

Automation of Intermittent VFFS Machine

Using Allen-Bradley® Micro850™ Programmable Controllers



This paper provides an overview of how a Micro850™ programmable controller can be used on an intermittent VFFS machine while saving OEMs engineering effort and helping them maximise productivity.

LISTEN.
THINK.
SOLVE.®

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Executive Summary

As a machine builder, you are challenged to differentiate yourself amidst global competition and rapidly evolving technology. Product packaging demands Vertical Form Fill and Seal (VFFS) 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 variations in bag dimensions and sophisticated designs.

Lower your Total Cost to Design, Develop and DeliverSM intermittent VFFS machines with Rockwell Automation Micro850TM Programmable Controllers

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

What may start out as an "order-by-order" relationship, can eventually develop into a mutually beneficial business relationship because we strive for a holistic approach that focuses on your machine and business performance.

Consider Rockwell Automation your VFFS machine automation supplier for each stage of your machine's life cycle from design, throughout development, to customer delivery and beyond.

Design

- Design Productivity
- Extensible Engineering
- Scalability
- Global Standards
- Risk Assessment
- Design for Sustainability

Develop

- Time to Market
- Supply Chain Efficiency
- Flexible Equipment Models
- Simplified Integration
- Design Optimization

Deliver

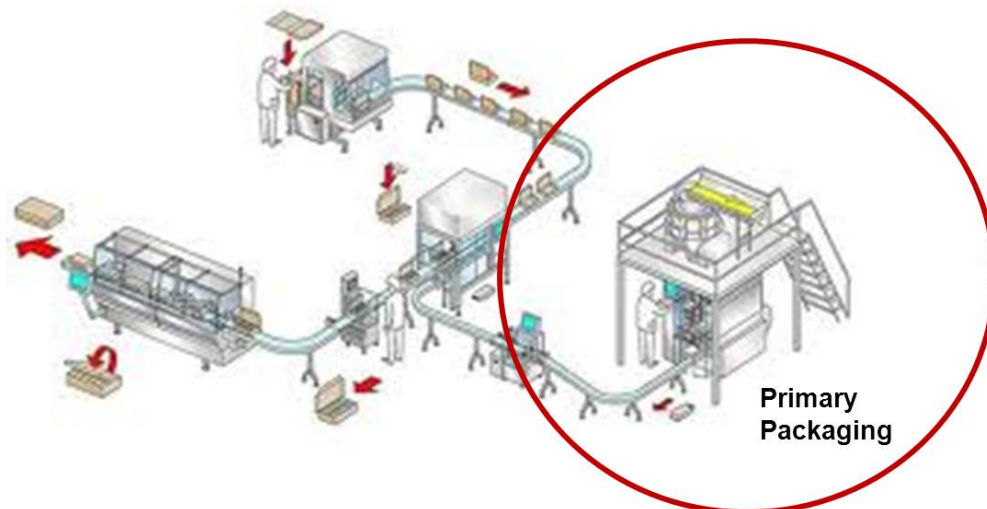
- Commissioning
- Global Service & Support
- Reliability & Quality
- Machine Performance

Introduction

Vertical Form, Fill and Seal (VFFS) machines are automated assembly line packaging systems used in packaging liquids and solids. VFFS machine can be intermittent or continuous motion. Intermittent motion machines operate on the principle that vertical bag seals are made when the film is moving and horizontal seals occur when the film stops. Intermittent motion machines offer a suitable solution for applications where speed is not absolutely paramount. On continuous motion machines the vertical and horizontal bag seals are applied without stopping the film and therefore higher production rates can be achieved.

For more details on VFFS machines refer to Rockwell Automation VFFS Machine Application white paper (http://literature.rockwellautomation.com/idc/groups/literature/documents/wp/oem-wp004_-en-p.pdf).

