Automation of Labeling Machine
Using Allen-Bradley® Micro850® Programmable Controllers

This paper provides an overview of how a Micro850® programmable controller can be used on a labeling machine to reduce an OEM’s engineering effort and to help them maximise productivity.
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Executive Summary

As a machine builder, you are challenged to differentiate yourself amidst global competition and rapidly evolving technology. Product labeling demands machines that combine high production output, consistent reliability and product quality with low manpower requirements and low maintenance costs. The machines also need to be flexible enough to adapt to different products and different label materials at different production speeds with varying environmental conditions.

Whether measured from a business, commercial or technical perspective, Rockwell Automation can help improve your labeling machine performance with solutions and services to lower the Total Cost to Design, Develop, and Deliver℠ machines and meet your customers’ requirement.

At Rockwell Automation, we strive for a holistic approach that focuses on your machine and business performance. What may start out as an “order-by-order” relationship, can eventually develop into a mutually beneficial business relationship. Rockwell Automation will work with you to develop solutions that will help give you a competitive advantage throughout your machine’s life cycle.
Introduction

Labels play a large part in the life of a packaged product. Labeling is critical to the product packaging process. If you can’t label a package, you can’t identify or ship a product and are even forbidden to sell product in most of the markets.

Like labels, labeling machines come in a wide variety. They are generally categorized by the requirement of adhesive application.

- Adhesives required:
  o Pressure Sensitive Labeling Machine
  o Hot Melt Glue Labeling Machine
  o Wet Glue Labeling Machine

- No adhesive required:
  o Shrink labeling/Sleeving machine
  o Stretch labeling/Sleeving machine

A Pressure Sensitive Labeling Machine applies pre-glued labels that are supplied on a reel of release paper or film. Pressure sensitive labels undergo multiple manufacturing steps to have the label temporarily adhere to a web or roll but will permanently adhere to the package. There are multiple types of applicators but they all share the capability to peel the label away from the web or backing and transfer it to a package. After the pre-glued label is peeled from the web there are several ways to apply the label. The simplest way is to wipe the leading edge onto the package. The other is to transfer the label to an applicator drum which holds on to the label by vacuum or other mechanical means before transfer to the package. Typical speeds are 0.5m/s but higher speeds are possible.

A Pressure Sensitive Labeling Machine has three basic sections:

- The labeling head: Its function is to accurately dispense a single label from the carrier tape to the applicator at the required speed. It is a motor driven tape transport mechanism. The label which is on the tape is dispensed when reaching the peeling plate.
- The applicator: Its function is to accurately place the label on the product at the required speed.
- The product handling system: Its function is to place the product consistently at the required speed in position for label pasting. Normally a product conveyor with guiding mechanism is employed.

Pressure sensitive labeling machines are becoming more popular because the user does not have to use glue, thus resulting in lower maintenance and lower operator intervention.

This white paper describes how Micro850® programmable controllers can be applied on a labeling machine. Sample code, Bill of Materials, wiring diagrams and other information about this solution are available to help OEMs quickly design, develop and deliver labeling machines. The sample code has been successfully tested on a pressure sensitive labeling machine. The sample code and other information can be found in Rockwell Automation sample code library: http://www.rockwellautomation.com/go/scMicro800
The sample code is targeted for common type pressure sensitive labeling machines with speeds of 200 labels/min and pasting accuracy of less than ±1 mm. A brush mounted just after the peeling plate serves as label applicator which wipes the label onto the product after the label is dispensed. An encoder is attached to the product conveyor motor to detect conveyor speed and also to align the label with the product.

The sequences of the labeling machine are:

1. The product passes the Product Sensor, a signal is sent to the controller.
2. The controller starts to count the conveyor encoder output pulses.
3. The controller starts Labeling Head motor when the encoder count reaches a defined value.
4. The Applicator applies the label to the product, while the Label Sensor looks for the gap between labels.
5. The labeling head motor stops when the label sensor detects the gap.
6. The system is ready for the next product.

