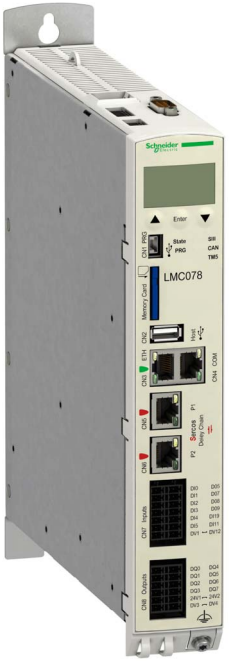
Modicon LMC078

Motion Controller
Hardware Guide

03/2018



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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ 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 is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

The purpose of this document is to:

- Demonstrate how to install and operate your Modicon LMC078 Motion Controller,
- Show how to connect the Modicon LMC078 Motion Controller to a programming device equipped with SoMachine software,
- Help you understand how to interface the Modicon LMC078 Motion Controller with other devices,
- Help you become familiar with the Modicon LMC078 Motion Controller features.

Read and understand this document and all related documents *(see page 8)* before installing, operating, or maintaining your Modicon LMC078 Motion Controller.

Validity Note

This document has been updated for the release of TM3TI4D Add-on for SoMachine V4.3.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the reference or product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product Datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Title of Documentation	Reference Number
Modicon LMC078 Motion Controller Programming Guide	*EIO0000001909 (ENG)* *EIO0000001910 (FRE)* *EIO0000001911 (GER)* *EIO0000001912 (SPA)* *EIO0000001913 (ITA)* *EIO0000001914 (CHS)* *EIO0000001916 (TUR)*
Modicon LMC078 Motion Controller PLCSystem Library Guide	*EIO0000001917 (ENG)* *EIO0000001918 (FRE)* *EIO0000001919 (GER)* *EIO0000001920 (SPA)* *EIO0000001921 (ITA)* *EIO0000001922 (CHS)* *EIO0000001924 (TUR)*
Modicon LMC078 Motion Controller Communication Modules Hardware Guide	*EIO0000001933 (ENG)* *EIO0000001934 (FRE)* *EIO0000001935 (GER)* *EIO0000001936 (SPA)* *EIO0000001937 (ITA)* *EIO0000001938 (CHS)* *EIO0000001940 (TUR)*
Modicon TM5 / TM7 Flexible System - System Planning and Installation Guide	*EIO0000000426 (ENG)* *EIO0000000427 (FRE)* *EIO0000000428 (GER)* *EIO0000000429 (SPA)* *EIO0000000430 (ITA)* *EIO0000000431 (CHS)*
Modicon TM5 Sercos III Interface Hardware Guide	*EIO0000001941 (ENG)* *EIO0000001942 (FRE)* *EIO0000001943 (GER)* *EIO0000001944 (SPA)* *EIO0000001945 (ITA)* *EIO0000001946 (CHS)*

Title of Documentation	Reference Number
Lexium LXM32S Product Manual	*0198441114060 (ENG)* *0198441114061 (FRE)* *0198441114059 (GER)* *0198441114063 (SPA)* *0198441114062 (ITA)* *0198441114064 (CHS)* *0198441114065 (TUR)*
Modicon LMC078 Motion Controller Instruction Sheet	*EAV72939*

You can download these technical publications and other technical information from our website at https://www.schneider-electric.com/en/download

Product Related Information

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in this manual, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
EN 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2008	Safety of machinery: Safety related parts of control systems. General principles for design.

Standard	Description
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 1088:2008 ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2006	Safety of machinery - Emergency stop - Principles for design
EN/IEC 62061:2005	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2008	Digital data communication for measurement and control: Functional safety field buses.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Chapter 1
Modicon LMC078 Motion Controller Features

Introduction

This chapter describes the features of the Modicon LMC078 Motion Controller.

What Is in This Chapter?

This chapter contains the following topics:

About the Modicon LMC078 Motion Controller

Overview

The Schneider Electric Modicon LMC078 Motion Controller (LMC078CECS20T) is a controller with various powerful features. It can control a wide range of applications.

The Modicon LMC078 Motion Controller centrally implements the controller and motion functions. A Modicon LMC078 Motion Controller synchronizes, coordinates, and creates the motion functions of a machine for a maximum of 24 axes (synchronized in as little as 4 ms).

This controller is the optimized solution for axis positioning using the SoMachine software platform, which includes embedded automation functions and an ergonomic interface for axis configuration. Combined with Lexium 32S servo drives, this lets you design and commission your applications.

For more information about Lexium 32S servo drives, refer to the LXM32S Product Manual.

The software configuration is described in the SoMachine Programming Guide and in the LMC078 Motion Controller Programming Guide.

Key Features

The SoMachine software supports the following IEC61131-3 programming languages for use with these controllers:

- IL: Instruction List
- LD: Ladder Diagram
- ST: Structured Text
- FBD: Function Block Diagram
- SFC: Sequential Function Chart

SoMachine software can also be used to program these controllers using CFC (Continuous Function Chart) language.

The LMC078 Motion Controller supports the following fieldbusses:

- With embedded communication interfaces:
  - CANopen Master/Slave
  - Sercos III
  - Ethernet TCP/IP
  - Serial Line
- With optional communication modules:
  - EtherNet/IP Adapter/Scanner
  - PROFIBUS DP Slave

The LMC078 Motion Controller supports the following I/O types:

- Master encoder input
- Embedded I/Os
  - Digital I/Os
  - Advanced digital inputs (touchprobe and interrupt inputs)
- Distributed I/Os on CANopen and Sercos fieldbusses (TM5/TM7 modules)

Performance

The LMC078 Motion Controller has the following performance:

- Up to 8 axes with a minimum synchronization time of 1 ms
- Up to 16 axes with a minimum synchronization time of 2 ms
- Up to 24 axes, with a minimum synchronization time of 4 ms (available with product hardware version greater than or equal to RS02).
- Minimum task cycle time (not for motion): 250 µs

To display the hardware version, either:

1. Display the configuration parameters *(see Modicon LMC078, Motion Controller, Programming Guide)* of the controller.
2. Verify that the first 2 characters of the `HW_Code` parameter are “0” and “2” respectively.

or:

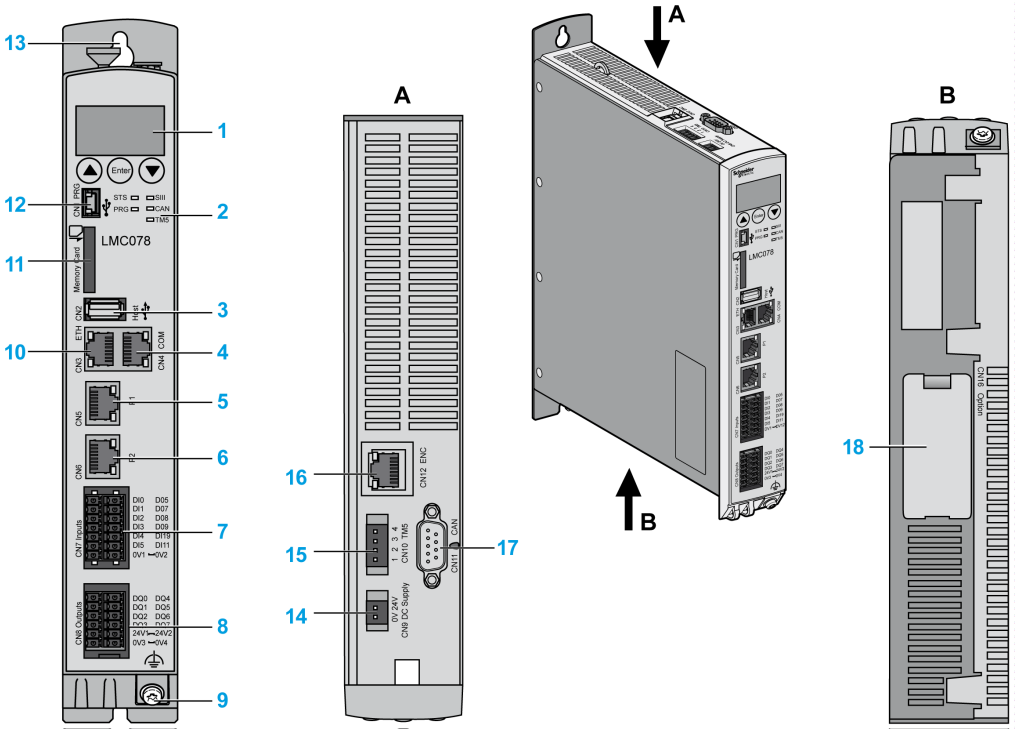
1. Consult the LC Display *(see page 49)* of the controller.
2. Use the menu buttons to display the `HwCode` menu item.
3. Verify that the first 2 characters of the `HwCode` parameter are “0” and “2” respectively.

Example `HW_Code` or `HwCode` parameter for hardware version RS02:

0224013000000000

Controller Description

Physical Description of the LMC078 Motion Controller



N°	Description		Connector type	Refer to
1	Display		-	LC Display *(see page 49)* Menu Navigation *(see page 52)*
2	Controller status LEDs		-	STS LED *(see page 49)*
3	CN2	USB port (**Host**)	USB A	USB Host Port *(see page 66)*
4	CN4	Serial line port (**COM**)	RJ45 (RS-485 or RS-232 software configured)	Serial Line Port *(see page 70)*
5	CN5	Sercos port 1 (**P1**)	RJ45 (Sercos III (Master))	Sercos Port *(see page 68)* SIII LED *(see page 50)* Sercos Status LEDs *(see page 51)*
6	CN6	Sercos port 2 (**P2**)	RJ45 (Sercos III (Master))	
7	CN7	Digital inputs	Spring terminal block	Digital Inputs *(see page 78)*
8	CN8	Digital outputs	Spring terminal block	Digital Outputs *(see page 81)*

N°	Description		Connector type	Refer to
9		Functional ground screw	M4	Grounding *(see page 42)*
10	CN3	Ethernet port (**ETH**)	RJ45	Ethernet Port *(see page 60)* Ethernet Port Connection *(see page 87)* Ethernet Status LEDs *(see page 51)*
11	SD Card slot (memory card)			SD Card *(see page 54)*
12	CN1	USB mini-B (**PRG**)	Mini-B	USB Mini-B Programming Port *(see page 64)* USB Mini-B Port Connection *(see page 85)* PRG LED *(see page 49)*
13	Mounting plate			Mounting Hole Layout *(see page 38)*
14	CN9	24 Vdc power supply	Spring terminal block	Power Supply Connection *(see page 40)*
15	CN10	Not used	-	-
16	CN12	Master encoder input (**ENC**)	RJ45 with 2 additional power supply contacts (A, B)	Encoder Interface *(see page 73)*
17	CN11	CANopen port (**CAN**)	Sub-D9, 9 pins male	CAN Port *(see page 62)* CAN LED *(see page 50)*
18	CN16	Slot for optional communication module	-	Communication Modules *(see page 19)*

Controller Characteristics

Programming

Use the SoMachine software to program the controller.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

SoMachine is a professional, efficient, and open OEM software solution that helps you develop, configure, and commission the entire machine in a single environment (including logic, motor control, HMI, and related network automation functions).

All information about SoMachine is included in the global SoMachine software help system.

Memory

The table describes the different kinds of memory:

Memory type	Size	Used
System RAM	512 Kbytes	Processor cache.
RAM	512 Mbytes	To execute the application.
NVRAM	128 Kbytes	Retained variables.
Flash (SD card)[1]	512 Mbytes	• Transferring application and data. • Update the controller firmware. • Store firmware, configuration, application, and user data.

[1] The latest firmware version for the LMC078 Motion Controller is contained on the SD card delivered with the controller.

SD Card Characteristics

An SD card is provided with the controller.

