

LISTEN.
THINK.
SOLVE.®

L04 - Basic PLC Programming with Micro800® Controllers



PUBLIC



Allen-Bradley • Rockwell Software

**Rockwell
Automation**

Agenda

Introduction to Terms / Concepts

Micro800 Family

Connected Components Workbench

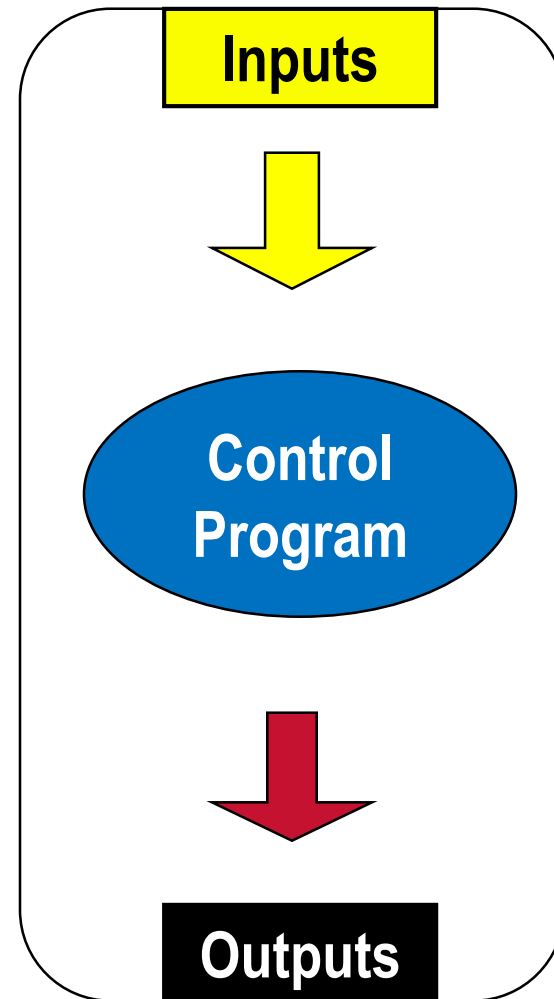
Application Examples

Hands-On Lab



What is a PLC?

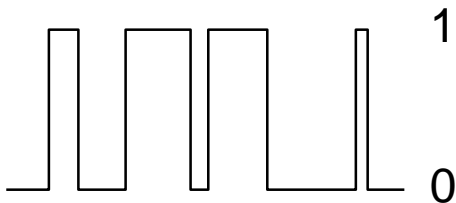
- A solid state (electronic) device that controls output devices based on control program and input signals.



Two Types Of I/O (Inputs & Outputs)

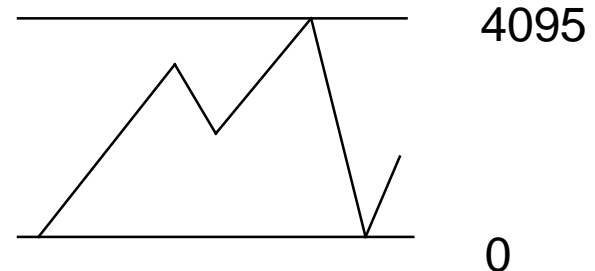
■ Digital

- Also called Discrete
- Has two possible states
- Represented by “1” or “0”
- Electrically:
 - “0” is usually 0 Volts (AC or DC)
 - “1” is a fixed voltage value such as 5VDC, 24VDC, 120VAC, etc.
- Technology: Relays, Triac, Transistor, MOSFET, TTL



■ Analog

- Has many possible states between two values
- Example: Temperature sensor
- Range of values between two limits. For example:
 - 0°F represented by “0”
 - 100°F represented by “4095” (example)
- Electrically: 4-20mA, 0-5VDC, -10 to 10VDC



Ladder Logic Example

This is a very simple rung of logic, from a PLC program:



The rung is read as:

If the Start Button is on, turn ON the Light.

