lost or damaged label, contact MagneMotion and reference its name.

*Table 2-4: Labels Used on the NC-S Node Controller*

| | |
|---|---|
|  | Product Information Label<br>Qty: 1<br>Location: On the top of the NC-S node controller |
|  | MAC ID Label<br>Qty: 1<br>Location: On the top of the NC-S node controller |

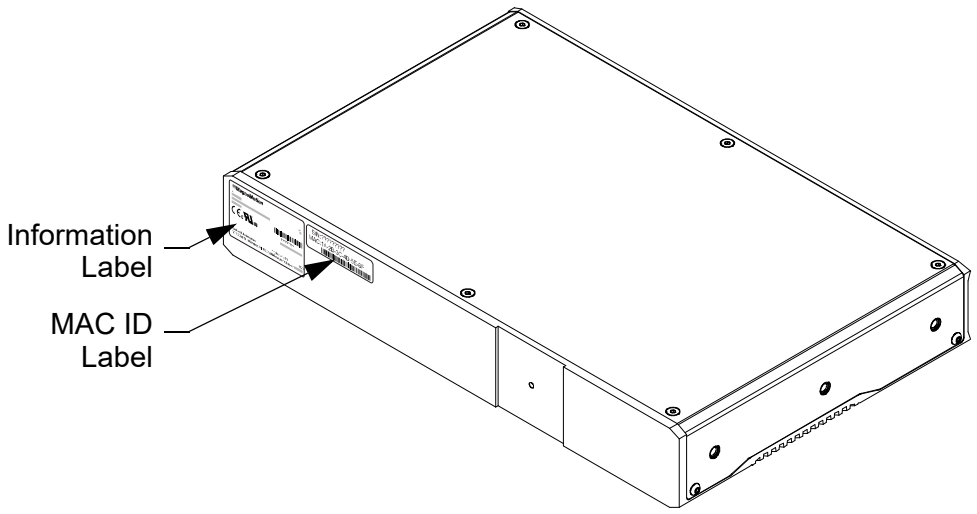
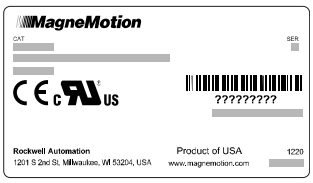



*Figure 2-1: Label Locations on the NC-S Node Controller*

*Table 2-5: Labels Used on the NC-E Node Controller*

| | |
|---|---|
|  | Product Information Label<br>Qty: 1<br>Location: On the back of the NC-E node controller |

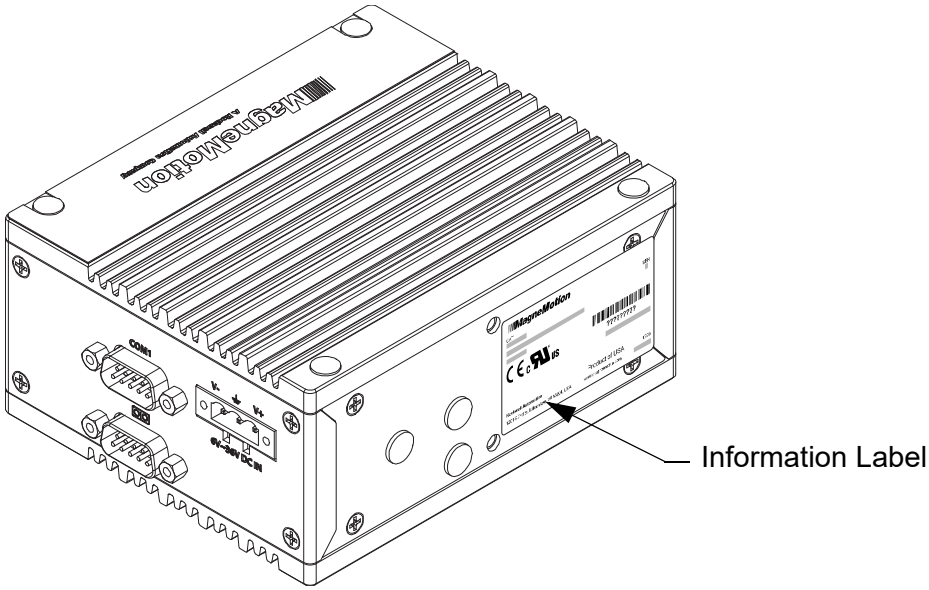
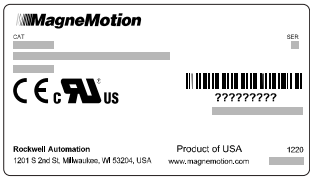
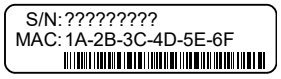



*Figure 2-2: Label Locations on the NC-E Node Controller*

*Table 2-6: Labels Used on the NC-12 Node Controller*

| | |
|---|---|
|  | Product Information Label<br>Qty: 1<br>Location: On the back of the NC-12 node controller |
|  | MAC ID Label<br>Qty: 1<br>Location: On the back of the NC-12 node controller |

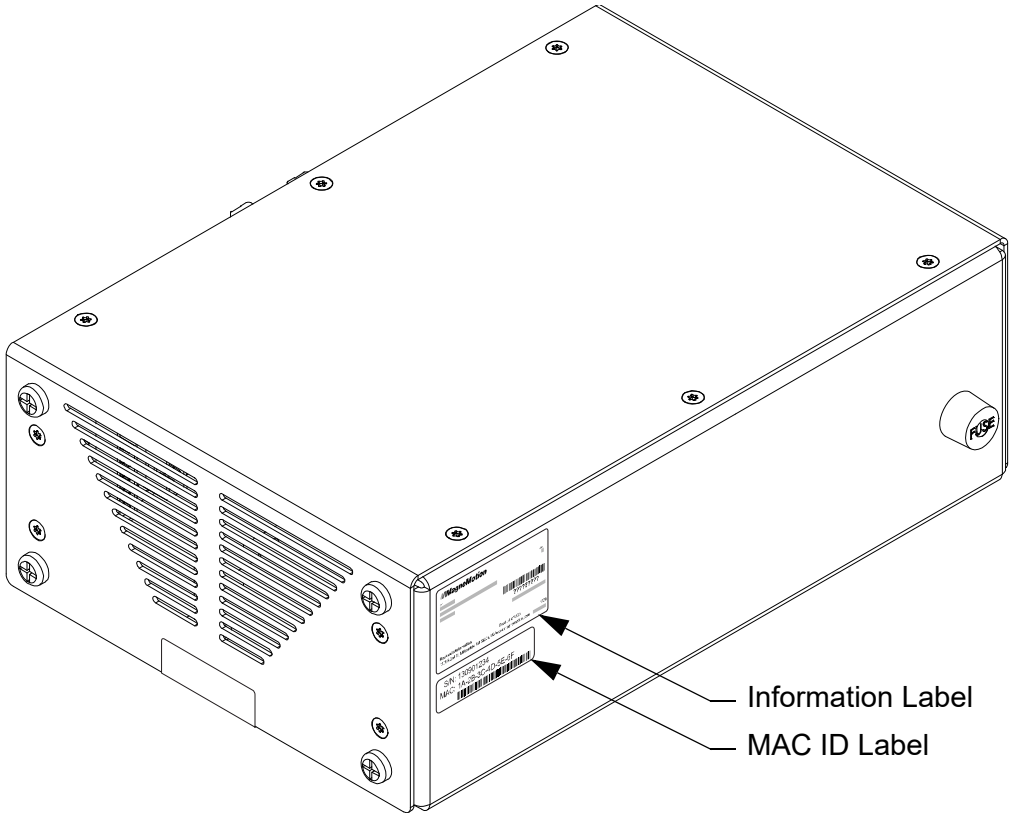
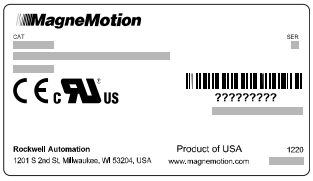
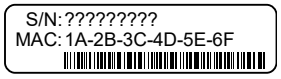



*Figure 2-3: Label Locations on the NC-12 Node Controller*

*Table 2-7: Labels Used on the NC LITE*

| | |
|---|---|
|  | Product Information Label<br>Qty: 1<br>Location: On the top of the NC LITE |
|  | MAC ID Label<br>Qty: 1<br>Location: On the top of the NC LITE |

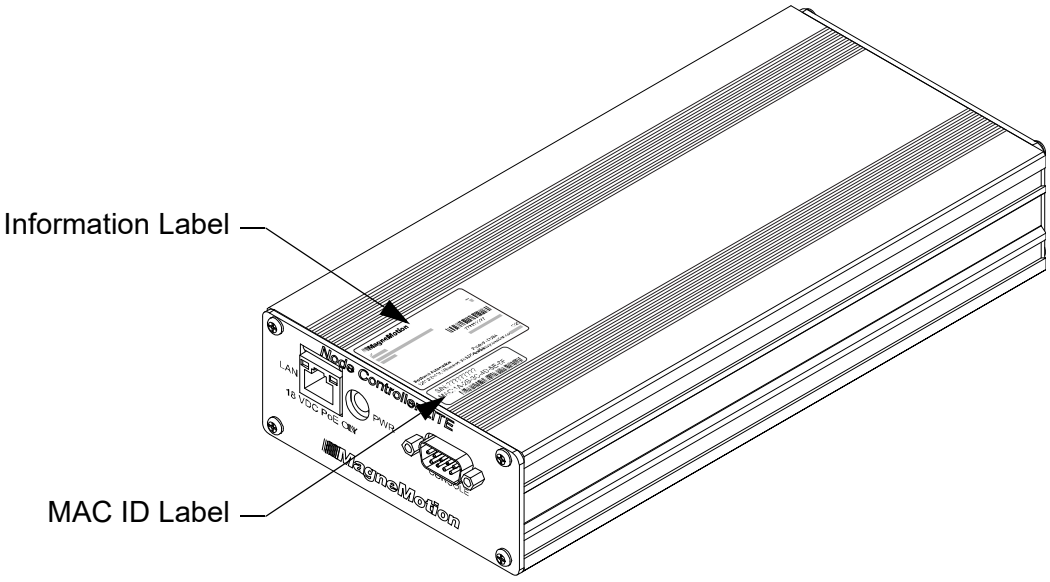



*Figure 2-4: Label Locations on the NC LITE*

# Electrical Hazards

The MagneMotion node controllers are classified as low voltage devices, no additional safety precautions are required.

The power supplies for the node controllers are connected to the AC Mains of the facility and can generate hazardous energy. The proper precautions for operating and servicing electrical equipment must be observed. These precautions include following facility lockout/tagout procedures, and any other specified action within the facility where the node controllers are being used.

**⚠ CAUTION**

**Electrical Hazard**

To avoid electric shock, do not open any MagneMotion node controller. Node controllers do not contain any user-serviceable parts.

Do not turn on electrical power to the node controllers until after connecting all other transport system components.

***NOTICE***

To avoid equipment damage:

- Make sure that the node controllers are properly grounded.
- Do not connect or disconnect any components while the transport system has power.

# Recycling and Disposal Information

Information regarding disposal and recycling are provided in this section. The node controllers use the following items that require special handling for disposal or recycling. At the end of its life, this equipment must be collected separately from any unsorted municipal waste and disposed of as described in this section.

For China RoHS information, see https://literature.rockwellautomation.com/idc/groups/literature/documents/td/pec-td003_-en-e.pdf and reference Table B.

## Node Controllers

The node controllers contain the following materials and must be disposed of by following all facility, local, and national procedures for the disposal or recycling of electronic equipment:

- Aluminum/Anodized Aluminum.
- Circuit board with connectors and semiconductors.
- Zinc-plated Low Carbon Steel Screws.
- Stainless Steel Screws.
- Lithium battery (NC-12, NC LIGHT, NC-E).
- Alkaline battery (NC-S).

## Packaging

The packaging for the node controllers contains the following materials. If the packaging is not being saved, it must be disposed of by following all facility, local, and national procedures for the disposal of packaging material:

- Cardboard.
- Polyethylene Foam.

# Node Controller Overview 3

## Overview

This chapter provides an overview of the types of node controllers available for use with MagneMotion® transport systems.

Included in this chapter are:

- Node controller descriptions, including an overview of operations.
- Node controller specifications, including connector identification for all node controller types.

# Node Controller Description

The node controller is the controller that is used to monitor and control the motors in a MagneMotion transport system in response to commands from the host controller. The node controller also provides status information to the host controller as requested. There can be multiple node controllers in a transport system, each responsible for a subset of the transport system. Each node controller is connected to the local area network (LAN) for the transport system. Using a LAN to provide all communication to the node controllers allows them to be located near the motors they are controlling, which minimizes the length of all cabling.

Each node controller is responsible for coordinating all vehicle movement through the nodes that are assigned to it and along the paths that are connected to those nodes. The node controllers are also used to program the motors on the paths that are connected to it.

One node controller in the transport system also functions as the high-level controller (HLC). The HLC provides one point of contact for all communications with the host controller through either TCP/IP for a general-purpose computer-based controller or EtherNet/IP™ for a PLC. The HLC then distributes any communications to the appropriate node controller through the LAN using TCP/IP and passes any messages from the node controllers to the host controller. The HLC also assigns vehicle IDs and tracks vehicle movement as vehicles move from a path that one node controller controls to a path that another node controller controls. Tracking of vehicle movement between node controllers is to make sure that vehicle IDs are maintained throughout the transport system.

**NOTE:** All TCP communications is unicast. Additionally, do not connect the node controllers to a network with large amounts of broadcast traffic as this extra traffic can impact node controller communication.

## Node Controller Types

All node controllers support Ethernet communication and, depending on the model, provide up to 12 RS-422 ports for communication with the motors. Some node controller models also provide Digital I/O and/or Serial I/O for external devices such as switches, E-stops, light stacks, and interlocks.

### NC-S Node Controller

Node controller that supports both RS-422 and Ethernet motors with one active network port (NET 0) and eight RS-422 ports (see page 54). This node controller supports multiple nodes (for example, Simple, Merge, Diverge, and Relay).

### NC-E Node Controller

Node controller that supports Ethernet motors with one active network port, 4 digital inputs, and 4 digital outputs (see page 57). This node controller supports multiple nodes (for example,

Simple, Merge, Diverge, and Relay) and additional functions (for example, E-stop and interlocks).

### NC-12 Node Controller

Node controller that supports both RS-422 and Ethernet motors with one network port, 12 RS-422 ports, two RS-232 ports, 16 digital inputs, and 16 digital outputs. This node controller is available with an RJ45 Ethernet connector (see page 58) or an M12 Ethernet connector (see page 59). This node controller supports multiple nodes (for example, Simple, Merge, Diverge, and Relay) and additional functions (for example, E-stop and interlocks).

### NC LITE Node Controller

Node controller that supports both RS-422 and Ethernet motors with one network port and four RS-422 ports (see page 62). This node controller typically supports one node (for example, Merge). However, some configurations of nodes allow the node controller to support multiple nodes (for example, Simple and Relay).

# Node Controller Communications

## System Communication

All node controllers constantly communicate with the node controller configured as the HLC through a LAN. Additionally, the node controller that is designated as the HLC communicates with the host controller through the same network.

All node controllers have the same IP address when they leave the factory. Individual node controllers with the same IP address cannot be distinguished on a network and must not be connected to the network until configured with unique IP addresses. The *Node Controller Interface User Manual* describes how to configure the node controller IP address so it matches the addressing structure of the network for the transport system.

**NOTE:** When setting the IP addresses on the node controllers for the first time, make sure that they are not all connected to the network simultaneously to avoid address conflicts.

## User Communication

For normal operations, the node controller is accessed through a web-based user interface. To access the web interface, use any web browser that supports frames (for example, Chrome, Firefox, or Internet Explorer) on a service computer. Connect the computer to the same network as the node controller and enter the IP address of the node controller in the address bar for the browser and log in.

For some setup tasks, the node controller can be accessed through an RS-232 console interface. To access the console interface, use any terminal emulator that supports serial communication (for example, PuTTY) on a service computer. Connect the computer directly to the console port (COM1) on the node controller and log in.

## Ethernet Motor Communication

All Ethernet motors constantly communicate with the node controller they are connected to through a LAN. The MagneMotion Information and Configuration Service (MICS) file is used to define the IP addresses of all motors so they match the addressing structure of the transport system network. The motor user manual describes how to create the MICS file.

Motors that use Ethernet communication can use different network connection schemes depending on the application. When using Ethernet, all motors in a specific path must be connected to the same node controller. Additionally, multiple paths can be connected to one node controller through the same Ethernet chain. The motor user manual describes different motor network topologies and provides examples.

## Configuration Recommendations

- Recommended Ethernet addressing scheme (see Figure 3-1):

  Network.Path.Motor

  - Network addresses are used for network configuration.
  - Path 0 addresses are used for Subnet configuration:

    x.y.0.m

    Where:

    **m** – Node controllers/Network devices
  - Path p addresses are used for motors on that path:

    x.y.p.m

    Where:

    **p** – path
    **m** – motor

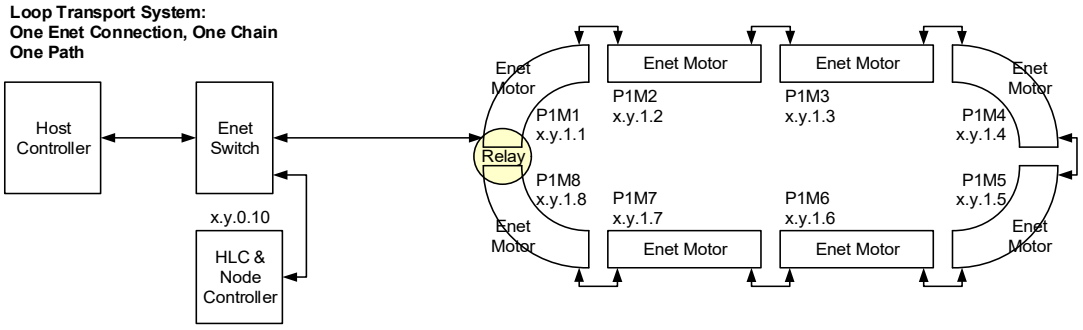



*Figure 3-1: Ethernet Motor Wiring Example*

- Switches are two logical track paths, only one IP address is assigned.
- Maximum number of motors per Ethernet chain = 50.
- Factory network design must minimize extra traffic on the physical network that the transport system is using.
  - Only use Chain or Star Ethernet connection topologies.
  - Closed-loop (ring) Ethernet connections must be avoided (industry standard Ethernet practice) to help prevent network saturation.
  - Large amounts of traffic can degrade the performance of the transport system. Only pass transport system communication through the Ethernet chains in the transport system.
- Standard IP UDP communication, low latency.
- 100BASE-TX Fast Ethernet (IEEE 802.3u) compliant.
- Minimum of CAT 5 cabling is required.

- Ethernet communication topology is independent of transport system configuration (Ethernet chaining does not have to follow the physical path layout).
- The use of Allen-Bradley® Stratix® Managed Ethernet Switches is recommended to deliver the required network performance.
- Ethernet chains can consist of multiple paths (as defined in the transport system layout drawing).
- Chains do not need to start at the beginning of a path.
- If all motors in a path are not part of the same Ethernet chain, all chains the path is a member of must connect to the same network as the node controller.

# Node Controller Loading

When using RS-422 for motor communication, the load on the node controllers is physically limited by the number of nodes that can be connected to a node controller. When using Ethernet for motor communication, there is no physical limit to the number of nodes that are connected to the node controller.

When running as the HLC, there is an additional load on the node controller due to communication with the host. When using multiple node controllers, the node controllers without the HLC function have no additional load and can support the maximum number of multi-port nodes. In systems where there are multiple node controllers, split the load evenly between all node controllers.

Multi-port node types are nodes that connect multiple paths and require multiple connections to the node controller such as Relay, Diverge, or Merge nodes. These types of nodes result in the same amount of load on the node controller even if they have different numbers of paths that are connected to the node controller. Single-port node types (Simple and Terminus) present a negligible load. When using two Terminus nodes to pass vehicles between paths, they count as one multi-port node due to the increased communication load.

Multi-port node types are nodes that connect multiple paths and require multiple connections to the node controller such as Relay, Diverge, or Merge nodes. These types of nodes result in the same amount of load on the node controller even if they have different numbers of paths that are connected to the node controller. Single-port node types (Simple and Terminus) present a negligible load. When using two Terminus nodes to pass vehicles between paths, they count as one multi-port node due to the increased communication load. See Table 3-1 for node controller loading using the different motor communication types.

## Using RS-422 Communication

When using RS-422, the total load on the NC-S, NC LITE, and NC-12 node controllers is limited by the number of connections to the node controller. Even though there is a physical limit to the number of nodes that are connected to the node controller, connections must be limited based on the load they place on the processor as shown in Table 3-1.

When using RS-422, all motors in a specific path are daisy chained together. The ends of the motor chains that start or end at a node are connected to a node controller. The number of RS-422 connections on a node controller determines the maximum number of motor chains that can be connected.

## Using Ethernet Communication

When using Ethernet, the total load on the node controllers is limited by the processing power of the node controller. Since there is no physical limit to the number of nodes that are connected to the node controller, connections must be limited based on the load they place on the processor as shown in Table 3-1.

When using Ethernet, all motors in a specific path must be connected to the same node controller even if they are on different Ethernet chains. Additionally, multiple paths can be connected to the node controller through the same Ethernet chain.

The processor loading on the NC-S, NC LITE, NC-12, and NC-E node controllers when using Ethernet to communicate with the motors has been determined based on the various use cases as shown in Table 3-1. When running as the HLC with an EtherNet/IP interface to the host, the load on the node controller is greatest since the host is continuously updated with status information. When running as the HLC with a TCP interface to the host, the load on the node controller is less since the host is only updated on request.

*Table 3-1: Node Controller Loading*

| Configuration | | Max Multi-port Nodes | | | |
|---|---|---|---|---|---|
| | | NC LITE† | NC-12‡ | NC-E§ | NC-S¶ |
| **Ethernet Only** | NC + HLC + EtherNet/IP Host comm | 4 | 15 | 23 | 15 |
| | NC + HLC + TCP/IP Host comm | 4 | 15 | 28 | 15 |
| | NC Only | 5 | 16 | 36 | 16 |
| **RS-422 Only** | NC + HLC + EtherNet/IP Host comm | Limited by number of RS-422 ports | Limited by number of RS-422 ports | None | 3 |
| | NC + HLC + TCP/IP Host comm | | | None | 3 |
| | NC Only | | | None | 4 |
| **Hybrid* (Ethernet and RS-422)** | NC + HLC + EtherNet/IP Host comm | No Data | No Data | None | 5 |
| | NC + HLC + TCP/IP Host comm | | | None | 5 |
| | NC Only | | | None | 6 |

* Hybrid nodes are those multi-port nodes where some of the node connections are made using RS-422 and some connections are made using Ethernet. This typically occurs when a node (for example, a Relay node) is being used to connect RS-422 motors to Ethernet motors.

† For NC LITE node controllers, the recommended maximum number of multi-port nodes that are connected using Ethernet communication is 4 if the node controller is also running as an HLC. If the node controller is not running as an HLC, the recommended maximum number of multi-port nodes that are connected is 5.

‡ For NC-12 node controllers, the recommended maximum number of multi-port nodes that are connected using Ethernet communication is 15 if the node controller is also running as an HLC. If the node controller is not running as an HLC, the recommended maximum number of multi-port nodes that are connected is 16.

§ For NC-E node controllers, additional node controller functions determine the recommended maximum number of multi-port nodes that are connected using Ethernet communication.

- If the node controller is also running as an HLC that uses EtherNet/IP communication with Host, the recommended maximum number of multi-port nodes that are connected is 23.
- If the node controller is also running as an HLC that uses TCP/IP communication with Host, the recommended maximum number of multi-port nodes that are connected is 28.
- If the node controller is not running as an HLC, the recommended maximum number of multi-port nodes that are connected is 36.

