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2009

Rockwell 控制系统
在包装机器中的应用

Simon Zhang GOTC
George Xu GOTC
gxxu@ra.rockwell.com 138 1833 1234

Rockwell Automation OEM China

Allen-Bradley • Rockwell Software

Rockwell Automation

Agenda

1. Preface
2. Packaging Machine Summary
3. RA Advantage in Packaging
4. Success Stories
5. Others (Open Discussion)

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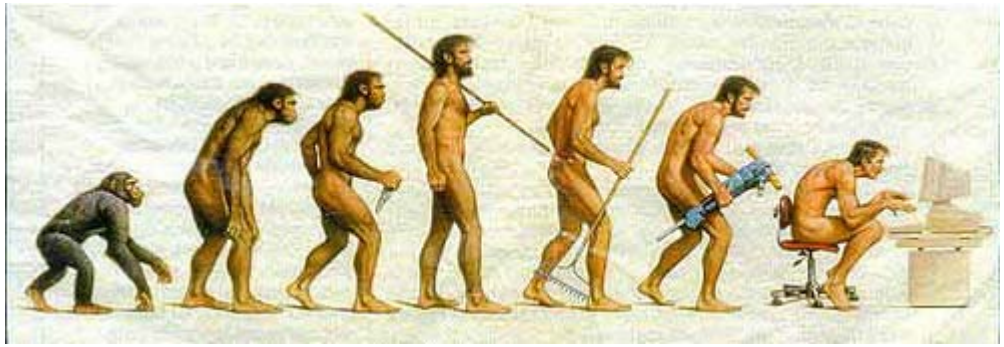
Preface

Simon Zhang
George Xu

The Way We're Walking On…



数百万年以来，他们切身地体会并表现着关于人类演化的历程……

在这个永不停歇的旅程中，我们将继续参与并深刻地领会：

蜕化、进化、消亡与发展……

第一代工具

第二代工具

第三代工具

第四代工具

第五代工具

在这一革命性的旅程中，工具亦随之发生着翻天覆地的变化

The Way We're Walking On…

伴随工具的革命，我们在生命活动中，
所创造的智慧也经历着革命性的发展进程，
而且将越来越快……

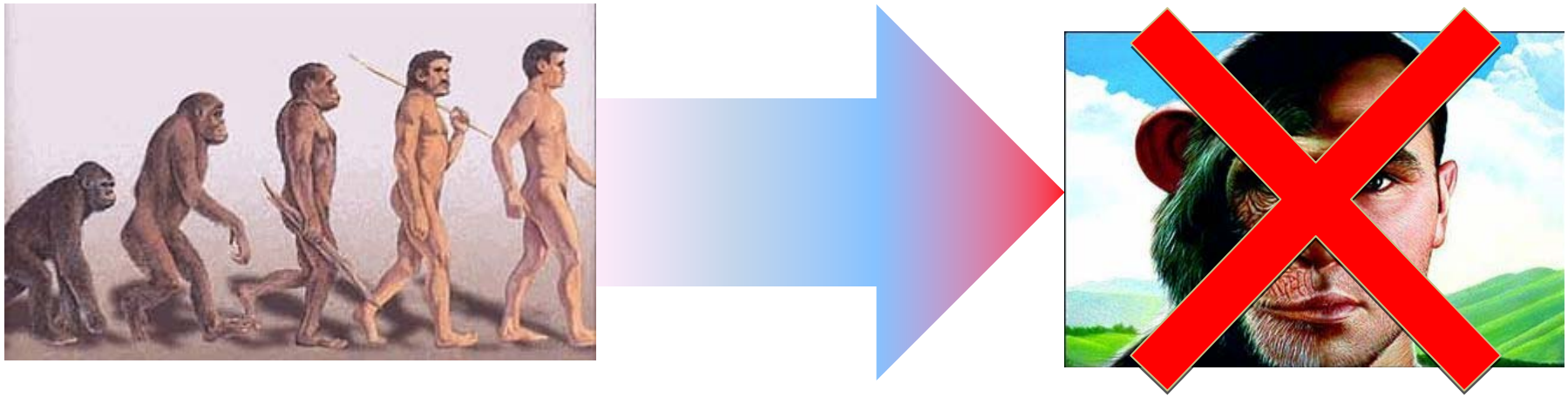
1610 1779 1902 1990 2002

那么，你的机器革命呢？

The Way We're Walking On…

- 在今天，我们必须确保：

  沿着正确的方向、行进在正确的道路上



错误地把握趋势，往往是致命的！

我们的机器亦然……

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包装设备概论

Simon.Zhang
George.Xu

GOTCs Shanghai

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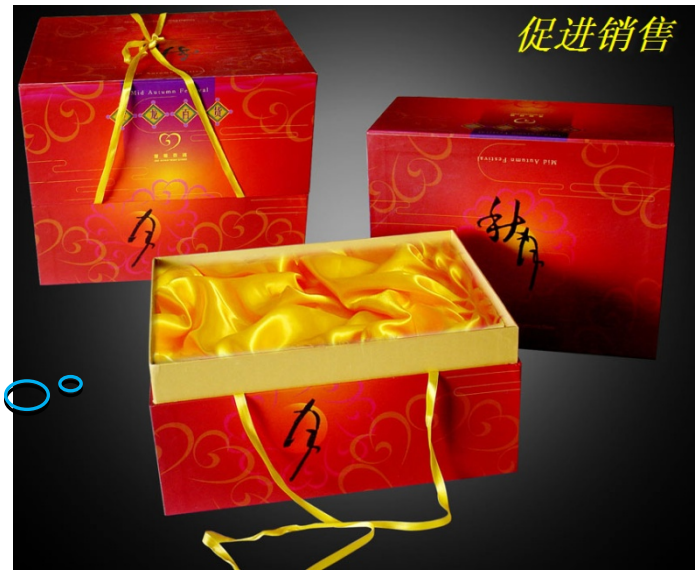
What is Pack?

- 包装是指在流通过程中保护产品、方便储存、促进销售，按一定技术方法而采用的容器、材料及辅助物等的总体名称。

维护安全

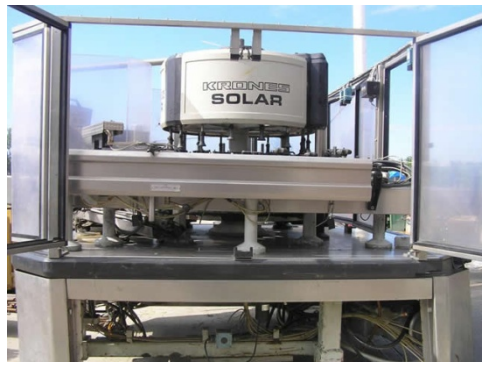


质量保护

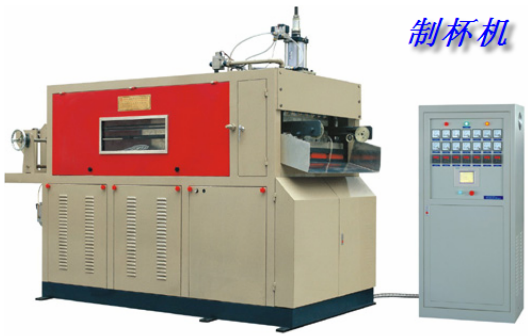
价值提升

Kinds Of Packaging Machine

- 包装机械的分类
  - 完成包装生产过程的机器：充填、灌装、封口、捆包、缠绕、封合、加标、容器清洗和灭菌.....或者他们当中的几个功能组合的机械



  - 完成包装材料生产过程的机器：造纸、印刷、裁切、制杯.....或者他们当中的几个功能组合的机械



包装机器控制方法

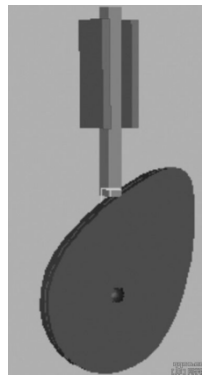
主要控制方法

MAM

定位控制

MAG / MAPC

同步控制



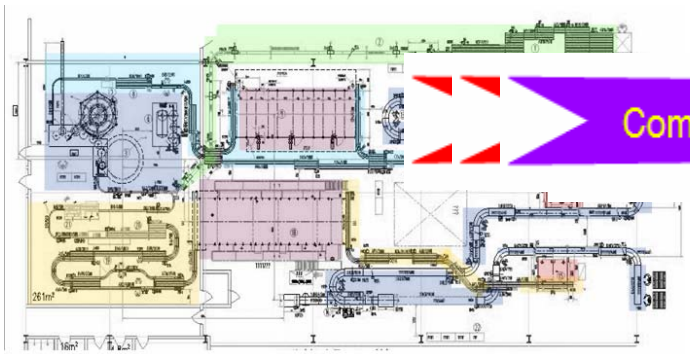
- 高精度位置注册
- **No-Product-No-Bag**
- **Schedule Output**
- **…**

包装机器客户及行业分布概略

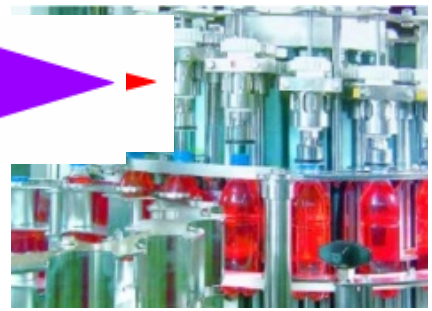
包装设备制造业的发展与期望

行业的发展伴随着客户越来越高的期望

发展与期望



Complete Line Supply - Line Control



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Rockwell 在包装行业的应用优势

Simon.Zhang
George.Xu

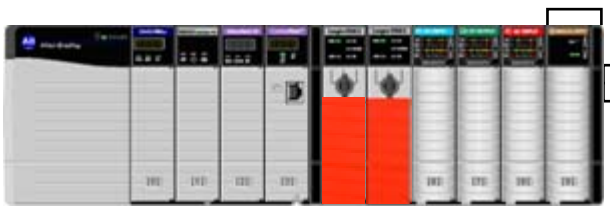
GOTCs Shanghai

Lower Total Cost Ownership: Integration

Integration costs, engineering time, spare parts, maintenance personnel, system complexity, cost to purchase, total cost!!!!

Code for linking logic

Code for linking logic



Code for linking logic

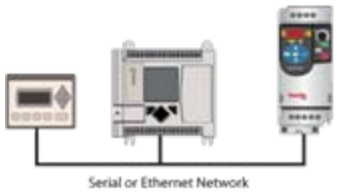
- Reduced Integration Costs
- Reduced Engineering Costs
- Reduced Spare Parts
- Reduced Manpower Requirements
- System Simplicity
- Lower Total Cost
- Reduced Panel Space
- Up to 3 axis systems

Lower Total Cost Ownership: Scalability

Components & Intelligent Motor Control

Integrated Architecture

Connected Components



Simple Connectivity

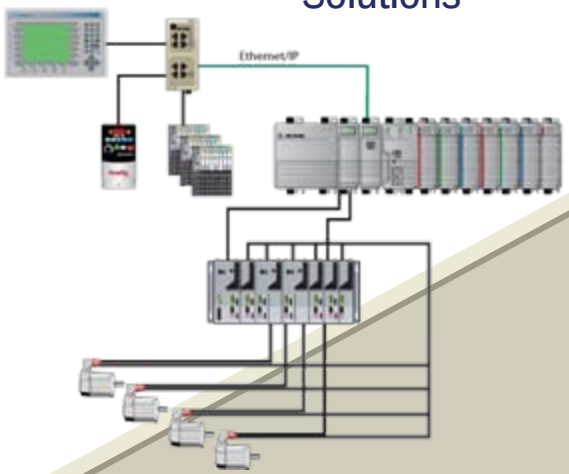
Mechanical linked machine

Stand alone machine

Low cost

Just enough control

Compact Machine Solutions



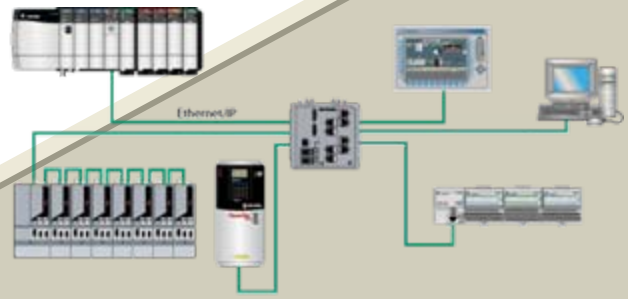
Multi axis motion

Increased controller capabilities

Mix of mechanical and electrical controls

Low engineering costs

Advanced Machine Solutions



Coordinated Multi axis motion

Robotic Feeders

Electronic Line Shafting

Advanced connectivity

Advanced information capabilities

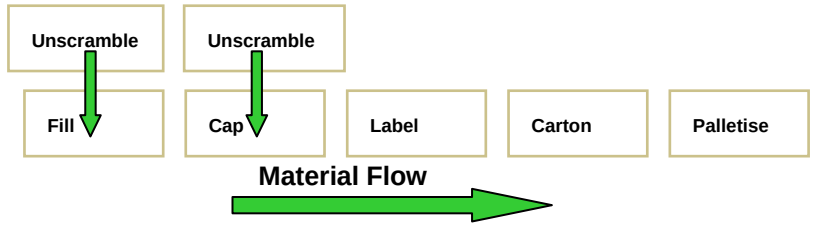
Integration Continuum

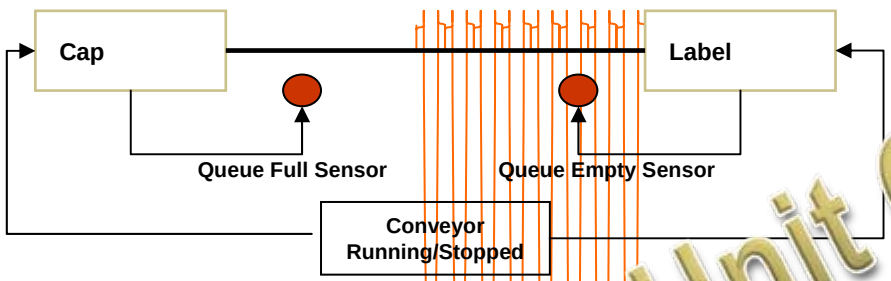
Low

High

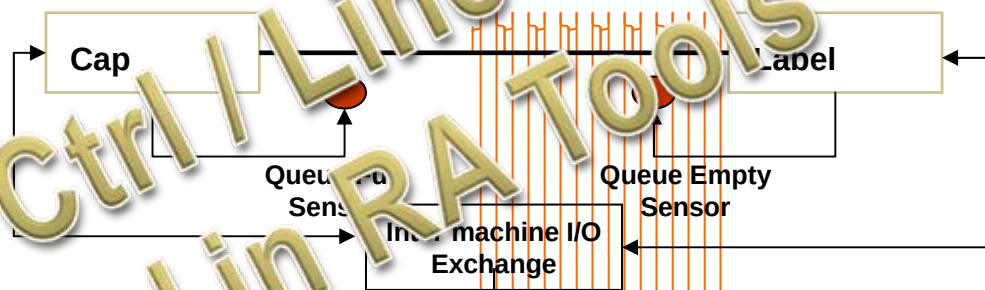
Broadest offering available for Machine Builder (OEM) needs