If the Start Button is off, turn OFF the Light.

Simple PLC Instructions (IEC 1131)

■ Contacts

■ Direct



■ Reverse



■ Coils

■ Direct



■ Reverse



■ Set



■ Reset



■ Instruction Blocks

- Arithmetic (+ - * / COS SIN TAN)
- Binary (Mask, Shift)
- Boolean (AND,OR,NOT,XOR)
- Comparator (< > = CMP)
- Counter (CTD, CTU, CTUD)
- Data Conversion (ANY_TO_**)
- Process (PID, SCALER, more...)
- String (FIND, REPLACE, more...)
- Time (TON,TOF,TONOFF)

PLC Control Program

■ Program

- Instructions used to process inputs and set outputs
 - Primarily written as (Relay) Ladder Diagram:



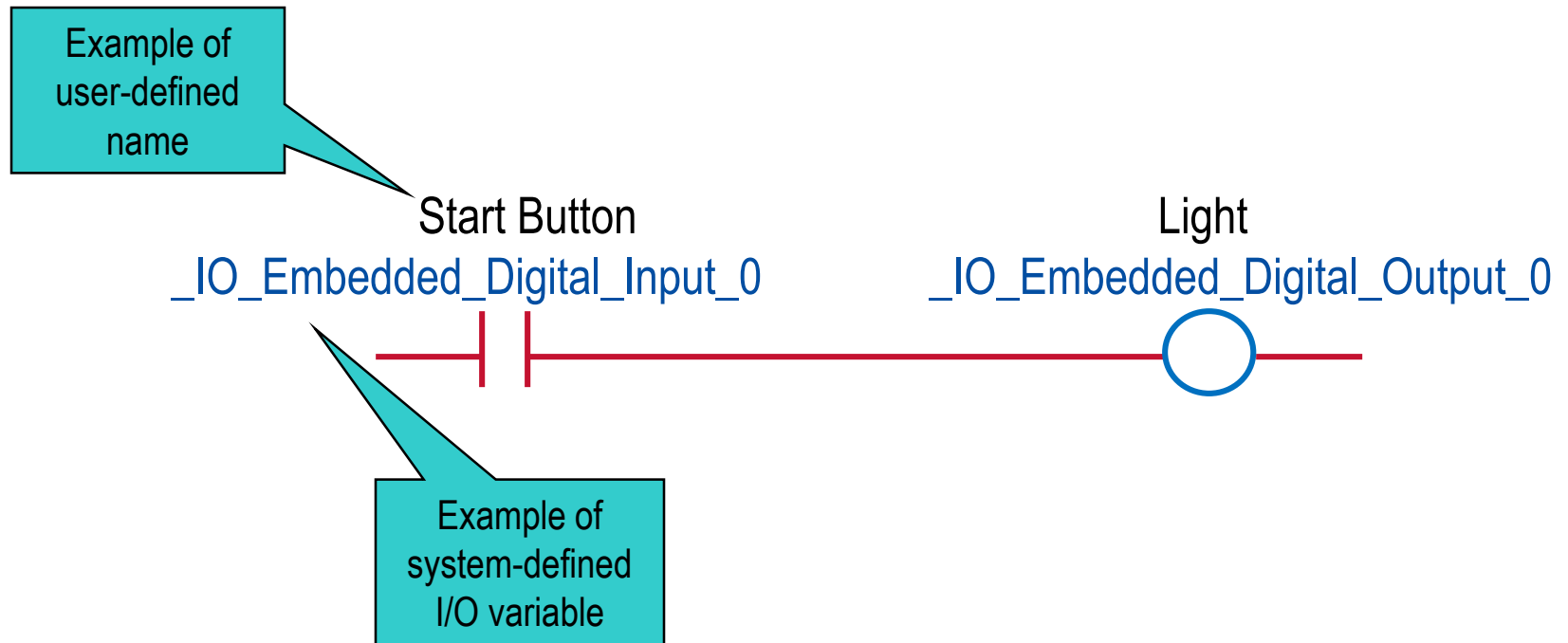
- Programs can also be written in other languages
 - Function Block or Structured Text

■ Data (Variables)

- Examples
 - Start_Button is assigned to a digital input
 - Light is assigned to a digital output

I/O Addressing

Often, a descriptive name of the device connected to the I/O point is used in addition to, or in place of the I/O variable which describes the physical location on the controller.



