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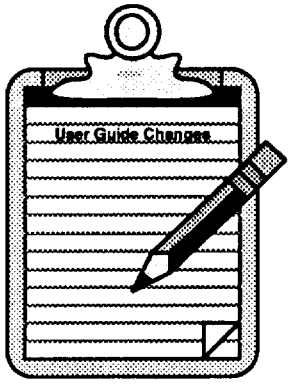
CX Indexer/Drive
User Guide

Compumotor Division
Parker Hannifin Corporation
p/n 88-005939-04 A May 7, 1993

Parker

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U S E R G U I D E C H A N G E S U M M A R Y



The following is a summary of the primary changes to this user guide since the last version was released. This user guide, version 88-005939-04A, supersedes version 88-005939-04Y.

The entire user guide has been changed according to the new Compumotor user guide styles and illustration standards. Also, the chapters have been renumbered and reorganized.

Chapter 1. Introduction

Changes to Chapter 1 are summarized as follows:

- ❑ New voltage requirements (CX and CXT Drives)
- ❑ Updated product features
- ❑ New theory of operation section

Chapter 2. Getting Started

Changes to Chapter 2 are summarized as follows:

- ❑ New and updated system connection procedures
- ❑ New factory default jumper settings
- ❑ Additional jumper-selectable motor resolutions
- ❑ Ship kit changes

Chapter 3. Installation

Changes to Chapter 3 are summarized as follows:

- ❑ All optional jumper settings moved to Chapter 2
- ❑ New drive mounting guidelines
- ❑ Added guidelines for coupling the load to the motor

Chapter 4. Software Reference

Changes to Chapter 4 are summarized as follows:

- ❑ Complete list of all X commands, with syntaxes and descriptions

Chapter 5. Hardware Reference

Changes to Chapter 5 are summarized as follows:

- ❑ Added default jumper settings
- ❑ Added CX and CXT Series motor specifications
- ❑ New system pinouts and connector illustrations
- ❑ Updated Compumotor motor cable color codes
- ❑ Updated drive dimensional drawings (refer to catalog for motor dimensional drawings)
- ❑ Removed speed/torque curves (refer to the catalog)
- ❑ Removed options jumper settings (refer to Chapter 2)
- ❑ System specifications updated to show new input power requirements and available resolutions.

Chapter 6. Maintenance & Troubleshooting

Changes to Chapter 6 are summarized as follows:

- ❑ New list of suggested spare parts
- ❑ New drive and motor maintenance information
- ❑ New troubleshooting methods
- ❑ New procedures for returning the system to affect repairs or upgrades

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O V E R V I E W

How To Use This User Guide

This user guide is designed to help you install, develop, and maintain your system. Each chapter begins with a list of specific objectives that should be met after you have read the chapter. This section is intended to help you find and use information in this manual.

Assumptions

This user guide assumes that you have the skills or fundamental understanding of the following information.

- ❑ IBM (or IBM-compatible) computer experience
- ❑ Basic electronics concepts (voltage, switches, current, etc.)
- ❑ Basic motion control concepts (torque, velocity, distance, force, etc.)

With this level of understanding, you can effectively use this manual to install, develop, and maintain your system. You can get information about basic motion control concepts by referring to the current Parker Compumotor Motion Control Catalog.

Contents of This User Guide

This user guide contains the following information.

Chapter ① Introduction — This chapter provides a description of the product and a brief account of its specific features.

Chapter ② Getting Started — This chapter contains a list of items you should have received with your shipment. It will help you become familiar with the system and ensure that each component functions properly. You will configure the system properly in this chapter.

Chapter ③ Installation — This chapter will help you properly mount the system and make all electrical and non-electrical connections. Upon completion of this chapter, your system should be completely installed and ready to perform basic operations.

Chapter ④ Application Design — This chapter will help you customize the system to meet your application's needs. Important application considerations are discussed. Sample applications are provided.

Chapter ⑤ Software Reference — This chapter explains Compumotor's X-Series programming language in detail. It describes command syntax and system parameters that affect command usage. An alphabetical list of all commands, with a syntax and command description for each command is included.

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Chapter ⑥ Hardware Reference	This chapter contains information on system specifications (dimensions and performance). This chapter is as a quick-reference tool for proper switch settings and I/O connections.
Chapter ⑦ Maintenance & Troubleshooting	This chapter describes Compumotor's recommended system maintenance procedures. It also provides methods for isolating and resolving hardware and software problems.

Process Overview

To ensure trouble-free operation, you should pay special attention to the environment in which the CX Indexer/Drive equipment will operate, the layout and mounting, and the wiring and grounding practices used. These recommendations are intended to help you easily and safely integrate CX Indexer/Drive equipment into your facility. Industrial environments often contain conditions that may adversely affect solid state equipment. Electrical noise or atmospheric contamination, may also affect the CX Indexer/Drive System.

Developing Your Application

Before you develop and implement your application, there are several issues that you should consider and address.

- ❑ Clarify the requirements of your application. Clearly define what you expect the system to do.
- ❑ Assess your resources and limitations. This will help you find the most efficient and effective means of developing and implementing your application.
- ❑ Follow the guidelines and instructions outlined in this user guide. Do not skip any steps or procedures. Proper installation and implementation can only be ensured if all procedures are completed in the proper sequence.

Installation Procedures

Before you attempt to install this product, you should complete the following steps:

① Review this entire user guide. Become familiar with the manual's contents so that you can quickly find the information you need.

② Develop a basic understanding of all system components, their functions, and interrelationships.

③ Complete the basic system configuration and wiring instructions provided in *Chapter 2, Getting Started.*

④ Perform as many basic moves and functions as you can with the preliminary configuration. You can only perform this task if you have reviewed the entire user guide. You should try to simulate the task(s) that you expect to perform when you permanently install your application (however, do not attach a load at this time). This will give you a realistic preview of what to expect from the complete configuration.

⑤ After you have tested all of the system's functions and used or become familiar with all of the system's features, carefully read *Chapter 3, Installation.*

⑥ After you have read *Chapter 3, Installation and* clearly understand what must be done to properly install the system, you should begin the installation process. Do not deviate from the sequence or installation methods provided.

⑦ Before you begin to customize your system, check all of the system functions and features to ensure that you have completed the installation process correctly.

The successful completion of these steps will prevent subsequent performance problems and allow you to isolate and resolve any potential system difficulties before they affect your system's operation.

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Related Publications

The following publications may be helpful resources.

The current Parker Compumotor Motion Control Catalog. The catalog is available from Parker Compumotor at (800) 358-9068 or (707) 584-7558.

Schram, Peter (editor). The National Electric Code Handbook (*Third Edition*). Quincy, MA: National Fire Protection Association.

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C H A P T E R ①

Introduction

Chapter Objectives

The information in this chapter will enable you to:

- ❑ Understand the product's basic functions & features
- ❑ Understand basic motion control concepts and apply them to your application

Product Description

The CX Indexer/Drive combines a 12,800 step/rev microstepping drive and a complete indexer with an RS-232C interface in a single, small package. The CX Indexer/Drive will operate with almost any standard size 23, 34, or 42 hybrid step motor and requires an external power supply. Both motor and power supply may be supplied by the user or Compumotor. The built-in indexer features: RS-232C interface, 71 commands, a daisy-chain capacity for up to 8 devices, user selectable microstepping waveform for optimal smoothness with all motors, 2K bytes non-volatile program memory for storing up to 7 multiple move sequences.

Product Features

- ❑ Compact (4.1" by 6.5" x 3.2 inch) enclosure with drive, indexer, and integral heatsink
- ❑ Advanced 20Khz pulse width modulated amplifiers capable of 5 amps/phase at supply voltages from 12 to 90V
- ❑ Torques up to 700 oz/in
- ❑ Jumper selectable motor current from 0.15 to 5 amps/phase (unipolar)
- ❑ High resolution microstepping provides high accuracy and smooth low speed operation with standard 1.8 degree hybrid step motor.
- ❑ High speed operation to 3,000 rpm
- ❑ Fully short circuit, overtemperature, and undervoltage protected
- ❑ Operates with virtually any 6 or 8 lead hybrid step motor provided by Compumotor or the user
- ❑ Sequence execution can be initiated by external switches, computer, or programmable controller
- ❑ Sequence upload, download, and memory verify
- ❑ Optically isolated home and end-of-travel limit inputs

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Theory of Operation

Compumotor's X series combines the functions of an indexer and drive in one compact system loaded with features. The CX Series is designed to control brushless 1.8° hybrid step motors. The Indexer/Drive is capable of storing multiple move motion program in an non-volatile (EEPROM) memory. Any of the seven programs can be selected in a variety of ways including BCD switches, programmable controllers or a computer via the RS-232C interface. The CX Series uses the same programming language as our other indexers. Not only is the language flexible, but also proven and debugged. Commands are entered on a simple three wire RS-232C interface from a computer programmable controller or any RS-232C device.

A choice of input devices, all-digital drives, and a proven command language all add up to the most complete versatile programmable stepper control system available anywhere.

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C H A P T E R ②

Getting Started

Chapter Objectives

The information in this chapter will enable you to:

- ❑ Verify that each component of your system has been delivered safely
- ❑ Become familiar with system components and their interrelationships
- ❑ Ensure that each component functions properly
- ❑ Configure the system properly

What You Should Have

Inspect your CX Indexer/Drive shipment upon receipt for obvious damage to its shipping container. Report any such damage to the shipping company immediately. Parker Compumotor cannot be held responsible for damage incurred in shipment. The items listed in the following table should be present and in good condition.

Ship Kit Table

Description	Part Number
Possible Drives:	
CX Drive	CX Drive
CXT Drive	CXT Drive
Motor (optional)	Refer to the following table
CX Indexer User Guide	88-005939-05

Motor Configuration

Description	Part Number
CX57-51 Motor	057051-2-6-010-010
CX57-83 Motor	057083-2-6-016-010
CX57-102 Motor	057102-2-6-017-010
CX83-62 Motor	083062-2-3-020-010
CX83-93 Motor	083093-2-6-025-010
CX83-135 Motor	083135-2-6-035-010
CX 106-120 Motor	106120-1-6-045-100
CX106-178 Motor	106178-2-6-505-100
CXT25-30 Motor*	025030-1-6-004-010
CXT27-38 Motor*	027038-1-6-003-010
CXT32-39 Motor*	032039-1-6-010-010

*Used only with the CXT Drive

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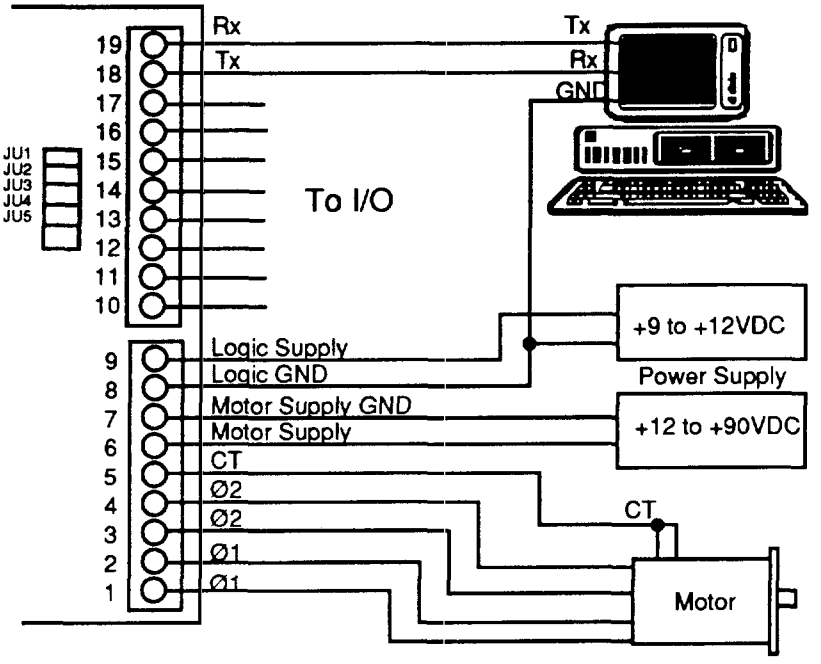
Basic System Configuration

The CX Indexer/Drive is protected against short circuit and over temperature. Compumotor does not recommend that you test these features or operate your system in such a way as to induce short circuiting or over temperature situations.

CAUTION

Never disconnect the motor with power on. It will damage the contacts of the motor connector. Follow the steps described below to complete the basic configuration of your system.

Basic System Wiring



Setting Drive Functions

The CX Indexer/Drive is equipped with five jumpers. They are used to set the motor phase current.

Model	Current	JU1	JU2	JU3	JU4	JU5
CX57-51	0.94 Amps/Phase	0	0	1	0	1
CX57-83	1.56 Amps/Phase	0	1	0	0	1
CX57-102	1.72 Amps/Phase	0	1	0	1	0
CX83-62	2.03 Amps/Phase	0	1	1	0	0
CX83-93	2.50 Amps/Phase	0	1	1	1	1
CX83-135	3.44 Amps/Phase	1	0	1	0	1
CX106-120	4.53 Amps/Phase	1	1	1	0	0
CX106-178	5.00 Amps/Phase	1	1	1	1	1
CXT32-39		1	0	0	1	1
CXT25-30		0	1	1	0	0
CXT27-38		0	1	0	0	1

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Motor Connections

If you purchased an CX drive/motor package, the motor will be pre-wired and ready to connect to the CX Drive motor connector.

Connect your motor to the CX Drive and verify that the color code is correct. The wire colors provided below are for Compumotor-supplied motors.

Motor Cable Color Codes

Pin #	Description	CT	CX57 & CX83	CX106
1	Phase 1	Red	Red	Red
2	Phase 1	Yellow	Red/White	Black
3	Phase 2	Green	Green	Yellow
4	Phase 2	Blue	Green/White	Green
5	CT	Brown, Black, White & Violet	White & Black	Orange & Brown

*center tap wires for both phases should be connected to this terminal

Power Connections

Connect the power supply to the CX Drive as illustrated in the previous figure. The motor supply requires 12 to 90VDC input. The logic supply (pin 8-9) requires 9 to 12VDC.

Close attention is required when wiring the DC4 to the CX Drive. Pinout of the DC4 are indicated on the rear of the power supply unit. Refer to the **DC4 User Guide** for power supply specifications and set-up instructions.

Pin #	Description
6	Motor supply (+12 to +90VDC)
7	Motor supply ground
8	Logic supply ground
9	Logic supply (+9 to +12VDC)

CAUTION

Make sure that AC power is removed from the power supply before connecting it to the CX Drive.

Do not apply power at this time.

Establish Communications

To communicate with the CX system, your computer or terminal must have an RS-232C serial port. It it does not, you can purchase one from your local computer dealer.

You cannot change the communication parameters on the CX. Therefore, you must set your computer/terminal to the following RS-232C protocol parameters:

- Baud Rate: 9,600
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Echo: Off (Full Duplex)

Refer to your computer/terminal user guide for instructions on how to set the communication parameters so that they are compatible with the CX Drive's settings.

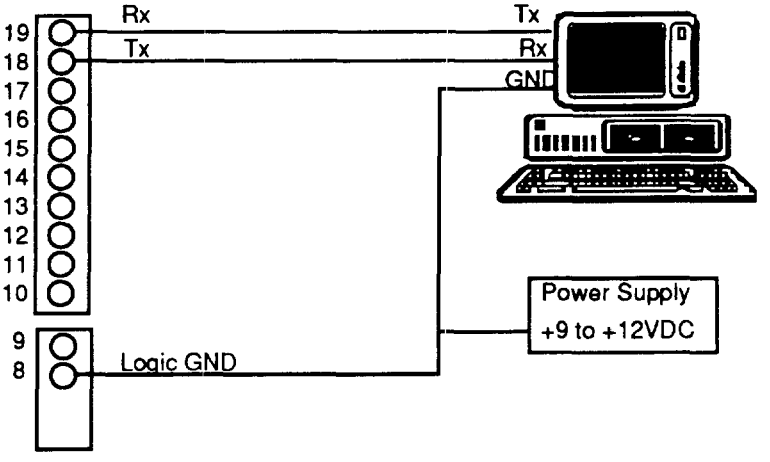
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RS-232C Connections

The CX Drive uses a simple three-wire implementation of RS-232C serial communication. Receive Data (Rx), Transmit Data (Tx), and Common (COM) signals are transmitted via pins 1, 2, and 3 on the CX Drive's two part screw terminal connector. Use the following figure as a guide for connecting the CX to the computer/terminal communication port.

> **CAUTION**
>
> **The common (COM) connection on drive's auxiliary connector is signal ground, or common, as opposed to earth ground (GND) on the power connectors. The COM on the auxiliary connector should be isolated from the earth ground. Do not connect COM on the auxiliary connector to GND on the power connectors. This type of miswiring can cause system damage.**

The CX does not support handshaking of any form; therefore, you should disable the handshaking function of the computer or terminal sending characters to the CX. If your communications program cannot disable handshaking, the handshaking function is disabled by connecting RTS to CTS (usually pins 4 and 5) and DSR to DTR (usually pins 6 and 20) on the computer's or terminal's 25-pin RS-232C port (see the following figure). Refer to your computer or terminal user guide for the exact instructions to disable handshaking.



Powering up the System

Before you power-up the CX System, verify that the power supply and motor cables are properly connected. If everything is OK, the drive will be enabled (evident by holding torque on the motor) when you apply power. If the motor does not have holding torque, remove power to the system and refer to *Chapter 5, Maintenance & Troubleshooting.*

Drive LED

The CX Drive's LED is located on the back panel opposite the connector side of the drive. It indicates one of the three conditions described below. *The following conditions assume that the Bias Supply is properly applied to the drive.*

- The LED will be off when the CX is functioning properly and no step pulses are being sent to the drive.
- The LED will turn green when the CX is functioning properly and the drive is receiving step pulses. The LED step indicator is a proportional indicator that will vary in brightness to indicate varying step rates.
- The LED will turn red when the amplifier is off. The amplifier can be turned off by a short circuit, an over-temperature condition, or by activating the shutdown input. *The red LED condition is a priority condition that overrides all other condition.*

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CAUTION

If the drive experiences a short circuit, a power dump overload, or an over-temperature condition, the fault is latched. The power to the drive must be cycled to unlatch the fault condition. The source of the fault must be corrected before power is reapplied to the unit.

Bypass Limit Switch for Testing

The CX is equipped with two end-of-travel limit inputs: CW and CCW. You can control these inputs with software commands and load-activated switches. The CW and CCW limit inputs prevent the load from crashing into a mechanical stop and damaging equipment or injuring personnel.

At this time, you do not need to set up load-activated switches in your system (you will establish these switches in *Chapter 3, Installation*). To test your motor and the RS-232C interface you must now disable the limit inputs by issuing an **LD3** command.

Testing the System

Testing RS-232C Interface

To test for proper three-wire RS-232C serial communication, power-up your computer or terminal *and then* power-up the CX system. If your terminal displays garbled characters, check the computer's protocol set-up; the baud rate setting is probably not equal to the CX's (9,600 baud). If the baud rates are equal, press the space bar several times. If the cursor does not move, switch the transmit (Tx) and receive (Rx) wires (CX pins 1 and 2) and try this test again.

Once you are able to make the cursor move, enter some characters. These characters should appear on the computer CRT. If each character appears twice, your computer is set to half-duplex. It should be set to full-duplex. Consult your computer user guide for instructions on how to change the set-up to full-duplex.

Test Routine

Issue the following command string to verify the system is running properly.

Commands	Description
LD3	Disables CW and CCW limits
MN	Sets indexer to normal mode
MPI	Sets positioning mode to incremental
A2	Sets acceleration to 2 rps^2
V1	Sets velocity to 1 rps
D12800	Sets distance to 12,800 steps
G	Executes the move (Go)
T.5	Waits 0.5 seconds after finishing the move
H	Changes the direction of the next move
G	Executes the move (Go)

After issuing these commands the motor turns one CW revolution, pauses for 0.5 seconds, and turns one CCW revolution.