OMAC Typical Packing Line Arrangements

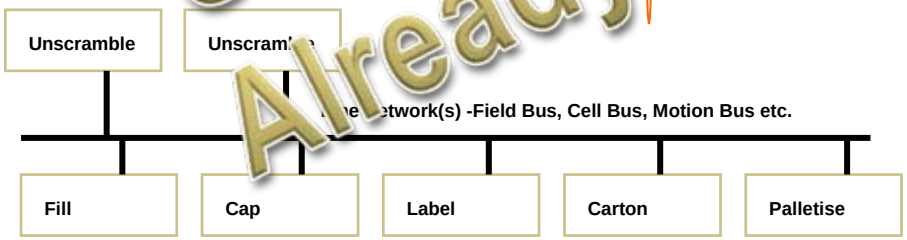




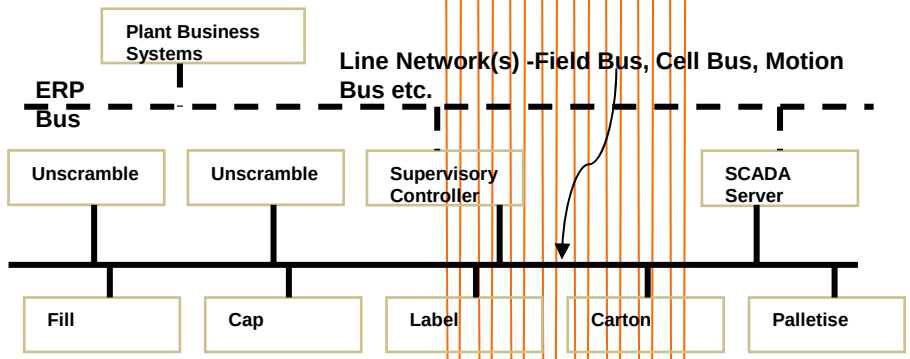
No Inter machine Communication



Inter machine Communication by hardwired I/O



Inter machine Communication via a network



Add Supervisory Control and connection to enterprise systems

Power Programming – Do Things Professional

- 标准及标准的组织(一)
  - International Society of Automation

About ISA

- Founded in 1945, The International Society of Automation is a leading, global, nonprofit organization that is setting the standard for automation by helping over 30,000 worldwide members and other professionals solve difficult technical problems, while enhancing their leadership and personal career capabilities. Based in Research Triangle Park, North Carolina, ISA develops standards; certifies industry professionals; provides education and training; publishes books and technical articles; and hosts the largest conference and exhibition for automation professionals in the Western Hemisphere. ISA is the founding sponsor of The Automation Federation (www.automationfederation.org).

ISA S88

- 标准简介
  - 无严格定义的标签
  - 较为详尽的状态机
  - 适合批处理、批处理以外的设备系统的控制规划
  - 包含对设备机械本身的模块化划分

Power Programming – Do Things Professional

- 标准及标准的组织(二)
  - Organization for Machine Automation and Control
  - Open Modular Architecture and Controls Users' Group

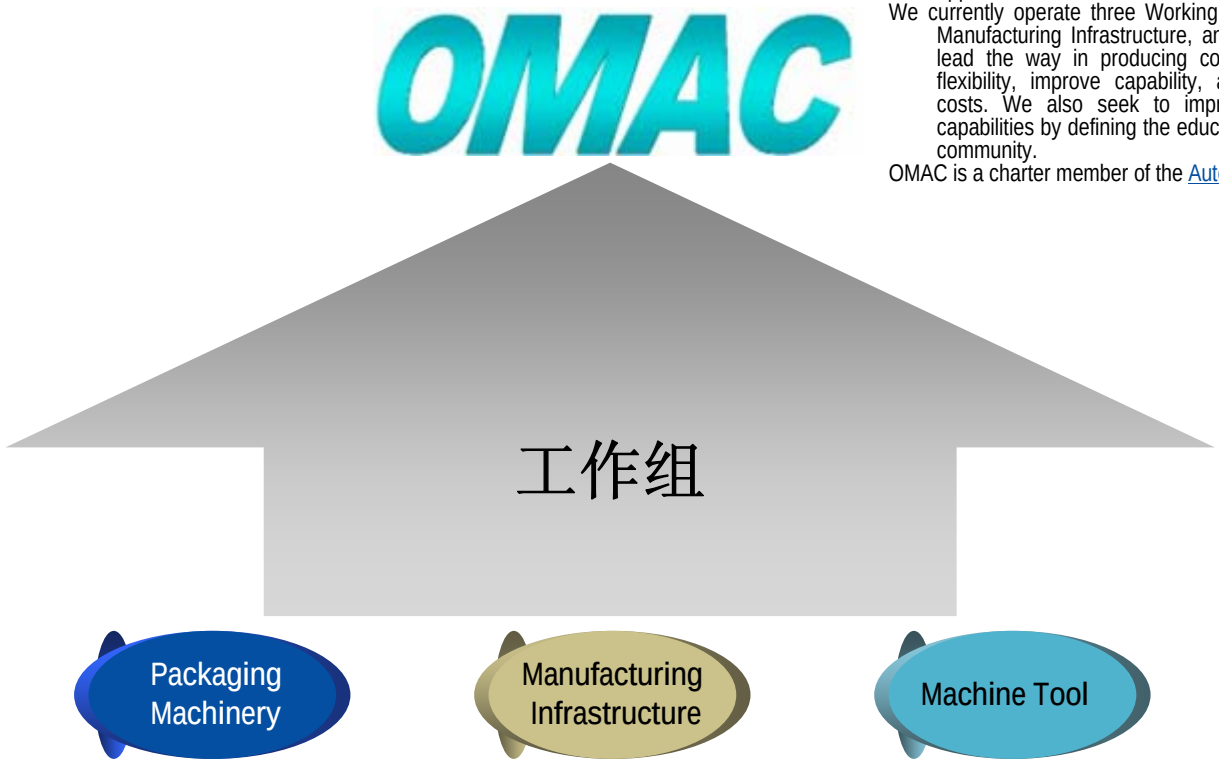
About OMAC

The OMAC Users Group was formed in 1994; OMAC—Organization for Machine Automation and Control—is the global organization for automation and manufacturing professionals that is dedicated to supporting the machine automation and operational needs of manufacturing.

OMAC has about 500 members from end-user companies, OEM's, and technology providers and integrator companies. These members include companies with vested interest in developing and implementing open control technologies for manufacturing applications.

We currently operate three Working Groups: Packaging Machinery, Manufacturing Infrastructure, and Machine Tool. These groups lead the way in producing consensus guidelines to improve flexibility, improve capability, and reduce system integration costs. We also seek to improve the automation industry's capabilities by defining the educational and training needs of our community.

OMAC is a charter member of the Automation Federation



OMAC - PackML

- 标准简介
  - 严格定义的标签
  - 详尽的状态机
  - 适合包装机器的控制规划
  - 但不涉及对设备机械本身的模块化划分

包装工作组分支

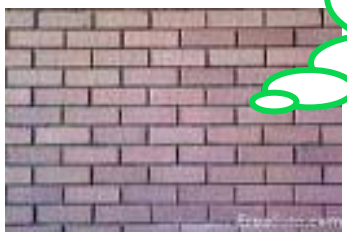
- Pack*ML* = Packaging Machinery Language
- A new subgroup, formed February 2001. used to standardize all states definition of all kinds of packaging machines
- "If packaging machines could talk, Pack*ML* would be their language"
- Web site: www.packml.org

Power Programming-Why We Need Standard?

- 关于OEM设备的控制开发，通常我们会关注的是：
  - 模块化编程 (良好的程序结构)
  - 开发过程良好的衔接性能 (项目人员变动时，无缝衔接)
  - 有效编程 (可靠的、快速完成设备功能→设备上市时间短)
  - 代码重用 (减少工作量、增加代码可靠性 → 基于过去的经验并为将来积累经验)
  - 易于故障查找 (程序可读性强)
  - 机器安全 (正确的初始化、上电、条件互锁等)
  - ……
- 上述所有需要得以满足的前提是：

  当我们设计整个机器程序的时候必须基于一定的*标准*。

模块化编程概念探讨



PowerProgramming

- 项目构建

模块化编程

- 编程设计

S88,PackML,OEE…

DeviceLogix – New For You

1734/1738 DeviceLogix and Self-Configurable

Phase 1 – AFC Already in Dec 2008!

- 1734 Non-DeviceLogix, Self-Configurable (1734-8CFG)
- 1738 Non-DeviceLogix, Self-Configurable (1738-8CFGM8 & 1738-8CFGM23)

Non-DeviceLogix

Phase 2 – Maybe Delayed !

- 1734 DeviceLogix, Self-Configurable (1734-8CFGDLX)
- 1738 DeviceLogix, Self-Configurable (1738-8CFGDLXM8 & 1738-8CFGDLXM23)

DeviceLogix

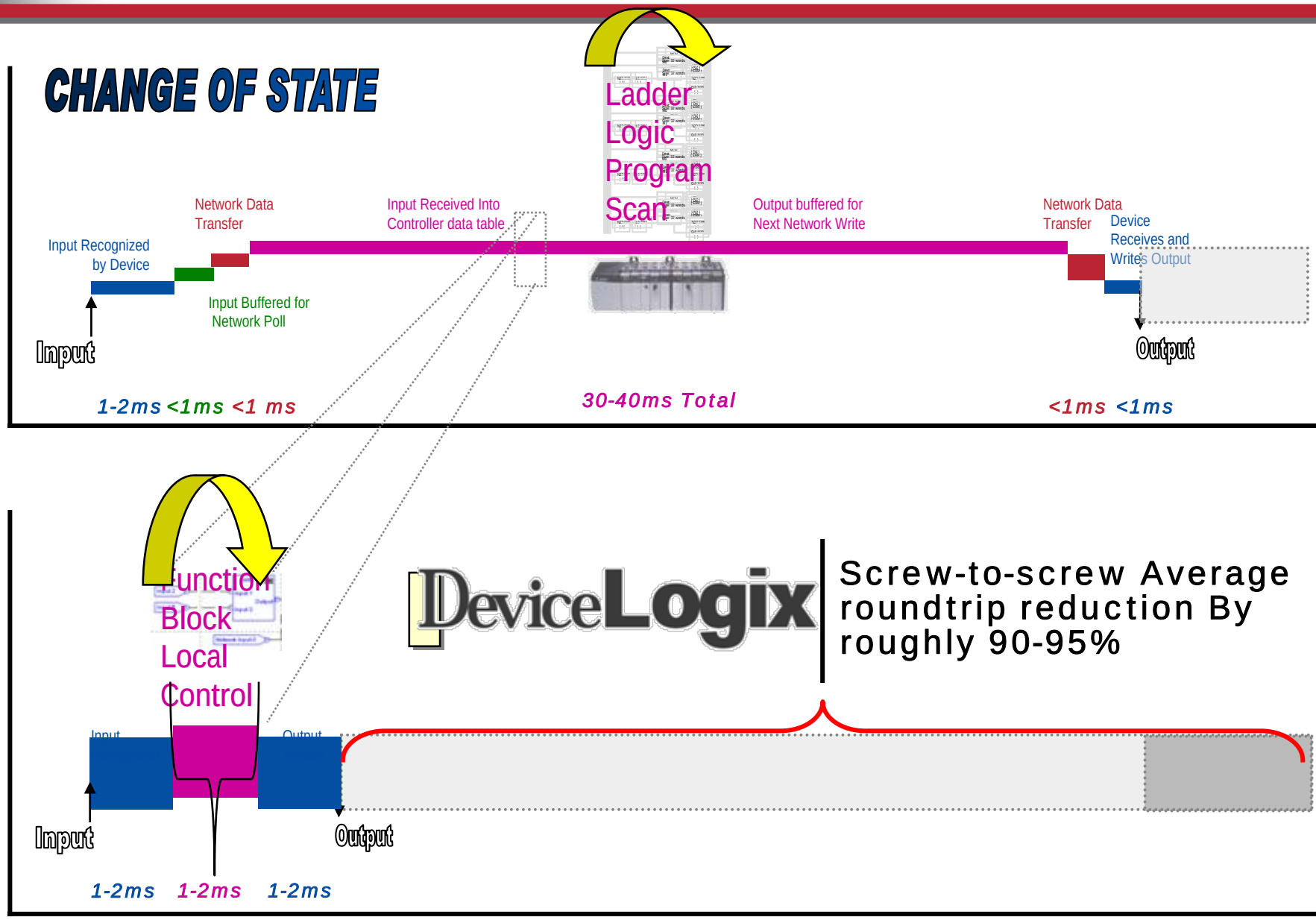
Phase 3 – May 2009 !

- 1738 Non-DeviceLogix, Self-Configurable (1738-8CFGM12)
- 1738 DeviceLogix, Self-Configurable (1738-8CFGDLXM12)

M12 Connectors

Note: Product follow 1738 16-Points product AFC due to adoption of same sealing technology.