This white paper describes how Micro850™ programmable controllers can be applied on an intermittent VFFS machine. Sample code, Bill of Materials, schematic drawings and other information about this solution are available to help OEMs quickly design, develop and deliver VFFS machines. The sample code has been successfully tested on an intermittent VFFS machine. The sample code and other information can be found in Rockwell Automation sample code library (<http://www.rockwellautomation.com/go/scmicro800>)



A Sample Production Flow Chart for Assembly Line
(Source: Internet)

Generic VFFS Machine Process

A roll of film is unwound and formed into a tube over a forming collar. A vertical overlap seal is applied to the tube by the vertical sealing bars. A bottom seal is created by the horizontal sealing bars in the cross jaws.

The formed pouch is then filled with correct amount of product while the film tube is being fed by the film transport belts. Often a precision scale or an auger ensures that the proper amount of product is placed in the pouch in a consistent manner.

After the correct length of film tube has been fed, a top seal of the filled pouch is created by the horizontal sealing bars, while the filled pouch is cut from the descending film tube by a knife in the cross jaws.

If the film is pre-printed, a registration sensor is added to the system to correct the film position in order to maintain the correct print position relative to the end of the pouch. The bottom seal creation of the empty pouch, top seal creation of the filled pouch and cutting of the filled pouch all occur at the same time.

Product enters the system through the forming tube.

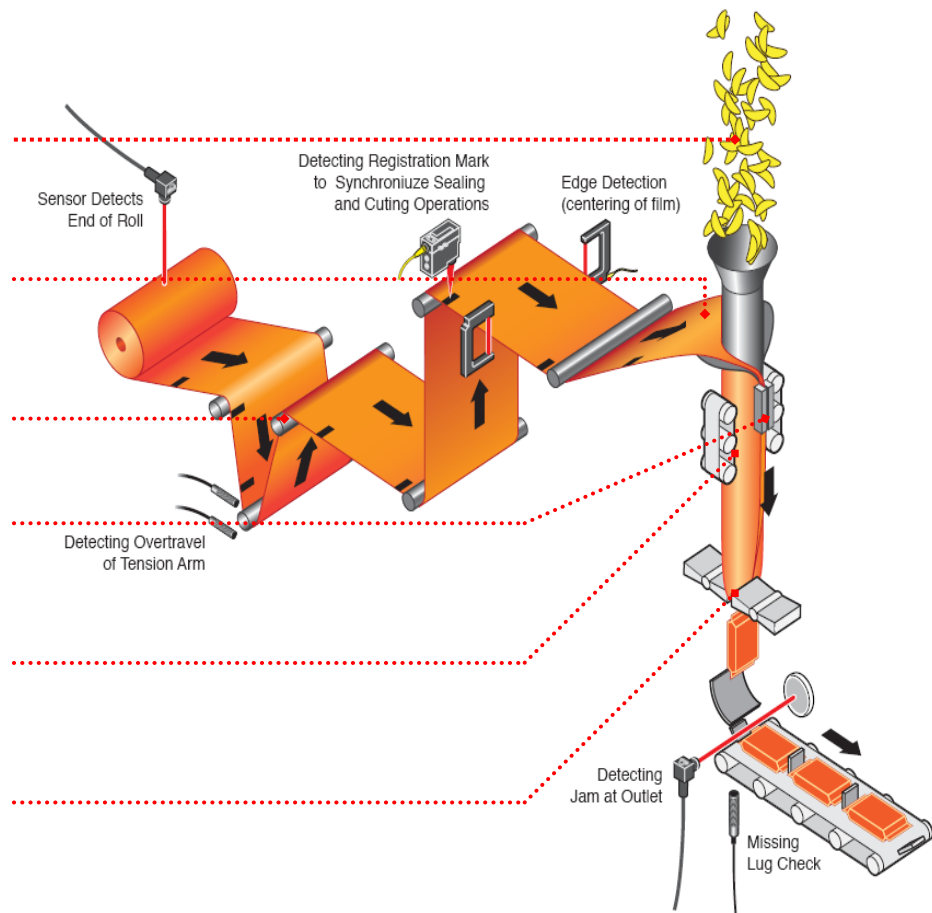
The forming collar shapes the flat film into a round film tube.

