USER GUIDE CHANGE SUMMARY

The following is a summary of the primary changes to this user guide since the last version was released. This user guide, version 88-011631-01**G**, supersedes version 88-011631-01**F**.

The entire user guide has been changed according to the new Compumotor user guide styles, format, and illustration standards. Also, the chapters have been renumbered and reorganized. Technical changes to each chapter are summarized below.

Chapter ① Introduction is unchanged.

Chapter ② Getting Started is unchanged.

Chapter ③ Installation

The following information was updated or changed:

- ❑ Programmable Input I/O drawing was changed

Chapter ④ Application Design

Chapter ⑤ ZXF Following is unchanged.

Chapter ⑥ Z Series Shunt Regulator

Chapter ⑦ Hardware Reference

The following information was updated or changed:

- ❑ Typical Input & Output Circuit drawing was corrected
- ❑ Motor vendor information was deleted
- ❑ Corrected Data (Voltage Constant on Line 2 of Motor Specifications

Chapter ⑧ Maintenance & Troubleshooting

T A B L E O F C O N T E N T S

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 should help you find and use the information in this user guide.

Assumptions

This user guide assumes that the user has a fundamental understanding of the following information.

- ❑ Basic electronic concepts (voltages, switches, current, etc.)
- ❑ Basic motion control concepts (torque, velocity, distance, force, etc.)

Installation Process Overview

To ensure trouble-free operation, you should pay special attention to the environment in which the Z Drive equipment will operate. Environmental conditions include the layout, mounting, and wiring and grounding practices used. These recommendations are intended to help you easily and safely integrate the Z Drive into your facility.

Installation Procedures

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

① Review this user guide. Become familiar with the user guide'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 After you have read Chapter ③ and clearly understand what must be done to properly install the system, begin the installation process. Do not deviate from the sequence or installation methods provided.

④ Before you 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.

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 features.

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

Chapter ③ Installation — This chapter provided instructions for you to 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 provides additional information that will help you customize the system to meet your application's needs. Important application considerations are discussed. Sample applications are provided.

Chapter ⑤ ZXF Follower — This chapter discusses the following capabilities of the ZXF Drive.

Chapter ⑥ Z Series Shunt Regulator — This chapter contains information on the shunt regulator option for ZX/ZXF Drive/Indexers. Installation instructions, dimensions, and selection criteria (400W version vs. 800W version) are included.

Chapter ⑦ Hardware Reference — This chapter contains information on system specifications (dimensions and performance). This chapter may be used as a quick-reference tool for proper I/O connections.

Chapter 8
Maintenance & Troubleshooting

This chapter describes Compumotor's recommended system maintenance procedures. It also provides methods for isolating and resolving hardware and software problems. Diagnostic error codes are listed.

Conventions

To help you use this user guide effectively, conventions used throughout this user guide are explained here.

Commands

All commands that you are instructed to enter are shown in capital letters. The symbol **>**, is the ZX Indexer/Drive command prompt. The command is shown in boldface. A delimiter (space or carriage return) is required after each command. A description is provided next to each command example.

Command	Description
> CCA2Ø.ØØ	Sets average current limit to 20.00A

The system ignores command syntax that is not within the valid range for a specific command. A **?** prompt will be returned by the drive when the last command entered was not understood, or a parameter limit was exceeded.

Related Publications

The following publications may be helpful resources.

- Seyer, Martin. RS-232C Made Easy: Connecting Computers, Printers, Terminals and Modems. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1984
- Current Parker Compumotor Motion Control Catalog
- Manual for the IBM or IBM-compatible computer that you may use with the Z Drive
- Schram, Peter (editor). *The National Electric Code Handbook (Third Edition).* Quincy, MA: National Fire Protection Association

C H A P T E R ①

Introduction

The information in this chapter will enable you to:

- ❏ Understand the product's basic functions, features

Product Description

The ZX Series servo system incorporates all the functions of a high-level indexer with the power of a Z servo system. The ZX is a brushless servo positioning system that includes a brushless servo motor, brushless resolver feedback, a digital signal processor (DSP) based closed-loop drive amplifier, and a powerful X language indexing system.

The ZX has Compumotor's latest X language enhancements. It offers registration and complex segmented-move capabilities. The ZX provides PLC communication and thumbwheel input functionality with its seven inputs and four outputs. The ZXF also provides position and velocity following capabilities.

☞ ***Helpful Hint:***
ZX's are configured at the factory as packaged systems that compensate for your typical load and performance requirements.

The ZX's servo drive uses a DSP and a sophisticated servo control algorithm for superior closed-loop performance. The control loop is closed around the motor shaft. The motor's resolver provides position feedback. All servo performance parameters are stored in battery-backed memory. You do not have to make analog tuning potentiometer adjustments that conventional systems require.