Characteristics	Description
Card removal durability	Minimum 1000 times
File retention time	10 years @ 25 °C (77 °F)
Flash type	SLC NAND

Characteristics	Description
Memory size	512 MB
Ambient operation temperature	–10… +85 °C (14...185 °F)
Storage temperature	–25…+85 °C (–13...185 °F)
Relative humidity	95% maximum, non-condensing
Write/Erase cycles	3,000,000 (approximately)

Embedded Communication Features

The 5 kinds of ports on the controller are:
- Ethernet port
- CAN ports
- USB ports
- 2 Sercos ports
- Serial line port

For more details, refer to the chapter Integrated Communication Ports *(see page 59)*.

Encoder Interface Description

The encoder interface *(see page 73)* supports incremental and absolute encoders.

The encoder interface supports the following two types of connections:
- Absolute Hiperface
- Incremental RS422

Embedded Input/Output

The controller includes:
- 8 digital inputs (**DI0...DI7**)
- 4 advanced inputs (touchprobe and interrupt inputs) (**DI8...DI11**)
- 8 digital outputs (**DQ0...DQ7**)

Communication Modules

You can add a communication interface by adding a communication module. This table lists the communication modules available:

Reference	Description
VW3E704100000	Communication module EtherNet/IP
VW3E704000000	Communication module PROFIBUS DP

For more information, refer to the LMC078 Communication Modules Hardware Guide *(see Modicon LMC078, Ethernet and PROFIBUS DP Communication Modules, Hardware Guide)*.

Distributed I/O Architecture

Introduction

The LMC078 Motion Controller offers the possibility of creating distributed I/O islands via:

- Sercos fieldbus with TM5 fieldbus interface (TM5NS31)
- CANopen fieldbus with TM5 fieldbus interface (TM5NC31) or TM7 fieldbus interface (TM7NCOM•••)

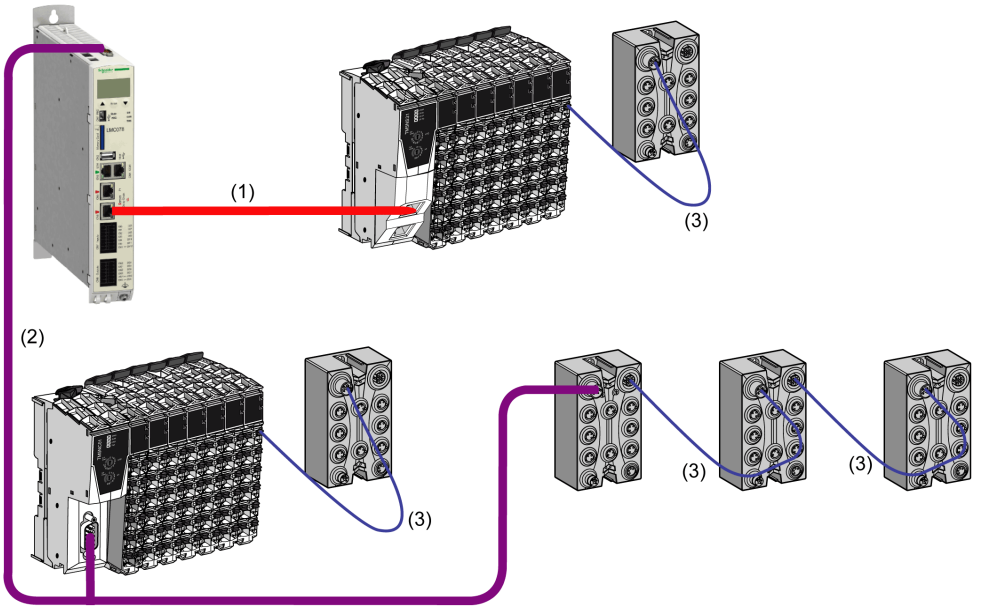
LMC078 Motion Controller Distributed Architecture

Optimized remote configuration and flexibility are provided by the association of:

- LMC078 Motion Controller
- TM5 and/or TM7 fieldbus interface
- TM5 and/or TM7 expansion modules

Application requirements determine the architecture of your LMC078 Motion Controller configuration.

This illustration presents a distributed configuration on Sercos and CANopen fieldbusses:



(1) Sercos fieldbus
(2) CANopen fieldbus
(3) TM5/TM7 expansion bus

For more information on TM5 and TM7 expansion bus, refer to TM5 / TM7 Distributed I/Os Architecture *(see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)*.

Sercos Topology

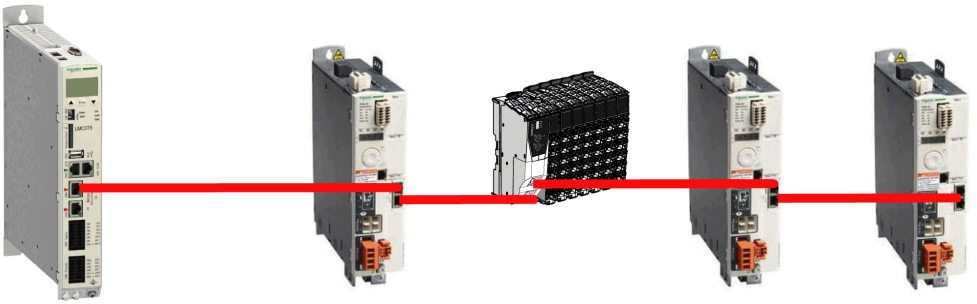
Overview

The two Sercos ports of the LMC078 Motion Controller allows you to use the network topology that meets your application needs. The controller supports line and ring topologies.

NOTE: The overall bus length is determined by the distance between nodes on the network, called a bus segment. The maximum length of a Sercos bus segment is 100 m (328 ft).

Line Topology

This illustration presents an example of line topology:



NOTE: In this example, the Sercos bus length is 400 m (1312 ft) maximum: four segments at a maximum of 100 m (328 ft) each.

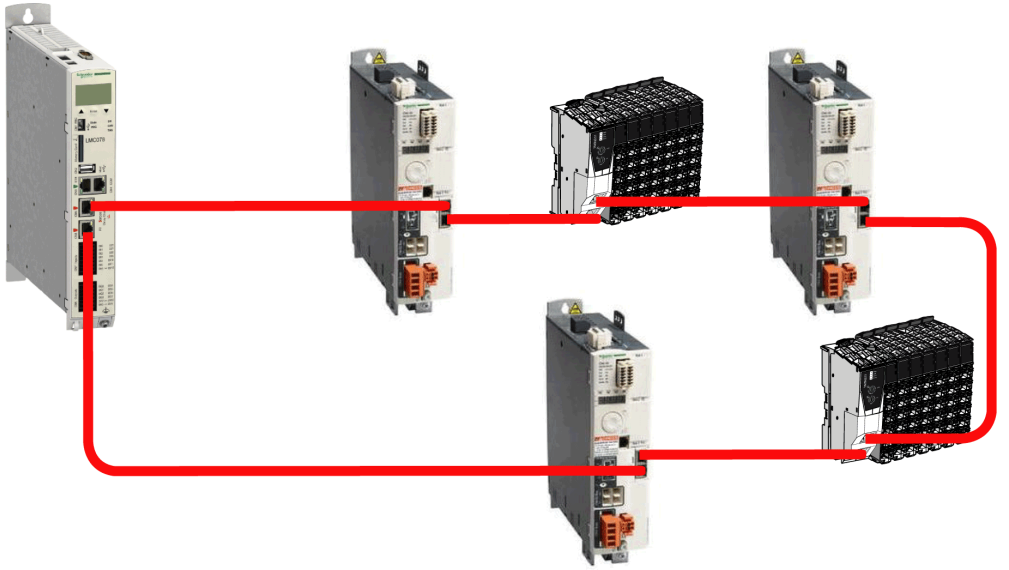
Performing maintenance on any device not physically located at the end of the line (for example, by removing the network cable, or by rebooting the device) affects any devices located down the line from the maintained device.

Ring Topology

The ring topology provides a redundancy (loop back on the Sercos port 2).

If a bus segment becomes inoperable, or a cable is detached or severed, the Sercos bus remains, as does all other devices, operational.

This illustration presents an example of ring topology:



NOTE: In this example, the maximum Sercos bus length is 600 m (1968 ft).

Real Time Clock (RTC)

Overview

These controllers include an RTC to provide system date and time information, and to support related functions requiring a real-time clock.

To continue to keep time when power is off, a non-rechargeable but replaceable battery is integrated into the controller.

This table presents how RTC drift is managed:

RTC characteristics	Description
RTC drift	± 1 s in 24 h
RTC drift with user logic assistance	The RTC can be calibrated with the function `MyController.SetRealTimeClock`, in this case the RTC drift depends on time source used by the application code.

NVRAM (Non-Volatile RAM) and RTC Battery

The controller has one battery.

In the event of a power outage, the backup battery retains the time of the controller and NVRAM data.

This table presents the characteristics of the battery:

Characteristics	Description
Use	In the event of a transient power outage, the battery will power the RTC and NVRAM.
Backup time	at least 10 years under normal use conditions
Battery monitoring	“Empty battery “ message displayed on the LCD screen when the battery is getting low.
Replaceable	Factory replacement only

Installing and Replacing the RTC Battery

The LMC078 Motion Controller must be returned for battery replacement every 10 years. Only Schneider Electric personnel are authorized to replace the battery.

NOTE: When the battery is depleted (empty) and the 24 Vdc supply is disconnected, retain variables and all the data on the NVRAM are no longer saved.
When the battery is depleted (empty), the real-time clock is set to a default value at every start and you must set the real-time clock.

Accessories

Overview

This section describes the accessories and cables.

Accessories

Reference	Description
TMASD2	SD replacement card *(see page 54)*
VW3E704000000	PROFIBUS DP communication module
VW3E704100000	EtherNet/IP communication module

Cables

Reference	Description	Length
TCSXCNAMUM3P	USB cable for USB mini-B programming port	3 m (10 ft)
BMXXCAUSBH018	USB cable for USB mini-B programming port **NOTE:** Grounded and shielded, this USB cable is suitable for long duration connections.	1.8 m (5.9 ft)
VW3E5001R•••	Sercos III cable	0.5, 1, 1.5, 2, 3, 5, 10, 15, 20, 25, 30, 40, or 50 m 1.64, 3.28, 4.92, 6.56, 9.84, 16.4, 32.8, 49.2, 65.6, 82, 98.4, 131.2, or 164 ft
490NTW000••	Standard Ethernet shielded cable for DTE connections (CE compliant)	2,5,12,40, or 80 m (6.56,16.4, 39.37, 131.23, or 262.47 ft)
490NTW000••U	Standard Ethernet shielded cable for DTE connections (UL compliant)	2,5,12,40, or 80 m (6.56,16.4, 39.37, 131.23, or 262.47 ft)
TCSECE3M3M••S4	Harsh environment Ethernet shielded cable for DTE connections (CE compliant)	1, 2, 3, 5, or 10 m (3.28, 6.56, 9.84, 16.4, 32.81 ft)
TCSECU3M3M••S4	Harsh environment Ethernet shielded cable for DTE connections (UL compliant)	1, 2, 3, 5, or 10 m (3.28, 6.56, 9.84, 16.4, 32.81 ft)

Reference	Description	Length
TSXCANCA•••	CANopen cables dedicated to the European market, LSZH (low smoke zero halogen)	0.3, 1, 3, 5, 50, 100 or 300 m (0.98, 3.28, 9.84, 16.4, 164, 328, 984 ft)
TSXCANCB•••	CANopen cables dedicated to the American market, UL and CSA certified, fire retarding	50, 100, 300 m (164, 328, 984 ft)
TSXCANCD•••	CANopen cables dedicated to severe environments, good chemical resistance to oil and grease, LSZH (low smoke zero halogen)	50, 100, 300 m (164, 328, 984 ft)
VW3A8306D30	Modbus SL drop cable (1 RJ45 connector and free wires at other end)	3.0 m (9.84 ft)
VW3E2097R•••	Cable for incremental encoder (RS422)	1.5...50 m (4.9...164 ft)
VW3E2094R•••	Cable for Hiperface encoder	2...50 m (6.56...164 ft)

Chapter 2
Modicon LMC078 Motion Controller Installation

Introduction

This chapter describes the installation requirements, wiring rules, environmental characteristics, first startup, dimensions and mounting position of the Modicon LMC078 Motion Controller.