Verifying Indexer Status

Enter the characters shown below. If communication is successful and the indexer is ready for normal operation, the corresponding response will be displayed as follows:

Input from keyboard	Response
1 R	*** R**

If you are unsuccessful, check the address setting and interface wiring and type the command again. If you are still unsuccessful, check your wiring and consult *Chapter 7, Maintenance & Troubleshooting.*

Making An Open-Loop Move

The following example disables the limit switches. ***Never attach a load when you disable the limit switches.*** Type the following commands:

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Commands	Description
LD3	Disables CW and CCW limits
A1	Sets acceleration to 1 rps^2
V1	Sets velocity to 1 rps
D128ØØ	Sets distance to 12,800 steps
G	Executes the move (Go)
1PR	Requests the position report for device 1

The motor moves 12,800 steps (one revolution). After the motor stops, you should see the following response on your computer CRT:

+0000012800

If the motor does not move, refer to *Chapter 7, Maintenance & Troubleshooting.*

If you were able to perform the open-loop move and the test routine successfully, try to perform as many moves as possible with the basic configuration. Simulate the moves you intend to perform with your permanent application. For other applicable commands refer to *Chapter 5, Software Reference.* After you complete these exercises, read *Chapter 3, Installation.*

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C H A P T E R ③

Installation

Chapter Objectives

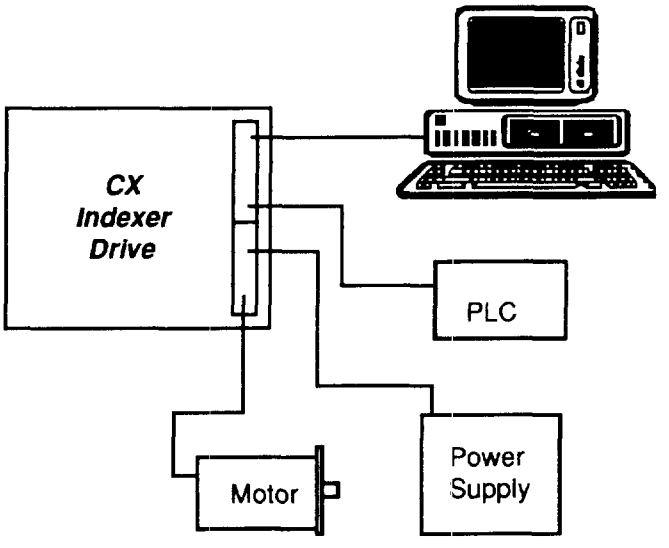
The information in this chapter will enable you to:

- ❑ Mount the drive properly
- ❑ Connect all electrical inputs and outputs properly
- ❑ Ensure that the complete system is installed properly
- ❑ Perform basic system operations

Complete System Configuration

In this section, you will go through complete set-up procedures for setting drive and indexer functions, and setting encoder functions (if you are using an encoder). This section addresses all of the procedures that you must complete before you wire or apply power to your system.

☛ **WARNING!** Ensure that AC power is disconnected before attempting to do any wiring. NEVER disconnect the motor with power applied to the drive. *Lethal voltages* are present inside the drive and on the screw terminals.



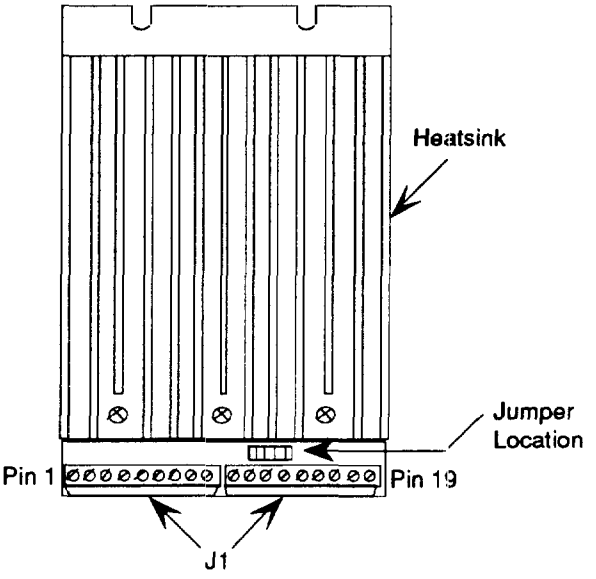
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Drive functions are set with jumpers located behind the connector (J1). The drives are shipped with jumpers JU1 through JU5 removed. Before operating the drive, you must configure the motor current setting for your motor. You will find additional jumpers in the ship kit.

The ON/OFF jumper convention used in the following tables is described below.

- ON = Jumper is installed over the two pins
- OFF = Jumper is not installed

☛Warning!
Always be sure power is removed before adjusting the drive jumpers.



Motor-Current

Pins JU1-JU5 control motor current. If you are using motors supplied by Compumotor, refer to the following table for the appropriate current settings.

If you are using a non-Compumotor motor, refer to the following tables for optional current settings.

CAUTION
Incorrect current settings can damage the motor and drive.

The recommended motor current setting will provide smooth operation. If enhanced smoothness is required, reducing the current 10-15% will improve low-speed smoothness *at the expense of torque*. Current can be increased up to 9% if additional torque is needed. **However, increasing the current to the motor is not recommended.**

Motor Model	Current (Amps/phase)	JU1	JU2	JU3	JU4	JU5
CX57-51	0.94	ON	OFF	ON	OFF	ON
CX57-83	1.56	OFF	ON	OFF	OFF	ON
CX57-102	1.72	OFF	ON	OFF	ON	OFF
CX83-62	2.03	OFF	ON	ON	OFF	OFF
CX83-93	2.50	OFF	ON	ON	ON	ON
CX83-135	3.44	ON	OFF	ON	OFF	ON
CX106-120	4.53	ON	ON	ON	OFF	OFF
CX106-178	5.00	ON	ON	ON	ON	ON
CXT25-30*	0.62	ON	OFF	OFF	ON	ON
CXT27-38*	0.41	OFF	ON	ON	OFF	OFF
CXT32-39*	0.31	OFF	ON	OFF	OFF	ON

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Current Settings

Standard CX Indexer/Drive						CXT					
Current	JU1	JU2	JU3	JU4	JU5	Current	JU1	JU2	JU3	JU4	JU5
0.14*	0	0	0	0	0	0.03	0	0	0	0	0
0.31	0	0	0	0	1	0.06	0	0	0	0	1
0.47	0	0	0	1	0	0.09	0	0	0	1	0
0.62	0	0	0	1	1	0.12	0	0	0	1	1
0.78	0	0	1	0	0	0.16	0	0	1	0	0
0.94	0	0	1	0	1	0.19	0	0	1	0	1
1.09	0	0	1	1	0	0.22	0	0	1	1	0
1.25	0	0	1	1	1	0.25	0	0	1	1	1
1.41	0	1	0	0	0	0.28	0	1	0	0	0
1.56	0	1	0	0	1	0.31	0	1	0	0	1
1.72	0	1	0	1	0	0.34	0	1	0	1	0
1.87	0	1	0	1	1	0.37	0	1	0	1	1
2.03	0	1	1	0	0	0.41	0	1	1	0	0
2.19	0	1	1	0	1	0.44	0	1	1	0	1
2.34	0	1	1	1	0	0.47	0	1	1	1	0
2.50	0	1	1	1	1	0.50	0	1	1	1	1
2.66	1	0	0	0	0	0.53	1	0	0	0	0
2.81	1	0	0	0	1	0.56	1	0	0	0	1
2.97	1	0	0	1	0	0.59	1	0	0	1	0
3.12	1	0	0	1	1	0.62	1	0	0	1	1
3.28	1	0	1	0	0	0.66	1	0	1	0	0
3.44	1	0	1	0	1	0.69	1	0	1	0	1
3.59	1	0	1	1	0	0.72	1	0	1	1	0
3.75	1	0	1	1	1	0.75	1	0	1	1	1
3.91	1	1	0	0	0	0.78	1	1	0	0	0
4.06	1	1	0	0	1	0.81	1	1	0	0	1
4.22	1	1	0	1	0	0.84	1	1	0	1	0
4.37	1	1	0	1	1	0.87	1	1	0	1	1
4.53	1	1	1	0	0	0.91	1	1	1	0	0
4.68	1	1	1	0	1	0.94	1	1	1	0	1
4.84	1	1	1	1	0	0.97	1	1	1	1	0
5.00	1	1	1	1	1	1.00	1	1	1	1	1

(0 = OFF/ 1 = ON)

Current Settings (CXT32-39, 25-30 and 27-38)

Motor Size	JU1	JU2	JU3	JU4	JU5
CXT32-39	1	0	0	1	1
CXT25-30	0	1	1	0	0
CXT27-38	0	1	0	0	1

Setting Indexer Address

Inputs AS1 - AS3 on J1 Connector (Pins 14-16) are used to select the device address for RS-232C communication. In power-on run mode these inputs are used to select the sequence number. ON is equivalent to the input being pulled down to 0V. The CX's optically isolated inputs are all active low, which means that in order to energize them they must be at logic 0. OFF is equivalent to logic high. If the inputs are not connected they will be in the de-energized or high state. Leaving all inputs connected will put the unit at device address 8.

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Device	Pin 14	Pin 15	Pin 16
1	ON	ON	ON
2	OFF	ON	ON
3	ON	OFF	ON
4	OFF	OFF	ON
5	ON	ON	OFF
6	OFF	ON	OFF
7	ON	OFF	OFF
8	OFF	OFF	OFF

Environmental Considerations

The CX Drive system should be operated in accordance with the following environmental constraints:

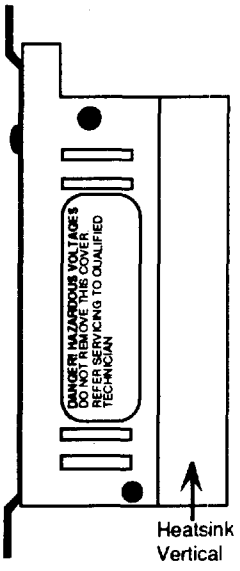
Parameter	Value
Operating	32°F to 122°F (0°C to 50°C)
Drive	Maximum allowable heatsink fin temperature is 144°F (65°C). Fan cooling may be required.
Motor	212°F (100°C) maximum motor case temperature. Actual temperature rise duty cycle dependent.
Storage	-40°F to 185°F (-40°C to 85°C)
Humidity	0-95%, Non-condensing

System Mounting

You should give special attention to the environment and location in which you will operate your CX Drive system. Consider atmospheric contamination and excess heat before you install and operate your CX Drive system.

Motor

The CX Drive is designed to be convection cooled. The drive should be mounted with the heatsink oriented vertically and in an area that will allow sufficient air to circulate over the heatsink. The heatsink should never exceed a temperature of 150°F (65°C). This will normally not be a problem when the drive is powering 23 and 34 frame size motors. If the unit is driving large motors or is in an enclosed area, providing cooling air over the heatsink may be required. The drive will automatically shut down if this temperature is exceeded.



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The CX Indexer/Drive is protected against short circuit and overtemperature. Compumotor does not recommend that you test these features or operate your system in such a way as to induce short circuiting or over-temperature situations.

Wiring Guidelines

Proper grounding of electrical equipment is essential to ensure the safety of personnel. You can reduce the effects of electrical noise due to electromagnetic interference (EMI) by grounding. All Compumotor equipment should be properly grounded. A good source of information on grounding requirements is the National Electrical Code published by the National Fire Protection Association of Boston, MA.

In general, all components and enclosures must be connected to earth ground through a grounding electrode conductor to provide a low-impedance path for ground fault or noise-induced currents. All earth ground connections must be continuous and permanent. Compumotor recommends a single-point grounding setup.

One commonly used method is to prepare components and mounting surfaces prior to installation so that good electrical contact is made between mounting surfaces of equipment and enclosure. Remove the paint from equipment surfaces where the ground contact will be bolted to a panel and use star washers to ensure solid bare metal contact. You should connect the case of the motor to the motor ground terminal on the CX Drive. (This is done for you with Compumotor supplied cables.)

For temporary installation, or when you cannot implement the grounding method described above, you must connect the GND terminal on the AC power connector to the earth ground.

Shielding

Motor leads should be shielded to reduce electro-magnetic interference (EMI). This shield must be returned to earth ground, not DC ground.

Power supply wires should also be shielded (separate from the motor leads). The pair of wires from the logic supply should be shielded and that shield should be connected to earth ground. The pair of wires from the motor supply should also be shielded (separate shield than the logic supply) and that shield connected to earth ground.

Grounding

The CX Drive chassis should be connected to a reliable earth ground for safety reasons. There is a grounding screw/star washer combination on the side of the drive available for this purpose. This screw should be removed and a ring-tongue terminal or lug connected through a wire to earth ground should be placed under the screw and the screw should be re-inserted.

The logic supply and motor supply wires should be at least 18 gauge for most applications. The return, or ground wires, for each supply should be connected together only at the drive (this is done internal to the drive). This prevents motor current spikes from entering the unit's logic ground.

Power Supplies

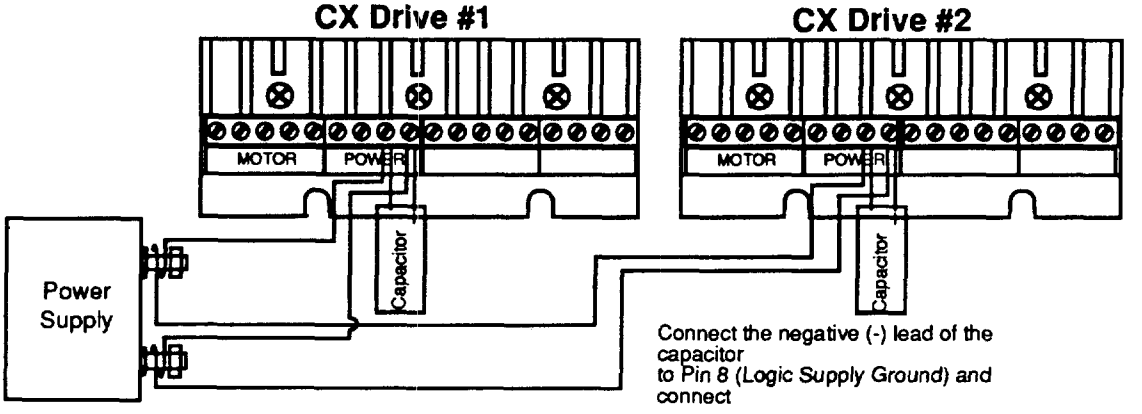
The CX requires an unregulated linear power supply to allow the drive to provide the necessary peak currents required by the motor. The voltage output must be 12-90VDC with less than 10% ripple. The power supply must be capable of continuously delivering 2 amps for each drive.

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Motor Supply

When operating two or more CX Drives from one power supply, a star connection configuration should be implemented. Power cables should be connected directly at the power supply not chained from CX to CX. With power chained from drive to drive, cross-static is possible resulting in erratic noise related problems. To ensure against power problems, a 0.1 microfarad capacitor rated for a minimum of 150V should be installed across the power inputs at each drive.

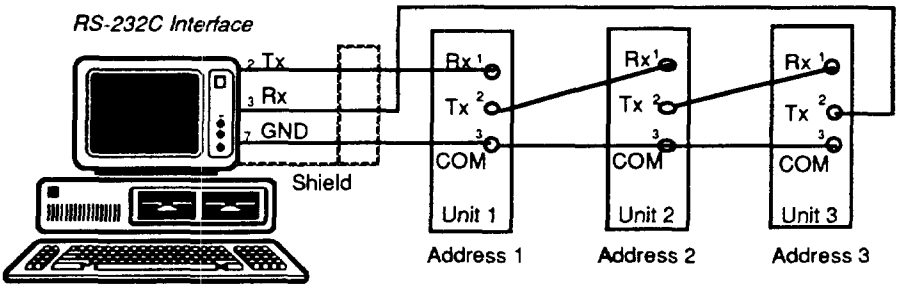
If you intend to power more than one CX unit from one power supply, you must add an electrolytic capacitor across the logic supply input terminals. An electrolytic capacitor of 330µf at 35VDC should be sufficient.



All power and signal lines should be shielded twisted pairs with all shields connected to chassis ground at one end only. Signal lines and 90V power lines should be kept separate from each other.

Daisy-Chain Connections

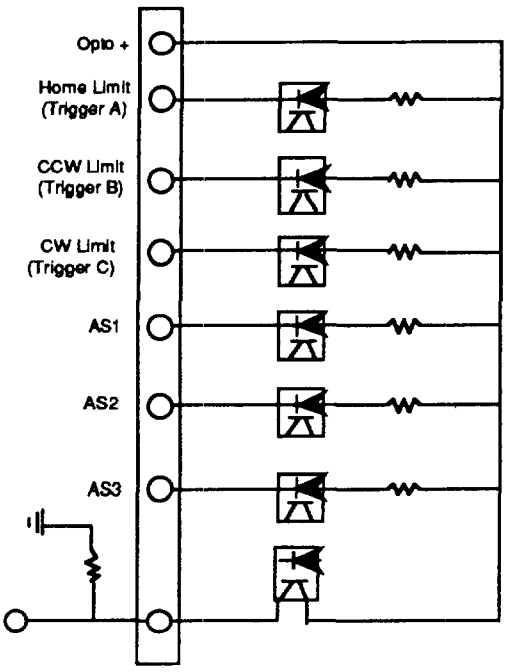
You can daisy-chain up to 8 CX Indexer/Drives to a single RS-232C port on a computer or terminal. Use the following figure as a guide for daisy-chain connections. You must establish a unique device address for each CX Indexer/Drive so that you can distinguish them when programming. The device address is set with Jumpers 1 through 5.



I/O Connections

This section discusses wiring the user I/O interface circuits from the 19 pin connector on the CX Drive. The following figure illustrates the I/O connections.

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End-of-Travel Inputs

End-of-Travel limits must normally be low to allow motor motion. Should a limit go high while the motor is moving in the direction of that limit, the CX will stop motor motion instantly. The home input is used for establishing a home reference position. Giving the GH command causes the motor to search for a transition on its home input. After successfully finding the home position it sets its absolute position to zero.

All of the limit inputs may be reconfigured as trigger inputs using the Limit Disable (LD) command.

Home Inputs The Go Home function of the CX is initiated by issuing the Go Home (GH) command. When the Go Home command is issued, the direction and velocity in which it should search for home must be included. The home input on the CX is optically isolated, and is normally high. A normally open, load activated switch to ground is the most common way for determining the home position. When the CX is commanded to Go Home, it will begin to move in the direction and at the velocity specified and look for the home limit input to go low. When it sees the home limit input go low it will decelerate to a stop at the last defined acceleration rate. If when it comes to a stop the home limit input is no longer low, the motor will reverse direction and accelerate to 0.5rps and look for the home limit input to go low again. As soon as the home limit input goes low the motor will come to an immediate stop If the motor comes to a stop after detecting an active home limit input during its initial search and the home limit input is still low, the motor will consider itself at home and will not move. If the motor encounters an end-of-travel limit while searching for home, it will reverse direction and look for the home limit input to go active in the opposite direction. If the other limit is encountered before the home signal is detected, the Go Home move will be aborted and the motor will stop.

Trigger Inputs Both CW and CCW end-of-travel limit inputs and the home limit input can be reconfigured as trigger inputs (using the LD command). The trigger inputs are normally high and optically isolated.

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Verifying Proper Installation

Now that you have connected the power, motor, and RS-232C interface to the CX Drive, you should verify that the CX system operates properly with these connections.

This section provides instructions to test proper installation of a single-axis CX system. If you have a multi-axis (daisy-chained) system, you should test every axis. To test every axis, you must repeat every device-specific command for each axis. All universal commands will be performed by every CX unit in the chain. Status reports for each axis should yield the same response.

Verifying RS-232 Link

You should test for proper RS-232C communication before continuing with this section. Refer to *Testing the System* in Chapter 2, *Getting Started*, for RS-232C testing procedures.

Utility Commands

The utility commands below may be useful throughout this section while testing your CX.

Command	Description
K	Halts the motor immediately. The immediate deceleration may cause a loss of position. This is a *panic* stop. This command takes effect immediately after you issue it.
S	Decelerates the motor to a stop using the last defined acceleration value. The system executes this command immediately after you issue it.
LD3	Disables the limit switch functions. It allows motor motion with no limits connected.
^H	Instructs the CX to backspace the cursor and delete the last character you entered
PS	Instructs the motor to pause for a period of time that you specify. Commands that follow the Pause command are not executed until the indexer receives a Continue (C) command to clear the pause and resume execution.
Z	Resets the system (like cycling power)

Open-Loop Moves

This section contains examples of open-loop moves that you can perform with the CX system. Open-loop moves *do not* use external sensors to provide position correction.

Testing Normal Mode Moves

To test the Normal Mode (MN) moves, enter the following string of commands.

Command	Description
LD3	Disables limit switches (*use **only** if limits are not installed*)
MN	Sets move to normal mode
A5	Sets acceleration to 5 rps^2
V2	Sets velocity to 2 rps
D128ØØ	Sets distance to 12,800 steps
G	Executes the move (Go)

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The motor moves CW one revolution. To move the motor in the opposite direction (CCW), enter the following string of commands:

Command	Description
D-128ØØ	Sets distance to 12,800 steps
G	Executes the move (Go)

The motor will move the same distance in the opposite direction.

To report the absolute position on all axes, you will have to issue a **PR** command (a device-specific command) with the appropriate device address as follows:

Command	Description
1PR	Reports Absolute Position for CX unit 1
2PR	Reports Absolute Position for CX unit 2
3PR	Reports Absolute Position for CX unit 3

The absolute position report for each axis should be the same.

