

Quantum with Unity Pro

141 MMS 425 01, 141 MMS 535 02

SERCOS Multi-Axis Motion Controller

User Manual

10/2014

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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.

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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, 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

This documentation acquaints you with the SERCOS Multi-Axis Motion Controller. It describes the motion controller, the setup, and installation, and the mechanical and interface specifications, the operational specifications, and the electrical specifications.

Validity Note

This documentation is valid for Unity Pro V8.1 or later.

Related Documents

Title of Documentation	Reference Number
Modicon Modbus Plus Network, Planning and Installation Guide	31003525
MMF Programming Overview Guide	890USE11300
M100S Series Servo Drive User Guide	890USE11400
Cyberline 1000S SERCOS Drive User Guide	GI-CYBL-005
Cyberline 1000A System Design and Installation Manual	GI-CYBL-002
Modicon Servo Motor Kit	890USE13900

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

Chapter 1

Product Description

Introduction

This chapter presents a product overview of the Quantum SERCOS multi-axis motion controller.

What Is in This Chapter?

This chapter contains the following topics:

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Controller Overview

General Description

The Quantum SERCOS multi-axis motion controller is a Quantum Automation Series CPU expanded to a double width housing to allow inclusion of a SERCOS link:



The controller itself is an embedded PC, running Microsoft DOS 5.0. The controller's memory areas and processor are designed to mirror a standard PC.

Model Differences

The controller is available in two models that support various motion network requirements:

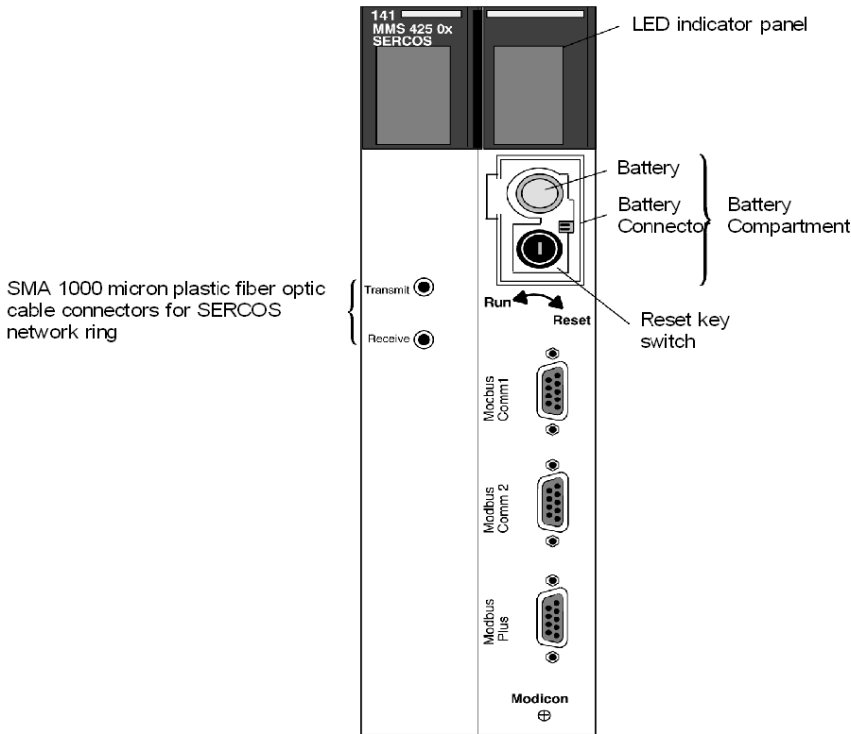
- 141MMS42501: includes a 486, DX2 processor that runs at 66 mHz
- 141MMS53502: includes an expanded memory capability and a 586, DX5 processor with a speed of 133 mHz that allows you to run more extensive applications, such as high-axis count or large data applications.

The differences between the two models are described at Quantum SERCOS System Specifications ([see page 31](#)).

