

Dancer control slims down while gaining functionality

Delta Servo drives with onboard control plus integrated HMI eliminate the need for a PLC on a film handling module.

When Company X decided to build a new generation standalone packaging film processing machine module, its control engineering group had two things in mind: a slimmer control architecture and a flexible design to accommodate the progressive demands of the packaging market. To minimize cost, the number of components had to be reduced without jeopardizing machine performance. Plus, the new system had to offer more features with higher functionality so the natural evolution of next gen design wouldn't be limited.

APPLICATION NEEDS

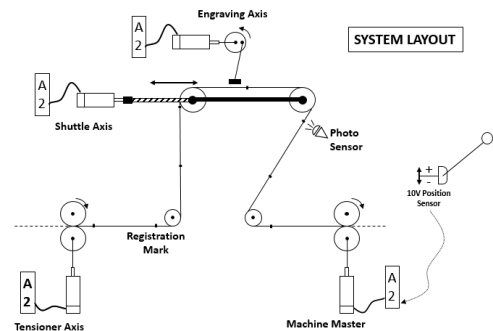
The heart of the module consists of four motion axes: two to drive nip-rolls that control the speed and tension of the operation; and two for a linear flying, stamping and engraving process. The control system also had to satisfy two modes of operation: continuous run (with and without registration) and intermittent indexing correlated with a registration mark. An operator interface was needed for machine setup and storage of information.

The pre-processed film is pulled by one of the nip-rolls (the machine master), which in the continuous run mode must take its speed command input from an upstream dancer analog position reference.

Consequently, the tension must be closely controlled in the section between the two nip rolls. This is accomplished by accurately slowing the second nip-roll

by an operator-defined percentage (allowing film slip at the second nip-roll). This lagging variance may change due to the elasticity and memory properties of the material. Therefore, the HMI had to be capable of on-the-fly manual adjustments of the ratio (+/- 1 to 3 percent).

While keeping the right tension between the two nip-rolls, a linear actuator, which connects two separated rolls, has to advance a shuttle at the speed of the web for 80 percent of the total moving distance, and then return to the starting position for its next cycle. This action virtually stops the web, allowing the stationary press head to descend, touch the film and engrave a logo. To prevent the film from being damaged, stretched or ripped by the die head, the engrave action has to be controlled and adjusted depending on the die size and the amount of force and time required.



Since motion control is governed by the ASDA-A2 servo drive's built-in functions and Motion Macros, there's no need for a PLC.

SUCCESS CASE: ASDA-A2 SERVO



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This operation may require a continuous mode with no registration mark, representing a repeated section length. There's also a registration matching mode, which requires syncing with a mark on the film.

Using the HMI, the operator should be able to load new recipes. This machine setup can be random; and there may be situations where no predefined e-cams are preloaded. The machine axes have to automatically adjust based on the film registration mark position feedback.

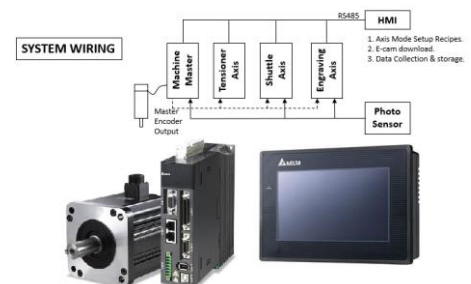
Since this is a standalone machine module that does not require many inputs/outputs (I/Os) and all are tightly triggered depending on the axes position or speed, the customer wished to eliminate the programmable logic controller (PLC) and use the I/Os available on the servo drives to reduce the system cost and increase the responsiveness of the local I/Os. Moreover, the customer wanted to use the built-in functionalities of the servo drive to fully operate the machine, consequently, eliminating the need and cost of a centralized upper motion controller.

THE DELTA SOLUTION

The solution from **Delta Products Corp. (Booth S-8078)** Industrial Automation Business Group, Research Triangle Park, North Carolina, meets the needs of the application and provides additional features. The whole system control scheme can be run using four parameterized, motion-intelligent ASDA-A2 servos and a DOP-B07P Professional HMI. The distributed control of the ASDA-A2 made it possible to eliminate the upper controller, while software wizards expedited setup. With many critical motion functions parameterized through built-in macros (macroinstructions), there's no programming and less troubleshooting. Testing is simpler too. "What is so unique about this A2 servo drive is that many critical motion functions are parameterized through MACROs built-in the drive – for us that meant no programming & less troubleshooting.", according to the customer. Since Delta manufactures the ASDA-A2 servo and DOP-B HMI, additional functionality was added to make the two products work together more efficiently, further reducing the programming effort.

The master-axis operation consists of two modes: continuous and intermittent. The continuous mode runs the system based on a speed command from a dancer, which is fed directly to the master axis. Since the machine does not have an external master encoder, the master axis encoder serves as the reference for the other axes motion: the tensioner nip-roll, the shuttle and the press.

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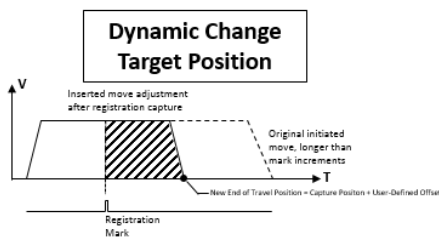


Dancer control system consists of four motion-intelligent A2 servo drives and a DOP-B07P Professional HMI.