What Is in This Chapter?

This chapter contains the following topics:

Installation and Maintenance Requirements

Before Starting

Read and understand this chapter before beginning the installation of your system.

The use and application of the information contained herein require expertise in the design and programming of automated control systems. Only you, the user, machine builder or integrator, can be aware of all the conditions and factors present during installation and setup, operation, and maintenance of the machine or process, and can therefore determine the automation and associated equipment and the related safeties and interlocks which can be effectively and properly used. When selecting automation and control equipment, and any other related equipment or software, for a particular application, you must also consider any applicable local, regional or national standards and/or regulations.

Pay particular attention in conforming to any safety information, different electrical requirements, and normative standards that would apply to your machine or process in the use of this equipment.

Disconnecting Power

All options and modules should be assembled and installed before installing the control system on a mounting rail, onto a mounting plate or in a panel. Remove the control system from its mounting rail, mounting plate or panel before disassembling the equipment.

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

Programming Considerations

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Operating Environment

In addition to the **Environmental Characteristics**, refer to **Product Related Information** in the beginning of the present document for important information regarding installation in hazardous locations for this specific equipment.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Install and operate this equipment according to the conditions described in the Environmental Characteristics.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Installation Considerations

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use appropriate safety interlocks where personnel and/or equipment hazards exist.
- Install and operate this equipment in an enclosure appropriately rated for its intended environment and secured by a keyed or tooled locking mechanism.
- Use the sensor and actuator power supplies only for supplying power to the sensors or actuators connected to the module.
- Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment.
- Do not use this equipment in safety-critical machine functions unless the equipment is otherwise designated as functional safety equipment and conforming to applicable regulations and standards.
- Do not disassemble, repair, or modify this equipment.
- Do not connect any wiring to reserved, unused connections, or to connections designated as No Connection (N.C.).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: JDYX2 or JDYX8 fuse types are UL-recognized and CSA approved.

Wiring Best Practices

Overview

This section describes the wiring guidelines and associated best practices to be respected when using the LMC078 Motion Controller system.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

Wiring Guidelines

The following rules must be applied when wiring a LMC078 Motion Controller system:

- I/O and communication wiring must be kept separate from the power wiring. Route these 2 types of wiring in separate cable ducting.
- Verify that the operating conditions and environment are within the specification values.
- Use proper wire sizes to meet voltage and current requirements.
- Use copper conductors (required).
- Use twisted pair, shielded cables for advanced inputs.
- Use twisted pair, shielded cables for networks, and fieldbus.

Use shielded, properly grounded cables for all analog and high-speed inputs or outputs and communication connections. If you do not use shielded cable for these connections, electromagnetic interference can cause signal degradation. Degraded signals can cause the controller or attached modules and equipment to perform in an unintended manner.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use shielded cables for all fast I/O, analog I/O and communication signals.
- Ground cable shields for all analog I/O, fast I/O and communication signals at a single point[1].
- Route communication and I/O cables separately from power cables.

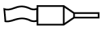
Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1]Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

NOTE: Surface temperatures may exceed 60 °C (140 °F). To conform to IEC 61010 standards, route primary wiring (wires connected to power mains) separately and apart from secondary wiring (extra low voltage wiring coming from intervening power sources). If that is not possible, double insulation is required such as conduit or cable gains.

Rules for Removable Spring Terminal Block

The following table presents the cable types and wire sizes for a removable spring terminal block (I/Os and power supply):

mm / *in.* **10 / *0.39***			
mm^2	0.2…1.5	0.2…1.5	0.25…0.75
AWG	*24…16*	*24…16*	*24...18*

The use of copper conductors is required.

⚠ DANGER

FIRE HAZARD

Use only the correct wire sizes for the current capacity of the I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

The spring clamp connectors of the terminal block are designed for only one wire or one cable end. Two wires to the same connector must be installed with a double wire cable end to help prevent loosening.

⚠⚠ DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

Do not insert more than one wire per connector of the terminal block unless using a double wire cable end (ferrule).

Failure to follow these instructions will result in death or serious injury.

Protecting Outputs from Inductive Load Damage

Depending on the load, a protection circuit may be needed for the outputs on the controllers and certain modules. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

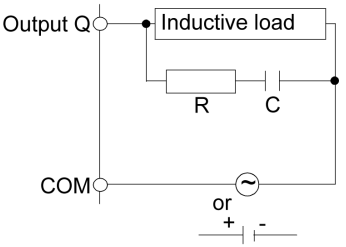
⚠ CAUTION

OUTPUT CIRCUIT DAMAGE DUE TO INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk of inductive direct current load damage.

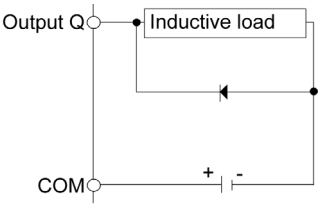
Failure to follow these instructions can result in injury or equipment damage.

Protective circuit A: this protection circuit can be used for DC load power circuits.



C Value from 0.1 to 1 µF
R Resistor of approximately the same resistance value as the load

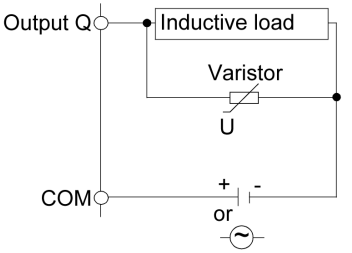
Protective circuit B: this protection circuit can be used for DC load power circuits.



Use a diode with the following ratings:

- Reverse withstand voltage: power voltage of the load circuit x 10.
- Forward current: more than the load current.

Protective circuit C: this protection circuit can be used for DC load power circuits.



In applications where the inductive load is switched on and off frequently and/or rapidly, ensure that the continuous energy rating (J) of the varistor exceeds the peak load energy by 20 % or more.

Environmental Characteristics

Environmental Characteristics

Procedure	Characteristic	Description	Reference standard
Operation	**Class 3K3**		**IEC/EN 60721-3-3**
	Degree of protection	IP 20	
	Pollution degree	2, according to IEC 61131-2, UL508	
	Ambient temperature	+5...+55°C *(+41...+131°F)*	
	Condensation	Prohibited	
	Icing	Prohibited	
	Relative humidity	5...95% (non-condensing)	
	Installation altitude without derating	0...2000 m *(0...6561 ft)*	
	Installation high altitude derating, 2000...3000 m *(6561...9842 ft)*	40 °C *(104 °F)* maximum ambient temperature	
	Class 3M4		
	Shock	100 m/s²	
	Vibration	10 m/s²	
Transport	**Class 2K3**		**IEC/EN 60721-3-2**
	Ambient temperature	-25...+70 °C *(-13...+158 °F)*	
	Condensation	Prohibited	
	Icing	Prohibited	
	Relative humidity	5...95% (non-condensing)	
	Maximum altitude of transport	10000 m *(32808 ft)*	
	Class 2M2		
	Shock	300 m/s²	
	Vibration	15 m/s²	
Storage in transport packaging	**Class 1K4**		**IEC/EN 60721-3-1**
	Ambient temperature	-25...+55 °C *(-13...+131 °F)*	
	Condensation	Prohibited	
	Icing	Prohibited	
	Relative humidity	5...95% (non-condensing)	
	Maximum altitude	3000 m (9843 ft)	

Certifications and Standards

Introduction

The Modicon LMC078 Motion Controller is designed to conform to the main national and international standards concerning electronic industrial control devices:

- IEC/EN 61131-2-2007 (Zone B)
- UL 508
- CSA 22.2 No. 142

The Modicon LMC078 Motion Controller has obtained the following conformity marks:

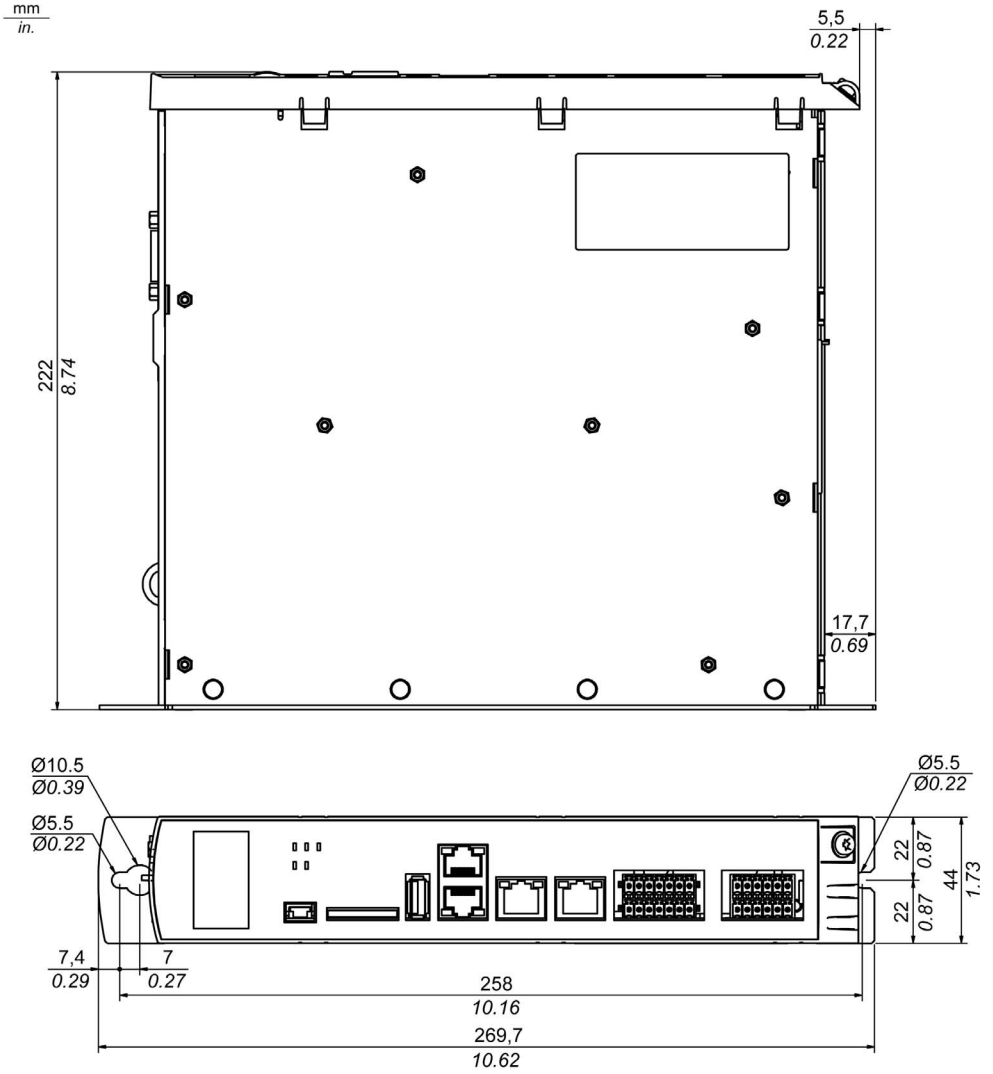
- CE
- cULus

For product compliance and environmental information (RoHS, REACH, PEP, EOLI, etc.), go to *www.schneider-electric.com/green-premium*.