There are two additional modules on the machine. One is the product separating mechanism which adjusts incoming product pitch before label pasting. The other is the sponge wheel which applies pressure on the labeled product to secure the pasting. These two mechanisms are driven by two variable frequency drives (VFDs).
Challenges

End Users and Machine Builders expect labeling machines to be:

- **Productive**: Machines are expected to deliver maximum throughput, minimize waste, produce high quality products and minimize downtime;

- **High performance**: Meet ever increasing labeling tolerance requirements across full range of machine speed and overcome variability in raw material being processed.

- **Flexible and scalable**: Adapt to more frequent product and label material changeovers; reduce changeover time. Have the capability to integrate more advanced functions and technologies including trace and track, print and apply, inspect and reject etc.

- **Easy to use**: Easy to maintain, operate with least human involvement.

Machine Builders specifically expect labeling machines to be:

- **Modular and scalable**: Mix and match labeling machine functions that are specific to products, customer’s applications and local market demand.

- **Standard**: Develop and document mechanisms common to labeling machines that can be easily redeployed with minimum modifications. Reduce machine design and development time.

- **Cost-effective**: Reduce costs on machine integration, mechanical, electrical optimization and wiring. Shorten software development time and maintenance.
Solutions & Benefits

Labeling Machine Solution with Micro850® Programmable Controller

- Modular Software Design
- Advanced Motion Control
- Touch Probe / Registration
- Versatility of Interfaces
- High Performance and High Flexibility

In this solution, a 24 point Micro850® controller is used, which communicates to the PanelView™ Component (PVC) Human Machine Interface (HMI) through Ethernet. A Kinetix® 3 servo drive is employed to drive the labeling head mechanism which interfaces with the Micro850® controller through Pulse Train Outputs (PTO). Three PowerFlex® 4 Variable Frequency Drives (VFDs) are used to drive the conveyor and guiding mechanism, the product separating mechanism, and the sponge wheel respectively, they communicate to the Micro850® controller with Modbus RTU protocol through an isolated serial port plug-in. The encoder is connected to a High Speed Counter (HSC) input of the Micro850® controller.
Modular Software Design

Allen-Bradley® Connected Components Workbench™ software is the common programming and configuration software for the Micro800® family of controllers, PowerFlex® drives, PanelView™ Component graphic terminals and other Allen-Bradley® devices. Allen-Bradley® Connected Components Workbench™ software supports programming in ladder diagram, function block diagram and structured text. Any combination of programming languages can be used in the same project so the programmer can pick whatever language best fits the task at hand. In addition, User Defined Function Blocks (UDFBs) are supported to implement a modular code structure. Modular code can be developed once and encapsulated within a function block and then easily reused within the same project or in another project. A good example of this is using the PowerFlex® drives User Defined Function Block which makes it easy to do speed control of a drive over Modbus RTU without having to understand and program using Modbus RTU messages. The UDFB interface can be made generic to drives of various vendors.

Advanced Motion Control

The Micro850® programmable controller supports up to 3 motion axes using Pulse Train Outputs to stepper and servo drives. Graphical Axis configuration screens are provided in the Allen-Bradley® Connected Components Workbench™ software to aid in configuration. The axis is defined in user defined units for position (e.g. mm, cm) making programming easier. Motion control programming is easy with intuitive PLC open based Motion Control Function Blocks (MCFBs) including Home, Move Velocity, Move Absolute, and Move Relative etc.
The Touch Probe function is able to capture accurate registration position at high speeds with built-in hardware. This is extremely useful for applications like labeling machines where precise positioning is required at high speeds. In comparison to capturing registration in servo drives, Touch Probe provides flexibility in post registration distance adjustment, tighter and direct control, better diagnostics and monitoring.