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The intermittent mode runs the system at an index interval based on the film registration marks. In this mode, the distances between the registration marks may not be consistent, yet the index distance has to be an operator-defined and very precise distance from the registration mark. Since the master is in fact the servo axis driving the nip-roller, the index target distance is virtually redefined internally by the axis after it starts moving and after capturing the registration mark. The master axis using the ASDA-A2’s 5 microsec fast-capture registration feature, can internally change the move target reference to the actual registration capture position,

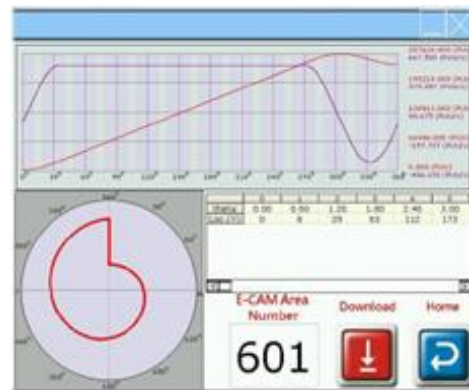


eliminating any communication delay with an upper controller. Therefore, even with irregular mark distances at high film speeds, the machine master is able to index accurately for the press to engrave in a precise distance from the mark. According to the customer, “changing the target position on-the-fly from an internal calculation in the drive was a real game changer for us.”

In order to control the section tension and keep the same speed reference level as commanded by the dancer position feedback, the encoder output from the master axis is scaled and then passed to the second nip-roll. This scaling can be manually overwritten on-the-fly by the operator using the HMI to increase or decrease the film tension to match the specs of the material used.

Since the master axis encoder feedback is used by all the machine axes, an ASDA-A2 drive bypass function is used allowing the encoder signal to be amplified and resent to the next drive with only 50-nanosecond propagation delay per drive. At a maximum machine speed of 240 ft. per min., a 100-nanosecond delay between the master and the fourth axis reflects only one-half an encoder count on a 100,000-count-per-motor-revolution feedback.

To stamp and engrave properly at high speeds, the shuttle has to match the film speed for at least 80 percent of the actuator’s total travel distance. In the non-registration mode, the operator is able to set the desired speed, matching zone distance between the engrave marks. The DOP-B07P Professional Series HMI is used to graphically set up and generate the e-cam profile and download to the shuttle ASDA-A2 servo axis, which runs continuously based on the master feedback. This allows for e-cam profile customization without the need for plugging in a personal computer, further simplifying setup and operator usage.



DOP-B Professional Series HMI includes pre-engineered eCAM editing & download functionality.

“Setting up the Flying Press axis with only five parameters was unheard of—the ASDA-A2 is like an automation controller in itself!”

In registration matching mode, the shuttle motion has to coordinate with the registration mark position, which may create a challenge due to mark misprint and/or material stretch. A Synchronized Axis macro function compensates and implements the necessary corrections. With less than five parameter settings, this macro is turned on, and the ASDA-A2 servo drive will continuously and automatically capture and compare registration marks and implement the necessary adjustments on the e-cam profile on-the-fly. “Setting up the Flying Press axis with only five parameters was unheard of—the ASDA-A2 is like an automation controller in itself!” noted the customer.

This Synchronized Axis macro also ensures the engrave axis prints in the right place. However, to ensure this axis presses with the correct pressure, the operator also must be able to regulate the amount of torque and determine the window within the press e-cam cycle where the torque limiting will occur. For this requirement, the ASDA-A2 drives’ Output Range I/O function was used to dynamically limit the torque output according to the operator setting.

The ASDA-A2 servo drive offers two additional options. If the user wants to implement the operation with an external encoder for slip compensation, the ASDA-A2 comes with a second encoder feedback input for a full-closed loop control operation. If the graphics on the film interfere with the registration mark operation, a registration mask range feature allows the user to specify a distance window within the cam cycle where the ASDA-A2 Sync Axis operation would disregard any action on the registration input.

Delta Products achieved the customer’s machine functionality and production mode requirements, and, in the process, reduced the system components in a scalable, standalone and cost-effective system to accurately control all four axes of complex motion—without a PLC. Instead motion control is governed by the ASDA-A2 servo drives’ built-in functions and Motion Macros such as synchronous e-cam, e-gear, position capture and compare, dynamic endpoint change and second full-closed loop, and DOP-B PE series with downloadable user-defined cams.

SUCCESS CASE: ASDA-A2 SERVO

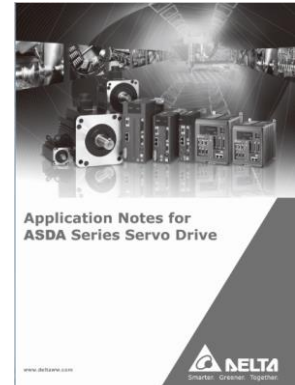


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MORE INFORMATION

To learn more, download a free ASDA-A2 Series Servo Application Manual at www.delta-america.com/A2 for a guide to applications on other standalone machines including linear flying shear/fill, rotary knife/seal, wind/unwind, electronic line shafting, index to registration, orienting and placing, ABS rotary dial table, x-x' gantry control, profile blending, point-to-point positioning and motion sequencing.

For more information, visit www.delta-america.com/A2.



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