Testing Continuous Mode Moves

The Continuous Mode (**MC**) is useful for applications that require constant movement of the load, when the motor must stop after a period of time has elapsed (rather than after a fixed distance), or when the motor must be synchronized to external events such as trigger input signals. To test continuous mode moves, enter the following string of commands. Use the **S** or **K** command to stop the motor in an emergency.

Command	Description
MC	Move continuous
A25	Sets acceleration to 25 rps^2
V5	Sets velocity to 5 rps
CTM5	Remain at velocity for 5 seconds
CV1	Decelerate at 25 rps^2 to 1 rps
CTRXXØ	Wait for trigger input 3 to go low
CA5	Accelerate at 5 rps^2
CV1Ø	To velocity 10 rps
CTM5	Remain at velocity for 5 seconds
CVØ	Change velocity to zero rps (stop)
G	Executes the move (Go)

This sequence sets the indexer to the Continuous Mode. The motor reaches 5 rps, waits 5 seconds, changes velocity to 1 rps, and waits for trigger three to go low. When you ground trigger three, the motor accelerates at 5 rps^2 to 10 rps, waits 5 seconds, and then stops. Note that the buffered **CVØ** command stops the motor (***the S command is not a buffered command and cannot be used in a sequence***).

Testing CW and CCW Limit Switch Operation

Before you verify that the limit switches are working properly, check the following connections:

- ❑ Ensure that the CW and CCW limit switches are wired properly (normally closed switches that open when the load moves to the limit position).
- ❑ Make sure that the load is not attached to the motor.
- ❑ Make sure that you can manually open and close the limit switches.

Use the following procedures to test the limit input switches:

☛Step ① Open both CW and CCW switches.

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☛Step ② Type `1IS` . If all other inputs are opened, the response should be `1111111111`; this means that both CW and CCW limits (represented by the 5th and 6th digits) are opened.

☛Step ③ Close the CW limit.

☛Step ④ Type `1IS`. Assuming no other inputs are closed, the response to this command should be `1111101111`.

☛Step ⑤ Close the CCW limit switch.

☛Step ⑥ Type `1IS`. The response should be `1111001111`.

To test the CW limit with the CX system, enter the following string of commands:

Command	Description
`LDØ`	Enables CW and CCW limits
`MC`	Sets indexer to continuous mode
`A5`	Sets acceleration to 5 revs/sec^2
`V2`	Sets velocity to 2 rps
`H+`	Changes motor direction (+ = CW)
`G`	Executes the move (G0)

The motor moves at a constant velocity until you open the CW limit switch. The motor then comes to an immediate halt.

To test the CCW limit, enter the following string of commands:

Command	Description
`MC`	Sets indexer to Continuous mode
`A1`	Sets acceleration to 1 rps^2
`V1`	Sets velocity to 1 rps
`H-`	Sets move to the CCW direction
`G`	Executes the move (Go)

The motor moves at a constant velocity until you open the CCW limit switch. The motor then comes to an immediate halt. If the motor continues to move, open the CW limit switch. If the motor stops when you open the CW limit input, switch the CW and CCW limit wires.

If neither of these limit switches stop the motor, recheck your switch wiring and refer to Chapter 7, *Maintenance and Troubleshooting.*

Homing The Motor

You can initiate the Go Home function by issuing the Go Home (`GH`) command. When you issue the Go Home command, you must include the direction and velocity that the motor should use to search for home.

When you command the CX to go home, the motor begins to move in the direction and at the velocity you specified. It performs this move at the last defined acceleration rate, and looks for the home limit input to go active. If the motor encounters an end-of-travel limit while it searches for home, it will reverse direction and look for the home limit input to go active in the opposite direction. If the motor encounters the other limit before it detects the home signal, the Go Home move will be aborted and the motor will stop.

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It is not possible to keep the home input grounded and search for the Z Channel in encoder step mode.

To test the functionality of the home input switch, manually open the switch and type **1IS** . Assuming your end-of-travel limits are closed and all other inputs are open, the response will be **1111001111**. The last digit in the response represents the home input status. Now close the home switch and type **1IS**; the response should be **1111001110**. This verifies that the switch is functioning properly.

Use the following procedure to test the CX's homing function:

☛Step ① Enter the following string of characters:

Command	Description
A5	Sets acceleration to 5 revs/sec^2
GH+2	Instructs the motor to go home (CW) at 2 rps

The motor moves in the positive direction at a constant velocity (2 rps).

☛Step ② Momentarily ground (close) the home limit input (turn it on).

The motor decelerates to a stop, moves in a negative direction until it is 1/32 of a revolution past the point where the home signal was detected, then moves at 0.1 rps in the positive direction.

☛Step ③ Momentarily close the home switch again to stop the motor.

When the home limit input (pin 7) goes active after a **GH** command, the system recognizes the location where the input became active as *home*. The drive decelerates the motor at the last rate specified. At the end of the Go Home move, the indexer automatically resets the absolute counter to zero. This is equivalent of issuing the Position Zero (**PZ**) command.

Coupling the Load

Special couplings that accommodate different types of misalignment are available. The following are the three types of misalignments; they can exist in any combination.

- *Parallel Misalignment*. The offset of two mating shaft center lines, although the center lines remain parallel to each other.
- *Angular Misalignment*. When two shaft center lines intersect at an angle other than zero degrees.
- *End Float*. A change in the relative distance between the ends of two shafts.

Special couplings are used to accommodate the above misalignments and to transmit the desired torque. The coupling manufacturer should be consulted to ensure that the coupling is being used within its specified torque capacity and misalignment ranges.

Shaft couplings may be divided into three types: single-flex, double-flex, and digit. Like a hinge, a single-flex coupling accepts angular misalignment only. A double-flex coupling accepts both angular and parallel misalignments. Both single-flex and double-flex, depending on their design, may or may not accept end-play. A rigid coupling cannot compensate for any misalignment.

CAUTION

Do not machine the motor shaft without consulting a Compumotor Applications Engineer at (800) 358-7090. Improper shaft machining can destroy the motor bearings.

Single-Flex Coupling

When a single-flex coupling is used, one and only one of the shafts must be free to move in the radial direction without constraint. Do not use a double-flex coupling in this situation because it will allow too much freedom and the shaft will rotate eccentrically; this will cause large vibrations and immediate failure.

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Double-Flex Coupling

Use a double-flex coupling whenever two shafts are joined that are fixed in the radial and angular direction (angular misalignment). Do not use a single-flex coupling with a parallel misalignment; this will bend the shafts, causing excessive bearing leads and premature failure.

Rigid Coupling

Rigid couplings are generally not recommended. They should be used only if the motor is on some form of floating mounts which allow for alignment compensation.

Coupling Manufacturers

HELI-CAL
901 McCoy Lane
P.O. Box 1460
Santa Monica, CA
(805) 928-3851

ROCOM CORP
5957 Engineering Drive
Huntington Beach, CA 92649
(714) 891-9922

For unusual motor installations contact Compumotor Applications Engineering for assistance.

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C H A P T E R ④

Application Design

Chapter Objectives

The information in this chapter will enable you to:

- ❑ Recognize and understand important considerations that must be addressed before you implement your application
- ❑ Understand the capabilities of the system
- ❑ Customize the system to meet your requirements
- ❑ Use sample applications to help you develop your application

Mechanical Resonance

Resonance, a characteristic of all stepper motors, can cause the motor to stall at low speeds. Most full-step motor controllers *jump* the motor to a set minimum starting speed to avoid this resonance region. This causes poor performance below one rev per second. In nearly all cases, the stepping features of the CX will overcome these problems. However, in some cases the drive will need to be optimized with some simple adjustments to overcome resonance.

Resonance occurs at speeds which approach the natural frequency of the motor's rotor and the first and second harmonics of those speeds. It causes the motor to vibrate at these speeds. The speed at which fundamental resonance occurs is typically between 0.3 and 0.8 revs per second and is highest for small motors and lowest for large motors.

Motors which will not accelerate past one rev per second may be stalling due to resonance. The resonance point may be lowered to some extent by adding inertia to the motor shaft. This may be accomplished by putting a drill chuck on the back shaft. *Note that this technique is applicable only to double-shaft motors with the shaft extending from both ends of the motor.* In extreme cases, you may also need a viscous damper to balance the load.

Adjusting the waveform (**WV** command), changing the velocity (**V** command) and acceleration (**A** command), or tuning the drive may also help a resonance problem.

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Ringing or Overshoot

The motor's springiness, along with its mass, form an underdamped resonant system that *rings* in response to acceleration transients (such as at the end of a move). Ringing at the end of a move prolongs settling time. *Overshoot* occurs when the motor rotates beyond the actual final position. The actual settling time of a system depends on the motor's stiffness, the mass of the load, and any frictional forces that may be present. By adding a little friction, you can decrease the motor's settling time.

Move Times: Calculated vs Actual

You can calculate the time it takes to complete a move by using the acceleration, velocity, and distance values that you define. However, you should not assume that this value is the actual move time. There is calculation delay and motor settling time that make your move longer. After you issue the Go (G) command, the indexer can take up to 5 milliseconds to calculate the move before the motor starts moving. You should also expect some time for the motor to settle into position. Settling time varies depending on the load, but it can be 50 milliseconds or longer.

Positional Accuracy vs. Repeatability

In positioning systems, some applications require high absolute accuracy. Others require repeatability. You should clearly define and distinguish these two concepts when you address the issue of system performance.

If the positioning system is taken to a fixed place and the coordinates of that point are recorded, the only concern is how well the system repeats when you command it to go back to the same point. For many systems, what is meant by accuracy is really repeatability. Repeatability measures how accurately you can repeat moves to the same position.

Accuracy, on the other hand, is the error in finding a random position. For example, suppose the job is to measure the size of an object. The size of the object is determined by moving the positioning system to a point on the object and using the move distance required to get there as the measurement value. In this situation, basic system accuracy is important. The system accuracy must be better than the tolerance on the measurement that is desired.

For more information on accuracy and repeatability, consult the technical data section of the Compumotor Catalog.

Modes of Operation

The examples provided in this section assume that the CX device address is set to #1. Refer to *Chapter 3, Installation*, for detailed instructions for setting the device address.

Normal Mode

A preset move is a move distance that you specify (in micro-steps). You can select preset moves by putting the CX into normal mode using the Mode Normal (**MN**) command. Preset moves allow you to position the motor in relation to the motor's previous stopped position (incremental moves) or in relation to a defined zero reference position (absolute moves). You can select incremental moves by using the Mode Position Incremental (**MPI**) command. You can select absolute moves using the Mode Position Absolute (**MPA**) command.

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Incremental Preset Mode Moves

When you are in the Incremental mode (MPI), a preset move moves the shaft of the motor the specified distance from its starting position. For example, to move the motor shaft 1.5 revolutions, a preset move with a distance of +19,200 steps (1.5 revs at 12,800 steps/rev) would be specified. Every time the indexer executes this move, the motor moves 1.5 revs from its resting position. You can specify the direction of the move in one command. Specify the direction by using the optional sign (D+2Ø,ØØØ or D-1Ø,ØØØ), or define it separately with the Set Direction (H) command (H+ or H-). Whenever you do not specify the direction, the unit defaults to the positive (CW) direction.

☛Sample Incremental Mode Moves

The moves shown below are incremental moves. The distance specified is relative to the motor's current position. This is the default (power-up) positioning mode.

Command	Description
MPI	Sets unit to Incremental Position Mode
A2	Sets acceleration to 2 rps^2
V5	Sets velocity to 5 rps
D256ØØ	Sets distance to 25,600 steps
G	Executes the move (Go)
G	Repeats the move (Go)
H	Reverses direction of next move
G	Executes the move (Go)

The motor moves two CW revolutions and stops. It then moves two more CW revolutions in the same direction and stops. The motor changes direction and moves two CCW revolutions.

Command	Description
D-256ØØ	Changes the distance to 25,600 steps in the opposite (CCW) direction.
G	Executes the move (Go)

The motor returns to its original starting position.

Command	Description
H	Toggles the motor direction of the next move, but maintains existing acceleration, velocity, and distance parameters.
G	Executes the same move profile as the previous move, but in the opposite direction(Go)

The motor moves 25,600 steps in the positive (CW) direction.

If you wish to load all the commands before executing them, you may use the Pause (PS) and Continue (C) commands.

Command	Description
PS	Pauses execution until the indexer receives a Continue (C) command
G	Executes the 25,600-step move (Go)
T3	Waits 3 seconds after the move
G	Moves 25,600 steps
C	Starts G T3 G commands

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Absolute Preset Mode Moves

A preset move in the absolute mode (**MPA**) moves the motor the distance that you specify (in motor steps) from the absolute zero position. You can set the absolute position to zero with the Position Zero (**PZ**) command, issuing the Go Home (**GH**) command, or by cycling the power to the drive. The absolute zero position is initially the power-up position.

The direction of an absolute preset move depends upon the motor position at the beginning of the move and the position you command it to move to. For example, if the motor is at absolute position +12,800, and you instruct the motor to move to position +5,000, the motor will move in the negative direction a distance of 7,800 steps to reach the absolute position of +5,000.

The CX powers up in Incremental mode. When you issue the Mode Position Absolute (**MPA**) command, it sets the mode to absolute. When you issue the Mode Position Incremental (**MPI**) command the unit switches to Incremental mode. The CX Indexer/Drive retains the absolute position, even while the unit is in the Incremental mode. You can use the Position Report (**PR**) command to read the absolute position.

Sample Absolute Mode Moves

The moves shown below are absolute mode (**MPA**) moves. The distance specified is relative to the CX's absolute zero position.

Command	Description
MN	Set to Normal mode
MPA	Set to Absolute Position mode
PZ	Set the current absolute position to zero
A5	Set acceleration to 5 rps^2
V3	Set velocity to 3 rps
D5ØØØ	Set move to absolute position 5,000
G	Execute move (Go)

Command	Description
D1ØØØØ	Set the motor to absolute position 10,000. (Motor will move 5,000 additional steps in the CW direction.)
G	Execute the move (Go)
DØ	Sets the motor to absolute position 0. (Since the motor is at absolute position 10,000, the motor will move 10,000 steps in the CCW direction.)
G	Executes the move (Go)

Continuous Mode

The Continuous Mode (**MC**) is useful for applications that require constant movement of the load, when the motor must stop after a period of time has elapsed (rather than after a fixed distance), or when the motor must be synchronized to external events such as trigger input signals. You can manipulate the motor movement with either buffered or immediate commands. After you issue the **G** command, buffered commands are executed in the order in which they were programmed. Immediate commands are used to instantaneously change the motor's acceleration and velocity when the motor is already in continuous motion.

Sample Continuous Mode Moves

The following example demonstrates buffered commands in the continuous mode.

Command	Description
MC	Set to Continuous mode
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
CL2	Loop continuously 2 times
CV5	Change velocity to 5 rps
T5	Wait 5 seconds
CV2	Change velocity to 2 rps
T3	Wait 3 seconds
CN	End continuous mode loop
CVØ	Change velocity to 0
G	Execute the move (Go)

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The motor accelerates to 5 rps, waits 5 seconds, decelerates to 2 rps, waits 3 seconds, accelerates to 5 rps, waits 5 seconds, decelerates to 2 rps, waits 3 seconds, then comes to a stop. Note that issuing the CVØ command stops the motor (the S command is not a buffered command and cannot be used in a sequence).

The following Continuous Mode (MC) commands will accelerate or decelerate the motor to a specified velocity and continue at that velocity. To make an immediate change in acceleration while the motor is moving, use the Acceleration Change (AC) command. To immediately change the velocity while the motor is moving, use the Velocity Change (VC) command. To stop the motor, issue the Stop (S) command or enter VCØ. The motor will stop if a limit is encountered.

Command	Description
LDØ	*Enables CW and CCW limits*
MC	Set to Continuous mode
A1	Set acceleration to 1 rps^2
V.5	Set final velocity to 0.5 rps
G	Execute the move (Go)

While the motor is in motion, enter the following commands:

Command	Description
VC.4	Immediately changes velocity to 0.4 rps
•	
•	
AC3	Immediately changes acceleration to 3 rps^2
VC.2	Immediately changes velocity to 0.2 rps at 3 rps^2
•	
•	
VCØ	Decelerates the motor to a stop

Program Control

Triggers

You can use the Wait for Trigger (TR) command to specify a configuration of trigger conditions to be matched before executing a sequence of buffered commands. The trigger inputs are TRIG 1, TRIG 2, and TRIG 3. The three possible conditions you can specify are as follows:

- 1 = Wait for trigger input to be high (*off*, no current flows)
- Ø = Wait for trigger input to be low (*on*, current flows)
- X = Ignore the trigger input

Command	Description
MN	Sets to Preset mode
A2	Sets acceleration to 2 rps^2
V5	Sets velocity to 5 rps
D256ØØ	Sets distance to 25,600 steps
TRØ1X	Waits for Trigger Input 1 to turn on and Trigger Input 2 to turn off (ignores Trigger Input 3)
G	Executes 4,000-step move (Go)

The move will not be executed until current flows on the TRIG 1 input and no current flows on the TRIG 2 input.

The TS command is useful for checking the status of the trigger inputs when it appears as though execution is being halted by the TR command and all conditions for matching the trigger input configuration defined by the TR command appear to be met. It may also be used to initiate external actions by monitoring the trigger inputs manually with a computer controlling the CX.

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POBs (Programmable Output Bits)

Programmable output bits (OUT 1 and OUT 2) can be turned on and off using the Output (O) command. You can use the outputs to signal remote controllers, turn on LEDs, sound buzzers, etc. A one (1) turns on a given output, a zero (0) turns the output off, and an X leaves the output unchanged. The outputs conduct current when they are on and do not conduct when they are off (see the O command description in *Chapter 5, Software Reference*).

Command	Description
MN	Set to Normal mode
PS	Pause execution until indexer receives a Continue (C).
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D384ØØ	Set move distance to 38,400 steps
OØ1	Set programmable output 1 off and output 2 on
G	Execute the move (Go)
OXØ	At end of move, leave output 1 unchanged and output 2 off
C	Cancel the Pause and executes the move

Delays

You can use the Time Delay (T) command to halt the operation of the indexer function for a preset time. If you are in the Continuous Mode (MC), you may use the Continuous Time (CTM) command to run the motor at continuous velocity for a set time, then change to a different velocity.

In the Preset mode (MN), the motor finishes the move before the indexer executes the time delay.

Command	Description
PS	Waits for the CX to receive a Continue (C) command before executing next command
A7	Set acceleration to 7 rps^2
V6	Set velocity to 6 rps
D256ØØ	Set distance to 25,600 steps
G	Move motor 25,600 steps
T5.Ø	Wait 5 seconds after the move ends
H	Change motor direction
G	Move motor 25,600 steps in the opposite direction
C	Cancel Pause and executes the move

Loops

This section discusses methods of establishing loops in the programs you write for your application. Loops can be created individually or nested within each other.

Single Loops

You may use the Loop (L) command to repeat certain programs such as the one provided below. All the commands between the L command and the N command are looped (repeated) the number of times indicated in the L command. You can use the Immediate Pause (U) command to temporarily halt execution of the loop while it is in progress. *The U command does not work in continuous mode.* To resume loop execution, issue the Continue (C) command.

Command	Description
PS	Pause execution until the indexer receives a Continue (C)
MPI	Set to Incremental mode
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
L5	Loop 5 times
D128ØØ	Set distance to 12,800 steps
G	Execute the move (Go)
T2.Ø	Delay 2 seconds after the move
N	End Loop
C	Cancel pause and execute the move

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The motor moves a total of 64,000 steps (a succession of five 12,800-step moves with a 2-second pause between each move).

Move Completion Signal

When you complete a move, you may use the CX's programming capability to signal the end of the current move. In a preset move, you may use one of the following commands:

- ❑ `LF` Line feed (see example #1)
- ❑ `CR` Carriage return (see example #2)
- ❑ `O` Output command (see example #3)
- ❑ `"` Quote command (see example #4)

Example #1

Command	Description
PS	Pauses execution until indexer receives a Continue (C)
MN	Set to Normal mode
A2	Set acceleration to 2 rps^2
V2	Set velocity to 2 rps
D384ØØ	Set distance to 38,400 steps
G	Execute the move (Go)
1LF	Send a line feed over the RS-232C interface
C	Cancel the Pause and executes the move

The motor moves 38,400 steps. When you complete the move, the unit issues a line feed from the CX to the host over the RS-232C interface.

Example #2

Command	Description
`PS`	Pauses execution until indexer receives a Continue (C)
`MN`	Set to Normal mode
`A2`	Set acceleration to 2 rps^2
`V2`	Set velocity to 2 rps
`D384ØØ`	Set distance to 38,400 steps
`G`	Execute the move (Go)
`1CR`	Send a carriage return
`C`	Cancel the Pause and executes the move

The motor moves 38,400 steps. When the CX completes the move, it issues a carriage return to the host over the RS-232C interface.