Today's applications require a high level of control capability and advanced features



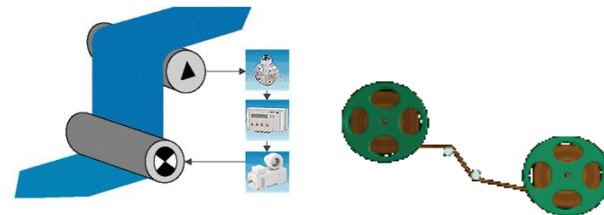
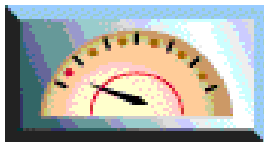
- Arithmetic (Addition, Subtraction, Multiplication, Division, etc.)
- Data Comparison (Equal, Greater Than or Equal, Less Than or Equal)
- Word Manipulation (Copy, Move, etc.)
- Communications or Messaging data between PLC's



- Sequencing
- Data Manipulation



- Motion and Process Control (Used for Temperature, Pressure, Speed, Flow regulation)



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Micro800 Controller Family

Nano PLC

Micro PLC

Each controller is cost and performance optimized for specific applications



Micro850
For standalone machines with motion and more I/O and Ethernet connectivity

EtherNet/IP™



Micro830
For standalone machines with motion



Micro820
For simpler standalone machines and remote automation

EtherNet/IP™



Analog I/O

Micro810
Programmable relay replacer and timer

Analog I/O



Performance/Features

Local I/O

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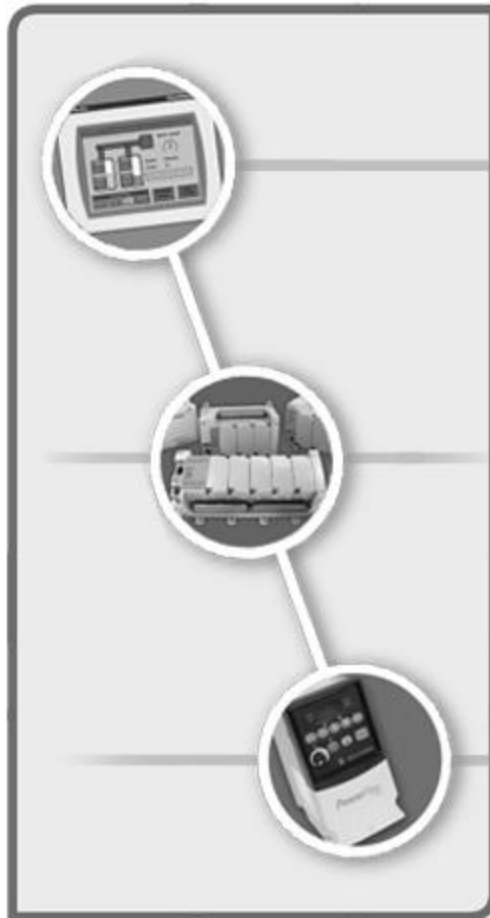
Micro800 Family

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Connected Components Workbench