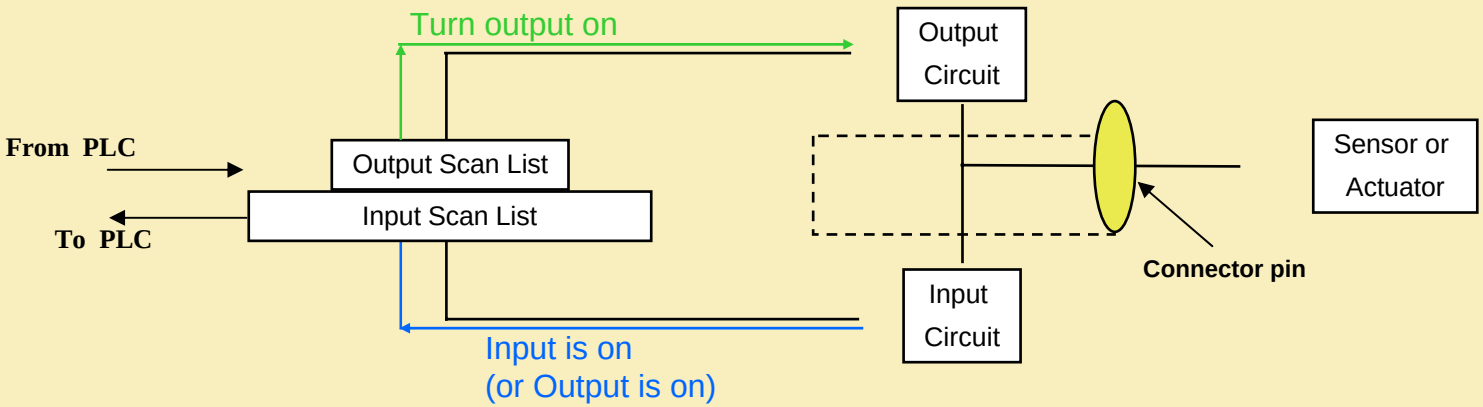
Throughput Optimization Gained from Local Control



1734 Point 8-Channel Self-Configuring Modules (With or Without DeviceLogix)

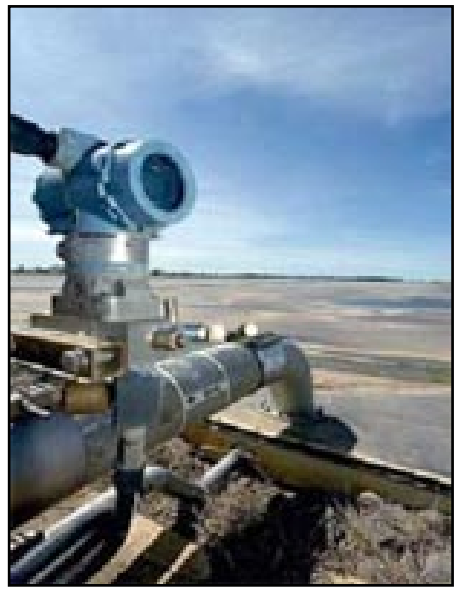
- 24Vdc 8-channel discrete I/O module
- Each channel can be either an input or an output (self-configuring)
- If DeviceLogix not enabled (default), the “master” controls the outputs and reads the inputs
- If DeviceLogix enabled then it becomes the “Master” i.e. it controls the onboard outputs and reads the inputs
- 8-bit consume assembly, 8-bit produce assembly

Self-Configuring circuits



DeviceLogix – Target Application

- Material & Handling
- Automotive
- Aggregate/Mining/Cement
- Oil & Gas
- Chemical, Waste Water, Food & Beverage
- Entertainment
- Transportation
- HVAC – Air Handling

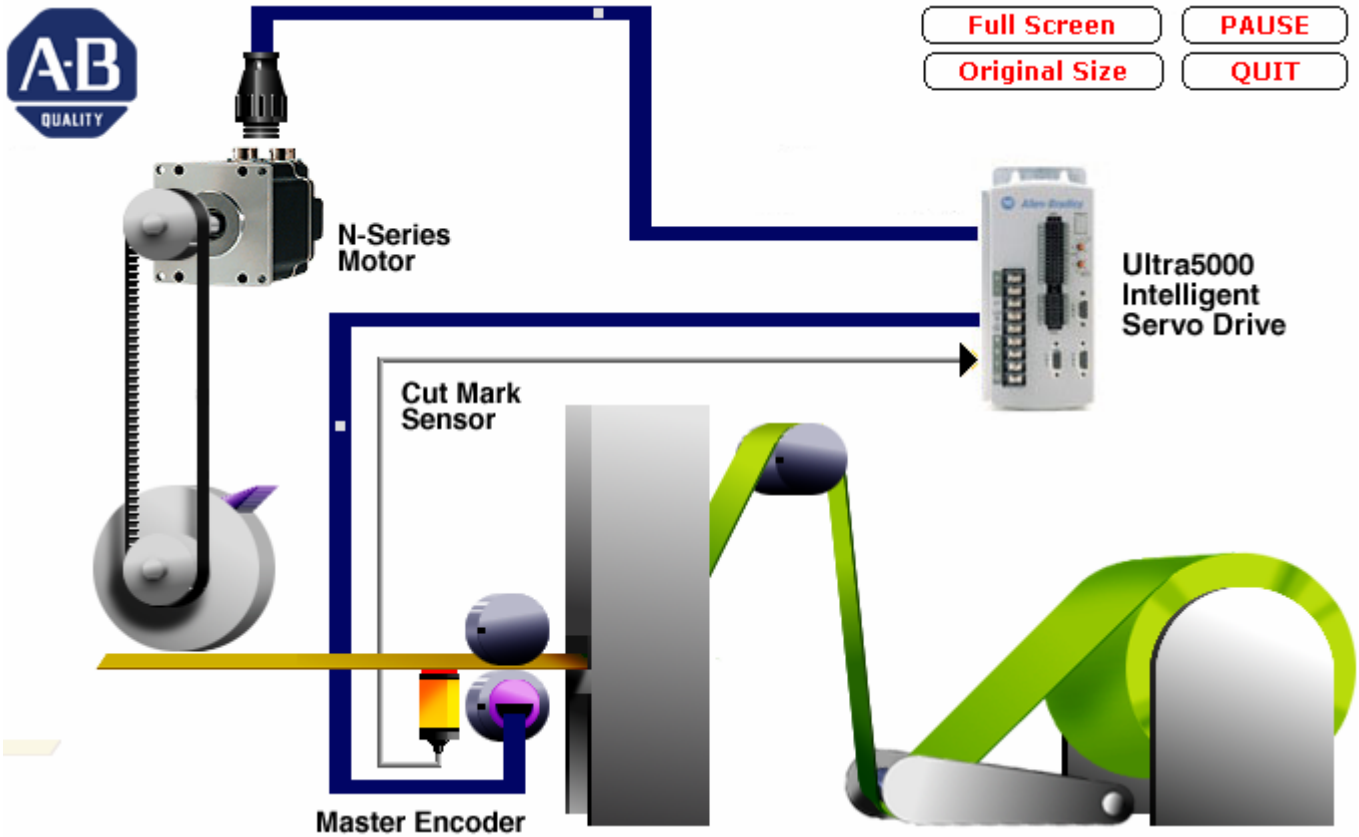


需要快速扫描、置于高速旋转设备上的就地**IO**及程序解决方案

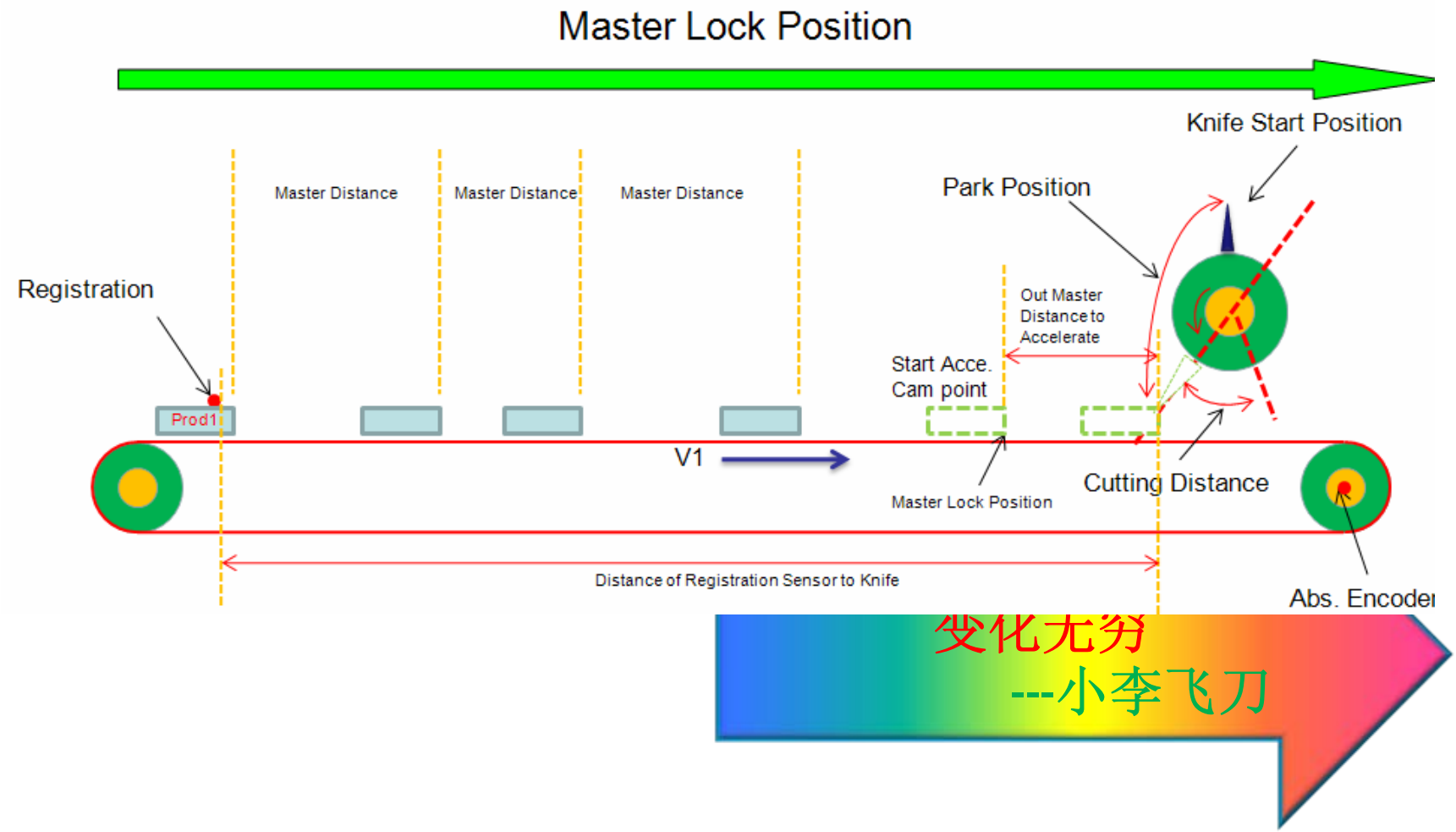
No-Product-No-Bag

- 该控制方法被广泛应用：
  - 旋转刀
  - 智能皮带
  - 分配产品

No-Product-No-Bag – RotaryKnife Application

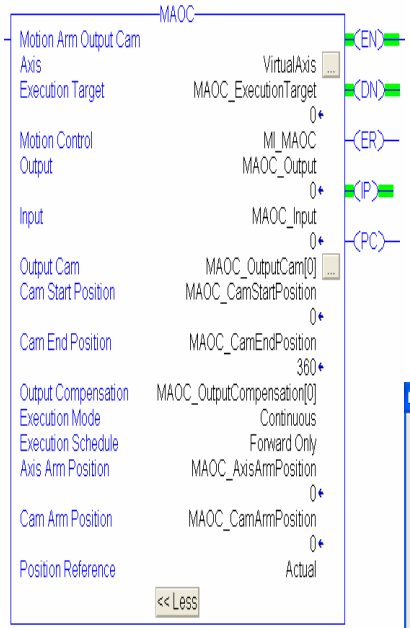


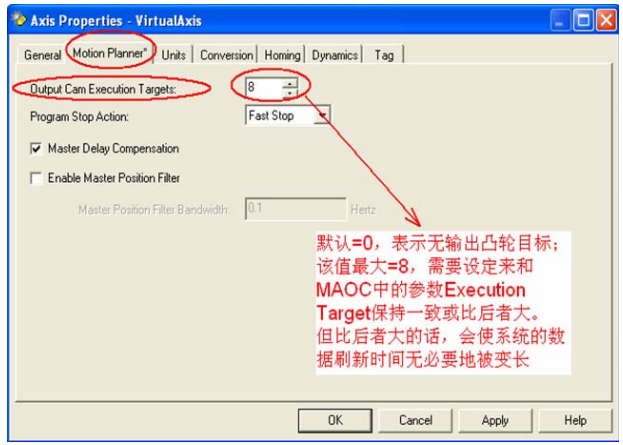
No-Product-No-Bag – RotaryKnife Application