The ZX's power amplifier section uses a rugged, bipolar 7 kHz pulse width modulation (PWM) sinusoidal current control scheme. This construction improves reliability, power regulation, and low-speed smoothness.

Product Features

The ZX provides the following flexible programming features.

- ❏ One registration input that is given the highest priority
- ❏ Calculation delay times for motion as low as 500 µs
- ❏ A complex motion profiling system that allows you to:
  - Change velocity based on distance without stopping
  - Change distance, or turn on outputs on-the-fly
- ❏ High-level programming commands such as:
  - `IF/THEN/ELSE/WHILE`
  - `REPEAT/UNTIL`
  - `GOTO AND GOSUB`
- ❏ Complex evaluations such as checking input levels, error conditions, boolean evaluations, and variable comparisons for basic programming branching decisions can be made
- ❏ An output can be configured to provide pulse and direction to second axis to control velocity and distance
- ❏ PLC functionality and interfacing capability using the 7 inputs and 4 outputs

The ZX provides the following hardware and performance features.

- ❏ Brushless servomotor
- ❏ Brushless resolver feedback
- ❏ Torques to 9,000 oz-in continuous (18,000 oz-in peak)
- ❏ User programmable resolutions from 200 - 65535 steps/rev
- ❏ Multi-processor control: no drift, no analog pots to adjust
- ❏ Fan-cooled compact drive enclosure
- ❏ 7 kHz PWM switching frequency
- ❏ Analog (±10V) output monitor for either velocity or torque
- ❏ Various parameters factory-set and stored in battery-backed RAM (random access memory)
- ❏ High-noise immunity due to optical isolation and brushless resolver technology
- ❏ Simple pushbutton adjustment of servo gains
- ❏ Alphanumeric display for fault and servo data

Following Option (ZXF)

The ZXF option can perform velocity following and distance following moves at a *following ratio*. The ZXF can follow from an incremental encoder.

You can program the ZXF for following applications with its command language and report back/verification feature. You can enter following ratios via thumbwheels and change them on-the-fly.

You can perform preset moves at a specified velocity ratio. You can perform registration moves while in the Following mode. Registration moves can either follow at a ratio of the master velocity or be executed in the standard motion modes. The ZXF can jog the motor in Following mode to help set up a system. You can change the following ratio incrementally with the **UP** and **DOWN** pushbuttons on the front panel.

You can use the ZXF's special Synchronization mode to compensate for system errors (e.g., stretching in a web processing system).

Following Option Features

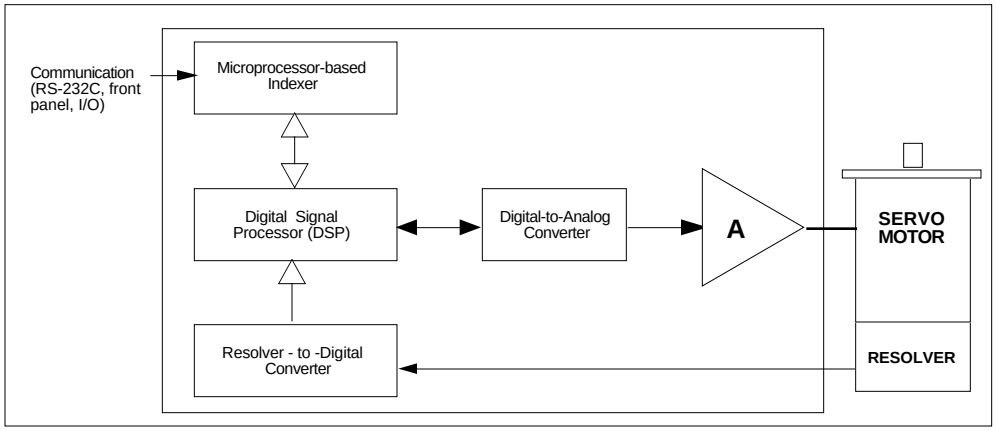
The Model ZXF provides the following additional features:

- ❏ Controls a speed based on a ratio of a primary axis speed
- ❏ Makes preset moves at a velocity ratio of a primary axis
- ❏ Synchronizes speed to a primary axis based on registration marks on material
- ❏ Changes following ratio and other functions based on the encoder position of a primary axis (*Cam Following*)