Controller Components

Front View

The front of the controller, shown in the following figure, contains the LED indicator panel, the battery compartment, three communications ports, and two fiber optic cable connectors:



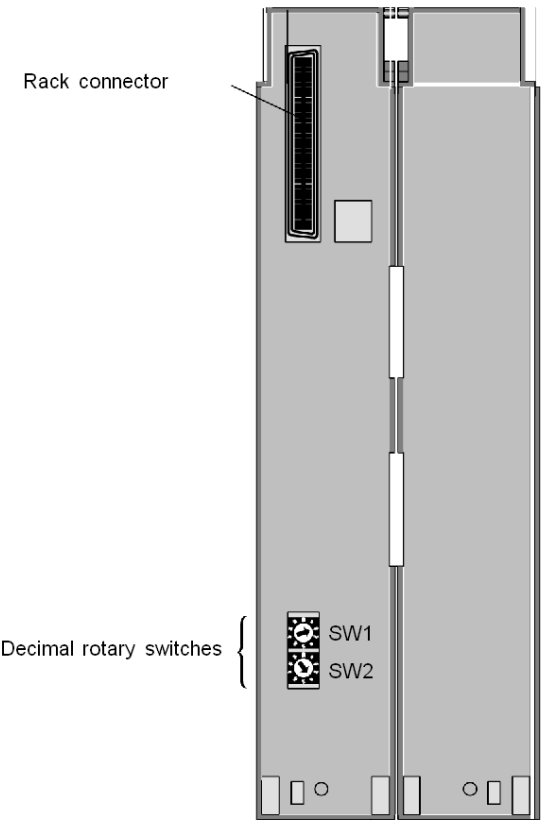
NOTE: Controller shown with door removed

The table describes the front panel components:

Component	Description of Function
LED indicator panel	Indicates the operating status of the controller and the fiber optic and Modbus communications networks it is connected to. (See LED Indicators (see page 14).)
Battery	Supplies backup power to the controller's volatile SRAM. (See Replacing the Battery (see page 25).)
Battery connector	Connects the battery to the controller and allows for easy replacement of the battery
Reset key switch	Reinitializes the controller when operated by the companion key. (See the instructions for resetting the controller (see page 27).)
Transmit connector	Provides a receptacle for the fiber optic cable TX connector on a SERCOS network ring.
Receive connector	Provides a receptacle for the fiber optic cable RX connector on a SERCOS network ring.
Modbus Comm 1 port	Provides a nine-pin RS 232 D-shell female connector that can serve as either a Modbus port or a standard serial port. When used as a Modbus port, the controller can serve as either a master or slave.
Modbus Comm 2 port	Provides a nine-pin RS 232 D-shell female connector that can serve as either a Modbus port or a standard serial port.
Modbus Plus port	Provides a nine-pin RS 232 D-shell female connector that supports a single-cable Modbus Plus network

Rear View

The back of the controller, shown in the following figure, contains the rack connector and two decimal rotary switches:



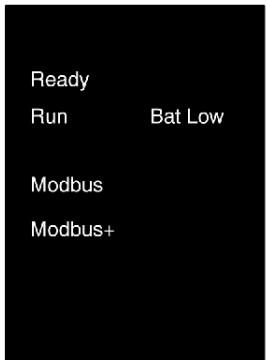
The following table describes the controller's rear side components:

Component	Description of Function
Rack connector	A 68-pin socket that connects the controller to a Quantum rack. (See Installing the Controller (see page 23).)
Decimal rotary switches	Two rotary switches used to set the controller's address on a Modbus Plus network. (See Setting the Modbus Plus Network Address (see page 22).)

LED Indicators

LED Indicator Panel

The LED indicator panel provides continuous operating information regarding the controller and its associated networks:



Each indicator is only visible when its associated LED is energized.

Indicator Descriptions

The functions of the LED indicators are described in the following table.

LED Indicator	Description of Function
Ready	Lights green to indicate that the controller is powered up and operating properly. Blinks during power-up if the controller detects a problem.
Run	Lights green when the SERCOS fiber optic network ring is operating properly.
Bat Low	Lights red when the battery voltage is low or is not present.
Modbus	Lights green when Modbus communication is active and functioning properly.
Modbus+	Blinks continuously at a rate of six times per second during normal Modbus Plus network operation. Blinks at various rates to indicate network detected error conditions, for more details refer to the Modbus Plus Network Planning and Installation Guide (see page 7).