¶ For NC-S node controllers, use the following calculation to determine NC-S loading when using a combination of node connection types (that is, some Ethernet nodes and some RS-422 nodes).

$85\% \geq \text{Serial Nodes}*20\% + \text{Hybrid Nodes}*14\% + \text{Ethernet Nodes}*5\% + \text{HLC}*10\%$

# General Purpose Digital I/O

When using an NC-E or NC-12 node controller, digital inputs and outputs can be monitored and controlled, respectively. These circuits can be wired directly to the digital I/O terminals on the node controller for monitoring and control of local options or for any user-defined use. These optional circuits are the responsibility of the user and require additional user-supplied hardware including a power supply.

Functions such as E-stops, interlocks, and light stacks can be configured as part of transport system operation. See the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual* for information on digital I/O configuration and use.

The host controller can issue commands to set the value of the Digital Outputs, or read the value of the Digital Inputs. See the *Host Controller TCP/IP Communication Protocol User Manual* or the *Host Controller EtherNet/IP Communication Protocol User Manual* for details on the use of the digital I/O.

**NOTE:** An external power supply for the digital I/O circuits is required (see Figure 3-2).

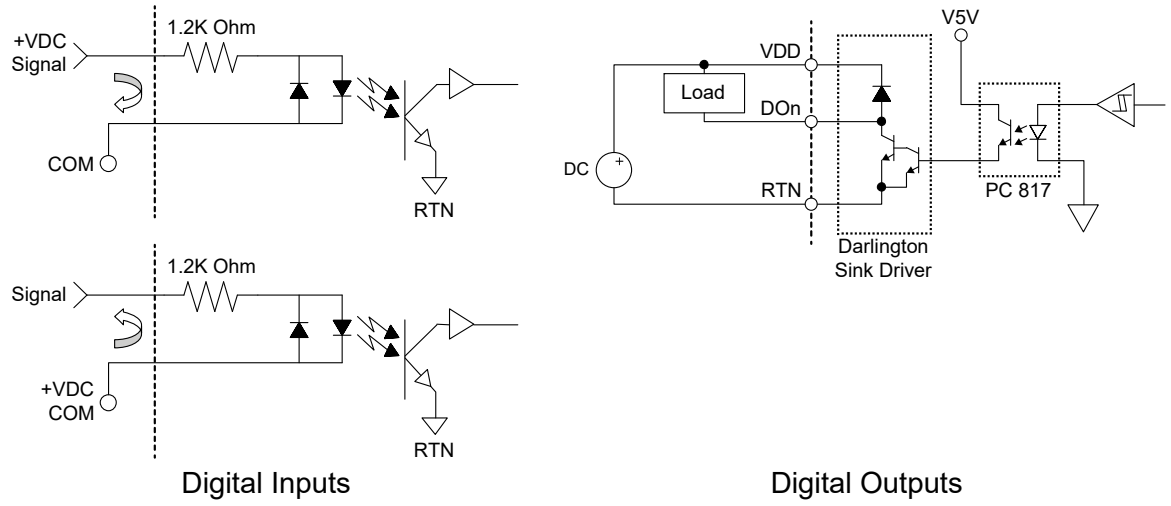



*Figure 3-2: Digital I/O Equivalent Circuits*

*Table 3-2: Digital I/O Power Requirements*

| | NC-E | NC-12 |
|---|---|---|
| Digital Inputs (+VDC) | +5–24V DC | +3–24V DC |
| Digital Outputs (DC) | +5–35V DC | +5–35V DC |

## NC-E Digital I/O Connection

The NC-E node controller provides four optically isolated digital input bits and four optically isolated digital output bits. See Figure 4-12 for the location of these connections on the node

controller and Table 4-13 for the pinout. See Figure 3-2 for the digital I/O equivalent circuits and Figure 3-2 for the power specification.

The digital inputs can be wired as a sink, where a +5–24V DC signal is wired to the appropriate digital input and COM is connected to the return (minus) side of the signal as shown in Figure 3-2. The digital inputs can also be wired as a source, where +5–24V DC is wired to the COM and the appropriate input is wired through the signal to ground as shown in Figure 3-2.

The digital outputs can only be wired as a sink, where a +5–35V DC supply is wired through a load and sunk when the digital output in use is turned on by the node controller as shown in Figure 3-2.

## NC-12 Digital I/O Connection

The NC-12 node controller provides 16 optically isolated digital input bits and 16 optically isolated digital output bits. See Figure 4-13 for the location of these connections on the node controller and Table 4-22 for the pinout. See Figure 3-2 for the digital I/O equivalent circuits and Figure 3-2 for the power specification.

The digital inputs can be wired as a sink, where a +3–24V DC signal is wired to the appropriate digital input and COM is connected to the return (minus) side of the signal as shown in Figure 3-2. The digital inputs can also be wired as a source, where +3–24V DC is wired to the COM and the appropriate input is wired through the signal to ground as shown in Figure 3-2.

**NOTE:** The GND pin on the node controllers is not used for the digital inputs even though there is a spring clamp on the “Inputs” side for GND.

The digital outputs can only be wired as a sink, where a +5–35V DC supply is wired through a load and sunk when the digital output in use is turned on by the node controller as shown in Figure 3-2.

To make digital I/O connections, use 12–26 AWG insulated wires and connect them to the appropriate input or output bits and to the respective COM, GND, or VDD connections. Insert a small flat-blade screwdriver into the connector release slot above the appropriate connector as shown in Figure 3-3. Rotate it to open the connector and insert the wire. Once the wire is fully seated, release and remove the screwdriver. Make sure that the connector blades are making direct contact with the wire and are not in contact with the insulation.

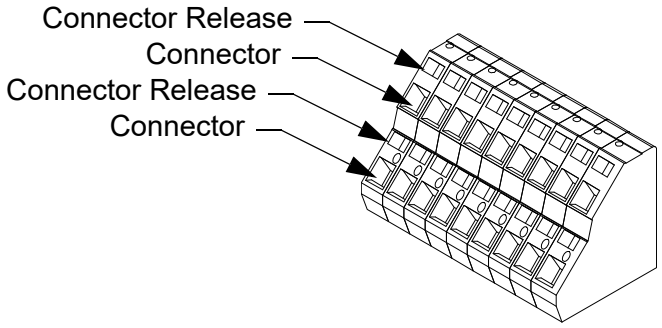



*Figure 3-3: Digital I/O Connections*

## Digital I/O Uses

### E-stop Circuit

When using an NC-12 node controller, the digital I/O on the node controller can be connected directly to an E-stop circuit as shown in Figure 3-4 and Figure 3-5. An E-stop is a user-supplied circuit with a locking button that an operator can press if an emergency situation arises to halt all motion on the specified paths. When the node controller detects that the E-stop button is activated, it commands all paths that are associated with that E-stop to suspend vehicle movement. All motors on those paths suspend vehicle target requests and permissions and all vehicles come to a controlled stop and are held in position by the motors. Stopping time for each vehicle is dependent on the mass of the vehicle, including any load, and the acceleration setting of the current movement command for the vehicle.

**⚠ CAUTION**

**High Voltage Hazard**

The E-stop is not the same as an EMO (Emergency Off), which removes power to the transport system.

Multiple E-stop circuits can be connected to one NC-12 node controller. Each path can then be configured to be associated with a specific E-stop bit. Any or all paths can be associated with the same E-stop bit. See the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual* for information on E-stop configuration and use.

**NOTE:** An external power supply for the E-stop circuit is required.

An E-stop circuit can have multiple buttons that are wired together in series as shown in Figure 3-4 so that pressing any button initiates an E-stop. The same E-stop circuit can be used for multiple paths that are connected to different node controllers by wiring the E-stop circuit to each node controller in series as shown in Figure 3-5 to a maximum of eight node controllers. The E-stop must be configured to reference the appropriate Digital Input Bit on each path. The E-stop is cleared by releasing the button that was pressed and having the host issue a Resume command.

**NOTE:** Motion cannot resume until the button is released and the host controller issues a Resume command to the paths associated with the E-stop.

**⚠ CAUTION**

**Electrical Hazard**

The E-stop only executes the actions that are described, it is not the same as an EMO (Emergency Off), which removes power to the transport system.

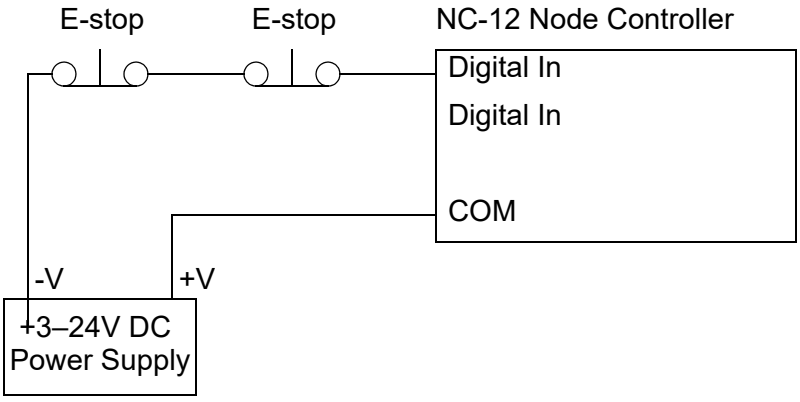



*Figure 3-4: E-stop Wiring Diagram, Single Node Controller*

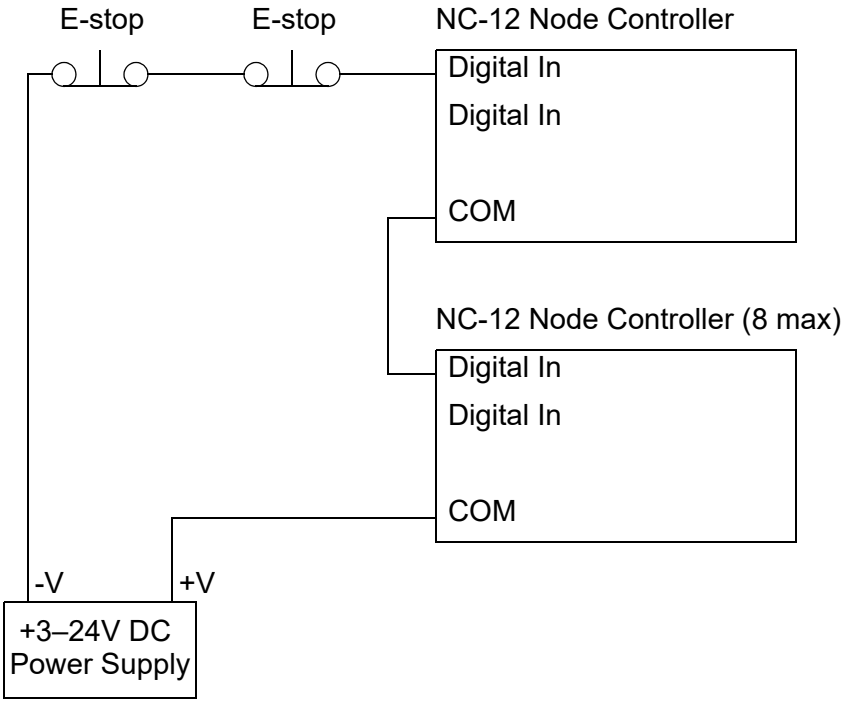



*Figure 3-5: E-stop Wiring Diagram, Multiple Node Controllers**

* In this configuration other digital I/O functions are not available.

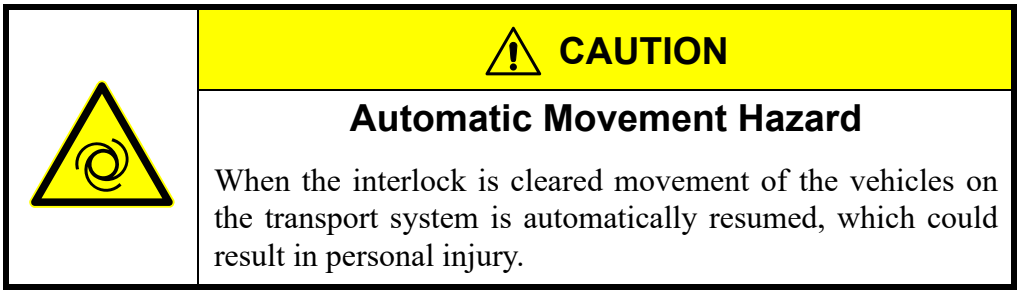
## Interlock Circuit

When using an NC-12 node controller, the digital I/O on the node controller can be connected directly to an interlock circuit as shown in Figure 3-6. An interlock is a user-installed circuit that another piece of equipment in the facility activates to halt all motion on the specified paths temporarily. When the node controller detects that the interlock circuit is activated, it commands all paths that are associated with that interlock to suspend vehicle movement. All motors on those paths suspend vehicle target requests and permissions and all vehicles come to a controlled stop and are held in position by the motors. Stopping time for each vehicle is dependent on the mass of the vehicle, including any load, and the acceleration setting of the current movement command for the vehicle.

Multiple interlock circuits can be connected to one NC-12 node controller. Each path can then be configured to be associated with a specific interlock bit. Any or all paths can be associated with the same interlock bit. See the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual* for information on interlock configuration and use.

**NOTE:** An external power supply for the interlock circuit is required.

The interlock circuit, which is shown in Figure 3-6, is connected to a digital output on the host controller such that breaking the circuit activates the interlock. The interlock is cleared by taking the interlock signal High.



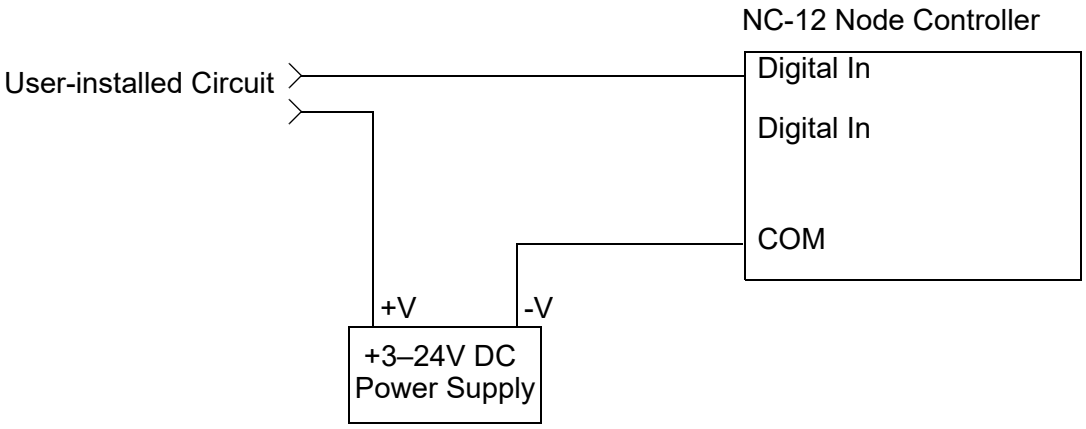




*Figure 3-6: Interlock Wiring Diagram*

## Light Stack Circuit

When using an NC-12 node controller, the digital I/O on the node controller can be connected directly to a light stack as shown in Figure 3-7. A light stack is a user-installed visual signal that is used to provide transport system status. The light stack can be used to monitor the status of any, or all, paths on the node controller where it is connected. Multiple light stacks can be connected to one NC-12 node controller. Each path can then be configured to be associated with a specific light stack. Any or all paths can be associated with the same light stack.

The transport system supports standard three color light stacks (typically green, yellow, and red) as shown:

- **Run Bit** (Green Light) – Vehicle movement active/enabled, expect vehicle movement.
- **Warning Bit** (Yellow Light) – System faults, the system could still be operational with vehicles moving.
- **Stop Bit** (Red Light) – Vehicle movement halted/stopped, movement can resume at any time with no warning.

The optional light stack circuit is the responsibility of the user and requires a user-supplied 3-color light tower and power supply (sized for the light stack) for the Digital Outputs. See Figure 3-2 on page 47 for the digital I/O equivalent circuits. See the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual* for information on light stack configuration and use.

**NOTE:** An external power supply for the light stack circuit is required.

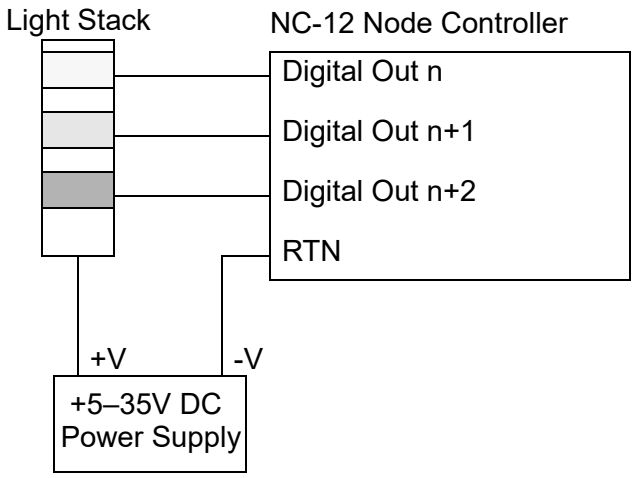



*Figure 3-7: Light Stack Wiring Diagram*

# Specifications and Site Requirements 4

## Overview

This chapter describes specifications for the MagneMotion® node controllers and the requirements for installation.

Included in this chapter are:

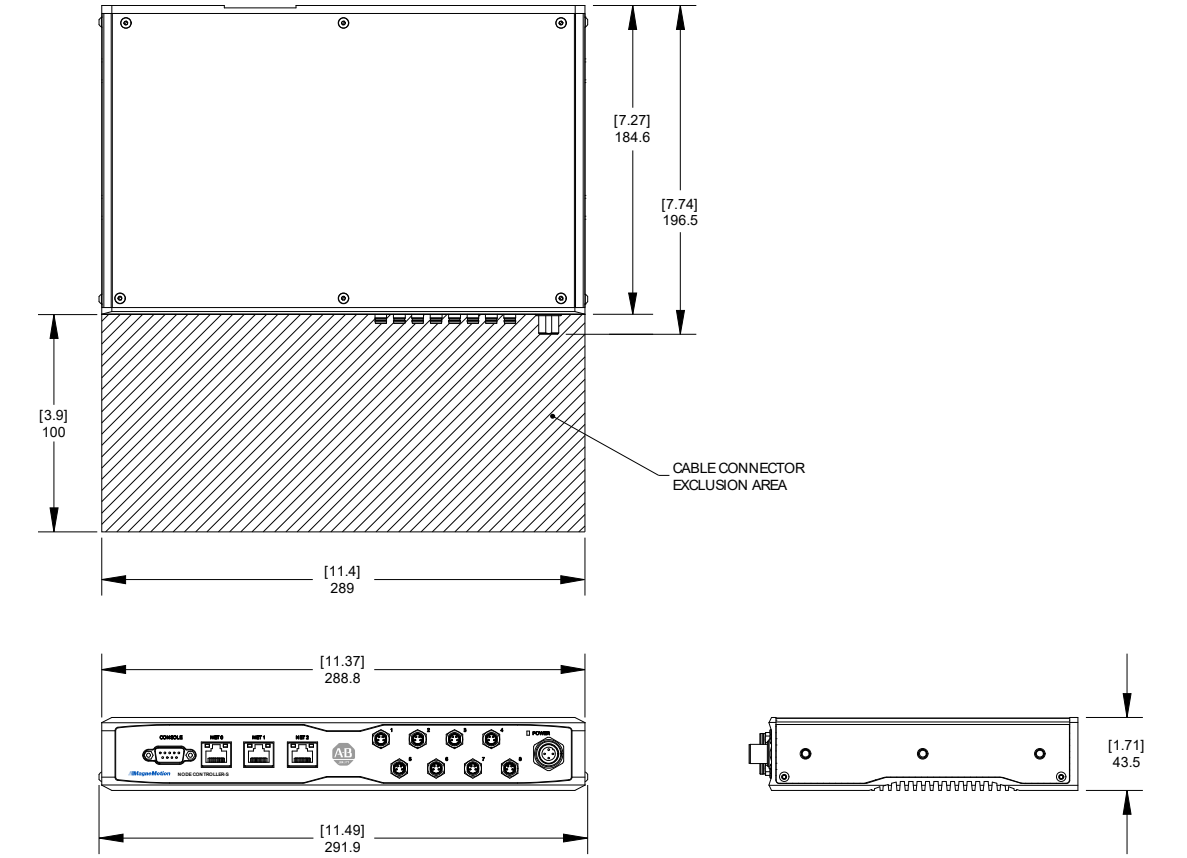
- Mechanical specifications for all node controllers, including dimensions.
- Electrical specifications for power and communications, including connector pinouts.
- Site requirements, including environmental and service access.

# Mechanical Specifications

All drawings within this manual are generic and may not reflect specific configurations of the node controllers. To obtain current drawings, contact ICT Customer Support.

## NC-S Node Controller

MMI-NC-SER08-01




Weight: 1.95 kg [4.3 lb]

All Dimensions in Millimeters [Inches]

*Figure 4-1: NC-S Node Controller Mechanical Drawing*

**NOTE:** Mounting kits for surface mounting, 19 inch rack mounting, and DIN rail mounting are available.

Ingress Protection Rating: Designed for IP20.

See *NC-S Node Controller* on page 64 for the electrical specifications.

Contact ICT Customer Support for current detail drawings.

### Exposed Materials

The node controller has unprotected openings and must not be installed in locations where harsh conditions exist.

## NC-S Mounting Plate

Two mounting plates can be used for mounting the NC-S node controller to any flat surface.

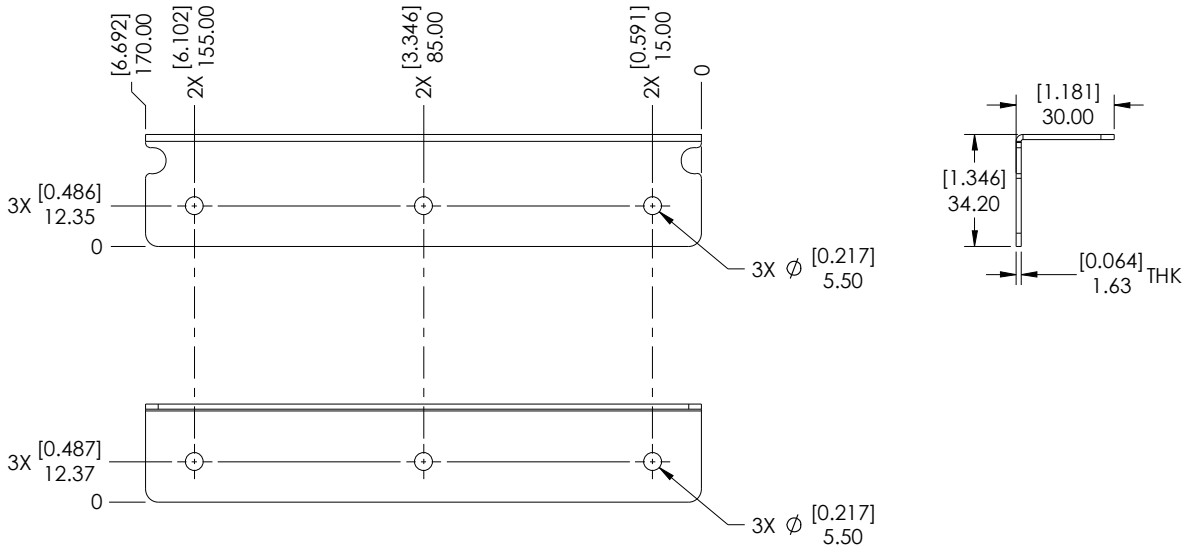



*Figure 4-2: NC-S Mounting Plate Mechanical Drawing*

**NOTE:** Contact ICT Customer Support for current detail drawings.

## Exposed Materials

- 5052-H32 Aluminum.
- Epoxy powder coat paint.

## NC-S Rack Mounting Bracket

The 1U rack mounting brackets can be used for mounting the NC-S node controller in a standard 19 in electronics rack.