Example #3

Command	Description
`PS`	Pause execution until indexer receives a Continue (C)
`MN`	Set to Normal mode
`A2`	Set acceleration to 2 rps^2
`V2`	Set velocity to 2 rps
`D384ØØ`	Set distance to 38,400 steps
`G`	Execute the move (Go)
`O1X`	Turn on Output 1
`C`	Cancel the Pause and executes the move

The motor moves 38,400 steps. When the CX completes the move, Output 1 is turned on.

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Example #4

Command	Description
PS	Pause execution until indexer receives a Continue (C)
MN	Set to Normal mode
A2	Set acceleration to 2 rps^2
V2	Set velocity to 2 rps
D384ØØ	Set distance to 38,400 steps
G	Execute the move (Go)
"DONE	Send the message, DONE, to the terminal
C	Cancel the Pause and executes the move

The motor moves 38,400 steps.

Sequences

A sequence is a series of commands. These commands are executed in their programmed order whenever the sequence is run. Immediate commands cannot be stored in a sequence, just as they cannot be stored in the command buffer. Only buffered commands may be used in a sequence.

Sequence Buffer vs. Command Buffer

Individual commands and command groups in any combination are entered into the command buffer until the total number of characters currently stored (including delimiters) fills the buffer. This buffer is 1400 characters in size. The indexer uses a first-in-first-out serial buffer. As commands are read from the buffer, additional commands can be entered to replace them.

Sequence Programming

Use the following commands to define, erase, and run sequences:

Command	Description
XD	Start sequence definition
XE	Delete sequence from EEPROM
XP	Set Power-up Sequence mode
XQ	Set/reset interrupted Run mode
XR	Run a sequence
XRP	Run a sequence with a pause
XT	End sequence definition
XU	Upload sequence
XZ	Set power-up sequence to zero

The commands that you enter to define a sequence are presented vertically in the examples below. This was done to help you read and understand the commands. When you are actually typing these commands into your terminal, they will be displayed horizontally.

It is a good practice to erase the sequence with the **XE** command before defining the sequence with the **XD** command. To begin the definition of a sequence, enter the **XD** command immediately followed by sequence identifier number (1 to 40) and a delimiter (pressing the space bar or the carriage return key). The **XT** command ends the sequence definition and automatically loads the sequence into the CX's EEPROM. All commands entered after the **XD** command and before the **XT** command are executed when the sequence is run. Examples are provided below.

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Once you define a sequence, it cannot be redefined until you delete it. You can delete a sequence from EEPROM by entering the **XE** command immediately followed by a sequence identifier (1 to 7) and a delimiter. You may then redefine that sequence into EEPROM . You can issue the Sequence Status Definition (**XSD**) command (preceded by a device address) to verify if the last sequence definition was successful. The possible responses seen on your terminal are *0*, *1*, or *2*. A *0* means the sequence was successfully defined. A *1* means the sequence already exists with the number you have specified. A *2* means there was not enough space in the sequence buffer for that sequence.

To check the status of a sequence, issue the Sequence Status (**XSS**) command. This command must be preceded by a device address and followed immediately by the number (1 to 7) of the sequence and a delimiter. The possible responses are *0* (Empty), *1* (Bad checksum), or *3* (O.K.).

If you wish to check the contents of a sequence, enter the **XU** command. For example, issuing the **1XU1** command causes the CX to send the contents of sequence number 1 to the computer terminal's screen. The 1 preceding the **XU** command is the device address which must be present since the **XU** command is a *device-specific* command. We are assuming in these examples that the CX is set up at device address 1. The default address for the CX is #8.

Example #1 This example shows how a single move is defined in a sequence.

Command	Description
XE1	Erase Sequence 1
XD1	Begin defining Sequence 1
A2Ø	Acceleration is set to 20 rps^2
V5	Velocity is set to 5 rps
D8ØØØ	Move to position 8,000
G	Execute the move
XT	End sequence definition

Example #2 This example program defines Sequence 2 to move the motor to position 10000.

Command	Description
XE2	Erase sequence 2
XD2	Begin defining sequence 2
A2	Acceleration is set to 2 rps^2
V.5	Velocity is set to 0.5 rps
D1ØØØØ	Move to position 10,000
G	Execute the move
XT	End sequence definition

Example #3 This example program defines sequence 3 to move the motor to position 0.

Command	Description
XE3	Erase sequence 3
XD3	Begin defining sequence 3
MPA	Set to Absolute mode
A2Ø	Acceleration is set to 20 rps^2
V5	Velocity is set to 5 rps
DØ	Move to position 0
G	Execute the move
XT	End sequence definition

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Example #4 This example program defines sequence 28 to move the motor to position 8000.

Command	Description
XE28	Erase sequence 28
XD28	Begin defining sequence 28
A2	Acceleration is set to 2 rps^2
V.5	Velocity is set to 0.5 rps
D8000	Move position 8,000
G	Execute the move
XT	End sequence definition.

Sequence Selection

After you define the sequences over the RS-232C interface, you can execute the sequences by using one of the following modes of operation:

- *Stand-alone Operation*
- *Host Computer Operation*
- *Programmable Logic Controller (PLC) Operation*

Stand-alone Operation

This section explains and provides examples of how to store sequences to be automatically executed when you power-up the system, or executed by remote switches. You will first have to define the sequences into the CX non-volatile memory. You will need a computer or PLC with RS-232C communication capabilities for programming the CX .

Power-up Sequence Execution

A single, predefined sequence may be executed on power-up by issuing the Set Power-Up Sequence Mode (**XP**) command immediately followed by a sequence identifier number and a delimiter. For example, if an **XP1** command was entered, sequence #1 would continue to execute on each subsequent power-up until you issue an Set Power-Up Sequence to Zero (**XZ**) command or a new **XP** command. Once the pre-defined sequence is finished executing, the CX returns control to the RS-232C communications port. If no sequence has been defined as Sequence, control would automatically go to the RS-232C communications port.

The **XP** command may be issued at any time, except during sequence definition. Once an **XP** command is entered, it is automatically saved in the CX's non-volatile memory.

To determine which, if any, sequence will be executed on power-up, issue the Sequence Status Power-Up (**XSP**) command.

Using Remote Sequence Inputs

By issuing the **XP9** command you can perform sequences. The **XP9** command will not cause any sequence to be immediately executed. Once you issue the **XP9** command, the XC reads the sequence select inputs (Pins 15-16 on the CX I/O connector) every time it is powered-up or every time the **Z** (Software reset) command is issued. The status of the sequence select inputs will be interpreted by the CX as a sequence number (see Table 2-4). If, at the time of power-up, the number represented by the sequence select inputs is a valid pre-defined sequence number (1 to 7), the CX will automatically execute that sequence. When this first sequence is finished executing, the CX will once again read the sequence select inputs and execute the next valid sequence number present on these inputs. The CX will continue to execute sequences in this fashion until you issue a Stop (**S**) or Kill (**K**) command, or if an end-of-travel limit is encountered. If the CX reads the number 8, or any number that has no sequence defined, it will wait until the status of the inputs change to a valid, pre-defined sequence.

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Sequence	SEQ1	SEQ2	SEQ3
1	ON	ON	ON
2	OFF	ON	ON
3	ON	OFF	ON
4	OFF	OFF	ON
5	ON	ON	OFF
6	OFF	ON	OFF
7	ON	OFF	OFF
8	OFF	OFF	OFF

*Non-valid sequence

OFF = open switch (not pulled to ground)
ON = closed switch (pulled to ground)

When in the **XP9** mode, it is possible to cause the CX to pause between sequence execution. This is done with the **XP1** command. Then the **XP1** command is present within a sequence, the CX will pause after the execution of the sequence and will wait for all sequence select inputs to be OFF. The CX will then read the status of the sequence select inputs and execute the corresponding sequence number. This interrupted run mode will continue until you issue the **XPØ** command.

You can also program the CX to read the sequence select lines on power-up with the **XP8** command. This command will cause the CX to execute the first valid sequence number it reads on the sequence select inputs after power-up (exactly like the **XP9** command). It differs from the **XP9** command in that it returns control to the RS-232C communications port after it finished executing the first sequence, rather than reading the sequence select lines again and executing another sequence.

Sample Applications and Commands

The following are step-by-step procedures demonstrating how to run sequences. Using a terminal or a computer, key in the following commands:

Step ① Issue the **XP9** command

Step ② Define the following sequences:

Command	Description
XE6	Erase sequence #6
XD6	Define sequence #6
MN	Set to mode normal
A1	Set acceleration to 1 rps^2
V2Ø	Set velocity to 20 rps
D128ØØ	Set distance to 12,800 steps
G	Execute the move (Go)
XT	End sequence #6 definition

Step ③ Verify that your programs were stored properly by uploading each entered sequence (**XU** followed by the number of the sequence). If you receive responses that differ from what you programmed, re-enter those sequences.

Step ④ Make sure all the sequence select inputs are off (not grounded).

Step ⑤ Cycle power or enter the **Z** command. The CX will go through the normal **XP9** mode operation. In **XP9** mode, the CX scans the sequence select inputs, looking for a valid sequence according to the binary value of the three inputs.

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Step ⑥ Momentarily turn on (ground) the SEQ2 input. This will execute sequence #6. After the sequence has finished executing, the inputs are again scanned to execute another sequence.

Step ⑦ To execute sequence #7 turn on (ground) the SEQ1 input.

Host Computer Operation

This section assumes you have successfully communicated with the CX. If you have not verified that your RS-232C communications link is functioning properly, return to *Chapter 2, Getting Started*, and complete this check before attempting to complete this section.

An IBM-compatible software diskette providing terminal emulation is available from Parker Compumotor.

Immediate Sequence Execution

You can execute a sequence by entering the **XR** command immediately followed by a sequence identifier number (1 to 397 and a delimiter. The sequence will be executed immediately after the delimiter.

You can issue the Sequence Status Run (**XSR**) command to verify if the last sequence you issued was executed successfully. The possible responses are as follows:

- ø — Running
- *Non-Zero* — Not running:
  - 1 — In a loop
  - 2 — Invalid sequence
  - 3 — Erased
  - 4 — Bad checksum

The following are step-by-step procedures demonstrating how to run sequences from a host computer. This example uses sequences #1, #2, #3, and #4 defined in the Sequence Programming section discussed earlier in this chapter. Using a terminal or a computer, key in the following commands:

Step ① Type the following commands (check responses):

Command	Response
1XU1	A20 V5 D8000 G LF
1XU2	A20 V.5 D10000 G LF
1XU3	A20 V5 D0 G LF
1XU28	A2 V.5 D8000 G LF

If you receive responses that differ from what you programmed, re-program those sequences.

Step ② Turn off power to the CX; then reapply power.

Type **XR1**. The motor should move to absolute position 8,000.

Type **XR2**. The motor should move to absolute position 10,000.

Type **XR3**. The motor should move to absolute position 0.

Type **XR28**. The motor should move back to absolute position 8,000.

If any of these moves are not executed properly, go back to step 2 and verify that all the sequences are defined properly.

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Multi-Axis Control

Device-specific commands require that a device address precede them. The CX will not execute a device-specific command if there is no device address preceding the command, or if the device address setting in the CX does not match the address preceding the command. *Universal* commands do not require device identifiers preceding them. A universal command with no device address will be executed regardless of the address setting of the CX. If a device address does precede a universal command, it will only be executed by an CX set to that particular address.

The **E** (Enable RS-232 communication) and **F** (Disable RS-232 communication) commands are useful in a daisy chain for locking out particular indexers from responding to universal commands with no preceding device address.

*The **F** command will keep the CX from executing any commands (except the **E** command) sent to it over the RS-232C interface, but will not prevent the command from being echoed.*

For Example, to lock-out the CX unit set to device address 1, so that universal commands are only executed by the CX's set to address 2 and 3, the following step is performed:

> Send the **1F** command over the RS-232C communication line, locking out the CX at device address 1.

All universal commands (with no preceding device address) will now be executed only by the CX's at Device addresses 2 and 3. Entering a **2F** command in addition to **1F** command would allow only the CX at device address 3 to execute universal commands with no preceding device address. This eliminates the need to precede every command intended for a specific CX (in this case, the CX at device address 3) with a device address. Sending an **E** command over the RS-232C line will re-enable all drives previously disabled with the **F** command. Preceding the **E** command with a device address will re-enable only the CX set to that particular device address.

When using the **XU** command to upload the contents of a specified sequence from an CX in a daisy-chain, it is necessary to disable all the drives in the chain that come after the drive being queried with the **F** command (as described above). This will prevent subsequent drives from executing the commands being sent back to the terminal. See the **XU** command description in *Chapter 5, Software Reference.*

For daisy-chain wiring instructions, refer to *Chapter 2, Getting Started.*

Sample Application and Commands

Three indexers are on an RS-232C daisy chain. Send the following commands:

Command	Description
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2 for all three indexers
V1Ø	Set velocity to 10 rps for all three indexers
1D64ØØ	Set Axis 1 distance to 6,400 steps
2D128ØØ	Set Axis 2 distance to 12,800 steps
3D192ØØ	Set Axis 3 distance to 19,200 steps
G	Execute the move (Go)

Unit 1 moves 6,400 steps, unit 2 moves 12,800 steps, and unit 3 moves 19,200 steps. All three units use the same acceleration and velocity rates. Units 1, 2, and 3 will start at about the same time (2ms apart, due to a propagation delay of 2 characters (i.e., **G +"space"**) over the RS-232C interface).

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You can use a PLC to execute 7 different sequences that are stored in the CX non-volatile memory. Six outputs from the PLC can be used to execute sequences, and two inputs to the PLC can be used to monitor CX outputs.

The PLC's program monitors two input lines connected to outputs 1 and 2. The PLC interrupts its program if input 2 goes high (current does not flow). This indicates that the CX has either lost power or a fault exists. The PLC waits until the fault line goes low again (current flows) before it finishes the current move. The PLC then goes on to the next move. This procedure is similar to the grinding application (using RS-232C), which was discussed in the previous section, Host Computer Operation. The difference between these two applications is the means of communication. The PLC communicates in BCD fashion while the computer communicates via an RS-232C interface.

Scanning for Sequence Execution

Changing the BCD values of sequence and trigger input lines results in a new sequence being run that corresponds to the new value. As indicated in Table 4-1, the configuration of the values issued determines which sequence the indexer will run. For example, turning on (grounding) SEQ2 and SEQ3 executes Sequence #7.

Issuing the **XP8** or the **XP9** commands causes the CX to scan the sequence select inputs and execute the first valid sequence it encounters (on power-up). When in XP8 mode, the CX returns control to the RS-232C port after executing the first valid sequence. When in the **XP9** mode, the CX will continue scanning inputs and executing valid sequences until you issue an **S** or a **K** command.

The Scan (**SN**) command determines how long the sequence select input must be maintained before the indexer executes the program. This is a debounce time.

Sample Applications and Commands

This section provides step-by-step procedures to run sequences from your PLC. First, you need to enter the programs into the CX drive. You will need a terminal or a computer with RS-232C communication capability. You must define the sequences before you can execute them with your PLC's BCD outputs. This example uses sequences 1, 2, 3, and 28 defined in the Sequence Programming section discussed earlier in this chapter.

Step ① Issue the **IM2** command. This selects the input mode for externally selecting up to 7 pre-defined sequences.

Step ② Verify that your programs were stored properly by uploading each entered sequence (**XU** command preceded by the device address and followed by the number of the sequence).

Command	Response
1XU1	A20 V5 D8000 G LF
1XU2	A2 V.5 D10000 G LF
1XU3	A20 V5 D0 G LF
1XU28	A2 V.5 D8000 G LF

If you receive responses that differ from what you programmed, re-enter those sequences.

Step ③ Cycle Power or enter the **Z** command. The CX will go through the normal **XP9** mode-type operation. The CX scans the sequence select inputs and selects and executes the first available valid sequence according to the binary value of the three inputs. After the sequence is executed, the inputs are again scanned to execute another sequence. The CX will continue to execute sequence in this fashion until you issue an **S** or a **K** command, or if an end-of-travel limit is encountered.

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Step ④ To run sequence #1, momentarily close the switch from TRIG 1 to GND (equal to BCD 1 on a PLC), then open the switch. The motor moves to absolute position 8,000.

Step ⑤ To run sequence #3, momentarily close the switch from TRIG1 and TRIG2 to GND at the same time (equal to BCD 3 on a PLC), then open both switches. The motor should go back to absolute position 0.

Step ⑥ To run sequence #2, momentarily close the switch from SEQ1 and SEQ3 to GND at the same time (equal to BCD 28 on a PLC), then open both inputs. The motor should move at 0.5 rps to position 8,000.

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C H A P T E R ⑤

Software Reference

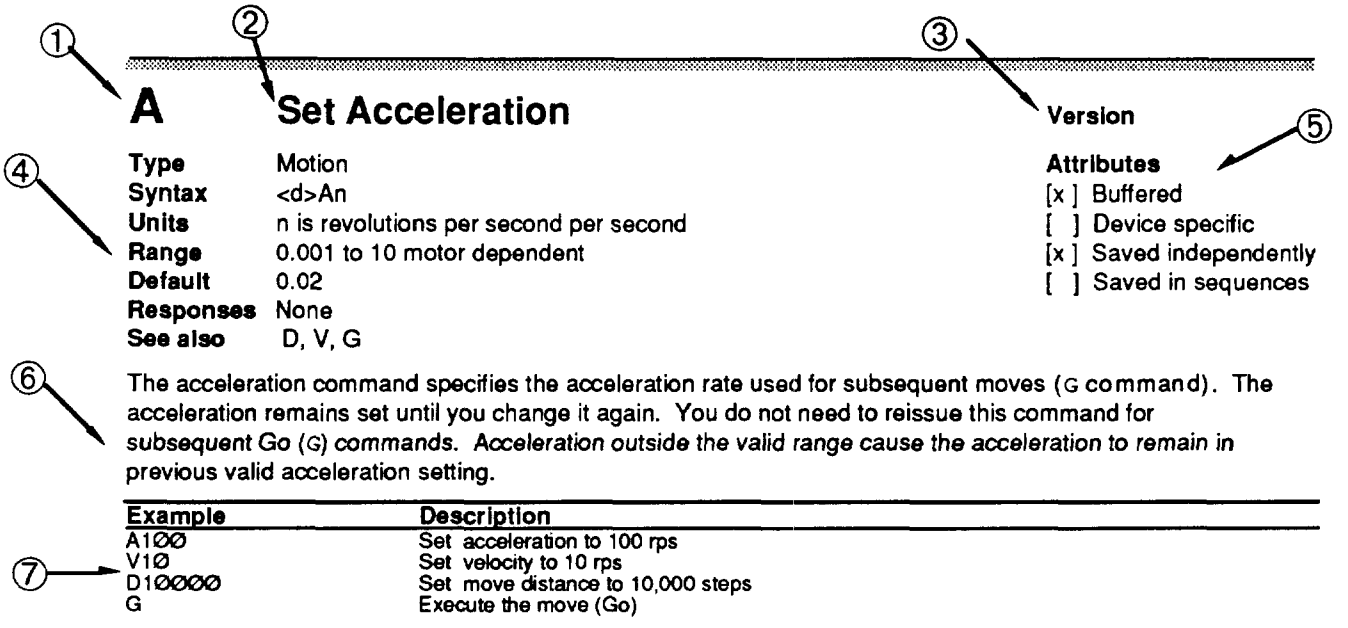
Chapter Objectives

The information in this chapter will enable you to:

- Identify the four types of commands in Compumotor's X-Series Language
- Use this chapter as a reference for the function, range, default, and sample use of each command

Description of Format

The following section describes the format of the command descriptions used in this chapter. The numbered arrows refer to the numbered sections below the drawing.



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① Command Identifier

The letter or letters used to represent the command.

② Command name

This name used to refer to the command. For example, Acceleration for the A command.

③ Version

The revision of software in the CX Indexer/Drive when the described command was first introduced or last modified. If the revision level of the software you are using is equal to or greater than the revision level listed here, the command is available in your unit. You can determine the level of software in your CX Indexer/Drive by issuing the Revision Level (RV) command.

④ Characteristics

The following sections describe the main characteristics of the command.

Type

This portion of the box contains the command's type. The four command types are listed below.

Set-Up: These commands define Set-Up conditions for the application. Set-Up commands include the following types of commands:

- ❑ Homing (go home acceleration and velocity, etc.)
- ❑ Input/Output (limits, scan time, in-position time, etc.)
- ❑ General (set switches, return to factory settings, etc.)

Programming: Programming commands affect programming and program flow. For example, trigger, output, all sequence commands, time delays, pause and continue, loop and end loop, line feed, carriage return, and backspace.

Status: Status commands respond (report back) information.