Interfaces and Product Compatibility

Rack Requirements

Depending on the type of CPU used in the PLC master module, two to six Network Option Modules (NOM) that communicate via the NOM protocol can be installed in a Quantum rack. The Quantum SERCOS multi-axis motion controller operates as one of the allowed NOM modules on the rack. It takes up two slots in the rack and can be installed in any location.

For additional information regarding rack and backplane applications, refer to the Modicon TSX Quantum Automation Series Hardware Reference Guide, 840 USE 100 00.)

CAUTION

LOSS OF DATA

Do not hot swap the Quantum SERCOS multi-axis motion controller. Hot-swapping the controller may produce corrupted data on the C: drive.

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

Power Interface

The Quantum SERCOS multi-axis motion controllers require different amounts of power from the Quantum rack:

- 141MMS42501: 2.5 A
- 141MMS53502: 3.0 A

SERCOS Network Data Rate

The SERCOS network protocol accommodates two different data rates depending on the address assignments of the Cyberline drive axes on the network.

- A rate of 2 MBaud for axis addresses 1 ... 50
- A rate of 4 MBaud for axis addresses 51 ... 99

Communications Port Interfaces

The three communication ports ([see page 11](#)) supplied with the Quantum SERCOS multi-axis motion controller allow you to interface with a variety of devices. The Modbus Plus port provides access to a host of diverse Modicon products over the Modbus Plus network. The two Modbus communication ports (Comm 1 and Comm 2) can serve as either Modbus ports or as standard RS 232 ports.

Controller Processor Boards

Overview

The Quantum SERCOS multi-axis motion controller contains three printed circuit boards. Each board plugs in to connectors on the module's internal ISA interface. A brief description of each board is given below.

Processor Board

The processor board contains the microprocessor, memory area, A and C drives, and associated control circuits. This board, in essence, contains all the features of a standard PC.

Interface Board

The interface board carries the communication circuits for the three communication ports and for the backplane. It also contains the digital rotary switches for Modbus Plus network addressing, the battery compartment, and reset switch.

SERCOS Board

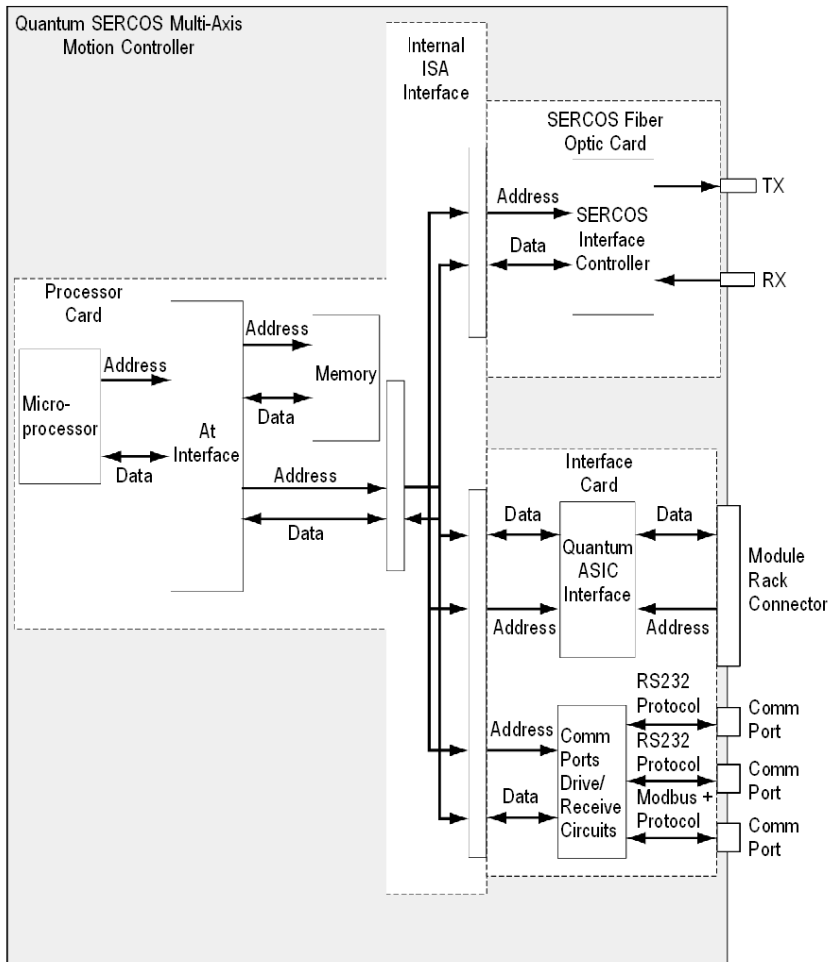
The SERCOS board carries the fiber optic receive and transmit circuits for communication with the Cyberline servo drives. The TX (transmit) and RX (receive) fiber optic connector receptacles are mounted on this board.