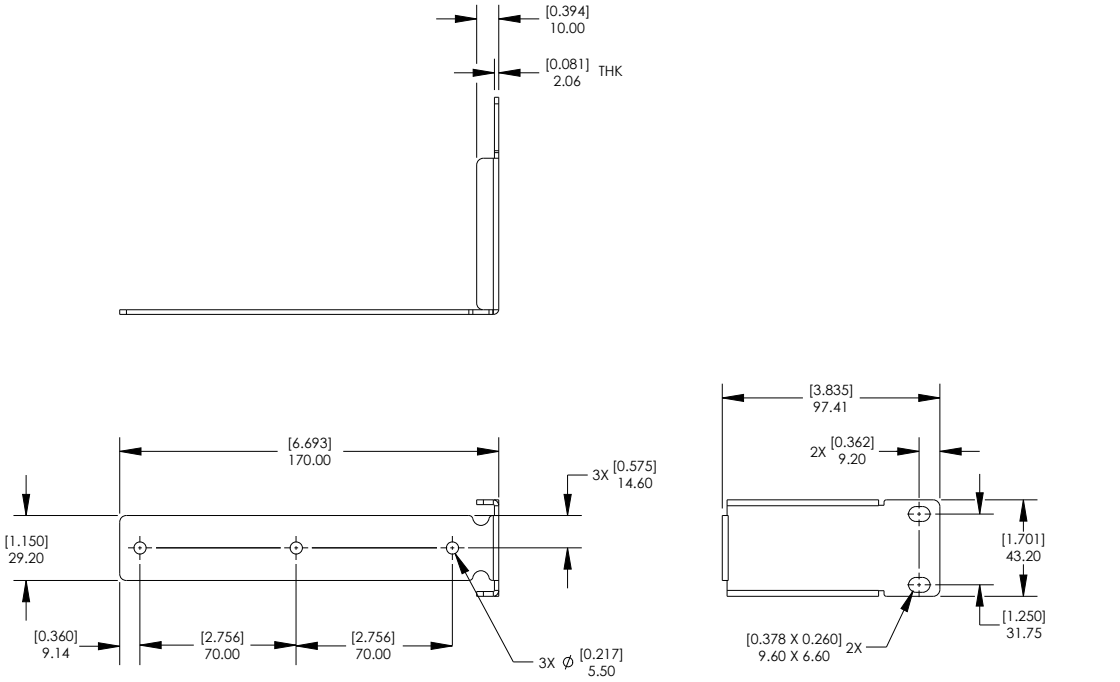



*Figure 4-3: NC-S Rack Mounting Bracket Mechanical Drawing*

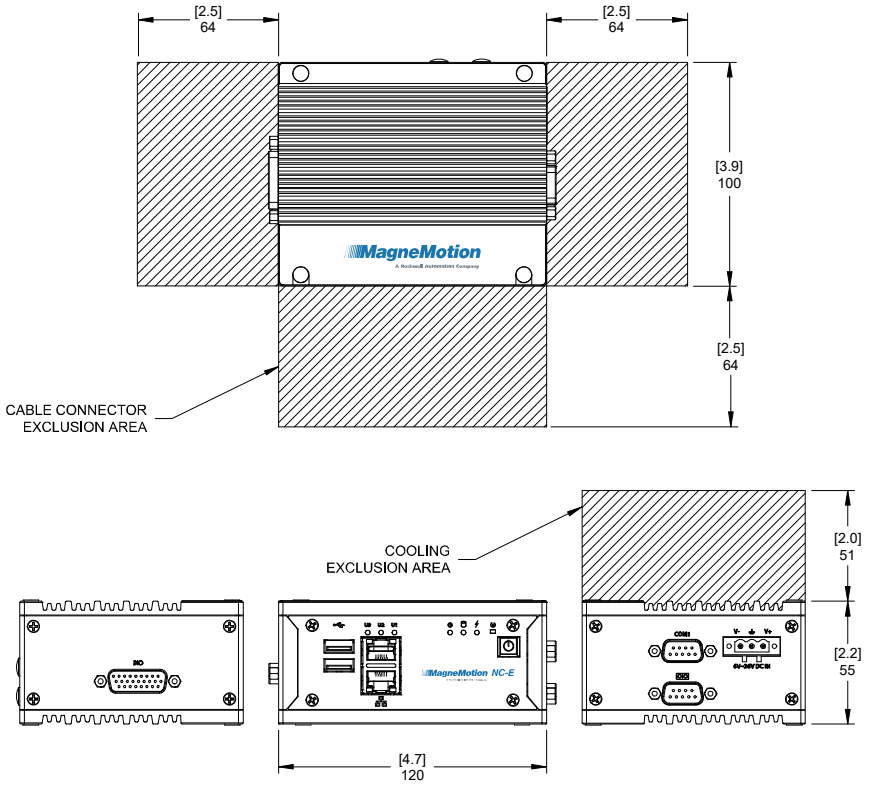
**NOTE:** Contact ICT Customer Support for current detail drawings.

## Exposed Materials

- 5052-H32 Aluminum.
- Epoxy powder coat paint.

## NC-E Node Controller

MMI-NC-ENET-01




Weight: 0.65 kg [1.43 lb] All Dimensions in Millimeters [Inches]

*Figure 4-4: NC-E Node Controller Mechanical Drawing*

**NOTE:** Mounting kits for surface mounting and DIN rail mounting are supplied with the node controller.

Ingress Protection Rating: Designed for IP30.

See *NC-E Node Controller* on page 68 for the electrical specifications.

Contact ICT Customer Support for current detail drawings.

### Exposed Materials

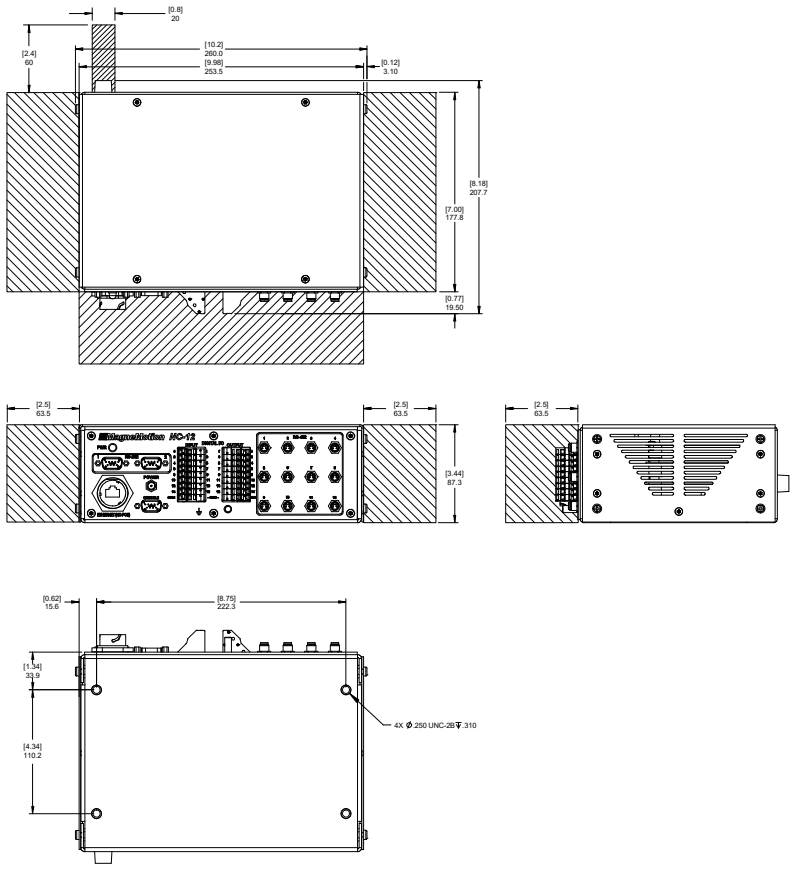
The node controller has unprotected openings and must not be installed in locations where harsh conditions exist.

## NC-12 Node Controller

The NC-12 node controller is available in two different configurations. The 700-1482-00 version provides a standard RJ45 network connection and a 2 mm coax power connection. The 700-1573-00 version provides an M12 Eurofast® network connection and an M12 Eurofast power connection.

### NC-12 Node Controller, RJ45 Ethernet

700-1482-00




Weight: 3.6 kg [8 lb] All Dimensions in Millimeters [Inches]

*Figure 4-5: NC-12 Node Controller Mechanical Drawing, RJ45 Ethernet*

**NOTE:** A minimum of 50% of each vent must be clear for unobstructed airflow.

A mounting kit is available for standard 19 in electronics racks (see *NC-12 Rack Mounting Bracket* on page 61).

Ingress Protection Rating: IP20.

See *NC-12 Node Controller* on page 72 for the electrical specifications.

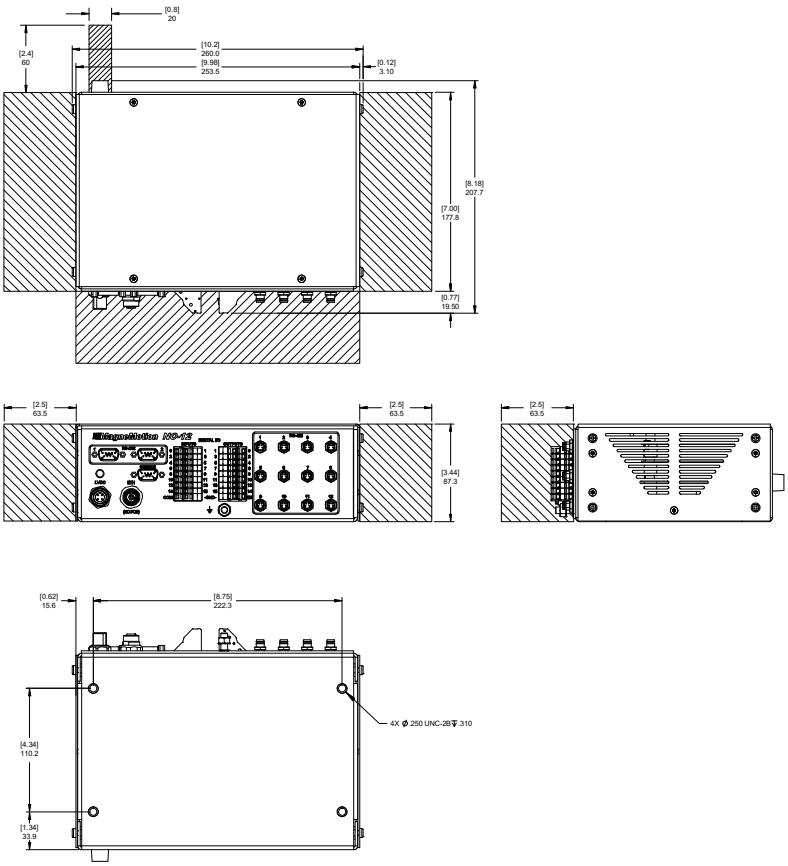
Contact ICT Customer Support for current detail drawings.

### Exposed Materials

The node controller provides openings for airflow and must not be installed where harsh conditions exist.

## NC-12 Node Controller, M12 Ethernet

700-1573-00




Weight: 3.6 kg [8 lb] All Dimensions in Millimeters [Inches]

*Figure 4-6: NC-12 Node Controller Mechanical Drawing, M12 Ethernet*

**NOTE:** A minimum of 50% of each vent must be clear for unobstructed airflow.

A mounting kit is available for standard 19 in electronics racks (see *NC-12 Rack Mounting Bracket* on page 61).

Ingress Protection Rating: IP20.

See *NC-12 Node Controller* on page 72 for the electrical specifications.

Contact ICT Customer Support for current detail drawings.

### Exposed Materials

The node controller provides openings for airflow and must not be installed where harsh conditions exist.

## NC-12 Mounting Plate

Two mounting plates can be used for mounting the NC-12 node controller to any flat surface.

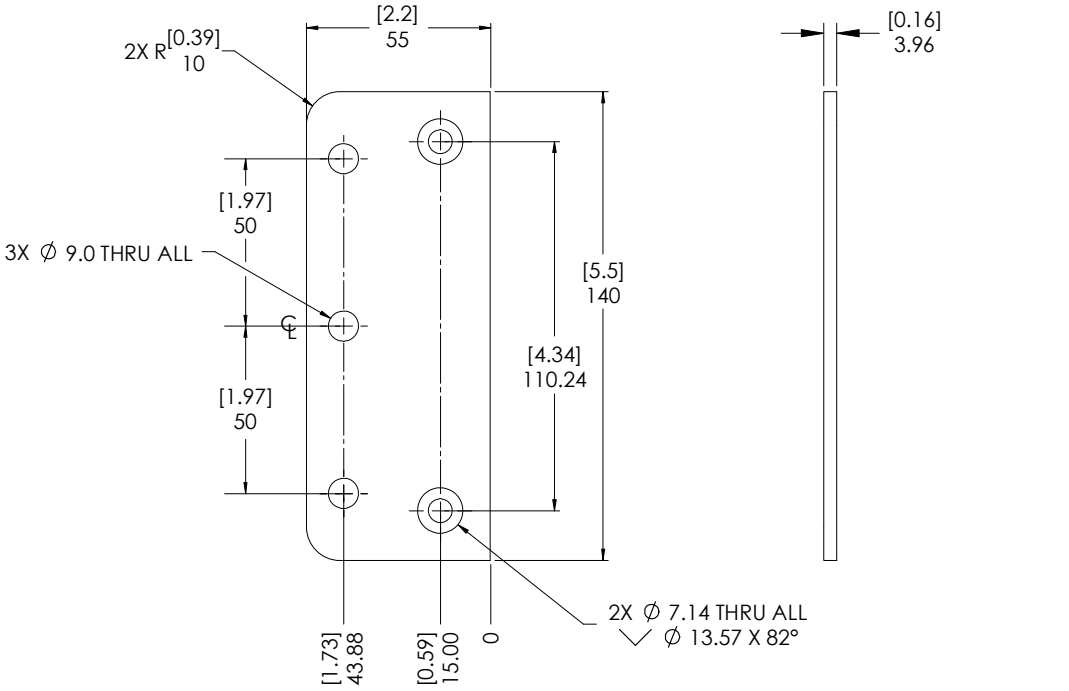



*Figure 4-7: NC-12 Mounting Plate Mechanical Drawing*

**NOTE:** Contact ICT Customer Support for current detail drawings.

## Exposed Materials

- 6061-T6 Aluminum.

## NC-12 Rack Mounting Bracket

The 2U rack mounting brackets can be used for mounting the NC-12 node controller in a standard 19 in electronics rack.

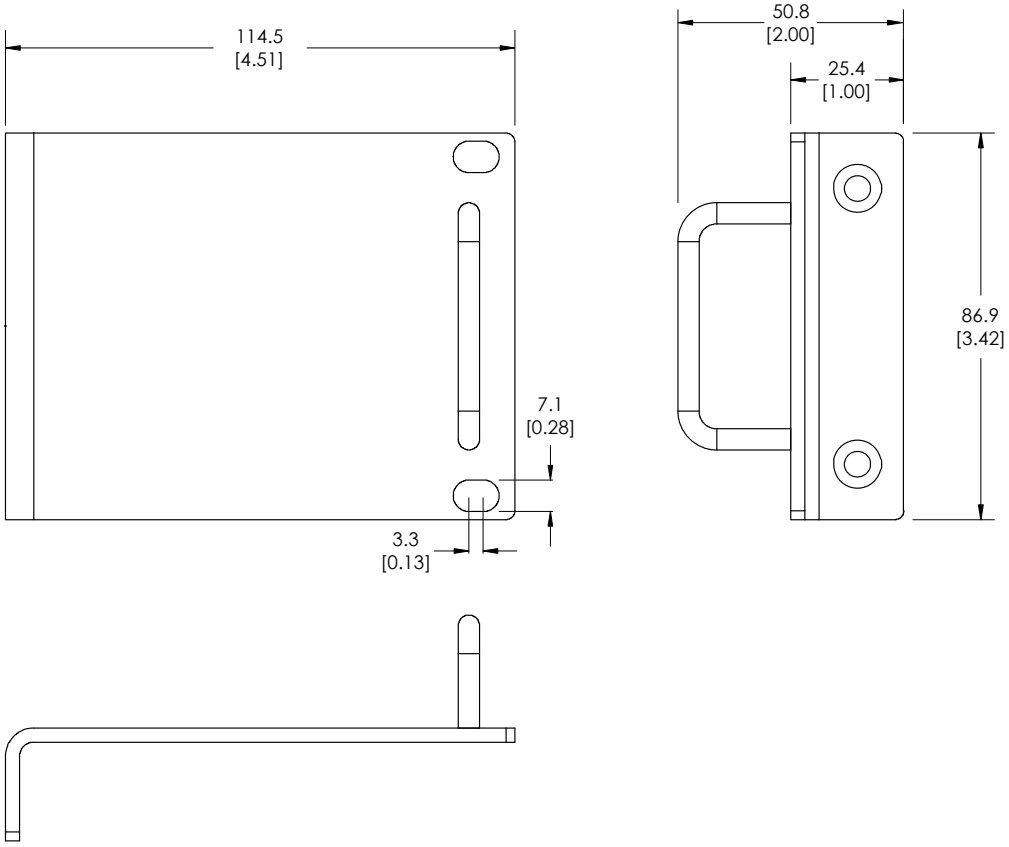



*Figure 4-8: NC-12 Rack Mounting Bracket Mechanical Drawing*

**NOTE:** Contact ICT Customer Support for current detail drawings.

## Exposed Materials

- Carbon Steel.
- 1018 Steel.
- Anodized Aluminum.

## NC LITE

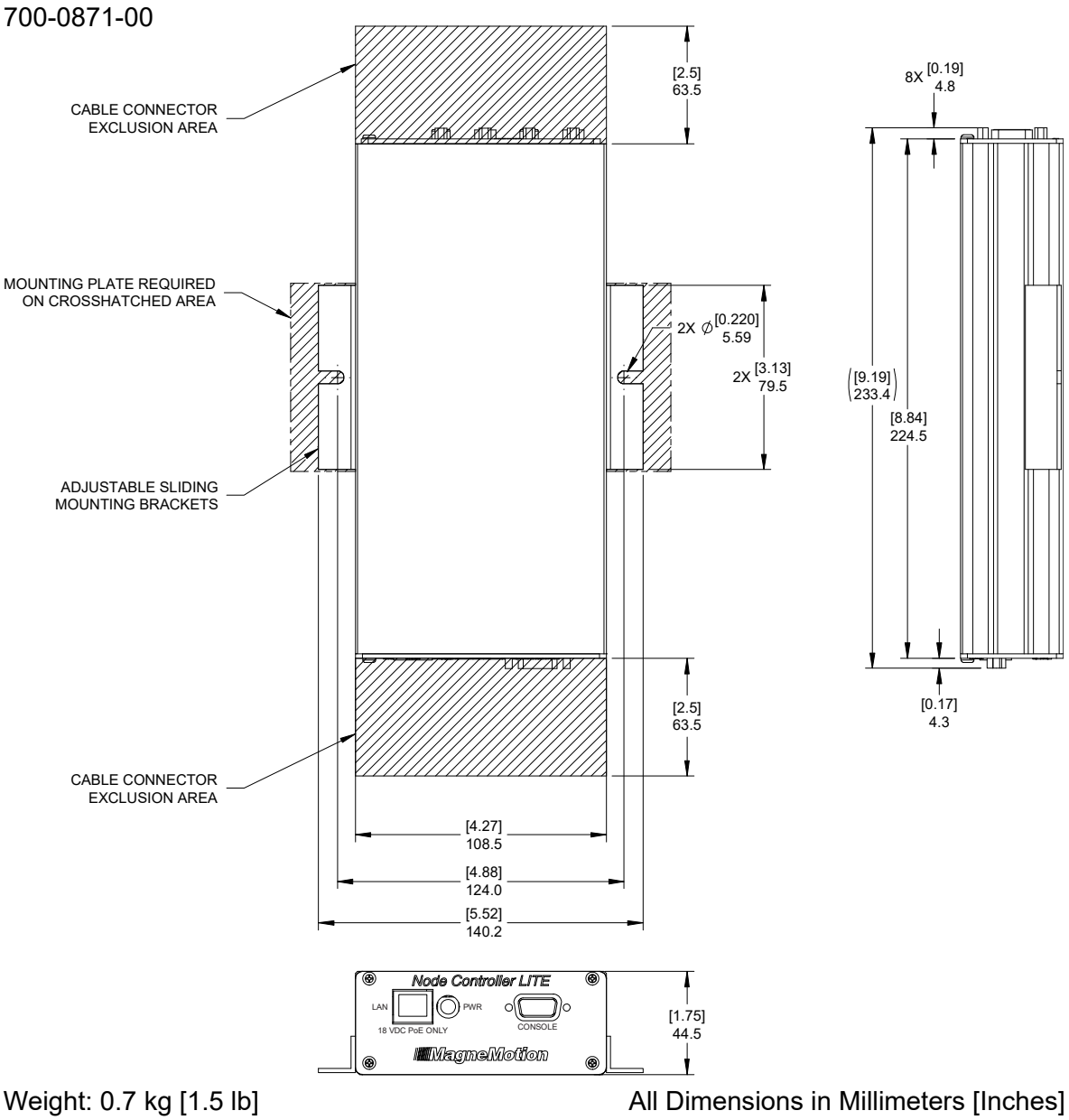



*Figure 4-9: NC LITE Mechanical Drawing*

**NOTE:** A plate is available for mounting (see *Electronics Mounting Plate* on page 63).

Ingress Protection Rating: IP30.

See *NC LITE* on page 78 for the electrical specifications.

Contact ICT Customer Support for current detail drawings.

### Exposed Materials

The node controller has unprotected openings and must not be installed in locations where harsh conditions exist.

## Electronics Mounting Plate

The Electronics Mounting Plate can be used for mounting the NC LITE, the SYNC IT controller, and Ethernet Switches.

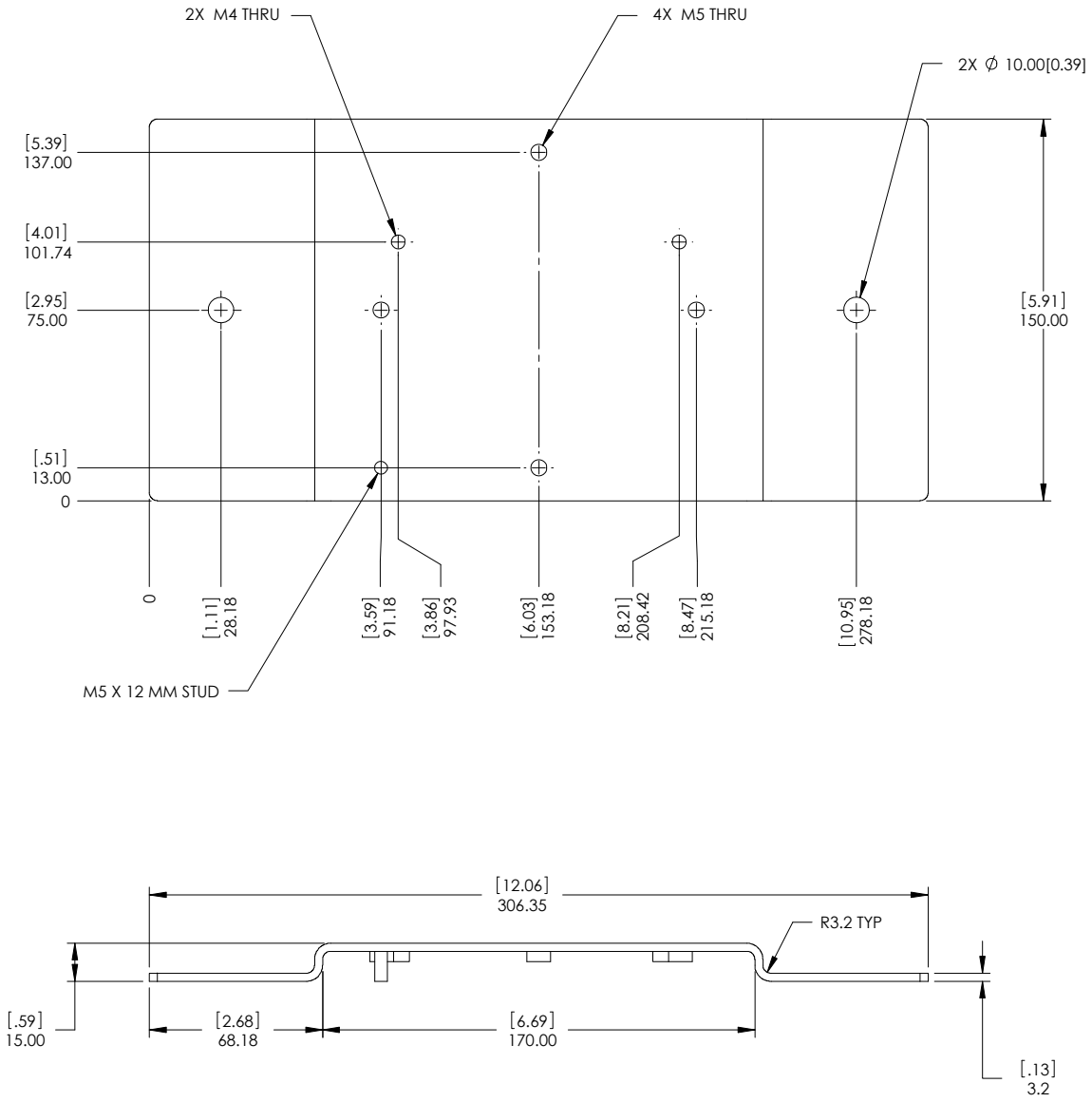



*Figure 4-10: Electronics Mounting Plate Mechanical Drawing*

**NOTE:** Contact ICT Customer Support for current detail drawings.

## Exposed Materials

- 5052-H32 Aluminum.
- 300 Series Stainless Steel.
- A-286 Hardened Stainless Steel.