The following oscilloscope screen shot demonstrates how the touch probe function is implemented in a labeling machine. The green color signal is the Pulse Train Output (PTO) sent to the labeling head servo, and the blue color signal is the label sensor output which serves as touch probe trigger input:

- As the incoming product on the Conveyor is sensed, the High Speed Counter (HSC) starts to track product position by counting Conveyor encoder pulses.
- Once the product reaches a predefined position, the Labeling Head is issued its first command to move (Green PTO signal “Pulses sent to servo”), so that the current label can be applied to the product accurately.
- As the Labeling Head moves, the Label’s edge is detected by a low to high transition of the Label Sensor (Blue Signal) and the position of the edge is recorded by the Touch Probe function.
- A correction offset based on label’s edge is calculated and sent as a second move command to the Labeling Head servo (Green PTO signal “Offset counts generated by second Absolute Move”). This correction ensures the pasting accuracy of the next label by stopping the head at desired position.
Versatility of Micro850® Interfaces

- Digital and analog Inputs & Outputs, up to 6 High Speed Counter inputs and up to 3 Pulse Train Outputs.
- Embedded USB programming port, serial port (RS232/485) and 10/100 Base-T Ethernet.
- Modbus RTU and CIP serial protocol support on both the embedded serial port (non-isolated) and the serial port plug-in (isolated).
- Ethernet/IP protocol with CIP Symbolic support for simplified Panel View Component HMI connectivity. Same symbolic tag name can be used in HMI and controller.
- Modbus TCP protocol for connectivity to other HMIs and RTU applications such as data collection from a supervisory controller.
High Performance and High Flexibility

- Plug-in and expansion modules allow you to optimize your machine cost by choosing performance and functionality specific to your machine needs:
  - Support up to 5 plug-ins, such as digital I/O, analog I/O, backup memory, isolated serial port, SMS, weigh scale etc., from Rockwell Automation and our Encompass™ partners.
  - Support up to 4 Expansion I/O modules and up to 132 digital I/O points, including high density digital I/O and high accuracy analog I/O.
- Touch Probe function combined with registration input achieves accurate positioning.

With its high performance and powerful features, the Micro850® programmable controller is suitable for not only labeling machines but other machines as well.

Benefits of the Solution

- High performance: maintain consistent high pasting accuracy, even when production speeds and label material vary, by using Micro850® advanced features like the Touch Probe.
- Reduced time to market: machine builders’ time to market may be reduced by using standard off-the-shelf components, common software tool and pre-existing templates.
- Ease of use: reduce product changeover and machine setup time by utilizing the ability of conveyor speed auto detection and label feeding starting position pre-configuration.
- Scalability: optimize your machine cost by selecting only the functionality you need. The Micro850® family offers wide range of expansion modules and plug-ins to provide flexibility and scalability to your machines.
- Flexibility: your machine can easily integrate with third party components by utilizing the variety of communication options and modular programming structure offered by Micro800.
Summary

The Micro850® programmable controller solution for labeling machines is packed with performance at an exceptional value. Allen-Bradley ® Connected Components Workbench™ software enables OEMs to develop modular and scalable solutions. OEMs can design, develop and deliver machines faster by leveraging the pre-existing sample code, wiring diagrams, bills of materials, and more.

With Micro850® labeling solution, OEMs have benefited with as much as 15% improvement in pasting accuracy compared to their previous solution.

How can the Micro850® solution help to optimize your machine performance?

Global Solutions – Locally Delivered

Whether you’re around the corner or around the world, our Services & Support network can provide the skills and resources you need to optimize performance and utilization of your automation equipment, helping you meet your business objectives.

- Global emergency support 24/7
- Offices and agents in more than 80 countries
- 35,000 distributors and agents
- 1000 service engineers, consultants and project managers worldwide
Resources

Call a Rockwell Automation sales office or an authorized distributor today or visit us online at: [www.rockwellautomation/solutions/oem](http://www.rockwellautomation/solutions/oem)

For more information on the Micro800 controller, please visit: [http://ab.rockwellautomation.com/Programmable-Controllers/Micro800](http://ab.rockwellautomation.com/Programmable-Controllers/Micro800)