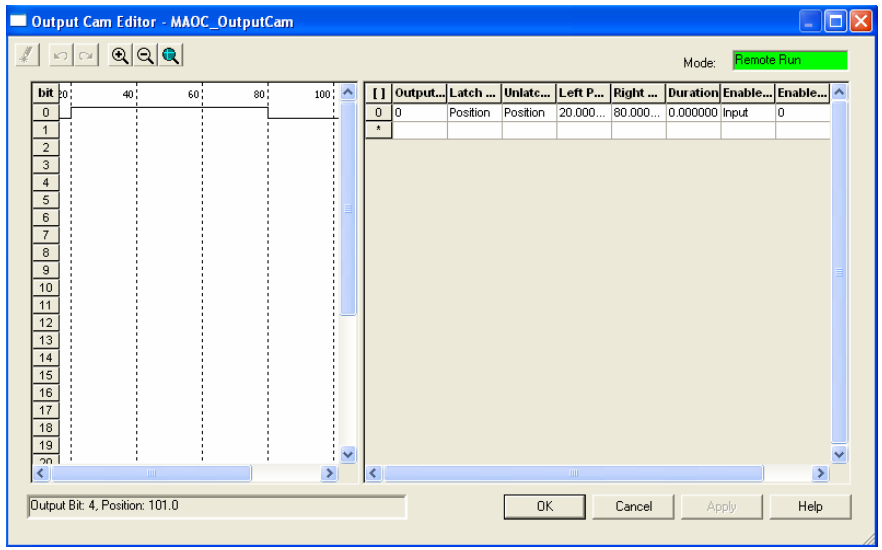


Schedule Output - MAOC

- 高速、高精度地输出脉冲---根据位置凸轮的位置
  - 典型应用：点胶







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Rockwell包装行业的成功应用 - VFFS

Simon.Zhang
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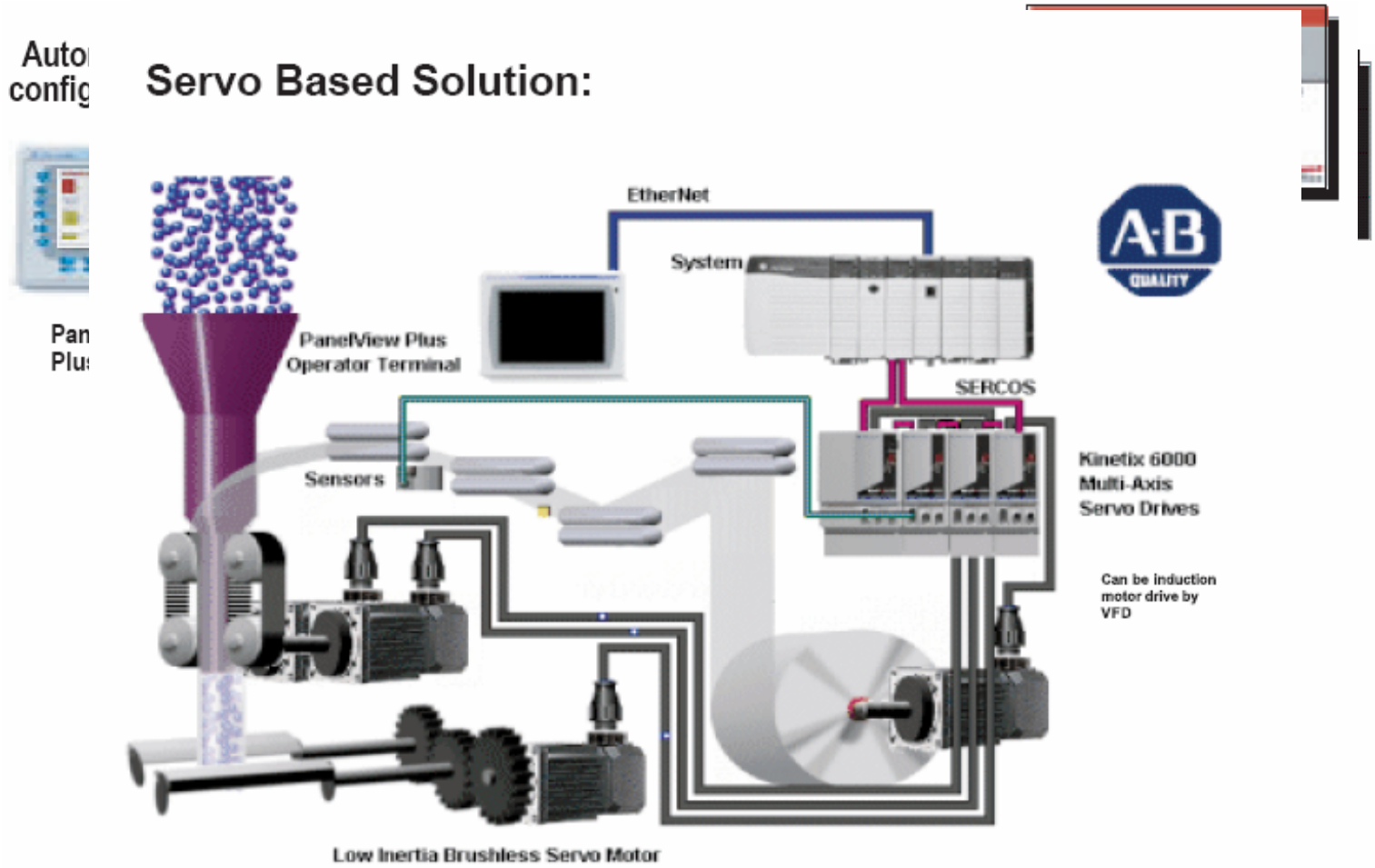
VFFS -- 高、中、低端应用方案集锦

高端应用



VFFS Solution → All Servo

PanelView Plus

Ethernet I/P

CompactLogix L4 or Control Logix

Sercos

Kinetix 6000 or Ultra 3000

24 VDC Inputs
24 VDC Outputs
Thermocouple Inputs
Isolated DC Outputs

Registration Sensor


Product Feed (Auger)


Film Unwind

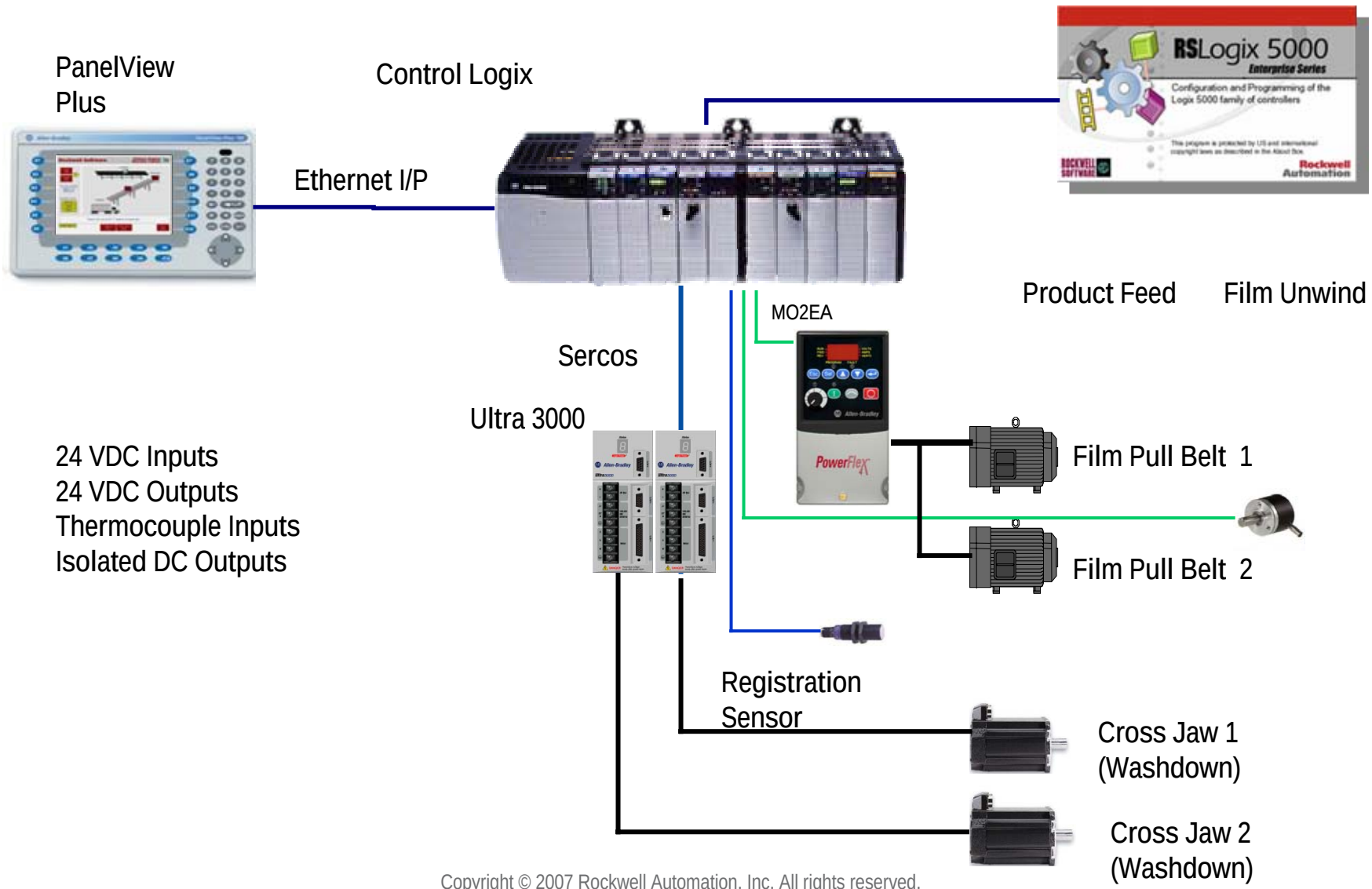

Film Pull Belt 1


Film Pull Belt 2

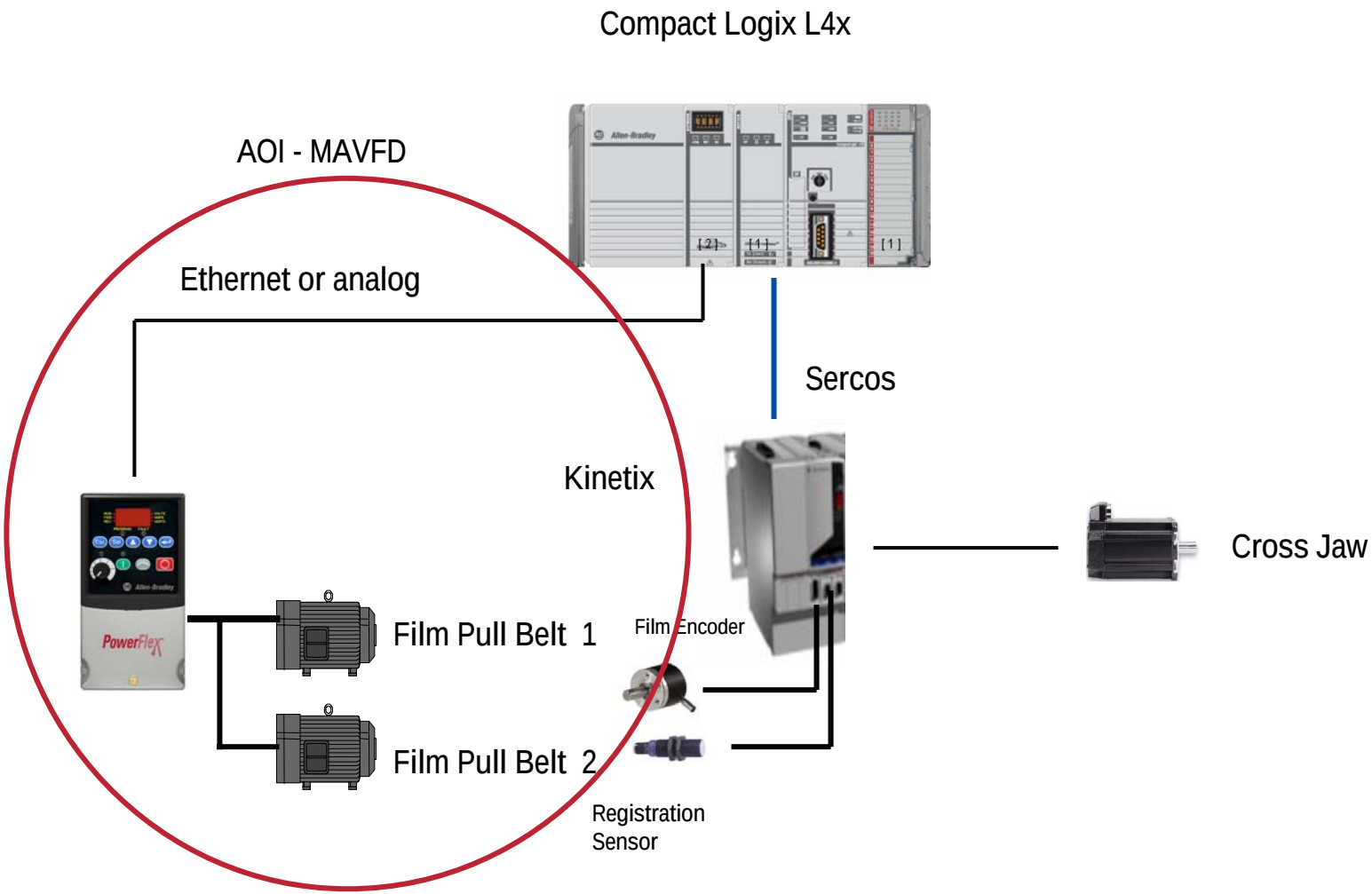

Cross Jaw 1 (Washdown)


Cross Jaw 2 (Washdown)

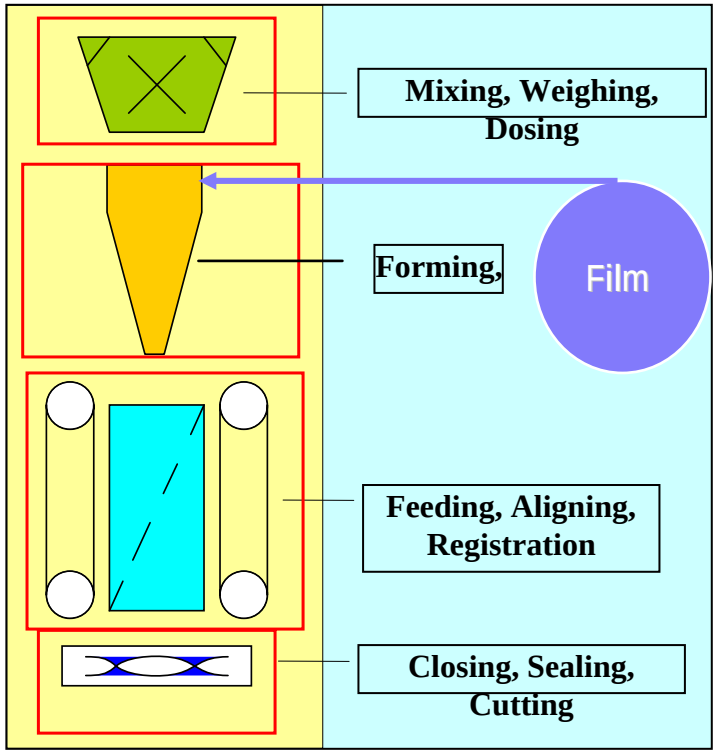
Example of a VFFS using VFD



RA Solution - Lower End VFFS



Machine Overview



- Mixing, Weighing, Dosing
  - Product is metered for entry into package
  - Can be liquid or a solid
- Film Feed & Forming
  - Film is fed and formed into package
- Feeding, Aligning and Registration
  - Correct amount of package is fed
  - Package is aligned with product
- Closing, Sealing, Cutting
  - Package with product is closed
  - Package with product is sealed
  - Package with product is cut