Dimensions

Dimensions

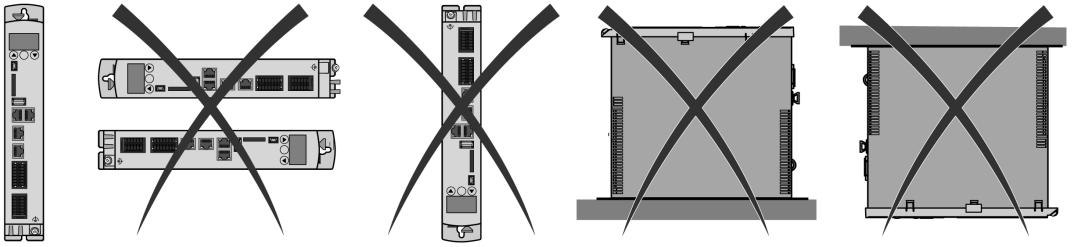
This illustration presents the dimensions of the Modicon LMC078 Motion Controller:



Mounting Position and Minimum Clearances

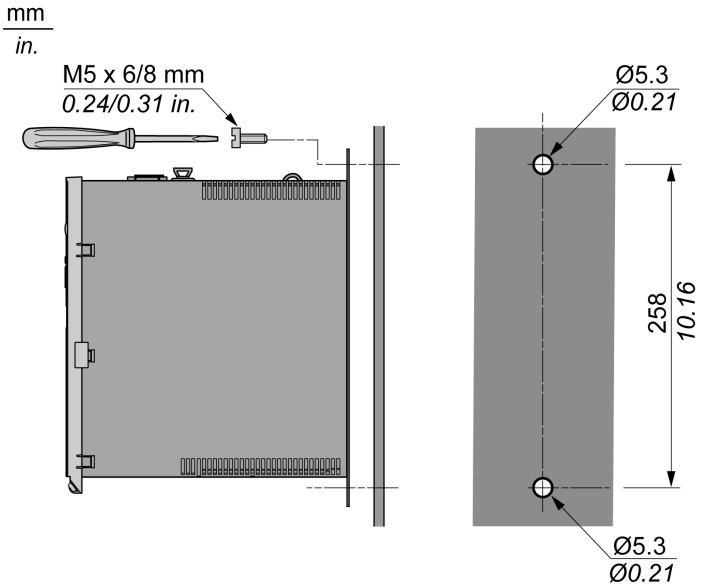
Mounting Position

Mount the Modicon LMC078 Motion Controller vertically inside the control cabinet:



Mounting Hole Layout

This illustration presents how to install the Modicon LMC078 Motion Controller on the back panel of the cabinet using the mounting holes:



Minimum Clearances

The Modicon LMC078 Motion Controller has been designed as an IP20 product and must be installed in an enclosure. Clearances must be respected when installing the product.

There are 3 types of clearances between:

- The Modicon LMC078 Motion Controller and all sides of the cabinet (including the panel door). This type of clearance allows proper circulation of air around the controller, and therefore keeps the sides of cabinet at the ambient temperature.
- The Modicon LMC078 Motion Controller terminal blocks and the wiring ducts. This distance avoids electromagnetic impulse between the controller and the wiring ducts.
- The Modicon LMC078 Motion Controller and other heat generating devices installed in the same cabinet.

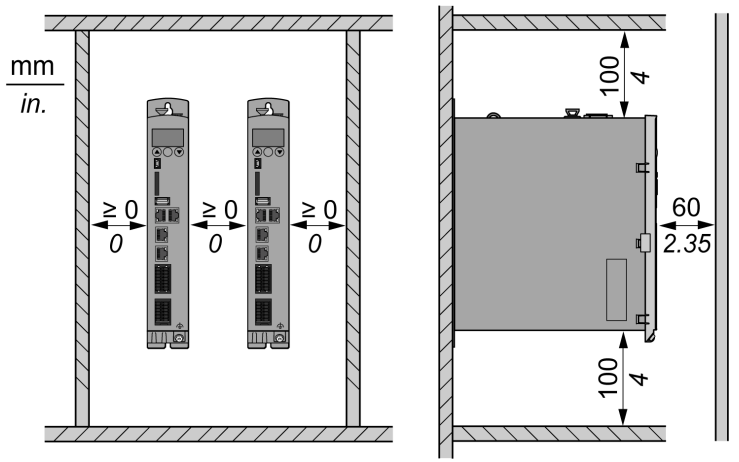
⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Place devices dissipating the most heat at the top of the cabinet and ensure adequate ventilation.
- Avoid placing this equipment next to or above devices that might cause overheating.
- Install the equipment in a location providing the minimum clearances from all adjacent structures and equipment as directed in this document.
- Install all equipment in accordance with the specifications in the related documentation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This illustration illustrates the assembly and air circulation distances:



Power Supply Wiring

Power Supply Characteristics

This table presents the DC power supply characteristics:

Characteristic	Description
Rated voltage	24 Vdc
Power supply voltage range	20.4...30 Vdc
Maximum power consumption	30 W
Maximum inrush current	10 A
Wire gauge	0.2...1.5 mm² (24...16 AWG)

The signal voltage and the control voltage of the devices are less than 30 Vdc, and must be designed, at a minimum, as PELV (Protective Extra Low Voltage) circuits. The PELV system specification, according to EN 61800-5-1:2007, contains a protective measure against direct and indirect contact with hazardous voltage through an implemented effective separation in the system/machine of the primary and secondary side. Be advised to design the system/machine with a protective separation.

⚠ DANGER

INADEQUATE PROTECTIVE SEPARATION

Only connect devices, electrical components or lines to the signal voltage connectors of these components that feature a sufficient, protective separation from the connected circuits.

Failure to follow these instructions will result in death or serious injury.

NOTE: Best practices dictate adherence to the standard EN50178: 1999 - Electronic equipment for use in power installations - Section 5.2.14.2:

- Ensure an effective separation in the entirety of the electric circuit.
- Design the cover or device connection so that it can only be removed using a tool.
- The protective measures must be implemented on all connected devices.

Power Supply Connection

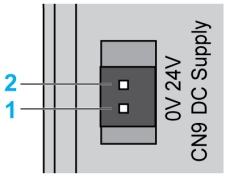
⚠ WARNING

POTENTIAL OF OVERHEATING AND FIRE

- Do not connect the equipment directly to line voltage.
- Use only isolating PELV or SELV power supplies to supply power to the modules.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This illustration presents the pin assignment of the **CN9** connection:



Pin	Description
1	0 Vdc
2	24 Vdc

⚠ DANGER

FIRE HAZARD

Use only the correct wire sizes for the current capacity of the power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

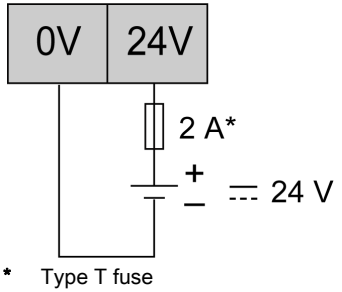
UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Wiring Diagram

This wiring diagram presents the power supply connection:



* Type T fuse

The power supply of this equipment does not have built-in reverse polarity protection. Incorrectly connecting polarity can permanently damage the output circuits and the internal backup battery or otherwise result in unintended operation of the equipment.

NOTICE
INOPERABLE EQUIPMENT Verify the wiring conforms to the polarity markings on the connections of this equipment and as described in the related documentation. **Failure to follow these instructions can result in equipment damage.**

Grounding

To help minimize the effects of electromagnetic interference, cables carrying the fast I/O, analog I/O, and field bus communication signals must be shielded.

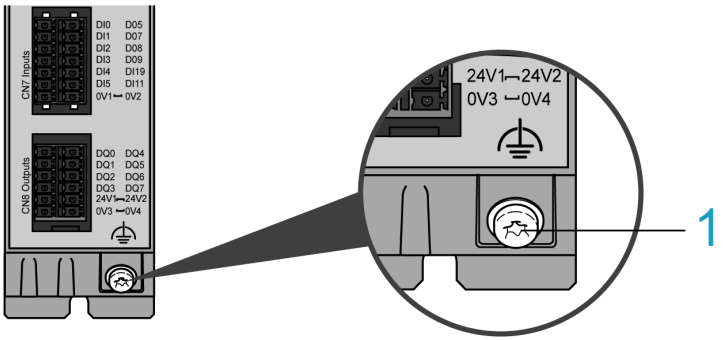
⚠ WARNING
UNINTENDED EQUIPMENT OPERATION ● Use shielded cables for all fast I/O, analog I/O, and communication signals. ● Ground cable shields for all fast I/O, analog I/O, and communication signals at a single point[1]. ● Route communications and I/O cables separately from power cables. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

[1]Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

The use of shielded cables requires compliance with the following wiring rules:

- For protective ground connections (PE), metal conduit or ducting can be used for part of the shielding length, provided there is no break in the continuity of the ground connections. For functional ground (FE), the shielding is intended to attenuate electromagnetic interference and the shielding must be continuous for the length of the cable. If the purpose is both functional and protective, as is often the case for communication cables, the cable must have continuous shielding.
- Wherever possible, keep cables carrying one type of signal separate from the cables carrying other types of signals or power.

The illustration presents the position of the grounding terminal of the controller:

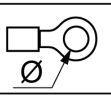
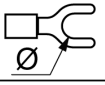


1 Grounding terminal

This table presents the grounding terminal characteristics:

Characteristic	Description
Minimum wire gauge	2.5 mm² (14 AWG)
Connection	Ring lug M4
Screw	M4 (slotted 5.5 mm (0.22 in) / torx T20)
Tightening torque	1.4 N.m (12.4 lbf.in)

This table presents the ring lug characteristics:

		
	Ø	Ø
mm	4.3	4.3
in.	*0.17*	*0.17*

First Startup

Overview

This procedure helps you through the installation and startup of your controller.

Startup Procedure

NOTICE

ELECTROSTATIC DISCHARGE

- Store all components in their protective packaging until immediately before assembly.
- Never touch exposed conductive parts such as contacts or terminals.

Failure to follow these instructions can result in equipment damage.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use appropriate safety interlocks where personnel and/or equipment hazards exist.
- Install and operate this equipment in an enclosure appropriately rated for its intended environment and secured by a keyed or tooled locking mechanism.
- Use the sensor and actuator power supplies only for supplying power to the sensors or actuators connected to the module.
- Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment.
- Do not use this equipment in safety-critical machine functions unless the equipment is otherwise designated as functional safety equipment and conforming to applicable regulations and standards.
- Do not disassemble, repair, or modify this equipment.
- Do not connect any wiring to reserved, unused connections, or to connections designated as No Connection (N.C.).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action	Refer To
1	Unpack your controller and verify the contents of the package.	-
2	Choose an appropriate cabinet.	Minimum clearances *(see page 38)*
3	Install your communication module (optional).	Communication modules *(see page 19)*
4	Install your controller in the cabinet.	-

Step	Action	Refer To
5	Connect the ground.	Grounding *(see page 42)*
6	Connect the inputs on the **CN7** connector.and the outputs on the **CN8** connector.	Embedded I/O *(see page 77)*
7	Connect the 24 Vdc power supply on the **CN9** connector.	Power Supply Wiring *(see page 40)*
8	Connect the communication fieldbusses and networks.	Integrated Communication Ports *(see page 59)*
9	Verify whether the SD card has been inserted.	SD Card *(see page 54)*
10	Connect your controller to the PC. **NOTE:** SoMachine must be installed on the PC.	Connecting the Controller to a PC *(see page 85)*
11	Verify all connections.	-
12	Turn on power.	-
13	Login to your controller.	Modicon LMC078 Motion Controller Programming Guide *(see Modicon LMC078, Motion Controller, Programming Guide)*
14	Create an application.	
15	Load your application into the controller.	
16	Create your boot application.	
17	Run the application.	