Motion: *Motion commands affect motor motion (for example, acceleration, velocity, distance, go home, stop, direction, mode, etc.)*

Syntax

This field shows the syntax for the command. CX Indexer/Drive commands use the following generic syntax: `acspd`

Variable a — This variable is the device address. If the address is optional it is shown in angle brackets: **<d>**. Only commands which require the CX Indexer/Drive to send a response require a device address. All commands may use a device address to designate which unit on a daisy chain the command is intended for.

Variable c — This variable is the command identifier, which is one or more letters.

Variable s — This variable represents a sign. A sign is not allowed for all commands. The **s** is not shown in the syntax if not allowed.

Variable n — This variable represents the parameters the command requires. There may be zero or more parameters. If the number of parameters is zero **n** is not shown in the syntax

Variable d — This variable is the end of command delimiter. This is always required and is not shown in the following descriptions for clarity. The delimiter may be a space character or a carriage return.

Units

This field describes what unit of measurement the parameter in the command syntax represents.

Range

This is the range of valid values that you can specify for **n** (or any other parameter specified).

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Default

The default setting for the command is shown in this box. A command will perform its function with the default setting if you do not provide a value.

Response

The response to the command is shown in this box. Status commands report a condition in the indexer. Status commands do not affect the status they read.

Commands that set parameters report the parameters when the command is issued without a parameter. For example, **IM2** sets the input mode to 2 rps, but **1IM** returns the current setting. ***Note:*** *To receive a response, a device address is required.*

See Also

Commands that are related or similar to the command described are listed here.

⑤ Attributes

Each command has attributes as shown below.

Attributes
[x] Buffered
[ ] Device specific
[x] Independently saved
[ ] Saved in sequences

Buffered

If the Buffered box is checked the command is buffered. If it is not checked the command is acted on immediately. Buffered commands are executed in the order they are received. An internal buffer, or storage area, holds the commands in a queue until the previous command has been executed.

Immediate commands are executed as they are received. Immediate commands are executed even if the command buffer has commands in it. For example, the Stop (**S**) command is immediate. When a Stop command is received the motor is stopped as soon as the command is received. The CX Indexer/Drive does not process the commands in its command buffer before stopping the motor.

Device specific

If the Device specific box is checked the command requires a device identifier. If it is not checked the command may be used with or without a device identifier. Commands which are device specific are normally Status commands. Device specific commands have a syntax description with a d by itself before the command. If it is not device specific the command syntax description has a **<d>** in angle brackets before the command.

Saved always

If the Independently saved box is checked the parameter controlled by the command is always saved. This differs from commands which may only be saved in sequences and those which are never saved. If neither the Saved always nor the Saved in sequences box is checked the command is never saved.

Saved in sequences

If the Saved in sequences box is checked the command will be saved only if it is in a sequence .

⑥ Description

A description of the command appears in this area along with any special considerations you should know about.

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⑦ Example

An example of how to use the command appears in this area. The left column contains the commands you would issue to the CX Indexer/Drive. The right column contains descriptions of what the commands do in the program.

Alphabetical Command List

A Acceleration

Version A

Type Motion
Syntax <a>An
Units n = rps2
Range 0.01 - 999.999
Default 100
Response None
See also D, G, V

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Acceleration command specifies the acceleration rate to be used upon executing the next Go (G) command. The acceleration remains set until you change it. You do not need to reissue this command for subsequent G commands. Accelerations outside the valid range cause the acceleration to remain in the previous valid A setting.

Command	Description
> MN	Set to Normal mode
> A5	Set acceleration to 5 rps^2
> V1Ø	Set velocity to 10 rps
> D1ØØØØ	Set distance to 10,000 steps
> G	Execute the move (Go)

AC Acceleration Change

Version A

Type Motion
Syntax <a>ACn
Units n = rps2
Range 0.01 - 999.999
Default 0
Response None
See also MC, A, VC

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Acceleration Change (AC) command is used only when the motor is moving in Continuous Mode (MC). The command allows velocity changes at different acceleration while moving. The command is used in conjunction with the velocity change command (VC).

This command is independent of the Acceleration (A) command, which affects the acceleration for preset moves and the initial acceleration for continuous moves. If the AC command is not issued during a continuous move the motor decelerates using the previous value of acceleration.

Command	Description
MC	Set to Continuous mode
A1Ø	Set acceleration to 10 rps^2
V1Ø	Set velocity to 10 rps
G	Execute the move (Go)
AC5	Change acceleration to 5 rps^2
VCØ	Decelerate to Zero Velocity

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B Buffer Status Report

Version A

Type Status
Syntax a**B**
Units None
Range None
Default None
Response *B or *R
See also BS

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The buffer status command will report the status of the command buffer. If the command buffer is empty or less than 90% full, the controller will respond with a *R[cr].

The command buffer is 384 bytes long. A *B[cr] response will be issued if less than 10% of the command buffer is free.

*R = More than 10% of the buffer is free

*B = Less than 10% of the buffer is free

This command is commonly used when a long series of commands will be loaded remotely. If the buffer size is exceeded, the extra commands will not be received by the Controller.

Command	Response
1B	*R (more than 10% of the Buffer is free)

BS Buffer Size Status

Version A

Type Status
Syntax a**BS**
Units None
Range None
Default None
Response nnn
See also B

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command reports the number of bytes remaining in the command buffer. When entering long string commands, check the buffer status to be sure that there is enough room in the buffer. Otherwise, commands may be lost. Each character (including delimiters) uses one byte. The range for the response is 000 - 384 bytes.

Command	Response
1BS	1ØØ (Space for 100 characters is remaining in the command buffer.)

C Continue

Version A

Type Status
Syntax <a>**C**
Units None
Range None
Default None
Response None
See also PS, U

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Continue (C) command ends a pause state. It enables your indexer to continue executing buffered commands. After you initiate a pause with the Pause (PS) command or the Pause and Wait for Continue (U) command, you can clear it with a Continue (C) command. This command is useful when you want to transmit a string of commands to the command buffer before you actually need to execute them.

Command	Description
PS	Pause execution until the indexer receives a C command
MC	Set to Continuous mode
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
G	Execute the move (Go)
C	Start executing commands in buffer

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CA Change Acceleration

Version A

Type Motion
Syntax <a>CAn
Units n = rps2
Range 0.00 - 999.99
Default 0
Response None
See also MC, A, CV, CTR, CTM, CBC

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Functionally, the CA command is the same as the AC command. If an acceleration change is required while the motor is moving, use the AC command. If the change is needed within a sequence, or needs to be buffered with other commands, the CA command must be used rather than the AC command. The new acceleration value entered with the CA command becomes the value used with all subsequent changes in velocity until a new CA is entered or the velocity reaches zero.

NOTE: Both CA and AC commands can be used only in continuous mode (MC) operation.

Command	Description
MC	Set to Continuous mode
A25	Set acceleration to 25 rps^2
V5	Set velocity to 5 rps
CTM5	Remain at velocity for 5 seconds
CV1	Decelerate at 25 rps^2 to 1 rps
CTRXX1	Wait for trigger input 3 to go high
CA5	Accelerate at 5 rps^2
CV1Ø	Set velocity to 10 rps
CTM5	Remain at previous velocity for 5 seconds
CVØ	Change velocity to zero rps
G	Execute the move (Go)

CBC Clear Buffered Commands

Version A

Type Programming
Syntax <a>CBC
Units None
Range None
Default None
Response None
See also CA, CB, CTR, CTM

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The CBC command clears the command buffer while in continuous mode at constant velocity. The K (Kill) and S (Stop) commands will clear the buffers but these are immediate commands and will stop all motion as well. The CBC command will clear the command buffer without affecting the move in progress.

Command	Description
MC	Set to Continuous mode
A25	Set acceleration to 25 rps^2
V5	Set velocity to 5 rps
CTM5	Remain at previous velocity for 5 seconds
CV1	Change velocity to 1 rps
CA5	Change acceleration to 5 rps^2
G	Execute the move (Go)
CBC	Clear command buffer of above commands. System will remain at last entered constant velocity (1 rps)

CTM Continuous Time

Version A

Type Programming
Syntax <a>CTMn
Units n = seconds
Range 0.01 - 999.99
Default 0
Response None
See also CV, CA, CTR, T

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Issuing this command while in continuous mode will cause a delay of the specified number of seconds before executing the next command in the buffer. A Time Delay (T) command will not work in continuous mode.

Command	Description
MC	Set to Continuous mode.
A25	Set Acceleration to 25 rps^2.
V5	Set Velocity to 5 rps.
CTM5	Wait 5 seconds before executing the next command.
CVØ	Change Velocity to 0 rps.
G	Execute the move (Go)

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CTR Constant Velocity Wait for Trigger

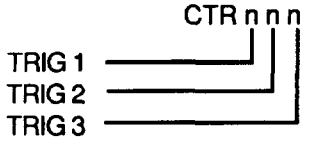
Version A

Type Motion
Syntax <a>CTRn
Units n = velocity
Range 0, 1, or X
Default None
Response None
See also CA, CV, CTM, CBC

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Triggers are used to synchronize indexer operations with external events. They can be used to implement a handshaking function with other devices. The three characters used for nnn variables are listed below:

n=1: Wait for the trigger input to be high (opened)
n=0: Wait for the trigger input to be low (grounded)
n=X: Ignore the trigger input



When CTR command is used in a buffer, the indexer will get to this command and wait until the input pattern is matched before going on to the next command. ***NOTE: This command is used only for moves in the continuous mode while the motor is moving. If the motor is not moving, even if in continuous mode, then use the TR command.***

Command	Description
MC	Set to Continuous mode
A25	Set acceleration to 25 rps^2
V5	Set velocity to 5 rps
CTM5	Dwell 5 seconds after reaching constant velocity
CV1	Ramp at last set acceleration to 1 rps
CTRXX1	Wait on trigger 3 to go high before continuing (ignore triggers 1 & 2)
CA5	Set acceleration for continuous mode velocity changes during this move.
CV1Ø	Ramp to a velocity 10 rps at acceleration rate set with CA command
CTM5	Dwell for 5 seconds
CVØ	Ramp to a velocity of zero at acceleration rate set with CA command
G	Execute the move (Go)

CV Change Velocity

Version A

Type Motion
Syntax <a>CVn
Units n = rps
Range 00.001 - 50.000
Default 0
Response None
See also CA, TR, CTM, CBC, VC

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command allows you to change the motor's velocity while operating in the continuous mode (MC). This command does not change the velocity value set by the V command.

Command	Description
MC	Set to Continuous mode
A25	Set acceleration to 25 rps^2
V5	Set velocity to 5 rps
CTM5	Dwell 5 seconds after reaching constant velocity
CV1	Ramp at last set acceleration to 1 rps
CTRXX1	Wait on trigger 3 to go high before continuing
CA5	Set acceleration to 5 revs/sec^2 for continuous mode velocity changes during this move.
CV1Ø	Ramp to a velocity 10 rps at acceleration rate set with CA command
CTM5	Dwell for 5 seconds
CVØ	Ramp to a velocity of zero at acceleration rate set with CA command
G	Execute the move (Go)

After the G command is issued, the motor will accelerate at 25 rps^2 to a velocity of 5 rps. The motor will remain at 5 rps for 5 seconds and then decelerate at 25 rps^2 to 1 rps; it will operate continuously at the velocity until Trigger input 3 goes high (not pulled to 0 volts). When Trigger input 3 goes high, the motor will accelerate at 5 rps^2 to 10 rps. The motor will remain at 10 rps for 5 seconds, and then decelerate at 5 rps2 to zero velocity.

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D Distance

Version A

Type Motion
Syntax <a>Dn
Units n = steps
Range 0 - ±1,999,999,999
Default 0
Response None
See also A, G, V, MN

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Distance (D) command defines either the number of steps the motor will move or the absolute position it will seek after a Go (G) command is entered.

In Incremental mode (MPI), the value set with the Distance (D) command will be the distance (in steps) the motor will travel on all subsequent Go (G) commands.

In Absolute mode (MPA), the distance moved by the motor will be the difference between the current motor position and the position (referenced to the zero position) set with the D command. A distance must be defined with the D command before a preset move can be executed. The Distance (D) command has no effect on continuous moves (MC).

Command	Description
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2
V1Ø	Set velocity to 10 rps
D64ØØØ	Set distance to 64,000 steps
G	Execute the move (Go)

E Enable Communications Interface

Version A

Type Programming
Syntax <a>E
Units None
Range None
Default None
Response None
See also F

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Enable Communications Interface (E) command allows the indexer to accept commands over the communications interface. You can re-enable the communications interface with this command if you had previously disabled the interface with the Disable Communications Interface (F) command. This command is useful when units are daisy-chained and you want to upload a sequence without other indexers executing the commands issued.

Command	Description
F	Disable all units (axes) on the communications interface
4E	Enable unit 4
4XU5	Upload Sequence from Device 4
E	Enable all devices

F Disable Communications Interface

Version A

Type Programming
Syntax <a>F
Units None
Range None
Default None
Response None
See also E

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Disable Communications Interface (F) command is useful when you are programming multiple units on a single interface. Axes that are not intended to process global commands receive device specific F commands. This allows you to program other units without specifying a device identifier on every command. If you do not disable other units in a daisy chain, uploading programs may cause other units on the daisy chain to perform uploaded commands.

Command	Description
1F	Disable the communications interface on the unit with device address 1
3F	Disable the communications interface on the unit with device address 3
G	All of the indexers except 1 and 3 will execute a move (Go)

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G Go

Version A

Type Motion
Syntax <a>G
Units None
Range None
Default None
Response None
See also S, MN, MC, A, V, D, RA, RB, RC

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Go (G) command instructs the motor to make a move using motion parameters that you have previously entered. You do not have to re-enter Acceleration (A), Velocity (V), Distance (D), or the current mode (MN or MC) commands with each G command. In the Incremental Preset mode (MPI), a G command will initiate the steps you specified with the D command.

A repeated Go (G) command in the Absolute Preset mode (MPA) will not cause motion unless you enter a change in D command first. In the Continuous mode (MC), you only need to enter the A and V commands prior to the G command. The system ignores the D command in this mode. No motor motion will occur until you enter the G command in both the Normal (MN) and Continuous (MC) modes. If motion does not occur with the G command, enter the status commands RA, RB, and RC.

Command	Description
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2
V1Ø	Set velocity to 10 rps
D256ØØ	Set distance to 25,600 steps
G	Execute the move (Go)
A1	Set acceleration to 1 rps^2
G	Execute the move (Go), moves 25,000 steps

Assuming the indexer is in the incremental preset mode (MPI), the motor turns 25,600 steps, then repeats the 25,600-step move using the new Acceleration (A) value of 1 rps^2 (total distance moved = 51,200 steps).

GH Go Home

Version A

Type Motion
Syntax <a>GHsn
Units n = rps
Range ±0.01 - ±50.00
Default 0
Response None
See also RC, V

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Go Home (GH) command instructs the controller to search for a home switch in the positive or negative direction at the commanded velocity. This value overwrites the old V command value at the commanded velocity. It causes the controller to seek the home position, whether in the motor step mode, or the encoder step mode. If in the motor step mode, the controller looks only at the Home Limit input. It will define Home as the position where the Home Limit signal changed states nearest the edge selected with the OS command. As soon as the selected edge is detected (usually via a load activated switch) the motor decelerates to a velocity of 0. The controller will then position the motor 1/32 of a rev on the outside of the selected edge. Finally, the motor will creep at .1 rps in the direction of the home active region, it will then stop, and the Homing process will be complete.

The process is the same in encoder step mode (MPI), except the controller also looks for the Z Channel input as well as the Home Limit input to be active at the same time. This means that the Z Channel pulse must be *enveloped* by the active region of the Home Limit input. When both are active the controller defines that position as the home position.

The controller will reverse direction if an End-Of-Travel limit is activated while searching for Home; however, if a second End-Of-Travel limit is encountered in the new direction, the Go Home procedure will stop and the operation will be aborted. The RC command will indicate if the operation was successful. If the Backup To Home Switch function is disabled with the OSBØ command, the motor will be considered at Home only if the Home limit input is still active at the end of the deceleration, following the encounter of the selected edge of the home switch. *See the OS command descriptions.*

When the Go Home routine is complete, the indexer automatically resets the absolute position counter to zero. This is equivalent to issuing the Position Zero (PZ) command.

Command	Description
GH-2	The motor moves in the negative direction (CCW) at 2 rps and looks for the Home Limit input to go active.

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^H Backspace

Version A

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Type Programming
Syntax ^H
Units None
Range None
Default None
Response None
See also None

This command allows you to delete the last character that you entered (unless it was a delimiter). The ^H command will not prevent execution of an immediate command. A new character may be entered at that position to replace the existing character. (^H indicates that the Ctrl key is held down when the H key is pressed.) This command prompts the indexer to backup one character in the command buffer, regardless of what appears on the terminal. On some terminals, the Ctrl and the left arrow <-- keys produce the same character. *Pressing the delete key does not delete the previous character.*

H Set Direction

Version A

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Type Motion
Syntax <a>Hs
Units s = direction
Range ±
Default +
Response None
See also D

The Set Direction (**H**) command changes or defines the direction of the next move that the system will execute. This command does not effect moves already in progress.

H+	=	Sets move to CW direction
H-	=	Sets move to CCW direction
H	=	Changes direction from the previous setting

In preset moves, a Distance (D) command entered after the Set Direction (H) command overrides the direction set by the H command. In Continuous mode(MC) only the Set Direction (H) command can set the direction of motion.

Command	Description
MN	Set to Normal mode
A5	Set acceleration to 5 revs/sec^2
V5	Set velocity to 5 revs/sec
D256ØØ	Set distance to 25,600 steps
G	Execute the move (Go) in CW direction
H	Reverse direction
G	Execute the move (Go) in CCW direction
MC	Set mode to continuous
H+	Set direction to CW
G	Move continuously in CW direction

IM Input Mode

Version A

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Type Set-Up
Syntax <a>IMn
Units n = mode
Range 1 or 2
Default 1
Response 1 or 2
See also None

IM1 sets the input mode to the standard CX configuration, where the maximum number of sequences is 7.

If the IM command is issued for the mode in which the CX is presently programmed, the command is ignored. If you include an address digit, but do not specify a mode, the system will report the unit's present mode. ***If the mode is changed, all existing sequences will be lost.***

IM2 sets the input mode for external selection of up to 39 pre-defined sequences. An additional sequence, Sequence 40, cannot be selected through remote inputs. Each sequence can consist of a single move if desired, giving 39 moves selected by the external inputs. Each sequence is 48 bytes (characters) long. In spite of the sequences' length, in most absolute applications it is desirable to define only one move per sequence. If you try to put more than 48 characters in 1 sequence, the whole sequence will be ignored.

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When in the IM2 mode, the home input serves as another sequence select input. The hex weighing of the sequence select pins has been modified to:

Input Name	Home	AS Slct 1	AS Slct 2	AS Slct 3
Pin Number	11	14	15	16
BCD Value	1	2	4	8

Sequence 7 may be run automatically on power-up, if XP7 is entered. It can be run by issuing the XR7 command. Sequence 40 cannot be selected via the external I/O. Invalid BCD combinations will be ignored.

Sequence 7 is typically used to store all set-up parameters. You may put a velocity and acceleration in sequence 7 if your application does not require them to change. This will save some execution time.

After execution of the power-up sequence (usually sequence 7) is completed, control will pass to the external BCD inputs. Sequence 0 always specifies a no move. All of the sequence commands have been modified to work with the expanded number of available sequences. Any of the available sequences may be run through the RS-232C link.

With the CX in IM2 mode, the output operates as a Moving/Not Moving indicator. It is ON (provides current path) while moving (executing a move), and OFF when not moving.

With the CX in IM2 mode, the output indicates Fault/No Fault. It is ON (provides a current path) under normal operation. OFF indicates a fault or a loss of power. A fault is cleared by the start of the next move.

When the CX is in the IM2 mode, there are three methods available for predefined sequence execution.

① Provide contact closure in BCD fashion to call up the desired sequence to be performed. The CX scans the inputs looking for the sequence number to execute.

② By entering XR1 - XR7 at the end of sequence, the length of the sequence may be increased. Once the power-up sequence is complete, the CX begins scanning the BCD inputs for further sequence execution. Sequence 40 is typically defined as the power-up sequence with the XP7 command.

③ Any sequence may be executed over the RS-232C interface with the XR command. Entering XR1 - XR7 prompts the system to execute the designated sequence.

K Kill

Version A

Type Motion
Syntax <a>K
Units None
Range None
Default None
Response None
See also S, FSC

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Kill (K) command is an emergency stop command and should only be used as such. This command causes indexing to cease immediately. There is *ino nfinite* deceleration of the motor.

WARNING

The Kill command may cause the motor to lose torque. The load could be driven past limit switches and cause damage to the mechanism and possibly to the operator.

In addition to stopping the motor, the K command will terminate a loop, end a time delay, abort down-loading a sequence (XD), and clear the command buffer.