# Electrical Specifications

## NC-S Node Controller

24–48V DC ±10%, 10 W max based on configuration and operating mode. See *NC-S Node Controller* on page 54 for the mechanical drawing.

### AC Power Option

The optional remote power supply for the NC-S node controller requires 90–264V AC @ 47–63 Hz, single-phase (phase-to-phase or phase-to-neutral), 0.7 A at 100V AC (25 W max). Inrush current 45 A/240V AC max The actual power being drawn depends on the operations being performed. However, all power wiring must be designed to carry the full load. See the data sheet provided by the power supply manufacturer for mechanical information.

**⚠ CAUTION**

**High-Voltage Hazard**

90–264V AC, 25 W

AC power must be disconnected before servicing.

### AC Power Cable

The optional remote power supply for the NC-S node controller is supplied with a power cable. Contact MagneMotion for replacement cables. The AC power cable plugs directly into the power supply.

### DC Power Option

DC power from a user-supplied power supply requires 24–48V DC, 10 W.

**NOTICE**

Any user-supplied power supply must be NRTL/ATL approved.

The actual power being drawn depends on the operations being performed. Make sure that all power wiring can carry the full load and has a limited power source or the power source is fused to the maximum rating of the wiring.

**NOTICE**

The NC-S node controller does not support Power over Ethernet. Never connect these node controllers to a powered network as damage to internal components can result.

**NOTICE**

Connecting to the DC power connector on the NC-S node controller must be done with the power supply off. Connecting with the power supply on can cause a short circuit at the connector, which can damage the power supply or any other equipment being powered by that power supply.

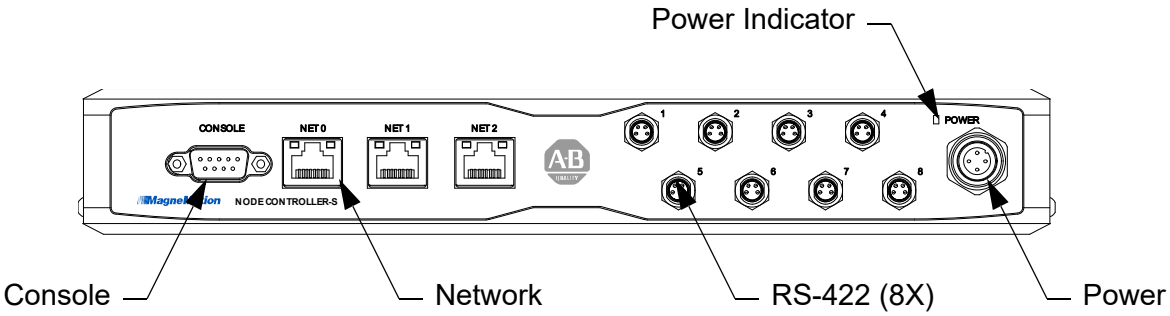



*Figure 4-11: NC-S Node Controller Electrical Connections, Controls, and Indicators*

*Table 4-1: NC-S Node Controller Electrical Connections*

| Label | Description | Connector Type |
|---|---|---|
| CONSOLE | External terminal | DE-9, Male |
| NET0 | Ethernet - 10/100/1000 Base-Tx (auto-MDIX, auto-negotiation) | RJ45, Female |
| NET1, NET2 | not used | RJ45, Female |
| 1-8 | RS-422 motor communications | M8 Nano-Mizer, 4-Pin, Male* |
| POWER | 24-48V DC ±10%, 10 W | M12 Eurofast, 4-Pin, Male† |

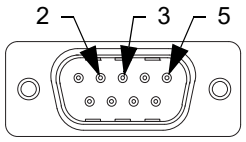
* MagneMotion recommends that the odd number connectors be used for upstream connections and the even number connectors be used for downstream connections.

† MagneMotion requires grounding the NC-S through the chassis ground connection on the power connector.

*Table 4-2: NC-S Node Controller Indicators*

| Label | Description | Indicator Type |
|---|---|---|
| POWER | ON – Indicates that DC power is on. | Green light |

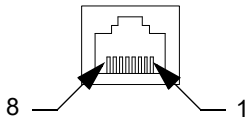
*Table 4-3: NC-S Node Controller Console Pinout*




**DE-9, Male**

| | |
|---|---|
| — | 1 |
| **Rx** | 2 |
| **Tx** | 3 |
| — | 4 |
| **RTN** | 5 |
| — | 6 |
| — | 7 |
| — | 8 |
| — | 9 |

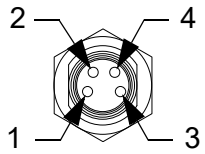
*Table 4-4: NC-S Node Controller Ethernet Pinout*




**RJ45, Female**

| | |
|---|---|
| **TD+** | 1 |
| **TD-** | 2 |
| **RD+** | 3 |
| — | 4 |
| — | 5 |
| **RD-** | 6 |
| — | 7 |
| — | 8 |

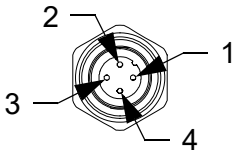
*Table 4-5: NC-S Node Controller RS-422 Pinout*




**M8 Nano-Mizer, 4-Pin, Male**

| | |
|---|---|
| **RxD+** | 1 |
| **RxD-** | 2 |
| **TxD+** | 3 |
| **TxD-** | 4 |

*Table 4-6: NC-S Node Controller Power Pinout*




**M12 Eurofast, FSFD, 4-Pin, Male**

| | |
|---|---|
| **PWR** | 1 |
| **—** | 2 |
| **RTN** | 3 |
| **GND** | 4 |

## NC-E Node Controller

6–36V DC, 40 W max based on configuration and operating mode. See *NC-E Node Controller* on page 57 for the mechanical drawing.

### DC Power Option

DC power from a user-supplied power supply requires 6–36V DC, 40 W.

**NOTICE**

Any user-supplied power supply must be NRTL/ATL approved.

The actual power being drawn depends on the operations being performed. Make sure that all power wiring can carry the full load and has a limited power source or the power source is fused to the maximum rating of the wiring.

**NOTICE**

The NC-E node controller does not support Power over Ethernet. Never connect these node controllers to a powered network as damage to internal components can result.

**NOTICE**

Connecting to the DC power connector on the NC-E node controller must be done with the power supply off. Connecting with the power supply on can cause a short circuit at the connector, which can damage the power supply or any other equipment being powered by that power supply.

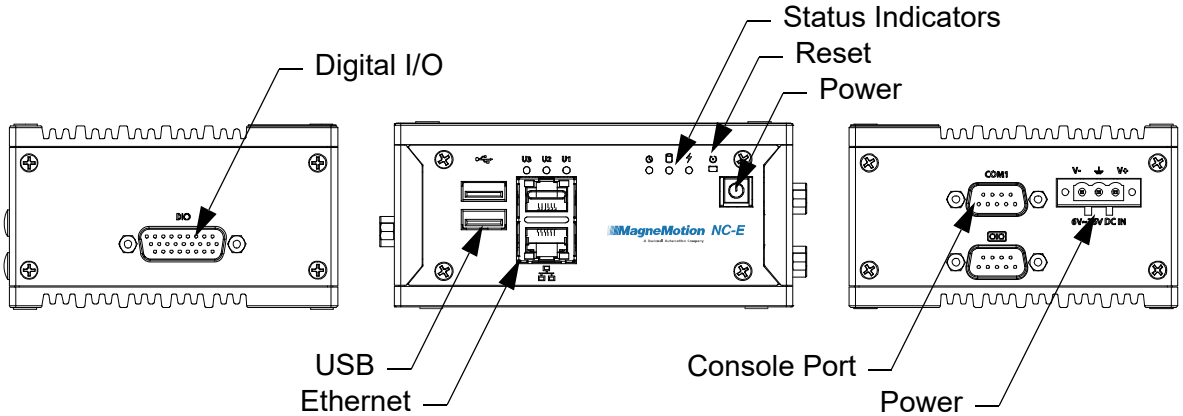



*Figure 4-12: NC-E Node Controller Electrical Connections, Controls, and Indicators*

*Table 4-7: NC-E Node Controller Electrical Connections*

| Label | Description | Connector Type |
|---|---|---|
| Digital I/O | Optically isolated, 4 input bits and 4 output bits | DA-26, Female |
| (USB) | Not used | USB 2.0, Female |
| (Network) | Ethernet – 10/100/1000 BaseTx (auto-MDIX, auto-negotiation) | RJ45, Female<br>Only the lower connector is used. |
| COM1 | External terminal | DE-9, Male |
| 6V~36V DC IN | 6–36V DC, 40 W | 3P pluggable connector with latch (V-, GND, V+)* |

* MagneMotion requires grounding the NC-E through the chassis ground connection on the power connector.

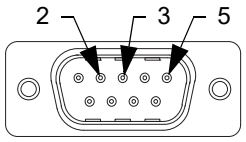
*Table 4-8: NC-E Node Controller Controls*

| Label | Description | Control Type |
|---|---|---|
| (Reset) | Forced reset of node controller. | Recessed push button |
| (Power) | Power on/off for the node controller.<br>Press and hold ~10 sec to turn off the NC-E. | Push button |

*Table 4-9: NC-E Node Controller Indicators*

| Label | Description | Indicator Type |
|---|---|---|
| U1 | *Reserved* | — |
| U2 | *Reserved* | — |
| U3 | *Reserved* | — |
| (Watchdog) | Indicates the watchdog timer status.<br>Blinks when the watchdog timer starts. When the timer is expired, the node controller auto-reboots. | Yellow light |
| (Hard Disk) | When blinking, indicates that the hard disk drive is active. | Orange light |
| (Standby) | Indicates that the node controller is in power standby mode. | Blue light |
| (Power) | Indicates that the NC-E is on. | Blue light |

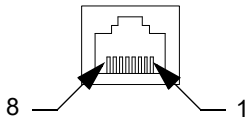
*Table 4-10: NC-E Node Controller COM1 (Console) Pinout*




**DE-9, Male**

| | |
|---|---|
| — | 1 |
| **Rx** | 2 |
| **Tx** | 3 |
| — | 4 |
| **RTN** | 5 |
| — | 6 |
| — | 7 |
| — | 8 |
| — | 9 |

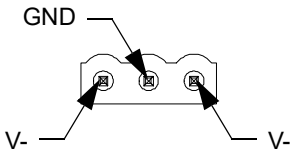
*Table 4-11: NC-E Node Controller Ethernet Pinout*




**RJ45, Female**

| | |
|---|---|
| **TD+** | 1 |
| **TD-** | 2 |
| **RD+** | 3 |
| — | 4 |
| — | 5 |
| **RD-** | 6 |
| — | 7 |
| — | 8 |

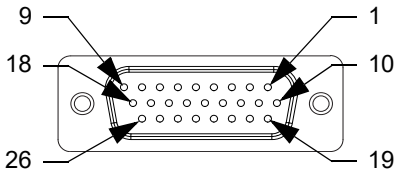
*Table 4-12: NC-E Node Controller Power Pinout*




**2.0 mm Coax, Male**

| | |
|---|---|
| **RTN** | 1 |
| **GND** | 2 |
| **PWR** | 3 |

*Table 4-13: NC-E Node Controller Digital I/O Pinout*




**DA-26, Female**

| | |
|---|---|
| **+VDD** | 1 |
| **+VDD** | 2 |
| **+V5DIO_CN_ISO** | 3 |
| **EOGND** | 4 |
| **DI3_H** | 5 |
| **DO0** | 6 |
| **DI3_L** | 7 |
| **EOGND** | 8 |
| **DI2_H** | 9 |

| | |
|---|---|
| **DO1** | 10 |
| **DI2_L** | 11 |
| **EOGND** | 12 |
| **DI1_H** | 13 |
| **DO2** | 14 |
| **DI1_L** | 15 |
| **EOGND** | 16 |
| **DI0_H** | 17 |
| **DO3** | 18 |

| | |
|---|---|
| **DI0_L** | 19 |
| **EOGND** | 20 |
| **NC** | 21 |
| **NC** | 22 |
| **NC** | 23 |
| **NC** | 24 |
| **NC** | 25 |
| **NC** | 26 |

## NC-12 Node Controller

The NC-12 node controller is available in two different configurations. The 700-1482-00 version provides a standard RJ45 network connection and a 2 mm coax power connection. The 700-1573-00 version provides an M12 Eurofast network connection and an M12 Eurofast power connection.

22–30V DC, 20 W max based on configuration and operating mode. See *NC-12 Node Controller* on page 58 or *NC-12 Node Controller, M12 Ethernet* on page 59 for the mechanical drawing.

### AC Power Option

The optional remote power supply for the NC-12 node controller requires 90–264V AC @ 47–63 Hz, single-phase (phase-to-phase or phase-to-neutral), 0.7 A at 100V AC (25 W max). Inrush current 45 A/240V AC max The actual power being drawn depends on the operations being performed. However, all power wiring must be designed to carry the full load. See the data sheet provided by the power supply manufacturer for mechanical information.

**⚠ CAUTION**

**High-Voltage Hazard**

90–264V AC, 25 W

AC power must be disconnected before servicing.

### AC Power Cable

The optional remote power supply for the NC-12 node controller is supplied with a power cable. Contact MagneMotion for replacement cables. The AC power cable plugs directly into the power supply.

### DC Power Option

DC power from a user-supplied power supply requires 22–30V DC, 20 W.

***NOTICE***

Any user-supplied power supply must be NRTL/ATL approved.

The actual power being drawn depends on the operations being performed. Make sure that all power wiring can carry the full load and has a limited power source or the power source is fused to the maximum rating of the wiring.

**NOTICE**

Connecting to the DC power connector on the NC-12 node controller must be done with the power supply off. Connecting with the power supply on can cause a short circuit at the connector, which can damage the power supply or any other equipment being powered by that power supply.

**NOTICE**

The NC-12 node controller does not support Power over Ethernet. Never connect these node controllers to a powered network as damage to internal components can result.

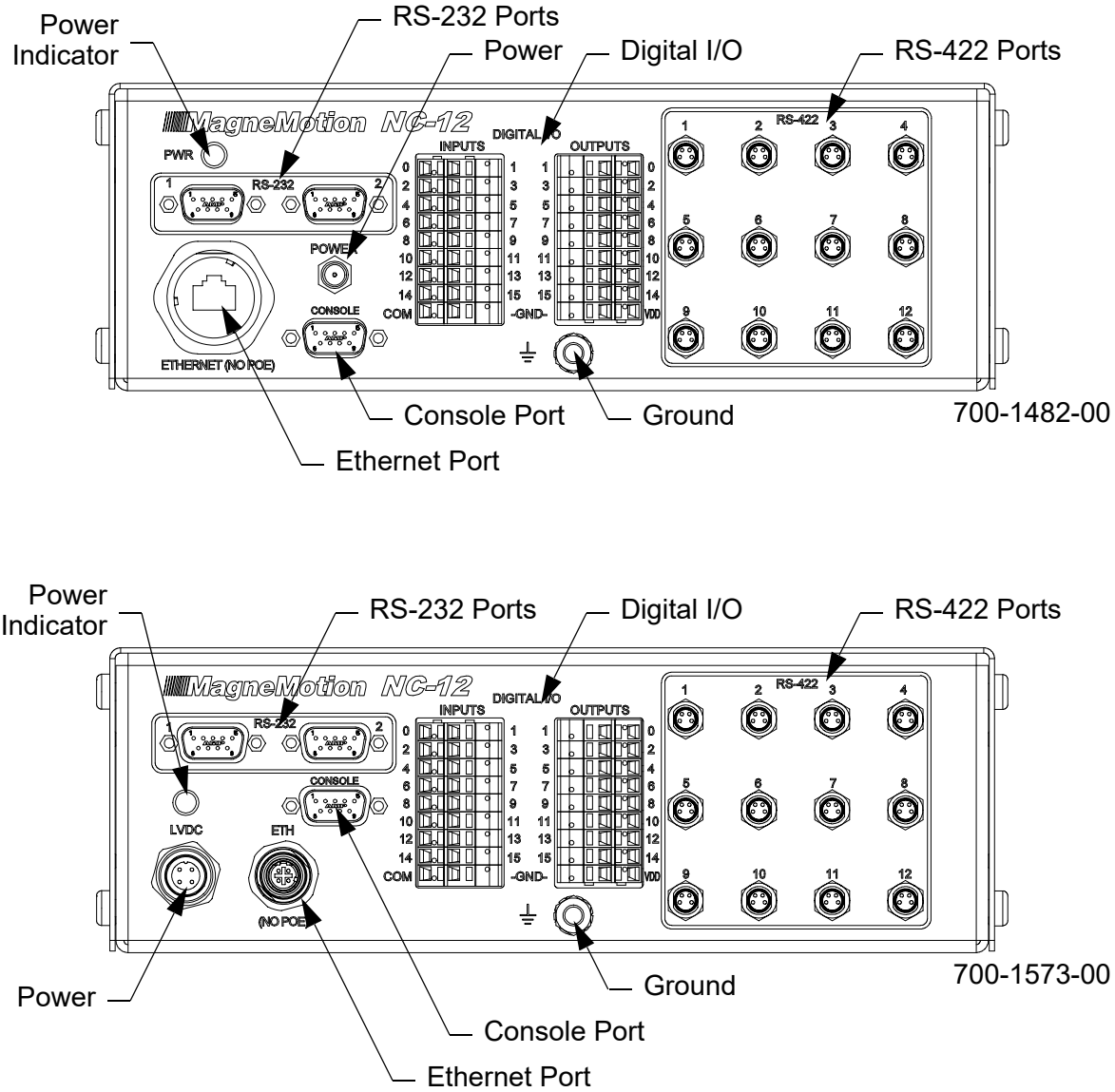



*Figure 4-13: NC-12 Node Controller Electrical Connections and Indicators*

*Table 4-14: NC-12 Node Controller Connections, 700-1482-00*

| Label | Description | Connector Type |
|---|---|---|
| CONSOLE | External terminal | DE-9, Male |
| ETHERNET | Ethernet – 10/100/1000 BaseTx (auto-MDIX, auto-negotiation) | RJ45, Female, IP67* |
| DIGITAL I/O | Digital I/O, optically isolated, 16 input bits and 16 output bits, see *General Purpose Digital I/O* on page 47 | Spring-cage clamp |
| RS-232 | RS-232 external communications | DE-9, Male |
| RS-422 | RS-422 motor communications | M8 Nano-Mizer, 4-Pin, Male† |
| POWER | 22–30 VDC, 20 W | DC Power Jack, 2.0 mm Coax, Male |
| ⏚ | Ground | M6 threaded stud‡ |

* IP67 rated mating connector is not required.

† MagneMotion recommends that the odd number connectors be used for upstream connections and the even number connectors be used for downstream connections.

‡ MagneMotion requires grounding the NC-12 through the ground stud with a minimum of 14 AWG wire.

*Table 4-15: NC-12 Node Controller Connections, 700-1573-00*

| Label | Description | Connector Type |
|---|---|---|
| CONSOLE | External terminal | DE-9, Male |
| ETH | Ethernet – 10/100/1000 BaseTx (auto-MDIX, auto-negotiation) | M12, Eurofast, 4-Pin, Female |
| DIGITAL I/O | Digital I/O, optically isolated, 16 input bits and 16 output bits, see *General Purpose Digital I/O* on page 47 | Spring-cage clamp |
| RS-232 | RS-232 external communications | DE-9, Male |
| RS-422 | RS-422 motor communications | M8 Nano-Mizer, 4-Pin, Male* |
| LVDC | 22–30 VDC, 20 W | M12 Eurofast, 4-Pin, Male |
| ⏚ | Ground | M6 threaded stud† |

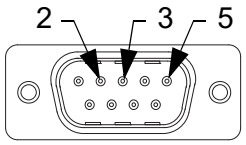
* MagneMotion recommends that the odd number connectors be used for upstream connections and the even number connectors be used for downstream connections.

† MagneMotion requires grounding the NC-12 through the ground stud with a minimum of 14 AWG wire.

*Table 4-16: NC-12 Node Controller Indicators*

| Label | Description | Indicator Type |
|---|---|---|
| PWR/LVDC | ON – Indicates that DC power is on. | Green light |

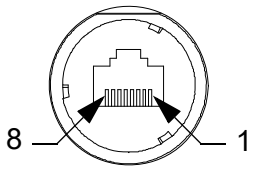
*Table 4-17: NC-12 Node Controller Console Pinout*



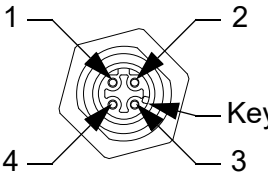

**DE-9, Male**

| | |
|---|---|
| — | 1 |
| **-Rx** | 2 |
| **+Tx** | 3 |
| — | 4 |
| **GND** | 5 |
| — | 6 |
| — | 7 |
| — | 8 |
| — | 9 |

*Table 4-18: NC-12 Node Controller Ethernet Pinout*



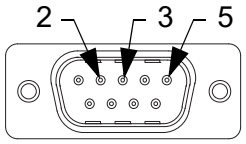

**700-1482-00**
**RJ45, Female**




**700-1573-00**
**M12 Eurofast, FKFDD, Female**

| | | |
|---|---|---|
| **TD+** | 1 | 1 |
| **TD-** | 2 | 3 |
| **RD+** | 3 | 2 |
| — | 4 | |
| — | 5 | |
| **RD-** | 6 | 4 |
| — | 7 | |
| — | 8 | |

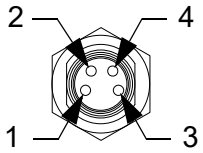
*Table 4-19: NC-12 Node Controller RS-232 Pinout*




**DE-9, Male**

| | |
|---|---|
| — | 1 |
| **-Rx** | 2 |
| **+Tx** | 3 |
| — | 4 |
| **GND** | 5 |
| — | 6 |
| — | 7 |
| — | 8 |
| — | 9 |

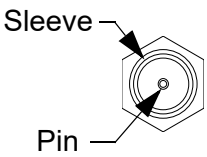
*Table 4-20: NC-12 Node Controller RS-422 Pinout*



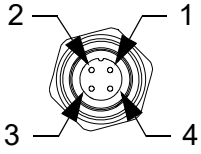

**M8 Nano-Mizer, 4-Pin, Male**

| | |
|---|---|
| **RxD+** | 1 |
| **RxD-** | 2 |
| **TxD+** | 3 |
| **TxD-** | 4 |

*Table 4-21: NC-12 Node Controller Power Pinout*



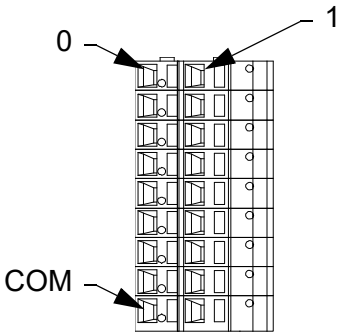

**700-1482-00**
**2.0 mm Coax, Male**




**700-1573-00**
**M12 Eurofast, FSFD, 4-Pin, Male**

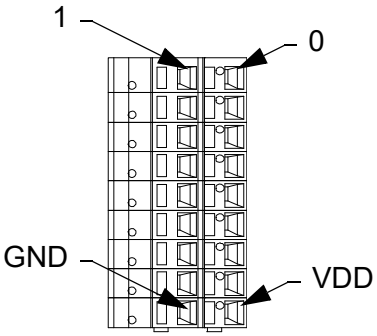
| | | |
|---|---|---|
| **PWR** | Pin | 1 |
| — | — | 2 |
| — | — | 3 |
| **RTN** | Sleeve | 4 |

*Table 4-22: NC-12 Node Controller Digital I/O Pinout*




**Cage Clamp – Input***

| | |
|---|---|
| **0** | Input |
| **1** | Input |
| **2** | Input |
| **.**<br>**.**<br>**.** | Inputs repeat for a total of 16 inputs |
| **15** | Input |
| **COM** | +3–24V DC |
| **GND**† | — |




**Cage Clamp – Output***

| | |
|---|---|
| **0** | Output |
| **1** | Output |
| **2** | Output |
| **.**<br>**.**<br>**.** | Outputs repeat for a total of 16 outputs |
| **15** | Output |
| **VDD** | +5–35V DC |
| **GND** | DC RTN |

* See Figure 3-2 on page 47 for the digital I/O equivalent circuits.