Machine Sections – Feeding System

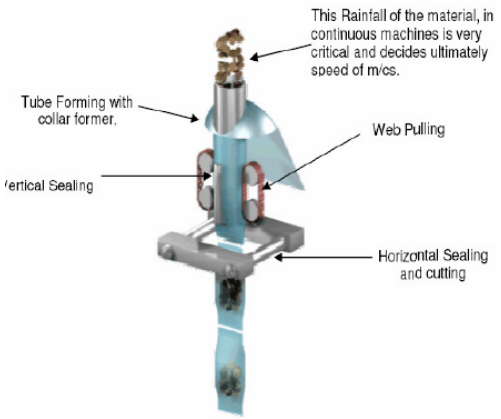
- Auger Filler
  - Typically servo fed – Index moves
  - VFFS can control the auger or communicate via discrete signals
- Weighing System
  - Mostly controlled by a specialized controller
  - VFFS communicates via discrete signals
- Volumetric Feeder
  - Can be servo actuated or pneumatic actuated
  - VFFS can control the feeder or communicate via discrete signals

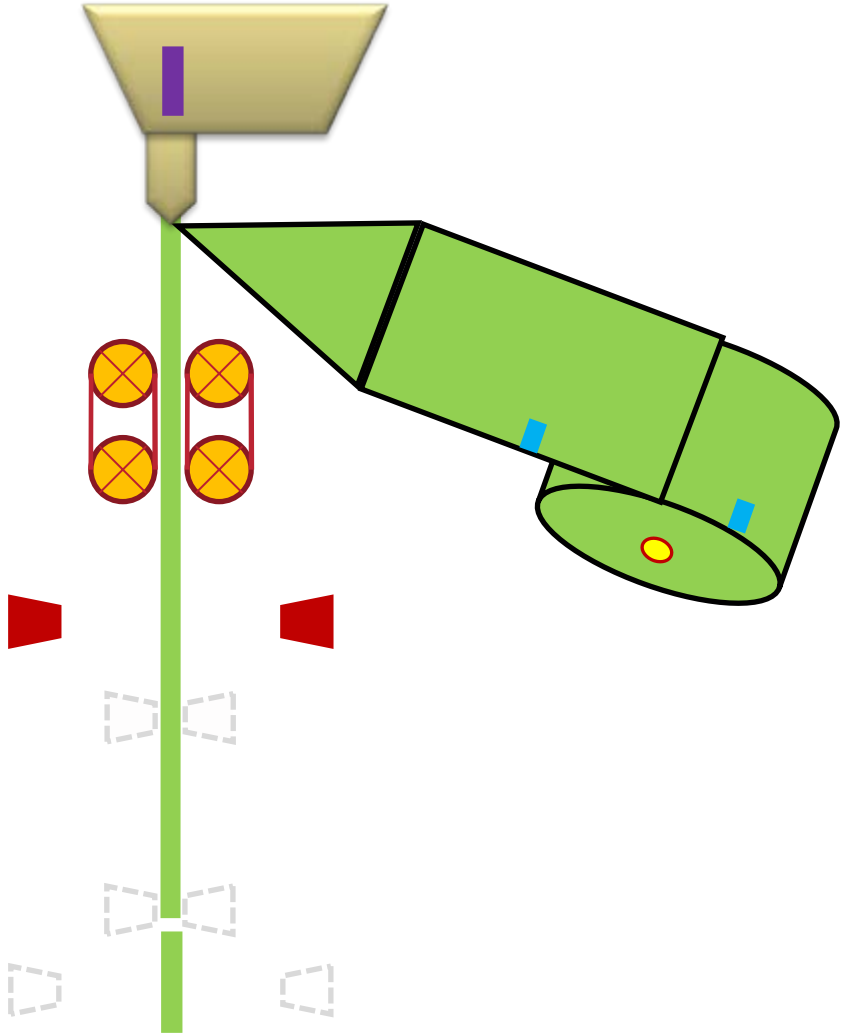
Auger Feeder

Multi-head Scale

Volumetric Feeder

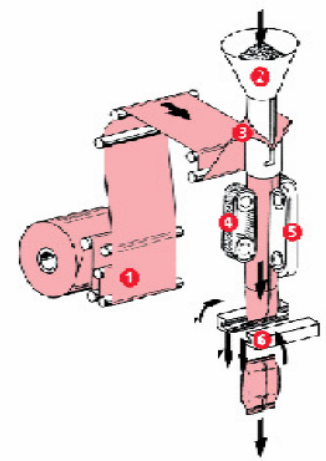
Machine Section – Forming/Pulling/Sealing

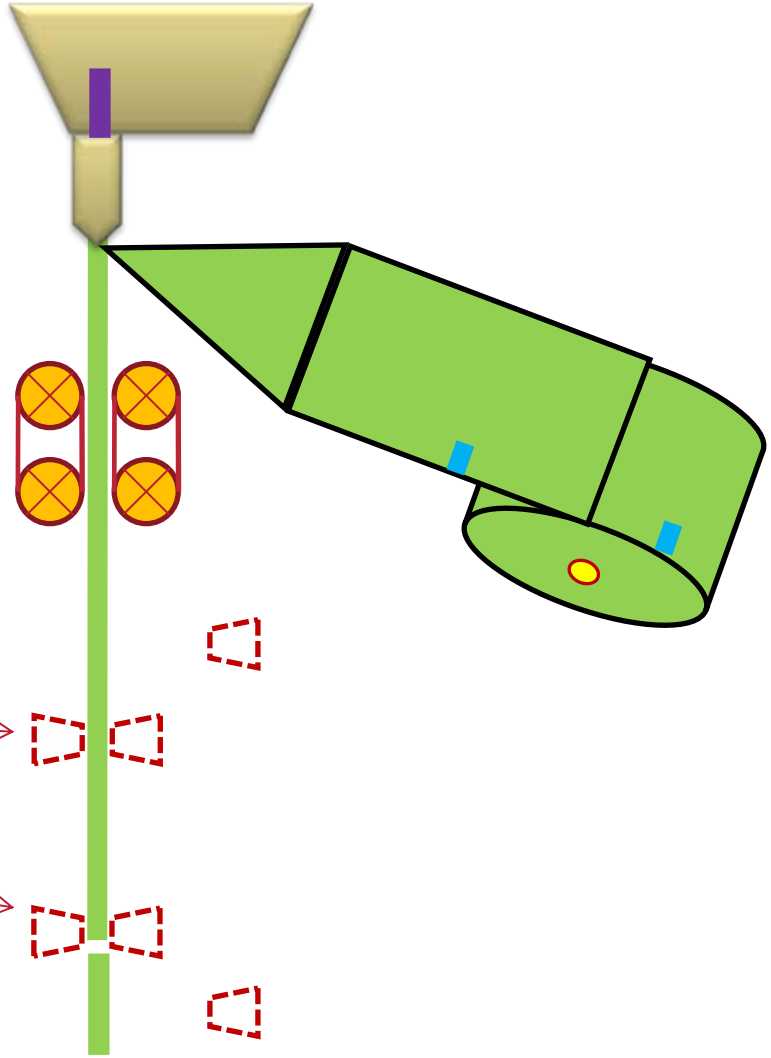




- After Open point sometimes there will be need a straffing velocity to separate bags

Machine Section – Forming/Pulling/Sealing





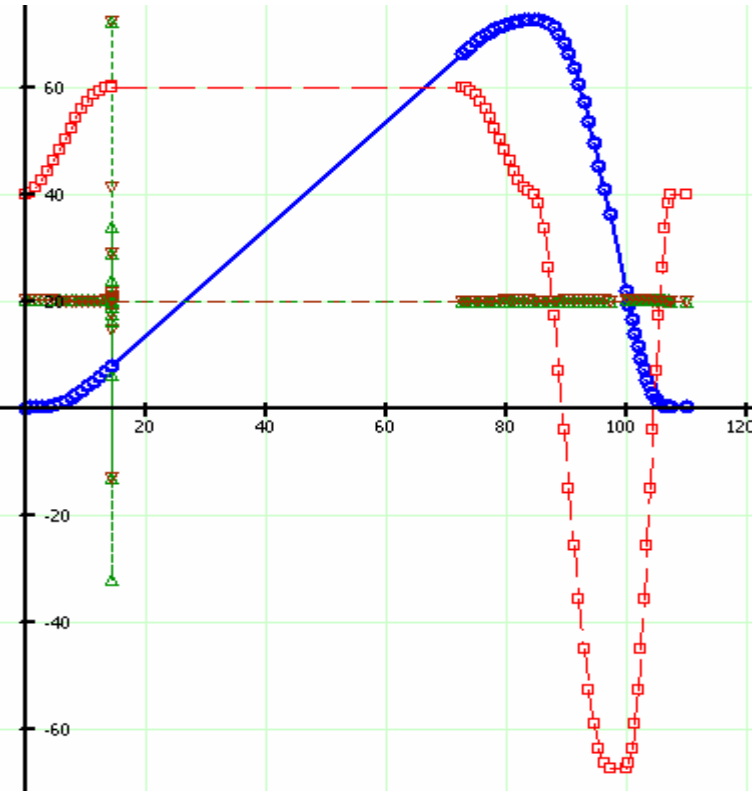
Home Position

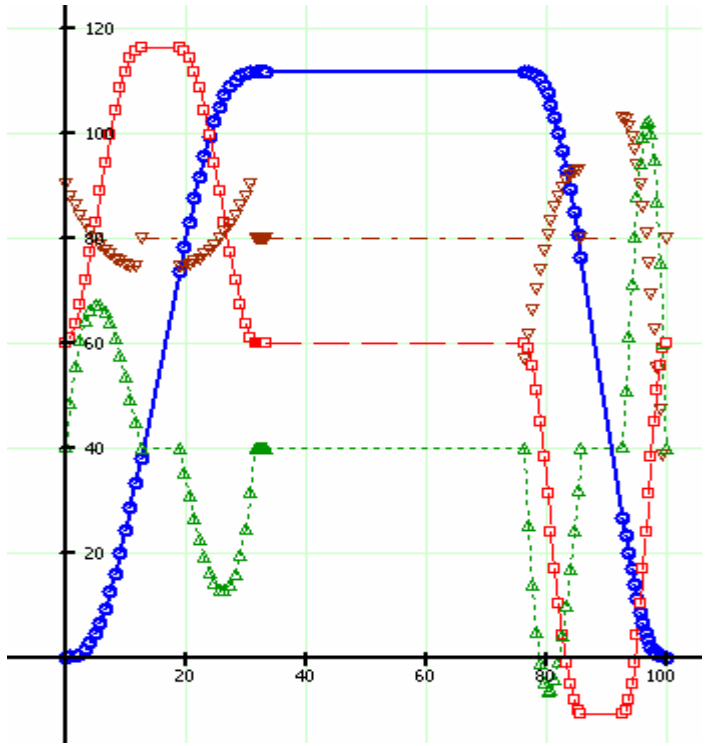
Close Position

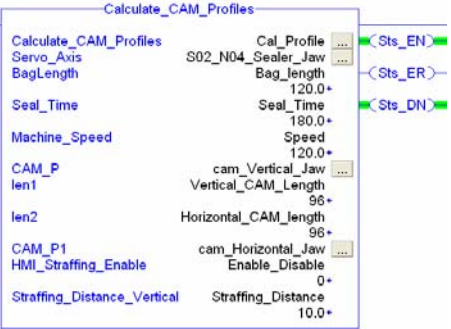
Open Position

Max. Vertical TravelLimit Position
(Maybe some machine has no
requirement about this data)

Jaw Horizontal/Vertical motion

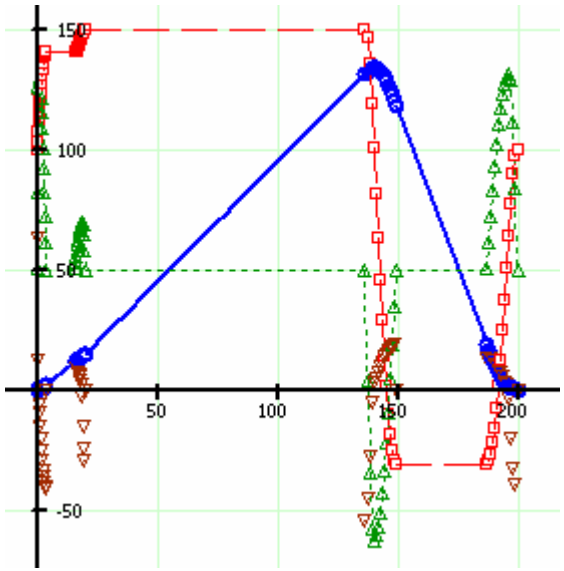






- Co-operation (both follow one axis)

Jaw Vertical Profile Analyze



AOI_Jaw_Virtical_Cam_Cal

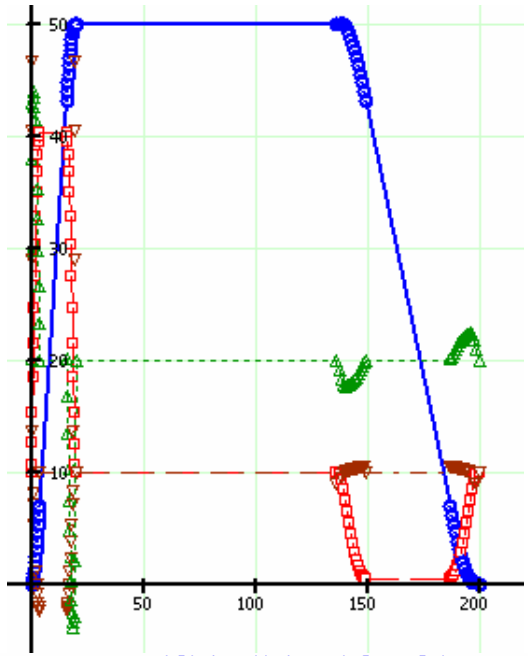
Calculate the continuous cam profile of Jaw virtical motion.