Low friction rollers guide the film to the forming area.

Vertical sealing bars seal the edges of the film tube together.

Film transport belts pull the film through the forming area.

Cross sealing jaws create top and bottom seals in the pouches, and cut the filled pouch from the empty pouch.



Challenges

End Users expect VFFS to be:

- **Productive:** Optimize packaging process to achieve maximum possible machine speed; maximize throughput with highest quality; shorten recovery time.
 - **High performance:** Satisfy strict accuracy requirements at high machine speeds and variable bag lengths.
 - **Flexible:** Release the burden of manual adjustment of film registration sensor position by introducing software adjustment scheme; improve changeover time.
- Easy to use:** In spite of machine complexity, machines must be easy to maintain and operate.

Machine Builders expect VFFS to be:

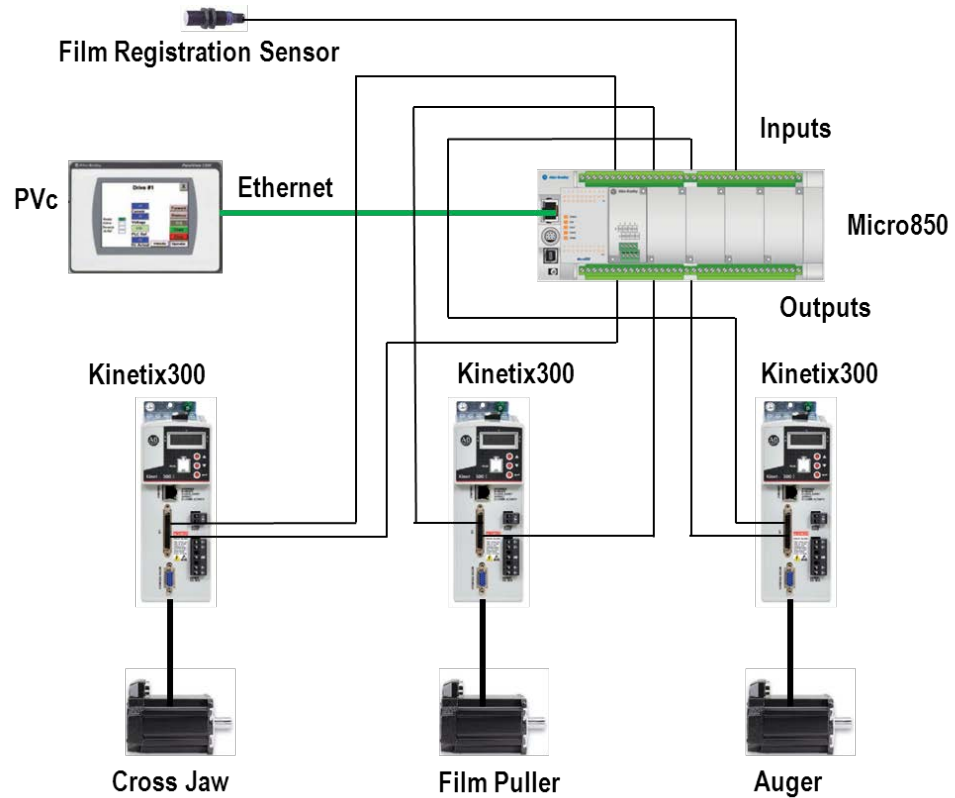
- **Modular and scalable:** Mix and match VFFS machine functions that are ideally suited for specific customer applications; customized functions to develop a new machine that is localized to market demands.
- **Standard:** Develop and document mechanisms common to VFFS machines that can be easily redeployed with minimum modifications, despite different machine sections/conditions that result in more complicated sequencing and interlocking, so that machine design and development time can be reduced.
- **Cost-effective:** Machine integration, mechanical, electrical optimization and wiring start up time costs are reduced.



