

# Harmonica Servo Drive Application

*Using Elmo Motion Control's Harmonica Digital Servo Drives, A North American Company that designs and manufactures Printed Circuit Board screen printers, has designed a new machine that uses the benefits of CANopen Servo Motion Control Architecture.*

## Background

The Electronic Assembly (EA) machinery market is very diverse and extremely price-conscious. This company's task was to develop a high performance yet highly flexible machine that would enable their customers to be competitive in small to very large production runs.

Automation in the EA market is not new, it is continually evolving. As materials and components change in the end product, so does the complexity of the Servo Motion System that needs to deliver high performance results. All phases of the production process, from board printing through assembly and automated inspection all require precise control.

Printed Circuit Boards are used in virtually every electronic device today, from cellular phones and personal computers to industrial and medical machinery. Companies supplying to these markets are the customers for these machines.

## The Design Approach

The company's approach was to develop a machine design that provided a network for hundreds of I/Os, 10+ servo motion axes, deterministic communications between these devices and a host computer with a Graphical User Interface (GUI). Cost, reliability and performance were all factors in deciding the communication architecture. CANopen, an open, non-proprietary and deterministic communication bus was selected.

CANopen is a common communication and servo motion communication bus that was

originally developed by Bosch for the automotive industry and made its way into the industrial automation world in the mid-90's, primarily in Europe. CANopen is now a very successful Servo motion control architecture with unlimited applications around the world in various industries.

The machine is a PCB screen printer which applies the solder to the electrical circuits on a substrate. In the machine architecture, there are two motion subsystems, one for applying the solder to the substrate and the other for visual quality inspection. These systems work independently within the machine providing a combined solution.



## The Challenge

Distribute motor controls in a limited amount of space to meet the following requirements:

- drive both rotary and linear motors
- severe space limitations
- connectivity via CANopen
- less wiring for easier assembly
- cost savings

## Elmo's Solution

The PC-based machine control platform was carried forward from a previous design. Although it did not have a real-time operated system, it was able to meet all the requirements when combined with Elmo's intelligent Harmonica Servo Drives. In this application the motion "trajectories" are sent from the host to the drives. The drives "interpret" the trajectories and drive the servo motors accordingly. The drives also run supervisory monitoring programs and can execute a programmed script that is stored in flash memory

Previously, a centralized controller with a PC front-end was used to interface with I/O, pneumatics and the motion system. This put the burden of the machine control system on a single processing system in which all devices received commands and reported back status (feedback position, sensor state, etc.).

The CANopen control architecture, using a Windows based PC, distributes the intelligence throughout the machine. The Servo drives were located very near if not actually on the moving axis eliminating the need for a centralized control cabinet. With intelligent nodes, wiring is greatly simplified; DC power is run to the servo drives and feedback wiring is run from the motor to the drive. All of the wiring back to a centralized control is eliminated and replaced with a simple dual-wire CAN cable that is daisy chained between the different intelligent nodes back to a CAN Master on the PC.

Having two subsystems running separately (automatic solder application and automatic visual inspection) but having the ability to interact for coordinated motion, allowed the overall machine to provide 20% more throughput. This coupled with a quicker changeover process provided greater machine utilization when smaller production runs dictated machine usage.

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## Harmonica Digital Servo Drive

The Harmonica is a fully digital servo drive that delivers up to 1 KW of continuous power (and 2 KW of peak power) for DC brush, brushless and linear motors. It can operate in current, velocity or position modes and functions with a wide variety of feedback options including Incremental Encoders, Resolvers, Interpolated Analog (Sine/



Cosine) Encoders, tachometers and potentiometers.

The tiny drive packs one horsepower into a 150 gram (5.3 oz) package. It features sinusoidal vector control, trapezoidal vector control, trapezoidal six-step and DC c o m m u t a t i o n

methods. The Harmonica

has an auxiliary feedback port for ECAM, Follower, Dual Loop and Pulse-and-Direction applications. Digital and analog ports are also available.

Integrated into the drive is highly efficient power switching technology aligned with Elmo's especially fast implementation of CANopen networking (DS-301/DS-402) protocol. One CANopen port is installed along with one RS-232 serial port for communications.

The Harmonica is fully programmable with Elmo Motion Control's programming language (32 KB of memory is available for storing programs). Using Elmo's Composer setup tool, Harmonica users can perform drive setup, configuration, tuning, analysis and drive programming quickly and easily.

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