† The GND pin is not used for the digital inputs.

## NC LITE

7–18V DC, 5 W max based on configuration and operating mode. See *NC LITE* on page 62 for the mechanical drawing.

### AC Power Option

The optional remote power supply for the NC LITE requires 90–264V AC @ 47–63 Hz, single-phase (phase-to-phase or phase-to-neutral), 0.7 A at 100V AC (25 W max). Inrush current 45 A/240V AC max The actual power being drawn depends on the operations being performed. However, all power wiring must be designed to carry the full load. See the data sheet provided by the power supply manufacturer for mechanical information.

**⚠ CAUTION**

**High-Voltage Hazard**

90–264V AC, 25 W

AC power must be disconnected before servicing.

### AC Power Cable

The optional remote power supply for the NC LITE is supplied with a power cable. Contact MagneMotion for replacement cables. The AC power cable plugs directly into the power supply. The remote power supply and AC cable for the NC LITE is not required if Power over Ethernet is being used.

### DC Power Option

DC power from a user-supplied power supply requires 7–18V DC, 5 W.

***NOTICE***

Any user-supplied power supply must be NRTL/ATL approved.

The actual power being drawn depends on the operations being performed. Make sure that all power wiring can carry the full load and has a limited power source or the power source is fused to the maximum rating of the wiring.

Or, power for the NC LITE can be provided using the MagneMotion custom Power over Ethernet network. The remote power supply is not required in this case.

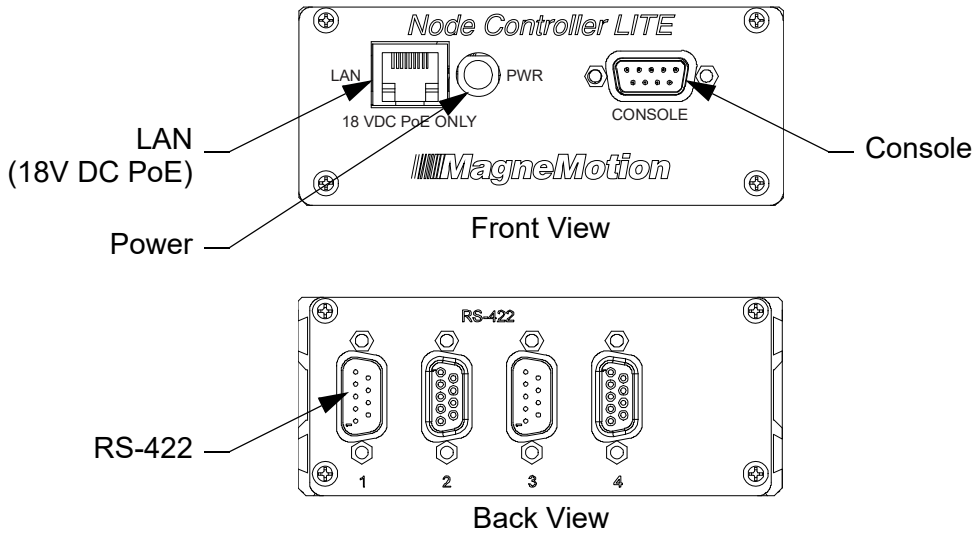



*Figure 4-14: NC LITE Electrical Connections*

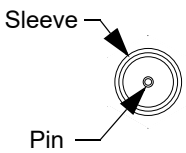
*Table 4-23: NC LITE Electrical Connections*

| Label | Description | Connector Type |
|---|---|---|
| LAN | Ethernet – 10/100 BaseTx<br>(auto-MDIX, auto-negotiation)<br>(Passive PoE, 18V DC) | RJ45, Female |
| PWR | 7–18V DC, 5 W* | DC Power Jack, 2.0 mm Coax, Male |
| CONSOLE | External terminal | DE-9, Male |
| RS-422 | RS-422 motor communications | DE-9, Male and Female† |

* MagneMotion requires grounding the NC LITE by mounting to a grounded surface.

† MagneMotion recommends that the odd number (male) connectors be used for upstream connections and the even number (female) connectors be used for downstream connections.

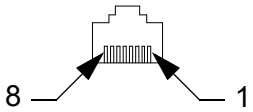
*Table 4-24: NC LITE Power Pinout*




**2.0 mm Coax, Male**

| | |
|---|---|
| **PWR** | Pin |
| **RTN** | Sleeve |

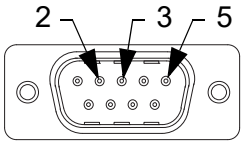
*Table 4-25: NC LITE LAN Pinout*




**RJ45, Female**

| | |
|---|---|
| **TD+** | 1 |
| **TD-** | 2 |
| **RD+** | 3 |
| **+18V DC** | 4 |
| **+18V DC** | 5 |
| **RD-** | 6 |
| **RTN** | 7 |
| **RTN** | 8 |

*Table 4-26: NC LITE Console Pinout*

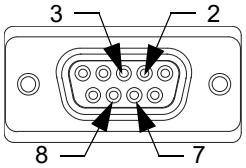



**DE-9, Male**

| | |
|---|---|
| **—** | 1 |
| **Rx** | 2 |
| **Tx** | 3 |
| **—** | 4 |
| **RTN** | 5 |
| **—** | 6 |
| **—** | 7 |
| **—** | 8 |
| **—** | 9 |

*Table 4-27: NC LITE RS-422 Pinout*

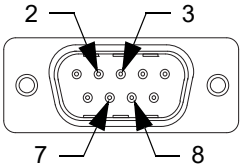
**Downstream**




**J2, J4 – DE-9, Female**

| | |
|---|---|
| — | 1 |
| **RxD-** | 2 |
| **TxD+** | 3 |
| — | 4 |
| — | 5 |
| — | 6 |
| **RxD+** | 7 |
| **TxD-** | 8 |
| — | 9 |

**Upstream**




**J1, J3 – DE-9, Male**

| | |
|---|---|
| — | 1 |
| **TxD-** | 2 |
| **RxD+** | 3 |
| — | 4 |
| — | 5 |
| — | 6 |
| **TxD+** | 7 |
| **RxD-** | 8 |
| — | 9 |

## Ethernet Switch with Power over Ethernet Injector

The Power over Ethernet switch provides +18V DC @ 2 A max/port for the NC LITE.

18V DC, 100 W max based on configuration and operating mode.

**NOTICE**

The voltage that is provided by the Power over Ethernet switch is non-standard (18V DC) and the switch does not disable power at any port.

Connecting any device other than an NC LITE to the PoE switch can damage the device.

### AC Power Option

The optional remote power supply for the Ethernet switch requires 85–264V AC @ 47–63 Hz, single-phase (phase-to-phase or phase-to-neutral), <1.0 A rms (100 W max), based on configuration and operating mode. Inrush current <37 A at 230V AC cold start. The actual power being drawn depends upon operations being performed, however all power wiring and all Ethernet cables that are used for PoE must be sized to carry the full load. See the data sheet provided by the power supply manufacturer for mechanical information.

**⚠ CAUTION**

**High-Voltage Hazard**

85–264V AC, 100 W

AC power must be disconnected before servicing.

### AC Power Cable

The Ethernet Switch with PoE power supply is supplied with a power cable. Contact MagneMotion for replacement cables. The AC power cable plugs directly into the power supply.

### DC Power Option

DC power from a user-supplied power supply requires 18V DC, 100 W.

**NOTICE**

Any user-supplied power supply must be NRTL/ATL approved.

The actual power being drawn depends on the operations being performed. Make sure that all power wiring can carry the full load and has a limited power source or the power source is fused to the maximum rating of the wiring.

# Site Requirements

## Environment

### NC-S

Temperature:

Operating: 0° C to 50° C [32° F to 122° F]
Storage: -18° C to 60° C [0° F to 140° F]

Humidity:

85% Maximum (relative, noncondensing)

### NC-E

Temperature:

Operating: 0° C to 50° C [32° F to 122° F]
Storage: -40° C to 85° C [-40° F to 185° F]

Humidity:

~95% @ 40° C [104° F] (noncondensing)

### NC-12

Temperature:

Operating: 0° C to 50° C [32° F to 122° F]
Storage: -18° C to 50° C [0° F to 122° F]

Humidity:

85% Maximum (relative, noncondensing)

### NC LITE

Temperature:

Operating: 0° C to 50° C [32° F to 122° F]
Storage: -18° C to 50° C [0° F to 122° F]

Humidity:

85% Maximum (relative, noncondensing)

### Derating at High Altitude

When operating in a high altitude environment with lower air pressure, the operating temperature range must be derated compared to that of sea level.

### Lighting, Site

No special lighting is required for proper operation of the node controllers. Maintenance can require a user-supplied service lamp (for example, a flashlight).

## Floor Space and Loading

The location for each node controller must meet the minimum space requirements as defined in the *Mechanical Specifications* on page 54 to make sure that there is proper clearance for installation, operation, and servicing. The dimensions that are given are for the node controllers only. Make sure that there is adequate space around the equipment for operation and service that is based on their needs.

## Facilities

The facility is responsible for providing power as specified in *Electrical Specifications* on page 64 to support proper operation of the node controllers. See *Electrical Connections* on page 97 for all connections to the node controllers.

The facility is responsible for the main disconnect device between the node controllers and the power source, making sure it complies with the appropriate facility, local, and national electrical codes. Service to the node controllers must have the appropriate circuit breaker rating.

## Service Access

The node controllers require adequate space for service access and for proper operation. Typical service space that is required for the node controllers is shown in Figure 4-4, Figure 4-5, Figure 4-6, and Figure 4-9. Make sure that installation of the node controller is such that it provides access to items required for service after installation, such as power and communication connections.

**NOTE:** The exclusion zones that are shown are for the node controllers only. Additional exclusion zones may be required based on the design of the transport system.

# Installation 5

## Overview

This chapter provides complete installation procedures for the various configurations of the MagneMotion® transport systems. To upgrade an existing node controller, see *Upgrading Node Controllers* on page 121.

Included in this chapter are:

- Unpacking and inspection of the MagneMotion transport system components.
- MagneMotion component installation including: hardware installation, facilities connections, and software installation and configuration.
- Initial power-up and check-out.

# Unpacking and Inspection

The node controllers are shipped in separate packages. Open each package carefully following the steps that are provided in *Unpacking and Moving* on page 86; inspect and verify the contents against the shipping documents. Report any damage or missing items immediately to the shipper and to MagneMotion.

One set of shipping documents is attached to the outside of the main shipping crate for easy access.

**NOTE:** The number and contents of the shipping packages depends on the items that are purchased and their configuration (that is, shipped as components or shipped as a system). See the shipping documents for the exact contents. Table 5-1, is an example and is provided for reference only.

*Table 5-1: Node Controller Packing Checklist Reference*

| Package | Contents |
|---|---|
| NC-S Node Controller | • Node controller. |
| NC-E Node Controller | • Node controller.<br>• Miscellaneous hardware. |
| NC-12 Node Controller | • Node controller. |
| NC LITE Node Controller | • Node controller.<br>• Power supply.<br>• Miscellaneous hardware.<br>• Cables. |

## Unpacking and Moving

The node controller arrives from the factory as an individual component ready for final installation. The information required to install the node controllers is provided in *Node Controller Installation* on page 87.

**NOTE:** Save the shipping packaging for possible future use. If the node controllers are shipped, the original shipping packaging must be used. If the original packaging has become lost or damaged, contact MagneMotion for replacements.

1. Upon receiving the packages, visually verify that the packaging is not damaged. Inform the freight carrier and MagneMotion of any inspection discrepancy.
2. Open each shipping package and verify the contents against the shipping documents. Do not remove any protective wrapping.
3. Carefully inspect each package for signs of shipping damage. Report any damage immediately to the shipper and to MagneMotion.
4. Move all items to their destination (see *Node Controller Installation* on page 87).

# Node Controller Installation

Locate the node controllers close to the nodes they are responsible for to minimize the length of all wiring.

**NOTICE**

Make sure that all mounting surfaces and mounting hardware provide a conductive path to the transport system ground connection.

## Mounting NC-S Node Controllers

Locate the NC-S close to the nodes it is responsible for to minimize the length of all wiring. The node controller can be oriented in any direction that is required, make sure the service and exclusion zones that are identified in Figure 4-1 on page 54 are maintained. Typical mounting methods for the NC-S use either *DIN Rail Mounting*, *Surface Mounting*, or *Rack Mounting*.

### DIN Rail Mounting

The NC-S can be mounted to a DIN Rail by attaching the optional DIN rail mounting bracket as shown in Figure 5-1.

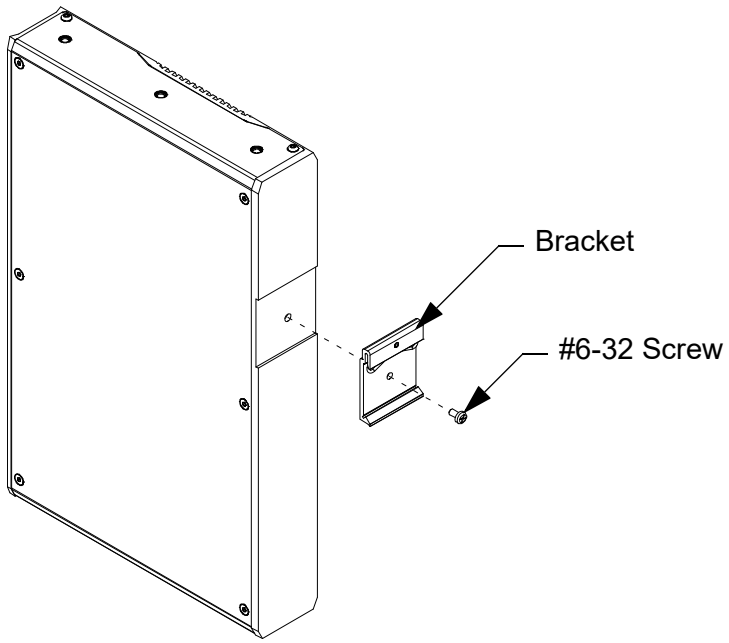



*Figure 5-1: NC-S Node Controller DIN Rail Mounting*

1. Install the DIN mounting bracket onto the node controller with the supplied #6-32 Phillips head screw. Tighten to 1.1 N•m [10 in•lb].

2. Clip the node controller onto the DIN rail in the appropriate location. Make sure that the service and exclusion zones are maintained.

3. Install cable management as required to secure the cables that are connected to the node controller.

### Surface Mounting

The NC-S can be mounted to a convenient surface by attaching the optional mounting brackets are shown in Figure 5-2.

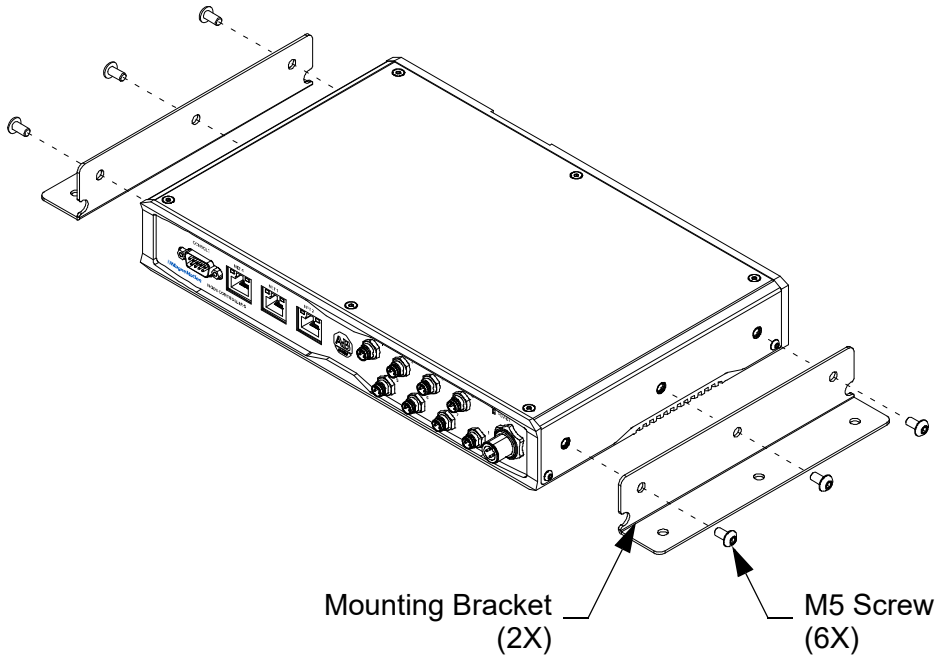



*Figure 5-2: NC-S Node Controller Surface Mounting*

1. Align each mounting bracket to the node controller and secure them with the supplied M5 screws. Tighten to 1.1 N•m [10 in•lb].

2. Locate the node controller as required and secure it with a minimum of two screws per mounting bracket. Make sure that the service and exclusion zones are maintained.

3. Install cable management as required to secure the cables that are connected to the node controller.

## Rack Mounting

The NC-S can be mounted in a standard 19 inch equipment rack by attaching the optional 1U rack mounting brackets as shown in Figure 5-3.

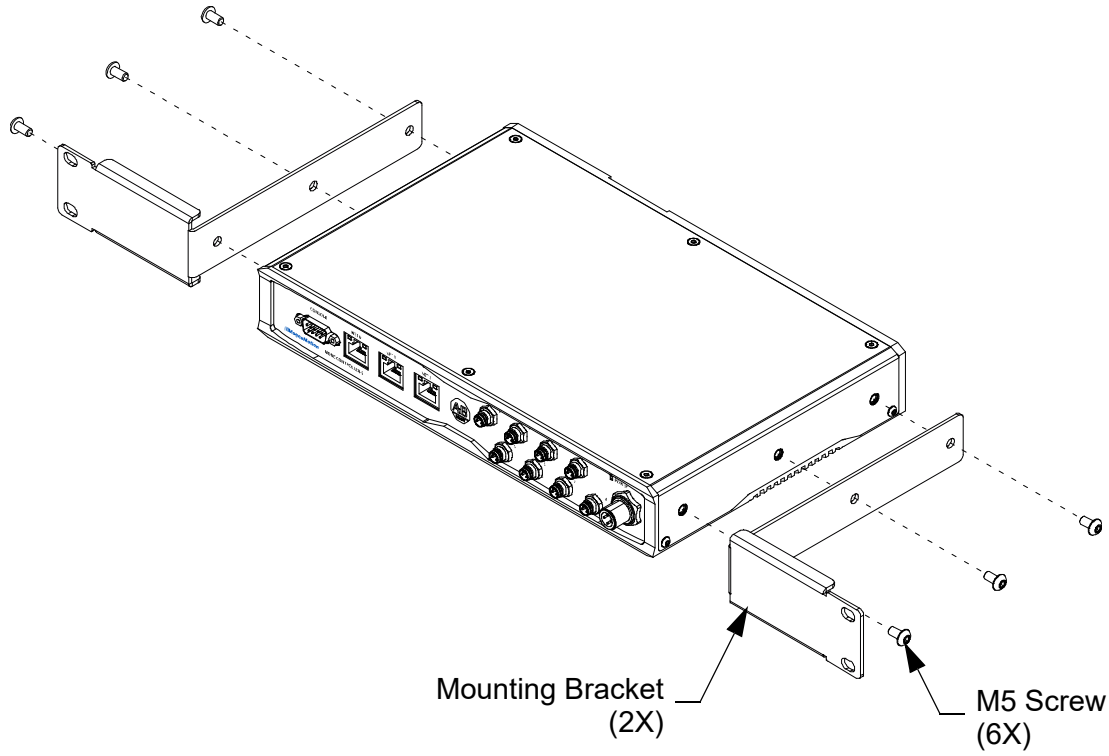



*Figure 5-3: NC-S Node Controller Rack Mounting*

1. Align each rack mounting bracket to the node controller and secure them with the supplied M5 screws. Tighten to 1.1 N•m [10 in•lb].

2. Locate the node controller in the rack and secure it with four screws (two per mounting bracket) as specified by the rack manufacturer. Make sure that the service and exclusion zones are maintained.

3. Install cable management as required to secure the cables that are connected to the node controller.

## Mounting NC-S Power Supplies

Locate the power supply close to the node controller it is powering to minimize the length of all wiring. The power supply can be oriented in any direction required.

## Mounting NC-E Node Controllers

Locate the NC-E close to the nodes it is responsible for to minimize the length of all wiring. The node controller can be oriented in any direction that is required, make sure the service and exclusion zones that are identified in Figure 4-4 on page 57 are maintained. Typical mounting methods for the NC-E use either *DIN Rail Mounting* or *Surface Mounting*.

### DIN Rail Mounting

The NC-E can be mounted to a DIN Rail by attaching the optional DIN rail mounting bracket as shown in Figure 5-4.