Solutions & Benefits

Intermittent VFFS Solution with Micro850™ Programmable Controller

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



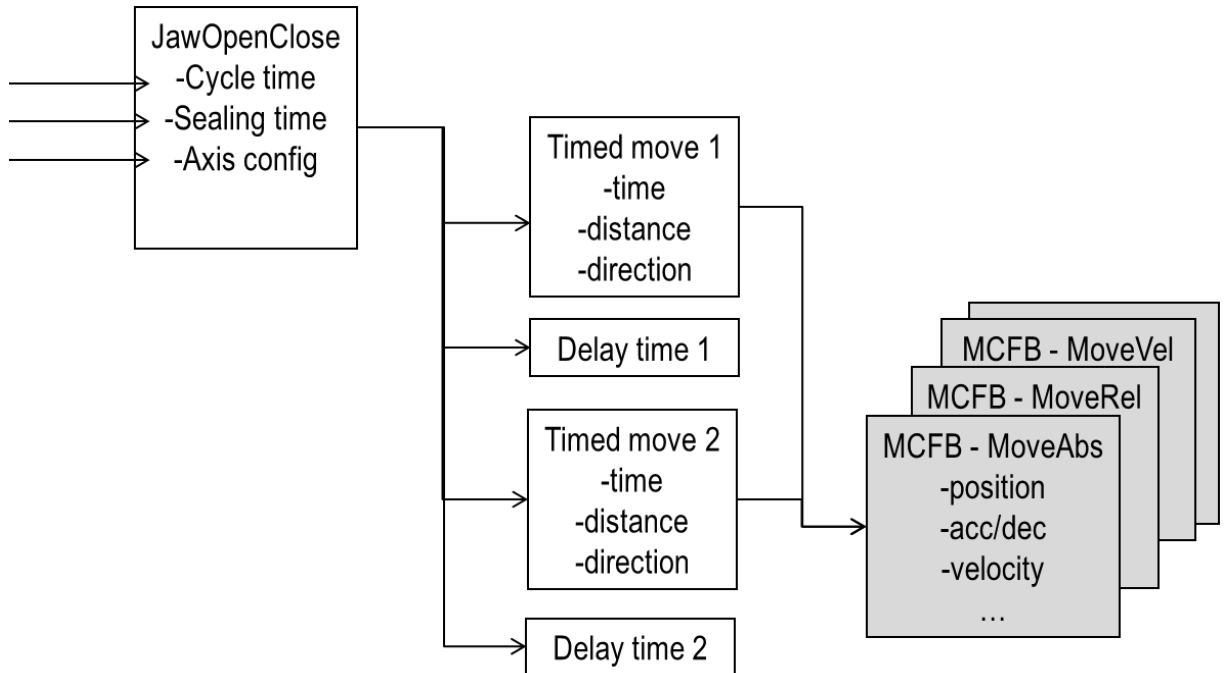
Module	Automation Components	Interface to Controller
Controller	Micro850™ (28/20 I/O)	-
HMI	Panel View Component	Ethernet or Serial
Cross Jaw	Kinetix®300 / Servo Motor	PTO and IO Control
Film Puller	Kinetix®300 / Servo Motor	PTO and IO Control
Auger	Kinetix®300 / Servo Motor	PTO and IO Control