Release 7.00

 Allen-Bradley • Rockwell Software

**Rockwell
Automation**

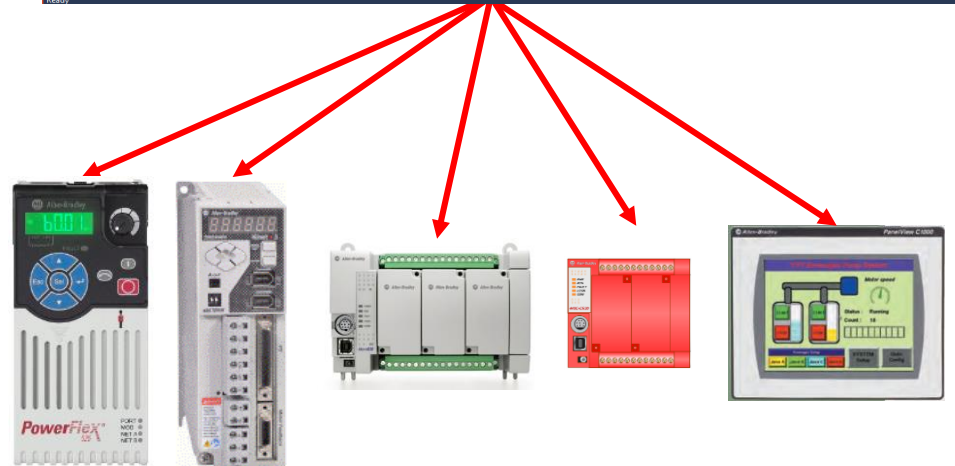
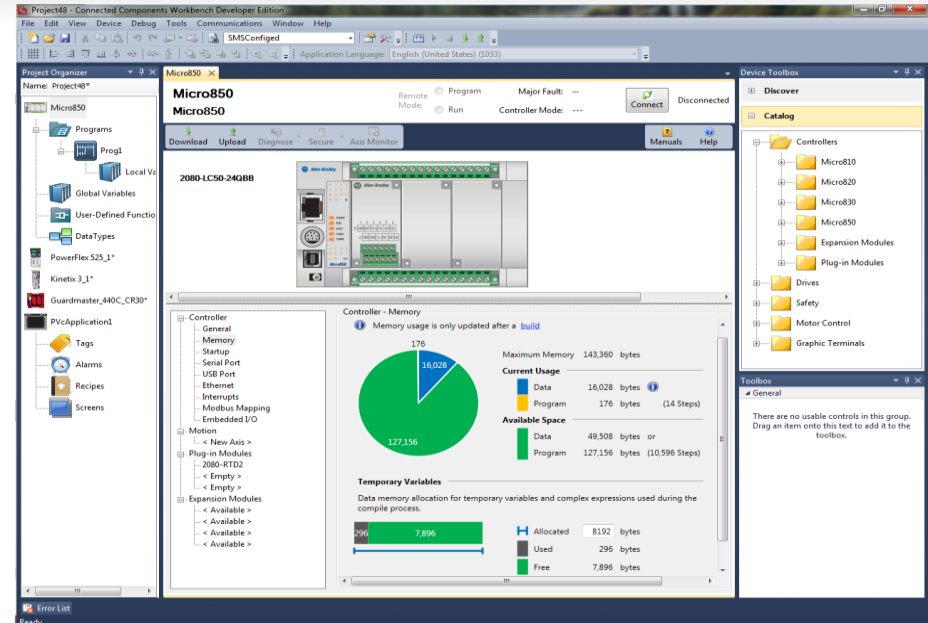
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Powered by Visual Studio

Connected Components Workbench™ Software

Rockwell
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- **Easy to Acquire/Install**
 - Free Internet download
- **Easy to Configure**
 - Single software for component class products
 - Graphical device configuration
- **Easy to Program**
 - Extensive use of Microsoft and IEC-61131 standards
 - Symbolic Programming
 - Rockwell Automation and user-defined function blocks
- **Easy to Update**
 - Software updates available via Internet



Connected Components Workbench Software

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- Graphical Micro800 controller configuration
- IEC 61131-3 editors
 - Ladder Diagram, Function Block, Structured Text
 - User-defined function blocks
 - Run-time program download
- Extensive Standard Instruction Set
 - IEC 61131-3 base instructions with Rockwell Automation extensions