Chapter 3
LMC078 Motion Controller Indicators and Control Elements

Introduction

This chapter describes the indicators and control elements of the LMC078 Motion Controller controller.

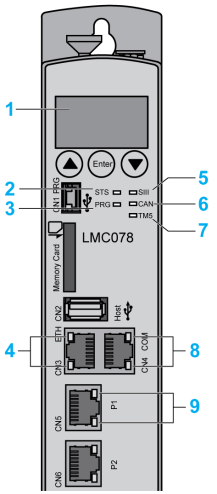
What Is in This Chapter?

This chapter contains the following topics:

Indicators of the Controller

Overview

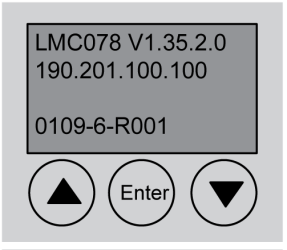
This illustration presents the different indicators of the controller:



N°	Label	Designation	Description
1	-	-	Liquid Crystal Display (LC display).
2	**STS**	STS LED	Indicates the controller state.
3	**PRG**	PRG LED	Indicates the state of the USB communication on the programming port (**CN1**).
4	-	Status LEDs Ethernet	Indicates the state of the Ethernet communication on the **CN3** port.
5	**SIII**	SIII LED	Indicates the state of the Sercos communication on the **CN5** and **CN6** ports.
6	**CAN**	CAN LED	Indicates the state of the CAN communication on the **CN11** port.
7	TM5	-	Not used.
8	-	Status LEDs serial line	Indicates the activity of the Serial line communciations on **CN4**.
9	-	Status LEDs Sercos	Indicates the activity of the Sercos communication on the **CN5** and **CN6** ports.

LC Display

In addition to the LED displays, further information about the operating status of the controller is given on the four line display (LCD). This illustration presents the default, initial display:



Line	Description
1	Controller type and firmware version.
2	Current IP address of the controller.
3	Not used.
4	Hardware and software versions

Three buttons allow you to navigate in the menu, for more information refer to Menu Navigation *(see page 52)*.

STS LED

The **STS** LED indicates the controller state:

LED state	Description
Off	No, or inadequate, 24 Vdc power.
Green	Normal operation, the power supply is in normal range.
Red	System error detected, error is presented on the LCD display.
	Initialization active after power-on.
	An other than System error was detected after controller initialization. For further information on the error, see the message logger.
Flashing red	The controller performs a warm restart.

PRG LED

The **PRG** LED indicates the state of the USB communication on the programming port (**CN1**):

LED state	Description
Off	No USB communication on programming port.
Green	USB communication detected.

SIII LED

The **SIII** LED indicates the state and the phases of the Sercos communication:

LED state	Description	Notes
Off	No Sercos communication.	-
Orange	The device is in a communication phase CP0 up to and including CP3.	SERC3.State = 0...3
Green	Sercos communication in communication phase CP4 without an error being detected.	SERC3.State = 4
Red	Communication error detected (reset condition: DiagQuit).	SERC3.State = 11

CAN LED

The **CAN** LED indicates the state and the phases of the CAN communication:

LED state	Display mode	Description
Off	-	No power.
Flashing green	On 50 ms then off 50 ms	Autobaud detection in progress.
Flashing green	On 200 ms then off 200 ms	Pre-operational state.
Flashing green	On 200 ms then off 1 s	Stopped state.
Green	Steady	Operating state.
Flashing red	Single flash	Limit to trigger diagnostic message reached.
	Double flash	A cyclic checking has detected an error.
	Triple flash	Synchronization error detected. No SYNC message received within the configured communication cycle timeout.
Red	Steady	Bus off.

Ethernet Status LEDs

The Ethernet connector has 2 LEDs.

The Ethernet status LEDs indicate the state of the Ethernet connection:

LED	State	Description
Green	On	Connection established.
	Flashing	Data traffic.
	Off	No connection, for example no cable connected or connected device has no power.
Yellow	On	100 MBit or 1 GBit connection.
	Off	10 MBit connection.

Sercos Status LEDs

Each Sercos connector has 2 LEDs.

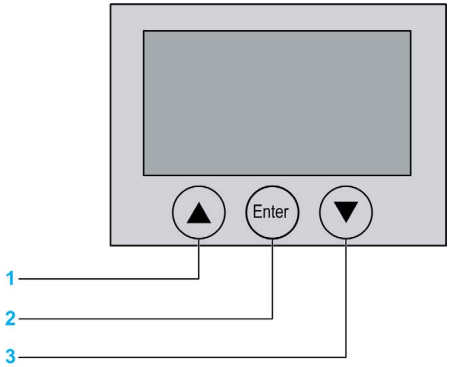
The Sercos status LEDs indicate the individual activity of the Sercos connection on the **CN5** and **CN6** ports:

LED	State	Description
Yellow	On	Connection established.
	Off	No connection, for example no cable connected or connected device has no power.
Green	On	Active communication.
	Off	No active communication.

Menu Navigation

Menu Buttons

3 menu buttons are located on the front side of the controller. With these menu buttons, you can open and navigate through the menu:



1 Up arrow button
2 Enter button
3 Down arrow button

Functions of the Menu Buttons

The menu buttons feature the following functions:

Button	Function
Press and hold ▼ and then press Enter.	Access of the menu
▲	Cursor up
▼	Cursor up
Enter	Open menu command
Press and hold ▲ and then press Enter.	One level up in the menu

If an up or down arrow is displayed on the right display edge, this indicates that the current menu has more lines than can be presented on the display. In this case, you can use the arrow buttons  and  to scroll up or down.

Menu Navigation

This table describes the menu structure:

Menu	Submenu	Entry	Description
1 Identification	1.1 Versions	1.1.1 FW	Currently used firmware version
		1.1.2 PFPGA	Version of the Controller-FPGA software
		1.1.3 SFPGA	Version of the System-FPGA software
		1.1.4 BIOS	BIOS version
	1.2 HCode/Serial No	1.2.1 SerialNo	Controller serial number
		1.2.2 HwCode	Controller hardware code
	1.3 IP Address	1.3.1 IP	IP address of the controller
		1.3.2 MASK	Subnet mask
		1.3.3 GW	Gateway address
	1.4 MAC Address	1.4.1 MAC Address	MAC address to identify the device in the network
2 Inputs/Outputs	2.1 Inputs	2.1.1 DI	Logic state of the digital inputs
		2.1.2 ADI	Logic state of the advanced inputs
	2.1 Outputs	2.2.1 DQ	Logic state of the digital outputs
3 Diagnostic	3.1 DiagMessage	A:BBBB:	A: Diagnostic class BBBB: Diagnostic code
		C...C	C...C: Diagnostic text

SD Card

Overview

When handling the SD card, follow the instructions below to help prevent internal data on the SD card from being corrupted or lost or a SD card malfunction from occurring:

NOTICE
LOSS OF APPLICATION DATA ● Do not store the SD card where there is static electricity or probable electromagnetic fields. ● Do not store the SD card in direct sunlight, near a heater, or other locations where high temperatures can occur. ● Do not bend the SD card. ● Do not drop or strike the SD card against another object. ● Keep the SD card dry. ● Do not touch the SD card connectors. ● Do not disassemble or modify the SD card. ● Use only SD cards formatted using FAT or FAT32. **Failure to follow these instructions can result in equipment damage.**

An SD card must be inserted in the SD card slot before to power on the LMC078 Motion Controller.

The SD card slot is located on the front side of the controller. The SD card slot is the receptacle for the permanent data storage (SD card) of the controller.

When using the LMC078 Motion Controller and an SD card, observe the following to avoid losing valuable data:

- Accidental data loss can occur at any time. Once data is lost, it cannot be recovered.
- If you forcibly extract the SD card, data on the SD card may become corrupted.
- Removing an SD card that is being accessed could damage the SD card, or corrupt its data.
- If the SD card is not positioned correctly when inserted into the LMC078 Motion Controller, the data on the card and the controller could become damaged.

NOTICE
LOSS OF APPLICATION DATA ● Backup SD card data regularly. ● Do not remove power or reset the controller, and do not insert or remove the SD card while it is being accessed. ● Do not remove the SD card when the controller is powered on. ● Become familiar with the proper orientation of the SD card when inserting it into the controller. **Failure to follow these instructions can result in equipment damage.**

TMASD2 Characteristics

The TMASD2 SD card is used for replacing the SD card delivered with the controller, or to increase the memory size.

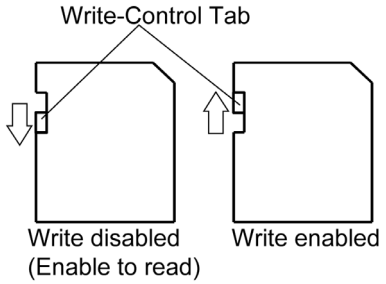
This SD card is delivered empty, you must load the firmware into the SD card.

Characteristics	Description
Card removal durability	Minimum 1000 times
File retention time	10 years @ 25 °C (77 °F)
Flash type	SLC NAND
Ambient operation temperature	–10… +85 °C (14...185 °F)
Storage temperature	–25…+85 °C (–13...185 °F)
Relative humidity	95% maximum, non-condensing
Write/Erase cycles	3,000,000 (approximately)

NOTE: The TMASD2 have been rigorously tested in association with the LMC078 Motion Controller. For other commercially available cards, please consult your local sales representative.

Write Protection of the SD Card

With the slide switch on the side of the SD card, the write protection of the SD card can be activated:

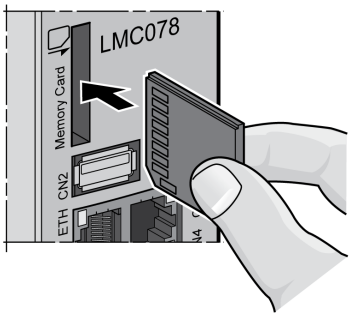


The slide switch has to be set to the position LOCK to activate the write protection. The slide switch has to be set to the opposite position to deactivate the write protection.

NOTE: With an activated write protection, a download of a project onto the controller or writing of parameters on the SD card, is not possible during the operation.

Insert SD Card

To insert an SD card, proceed as follows:

Step	Action
1	Remove the power from the controller.
2	Insert the SD card carefully into the SD card slot with the beveled corner forward and looking downwards as presented on the illustration until it clicks into place. 

NOTICE
INOPERABALE OR CORRUPTED SD CARD ● Remove all power from the controller before inserting the SD Card. ● Verify that you insert the SD card into the SD card slot correctly, with the beveled corner forward and looking downwards. **Failure to follow these instructions can result in equipment damage.**

Remove SD Card

To remove an SD card, proceed as follows:

Step	Action
1	Remove the power from the controller.
2	Push the SD card slightly inside until it disengages.
3	Remove the SD card from the SD card-slot.

NOTICE
INOPERABALE OR CORRUPTED SD CARD Remove all power from the controller before removing the SD Card. **Failure to follow these instructions can result in equipment damage.**

Chapter 4
Integrated Communication Ports

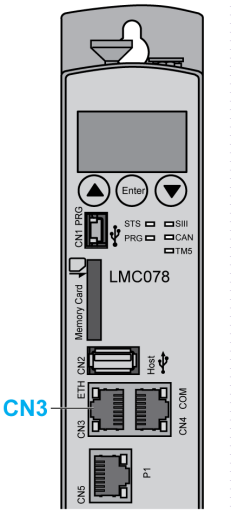
What Is in This Chapter?