Benefits of the Solution with Micro850™ Programmable Controller

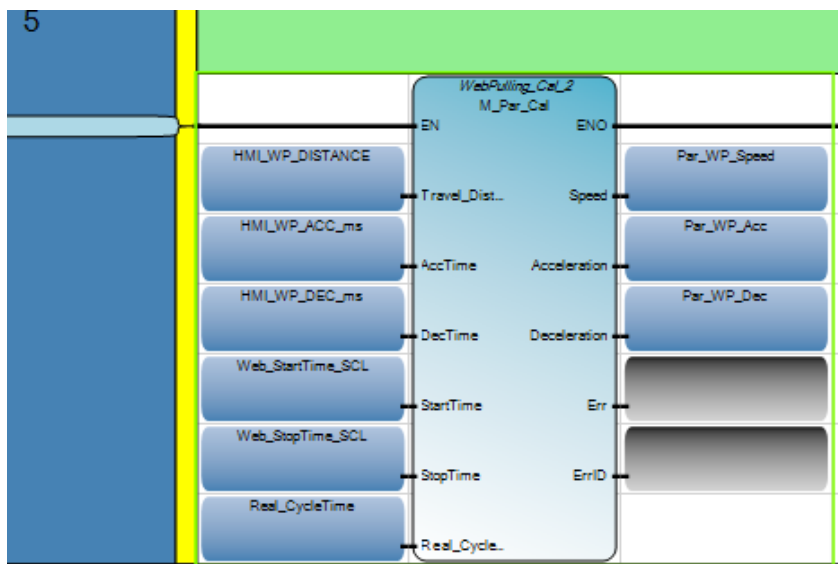
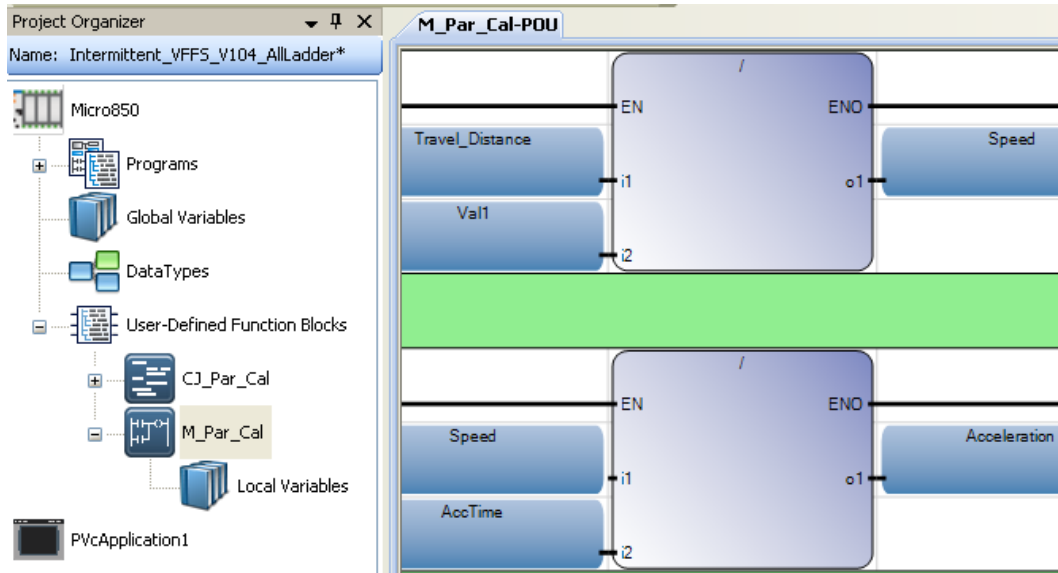
Modular Software Design

Connected Components Workbench (CCW) is the common programming and configuration software for Micro800 controllers (including Micro850™), PowerFlex® drives, PanelView® Component graphic terminals and other Rockwell Automation devices. CCW supports built-in instructions with the choice of programming in ladder diagram, function block diagram or structured text. In addition, User Defined Function Blocks (UDFB) are supported to implement a modular code structure. The modular structure allows easy interface to devices from various vendors with minor configuration changes.

The following graph shows a 'Technology' is developed in the sample code with a 3-level structure where UDFBs can be employed for functions such as 'Timed move'.