AOI_Jaw_Virtical_Cam_Cal	AOI_Jaw_V_1	EN
Par_BagLength_mm	BagLength	
	200.0	DN
Par_Seal_Offset_mm	Seal_Offset	
	0.0	ER
Par_Snych_Speed	V1	
	1.0	
Par_MachineSpeed_ppm	MachineSpeed	
	140	
Par_Seal_Time_ms	SealTime	
	250	
Par_SlaveToClosePoint_mm	SlaveToClosePoint	
	15.0	
Par_MasterToClosePoint_Percentage	MasterToClosePoint	
	10	
Par_Max_TravelLimit_mm	MaxTravelLimit_V	
	170.0	
InOut_Cam	Cam_V1	
InOut_Cam_Profile	CamP_V1	
Out_Master_To_ClosePoint	20.0	
Out_Slave_To_ClosePoint	15.0	
Out_Master_To_OpenPoint	136.66666	
Out_Slave_To_OpenPoint	131.66666	
Out_Max_Slave_TravelDist	133.80295	
Out_Seal_Zone	116.666664	
Out_Error_Code	0	

- Segment 1→compensation and offset adjust(hmi to set offset and this data will be used to calculate profile only once); make sure motion will be from Home position to Close Position
- Segment 2→ compensation, back to home position from open position.

- Max_travel limit is a para, only for adjust if the max. slave distance > TravelLimit, otherwise it will cause mechanical hurt

Jaw Horizontal Profile Analyze



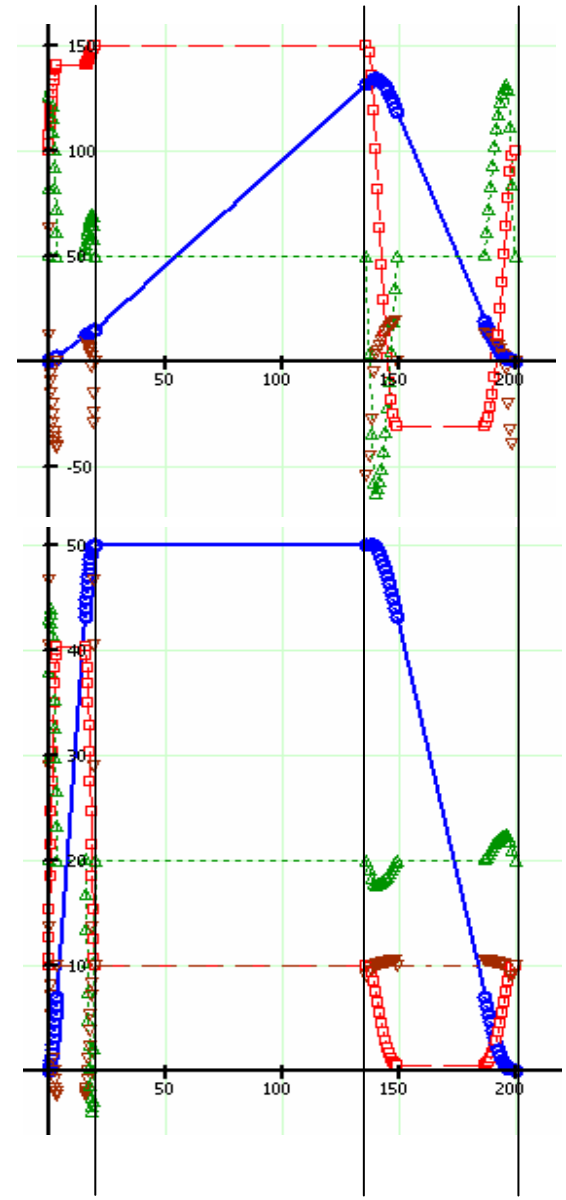
AOI_Jaw_Horizontal_Cam_Cal

Calculate the continuous cam profile of Jaw horizontal motion.

AOI_Jaw_Horizontal_Cam_Cal	AOI_Jaw_H	EN
Par_BagLength_mm	BagLength 200.0	DN
Par_Seal_Offset_mm	Seal_Offset 0.0	ER
Par_Max_TravelLimit_mm	MaxTravelLimit_H 50.0	
Par_MachineSpeed_ppm	MachineSpeed 140	
Par_Seal_Time_ms	SealTime 250	
Par_MasterToClosePoint_Percentage	MasterToClosePoint 10	
InOut_Cam	JawCam_H	
InOut_Cam_Profile	JawCamP_H	
Out_Master_To_ClosePoint	20.0	
Out_Slave_To_ClosePoint	50.0	
Out_Master_To_OpenPoint	136.66666	
Out_Slave_To_OpenPoint	50.0	
Out_Seal_Zone	116.666664	
Out_Error_Code	0	

- Segment 1→ compensation and offset adjustment(in these two AOIs, offset adjustment incl. in master distance), from home position to Close position
- Segment 2→At first there has 0 speed zone(Seal zone), after that do compensation and back to home position from Open position
- So in these two profile, at the close/open position the both profile have the same master data

Profile Summary



- For Vertical profile Area3 can be included into Area 4(Only for those machines which has no requirement about vertical max. travel limitation)

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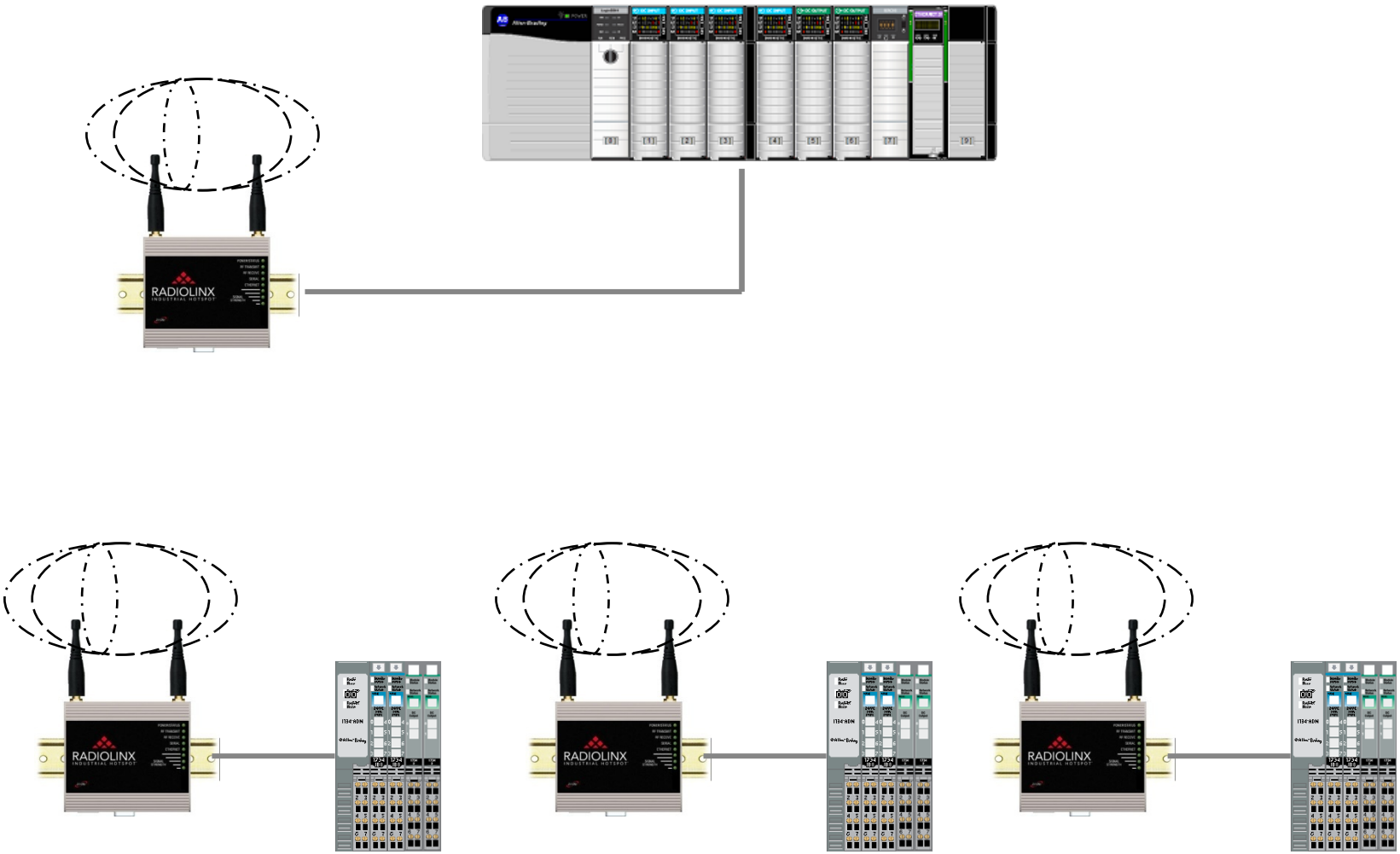
Rockwell包装行业的成功应用 – 无线通讯

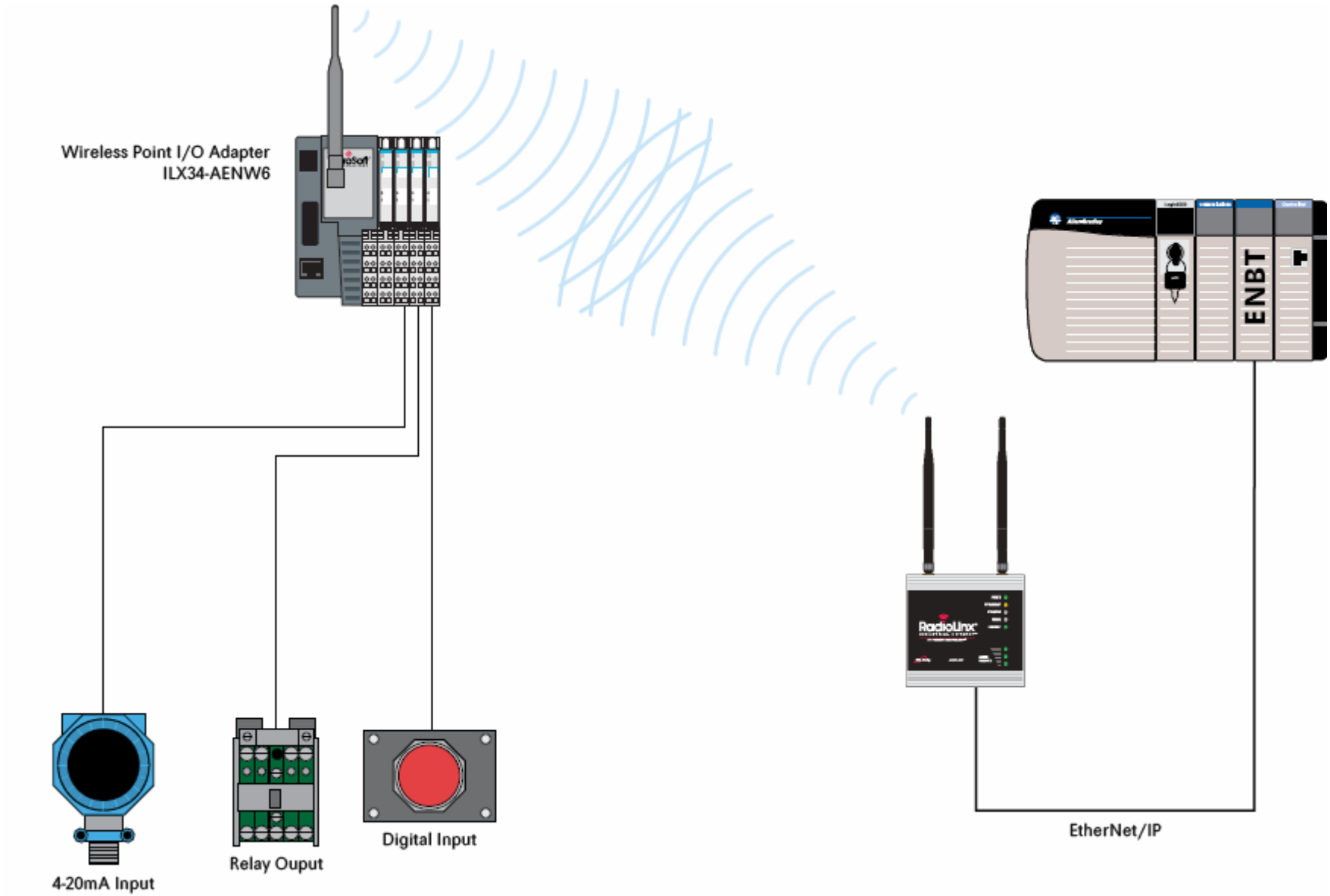
Simon.Zhang
George.Xu

GOTCs Shanghai

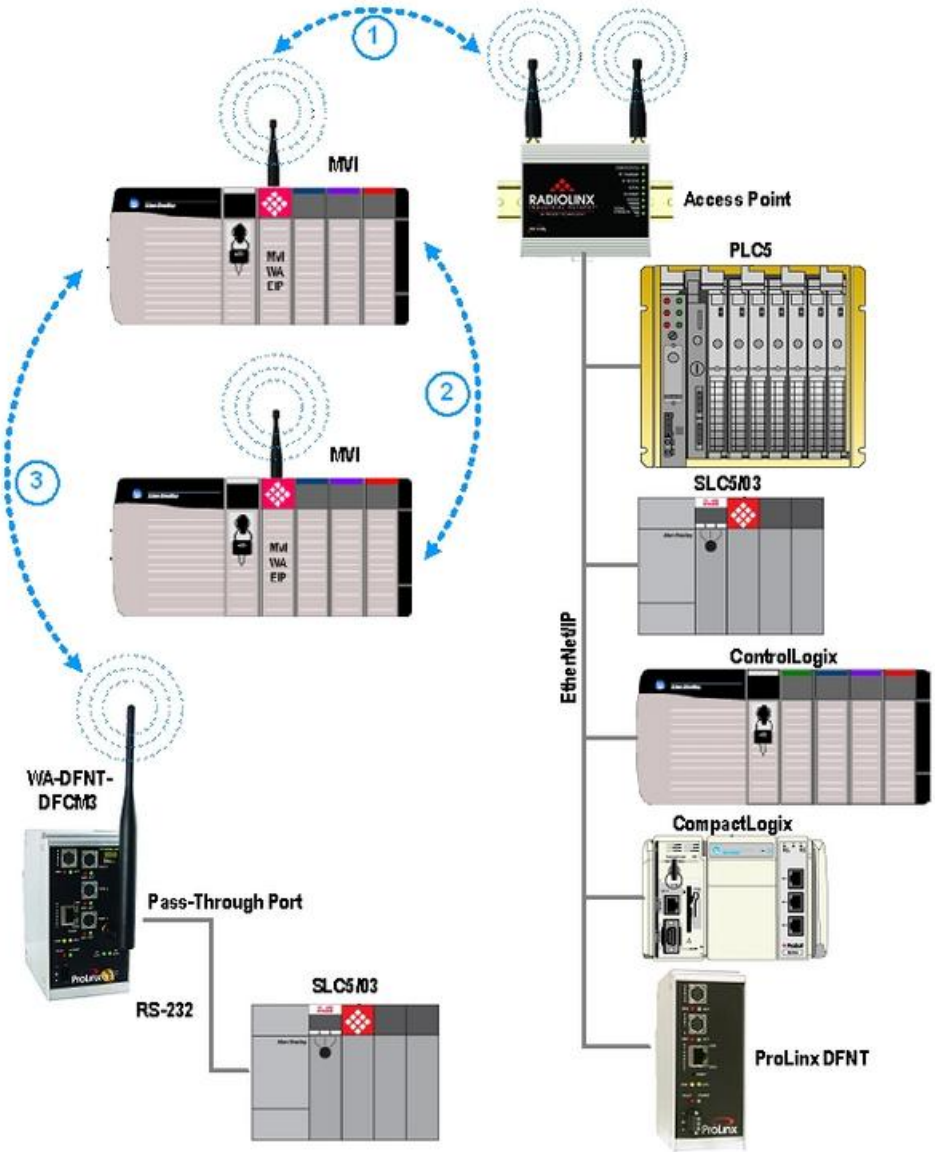
Rotary Packaging Machine - Wireless Solution Based On Logix - 1