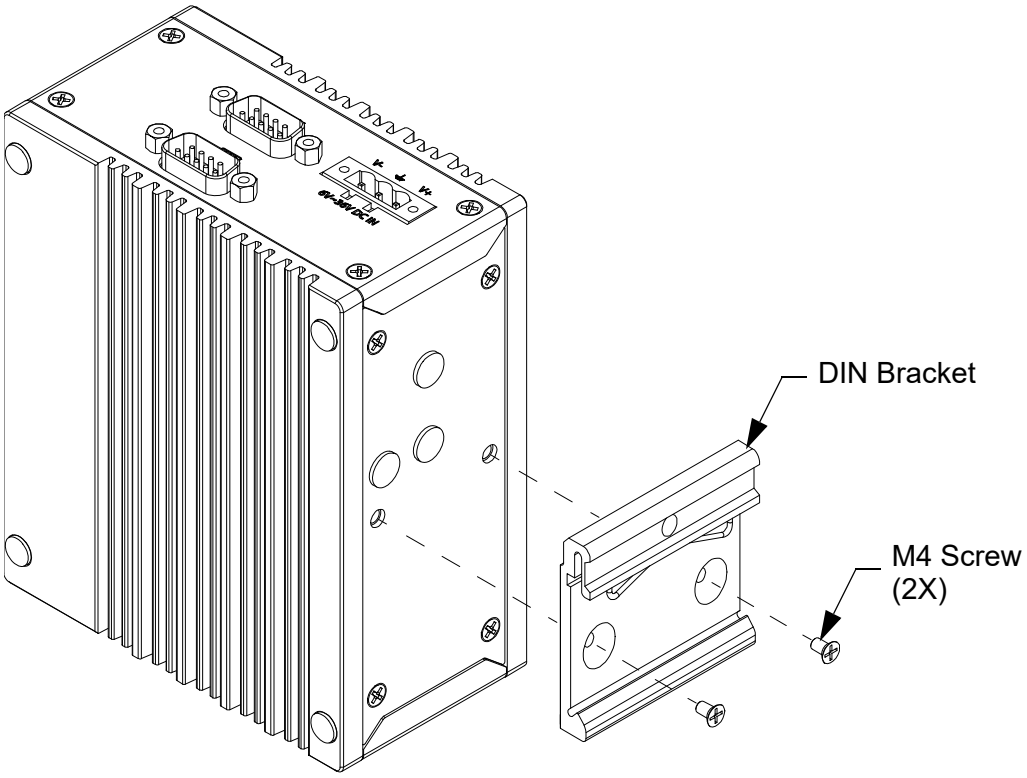



*Figure 5-4: NC-E Node Controller DIN Rail Mounting*

1. Remove the hole plugs from the back of the node controller.

2. Install the DIN mounting bracket onto the node controller with the two supplied M4 flat head screws. Apply Loctite 243 to the screws and tighten to 1.1 N•m [10 in•lb].

   **NOTE:** The Loctite must cure for 2 hours at 22° C [72° F] before using the transport system.

3. Clip the node controller onto the DIN rail in the appropriate location. Make sure that the service and exclusion zones are maintained.

4. Install cable management as required to secure the cables that are connected to the node controller.

## Surface Mounting

Typical methods for mounting the NC-E to a surface by attaching the optional mounting brackets are shown in Figure 5-5.

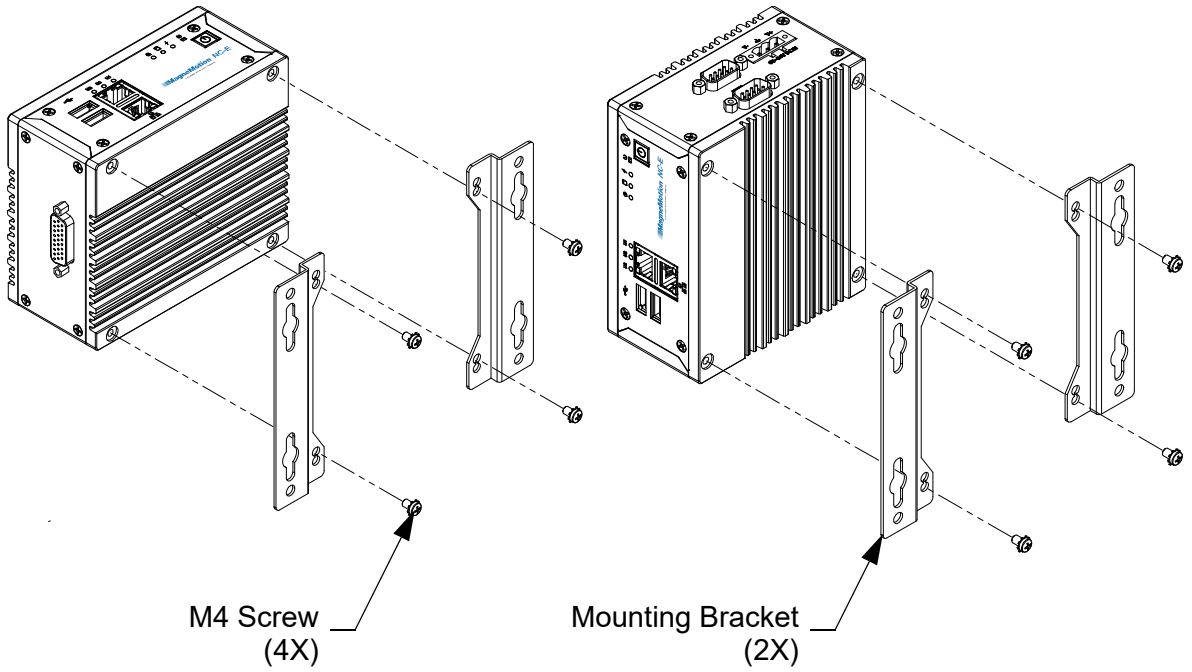



*Figure 5-5: NC-E Node Controller Surface Mounting*

1. Remove the four feet from the bottom of the node controller.

2. Align each mounting bracket to the NC-E and secure them to the node controller with the supplied M4 screws. Apply Loctite 243 and tighten to 1.1 N•m [10 in•lb].

   **NOTE:** The Loctite must cure for 2 hours at 22° C [72° F] before using the transport system.

3. Locate the node controller as required and secure it with four screws (two per mounting bracket) make sure that the service and exclusion zones are maintained.

4. Install cable management as required to secure the cables that are connected to the node controller.

## Mounting NC-12 Node Controllers

Locate the NC-12 close to the nodes it is responsible for to minimize the length of all wiring. The node controller can be oriented in any direction that is required. Make sure that the service and exclusion zones that are identified in Figure 4-5 on page 58 and Figure 4-6 on page 59 are maintained. Typical mounting methods for the NC-12 use either *Surface Mounting* or *Rack Mounting*.

### Surface Mounting

The NC-12 can be mounted to a convenient surface by attaching the optional mounting plates as shown in Figure 5-6. See Figure 4-7 on page 60 for dimensions.

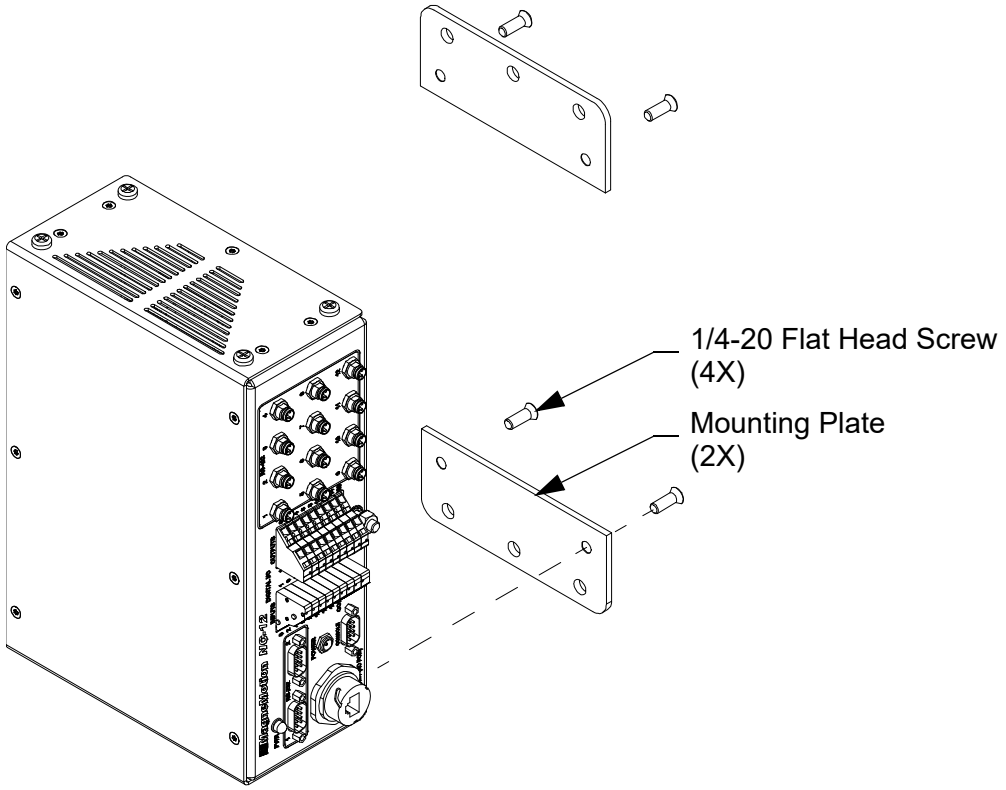



*Figure 5-6: NC-12 Node Controller Surface Mounting*

1. Align each mounting plate to the NC-12 and secure it to the node controller with two 1/4-20 flat head screws with Loctite 243 per plate. Tighten the screws to 10.1 N•m [90 in•lb] (four screws total). The maximum thread length into the threaded hole is 7.87 mm [0.310 in].

   **NOTE:** The Loctite must cure for 2 hours at 22° C [72° F] before using the transport system.

2. Orient the node controller with brackets as required and secure it with a minimum of two M8 screws with M8 split lock washers (one per mounting plate). Tighten the screws to 26 N•m [230 in•lb]. Make sure that the service and exclusion zones are maintained.

3. Install cable management as required to secure the cables that are connected to the node controller.

## Rack Mounting

The NC-12 can be mounted in a standard 19 inch rack by attaching the optional 2Urack mounting brackets as shown in Figure 5-7. See Figure 4-8 on page 61 for dimensions.

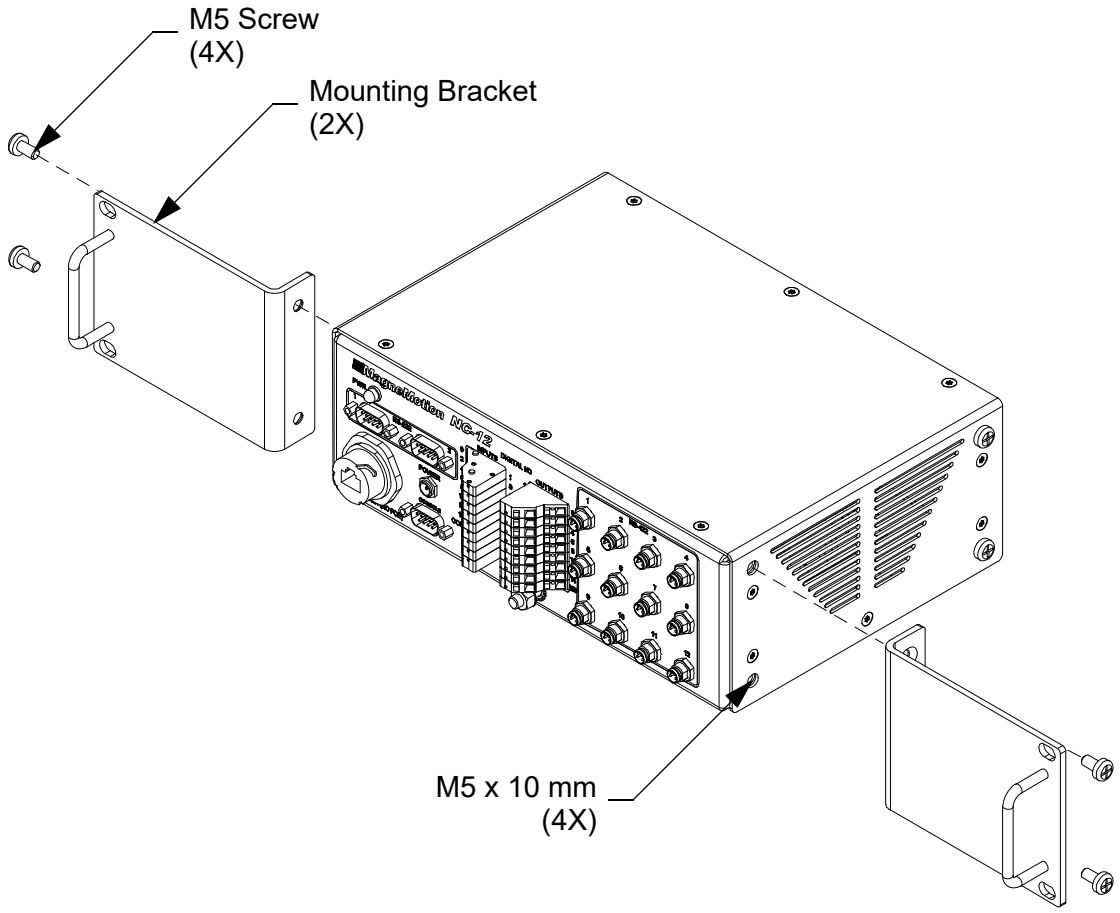



*Figure 5-7: NC-12 Node Controller Rack Mounting*

1. Remove the two M5 x 10 mm screws from the front of each side (four screws total).

2. Align each rack mounting bracket to the NC-12 and secure them to the node controller with two M5 X 12 mm flat head screws. Tighten to 2.0 N•m [18 in•lb] (four screws total).

3. Locate the node controller in the rack and secure it with four screws (two per mounting bracket) as specified by the rack manufacturer. Make sure that the service and exclusion zones are maintained.

4. Install cable management as required to secure the cables that are connected to the node controller.

## Mounting NC-12 Power Supplies

Locate the power supply close to the node controller it is powering to minimize the length of all wiring. The power supply can be oriented in any direction required.

## Mounting NC LITE Node Controllers

Locate the NC LITE close to the nodes it is responsible for to minimize the length of all wiring. The node controller can be oriented in any direction that is required, make sure that the service and exclusion zones that are identified in Figure 4-9 on page 62 are maintained.

### Surface Mounting

Typical methods for mounting the NC LITE on the mounting plate are shown in Figure 5-8. See Figure 4-10 on page 63 for dimensions.

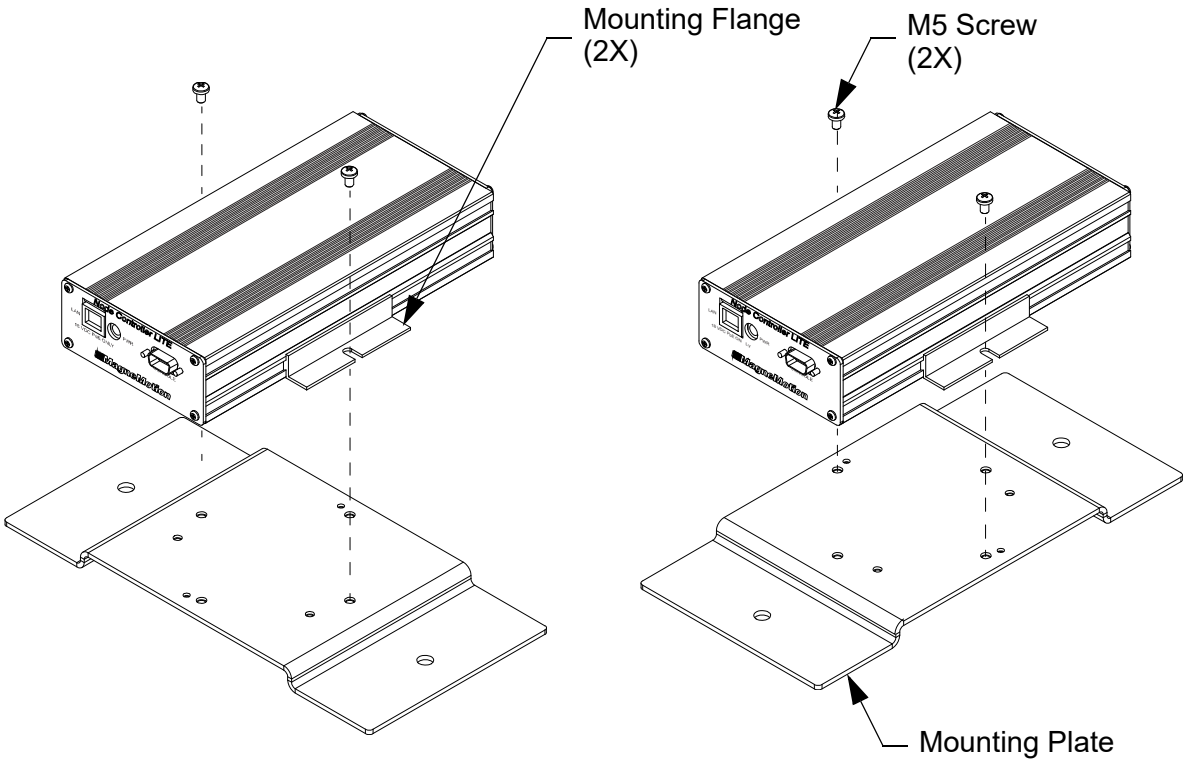



*Figure 5-8: NC LITE Surface Mounting*

1. Install the mounting flanges onto the NC LITE, if not already installed.

2. Orient the NC LITE on the mounting plate as required and secure it to the plate with two M5 x 10 mm screws with Loctite 243. Tighten the screws to 2.7 N•m [24 in•lb].

   **NOTE:** The Loctite must cure for 2 hours at 22° C [72° F] before using the transport system.

3. Orient the bracket with the node controller as required and secure it with two M8 screws with M8 split lock washers. Tighten the screws to 26 N•m [230 in•lb]. Make sure that the service and exclusion zones are maintained.

4. Install cable management as required to secure the cables that are connected to the node controller.

## Mounting NC LITE Power Supplies

If the node controller is powered using the remote power supply (instead of using PoE), locate the power supply close to the node controller it is powering to minimize the length of all wiring. The power supply can be oriented in any direction required.

# Electrical Connections

The standard configuration of the MagneMotion transport system requires user-supplied electrical power and communications connections. See *Electrical Specifications* on page 64 for descriptions and specifications of all required facilities.

## Power Connections

Electrical power is connected to the MagneMotion transport system for operation of the motors and other subsystems. An AC electrical connection is provided on those components that require facility power. See *Electrical Specifications* on page 64 for electrical requirements. Make sure that all electrical connections are for the appropriate voltage and power rating.

**NOTICE**

Do not turn on facility power until all installation procedures have been completed.

Connecting to the DC power connector on the controller must be done with the power supply off. Connecting with the power supply on can cause a short circuit at the connector, which can damage the power supply or any other equipment being powered by that power supply.

1. Connect power to each NC-S:

**NOTICE**

The NC-S node controller does not support Power over Ethernet. Never connect these node controllers to a powered Ethernet network as damage to internal components can result.

- Connect the AC power cable from either the optional remote power supply or a user-supplied power supply to the power distribution from the main power disconnect. Then, connect the DC power cable to the power connector on each NC-S node controller as shown in Figure 4-11, tighten the connector shell finger tight only – do not overtighten.

1. Connect power to each NC-E:

**NOTICE**

The NC-E node controller does not support Power over Ethernet. Never connect these node controllers to a powered Ethernet network as damage to internal components can result.

- Connect the AC power cable from either the optional remote power supply or a user-supplied power supply to the power distribution from the main power disconnect. Then, connect the DC power cable to the power connector on each NC-E node controller as shown in Figure 4-12, tighten the mounting screws to 3 in•lb [0.34 N•m] – do not overtighten.

2. Connect power to each NC-12:

**NOTICE**

The NC-12 node controller does not support Power over Ethernet. Never connect these node controllers to a powered Ethernet network as damage to internal components can result.

- Connect the AC power cable from either the optional remote power supply or a user-supplied power supply to the power distribution from the main power disconnect. Then, connect the DC power cable to the power connector on each NC-12 node controller as shown in Figure 4-13, tighten the connector shell finger tight only – do not overtighten.

3. Connect power to each NC LITE:

**NOTICE**

The NC LITE node controller supports the MagneMotion custom Power over Ethernet (+18V DC). Never connect the NC LITE to a standard powered Ethernet network as damage to internal components can result.

- When supplying Power over Ethernet to the NC LITE, make sure that the Ethernet connection goes to a PoE enabled switch then plug the switch power supply into the power distribution from the main power disconnect. Then, connect the cable from the switch power supply to the switch.
- When supplying power directly to each NC LITE, connect the AC power cable from either the optional remote power supply or a user-supplied power supply to the power distribution from the main power disconnect. Then, connect the cable from the NC LITE power supply to the NC LITE as shown in Figure 4-14.

## Network Connections

The node controllers use communication over an Ethernet network with a host controller for transport system control and for communication between node controllers. The following procedure provides the information that is required to make all network communications and Power over Ethernet connections to the node controllers as shown in Figure 5-9.

**NOTE:** The network for the transport system must be a dedicated, separate subnet to minimize any unrelated network traffic.

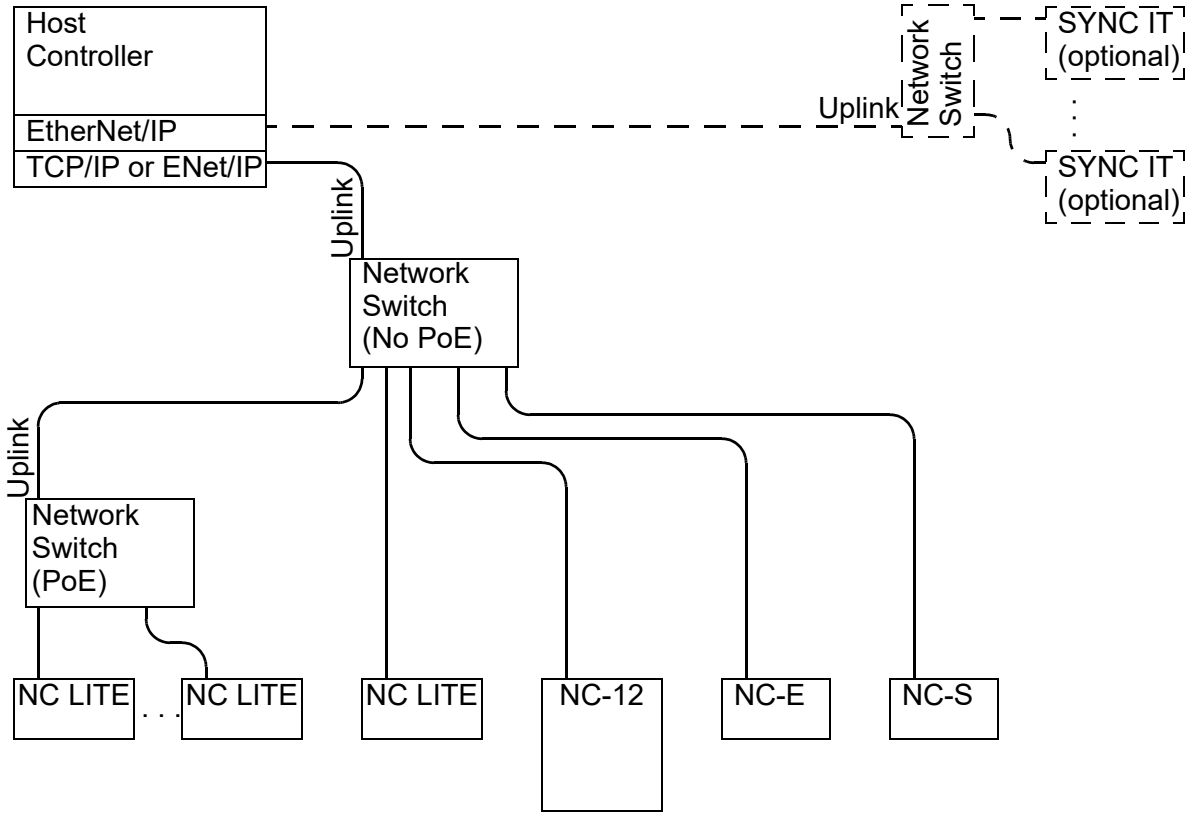



*Figure 5-9: Network Wiring*

1. Connect a Cat 5 network cable for transport system network communications from the host controller to the Uplink connector on the network switch.

**NOTICE**

The Ethernet cable that connects a Power over Ethernet switch to the host controller or other network switches must connect to the Uplink port. Connecting to other ports can damage the switch or other devices that are connected to the switch.

**NOTE:** When using multiple network switches to connect all node controllers, use one switch as a master and connect all other switches to it as shown in Figure 5-9.

When using multiple MagneMotion Power over Ethernet network switches, connect the Uplink from each switch to a master switch as shown in Figure 5-9, do not daisy chain these switches.

When using the optional SYNC IT controllers, use a network switch that is dedicated to those controllers connected directly to the EtherNet/IP™ port on the PLC dedicated to synchronization as shown in Figure 5-9.