Command	Description
A5	Set acceleration to 5 rps^2
V2	Set velocity to 2 rps
MC	Set mode to continuous
G	Execute the move (Go)
•	
•	
•	
K	*Stop the motor instantly*

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L Loop

Version A

Type Programming
Syntax <a>Ln
Units n = loops
Range 0 - 65,535
Default 0 (Infinite)
Response None
See also Y, N, U, C

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

When you combine the Loop (L) command with the End-of-Loop (N) command, all of the commands between L and N will be repeated the number of times indicated by *n*. If you enter the L command without a value specified for *n*, or with a Ø, subsequent commands will be repeated indefinitely.

The End-of-Loop command prompts the indexer to proceed with further commands after the designated number of loops have been executed. The Stop Loop (Y) command causes Loop execution to stop. The Immediate Pause (U) command allows you to temporarily halt loop execution. You can use the Continue (C) command to resume loop execution.

Command	Description
A5	Set acceleration to 5 rps^2
V1Ø	Set velocity to 10 rps
D256ØØ	Set distance to 25,600 steps
L5	Loop 5 times
G	*Execute the move (Go)*
N	Specifie the above 25,600-step move to be repeated five times

LD Limit Disable

Version A

Type Set-Up
Syntax <a>LDn
Units n = enable/disable
Range 0 - 3
Default 0
Response None
See also RA

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Limit Disable (LD) command allows you to enable/disable the end-of-travel limit switch protection. The LDØ condition does not allow the motor to turn without properly installing the limit inputs. If you want motion without wiring the limits, you must issue the LD3 command.

n = 0: Enable CCW and CW limits
n = 1: Disable CW limit
n = 2: Disable CCW limit
n = 3: Disable CCW and CW limit

Command	Description
LDØ	Enable CW and CCW limits.
LD3	Allows you to make any move, regardless of the limit input state.

MC Continuous Mode

Version A

Type Motion
Syntax <a>MC
Units None
Range None
Default None
Response None
See also MN, MA, CA, CV, CTR, CTM

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Mode Continuous (MC) command causes subsequent moves to ignore any distance parameter and move continuously. You can clear the MC command with the Move Normal (MN) command. The indexer uses the Acceleration (A) and Velocity (V) commands to reach continuous velocity.

Using the Time Delay (CTM), Trigger (CTR), and Change Acceleration (CA) commands, you can achieve basic velocity profiling.

Command	Description
MC	Set to Continuous mode.
A25	Set Acceleration to 25 rps^2.
V5	Set Velocity to 5 rps.
CTM5	Wait 5 seconds before executing the next command.
CVØ	Change Velocity to 0 rps.
G	Execute the move (Go)

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MN Normal Mode

Version A

Type Motion
Syntax <a>**MN**
Units None
Range None
Default None
Response None
See also MC, D, A, V

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Mode Normal (**MN**) command sets the positioning mode to preset. In Mode Normal, the motor will move the distance specified with the distance (**D**) command. To define the complete move profile, you must define Acceleration (**A**), Velocity (**V**), and the Distance (**D**). The **MN** command is used to change the mode of operation from Mode Continuous (**MC**) to Mode Normal, or *preset*.

To use the **MPA** or **MPI** commands, the indexer must be in mode normal (**MN**).

Command	Description
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
D64ØØ	Set distance to 6,400 steps
G	Execute the move (Go)

MPA Absolute Position Mode

Version A

Type Set-Up
Syntax <a>**MPA**
Units None
Range None
Default None
Response None
See also MN, MPI, D, PZ

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command sets the positioning mode to absolute. In this mode all move distances are referenced to absolute zero. NOTE: In absolute preset mode (**MPA**), giving two consecutive go (**G**) commands will cause the motor to move once, since the motor will have achieved its desired absolute position at the end of the first move.

Mode Position Absolute (**MPA**) is most useful in applications that require moves to specific locations, while keeping track of the beginning position.

You can set the absolute counter to zero by cycling power or issuing a Position Zero (**PZ**) command.

The indexer must be in Mode Normal (**MN**) to use this command. In Continuous Mode (**MC**), this command is ignored.

Command	Description
MN	Set to Normal mode
MPA	Set to Absolute Position mode
A5	Set acceleration to 5 rps^2
V1Ø	Set velocity to 10 rps
D256ØØ	Set distance to +25,600 steps
G	Motor will move to absolute position +25,600
D128ØØ	Set absolute position to +12,800 steps
G	Motor will move CCW to absolute position +12,800

MPI Incremental Position Mode

Version A

Type Set-Up
Syntax <a>**MPI**
Units None
Range None
Default None
Response None
See also MN, MPA, D

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command sets the positioning mode to incremental. In incremental mode all move distances specified with the Distance (**D**) command will be referenced to the current position. Mode Position Incremental (**MPI**) is most useful in applications that require repetitive movements, such as feed to length applications.

The indexer must be in Mode Normal (**MN**) to use this command. In Continuous Mode (**MC**), this command is ignored.

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Command	Description
MN	Set to Normal mode
MPI	Set to Incremental Position mode
A5	Sets acceleration to 5 rps^2
V1Ø	Sets velocity to 10 rps
D64ØØ	Sets distance of move to 6,400 steps
G	Move 6,400 steps CW
G	Move another 6,400 steps CW

N End of Loop

Version A

Type Programming
Syntax <a>N
Units None
Range None
Default None
Response None
See also L, PS, C, Y

Attributes
[X] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command marks the end of loop. You can use this command in conjunction with the Loop (L) command. All buffered commands that you enter between the L and N commands are executed as many times as the number that you enter following the L command.

Command	Description
PS	Pauses the execution until the indexer receives a Continue (C) command
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
D256ØØ	Set move distance to 25,600 steps
L5	Loop five times
G	Execute the move (Go)
N	End the loop
C	Clear pause and executes all the buffered commands

O Output

Version A

Type Programming
Syntax <a>On
Units n = output on/off
Range 0, 1, or X
Default None
Response None
See also OFA, OFB

Attributes
[X] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Output (O) command turns the programmable output bit on and off. This is used for signaling remote controllers, turning on LEDs, or sounding whistles. The output can indicate that the motor is in position, about to begin its move, or is at constant velocity, etc. The command is in the form On, where *nn* represents the output. The valid values for *n* are as follows:

1 = Turns on output
0 = Turns off output
X = Leaves output unchanged

Command	Description
A1Ø	Set acceleration to 10 rps^2
V5	Sets velocity to 5 rps
D256ØØ	Set move distance to 25,600 steps
O1	Set programmable output to on
G	Executes the move (Go)
OØ	After the move ends, turns the output off

Ox,Dyy Output on Position

Version A

Type Programming
Syntax <a>Ox,Dyyyy
Units y = steps, x = 0, 1
Range y = 0 - ±999,999,999
Default None
Response None
See also O

Attributes
[X] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

At the distance y, change the state of the output to x. The distance applies to either direction. The steps are incremental. The output on position feature only works with OFC on. Activating the POB does not disable the command (i.e., during the next move the POB-on-the-fly feature will be active).

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Command	Description
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5rps
MPA	Set to Absolute Position mode
O1,D25ØØØ	Turn on POB after traveling 25,000 steps
PZ	Set absolute counter to zero
OØ	Turn on POB
D2ØØØØ	Set distance to 20,000 steps
G	Execute the move (Go)
D4ØØØØ	Set distance to 40,000 steps
G	Execute the move (Go) POB turns on at absolute position

OFA Set-Up Output as Sequence Status

Version A

Type Set-Up
Syntax <a>**OFA**
Units None
Range None
Default None
Response None
See also OFB, OFC, O

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Select the output as *End of Sequence* status output. Issue this command only when **OFB** command is previously issued.

The current will flow when when the sequence is finished (**ON**). The current will not flow is sequence is still running (**OFF**).

Command	Description
OFA	Output will act as *End-of-Sequence* status until OFB command is issued.

OFB Set-Up Output as Programmable Output

Version A

Type Set-Up
Syntax <a>**OFB**
Units None
Range None
Default None
Response None
See also OFA, OFC, O

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Select the output as programmable output. The output can be toggled on and off within the program. Which enables the user to turn external devices on and off. This command also enables you to use the output as moving/not moving output.

Command	Description
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D1ØØØØ	Set move distance to 10000 steps
OFB	Set programmable output
O1	Turn on output 1
G	Executes the move (Go)
OØ	As soon as move is finished, turn off output 1.
OFA	Setup output as a *End-of-Sequence* Status.

OFC Set-Up Output as Programmable Output-On-The-Fly

Version A

Type Set-Up
Syntax <a>**OFC**n
Units None
Range None
Default None
Response None
See also OFA, OFB, O

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This mode is identical to the OFB mode with the addition of a POB-on-the-fly feature. The POB can be turned on or off at a specific distance into a move through the use of the Ox,Dyyyy command. The POB-on-the-fly values are checked only while moving. The default value on power-up is to turn off the POB at distance 0. If no Ox,Dyyyy values are entered a OØ,D0 command is assumed. This parameter is saved in EEPROM.

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Command	Description
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D1ØØØØ	Set move distance to 10000 steps
OFB	Set programmable output
O1	Turn on output 1
G	Executes the move (Go)
OØ	As soon as move is finished, turn off output 1.
OFA	Setup output as a *End-of-Sequence* Status.

PR Absolute Position Report

Version A

Type Status
Syntax a**PR**
Units None
Range None
Default None
Response ±nnnnnnnnnn
See also MPI, MPA, MON, PZ, D, PX, PXA

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Reports motor position with respect to power up position or last place a **PZ** command was issued. The absolute position counter can track (report on) up to $\pm 2^{31}$ -1, or 2,147,483,647 steps. If the counter is overrun in the relative position mode (by running the motor continuously for long periods of time, 24 hours at 20 rps and 5,000 steps per rev), the absolute position will be invalid.

You may reset the position counter to zero with the Position Zero (PZ) command.

Command	Description
PZ	Resets the absolute counter to zero
LD3	Disable both CW & CCW limits
MN	Set to Normal mode
A1Ø	Set Acceleration to 10 rps^2
V5	Set velocity to 5 rps
D256ØØ	Set move distance to 25,600 steps
G	Executes the move (Go)
1PR	Request absolute position report. (Response should be +0000025600)

PS Pause

Version A

Type Programming
Syntax <a>**PS**
Units None
Range None
Default None
Response None
See also C, U

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command pauses execution of a command string or sequence following the Pause (PS) command until the indexer receives a Continue (C) command. This command is useful if you need to enter a complete string of commands before you can execute your other commands.

This command is useful for interactive tests and in synchronizing multiple indexes that have long command strings.

Command	Description
PS	Pauses execution until the indexer receives the Continue (C) command
A5	Sets acceleration to 5 rps^2
V5	Sets velocity to 5 rps
D256ØØ	Sets move distance to 25,600 steps
G	Executes the move (Go)
T2	Delays the move for 2 sec
G	Executes the move (Go)
C	Continues execution

PZ Set Absolute Counter to Zero

Version A

Type Set-Up
Syntax <a>**PZ**
Units None
Range None
Default None
Response None
See also MN, MPI, MPA, PR, D, PX

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command sets the absolute position counter to zero. If the motor does not move after the last **PZ** command, the response will be +0000000000.

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Command	Description
MPA	Set to Absolute Preset mode
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D256ØØ	Set move distance to 25,600 steps
G	Execute the move (Go)
1PR	Response = +0000025600
PZ	Set the absolute counter to zero
1PR	Response = +0000000000

" Quote

Version A

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Type Programming
Syntax <a>"x
Units x = ASCII characters
Range up to any 12 characters
Default None
Response x
See also CR

Any characters entered after the quotation marks (") (up to 12 characters) will be transmitted, exactly as they were entered over the RS-232C link. A space entered by the space bar indicates the end of the command. You must use a character such as an underscore (_) to represent a space in the message. A space is always sent after the last character in the string. This command is used during buffered moves or sequences, or to command other Compumotor devices to move.

Command	Description
PS	Set pause of execution of current command string
MPA	Set to Absolute Position mode
A25	Set acceleration to 25 rps^2
V5	Set velocity to 5 rps
D125Ø	Set distance to 1,250 steps
G	Execute the move (Go)
"MOVE_DONE	Report back MOVE_DONE
C	Continue the move

The motor will travel to an absolute position of 1,250 steps. Upon completion of this move, the CX will send the message MOVE_DONE out the RS-232C port.

Command	Description
A25	Set acceleration to 25 rps^2
V5	Set velocity to 5 rps
D25ØØØ	Set distance to 25,000 steps
G	Execute the move (Go)
"2XR1	Report back 2XR1

Once the CX completes its move, it instructs a second CX to run sequence 1.

Q Enter/Exit Velocity Profiling Mode

Version A

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Type Set-Up
Syntax <a>Qn
Units None
Range None
Default None
Response None
See also QØ, RM

The Q1 command enters the indexer in the velocity profiling mode. Subsequent RM commands will cause an immediate change in motor velocity. The QØ command exits the velocity profiling mode. The motor will stop when QØ is issued.

Command	Description
Q1	Enter Velocity Streaming mode
RMØ19Ø	Accelerate to 1 rps
RMØ32Ø	Accelerate to 2 rps
RMØ46Ø	Accelerate to 3 rps
RMØ64Ø	Accelerate to 4 rps
RMØ46Ø	Decelerate to 3 rps
RMØ32Ø	Decelerate to 2 rps
RMØ19Ø	Decelerate to 1 rps
RMØØØØ	Decelerate to 0 rps
QØ	Exit Velocity Streaming mode

Motor movement will stop when QØ command is entered.

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R Request Indexer Status

Version A

Type Status
Syntax aR
Units None
Range None
Default None
Response *x
See also PVF, RA, RB, RC

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Request Indexer Status (R) command can be used to indicate the general status of the indexer. Possible responses are as follows:

Response	Definition
*R	Ready
*S	Ready, Attention Needed
*B	Busy
*C	Busy, Attention Needed

The following conditions will cause a response indicating that the indexer is busy:

- Performing a preset move
- Accelerating/decelerating during a continuous move
- A time delay is in progress. (T command)
- In RM mode
- Paused
- Waiting on a Trigger
- Going Home
- Running a sequence
- Executing a loop

The following conditions will cause a response indicating than an error exists:

- Go home failed
- Limit has been encountered
- Sequence execution was unsuccessful

When the response indicates that attention is required, more details on the error condition are available by using the RA, RB, or RC commands.

It is not recommended that this command be used in tight polling loops which could result in microprocessor over load. Time delays can alleviate this problem.

This command is not intended to be used to determine if a move is complete. Rather, it should be used after the move is complete to determine if there might be other errors or faults.

Use a buffered status request command or a programmable output to indicate move completion.

Command	Response
1R	*R (Indexer ready, no error conditions exist)

RA Limit Switch Status Report

Version A

Type Status
Syntax aRA
Units None
Range None
Default None
Response *x
See also R, RB, RC

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Limit Switch Status Report (RA) command responds with the status of the end of travel limits during the last move as well as the present condition. This is done by responding with one of 16 characters representing the conditions listed below.

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Response Character	Last Move Terminated by CW Limit	Last Move Terminated by CCW Limit	Current Limit Status CW Limit	Current Limit Status CCW Limit
*@	NO	NO	OFF	OFF
*A	YES	NO	OFF	OFF
*B	NO	YES	OFF	OFF
*C	YES	YES	OFF	OFF
*D	NO	NO	ON	OFF
*E	YES	NO	ON	OFF
*F	NO	YES	ON	OFF
*G	YES	YES	ON	OFF
*H	NO	NO	OFF	ON
*I	YES	NO	OFF	ON
*J	NO	YES	OFF	ON
*K	YES	YES	OFF	ON
*L	NO	NO	ON	ON
*M	YES	NO	ON	ON
*N	NO	YES	ON	ON
*O	YES	YES	ON	ON

The RA command is useful when the motor will not move in either or both directions. The report back will indicate whether or not the last move was terminated by one or both end-of-travel limits.

This command is not intended to be used to determine if a move is complete. Rather, it should be used after the move is complete to determine if there might be other errors or faults.

Command	Response
1RA	*@ (By issuing a 1RA command to the indexer with address of 1, the indexer responded with *@ indicating that the last move was not terminated by a limit and that no limits are currently active.)

RB Loop, Pause, Shutdown, Trigger Status Report

Version A

Type Status
Syntax aRB
Units None
Range None
Default None
Response *x
See also L, PS, R, RA, RC, ST, TR

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command receives a response from *@ to *O, as defined below. The four conditions for which status is indicated are as follows:

Loop Active: A loop is in progress
Pause Active: Buffered commands are not being executed due to a Pause (PS) command
Shutdown Active: The motor is shutdown by the ST1 command
Trigger Active: At least one trigger is active

Response Character	Loop Active	Pause Active	Shutdown Active	Trigger Active
*@	NO	NO	NO	NO
*A	YES	NO	NO	NO
*B	NO	YES	NO	NO
*C	YES	YES	NO	NO
*D	NO	NO	YES	NO
*E	YES	NO	YES	NO
*F	NO	YES	YES	NO
*G	YES	YES	YES	NO
*H	NO	NO	NO	YES
*I	YES	NO	NO	YES
*J	NO	YES	NO	YES
*K	YES	YES	NO	YES
*L	NO	NO	YES	YES
*M	YES	NO	YES	YES
*N	NO	YES	YES	YES
*O	YES	YES	YES	YES

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This command is not intended to be used to determine if a move is complete. Rather, it should be used after the move is complete to determine if there might be other errors or faults.

Command	Response
1RB	*A(After issuing 1RB, the response came back as *A. This means that the indexer is currently within a loop.)

RC Closed Loop Status

Version A

Type Status
Syntax aRC
Units None
Range None
Default None
Response *x
See also R, RA, RB

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The RC command has the same response format of RA and RB. The four conditions for which status is indicated are:

Response Character	Go Home Successful?
*@	YES
*A	YES
*B	NO
*C	NO

RM Rate Multiplier in Velocity Streaming Mode

Version A

Type Motion
Syntax <a>RMn
Units n = 1/400 rps (in hex)
Range 000 - 4E20
Default 0000
Response None
See also Q1, Q0

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The RM command followed by 4 hexadecimal digits represents a velocity. The 4 hex digit range is 000 to 4E20, corresponds to 1/400 - 50 revolutions per second units of 1/400 (0.0025) revolutions per second (0.0025) rps.

The velocity change is essentially instantaneous; there is no acceleration/deceleration ramp between velocities. A limit switch-closure will stop movement while in velocity profiling mode, but does not cause the Indexer to exit velocity streaming mode. RM (profiling) mode is unidirectional. The direction will be the last activated direction either from an actual move or from a D or H command. Bi-directional moves using this mode can be made by returning to velocity zero, switching off RM mode, changing the direction, and re-enabling RM mode. This extra overhead should be acceptable given the need to change to velocity zero when changing directions in real situations.

Situations requiring non-linear accelerations may use the Q0, Q1, and RM commands. Q1 is used to enter the velocity profiling mode, and Q0 is used to exit. While in this mode the RM command is used to generate velocity values that are immediately implemented while the motor is moving. This means that the RM command must be sent to the CX at the time the change in velocity is required. This creates a stair-step effect in velocity change. By implementing a large number of very small instantaneous velocity changes, a smooth, non-linear acceleration ramp can be achieved.

Command	Description
Q1	Enter Velocity Streaming mode
RM0190	Accelerate to 1 rps
RM0320	Accelerate to 2 rps
RM04B0	Accelerate to 3 rps
RM0640	Accelerate to 4 rps
RM04B0	Decelerate to 3 rps
RM0320	Decelerate to 2 rps
RM0190	Decelerate to 1 rps
RM0000	Decelerate to 0 rps
Q0	Exit velocity streaming mode

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RS Status of Sequence Execution

Version A

Type Status
Syntax aRS
Units None
Range None
Default None
Response *x
See also R, RA, RB, TC

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The RS command indicates the status of the latest sequence execution. Possible responses are as follows:

Response	Sequence Started	Sequence Ended
*@	NO	NO
*A	YES	NO
*B	NO	YES

Whenever a sequence is started, the sequence start bit is set and the sequence end bit is cleared (this only occurs if the sequence is valid and is actually run). Bit 0: Sequence started; Bit 1: Sequence Ended. Whenever a sequence is ended, the start bit is cleared and the end bit is set. Any abrupt move termination (e.g., limit activation), or a K or S command clears both bits.

Command	Response
1RS	*A (Sequence in progress)

RV Revision Level

Version A

Type Status
Syntax <a>RV
Units None
Range None
Default None
Response *92-nnnnnn-nn<xn>
See also None

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Revision (**RV**) command responds with the software part number and its revision level. The response is in the form shown below:

*92-nnnnnn-nn<xn>[cr]
part number revision level

The part number identifies which product the software is written for, as well as any special features that the software may include. The revision level identifies when the software was written. You may want to record this information in your own records for future use. This type of information is useful when you consult Parker Compumotor's Applications Department.