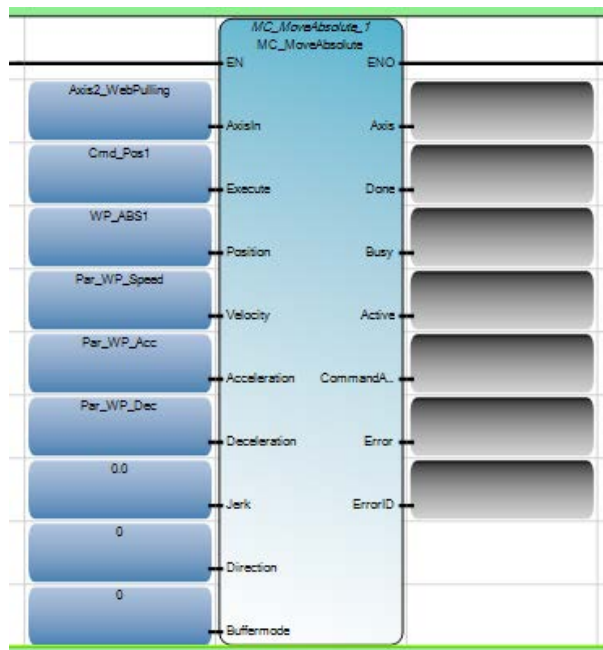
The following graphs show how a UDFB is defined and deployed in the program.



M_Par_Cal UDFB calculates motion speed, acceleration and deceleration parameters from timed move parameters including travel distance and travel time. This example shows the use of WebPulling_Cal_2. This makes it easy to share the algorithm with axes with motion defined by timed move which is common to cross jaw, film puller and auger. With this arrangement the code becomes more modular and easy to comprehend.

Advanced Motion Control

The Micro850™ Programmable Controller supports up to 3 motion axes using Pulse Train Output (PTO) to stepper and servo drives. Graphical Axis configuration screens are provided in the CCW 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 PLCopen based Motion Control Function Blocks (MCFBs) including Home, Move Velocity, Move Absolute, and Move Relative etc.

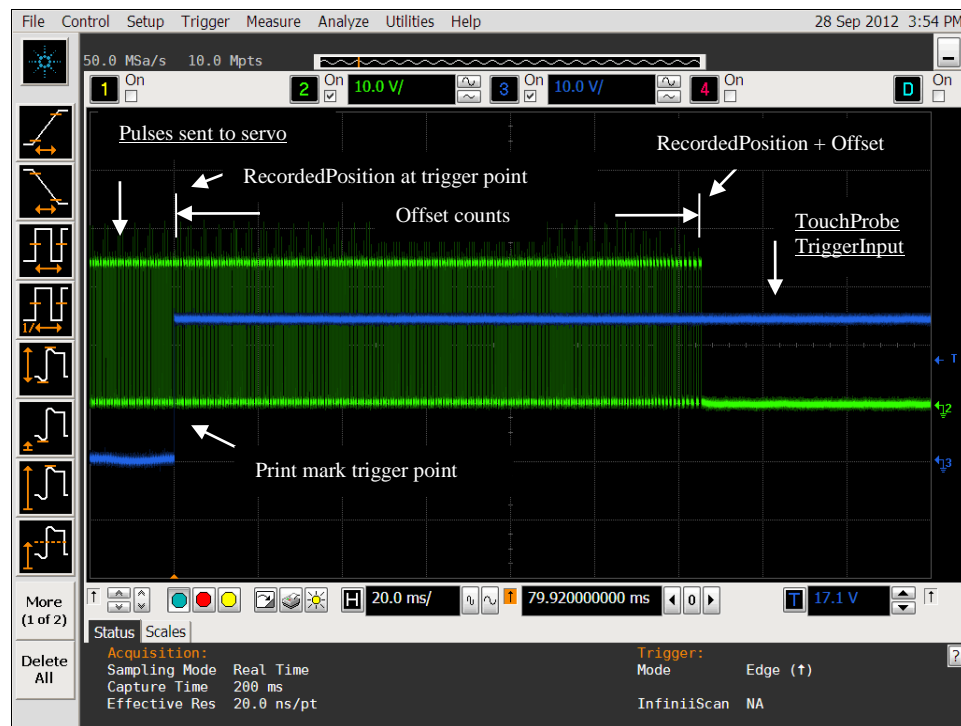


Touch Probe / Registration

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 VFFS 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 shows how the touch probe function works:

- The film puller servo is commanded to move by sending a Pulse Train Output (PTO). Green color signal is the PTO.
 - Print mark is detected. Blue color signal "Print mark trigger point".
 - The servo position corresponding to print mark and desired pouch length are used to calculate the additional distance the film needs to travel to achieve the desired pouch length.
 - The additional distance to travel is sent as PTO ("Offset counts").
- The film puller is stopped for the cut and the cycle repeats.