Theory of Operation

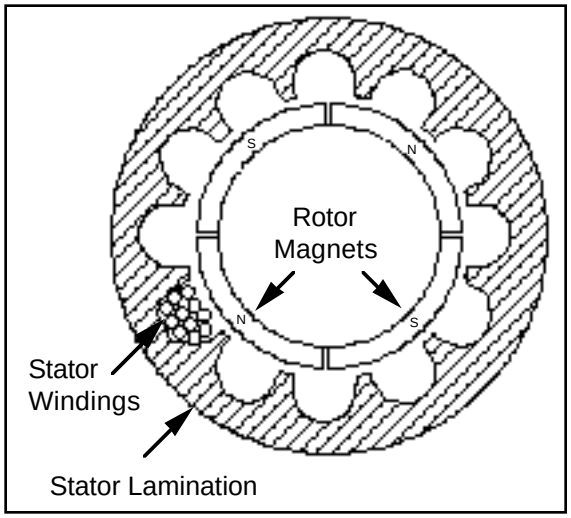
The ZX 's microprocessor-based indexer generates position set point commands that are sent to the ZX's DSP to control the drive. The ZX's DSP reads its actual position from the motor's resolver and compares it with the commanded set point. Any difference between the actual and commanded position creates a positional error. The drive converts this error into a commanded torque to correct the positional error.

The figure below illustrates three major components of the ZX Indexer/ Drive digital servo system: the servo motor, the drive, and the resolver.



ZX Indexer/Drive Digital Servo System

The ZX motor family consists of brushless, 3-phase, AC motors. The figure below illustrates the basic construction of the ZX servo motor. The permanent magnets are securely held in place by metal bands and composite fiber materials to allow high-speed performance. The rotors are precision-balanced, which provides low- and high-speed smoothness. The windings are located in the outer portion of the motor (stator). This *inside-out* construction allows better heat dissipation than conventional brush-type motors. As a result, higher continuous torque and horsepower ratings are achieved for a given motor size.



4-Pole Brushless Motor

B*rushless DC* motors produce a trapezoidal EMF (Electro-Motive Force) waveform. ZX Drive motors are *brushless AC* motors that produce sinusoidal back EMF waveforms. These motors provide smoother low-speed operation than trapezoidal motors.

The ZX Drive is a 3-phase inverter that controls the amplitude, frequency, and phase of each of the three motor stator currents. Controlling the current amplitude relates directly to the magnitude of the torque being generated. Since the motor is *synchronous*, controlling the frequency of the stator currents controls the mechanical rotation of the shaft. The following equation describes this relationship.

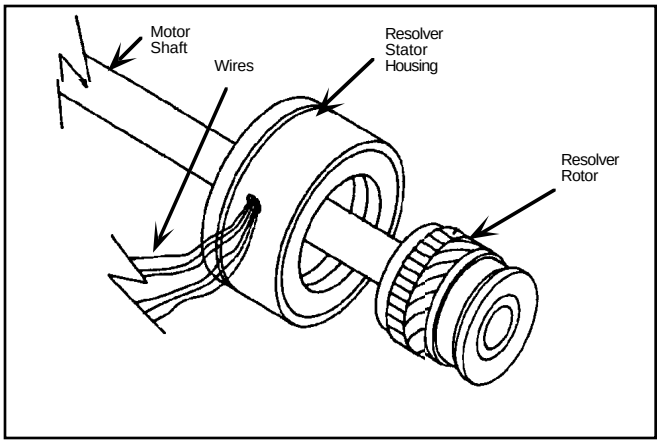
$\omega_e = \omega_r * (P/2)$

ω_e = Electrical frequency of the stator currents

ω_r = Mechanical frequency of the shaft

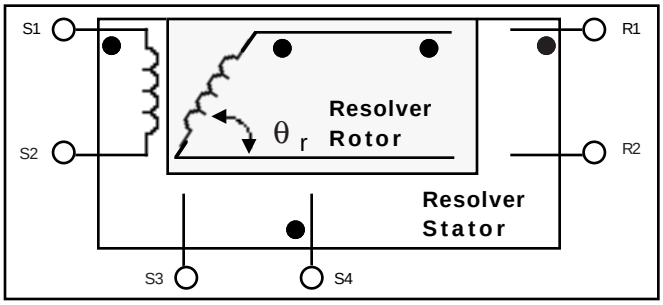
(P/2) = Number of motor pole pairs

Controlling the phase of each of the motor's stator currents ensures balanced 3-phase operation and minimizes torque ripple. Actual motor currents are sensed, and the current is adjusted using pulse width modulation. A single-speed, brushless, pancake-type resolver provides feedback. The figure below shows the resolver mounted directly to the motor shaft. This eliminates the need for internal coupling. The resolver stator windings are mounted to the motor housing.



Resolver Mechanical Drawing

The figure below shows the resolver's internal windings. S1/S2 and S3/S4 are stator windings. R1 and R2 are rotor windings. When a voltage is excited in the rotor winding, a voltage is induced in the stator windings. The stator (S1/S2 and S3/S4) phase voltages are compared to obtain a digital value (θ**r**) representing the motor shaft's physical position.



Resolver Electrical Drawing