Backplane Interface to Controller

The module plugs into the Quantum rack via a 68-pin socket attached to the rear of the interface board. Address and data information to/from the three printed circuit boards is facilitated via the internal ISA interface. In addition, address and data information is distributed to/from the PLC via the backplane connector on the Quantum rack.

Block Diagram

The figure shows a functional block diagram of the Quantum SERCOS multi-axis motion controller module:



Controller Drive/Memory Areas

Introduction

The memory and storage areas in the motion controller are designed to mirror a PC with the exception that the controller's A: and C: drives are actually part of the memory and not physical drives like a PC. The flash memory is the controller's A: drive, and the SRAM is the controller's C: drive. Dynamic RAM, which is comparable to the conventional memory in a PC, is the controller's third storage area. This design makes for:

- Easy storage
- Power up like a standard PC
- Booting via a customized BIOS
- An MS-DOS environment on the controller
- Easy communication with other automation components

The motion controller's three memory areas are described below.

A: Drive (Read-Only Flash Memory)

The read-only flash memory is configured as the controller's A: drive. It is initialized at the factory and contains several system files, including the MS/DOS command processor (COMMAND.COM), configuration and initialization files, DOS disk formatting and checking utilities, and a line editor.

C: Drive (SRAM Memory)

The read/write, battery backed, static RAM (SRAM) memory area in the motion controller is known as the C: drive. It emulates and interacts with the user like the hard-disk C: drive in a PC. Unlike the controller's read-only A: drive, you can write data to the C: drive. It is shipped to you unformatted and you must format it with Modicon's Quantum Advanced Motion Operating System (AMOS) before you can download your motion application programs. See the MMF Programming Overview Guide, 890 USE 113 00, for information on installing AMOS.

The controller's battery ensures that files stored in the volatile C: drive are maintained in the event of a power outage or power cycle.

NOTE: If it becomes necessary to restore an application program, be aware that the restoration process will automatically reformat the C: drive and overwrite AMOS with the version that was on the controller when the backup was performed.

Dynamic RAM Memory

The motion controller's dynamic RAM memory is comparable to the memory (conventional, extended, and upper) in a PC. It is used to run AMOS and your motion application programs.

Holding Registers

The Quantum SERCOS multi-axis motion controller provides non-volatile holding register memory for communication with other external devices. See the MMF Programming Overview Guide (890 USE 113 00) for information on the use of the controller's holding registers.

Memory Configurations

The table presents the memory capacities for the SERCOS multi-axis motion controllers:

Memory Type		141MMS42501	141MMS53502
Drive A (read only)		500 kbytes	500 kbytes
Drive C (read & write)		2000 kbytes	4000 kbytes
Dynamic RAM	Conventional	640 kbytes	640 kbytes
	Extended	7168 kbytes	7168 kbytes
	Upper	384 kbytes	384 kbytes
Holding Register		10,000 words	60,000 words

Chapter 2

Setup and Installation

Introduction

This chapter describes how to set the Modbus Plus network address, install the SERCOS multi-axis motion controller in a Quantum rack, replace the battery, and reset the controller.