This chapter contains the following topics:

Ethernet Port

Overview

This illustration presents the location of the Ethernet port of the controller (**CN3** port):



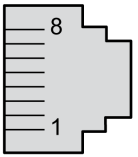
Characteristics

This table describes the different Ethernet characteristics:

Characteristic	Description
Standard	Ethernet
Connector type	RJ45
Baud rate	Supports Ethernet 10/100/1000 Base-T with auto-negotiation
Auto-crossover	MDI / MDIX
Protocol supported	• SoMachine protocol • Modbus TCP client/server • FTP client/server • HTTP server • SNMP
IP address negotiation type supported	• DHCP client • BOOTP client • Configured IP
Supplied current	No

Pin Assignment

This illustration shows the Ethernet connector pins:



This table describes the pin assignment of the Ethernet connector:

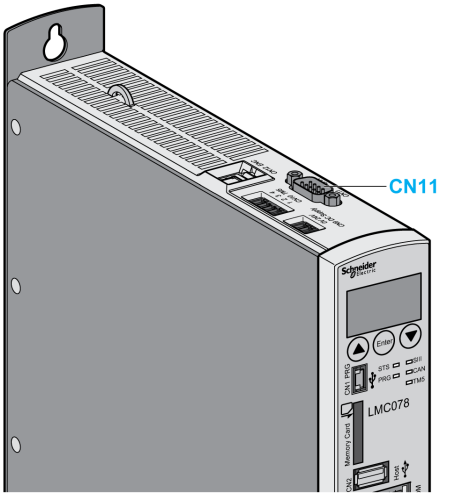
Pin N°	Signal	Description
1	TD+	Transmit data+
2	TD-	Transmit data-
3	RD+	Receive data+
4	-	-
5	-	-
6	RD-	Receive data-
7	-	-
8	-	-

NOTE: The controller supports the MDI/MDIX auto-crossover cable function. It is not necessary to use special Ethernet crossover cables to connect devices directly to this port (connections without an Ethernet hub or switch).

CAN Port

Overview

This illustration presents the location of the CAN port (**CN11**) of the controller:



Characteristics

This table describes the CAN port characteristics:

Characteristic	Description
Standard	CAN-CiA(ISO 11898-2:2002 part 2)[1]
Connector type	Sub-D9, 9 pins male
Protocol supported	CANopen (master/slave)
Maximum number of slaves on the bus	63 CANopen slaves devices
Maximal cable length	Refer to Maximum CANopen cable length table thereafter
Bit rate	Refer to Maximum CANopen cable length table thereafter
Line termination	No. See note[2]
Connector tightening torque	0.4 N.m *(3.54 lbf.in)*

1 Part 1 and part 2 of ISO 11898:2002 are equivalent to ISO 11898:1993.

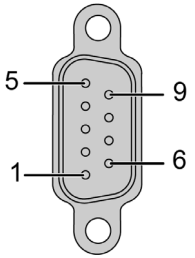
2 A line termination resistor (R) is required to be installed on each end of the CANopen fieldbus.

Maximum CANopen cable length:

Baud rate		1 Mbit/s	800 Kbit/s	500 Kbit/s	250 Kbit/s	125 Kbit/s	50 Kbit/s
Maximum cable length	m	4	25	100	250	500	1000
	ft.	13.12	82.02	328.08	820.20	1640.41	3280.83

Pin Assignment

This illustration describes the pins of the CAN port:



This table describes the pins of the CAN port:

Pin N°	Signal	Description
1	–	Reserved
2	CAN_L	CAN_L bus line (Low)
3	CAN_GND	CAN 0 Vdc
4	–	Reserved
5	–	Reserved
6	GND	0 Vdc
7	CAN_H	CAN_H bus line (High)
8	–	Reserved
9	–	Reserved
-	Shield	To be connected externally to the protective earth

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

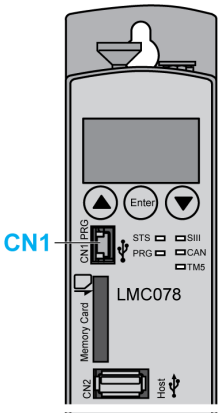
Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N.C.)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

USB Mini-B Programming Port

Overview

This illustration presents the location of the USB mini-B programming port of the controller (**CN1**):



The USB Mini-B port is the programming port you can use to connect a PC with a USB host port using SoMachine software. This connection is suitable for quick updates of the program or short duration connections to perform maintenance and inspect data values. It is not suitable for long-term connections such as commissioning or monitoring without the use of specially adapted cables to help minimize electromagnetic interference.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION OR INOPERABLE EQUIPMENT ● You must use a shielded USB cable such as a BMX XCAUSBH0•• secured to the functional ground (FE) of the system for any long-term connection. ● Do not connect more than one controller at a time using USB connections. ● Do not use the USB port(s), if so equipped, unless the location is known to be non-hazardous. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Characteristics

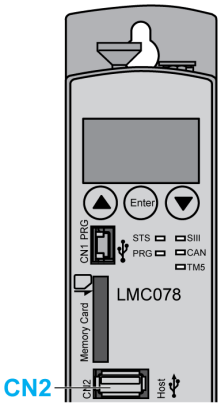
This table describes the characteristics for the USB programming port:

Parameter	USB programming port
Standard	Compatible with USB 2.0
Connector type	Mini-B
Maximum baud rate	115.2 kbps
Protocol supported	SoMachine protocol
Supplied current	No
Maximum cable length	3 m (9.8 ft)
Isolation	None

USB Host Port

Overview

This illustration presents the location of the USB type A host port of the controller (**CN2**):



NOTE: The USB type A host port provides 500 mA continuous current (USB-standard) and 700 mA for short duration current spikes.

The USB host port allows file transfers and memory extension using a USB memory key as a mass storage media.

The USB memory key can be accessed via the FTP or the application.

Characteristics

This table describes the characteristics for the USB host port:

Characteristic	Description
Standard	Hi-speed USB 2.0 host
Connector type	A
Maximum baud rate	480 Mbit/s
Protocol supported	Mass storage
Supplied current	5 Vdc USB standard
Isolation	None

The USB host port supports USB memory key with the following characteristics:

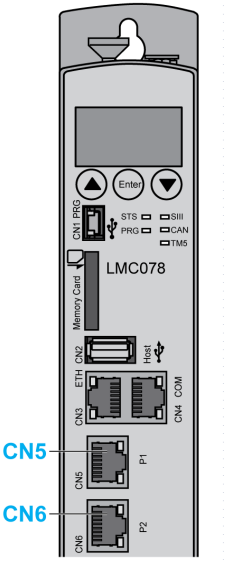
- 512 Mb minimum capacity
- USB 2.0 specification or less
- Formatted in FAT16 or FAT32
- A volume label must be set
- Single partition only

NOTE: Due to the lack of detailed specifications and the variety of typically purchased USB memory keys, even if a particular key appears to conform to these characteristics, it may still be unrecognized by the controller. Therefore, you should first test any given USB memory key to assure that it can be recognized by the controller before investing in large quantities of that key.

Sercos Port

Overview

This illustration presents the location of the Sercos ports of the controller:



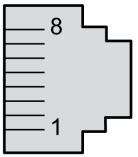
CN5 Sercos, port 1 (**P1**)
CN6 Sercos, port 2 (**P2**)

Characteristics

Characteristic	Description
Standard	Sercos III (Master)
Connector type	RJ45
Supported devices	• Up to 8 LXM32S synchronized at 1 ms • Up to 16 LXM32S synchronized at 2 ms • Up to 24 LXM32S synchronized at 4 ms • Up to 10 TM5NS31 Sercos bus interfaces

Pin Assignment

This illustration presents the pins of the Sercos ports:



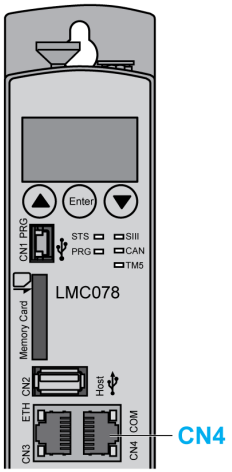
This table describes the pin assignment of the Sercos ports:

Pin	Signal	Description
1	TD+	Transmit data +
2	TD-	Transmit data -
3	RD+	Receive data +
4	-	Reserved
5	-	Reserved
6	RD-	Receive data -
7	-	Reserved
8	-	Reserved

Serial Line Port

Overview

This illustration presents the location of the serial line port of the controller (**CN4** port):



The serial line is used to communicate with devices supporting the Modbus protocol as either master or slave, ASCII protocol (printer, modem...), and SoMachine protocol (HMI,...).

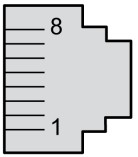
Characteristics

Characteristic	Description
Standard	RS-485 or RS-232 software configured
Connector type	RJ45
Baud rate	300 up to 115 200 bps [1]
Protocol supported	• ASCII • Modbus master/slave (RTU or ASCII) • Modbus master with I/O scanner • SoMachine • Modem serial line
Device power distribution	No

NOTE: [1] The maximum baud rate for the serial line port depends on the protocol used. For further information, refer to Serial Line Configuration *(see Modicon LMC078, Motion Controller, Programming Guide)*.

Pin Assignment

This illustration presents the pins of the **CN4** serial line port:



The table describes the pin assignment for RS-485 connection:

Pin	RS-485 signal	Description
1	-	Reserved
2	-	Reserved
3	-	Reserved
4	D1 (A+)	Modbus D1
5	D0 (B-)	Modbus D0
6	-	Reserved
7	-	Reserved
8	0 Vdc	Common

This table describes the pin assignment for RS-232 connection:

Pin	RS-232 signal	Description
1	TxD	Transmit data
2	RxD	Receive data
3	CTS	Clear to send
4	-	Reserved
5	-	Reserved
6	RTS	Request to send
7	-	Reserved
8	0 Vdc	Common

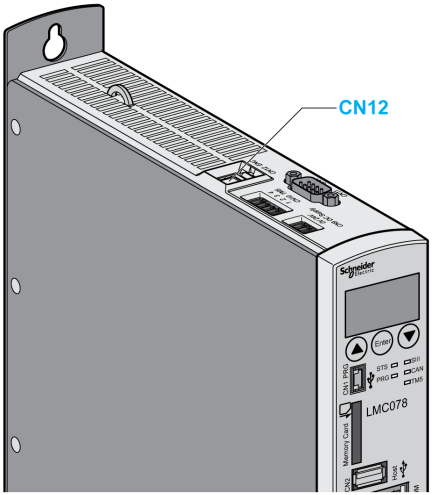
NOTE: These pinouts and those of other controllers may not correspond one to one. Consult the appropriate documentation concerning the pinout assignment of all products involved in your system.

Chapter 5
Encoder Interface

Encoder Interface

Overview

This illustration presents the location of the encoder interface of the controller (**CN12** connector):



Description

The encoder interface supports:

- Hiperface encoder
- Incremental encoder

The encoder interface provides the encoder power supply.