Rotary Packaging Machine - Wireless Solution Based On Logix - 2



Rotary Packaging Machine - Wireless Solution Based On Logix - 3



无线通讯的应用前景

- 旋转包装设备
  - 塔体上IO与系统的通讯
  - 不易布线的场合
- 被坚固物体阻隔的设备间的通讯
  - 如：墙里墙外的设备等

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Rockwell包装行业的成功应用 – 膜包机

Simon.Zhang
George.Xu

GOTCs Shanghai

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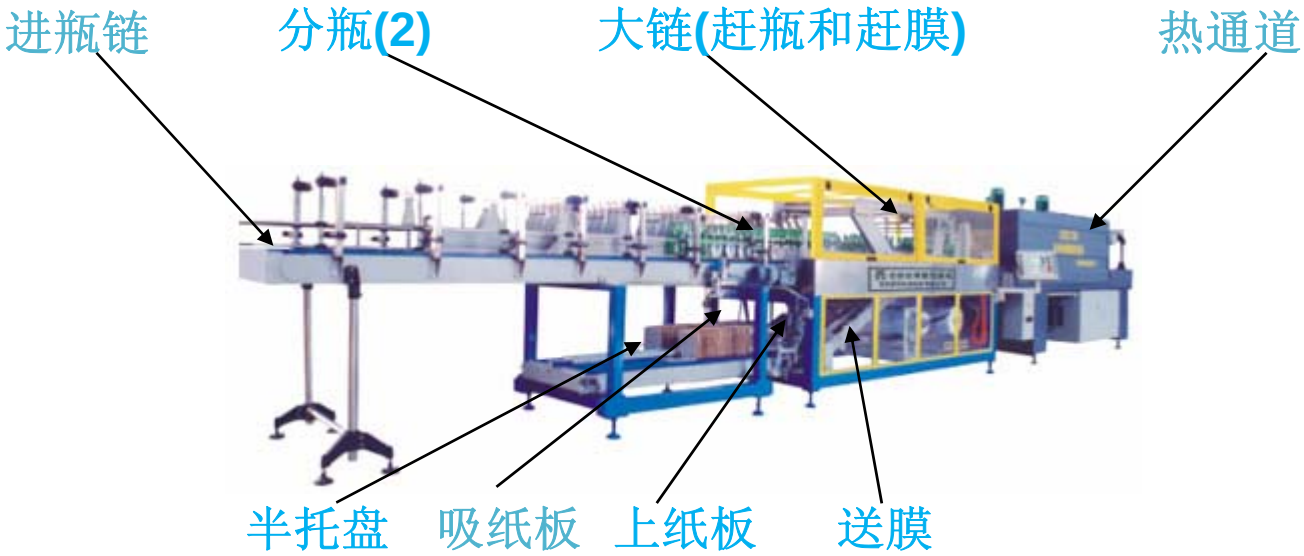
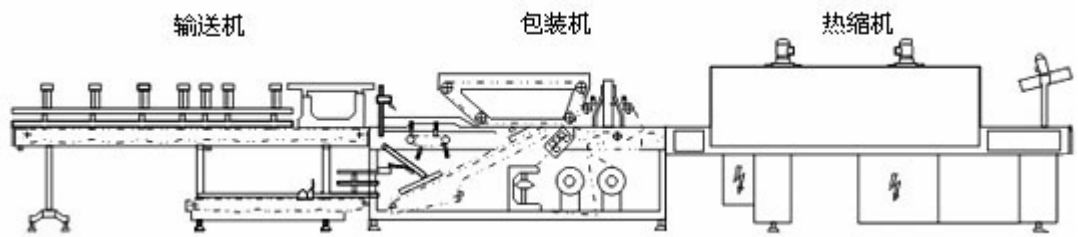
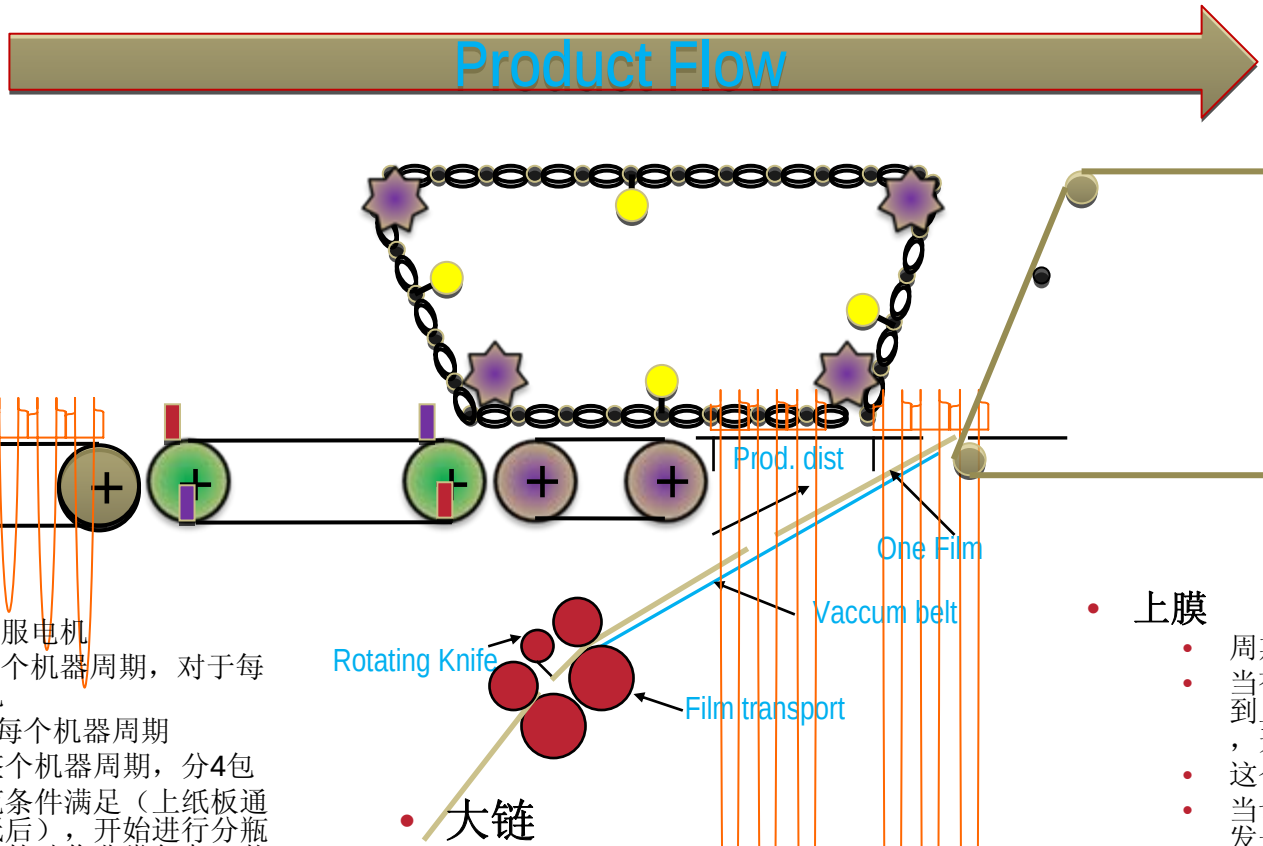
Shrink Wrapper Machine Overview





Shrink Wrapper Functional Blocks

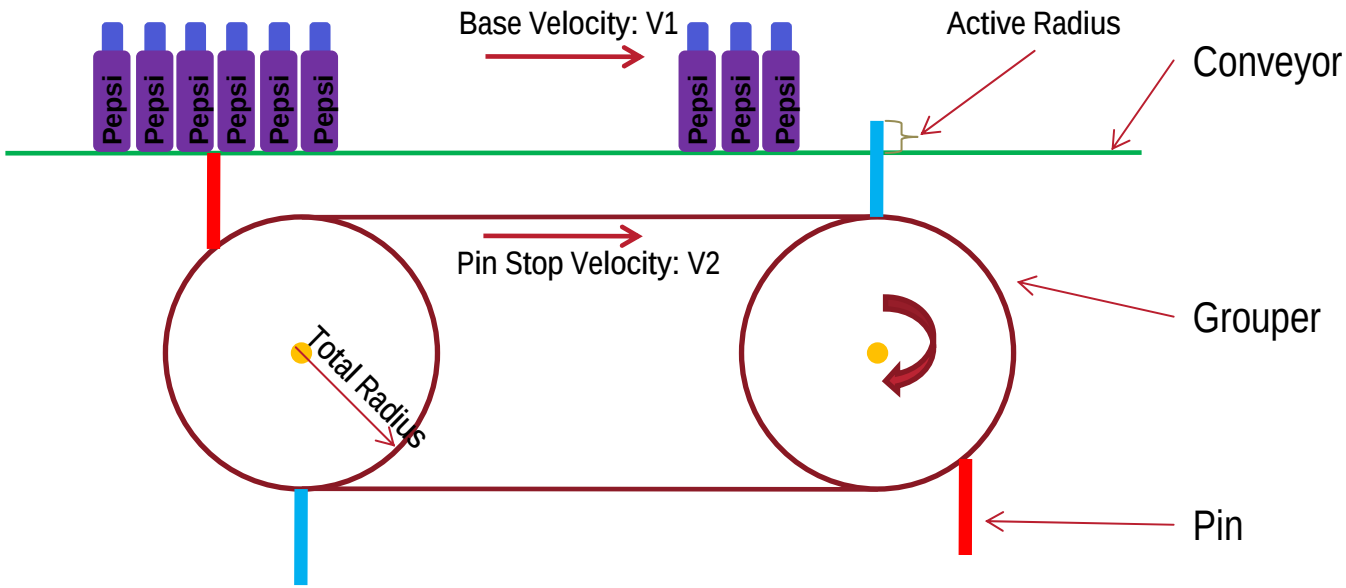


- 分瓶
  - 2 个伺服电机
  - 2 包每个机器周期，对于每个电机
  - 720度每个机器周期
  - 对于整个机器周期，分4包
  - 当分瓶条件满足（上纸板通道有纸后），开始进行分瓶，分瓶的动作非常复杂，共有6种工况：
  - Linear Cam In
  - Grouper CAM In
  - Linear Continuous CAM
  - Grouper Continuous CAM
  - Linear Cam Out
  - Grouper CAM Out

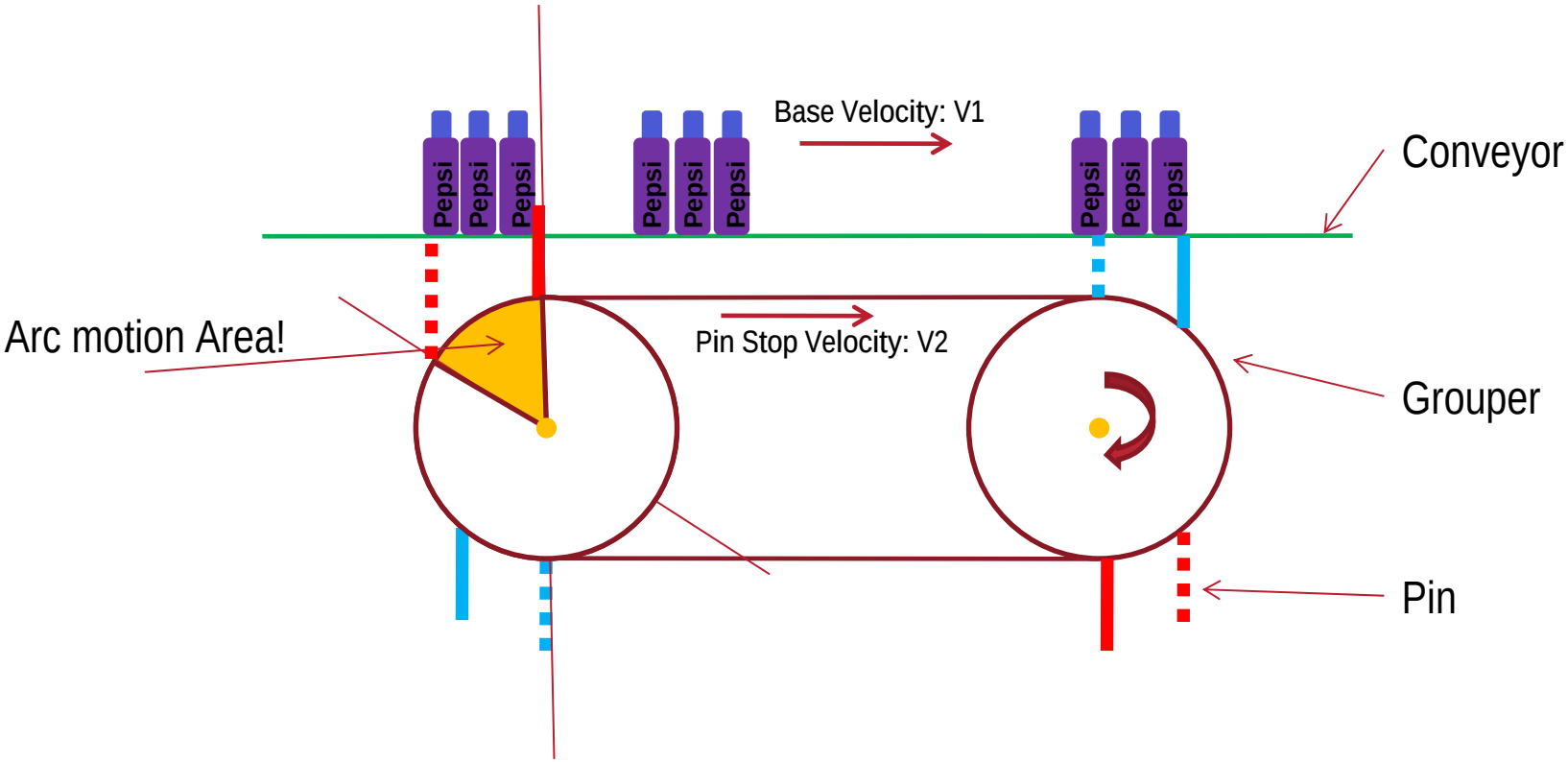
- 大链
  - 与虚主轴保持同步
  - 0-360 度 / 包， 一包为一个周期。
  - 与虚主轴的位置同步关系为1:1
  - 虚主轴启动，大链和半托则启动。