What Is in This Chapter?

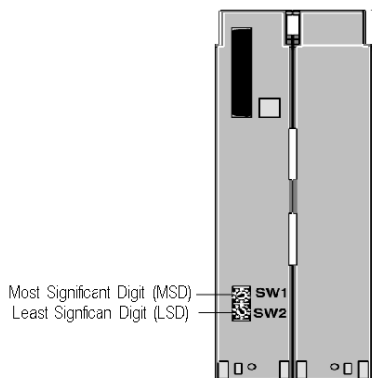
This chapter contains the following topics:

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Setting the Modbus Plus Network Address

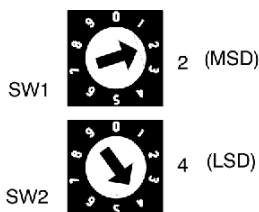
Switch Settings for Modbus Plus

Each device on a Modbus Plus network must be assigned a unique address in the range 01...64. Two decimal rotary switches are located on the back of the Quantum SERCOS multi-axis motion controller:



Setting the Controller's Address

Switch SW1 (the top switch) sets the most significant digit (tens) and SW2 (the bottom switch) sets the least significant digit (ones) of the Modbus Plus address. In the following figure, the switches are set to a Modbus Plus address of 24:



NOTE: Setting the switches to a value of 00 or any value greater than 64 is not allowed. If you do so, an illegal Modbus Plus address error will be generated and the Modbus+ indicator on the LED indicator panel will light steadily.

NOTE: Schneider Electric recommends that you reserve address 64 for future network maintenance. Be aware that address 1 is often used as the default address of the controller node's programming panel.

Installing the Controller

Quantum Rack

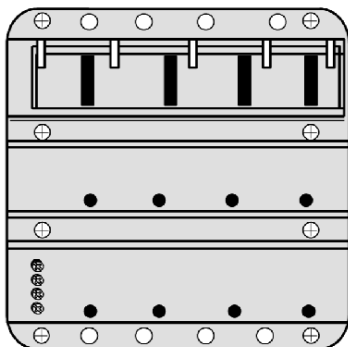
Characteristics of Quantum racks:

- Quantum racks are mechanically secure and electrically connect all modules that are mounted to them.
- A Quantum rack contains a passive circuit board that permits modules to communicate across the backplane and identify their slot numbers without further switch settings.
- Quantum racks are available in six different sizes ranging from 2 to 16 slots.

NOTE: For more information about Quantum rack assemblies refer to Appendix C in the Modicon TSX Quantum Automation Series Hardware Reference Guide (840 USE 100 00).

Quantum Four-Slot Rack

The Quantum SERCOS multi-axis motion controller is a double-width Quantum module that can be inserted into any two slots in a Quantum rack. Since a Quantum power supply must fill one slot, a three-slot rack is the minimum size required for the motion controller if no optional PLC is planned. A four-slot rack is necessary when an optional PLC is included:



Schneider Electric recommends that the Quantum power supply be installed in the first or last slots in the rack.

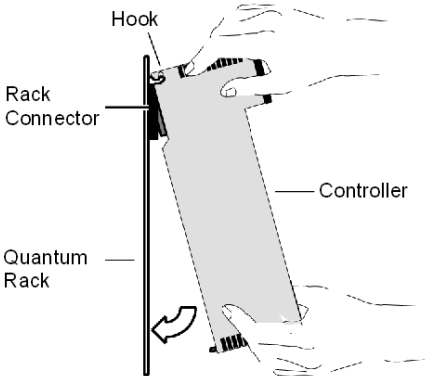
Before Installation

Before you install the controller:

- Choose a rack in which to mount the controller. Ensure that two adjacent slots are available in the rack.
- You need a medium-sized Phillips head screwdriver.