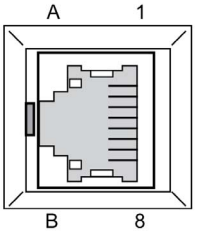
Characteristics

The table presents the characteristics of the encoder interface:

Encoder type	Characteristic	Value
Hiperface	Voltage output	10 V / 200 mA
	Analog channel	0.9...1.1 V_{PP} / 2.2...2.8 V_{offset} (maximum 250 kHz)
	Cable length	≤ 50 m *(164 ft)*
Incremental	Voltage output	5 V / 300 mA
	Level	According to RS422 (maximum 1 MHz)
	Cable length	≤ 50 m *(164 ft)*

Pin Assignment

This illustration describes the pin assignment of the **CN12** connector (RJ45 with 2 additional power supply contacts (A, B)):



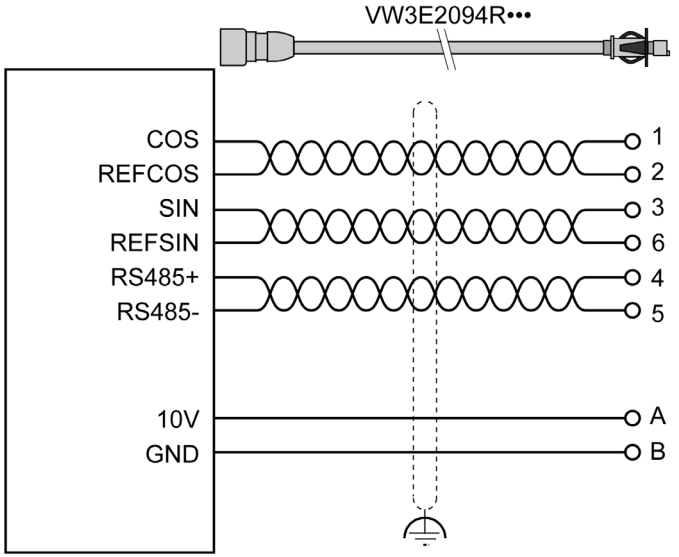
This table describes the encoder interface pins:

Type	Pin	Designation	Description
Hiperface encoder	1	COS	Cosine track
	2	REFCOS	Reference signal cosinus
	3	SIN	Sinusoidal trace
	4	RS485+	Parameter channel +
	5	RS485-	Parameter channel -
	6	REFSIN	Reference signal sine
	7	–	Reserved
	8	–	Reserved
	A	10 Vdc	Encoder supply
	B	GND	Ground

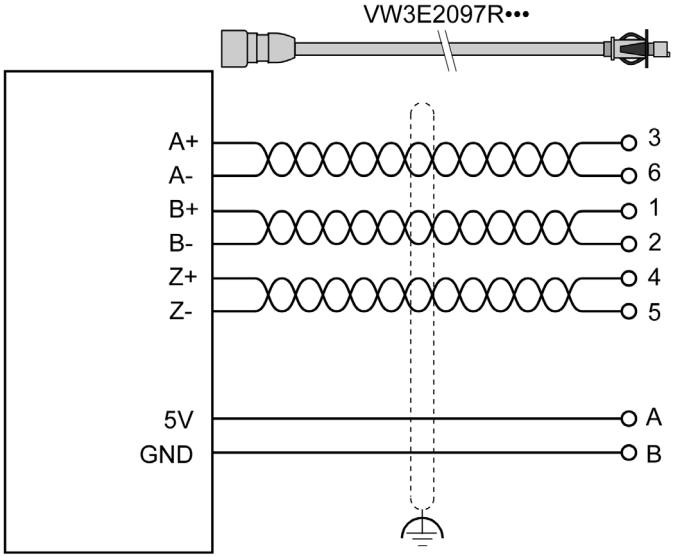
Type	Pin	Designation	Description
Incremental encoder	1	B+	Track signal B+
	2	B-	Track signal B-
	3	A+	Track signal A+
	4	Z+	Track signal Z+
	5	Z-	Track signal Z-
	6	A-	Track signal A-
	7	–	Reserved
	8	–	Reserved
	A	5 Vdc	Encoder supply
	B	GND	Ground

Wiring Diagram

This illustration describes the wiring diagram of an absolute Hiperface encoder mounted on the encoder interface:



This illustration describes the wiring diagram of an incremental encoder (RS422 / 5 Vdc) mounted on the encoder interface:



Chapter 6
Embedded I/O

Introduction

This chapter describes the embedded I/O.

What Is in This Chapter?

This chapter contains the following topics:

Digital Inputs

Overview

The Modicon LMC078 Motion Controller has 12 embedded inputs:

- 4 advanced digital inputs (touchprobe and interrupt inputs): **DI8...DI11**
- 8 digital inputs: **DI0...DI7**

The digital inputs are connected on the **CN7** connector on the front face of the controller.

⚠ DANGER

FIRE HAZARD

Use only the correct wire sizes for the current capacity of the I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Advanced Digital Input Characteristics

This table presents the characteristics of the touchprobe and interrupt inputs:

Characteristic	Value
Number of input channels	4 (DI8...DI11)
Input type	IEC61131-2 Type 1
Logic type	Sink
Rated input voltage	24 Vdc
Range U_{IN} 0 voltage	-3...5 Vdc
Range U_{IN} 1 voltage	15...30 Vdc
Input current	I_{IN} = 4 mA at U_{IN} = 24 Vdc
Polarized	Yes
Input filter	100 µs...4.29 s
Touchprobe resolution	10 µs
Connection	Removable spring terminal block (supplied)
Wire gauge	0.2...1.5 mm² (24...16 AWG)

Digital Input Characteristics

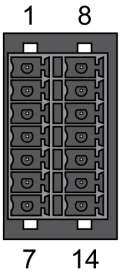
This table presents the characteristics of the digital inputs:

Characteristic	Value
Number of input channels	8 (DI0...DI7)
Input type	IEC61131-2 Type 1
Logic type	Sink
Rated input voltage	24 Vdc
Range U_{IN} 0 voltage	-3...5 Vdc
Range U_{IN} 1 voltage	15...30 Vdc
Input current	I_{IN} = 4 mA at U_{IN} = 24 Vdc
Polarized	Yes
Input filter	100 µs...4.29 s
Connection	Removable spring terminal block (supplied)
Wire gauge	0.2...1.5 mm² (24...16 AWG)

Pin Assignment

The digital inputs are connected on the **CN7** connector on the front face of the controller.

This illustration describes the pin assignment of the connector:



This table describes the pin assignment of the **CN7** connector:

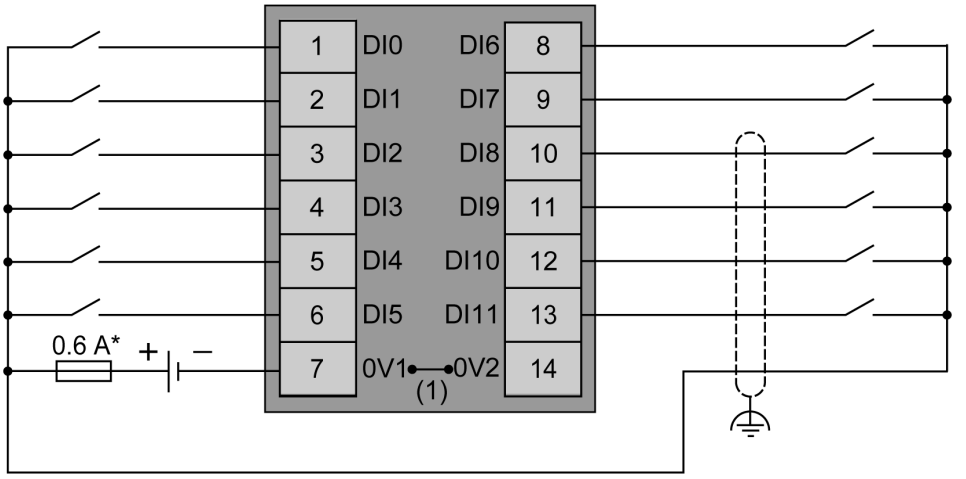
Pin	Label	Description
1	**DI0**	Digital input 0
2	**DI1**	Digital input 1
3	**DI2**	Digital input 2
4	**DI3**	Digital input 3
5	**DI4**	Digital input 4
6	**DI5**	Digital input 5

Pin	Label	Description
7	**0V1**	Reference potential DI0...DI11
8	**DI6**	Digital input 6
9	**DI7**	Digital input 7
10	**DI8**	Advanced digital input 8 (touchprobe/interrupt)
11	**DI9**	Advanced digital input 9 (touchprobe/interrupt)
12	**DI10**	Advanced digital input 10 (touchprobe/interrupt)
13	**DI11**	Advanced digital input 11 (touchprobe/interrupt)
14	**0V2**	Reference potential DI0...DI11

NOTE: The pins 7 and 14 (**0V1** and **0V2**) are connected internally.

Wiring Diagram

This illustration presents the connection of the inputs:



***** Type T fuse

(1) The **0V1** and **0V2** terminals (7 and 14) are connected internally.

Digital Outputs

Overview

The Modicon LMC078 Motion Controller has 8 digital embedded outputs.

The digital outputs are connected on the **CN8** connector on the front face of the controller.

⚠ DANGER

FIRE HAZARD

Use only the correct wire sizes for the current capacity of the I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Digital Output Characteristics

This table presents the characteristics of the digital outputs:

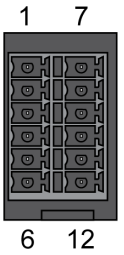
Characteristic	Value
Number of output channels	8 (DQ0...DQ7)
Input type	IEC61131-2 Type 1
Output supply voltage (UL)	24 Vdc (-15% / +25%)
Output voltage	UL-3 V < U_{out} < UL
Rated current	I_e = 500 mA rated per output and 2 A maximum for all outputs at once (for example 8 outputs with 250 mA)
Inrush current	I_{emax} < 2 A for 1 s
Leakage current when switched off	≤ 0.5 mA
Transmission time	< 100 µs
Short circuit protection	Yes
Open circuit protection	Yes
Open load detection	R_{load} > 150 kΩ
Overload detection	$R_{DQ+24\ V}$ - U_{DQx} > 4.0 V

Characteristic	Value
Connection	Removable spring terminal block (supplied)
Wire gauge	0.2...1.5 mm² (24...16 AWG)

Pin Assignment

The digital outputs are connected on the **CN8** connector on the front face of the controller.

This illustration presents the pin assignment of the **CN8** connector:



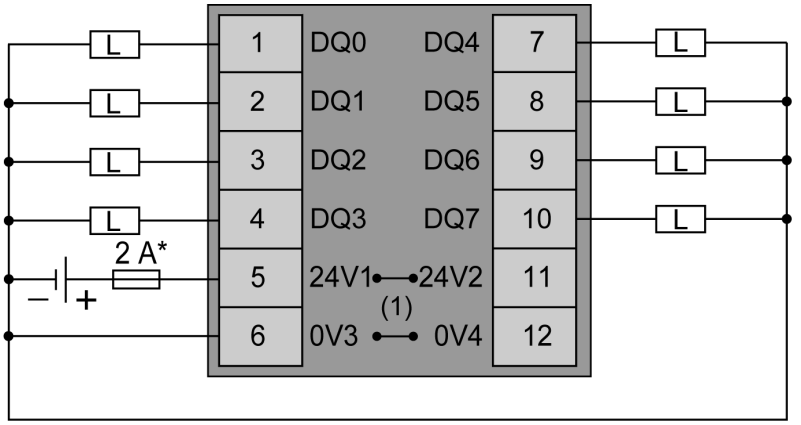
Pin	Label	Description
1	**DQ0**	Digital output 0
2	**DQ1**	Digital output 1
3	**DQ2**	Digital output 2
4	**DQ3**	Digital output 3
5	**24V1**	Supply voltage DQ0...DQ7 (24 Vdc)
6	**0V3**	Supply voltage DQ0...DQ7 (0 Vdc)
7	**DQ4**	Digital output 4
8	**DQ5**	Digital output 5
9	**DQ6**	Digital output 6
10	**DQ7**	Digital output 7
11	**24V2**	Supply voltage DQ0...DQ7 (24 Vdc)
12	**0V4**	Supply voltage DQ0...DQ7 (0 Vdc)

NOTE:
The following terminals are connected internally:

- **24V1** and **24V2**
- **0V3** and **0V4**

Wiring Diagram

This illustration presents the connection of the outputs:



* Type T fuse

(1) The **24V1** and **24V2** terminals (5 and 11) are connected internally. The **0V3** and **0V4** terminals (6 and 12) are connected internally.

The outputs of this equipment do not have built-in reverse polarity protection. Incorrectly connecting polarity can permanently damage the output circuits or otherwise result in unintended operation of the equipment.