Command	Response
> 1RV	*92-005782-01D3

The product is identified by 92-005782. The revision level is identified by 01D3.

S Stop

Version A

Type Motion
Syntax <a>S
Units None
Range None
Default None
Response None
See also K, Q0, A

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command decelerates the motor to a stop using the last defined Acceleration (A) command. This command normally clears any remaining commands in the command buffer, unless prevented from doing so by the Clear/Save The Command Buffer On Stop (SSH1) command. When the SSH1 command is present, the S command stops only the current move. The indexer executes the next command in the buffer. The Stop (S) command does not stop the motor if in Rate Multiplier (RM) mode. If you are in the RM mode, issue an Exit Velocity Profiling Mode (Q0) command to stop the motor.

Command	Description
MC	Set to Continuous mode
A1	Set acceleration to 1 rps^2
V10	Set velocity to 10 rps
G	Execute the move (Go)
S	Stop motor (motor comes to 0 rps at a deceleration rate of 1 rps^2

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SC Standby Current

Version A

Type Programming
Syntax <a>SCn
Units n = 1/8 of max. current
Range 1-8
Default 8
Response None
See also SCA

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command reduces motor current when the motor is not moving. The percentage of maximum current going to the motor is listed below:

n	Percentage of Maximum Current
1	13%
2	25%
3	38%
4	50%
5	63%
6	75%
7	88%
8	100%

This command keeps the motor cooler and saves energy; however, you sacrifice some holding torque at zero speed. Once the motor starts moving, full motor current is restored. This command is valid only while the motor is stationary. When the motor starts moving, you must re-issue the command to reduce current after the move.

Command	Description
SC1	Sets standby current level to 13%

SCA Standby Current Automatically

Version A

Type Programming
Syntax <a>SCAn
Units n = 1/8 of max. current
Range 1-8
Default 8
Response None
See also SC

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command reduces current going to the motor after move is complete. The percentage of maximum current going to the motor is n/8 x 100% of maximum current. When the motor starts moving again, full current is restored to the motor. This standby current will reduce holding torque when motor is not moving, however the motor will run cooler and uses less energy.

Command	Description
SCA2	When motor stops set current to the motor to 2/8 x 100% of the maximum current.

T Time Delay

Version A

Type Programming
Syntax <a>Tn
Units n = seconds
Range 0.01 - 999.99
Default None
Response None
See also None

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Time (T) command causes the indexer to wait the number of seconds that you specify (*n*) before it executes the next command in the buffer. This command is useful whenever you need to delay the motor's actions or when you wish to move the motor in continuous velocity for preset time.

Command	Description
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2
V6	Set velocity to 6 rps
D128ØØ	Set distance to 12,800 steps
G	Execute the move (Go)
T3	Delays 3 seconds between moves
G	Execute the move (Go)

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TR Wait for Trigger

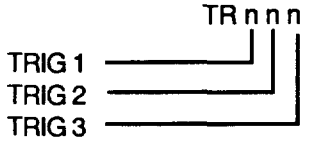
Version A

Type Programming
Syntax <a>**TR**n
Units n = input
Range 0, 1, or x
Default None
Response None
See also TS

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command allows you to specify a trigger configuration to be matched before continuing execution of the move. The command is in the form TR*nnn*, where *nnn* corresponds to triggers 1, 2, and 3 respectively. The possible values for *n* are as follows:

n = 1 Wait for the trigger input to be high (opened)
n = 0 Wait for the trigger input to be low (grounded)
n = X Ignore the trigger input



When TR command is used in a buffer, the indexer will get to this command and wait until the input pattern is matched before going on to the next command.

Command	Description
TR1ØX	Wait for input 1 to open and input 2 to be grounded before going on to the next command. Input 3 will be ignored.
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D256ØØ	Set distance to 25,600 steps
G	Executes the move (Go)

TS Trigger Input Status

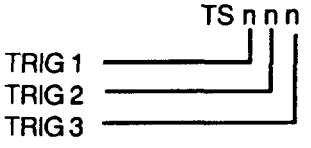
Version A

Type Status
Syntax a**TS**
Units None
Range None
Default None
Response nnn
See also TR

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command retrieves the state of the trigger inputs. The response is in the form nnn, where nnn reports the status of triggers 1, 2, and 3 respectively. The possible values for n are as follows:

n = 1 Input is high (opened)
n = 0 Input is low (closed)



TS command is useful for checking the status of the trigger inputs when it appears as though execution is being halted by a TR command. To make sure that your trigger pattern is met, you can check with TS command.

Command	Response
1TS	101

Trigger bits 1 and 3 are high (opened) and Trigger bit 2 is low (closed).

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U Pause and Wait for Continue

Version A

Type Programming
Syntax <a>U
Units None
Range None
Default None
Response None
See also PS, C

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command causes the indexer to complete the move in progress, then wait until it receives a Continue (C) to resume processing. Since the buffer is saved, the indexer continues to execute the program (at the point where it was interrupted). The indexer continues processing when it receives the C command. This command is typically used to stop a machine while it is unattended.

Command	Description
MN	Set to Normal mode
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
L	Loop indefinitely
D256ØØ	Set distance to 25,600 steps
G	Execute the move (G)
T1Ø	Wait 10 seconds after the move
N	End loop
U	Halt execution until the indexer receives the Continue command.

This command string pauses at the point where the U command is entered. A Continue (C) command causes execution to resume at the point where it was paused. In this example, the loop stops at the end of a move, and resumes when the indexer receives the C command. There may be a 10-second delay before motion resumes after the C command is executed, depending on when the Pause and Wait for Continue (U) command is completed.

V Velocity

Version A

Type Motion
Syntax <a>Vn
Units n = rps
Range 0.001 - 50.000
Default 0
Response None
See also A, D, G

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Velocity (V) command defines the maximum speed at which the motor will run when given the Go (G) command.

In preset mode, Mode Normal (MN) the maximum velocity may also be limited when the resulting move profile is triangular. In Mode Continuous (MC), when a Go (G) command is completed, the indexer moves on to the next command in the buffer once the specified velocity is reached.

When the Go Home (GH) command is executed, the velocity is changed accordingly; subsequent moves should include a new V command unless the Go Home velocity is applicable.

Once you define the velocity, that velocity will be valid until you define another velocity, cycle AC power or issue a Z command.

If the value specified for the V command is not valid, the CX ignores that value and defaults to the value specified in the last V command.

Command	Description
MC	Set to Continuous mode
A5	Set acceleration to 5 rps^2
V5	Set velocity to 5 rps
G	Execute the move (Go)

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VC Change Velocity in Continuous Mode

Version A

Type Motion
Syntax <a>VCn
Units n = rps
Range 0.001 - 50.000
Default None
Response None
See also AC, V

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command changes the velocity while moving in continuous mode. Valid velocities for this command range from 0.001 to 50.000 revolutions per second. This command is effective **only** when running at constant velocity. Velocity change occurs immediately following the issuance of the VC command. Not more than 2 digits before the decimal point are allowed. This command does not change the velocity value set by the V command.

Command	Description
MC	Set to Continuous mode
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
G	Execute the move (Go)
VC7	Change velocity to 7 rps at acceleration of 10 rps^2

The motor will ramp up to constant velocity at 5 rps after the first G command is entered. The motor will ramp up to a constant velocity of 7 rps after the VC command is entered.

W1 Signed Binary Position Report

Version A

Type Status
Syntax a**W1**
Units None
Range None
Default None
Response *W1nnnn
See also W3, PR

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Report back gives immediate binary representation of position relative to start of the current move. The format of the response is a four character response (*nnnn) that is interpreted as a 32-bit binary number. The number must then be interpreted by the computer to give a numerical position in steps. The format is in 2's complement notation. Moves in the negative direction (CCW) will report back negative numbers (bit 31 is set to 1).

If you are using a terminal to communicate with the indexer, the response may not be a printable character. The response must be decoded using a computer.

This command is useful if you want to receive a position report while the motor is moving.

W2 Hexadecimal Position Report

Version A

Type Status
Syntax <a>**W2**n
Units None
Range None
Default None
Response a**W2**nnnn
See also W1, PR

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The immediate hexadecimal character position report back (while motion is occurring) indicates position relative to start of current move. The format of the response is eight (8) hexadecimal characters. Your host computer needs to convert these characters into useable format. This command does not indicate the direction of the movement; you will only receive an unsigned number.

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where h can be one of the following values:

Decimal Value	Hexadecimal Value (h)
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

Command	Description
1W2	*ØØØØFA04 A distance of FA04 (64004 steps) has occurred since the start of the last move.

WV Select Waveform

Version A

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Type Programming
Syntax <a>WVn
Units n = waveform
Range 1 - 9
Default 5
Response None
See also None

The WV command will select 1 of 9 stored waveforms. The waveforms differ in the amount of 3rd harmonic that each has. Generally, the higher the current in the motor, the greater the percentage of out-of-phase 3rd harmonic you would want. Empirical determination of the best sine wave for a given motor and load is the best means for selecting a waveform.

Waveform	% of 3rd Harmonic
#1	-8
#2	-6
#3	-4
#4	-2
#5	0
#6	+2
#7	+4
#8	+6
#9	+8

Command	Description
1WV1	Waveform #1 is selected

XC Sequence Checksum

Version A

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

Type Status
Syntax aXC
Units None
Range None
Default None
Response nnn
See also XD, XE

This command computes the EEPROM checksum. After the indexer has been programmed, the response can be used for system error checking. The response is in the form nnn, where the range for nnn is 000 - 255. The number reported does not indicate the number of bytes programmed. This response is designed to be used for comparison. As long as the indexer is not reprogrammmed, the checksum response should always be the same.

Command	Response
1XC	149

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XD Sequence Definition

Version A

Type Programming
Syntax <a>**XD**n
Units n = sequences
Range 1 - 7 (IM1 mode)
Default None
Response None
See also XE, XR, XRP, XSD, XT

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command begins sequence definition for a specific sequence. All the commands between the **XD** command and the Sequence Termination (**XT**) command will be defined as a sequence. The sequences will automatically be saved when the **XT** command is issued. If a sequence you are trying to define already exists, you must erase that sequence (**XE** command) before defining it. Each sequence cannot be longer than 256 characters. Immediate commands cannot be entered into a sequence.

Command	Description
XE1	Erase sequence #1
XD1	Define sequence #1
MN	Set to Normal mode
A1Ø	Set acceleration to 10 rps^2
V5	Set acceleration to 5 rps
D256ØØ	Set distance to 25,600 steps
G	Execute the move (Go)
XT	End defining sequence #1
XR1	Execute sequence #1

XE Sequence Erase

Version A

Type Programming
Syntax <a>**XE**n
Units n = sequences
Range 1 - 7 (IM1 mode)
Default None
Response None
See also XD, XT, XT, XRP

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command allows you to delete a sequence. The sequence that you specify (n) will be deleted when you issue the command. As a good practice, you should delete a sequence before defining it.

XP Set Power-Up Sequence Mode

Version A

Type Set-Up
Syntax <a>**XP**n
Units n = sequence
Range 0 - 9
Default 0
Response None
See also K, S, XR, XQ, XSP, XSR, XZ

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command will cause a single sequence or multiple sequences to be executed on power-up. The possible settings for *n* are as follows:

n = 0 No sequence is executed
n =1-7 Sequence 1 - 7 is executed on power-up
n = 8 Sequence Select inputs are read (single run)
n = 9 Sequence Select inputs are read (continuous run)

A value of 1-7 for *n* will result in the sequence whose value = *n* being executed on power-up. Control will then be passed to the RS-232C interface.

A value of 8 for *n* will result in the sequence whose number appears on the sequence select inputs to be executed on power-up. Control will then be passed to the RS-232C interface.

A value of 9 for *n* will cause the sequence whose number appears on the Sequence Select inputs to be executed on power-up. When the first sequence is finished in XP9 mode, the CX will scan the Sequence Select inputs again and execute the next sequence whose number appears on the inputs. This cycle will continue until a Stop (**S**) or Kill (**K**) command is issued, a limit is encountered, or the unit is powered down.

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Command	Description
XP1	Execute Sequence #1 on power-up
XE1	Erase sequence #1
XD1	Define sequence #1
A1Ø	Set acceleration to 10 rps^2
D256ØØ	Set distance to 25,600 steps
GH5	Go Home at 5 rps
XT	End of sequence #1
Z	Reset the indexer, Sequence #1 runs automatically

XQ Sequence Interrupted Run Mode

Version A

Type Set-Up
Syntax <a>XQn
Units n = mode
Range 0 or 1
Default 0
Response None
See also XD, XE, XT, XZ, XP

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

XQ1 = Set interrupted run mode (on)

XQØ = Clear interrupted run mode (off)

This command can be used only when stand-alone power-up sequencing in XP9 mode. If XQ1 is executed, the indexer will ignore sequence select inputs, until all sequence select lines have been brought to a high state. After all lines have simultaneously been brought to a high state, the indexer will then read the sequence select lines and execute the sequence whose number appears there. This paused mode will continue until an XQØ command is executed. You may use S or K command to stop sequence execution.

The interrupted run mode is cleared at the start of execution of a sequence.

Command	Description
XE1	Erase sequence #1
XD1	Define sequence #1
LD3	Disable CW & CCW limits
XQ1	Set to Interrupt mode
XT	End Sequence #1
XP9	Set power-up sequences as sequence select inputs
Z	Reset the CX to start sequence scanning

If you execute Sequence 1 upon power-up by setting Sequence Select Inputs 1 - 3 properly, the interrupted run mode will be set. Sequence select input lines all need to go high (open) before selecting any other sequences.

XR Run a Sequence

Version A

Type Programming
Syntax <a>XRn
Units n = sequences
Range 1 - 7 (IM1 mode)
Default None
Response None
See also XE, XD, XT, XRP

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command loads a predefined sequence (identified by *n*) into the command buffer (clears the buffer first) and executes these commands as a normal set of commands. This command automatically recalls the sequence from EEPROM.

An XR command can be used within one sequence to start execution of another sequence; however, all commands in the first sequence following the XR will be ignored (in this respect an XR acts like a GOTO not a GOSUB). If using continuous mode, the velocity must be 0 rps when calling another sequence. An XR command placed within a loop will be ignored.

Command	Description
XE1	Erase sequence #1
XD1	Define sequence #1
A1Ø	Set acceleration to 10 rps^2
V5	Set acceleration to 5 rps
D256ØØ	Set distance to 25,600 steps
G	Execute the move (Go)
XT	End defining sequence #1
XR1	Execute sequence #1

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XRP Sequence Run with Pause

Version A

Type Programming
Syntax <a>**XRP**n
Units n = sequences
Range 1 - 7 (IM1 mode)
Default NOne
Response None
See also XR, XD, XT, XE, C

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command is identical to the Sequence Run (XR) command, except that it automatically generates a pause condition. You muse clear this condition with the Continue (C) command before the indexer executes the command buffer. The pause condition is asserted only if the sequence is valid. This allows you to execute a sequence without the delay of buffering that sequence.

Command	Description
XE5	Erase Sequence #5
XD5	Define Sequence #5
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D256ØØ	Set distance to 25,600 units
G	Execute the move (Go)
XT	End defining Sequence #5
XRP5	Run Sequence #5 with a pause
C	Execute Sequence #5

Upon issuing XRP5, Sequence #5 is entered into the command buffer, but is not executed. You must issue a Continue (C) command to execute Sequence #5.

XSD Sequence Download Status

Version A

Type Status
Syntax a**XSD**
Units None
Range None
Default None
Response None
See also XD, XE, XT

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command reports back the status of the previous sequence definition (XD...XT). The response is 0 - 3. The VALID values and descriptions of possible responses are shown below:

0 = Download O.K.
1 = A sequence already exists with the number you have specified.
2 = Out of memory. The sequence buffer is full.
3 = EEPROM write error.

The XSD command is useful for verifying that the last sequence definition attempt was successful.

Command	Response
1XSD	1 (This response indicates that you need to erase the existing sequence to define that specific sequence.)

XSP Power-Up Mode Sequence Status

Version A

Type Status
Syntax a**XSP**
Units None
Range None
Default None
Response n
See also XP, XSR, XZ

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Sequence Status Power-up (XSP) reports which, if any, sequence will be executed on power-up. After setting a power-up sequence using the Sequence Power-up (XP) command, you can check to make sure that proper sequence will be executed on power-up using the XSP command. The command reports back the sequence that the system will execute during power-up.

Command	Response
1XSP	3 (indicates that sequence number #3, if it exists, will be executed upon power-up or reset)

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XSR Sequence Run Status

Version A

Type Status
Syntax a**XSR**
Units None
Range None
Default n
Response None
See also XR, XRP

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command allows you to check whether or not the last sequence you issued was executed successfully without hitting limits, Stop (S), or Kill (K). The valid values and descriptions for *n* are shown below:

0 = Last attempt to run the sequence was successful
Non-zero = Not running:
1 = In a loop
2 = NON-VALID sequence was requested
3 = Erased sequence
4 = Bad checksum

Command	Response
XR2	Runs Sequence 2
1XSR	0 (Sequence ran OK)

XSS Sequence Status

Version A

Type Status
Syntax a**XSS**n
Units n = sequences
Range 1 - 7 (IM1 mode)
Default None
Response n
See also XD, XE, XT

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command reports whether the sequence specified by *n* is empty, has a bad checksum, or is OK. The possible responses are as follows:

0 = Empty
1 = Bad Checksum
3 = O.K.

This command is useful to see if the particular sequence exists and if that portion of memory has been corrupted.

Command	Response
1XSS1	0 (Nothing programmed in sequence #1)

XT Sequence Termination

Version A

Type Programming
Syntax <a>**XT**
Units None
Range None
Default None
Response None
See also XD, XE, XR

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The **XT** command is a sequence terminator. This command flags the end of the sequence currently being defined. Sequence definition is not complete (saved) until this command is issued.

Command	Description
XD1	Define sequence #1
MN	Set move to continuous
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D256ØØ	Set distance to 25,600 steps
G	Execute the move (Go)
XT	End sequence definition

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XU Upload Sequence

Version A

Type Status
Syntax a**XU**n
Units n = sequence
Range 1 - 7 (IM1 mode)
Default programmed sequence
Response None
See also XD, XE, XT, F

Attributes
[x] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command sends the contents of sequence *n* to the host computer via RS-232C interface. All commands in sequence n are displayed on the CRT. All command delimiters in the sequence will be sent out as spaces. Any device identifiers that were included in the original sequence will also be eliminated (they are not stored in the sequence).

NOTE: When using a daisy-chain, this command must be used cautiously as the contents of the sequence will go to all controllers in the loop between the indexer that is uploading and the host. The **F** *command may be useful in this context to turn off communication on units you are not uploading from.*

Command	Description
F	Turn off communication to all units
1E	Turn on communication to unit #1
1XU7	Upload sequence #7 from unit #1
E	Enable other units

XZ Set Power-Up Sequence to Zero

Version A

Type Programming
Syntax <a>**XZ**
Units None
Range None
Default None
Response None
See also Z, XSP, XSR, XP

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

This command sets the power-up sequence number to zero (thereby disabling sequence activation on power-up). The purpose of this command is to handle the situation in which the set power-up sequence has a checksum error, causing control to pass to the error routine (flashing LED) (only immediate commands are active in this error state). In testing externally controlled sequences, it can also be used to disable continuous run sequencing (followed by a **Z** command to reset the indexer).

Y Stop Loop

Version A

Type Programming
Syntax <a>**Y**
Units None
Range None
Default None
Response None
See also L, N, CL, CN

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Stop Loop (**Y**) command takes you out of a loop when the loop completes its current pass. This command does not halt processing of the commands in the loop until the indexer processes reach the last command of the current loop. At that time, the indexer executes the command that follows the End Loop (**N**) command. You cannot restart the command loop unless you enter the entire command structure, including the Loop (**L**) and End Loop (**N**) commands.

Command	Description
L	Loop indefinitely
A1Ø	Set acceleration to 10 rps^2
V5	Set velocity to 5 rps
D256ØØ	Set distance to 25,600 steps
T2	Wait 2 seconds
G	Execute the move (Go)
N	End loop
Y	Stop loop

The loop requires the motor to move 25,600 steps CW and then wait for 2 seconds. The loop terminates at the end of the loop cycle it is executing when it receives the **Y** command.

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Z Reset

Version A

Type Programming
Syntax <a>Z
Units None
Range None
Default None
Response None
See also S, K

Attributes
[ ] Buffered
[ ] Device specific
[ ] Saved independently
[ ] Saved in sequences

The Reset (z) command is equivalent to cycling logic power to the indexer. This command returns all internal settings to their power-up values. It clears the command buffer. Like the Kill (k) command, the z command immediately stops output pulses to the motor.

Any commands entered while resetting are ignored.

This command sets all position counters to zero.