Mounting the Controller on the Rack

To mount the SERCOS multi-axis motion controller in a Quantum rack:

Step	Action
1	<p>Hold the module at an angle and mount it on to the two hooks located near the top of the rack:</p> 
2	<p>Swing the module down so its connector engages the rack connector.</p>
3	<p>Using a Phillips head screw driver, tighten the screw at the bottom of the module between 2 and 4 in-lbs of torque.</p>

The Battery

About the Battery

A non-rechargeable lithium backup battery is located in the battery compartment housing, which is mounted to the interface board. It is accessible from the front of the controller ([see page 11](#)). The battery maintains the volatile SRAM memory when power is removed from the Quantum SERCOS multi-axis motion controller. Typically, the battery can maintain power to the SRAM memory for up to six months with no power applied to the controller.

The Bat Low LED

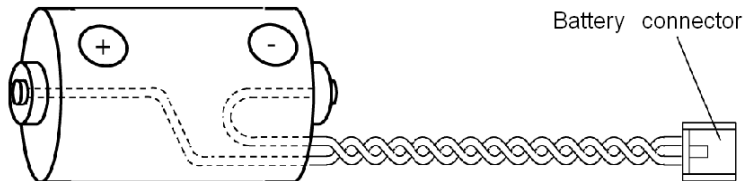
The red **Bat Low** indicator on the LED panel will light when:

- the battery charge is low
- a replacement battery is needed
- the battery is not present in the controller

NOTE: The battery should be changed within seven days from the time the **Bat Low** LED comes on. Read and follow the Battery Replacement Procedure, described below, to avoid loss of data from occurring to the controller's storage areas.

Part Number

Your Schneider Automation supplier carries replacement batteries under part number 043502625:



Remove the new battery from its packing bag and proceed with the following installation instructions.

Battery Replacement

Follow these instructions to remove the old battery and install the new one.

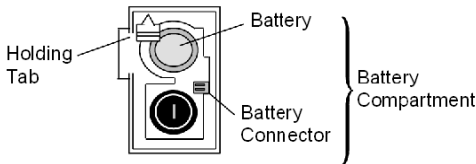
⚠ CAUTION

LOSS OF DATA

Ensure that power is applied to the controller before replacing the battery. Replacing the battery while power is removed from the controller results in corrupted programs and lost data on the C: drive and in the 4x holding registers.

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

Replace the old battery with a new one:

Step	Action
1	Open the door on the front of the controller to expose the battery compartment 
2	Push upward on the holding tab in the battery compartment and slide the battery out of the housing.
3	Unplug the battery connector from the two-pin socket located just above the reset switch.
4	Set the old battery aside.
5	Plug the new battery's connector into the two-pin socket in the battery compartment housing.
6	Insert the plus (+) terminal end of the new battery into the housing and slide it all the way in until the holding tab engages.
7	Dispose of the old battery in accordance with local requirements.

Ensure that the battery has been replaced properly:

Step	Action
1	Check the Bat Low indicator on the LED panel.
2	If the indicator is still lit, check whether the battery is backwards (see Step 6 in the preceding procedure).
3	If the battery is installed correctly, and the Bat Low indicator remains on, remove the existing battery and replace it with a known good battery.
4	If the problem still persists, contact your Schneider Automation customer representative.

Resetting the SERCOS Multi-Axis Motion Controller

Using the Reset Key Switch

Your motion controller is designed so that it can be reset in much the same manner as a PC, that is, using the reset button to reboot the system. In the case of your controller, the reset button is replaced by a key. Actually, you should have received two identical keys (the second one is a spare) packaged with your controller.

Use the key to reinitialize the system software, when necessary, without removing and reapplying (cycling) the power to the controller.

Resetting the Controller

To reset the controller, proceed as follows

Step	Action
1	Open the door on the front of the controller.
2	Insert the key into the reset key switch located in the battery compartment. <div data-bbox="463 701 934 967" data-label="Image"> <p>The diagram shows a rectangular battery compartment. At the top is a circular battery. Below it is a circular reset key switch. A bracket on the right side of the compartment is labeled 'Battery Compartment'. An arrow points from the text 'Reset key switch' to the key switch. Another arrow points from the text 'Run' to the top of the key switch, indicating its original position. A curved arrow points from the 'Run' position down to the 'Reset' position, which is indicated by a small 'I' symbol inside the key switch.</p> </div>
3	Turn the key clockwise 90 degrees to its reset position.
4	Turn the key counterclockwise 90 degrees back to its original run position.
5	Remove the key from the reset key switch.