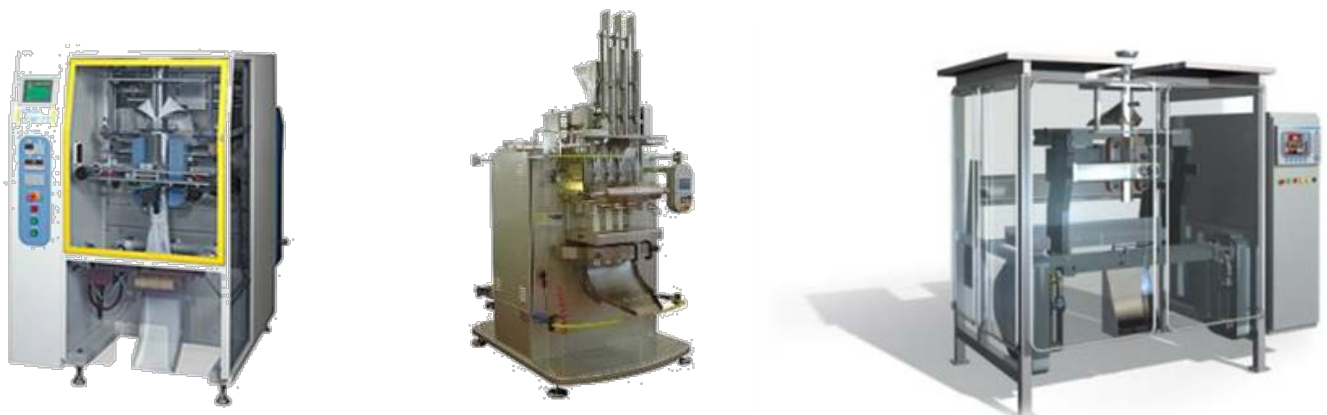
Versatility of Interfaces

- Up to 6 High Speed Counter inputs and up to 3 Pulse Train Outputs over embedded digital IO.
- Up to 5 plug-ins and up to 4 expansion IO modules.
- Embedded USB programming port, serial port (RS232/485) and 10/100 Base-T Ethernet.
- Modbus RTU and CIP serial (server) protocol support on both the embedded serial port (non-isolated) and the serial port plug-in (isolated).
- The Ethernet/IP protocol with CIP Symbolic support for simplified Panel View Component HMI connectivity.
- The 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 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 enables accurate positioning.

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



Summary

Micro850™ Programmable Controller solution for intermittent VFFS machines is packed with performance at an exceptional value. Connected Components Workbench (CCW) enables OEMs to develop modular and scalable solutions. OEMs can design, develop and deliver machines faster by leveraging the pre-existing: sample code, drawings, Bills of Materials, etc.

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

Micro850™ enables a 6 lane intermittent VFFS test machine to easily achieve throughput of 360 pouches per minute. In addition, M850 controller delivers the following:

- Improves machine performance by using build-in functions such as fast print mark registration.
- Optimizes machine cost. The Micro850™ controller is competitively priced .
- Reduces machine development time by utilizing pre-existing tools and templates and powerful instruction set.
- Scalability in machine functionality by having the option to choose from various Expansion Modules and Plug-In Modules.

Resources

Call a Rockwell Automation sales office or an authorized distributor today or visit us online at: www.rockwellautomation.com/solutions/oem

For more information on the Micro800 controller, please visit:
<http://ab.rockwellautomation.com/Programmable-Controllers/Micro800>

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