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C H A P T E R ⑥

Hardware Reference

Chapter Objectives

The information in this chapter will enable you to:

- ❑ Use this chapter as a quick-reference tool for most system specifications (dimensions & performance)
- ❑ Use this chapter as a quick-reference tool for most switch settings
- ❑ Use this chapter as a quick-reference tool for proper I/O connections

Environmental Specifications

Operating Temperature

The CX Drive system should be operated in accordance with the following environmental constraints:

Parameter	Value
Operating	32°F to 122°F (0°C to 50°C)
Drive	Maximum allowable heatsink fin temperature is 144°F (65°C). Fan cooling may be required.
Motor	212°F (100°C) maximum motor case temperature. Actual temperature rise duty cycle dependent.
Storage	-40°F to 185°F (-40°C to 85°C)
Humidity	0-95%, Non-condensing

System Specifications

Resolution

Resolution(Steps/Rev)	JU8	JU9
25,000	1	1
10,000	1	0
5,000	0	1
2,000	0	0

All Resolutions are in steps per revolution, and assume the use of a 1.8° (200 step/revolution) hybrid permanent magnet stepper motor.

Accuracy	± 5 arc minutes (.0833°) typical, unloaded-bidirectional with Compumotor supplied (3%) motors. Other motors may exhibit different absolute accuracy.
	±1 arc min (.167°) typical loaded - in addition to unloaded accuracy, per each frictional load equal to 1% rated torque.
Repeatability	±5 arc sec. (.0014°) typical Unloaded-one revolution returning to start point from same direction.

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Hysterisis	Less than 2 arc min. (.0334°) Unloaded-bidirectional
Velocity Range	Depends on motor inductance and supply voltage. 3,000 rpm possible with low inductance motors.

Pin Outs

J1 Connector

Pin	Description
1	Phase 1
2	Phase 1
3	Phase 2
4	Phase 2
5	Center Taps
6	+12-90VDC
7	Power Ground
8	Logic Ground
9	+9 to 12VDC
10	Opto + (Common Cathode)
11	Home Input*
12	CCW Limit Input*
13	CW Limit Input*
14	Address Select 1 Input*
15	Address Select 2 Input*
16	Address Select 3 Input*
17	Programmable Output*
18	Tx (RS-232C Transmit Data) Output
19	Rx (RS-232C Receive Data) Input

Motor Current Settings

CX Motor Current Settings						CXT Motor Current Settings					
Current	JU1	JU2	JU3	JU4	JU5	Current	JU1	JU2	JU3	JU4	JU5
0.14	0	0	0	0	0	0.03	0	0	0	0	0
0.31	0	0	0	0	1	0.06	0	0	0	0	1
0.47	0	0	0	1	0	0.09	0	0	0	1	0
0.62	0	0	0	1	1	0.12	0	0	0	1	1
0.78	0	0	1	0	0	0.16	0	0	1	0	0
0.94	0	0	1	0	1	0.19	0	0	1	0	1
1.09	0	0	1	1	0	0.22	0	0	1	1	0
1.25	0	0	1	1	1	0.25	0	0	1	1	1
1.41	0	1	0	0	0	0.28	0	1	0	0	0
1.56	0	1	0	0	1	0.31	0	1	0	0	1
1.72	0	1	0	1	0	0.34	0	1	0	1	0
1.87	0	1	0	1	1	0.37	0	1	0	1	1
2.03	0	1	1	0	0	0.41	0	1	1	0	0
2.19	0	1	1	0	1	0.44	0	1	1	0	1
2.34	0	1	1	1	0	0.47	0	1	1	1	0
2.50	0	1	1	1	1	0.50	0	1	1	1	1
2.66	1	0	0	0	0	0.53	1	0	0	0	0
2.81	1	0	0	0	1	0.56	1	0	0	0	1
2.97	1	0	0	1	0	0.59	1	0	0	1	0
3.12	1	0	0	1	1	0.62	1	0	0	1	1
3.28	1	0	1	0	0	0.66	1	0	1	0	0
3.44	1	0	1	0	1	0.69	1	0	1	0	1
3.59	1	0	1	1	0	0.72	1	0	1	1	0
3.75	1	0	1	1	1	0.75	1	0	1	1	1
3.91	1	1	0	0	0	0.78	1	1	0	0	0
4.06	1	1	0	0	1	0.81	1	1	0	0	1
4.22	1	1	0	1	0	0.84	1	1	0	1	0
4.37	1	1	0	1	1	0.87	1	1	0	1	1
4.53	1	1	1	0	0	0.91	1	1	1	0	0
4.68	1	1	1	0	1	0.94	1	1	1	0	1
4.84	1	1	1	1	0	0.97	1	1	1	1	0
5.00	1	1	1	1	1	1.00	1	1	1	1	1

(0 = OFF / 1 = ON)

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Current Settings for CXT32-39, 25-30 and 27-38

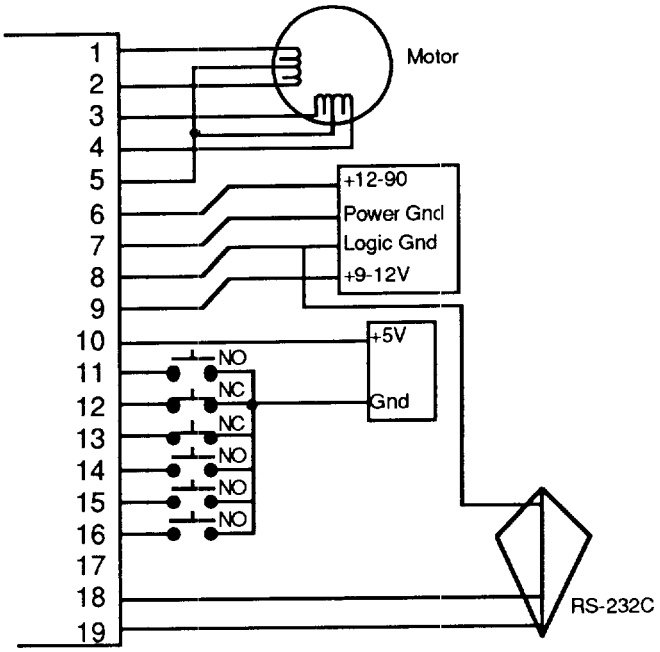
Motor Size	JU1	JU2	JU3	JU4	JU5
CXT32-39	1	0	0	1	1
CXT25-30	0	1	1	0	0
CXT27-38	0	1	0	0	1

The CXT Motors should not be run at 12V or less.

Motor Specifications

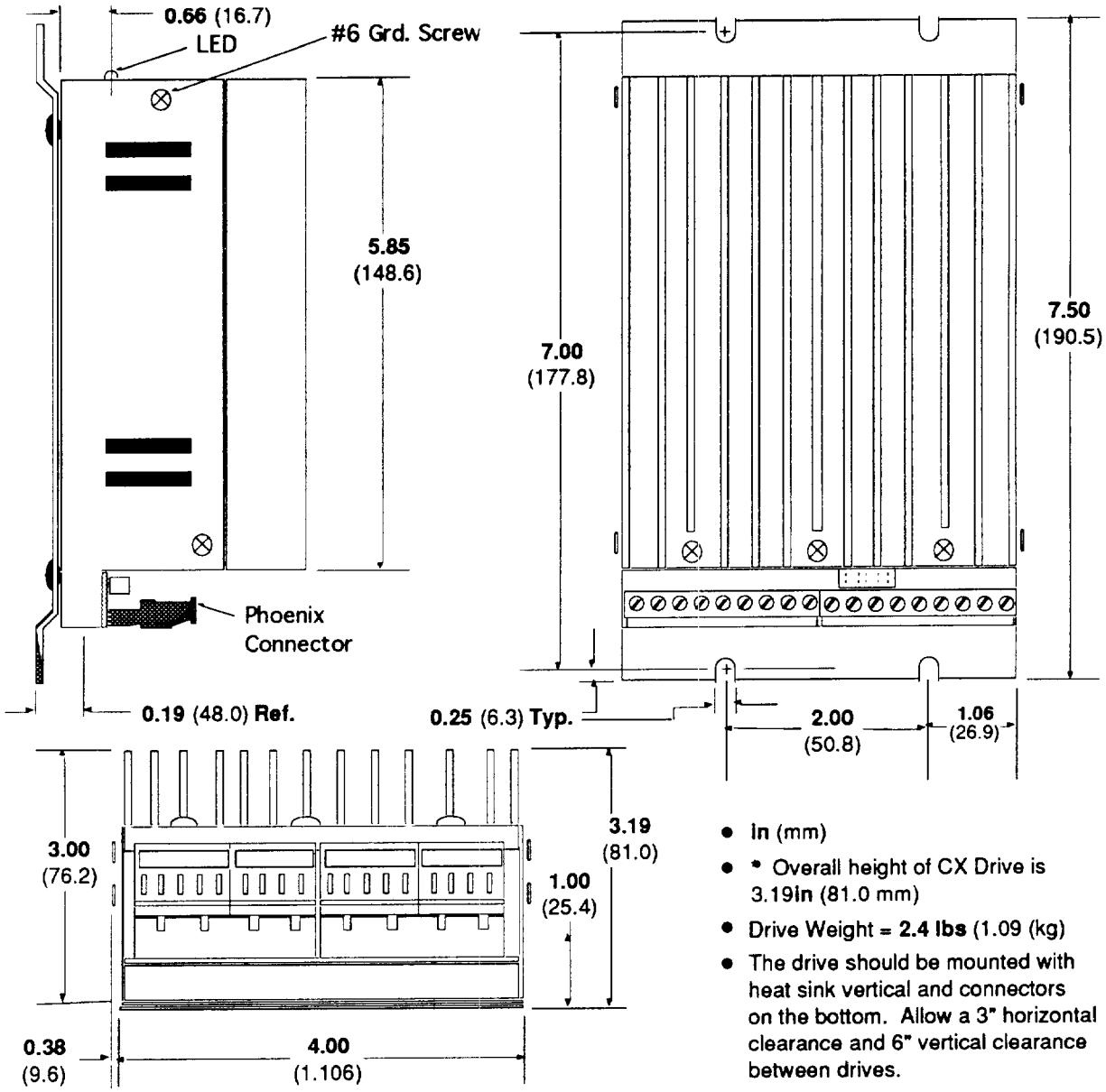
	Size 34			Size 34			Size 42	
	57-51	**58-83**	**57-102**	**83-62**	**83-93**	**83-135**	**106-120**	**106-178**
Static Torque								
oz-in	45	80	120	140	260	380	480	700
(N-m)	(0.32)	(0.55)	(0.85)	(1.00)	(1.85)	(2.70)	(3.40)	(4.90)
Rotor Inertia								
oz-in²	0.48	1.28	1.75	3.50	6.70	10.24	21.5	44.0
(Kg-cm²)	0.088	.0234	.0320	0.64	1.23	1.87	3.92	8.05
Bearings								
Thrust load lb	25	25	25	50	50	50	50	50
kg	(11.32)	(11.32)	(11.32)	(22.64)	(22.64)	(22.64)	(22.64)	(22.64)
Radial lb	15	15	15	25	25	25	25	25
kg	(6.79)	(6.79)	(6.79)	(11.32)	(11.32)	(11.32)	(11.32)	(11.32)
End Play in	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Reversing load	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Equal to 1lb								
Radial play in	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
Per 0.5 load cm	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Weight (Net) Motor								
lbs	1.6	2.4	3.2	3.8	5.12	8.3	8.5	19.11
(Kg)	(0.73)	(1.09)	(1.45)	(1.73)	(2.33)	(3.77)	(3.86)	(8.69)
Total Shipping Weight (Net) Motor/drive container								
lbs	6.0	7.8	8.6	9.2	10.52	13.7	13.9	24.51
(Kg)	(31.8)	(3.54)	(3.90)	(4.18)	(4.78)	(6.22)	(6.31)	(11.14)

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Dimensional Drawings



- In (mm)
- * Overall height of CX Drive is 3.19in (81.0 mm)
- Drive Weight = **2.4 lbs** (1.09 (kg)
- The drive should be mounted with heat sink vertical and connectors on the bottom. Allow a 3" horizontal clearance and 6" vertical clearance between drives.

Torque

Refer to the Compumotor Programmable Motion Control Catalog for Speed Torque Curves

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C H A P T E R ⑦

Maintenance & Troubleshooting

Chapter Objectives

The information in this chapter will enable you to:

- ❑ Maintain the system's components to ensure smooth, efficient operation
- ❑ Isolate and resolve system hardware problems
- ❑ Isolate and resolve system software problems
- ❑ Use this chapter as a quick-reference tool for a description of system error codes

Maintenance

The following system components require periodic maintenance:

- ❑ The Motor
- ❑ The Drive

Spare Parts Table

The following table provides a list of recommended spare parts to use with the CX system.

Part Description	Part Number
Possible Drives	
CX Drive	CX-Drive
CXT Drive	CXT-Drive
DC4 Power Supply (Optional)	DC4
Pkg of 5 Jumpers	43-002345-01
4-Pin Phoenix Connector	43-005560-01
5-Pin Phoenix Connector	43-005561-01

Motor Maintenance

You should inspect all mechanical parts of the motor regularly to ensure that no bolts or couplings have become loose during normal operation. This will prevent minor problems from developing into more serious problems.

The ball bearings used in the Compumotor-supplied motors are not sealed against severe environments, but are permanently lubricated and do not require any maintenance.

You should inspect the motor cables periodically for signs of wear. This inspection interval is duty-cycle, environment, and travel-length dependent. You should not apply excessive tensile force to the cable. Do

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not bend the cable beyond a one-inch radius of curvature during normal operation. Tighten all cable connectors.

Drive Maintenance

Check that the drive's heatsink is free of particles and has a free flow of air over its entire surface. Enclosures must be connected to earth ground through a grounding electrode conductor to provide a low-impedance path for ground-fault or noise-induced currents. All earth ground connectors must be continuous and permanent.

Troubleshooting

This section discusses methods to identify, isolate, and resolve problems that may occur with your CX Indexer/Drive.

Problem Isolation

If your system malfunctions, you must identify and isolate the problem. When you accomplish this, you can begin to eradicate and resolve the problem.

The first step is to isolate each system component and ensure that each component functions properly when it is run independently. You may have to dismantle your system and put it back together piece by piece to detect the problem. If you have additional units available, you may want to use them to replace existing components in your system to help identify the source of the problem.

Try to determine if the problem is mechanical, electrical, or software-related. Can you repeat or re-create the problem? Do not attempt to make quick rationalizations about problems. Random events may appear to be related, but they are not necessarily contributing factors to your problem. You must carefully investigate and decipher the events that occurred before the subsequent system problem.

You may be experiencing more than one problem. You must solve one problem at a time. Log (document) all testing and problem isolation procedures. You may need to review and consult these notes later. This will also prevent you from duplicating your testing efforts.

Once you isolate the problem, take the necessary steps to resolve it. Refer to the problem solutions contained in this chapter. If your system's problem persist, contact Compumotor's Applications Department.

Fault LED

The Fault LED may be activated (lit) if one of the following conditions exists.

- The drive is overheating. You may consider cooling the cabinet to the temperature specified in the Hardware reference section. Installing the fan kit would help the problem.
- Short circuit exists in the motor current output. Use the Ohm meter to make sure that there is not a short circuit between channel A, B, or to earth ground.
- A brown-out condition exists. Check the AC input voltage to make sure that you have more than 95VAC.

Motor Stalls

Probable Cause:

If the motor stalls during acceleration, the force requirements may be excessive, the acceleration ramp may be too steep, or the load inertia and forcer (or motor) inertia may be grossly mismatched. Lower acceleration may be required.

A stall may occur if the jumper setting for the current selection is wrong. The motor may not be receiving enough current to operate.

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Motor Fails to Run at High Speeds

Probable Causes:

- ❑ It is possible that the motor may not produce enough torque to move a given load at these velocities. Check the speed/torque curve and make sure you are trying to run the motor in the proper range.

Motor is Jerky or Weak

Check that there are no mechanical problems at the load causing highly variable loading condition. Disconnect the motor from the load and run it without a load connected.

References

Information about the equipment referred to may be obtained by calling the numbers listed below.

- ❑ Corcom line filters, (312) 680-7400
- ❑ OPTO-22 optically isolated relays, (714) 891-5861
- ❑ Crydom optically isolated relays, (213) 322-4987
- ❑ Potter Brumfield optically isolated relays, (812) 386-1000
- ❑ General Electric MOVs (315) 456-3266
- ❑ Teal Electronics Corporation–specializing in power line products–(800) 888-TEAL.

Returning The System

If you must return your CX Indexer/Drive to effect repairs or upgrades, use the following procedure:

① Get the serial number and the model number of the defective unit, and a purchase order number to cover repair costs in the event the unit is determined by Parker Compumotor to be out of warranty.

② Before you ship the indexer to Parker Compumotor, have someone from your organization with a technical understanding of the CX Indexer/Drive and its application include answers to the following questions:

- What is the extent of the failure/reason for return?
- How long did it operate?
- How many units are still working?
- How many units failed?
- What was happening when the unit failed (i.e., installing the unit, cycling power, starting other equipment, etc)?
- How was the product configured (in detail)?
- What, if any, cables were modified and how?
- With what equipment is the unit interfaced?
- What was the application?
- What was the system sizing (speed, acceleration, duty cycle, inertia, torque, friction, etc.)?
- What was the system environment (temperature, enclosure, spacing, unit orientation, contaminants, etc.)?
- What upgrades, if any, are required (hardware, software, user guide)?

③ Call Parker Compumotor for a Return Material Authorization (RMA) number. Returned products cannot be accepted without an RMA number. The phone number for Parker Compumotor Applications Department is (800) 358-9070.

④ Ship the unit to: Parker Compumotor Corporation
5500 Business Park Drive, Suite D
Rohnert Park, CA 94928
Attn: RMA # xxxxxxx

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A P P E N D I C E S

Command Listing

A	ACCELERATION
AC	ACCELERATION CHANGE
B	BUFFER STATUS REPORT
BS	BUFFER SIZE STATUS
C	CONTINUE
CA	CHANGE ACCELERATION
CBC	CLEAR BUFFERED COMMANDS
CTM	CONTINUOUS MODE TIME DELAY
CTR	CONSTANT VELOCITY WAIT FOR TRIGGER
CV	CHANGE VELOCITY
D	DISTANCE
E	ENABLE COMMUNICATIONS
F	DISABLE COMMUNICATIONS
G	GO
GH	GO HOME
^H	DELETE
H	SET DIRECTION
IM	INPUT MODE
K	KILL
L	LOOP
LD	LIMIT DISABLE
MC	MODE CONTINUOUS
MN	MODE NORMAL
MPA	MODE POSITION ABSOLUTE
MPI	MODE POSITION INCREMENTAL
N	END OF LOOP
O	OUTPUT
Ox, DYY	OUTPUT ON POSITION
OFA	SETUP OUTPUT AS SEQUENCE STATUS
OFB	SET OUTPUT AS PROGRAMMABLE OUTPUT
OFC	SET OUTPUT/PROGRAMMABLE OUTPUT-ON-THE-FLY
PR	POSITION REPORT
PS	PAUSE
PZ	POSITION ZERO
"	QUOTE
Q	EXIT/ENTER VELOCITY PROFILING MODE
R	REQUEST INDEXER STATUS
RA	LIMIT SWITCH STATUS REPORT
RB	LOOP, PAUSE, SHUTDOWN, TRIGGER STATUS REQUEST
RC	CLOSED LOOP STATUS
RM	RATE MULTIPLIER IN VELOCITY STREAMING MODE
RS	STATUS OF SEQUENCE EXECUTION
RV	REVISION LEVEL
S	STOP
SC	STANDBY CURRENT
SCA	STANDBY CURRENT AUTOMATICALLY
T	TIME DELAY
TR	WAIT FOR TRIGGER
TS	TRIGGER INPUT STATUS
U	PAUSE AND WAIT FOR CONTINUE
V	VELOCITY
VC	CHANGE VELOCITY IN CONTINUOUS MODE
W1	SIGNED BINARY POSITION REPORT
W2	HEXADECIMAL POSITION REPORT
WV	SELECT WAVEFORM
XC	SEQUENCE CHECKSUM
XD	SEQUENCE DEFINITION
XE	SEQUENCE ERASE
XP	SET POWER-UP SEQUENCE MODE
XQ	SEQUENCE INTERRUPTED RUN MODE
XR	SEQUENCE RUN
XRP	SEQUENCE RUN WITH PAUSE
XSD	SEQUENCE STATUS
XSP	SEQUENCE STATUS POWER-UP
XSR	SEQUENCE RUN STATUS
XSS	SEQUENCE STATUS
XT	SEQUENCE TERMINATION
XU	SEQUENCE UPLOAD
XZ	SET POWER-UP SEQUENCE TO ZERO
Y	STOP LOOP
Z	RESET

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