About the Key

NOTE: Return the key to its run position immediately after turning it to the reset position, otherwise the system will continuously reboot.

NOTE: Do not use the reset key switch to boot the system after upgrading the BIOS. A BIOS upgrade requires a complete power cycle (removing and then reapplying power to the controller) and cannot be accomplished with the reset key switch.

Appendices



Appendix A

Appendix

Introduction

This chapter contains the system specifications for SERCOS multi-axis motion controllers.

What Is in This Chapter?

This chapter contains the following topics:

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Mechanical & Interface Specifications

Mechanical Interface Table

This table lists the SERCOS multi-axis motion controller's mechanical and interface specifications.

Mechanical Feature	Specification
Assembly	Dual-Width Quantum Slot
Connectors	Two SERCOS fiber optic connectors: TX (transmitter) RX (receiver)
	Three DB9 (nine-pin) connectors: Modbus Comm 1Modbus Comm 2Modbus Plus
Switches	Two BCD rotary switches (Modbus Plus node addresses 1 ... 64)

System Interface Specifications

System interfaces for the SERCOS multi-axis motion controller are described in the table below.

System Interface	Description
SERCOS communication interface	Can be configured for any (1 254) servo drive-axis address. Supports fiber-optic based SERCOS protocol operating at 2 or 4 Mbaud.
Quantum backplane interface	As a network option module (NOM).

Operational Specifications

Operational Specifications Tables

Operational Specifications for both models of the SERCOS multi-axis motion controller are given in the table below:

Controller Features	Controller Model Specifications	
	141MMS42501	141MMS53502
Processor	486DX2 66 mHz	586DX5 133 mHz
DOS	MS ROM DOS 5.0	MS ROM DOS 5.0
Conventional memory	640 kbytes	640 kbytes
Extended memory	7,168 kbytes	7,168 kbytes
Drive A (read only)	500 kbytes	500 kbytes
Drive C (read & write)	2,000 kbytes	4,000 kbytes
Non-volatile memory	10,000 words	60,000 words

SERCOS Protocol Capacities Table

SERCOS protocol capacities common to both controller models are described in the following table:

SERCOS Protocol Capacities—common to both controller modules	
Addresses	1 254
Baud rate	2 or 4 Mbaud (software configurable)
Cycle time	1...15 msec, configurable 2 ms for 8 axes, typical
Rings	1

Electrical Specifications

Electrical Specifications Tables

Electrical specifications for the SERCOS multi-axis motion controller are described in the following table.

Electrical Feature	Specification	
Power Requirements	From Quantum backplane	
	141MMS42501	141MMS53502
	+ 5V at 2.5 A maximum	+ 5V at 3.0 A maximum
Optical light output reception	Conforms to SERCOS specification	
Battery	Non-rechargeable lithium battery that maintains volatile SRAM memory for up to 6 months. Assembly part number 043502625	

Electromagnetic Specifications Table

Electromagnetic specifications for the SERCOS multi-axis motion controller are described in the following table.

Electromagnetic Susceptibility Feature	Reference	Industrial
Radiated noise emission	N/A	Factory floor exempt
Transient surge	IEC 801-5 (level 2)	0.5 kV surge, comm. ports 2.5 kV shield to ground 2.0 kV common, 1kV normal
Fast transients	IEC 801-4	MB: 0.5 kV MB+, SERCOS 2 kV Through pwer supply 2 kV
Surge withstand (ringwave)	IEC 255 (IEEE) 472)	2.5 kV inductive coupled
Electrostatic discharge	IEC 801-2	8 kV, air, 10 discharges 4 kV, contact, 10 discharges 8 kV, horizontal & vertical coupling planes
Ringwave	IEC 255	2 kV



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