- 上膜
  - 周期：设定的膜长
  - 当有纸板包过来后，达到上膜触发设定角度后，开始上膜。
  - 这个过程是断续的。
  - 当切膜角度到达后，触发一个快速的切膜，通过切膜离合器触发。
  - 切膜采用快速任务。
  - 上膜曲线也分为加速，匀速，加速，匀速，减速几段

Shrink Wrapper Grouper

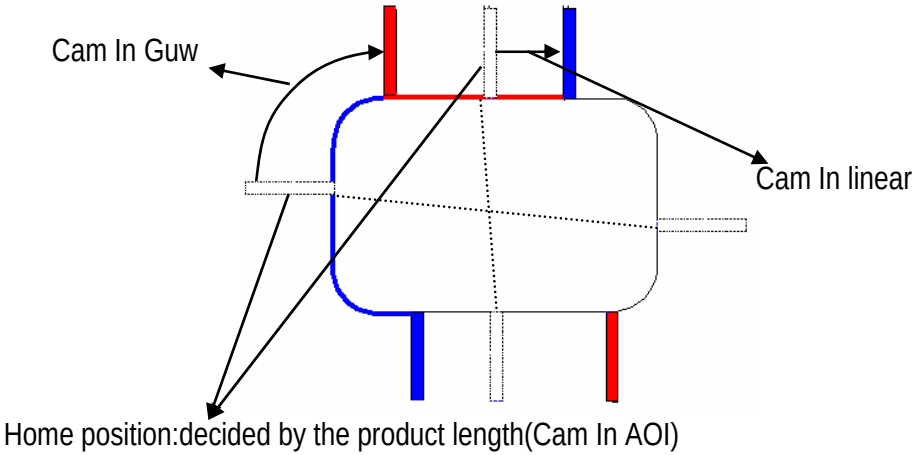


Shrink Wrapper Grouper

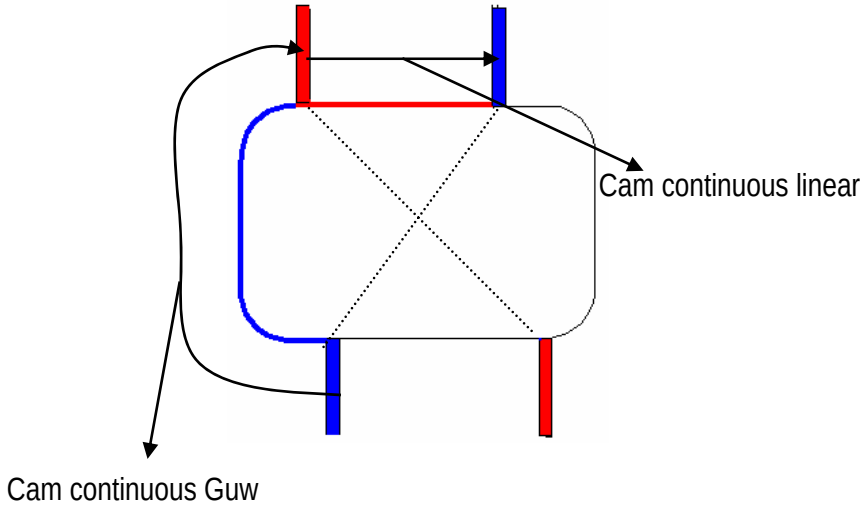


分瓶cam process

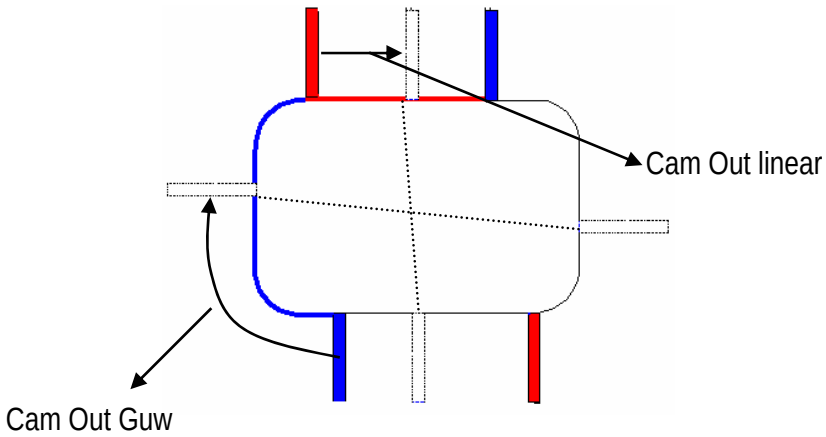
1、Cam In linear and guw

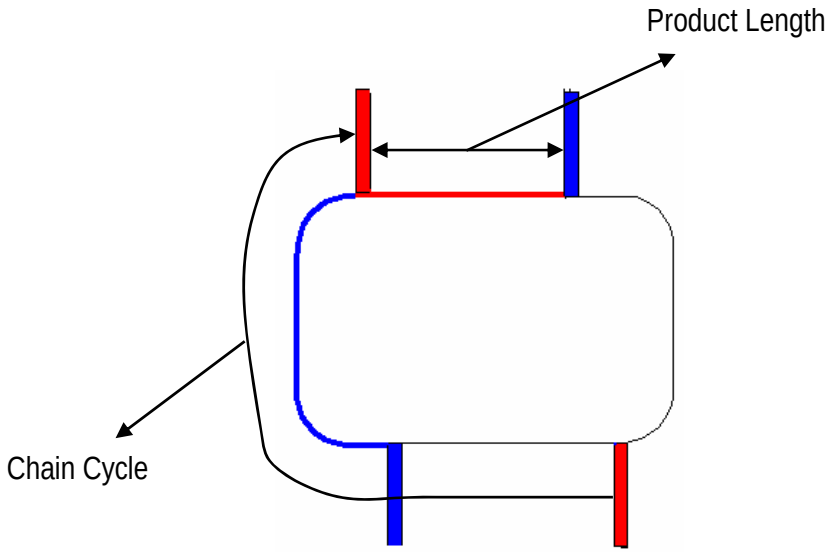


2、Cam Continuous linear and guw

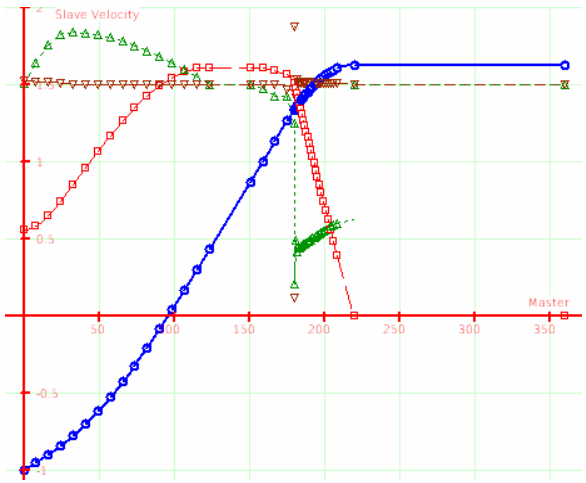


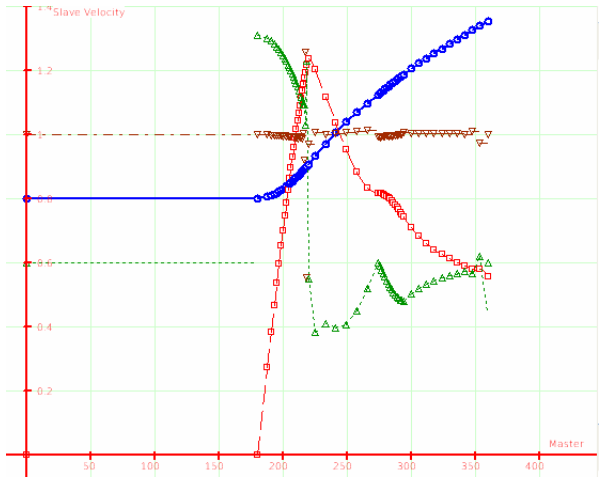
3、Cam Out linear and guw

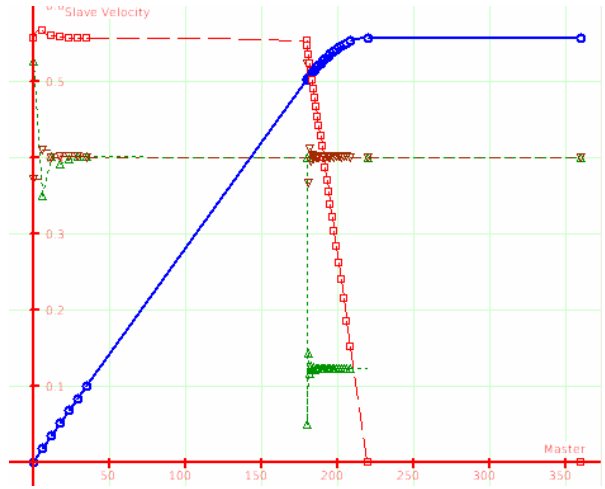


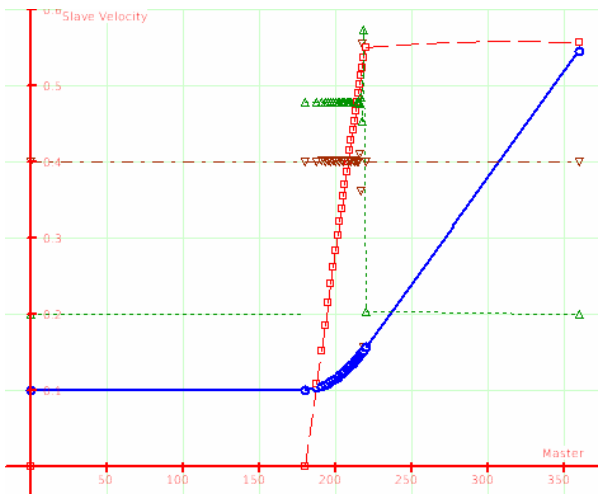


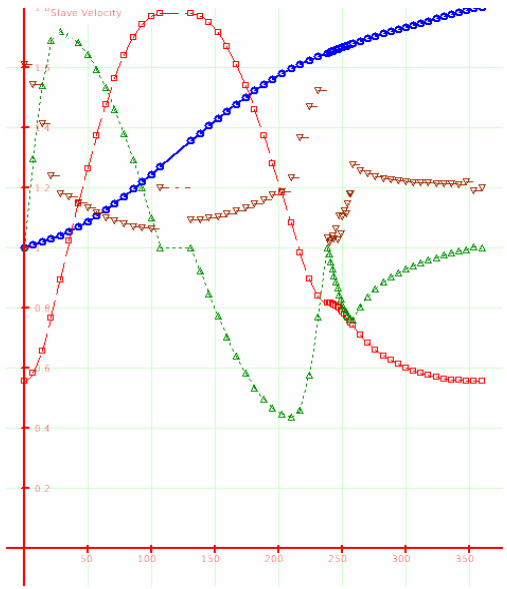
分瓶6 Cams

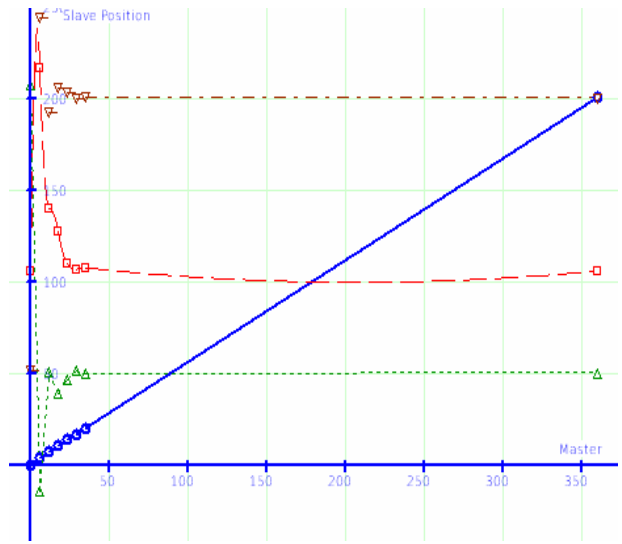












Value Delivered by RA (GOTC) to OEM

What have we developed in Tools and Applications Notes for Packaging?

- Shrink Wrapper
  - Film System
  - Grouper Section
  - Rotating Knife
  - Registration and Correction
  - Gluing Control
  - Dancer Systems
- VFFS
  - Complete Toolset for Intermittent (Feb)
  - Complete Toolset for Continuous (Feb)
  - Special Kinematics on Vertical
  - Registration and Correction
  - Position to Torque Switch Over
- HFFS
  - Rotating Knife
  - Registration and Correction
  - Compensation Cams
- Beverage
  - Power Programming Layout for Simple Beverage Line
- Cartoner
  - Rotating Knife
  - Grouper Section
  - Gluing Control
- Labeler
  - Sleevers
  - Continuous Labeler
  - Intermittent Labeler

And the basis for all these tools:
POWER PROGRAMMING

Living and Leading The Way Forward…

Thanks!

Please send your comments to:

gxxu@ra.rockwell.com or xinke.xu@gmail.com

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谢谢！

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