NOTICE
DAMAGED OUTPUT CIRCUITS Verify the wiring conforms to the polarity markings on the output connections of this equipment and as described in the related documentation. **Failure to follow these instructions can result in equipment damage.**

Chapter 7
Connecting the Modicon LMC078 Motion Controller to a PC

Connecting the Controller to a PC

Overview

To transfer, run, and monitor the applications, connect the controller to a computer that has SoMachine installed, using either a USB cable or an Ethernet connection.

NOTICE
INOPERABLE EQUIPMENT Always connect the communication cable to the PC before connecting it to the controller. **Failure to follow these instructions can result in equipment damage.**

USB Mini-B Port Connection

TCSXCNAMUM3P: This USB cable is suitable for short duration connections such as quick updates or retrieving data values.

BMXXCAUSBH045: Grounded and shielded, this USB cable is suitable for long duration connections.

NOTE: You can only connect 1 controller to the PC at any one time.

NOTE: The LMC078 Motion Controller must be selected in the Gateway Management Console, accessible by double-clicking the **Gateway Management Console** icon  in the Windows notification area. This option is not selected by default.

The USB Mini-B Port is the programming port you can use to connect a PC with a USB host port using SoMachine software. Using a typical USB cable, this connection is suitable for quick updates of the program or short duration connections to perform maintenance and inspect data values. It is not suitable for long-term connections such as commissioning or monitoring without the use of specially adapted cables to help minimize electromagnetic interference.

⚠ WARNING

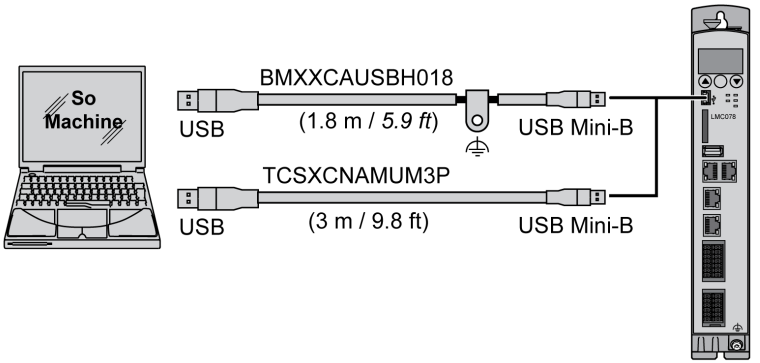
UNINTENDED EQUIPMENT OPERATION OR INOPERABLE EQUIPMENT

- You must use a shielded USB cable such as a BMX XCAUSBH0•• secured to the functional ground (FE) of the system for any long-term connection.
- Do not connect more than one controller at a time using USB connections.
- Do not use the USB port(s), if so equipped, unless the location is known to be non-hazardous.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The communication cable should be connected to the PC first to minimize the possibility of electrostatic discharge affecting the controller.

The following illustration presents the USB connection to a PC:



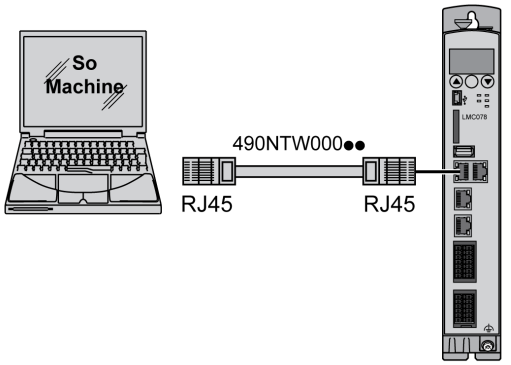
To connect the USB cable to your controller, follow the steps below:

Step	Action
1	**1a** If making a long-term connection using the cable BMXXCAUSBH045, or other cable with a ground shield connection, securely connect the shield connector to the functional ground (FE) or protective ground (PE) of your system before connecting the cable to your controller and your PC. **1b** If making a short-term connection using the cable TCSXCNAMUM3P or other non-grounded USB cable, proceed to step 2.
2	Connect the USB cable connector to the PC.
3	Connect the Mini-B connector of your USB cable to the controller USB connector.

Ethernet Port Connection

You can also connect the controller to a PC using an Ethernet cable.

The following illustration presents the Ethernet connection to a PC:



To connect the controller to the PC, do the following:

Step	Action
1	Connect your Ethernet cable to the PC.
2	Connect your Ethernet cable to the Ethernet port on the controller.

NOTE: The default IP address *(see Modicon LMC078, Motion Controller, Programming Guide)* is 190.201.100.100.

Glossary

A

application

A program including configuration data, symbols, and documentation.

ASCII

(*American standard code for Information Interchange*) A protocol for representing alphanumeric characters (letters, numbers, certain graphics, and control characters).

B

Boot application

(*boot application*) The binary file that contains the application. Usually, it is stored in the controller and allows the controller to boot on the application that the user has generated.

BOOTP

(*bootstrap protocol*) A UDP network protocol that can be used by a network client to automatically obtain an IP address (and possibly other data) from a server. The client identifies itself to the server using the client MAC address. The server, which maintains a pre-configured table of client device MAC addresses and associated IP addresses, sends the client its pre-configured IP address. BOOTP was originally used as a method that enabled diskless hosts to be remotely booted over a network. The BOOTP process assigns an infinite lease of an IP address. The BOOTP service utilizes UDP ports 67 and 68.

bps

(*bit per second*) A definition of transmission rate, also given in conjunction with multiplicator kilo (kbps) and mega (mbps).

C

CANopen

An open industry-standard communication protocol and device profile specification (EN 50325-4).

CFC

(*continuous function chart*) A graphical programming language (an extension of the IEC 61131-3 standard) based on the function block diagram language that works like a flowchart. However, no networks are used and free positioning of graphic elements is possible, which allows feedback loops. For each block, the inputs are on the left and the outputs on the right. You can link the block outputs to the inputs of other blocks to create complex expressions.

CiA

(*CAN in automation*) A non-profit group of manufacturers and users dedicated to developing and supporting CAN-based higher layer protocols.

configuration

The arrangement and interconnection of hardware components within a system and the hardware and software parameters that determine the operating characteristics of the system.

continuous function chart language

A graphical programming language (an extension of the IEC61131-3 standard) based on the function block diagram language that works like a flowchart. However, no networks are used and free positioning of graphic elements is possible, which allows feedback loops. For each block, the inputs are on the left and the outputs on the right. You can link the block outputs to inputs of other blocks to create complex expressions.

controller

Automates industrial processes (also known as programmable logic controller or programmable controller).

CTS

(*clear to send*) A data transmission signal and acknowledges the RDS signal from the transmitting station.

D

DHCP

(*dynamic host configuration protocol*) An advanced extension of BOOTP. DHCP is more advanced, but both DHCP and BOOTP are common. (DHCP can handle BOOTP client requests.)

E

Ethernet

A physical and data link layer technology for LANs, also known as IEEE 802.3.

EtherNet/IP

(*Ethernet industrial protocol*) An open communications protocol for manufacturing automation solutions in industrial systems. EtherNet/IP is in a family of networks that implement the common industrial protocol at its upper layers. The supporting organization (ODVA) specifies EtherNet/IP to accomplish global adaptability and media independence.

F

FB

(*function block*) A convenient programming mechanism that consolidates a group of programming instructions to perform a specific and normalized action, such as speed control, interval control, or counting. A function block may comprise configuration data, a set of internal or external operating parameters and usually 1 or more data inputs and outputs.

FE

(functional Earth) A common grounding connection to enhance or otherwise allow normal operation of electrically sensitive equipment (also referred to as functional ground in North America).

In contrast to a protective Earth (protective ground), a functional earth connection serves a purpose other than shock protection, and may normally carry current. Examples of devices that use functional earth connections include surge suppressors and electromagnetic interference filters, certain antennas, and measurement instruments.

FTP

(*file transfer protocol*) A standard network protocol built on a client-server architecture to exchange and manipulate files over TCP/IP based networks regardless of their size.

function block

A programming unit that has 1 or more inputs and returns 1 or more outputs. FBs are called through an instance (function block copy with dedicated name and variables) and each instance has a persistent state (outputs and internal variables) from 1 call to the other.

Examples: timers, counters

H

HMI

(*human machine interface*) An operator interface (usually graphical) for human control over industrial equipment.

I

I/O

(*input/output*)

IEC 61131-3

Part 3 of a 3-part IEC standard for industrial automation equipment. IEC 61131-3 is concerned with controller programming languages and defines 2 graphical and 2 textual programming language standards. The graphical programming languages are ladder diagram and function block diagram. The textual programming languages include structured text and instruction list.

IL

(*instruction list*) A program written in the language that is composed of a series of text-based instructions executed sequentially by the controller. Each instruction includes a line number, an instruction code, and an operand (refer to IEC 61131-3).

input filter

A special function that helps reject extraneous signals on input lines due to such things as contact bounce and inducted electrical transients. Inputs provide a level of input filtering using the hardware. Additional filtering with software is also configurable through the programing or the configuration software.

IP 20

(*ingress protection*) The protection classification according to IEC 60529 offered by an enclosure, shown by the letter IP and 2 digits. The first digit indicates 2 factors: helping protect persons and for equipment. The second digit indicates helping protect against water. IP 20 devices help protect against electric contact of objects larger than 12.5 mm, but not against water.

L

LD

(*ladder diagram*) A graphical representation of the instructions of a controller program with symbols for contacts, coils, and blocks in a series of rungs executed sequentially by a controller (refer to IEC 61131-3).

M

machine

Consists of several *functions* and/or *equipment*.

Modbus

The protocol that allows communications between many devices connected to the same network.

P

PE

(*Protective Earth*) A common grounding connection to help avoid the hazard of electric shock by keeping any exposed conductive surface of a device at earth potential. To avoid possible voltage drop, no current is allowed to flow in this conductor (also referred to as *protective ground* in North America or as an equipment grounding conductor in the US national electrical code).

Profibus DP

(*Profibus decentralized peripheral*) An open bus system uses an electrical network based on a shielded 2-wire line or an optical network based on a fiber-optic cable. DP transmission allows for high-speed, cyclic exchange of data between the controller CPU and the distributed I/O devices.

program

The component of an application that consists of compiled source code capable of being installed in the memory of a logic controller.

protocol

A convention or standard definition that controls or enables the connection, communication, and data transfer between 2 computing system and devices.

R

RTC

(*real-time clock*) A battery-backed time-of-day and calender clock that operates continuously, even when the controller is not powered for the life of the battery.

RTU

(*remote terminal unit*) A device that interfaces with objects in the physical world to a distributed control system or SCADA system by transmitting telemetry data to the system and/or altering the state of connected objects based on control messages received from the system.

RxD

The line that receives data from one source to another.

S

Sercos

(*serial real-time communications system*) A digital control bus that interconnects, motion controls, drives, I/Os, sensors, and actuators for numerically controlled machines and systems. It is a standardized and open controller-to-intelligent digital device interface, designed for high-speed serial communication of standardized closed-loop real-time data.

SFC

(*sequential function chart*) A language that is composed of steps with associated actions, transitions with associated logic condition, and directed links between steps and transitions. (The SFC standard is defined in IEC 848. It is IEC 61131-3 compliant.)

SNMP

(*simple network management protocol*) A protocol that can control a network remotely by polling the devices for their status and viewing information related to data transmission. You can also use it to manage software and databases remotely. The protocol also permits active management tasks, such as modifying and applying a new configuration.

ST

(*structured text*) A language that includes complex statements and nested instructions (such as iteration loops, conditional executions, or functions). ST is compliant with IEC 61131-3.

T

touchprobe input

Touchprobe inputs are advanced digital inputs. These inputs are used for measuring functions, which accurately detect positions relative to a measure input. Once a touchprobe function has been activated, it runs independently in the system, independent of the IEC program. The IEC program can use parameters to detect the state of the measuring function. This function is supported by hardware and software.

TxD

The line that sends data from one source to another.

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