2. Connect a cable for network communications from the network switch to each node controller as shown in Figure 5-9.

- For NC-S node controllers, connect the Ethernet cable to the NET 0 connector as shown in Figure 4-11.

**NOTICE**

The NC-S node controller does not support PoE. Connecting the controller to a powered Ethernet network can damage it.

- For NC-E node controllers, connect the Ethernet cable to the lower Network connector as shown in Figure 4-12.

**NOTICE**

The NC-E node controller does not support PoE. Connecting the controller to a powered Ethernet network can damage it.

- For NC-12 node controllers, connect the Ethernet cable to the ETHERNET/ETH connector as shown in Figure 4-13.

**NOTICE**

The NC-12 node controller does not support PoE. Connecting the controller to a powered Ethernet network can damage it.

- For NC LITE node controllers, connect the Ethernet cable to the LAN connector as shown in Figure 4-14.

**NOTICE**

The NC LITE only supports the custom MagneMotion Power over Ethernet. Never connect the NC LITE to a standard PoE network as damage to internal components can result.

## Motor Connections

The NC-S, NC-12, and NC LITE node controllers can use either RS-422 or Ethernet to communicate with the motors as shown in Figure 5-10, Figure 5-11, and Figure 5-12. The NC-E node controllers only use Ethernet to communicate with the motors as shown in Figure 5-11. The following procedure provides the information that is required to make all motor connections to the node controllers.

**NOTE:** The network for the transport system must be a dedicated, separate subnet to minimize any unrelated network traffic.

### RS-422 Only Motor Connections

RS-422 is the traditional method for connecting the motors to other motors and to the node controllers using daisy chained RS-422 communications as shown in Figure 5-10. The NC-S, NC-12, and NC LITE node controllers can use this connection scheme. See the *MagneMover LITE User Manual*, the *QuickStick 100 User Manual*, or the *QuickStick HT User Manual* for detailed connection information.

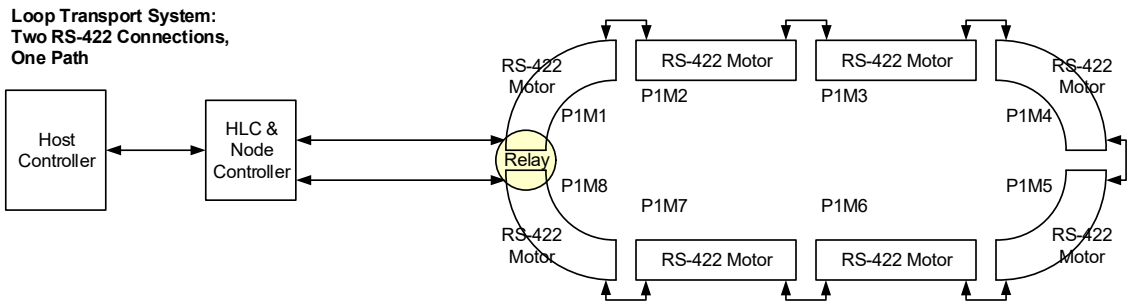



*Figure 5-10: RS-422 Motor Wiring Example*

1. Connect an RS-422 cable from an RS-422 port on the node controller to the upstream connection on the first motor in a path.
   - When connecting a DE-9 connector, tighten the mounting screws to 3 in•lb [0.34 N•m] – do not overtighten.
   - When connecting a Nano-Mizer connector, tighten the connector shell finger tight only – do not overtighten.
2. Connect an RS-422 cable from the downstream connection on the motor to the upstream connection on the next motor in the path.
   - When connecting a DE-9 connector, tighten the mounting screws to 3 in•lb [0.34 N•m] – do not overtighten.
   - When connecting a Nano-Mizer connector, tighten the connector shell finger tight only – do not overtighten.

3. Continue making motor-to-motor RS-422 connections until the last motor in the path is reached.

4. If the motor meets other motors in a node, connect an RS-422 cable to an RS-422 port on the node controller.

   - When connecting a DE-9 connector, tighten the mounting screws to 3 in•lb [0.34 N•m] – do not overtighten.
   - When connecting a Nano-Mizer connector, tighten the connector shell finger tight only – do not overtighten.

## Ethernet Only Motor Connections

Ethernet is the new method for connecting the motors to other motors and to the node controllers using only Ethernet communications as shown in Figure 5-11. This method is only used with NC-S, NC-12, NC LITE, and NC-E node controllers when using Ethernet motors. See the *MagneMover LITE User Manual* for detailed connection information.

**NOTE:** When using Ethernet to communicate with the motors, other connection schemes such as multiple chains per path and Ethernet star topologies are possible. Closed-loop Ethernet connections must be avoided to help prevent network saturation. The simple daisy chain that is shown in Figure 5-11 is typical, but not required.

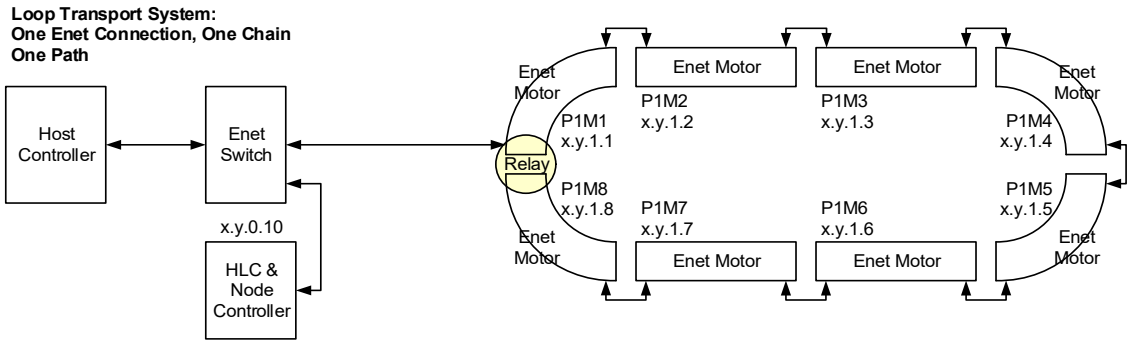



*Figure 5-11: Ethernet Motor Wiring Example*

1. Connect a Cat5 Ethernet cable from the switch where the node controller is connected to the first motor in the Ethernet chain.

2. Connect a Cat5 Ethernet cable from the downstream connection on the motor to the upstream connection on the next motor in the chain.

3. Continue making motor-to-motor Ethernet connections until the last motor in the path is reached.

4. Create a MICS file to define the Ethernet motor connections.

## RS-422 and Ethernet Motor Connections

This method mixes the traditional RS-422 connection scheme for connecting the motors to other motors and to the node controllers and the new Ethernet connection scheme as shown in Figure 5-12. This method is only used with NC-S, NC-12, and NC LITE node controllers when combining RS-422 motors and Ethernet motors in the same transport system. See the *MagneMover LITE User Manual* for detailed connection information.

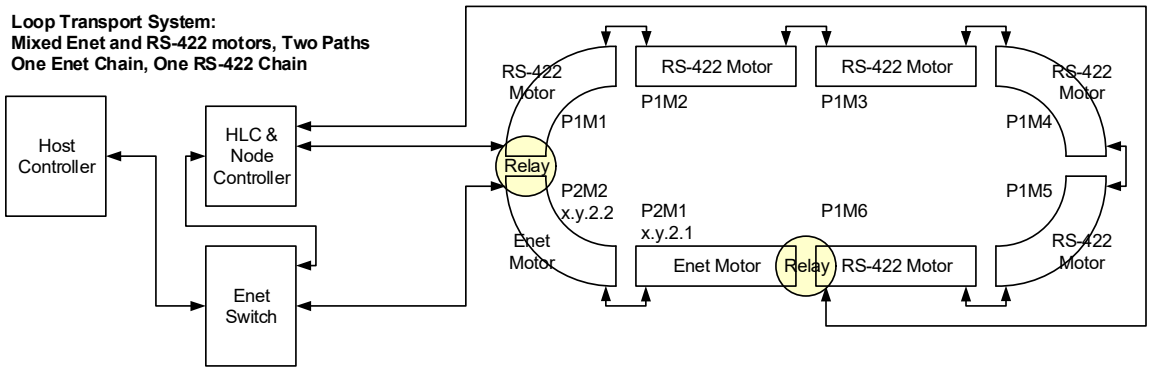



*Figure 5-12: RS-422 and Ethernet Motor Wiring Example*

1. Connect the motors that use RS-422 communications as described in *RS-422 Only Motor Connections*.

2. Connect a Cat5 Ethernet cable from the switch where the node controller is connected to the first motor in the Ethernet chain.

3. Connect a Cat5 Ethernet cable from the downstream connection on the motor to the upstream connection on the next motor in the chain.

4. Continue making motor-to-motor Ethernet connections until the last motor in the path is reached.

5. Create a MICS file to define the Ethernet motor connections.

# Configuration

The MagneMotion transport systems require user-creation of the Node Controller Configuration File and creation of host controller software to direct and monitor vehicle movement for the particular application. MagneMotion provides a number of software tools to simplify the creation of configuration files and for monitoring and testing the system. See *Transport System Software Overview* on page 22 for identification and descriptions of all software components and tools.

1. Set the unique IP address for each node controller. See the *Node Controller Interface User Manual* for more details. If EtherNet/IP is being used, see the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual* for additional configuration information.

2. Configure one node controller as a high-level controller. See the *Node Controller Interface User Manual* for more details.

## Software Configuration

Create the Node Controller Configuration File (node_configuration.xml) using the Configurator to define the components of the transport system and their relationship to each other. See the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual* for more details. The Configuration File must then be uploaded to each node controller in the transport system before using the system. See the *Node Controller Interface User Manual* for details.

If Ethernet communication is being used with the motors, create the MICS file. The MICS file must then be uploaded to each node controller in the transport system before using the system. See the *Node Controller Interface User Manual* for details.

Configure the host controller to control the transport system. See the *Host Controller TCP/IP Communication Protocol User Manual* or the *Host Controller EtherNet/IP Communication Protocol User Manual* depending on the host controller type.

## Software Installation

1. Use the web interface on the node controller to upload the node controller image files to each node controller. See the *Node Controller Interface User Manual* for details.

   **NOTE:** Activate the image and reboot the node controller for the changes to take effect.

2. Use the web interface on the node controller to upload the configuration files to each node controller. See the *Node Controller Interface User Manual* for details.

   **NOTE:** Restart the node controller for the changes to take effect.

# Software

## Software Overview

Node controllers ship with just a basic NC software image installed. All system files (configuration files, NC image, motor images and type files, and magnet array type files) must be uploaded to the node controller and activated before using the transport system. See the *Node Controller Interface User Manual* for details.

All MagneMotion motors ship with just a basic motor software image installed. The Motor ERF Image files must be uploaded to the motors through the node controller.

Upgrades to the software can be uploaded through the network communications link. See the Upgrade Procedure in the Release Notes supplied with the software upgrade.

**NOTE:** Only qualified MagneMotion personnel or personnel that are directed by MagneMotion should make alterations or changes to the software.

| ***NOTICE*** |
| --- |
| All software running on the MagneMotion transport system must be part of the same release. See the Release Notes provided with the software for additional information. |

# Check-out and Power-up

## Node Controller Check-out

Before the node controllers are started for the first time, or after servicing, it is necessary to check all operating and safety features.

The following startup procedure is used to apply power to the node controllers in an orderly manner to make sure that they are in known conditions. This procedure is used to prepare the node controllers for full operation.

### Mechanical Checks

- Make sure that the node controllers are properly and securely installed.
- Make sure that all connections are secure.
- If the optional E-stop circuit is being used, make sure that the button is functional.

### Facility Checks

- Make sure that all facilities meet, or exceed, the requirements as described in the *Electrical Specifications* on page 64 and *Site Requirements* on page 83.
- Make sure that the power and communications connections are complete.
- Check all cables. Verify that the connectors are fully seated and screws/locks are secured to make sure good continuity.
- Verify that all cables are routed in a safe place and away from any travel areas.
- Inspect all cables for restricting bend radii, excessive tension, or physical damage.

## Node Controller Power-up

Node controllers can be powered up and tested without being connected to the transport system. Once the node controller has been installed, check all connections and perform an initial power-up. This section describes the procedure for the initial installation check-out.

1. Make sure that all installation procedures that are described in this chapter have been completed.

2. Make sure that the node controller is properly grounded.

3. Connect the node controller to the main power disconnect. Make sure that power remains off.

**⚠ CAUTION**

**High-Voltage Hazard**

110V AC @ 0.7 A (25 W max).

The AC circuit must be properly protected.

4. Perform a Ground Continuity check from the surfaces of the node controller to a known good ground.

5. Apply power to the node controller.

   *The indicators on the node controllers light as shown in Table 5-2.*

*Table 5-2: Startup Indicators*

| Component | Indicator | Status |
|---|---|---|
| Node Controller, NC-S | Power | On |
| Node Controller, NC-E | ⏻ (Power) | On |
| Node Controller, NC-12 | Power | On |
| Node Controller, NC LITE | *None* | — |

6. If power-up was successful, the node controller is ready to accept commands. However, if the power-up sequence was unsuccessful, see *Troubleshooting* on page 116.

7. For new installations, set the node controller IP addresses and specify the node controller to be used as the high-level controller (see *Configuration* on page 105).

8. For new installations, upload the image and type files to each node controller (see the *Node Controller Interface User Manual*).

9. For new installations, create and upload the Node Controller Configuration File for the transport system (see *Software Configuration* on page 105 and the *MagneMover LITE Configurator User Manual* or the *QuickStick Configurator User Manual*).

10. If Ethernet motors are being used, create and upload the MICS file for the transport system (see *Software Configuration* on page 105, the *MagneMover LITE User Manual*, and the *MagneMover LITE Configurator User Manual*).

11. Program the motors with the Motor ERF Image files (see the *Node Controller Interface User Manual*).

12. Review the log files for each node controller to make sure that the system has been programmed and configured properly (see the *Node Controller Interface User Manual*).

# System Testing

Test the MagneMotion transport system to verify proper operation of all nodes, paths, and vehicles. Use the NCHost application that is supplied by MagneMotion to move vehicles without the host controller to verify proper operation before integrating a transport system into a production environment. Create Demo Scripts to perform repetitive testing throughout the transport system. See the *NCHost TCP Interface Utility User Manual* for details. If any problems are encountered, see *Troubleshooting* on page 116.

**⚠ CAUTION**

**Crush Hazard**

Moving mechanisms have no obstruction sensors.

Do not operate the MagneMotion transport system without barriers in place or personal injury could result in the squeezing or compression of fingers or other body parts between moving mechanisms.

1. Make sure that the transport system is fully configured.
2. Make sure that the Node Controller Configuration File is fully defined and has been uploaded to all node controllers (see the *Node Controller Interface User Manual*).
3. Make sure that the web interface for each node controller shows a status of running/valid (see the *Node Controller Interface User Manual*).
4. Issue a Restart Services command for each node controller (see the *Node Controller Interface User Manual*).
5. Issue a Reset command for all paths.

   *All motors on the paths in the transport system are reset.*
6. Issue a Startup command to all paths.

   *Motion on all paths is enabled, all vehicles on the paths are identified and located, and the paths become operational.*
7. Verify that the host controller has identified all vehicles in the transport system (see the *NCHost TCP Interface Utility User Manual*).
8. Move vehicles individually or create a Demo Script for repetitive testing (see the *NCHost TCP Interface Utility User Manual*).
9. Use the NCHost TCP Interface Utility to monitor transport system operation.

# Node Controller Shutdown

The following shutdown procedure is used to remove power from the node controllers in an orderly manner and place the components of the transport system in known conditions. This procedure is used to prepare the components for removal, replacement, or maintenance. Before shutting down the host controller, shut down the node controllers.

1. Complete all material transfers (move all material to appropriate locations).
2. Command all vehicles to known positions.
3. Issue a Suspend Movement command for all Paths.

   *All vehicles come to a controlled stop.*
4. Once all motion has stopped, issue a Reset command for all Paths.

   *Clears all vehicle records.*
5. Turn off all electrical power to the motors.
6. Turn off electrical power to the Node Controllers.
7. Turn off electrical power to the Host Controller.
8. Turn off the main power disconnect for the transport system.

**NOTE:** This procedure only shuts down facilities to the motors, their subsystems, and the Host Controller. Any user equipment remains powered up.

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# Maintenance 6

## Overview

This chapter provides maintenance schedules and procedures for the MagneMotion® node controllers. Only trained, qualified personnel should attempt to perform maintenance or troubleshooting on the node controllers. MagneMotion provides training in the troubleshooting and repair of the MagneMotion transport systems and components.

Included in this chapter are:

- Preventive maintenance procedures.
- Troubleshooting procedures.
- Contacting ICT Customer Support.
- Basic repair procedures.
- Component and system shipping procedures.

# Preventive Maintenance

The motors, node controllers, and power supplies of the MagneMotion transport system are self-contained components that are designed for use in a clean, inert environment, and require no maintenance other than that described here. Any deviation from this basic environment can affect the maintenance requirements, contact ICT Customer Support for additional information. See *Troubleshooting* on page 116 if any problems are detected.

*Table 6-1: Preventive Maintenance Schedule*

| Component | Maintenance Action | Frequency* | Page # |
|---|---|---|---|
| Node Controllers | *Transfer Log Files* | 3 months or as required | 115 |

* The specified frequency is based on a certified clean, inert environment. Adjust the facility Preventative Maintenance Schedule to account for any deviations from this environment.

## Transfer Log Files

Review the log files for each node controller and the high-level controller periodically to look for unexpected messages.

Log files can be transferred from the node controller or SysLog server to a network server so they can be archived or e-mailed to ICT Customer Support, see the *Node Controller Interface User Manual*.

# Troubleshooting

This section describes the common difficulties that can be encountered with the MagneMotion node controllers and software components.

For assistance, see *Contact ICT Customer Support* on page 119.

## Initial Troubleshooting

This section covers the initial determination of the problem area within the MagneMotion node controllers and provides direction to the second step of the troubleshooting process. If a specific problem is suspected, see that problem in Table 6-2. If the problem has not been identified, review each of the symptoms that are identified in Table 6-2 to help determine the problem area.

*Table 6-2: Initial Troubleshooting*

| Symptom | Possible Problem Area |
|---|---|
| Node controller logs do not indicate correct time. | See *Node Controller Troubleshooting* on page 117 |
| Communication to the node controller is lost or intermittent. | See *Communications Troubleshooting* on page 118 |

## Node Controller Troubleshooting

This section covers the determination of problems within the node controllers.

*Table 6-3: Node Controller Related Troubleshooting*

| Symptom | Problem Description | Corrective Action |
|---|---|---|
| Node controller logs do not indicate the correct time. | The battery for the clock in the node controller has lost its charge. | Manually correct the time each time the node controller is powered up or return the node controller to MagneMotion for repair. |
| | | Use the node controller web interface **Set Clock** function to set the time (see the *Node Controller Interface User Manual*). |

## Communications Troubleshooting

This section covers the determination of communications-related problems within the MagneMotion transport system.

*Table 6-4: Communications Related Troubleshooting*

| Symptom | Problem Description | Corrective Action |
|---|---|---|
| Intermittent communication with the host controller. | Communication is lost or intermittent. | Make sure that all network cables are properly seated. |
| | | Verify that there are no IP address collisions. |
| Intermittent communication with the motors. | Communication is lost or intermittent. | Make sure that all network cables are properly seated. |
| Communications problems when using multiple node controllers (ping message dropped). | Either faulty network cables or a network switch that cannot keep up with the traffic. | Check all network wiring and hardware to make sure it is operating properly. |
| The transport system responds to the host controller but motors do not operate. | Digital I/O E-stop or interlock circuit is activated. | Make sure any E-stops or interlocks that are configured for the paths where the motors are located are in the operate state. |

# Contact ICT Customer Support

To help you receive the most value from the Rockwell Automation Independent Cart Technology (ICT) Support Specialists, have the following information ready before contacting ICT Customer Support.

1. The name, email address, and telephone number of the person to contact.
2. The facility address where the system is located and the project name.
3. The date, time, and a detailed description of the anomaly.
   - The command the equipment was executing when the anomaly occurred.
   - The effect on system performance (for example, stalled vehicles, overheating).
   - How was the system operating before the anomaly occurred and for how long?
   - Any recent changes to the system (physical reconfiguration, speed/acceleration changes, configuration file changes).
   - Any corrective actions performed (for example, system reset, replaced parts, loaded software, power cycle). What were the results of those actions?
   - Any special system environmental conditions (for example, vacuum, high heat, high humidity).
   - Any potential non-MMI causes of the issue (for example, power outage, mechanical interference, host failure).
   - Can the problem be reproduced?
4. The equipment type, part number, serial number, and location in the system (path, motor id).
5. Include the following files from the time of the anomaly.
   - Node controller and high-level controller log files.
   - Node Controller Configuration Files.
   - Host controller command logs (if available).
   - Any product-related faults and error messages observed through the system host, NCHost, the web interface, and so on.
6. Is there any other information that can assist our Specialist?
7. Contact ICT Customer Support:

**Main Office**

MagneMotion, Inc.
A Rockwell Automation Company
139 Barnum Road
Devens, MA 01434, USA
Phone: +1 978-757-9100
Fax: +1 978-757-9200

**Customer Support**

+1 978-757-9102
ICTSupport@ra.rockwell.com

# Repair

If a component of the MagneMover LITE transport system malfunctions, see *Troubleshooting* on page 116 in this manual for diagnostic procedures. If these procedures are not adequate to determine the source of the problem, see *Contact ICT Customer Support* on page 119. Once the failed unit has been identified, a replacement unit can be ordered and installed as directed in *Installation* on page 85.

**NOTE:** The components of the MagneMover LITE transport system are designed for easy replacement. Motors, controllers, and other modules do not contain any user serviceable parts.

**NOTICE**

Only a qualified service representative can service the components of the MagneMover LITE transport system. Any attempt to open the transport system modules by anyone other than a qualified MagneMotion service representative voids the warranty.

*Table 6-5: MagneMover LITE Repair Procedures*

| Component | Maintenance Action | Page # |
|---|---|---|
| NC-S Node Controller | *Upgrading Node Controllers* | 121 |

## Upgrading Node Controllers

This procedure provides the steps necessary to upgrade from an NC-12 node controller to NC-S node controllers. The NC-12 supports twelve RS-422 connections while the NC-S supports eight RS-422 connections. If more that eight of the RS-422 connections on the NC-12 are being used, two NC-S node controllers are required and must be configured as described in this procedure.

### Installation Preparation

1. Backup the transport system.
   A. Run the web interface and connect to the HLC.
   B. Select **Configuration Files** on the Main Menu (see the *Node Controller Interface User Manual*).
   C. Select **Download** for each file in use (for example, Node Controller Configuration File, MICS file, Motor Type files, and Magnet Array Type files) and save the file.
   D. Select **Upgrade Software** on the Main Menu.
   E. Select **Download** for each file in use (for example, Node Controller Software Image file and Motor ERF Image files) and save the file.
2. Shutdown the transport system.
   A. Complete all material transfers (move all material to appropriate locations).
   B. Command all vehicles to known safe positions.
   C. Issue a reset command to all paths.
   D. Once the reset has completed, turn off the main power disconnect for the transport system.
3. Unplug the power cable to the old node controller.
4. Make sure all communication and signal wiring that is connected to the old node controller are labeled.
5. Disconnect all communication and signal wiring that is connected to the old node controller.
6. Remove the old node controller from the transport system.

### NC-S Installation

There are several mounting options for the NC-S node controllers. See *Mounting NC-S Node Controllers* on page 87. Use the appropriate mounting method to install the NC-S node controllers. Once the node controllers are mounted, they must be connected and configured for operation as described in *Configure and Connect the New Node Controllers*.

### Configure and Connect the New Node Controllers

All node controllers in the system must be running the same software version. Therefore, when upgrading any node controller to the NC-S it is necessary to upgrade all other node controllers in the system to the same software version. Upgrading to the NC-S may also require upgrading the motor software in all motors in the system.

Table 6-6 identifies the minimum software versions that are required for proper operation of the NC-S node controller.

*Table 6-6: Required Software Versions*

| Motor Type | Minimum Required Software |
|---|---|
| MagneMover LITE Gen 3 | 4.1.42 |
| MagneMover LITE Gen 4 | 13.7.13 |
| QS100 Gen 2 | 15.8.16 |
| QSHT | 15.8.16 |

If using a version of software on a QS 100 system that incorporates a lookup table (**On Curve** is selected in the Node Controller Configuration File for any motor) contact Customer Support for further guidance. The new motor software images exclude the system-specific software for the transport system and will not perform in the same manner.

1. Connect a power cable from the remote power supply to the Power connector on the first NC-S node controller.

2. Connect a service computer directly to the NET0 Ethernet connector on the node controller.

3. Turn on the power to the node controller.

4. Set the IP address of the NC-S node controllers.

   - Open a web browser and connect to the node controller to configure it (see the *Node Controller Interface User Manual*).

     For a direct replacement, use the address of the node controller that was removed.

     If the node controller being replaced was the High-Level Controller, configure the new NC-S as the HLC. When using two NC-S node controllers, do not configure the second NC-S as an HLC.

5. Repeat Step 1 through Step 5 for each additional node controller.

   - When replacing an NC-12 with two NC-S node controllers, use the next available IP address for the second NC-S.

6. Upload the new Node Controller Software Image file (see the *Node Controller Interface User Manual*).

7. Update the Node Controller Configuration File to reference the new node controllers if necessary (see Update the Node Controller Configuration File).

8. Upload the Node Controller Configuration File (see the *Node Controller Interface User Manual*). Use the updated file if any changes were made.

9. Upload the new Motor ERF Image files, Motor Type files, and Magnet Array Type file to the new node controllers (see the *Node Controller Interface User Manual*).

10. Install the new node controllers into the transport system (see Mounting NC-S Node Controllers on page 20).

11. Connect all communication, signal, and power wiring to the NC-S node controllers.
    - Connect the RS-422 communication wiring to the Nano-Mizer connectors.
    - Connect the network cable to the NET0 Ethernet connector.

12. Bundle and dress all cables (use nylon cable-ties) as needed for clean cable routing.

13. Turn on the main power disconnect for the transport system.

14. Make sure that all node controllers in the transport system are running the same version of software (see Table 9).
    - Upload the new versions of all system files to all node controllers in the transport system if the software version has been updated.
    - Program all motors on all node controllers if the software version has been updated.

15. Return the system to operation.
    - From the host controller, issue a Reset command for all paths, once all paths have completed their reset issue a Startup command to all paths.
    - Review the node controller log file to verify that the NC-S is operating properly.
    - Start the host application to begin normal operation.

### Update the Node Controller Configuration File

If the node controller being replaced had more than eight RS-422 connections, the Node Controller Configuration File must be updated to distribute those connections between two new NC-S node controllers. Typically, connections to ports 1–8 are connected to ports 1–8 of the first NC-S and connections to ports 9–12 are connected to ports 1–4 of the second NC-S. Keep the port number as consistent with the original layout as possible without splitting a node.

If the node controller being replaced had eight or fewer connections, only one NC-S is required for replacement. If the connections used only Ports 1–8, no changes are required. If any connections used Ports 9–12, those connections must be reconfigured to one of the available ports on the NC-S.

When redistributing the connections, make sure that all connections for a node are made to the same node controller.

1. Run the MagneMotion Configurator and open a copy of the current Node Controller Configuration File.

2. In the **Node Controllers** section of the **Configuration Tree**, open the **Node Controller Details** page for the node controller being replaced.
   - Remove ownership of those nodes that are connected to Comm Ports 9–12.

3. In the **Node Controllers** section of the **Configuration Tree**, add a new node controller.
   A. Set the IP address of the new node controller to match the IP address of the second NC-S added.
   B. Take ownership of those nodes that were connected to Comm Ports 9–12.
   C. Select the appropriate Comm Port for each connection.

4. Save the revised Node Controller Configuration File with a new name to identify it.

# Ordering Parts

If new or replacement parts are needed, contact MagneMotion Sales:

**Main Office**

MagneMotion, Inc.
A Rockwell Automation Company
139 Barnum Road
Devens, MA 01434
USA
Phone: +1 978-757-9100
Fax: +1 978-757-9200

**Sales**

+1 978-757-9101
ICT-InsideSales@ra.rockwell.com

# Shipping

If a node controller must be shipped, either for return to MagneMotion or to another location, it must be packaged properly to make sure it arrives undamaged. The following procedure provides the correct method for handling and packaging node controllers for shipment.

**⚠ CAUTION**

**Electrical Hazard**

Before beginning this procedure, the MagneMotion transport system must be shut down following the procedure that is provided in *Node Controller Shutdown* on page 111.

## Packing Procedure

When any node controllers are shipped, either for return to MagneMotion for service or to another location, they must be properly packaged to make sure that they arrive undamaged. The following procedure provides the correct method of handling and packaging the MagneMotion components for shipment.

**NOTE:** The original shipping packaging must be used when shipping MagneMotion components. If the original packaging has become lost or damaged, contact MagneMotion for replacements.

1. Turn off and disconnect all electrical power as detailed in *Node Controller Shutdown* on page 111.

2. Disconnect all communications connections as detailed in *Node Controller Shutdown* on page 111.

3. Make sure that the system or component has been properly decontaminated following the facilities decontamination procedures. Follow all facility, local, and national procedures for the disposal of any hazardous materials.

4. When shipping individual components, remove all components that will be shipped (reverse the sequence to install the components) and see *Shipping* on page 126.

## Shipping

1. Wrap, bag, and pack each component following standard packing procedures.

2. Use the container that the component was originally shipped in. Set the component into the container and secure using the supplied packing material.

3. Close the shipping container and secure.

4. Make sure that the container is properly labeled (This End Up, Caution – Heavy, and so forth) and all shipping documents are attached to the outside of the container.

5. When shipping to MagneMotion, make sure that the RMA number is clearly visible on the outside of the box.

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# Appendix

## Overview

The following appendices are included to provide the user with one location for additional information that is related to the node controller interfaces.

Included in this appendix are:

- File maintenance.
- Additional documentation.
- Transport system configuration limits.

# File Maintenance

## Backup Files

Making regular backups of all files that have been changed is recommended. Keep copies of all original and backup files at a remote location for safety.

## Creating Backup Files

Backup files are not created automatically. It is the responsibility of the user to create backups of all files by copying them to a safe location.

## Restoring from Backup Files

Damaged files can be restored by copying the backup files into the appropriate locations.

# Additional Documentation

## Release Notes

The Release Notes that are supplied with MagneMotion software include special instructions, identification of software versions, identification of new features and enhancements, and a list of known issues. Reading this file is recommended before using the software.

## Upgrade Procedure

The Upgrade Procedures that are supplied with MagneMotion software provide instructions for upgrading from one version of MagneMotion software to another. They also include the procedures for file and driver upgrades that are associated with the software.

# Transport System Limits

*Table A-1: MagneMotion Transport System Limits*

| | Path | Node Controller | System (HLC) |
|---|---|---|---|
| **Motors** | 20/RS-422<br>30/Ethernet | –† | 3,840 |
| **Node Controllers** | – | – | 96 |
| **Nodes** | 2 | –† | 256 |
| **Paths** | – | –† | 128 |
| **Stations** | – | – | 2048 |
| **Vehicles** | 50/RS-422*<br>300/Ethernet | 384 | 5,120‡ |

* When using RS-422 communications with the motors, 50 vehicles max per path when all vehicles on the path are commanded forward (downstream).
45 vehicles max per path when all vehicles on the path are commanded backwards.

† When using RS-422 communications with the motors, limited by the number of RS-422 connections on the node controller (NC LITE up to 4 connections, NC-12 up to 12 connections, NC-S up to 8 connections).
When using Ethernet communications with the motors, limited by the node controller configuration and processor loading (NC LITE up to 5 nodes, NC-12 up to 16 nodes, NC-E up to 36 nodes, NC-S up to 16 nodes), see *Node Controller Loading* on page 45.

‡ 6,000 vehicles max when using HLC Control Groups.

*Table A-2: MagneMotion Transport System Motion Limits**

| | Acceleration | Velocity | Thrust |
|---|---|---|---|
| **MagneMover® LITE** | 2.0 m/s$^2$ [0.2 *g*] | 2.0 m/s [4.5 mph] | 10.0 N/cycle† |
| **QuickStick® 100** | 9.8 m/s$^2$ [1.0 *g*] | 2.5 m/s [5.6 mph] | 16.3 N/cycle‡ |
| **QuickStick® HT** | 60.0 m/s$^2$ [6.1 *g*] | 3.5 m/s [7.8 mph] | 182.0 N/cycle§ |

* The limits that are shown are at the typical payloads (contact ICT Customer Support for payload guidance). Use of a smaller payload may permit higher limits. Use of a larger payload may lower the limits.

† Thrust at 25% duty cycle, nominal Vehicle Gap is 1 mm for G3 and 1.5 mm for G4.2.

‡ Thrust at 4.0 A stator current with a nominal Vehicle Gap of 3 mm with a standard magnet array.

§ Thrust at 10.9 A stator current with a nominal Vehicle Gap of 12 mm with a high flux magnet array.

# Glossary

**Block:** See *Motor Block*.

**Bogie:** A structure underneath a vehicle to which a magnet array is attached. The structure is then attached to the vehicle. For vehicles that travel over curves, the attachment is through a bearing that allows independent rotation.

**Brick-wall Headway:** The space that is maintained between vehicles to make sure that a trailing vehicle is able to stop safely if the lead vehicle stops suddenly ('hits a brick wall').

**Byte:** An octet of data (8 bits).

**Clearance Distance:** The distance from a node where the trailing edge of a vehicle is considered cleared from a node.

**Component:** The main parts that form a MagneMotion® transport system. Also called system components, these include *Motors* and *Node Controllers*.

**Configuration File:** See *Node Controller Configuration File*.

**Configurator:** The application that is used to define and edit the basic operating parameters of the transport system that is stored in the *Node Controller Configuration File*.

**Controller:** A device that monitors and controls the operating conditions of the equipment being monitored. In a MagneMotion transport system, the types of controllers include the *High-Level Controller*, *Node Controller*, and *Host Controller*.

**Cycle Length:** Cycle Length is the distance between the centerlines of two like poles on the magnet array.

**Demo Script:** A text file that is used with the NCHost TCP Interface Utility for test or demonstration purposes to move vehicles on the transport system.

**Design Specifications:** The unique parameters for a specific MagneMotion transport system.

**Downstream:** The end of a motor or path as defined by the logical forward direction. Vehicles typically enter the motor or path on the *Upstream* end.

**Downstream Gap:** The physical distance from the end of the stator in one motor to the beginning of the stator in the next motor downstream on the same path. This distance includes the *Motor Gap*.

**E-stop:** See *Emergency Stop*.

**Emergency Off:** A user-supplied device that disconnects AC power to the transport system.

**Emergency Stop:** A user-supplied circuit with a locking button that anyone can press to stop motion in the transport system. It can be wired through the digital I/O on the NC-12 *Node Controller*.

**EMO:** See *Emergency Off*.

**Entry Gate:** The position on a path associated with a node where the leading edge of a vehicle is considered cleared from the node.

**Entry Path:** A path whose downstream end is a member of a node. A vehicle that is moving downstream enters a node on an Entry Path.

**Ethernet Chain:** Ethernet chains allow devices to be connected in series with standard Ethernet cable, without the need for additional network switches. A daisy chain device has two embedded Ethernet ports that function as an Ethernet switch and an interface to the local device. This embedded switch allows information to flow to the device, or flow through the ports to other devices in the chain.

**Exit Path:** A path whose upstream end is a member of a node. A vehicle that is moving downstream exits a node on an Exit Path.

**Forward Direction:** The default direction of motion, from *Upstream* to *Downstream*, on a MagneMotion transport system.

**Glide Puck:** A preconfigured vehicle for use on MagneMover® LITE transport systems that uses low friction skids to slide on the integral rails.

**Global Directives:** The *Demo Script* commands that define the general operating characteristics for all vehicles specified. See also *Vehicle Directives*.

**Ground:** The reference point in an electrical circuit from which voltages are measured. This point is typically a common return path for electric current. See also *PE*.

**Guideway:** A component of the *Track System* that consists of rails or other devices in contact with the *Vehicle*, either through wheels or low friction runners on the vehicle. The guideway maintains the proper relationship between the vehicles and the motors. In the MagneMover LITE transport system, the guideway is the integral rails that are mounted on the motors.

**Headway:** The space that is maintained before a vehicle to make sure that the vehicle is able to stop safely. See *Brick-wall Headway*.

**Hall Effect Sensor:** A transducer that varies its output in response to changes in a magnetic field. Hall Effect Sensors (HES) are used by MagneMotion LSMs for vehicle positioning and speed detection.

**High-Level Controller:** The application in a node controller that communicates with the host controller. Only one node controller per HLC Control Group runs the high-level controller application. In a transport system with only one node controller, it runs both the node controller and high-level controller applications.

**HLC:** See *High-Level Controller*.

**HLC Control Group:** The portion of a multi-HLC LSM transport system under control of a specific HLC.

**Host Application:** The software on the host controller that provides monitoring and control of the transport system.

**Host Controller:** The user-supplied controller for the operation of the transport system. The controller can be either a *PC-Based Controller* or a *Programmable Logic Controller*.

**Host Control Session:** A session between a host controller application (such as the NCHost TCP Interface Utility) and an HLC that allows control of all aspects of transport system operation. The Host Control Session also allows active monitoring of transport system status.

**Host Status Session:** A session between a host controller application (such as the NCHost TCP Interface Utility) and an HLC that only provides active monitoring of transport system status.

**ICT:** See *Independent Cart Technology*.

**ID:** The software labels used to identify various components of the transport system to make sure proper execution of commands involving vehicle position, vehicle destination, and transport system configuration. ID types include vehicle and path.

**Independent Cart Technology:** A programmable intelligent conveyor system that uses linear synchronous motors for moving multiple independently controlled vehicles.

**Interlock:** A user-supplied circuit that is used to stop motion in the transport system. It is wired through the digital I/O on the NC-12 *Node Controller*.

**Inverter:** Hardware that converts DC from the propulsion power bus to AC to energize the coils in a *Motor Block*.

**Keep-out Area:** A unidirectional area of a *Path*. A vehicle that is moving in the specified direction of the area is not allowed to enter the area unless it has permission from the motors to either move past or stop within the area. Once a vehicle enters the keep-out area in the specified direction, all other vehicles that are moving in the same direction must wait to enter the area until that vehicle exits.

**Logic Power:** The power that is used for the controllers and signals. See also, *Propulsion Power*.

**LSB:** Least Significant Byte.

**LSM:** Linear Synchronous Motor. See *MagneMover LITE* and *QuickStick*.

**Master (also Master Controller):** The supervisory controller for each motor, it communicates with the *Slaves* to direct *Motor Block* operation and read motor sensors, and it communicates vehicle positions and other information to the *Node Controller*. It is internal to the motor assembly on MagneMover LITE and QuickStick® 100 motors. For QuickStick HT motors the master is in the motor controller.

**MagneMover LITE:** A MagneMotion linear synchronous motor with integrated guideways and vehicles that enable quick, efficient conveyance of small loads.

**MagneMover LITE System:** A group of specific components that contribute to a *Transport System*. These components include *MagneMover LITE* motors, *Node Controllers*, *Pucks*, and other parts available from MagneMotion.

**Magnet Array:** The magnets that are attached to the *Vehicle*. It is the motor secondary, moved by the primary in the motor.

**MM LITE™:** See *MagneMover LITE*.

**Motor:** See *LSM*.

**Motor Block:** A discrete motor primary section (coil or set of coils) in a motor that can be energized independently. This section can contain only one vehicle during transport system operation.

**Motor Controller:** The assembly that contains the *Master* and the *Inverter* for QuickStick HT motors.

**Motor Gap:** The physical distance between two motors that are mounted end to end. This gap excludes the distance from the end of the stator to the end of the motor housing.

**MSB:** Most Significant Byte.

**NC:** See *Node Controller*.

**Node:** A junction that is defined as the beginning, end, or intersection of *Paths*. The different node types define their use: Simple, Relay, Terminus, Merge, Diverge, and so on.

**Node Controller Configuration File:** The XML file unique to the transport system that defines the basic operating parameters of the transport system. A copy of the Node Controller Configuration File is uploaded to each node controller in the transport system.

**Node Controller:** The application in a node controller that coordinates vehicle motions along a path or paths of motors. The node controller is responsible for the motors on all paths that begin at nodes that the node controller is responsible for.

There can be multiple node controllers in a transport system each responsible for a subset of the nodes within the transport system.

**NRTL/ATL:** Nationally Recognized Test Lab/Accredited Test Lab.

OSHA recognizes NRTL organizations in accordance with 29 CFR 1910.7 to test and certify equipment or materials (products).

Accreditation bodies evaluate ATL organizations to ISO/IEC 17025 for testing and calibration laboratories.

**Path:** A designation for one or more motors placed end to end, which defines a linear route for vehicle travel. A path begins at the *Upstream* end of the first motor in the series and ends at the *Downstream* end of the last motor in the series. All paths must begin at a *Node* and the beginning of a path is always the zero position for determining positions along that path.

**PC-Based Controller:** The user-supplied general-purpose computer that provides control and sequencing for the operation of the transport system.

**PE:** Protective Earth. A conductor that is provided for safety purposes (for example, against the risk of electric shock) and which also provides a conductive path to earth. See also, *Ground*.

**Platooning:** A set of vehicles that are moving in a convoy and being controlled together. This group of vehicles is allowed to maintain a distance between each other while in motion that is less than the *Brick-wall Headway*.

**PLC:** See *Programmable Logic Controller*.

**Position:** A specific location on a *Path*, which is measured from the beginning of that path, which is used as a vehicle destination. Position zero on any path is defined as the leading edge of the first LSM in the path.

A vehicle at a specific position has its midpoint over that location on the path.

**Power Supply:** The equipment that is used to convert facility AC power to the correct voltages for the transport system.

**Programmable Logic Controller:** The user-supplied dedicated controller consisting of Processor and I/O modules that provide control, sequencing, and safety interlock logic for the operation of the transport system.

**Propulsion Power:** The power that is used for vehicle motion. See also, *Logic Power*.

**Protected Area:** The area around a node that is defined by the entry gates and clearance distances. This area is used to make sure that vehicles do not collide with other vehicles in the node or with the mechanism that is related to the node.

**Puck:** A preconfigured vehicle for use on MagneMover LITE transport systems. The magnet array is mounted to the puck and interacts with the motors, which move each vehicle independently. See *Glide Puck* and *Wheeled Puck*. See also, *Vehicle*.

**QS:** See *QuickStick*.

**QuickStick:** A MagneMotion linear synchronous motor that enables quick, efficient conveyance of large loads on user-designed guideways and vehicles. QuickStick 100 (QS 100) motors move loads up to 100 kg [220 lb] per vehicle. QuickStick High Thrust (QSHT) motors move loads up to 4,500 kg [9,900 lb] per vehicle.

**QuickStick System:** A group of specific components that contribute to a *Transport System*. These components include *QuickStick* motors, *Node Controllers*, *Motor Controllers* (QSHT only), *Magnet Arrays*, and other parts available from MagneMotion.

**Sensor Map:** A snapshot of the signal state of vehicle magnet array sensors that are collected from all blocks of a motor.

**Signal:** Each motor contains sensors that detect the magnetic field from the magnet array. When the signal from the sensors is higher than a threshold, the signal bit for the associated sensor is set high, otherwise it is set low.

**Single Vehicle Area:** A unidirectional area of a *Path*. Only one vehicle that is moving in the specified direction of the area is allowed to enter the area at a time. Other vehicles on the path that are moving in the same direction as the initial vehicle in the SVA must wait to enter this area until the previous vehicle exits. This queueing allows one vehicle to move backward and forward along a portion of a path without interfering with any other vehicles.

**Slave (also Slave Controller):** The subordinate controllers for the motor, they communicate with the *Master* and operate the *Inverters* and position-sense hardware. They are internal to the motor assembly on MagneMover LITE and QuickStick 100 motors. For QuickStick HT motors the slaves are in the motor controller.

**Station:** A specific location on a *Path*, which is measured from the beginning of that path, and identified with a unique ID, used as a vehicle destination.

**Stator:** The stationary part of the motor over which the magnet array is moved.

**Switch:** The mechanical guide for positioning a vehicle through guideway sections that merge or diverge.

**SYNC IT™:** Provides direct control by a PLC of up to three sync-zones (motors) where the host controller generates the vehicle motion profile.

**Sync Zone:** An area where vehicle motion can be synchronized with other systems through direct control of the motor by the host controller.

**System Component:** See *Component*.

**Tandem Vehicle:** A vehicle that uses dual *Bogies* to provide enough thrust to carry larger loads.

**Track System:** The components that physically support and move vehicles. For a QuickStick transport system, the track includes a *Guideway*, one or more *QuickStick* motors, mounting hardware, and a stand system. For a MagneMover LITE transport system, the track includes the *MagneMover LITE* motors and stands.

**Transport System:** The components that collectively move user material. These components include the *Motors*, external *Motor Controllers* (QSHT only), *Track System*, *Node Controllers*, *Vehicles,* cables, and hardware.

**Upstream:** The beginning of a motor or path as defined by the logical forward direction. The upstream ends of all paths are connected to node controllers. Vehicles typically exit the motor or path on the *Downstream* end.

**V-Brace:** The mechanical fixture that is used to align and secure MagneMover LITE guide rail and motor sections.

**Vehicle:** The independently controlled moving element in a MagneMotion transport system. The vehicle consists of a platform that carries the payload and a passive magnet array to provide the necessary propulsion and position sensing. All vehicles on paths in the transport system that are connected through nodes must be the same length.

The transport system constantly monitors and controls vehicle position and velocity for the entire time the vehicle is on the transport system. All vehicles

are assigned a unique ID at startup and retain that ID until the transport system is restarted or the vehicle is removed or deleted.

**Vehicle Directives:** The *Demo Script* commands that define the individual motion characteristics for a specific vehicle. See also *Global Directives*.

**Vehicle Gap:** The distance between the bottom of the magnet array that is attached to a vehicle and the top surface of a motor.

**Vehicle ID Master Database:** The HLC database for the assignment and tracking of Vehicle IDs in the transport system. When using *HLC Control Groups*, the Master HLC maintains this database.

**Vehicle ID Slave Database:** The Slave HLC database for tracking of Vehicle IDs in the HLC Control Group managed by that Slave HLC and assigned by the Master HLC. This database is only used when using *HLC Control Groups* to subdivide a transport system.

**Vehicle Master:** The motor controlling the vehicle.

**Vehicle Signal:** A motor software flag for each vehicle that is used to indicate if the vehicle is detected on the transport system.

**Vehicle Spacing:** The distance between two vehicles on the same path.

**Wheeled Puck:** A preconfigured vehicle for use on MagneMover LITE transport systems that uses low friction wheels to ride on the integral rails.

**Zero Point:** The position on the *Upstream* end of a *Path* that denotes the first part on which a *Vehicle* travels.

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**Notes:**

## Rockwell Automation Support

Use the following resources to access support information.

| | | |
|---|---|---|
| **Technical Support Center** | Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates. | https://rockwellautomation.custhelp.com/ |
| **Local Technical Support Phone Numbers** | Locate the phone number for your country. | http://www.rockwellautomation.com/global/support/get-support-now.page |
| **Direct Dial Codes** | Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer. | http://www.rockwellautomation.com/global/support/direct-dial.page |
| **Literature Library** | Installation Instructions, Manuals, Brochures, and Technical Data. | http://www.rockwellautomation.com/global/literature-library/overview.page |
| **Product Compatibility and Download Center (PCDC)** | Get help determining how products interact, check features and capabilities, and find associated firmware. | http://www.rockwellautomation.com/global/support/pcdc.page |

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