The screenshot displays the Rockwell Connected Components Workbench Developer Edition software interface. The main window shows a Micro800 controller configuration with a ladder logic diagram. The diagram features two CTU (Counter Up) blocks, CTU_1 and CTU_2, each with a Reset (RESET) input and a Pulse Value (PV) input. CTU_1 is connected to IO_EM_DI_00 and IO_EM_DO_00, while CTU_2 is connected to IO_EM_DI_04 and IO_EM_DO_01. The PV inputs are set to 100 and 200 respectively. The software interface includes a Project Organizer on the left, a Catalog on the right, and a toolbar at the top. A separate window shows the Structured Text editor with the following code:

```
1004 PWP_EN := TRUE;
1005 PWORD_WRITE_PV:=PWP_EN;
1006 IF PWORD_WRITE_PV.Sta = 1 THEN
1007   PWP_EN := FALSE;
1008   END_IF;
1009 END_IF;
1010 (* Sweep 4 of Plug-In Extensions: ON
1011 IF Ext_Usage = 0 THEN
1012   (NSC_Overflow[1] := 1407);
1013   NSC_RampPreset[1] := 1407;
1014   NSC_LowPreset[1] := 1407;
1015   NSC_HighPreset[1] := 1407;
1016   NSC_Overflow[1] := Overflow;
1017   NSC_RampPreset[1] := RampPreset;
1018   NSC_LowPreset[1] := LowPreset;
1019   NSC_HighPreset[1] := HighPreset;
1020   NSC_ODB[1] := 1407;
1021   NSC_Acc[1] := 1407;
1022   Apply_Data[1] := 1407;
1023   Apply_Decl[1] := 1407;
1024
1025   COP_OF(THROW, NSC_Overflow, Q, OFDATA, 0, 0, TRUE);
1026   COP_OF(THROW, NSC_RampPreset, Q, RFDATA, 0, 0, TRUE);
1027   COP_OF(THROW, NSC_LowPreset, Q, LFDATA, 0, 0, TRUE);
1028   COP_OF(THROW, NSC_HighPreset, Q, HFDATA, 0, 0, TRUE);
1029   COP_OF(THROW, NSC_ODB, Q, ODB_DATA, 0, 0, TRUE);
1030   COP_OF(THROW, NSC_Acc, Q, ACC_DATA, 0, 0, TRUE);
1031
1032   PW_RangeSetting := TRUE;
1033
1034   PWORD_WRITE_OF_PV_RangeSetting_SlotID, 16430, 0, OFDATA );
1035   PWORD_WRITE_SF_PV_RangeSetting_SlotID, 16431, 0, RFDATA );
1036   PWORD_WRITE_LF_PV_RangeSetting_SlotID, 16432, 0, LFDATA );
1037   PWORD_WRITE_HF_PV_RangeSetting_SlotID, 16433, 0, HFDATA );
1038   PWORD_WRITE_ODB_PV_RangeSetting_SlotID, 16434, 0, ODB_Data);
1039   PWORD_WRITE_Acc_PV_RangeSetting_SlotID, 16435, 0, ACC_Data);
1040   PWORD_WRITE_Apply_PV_RangeSetting_SlotID, 16436, 0, Apply_Data);
1041
1042   IF PWORD_WRITE_OF_Sta = 1 AND PWORD_WRITE_SF_Sta = 1 AND PWORD_WRITE_LF_Sta = 1
1043     AND PWORD_WRITE_HF_Sta = 1 AND PWORD_WRITE_ODB_Sta = 1 AND PWORD_WRITE_Acc_Sta = 1
1044     AND PWORD_WRITE_Apply_Sta = 1 AND PWORD_WRITE_Apply_Sta = 1 THEN
1045     PW_RangeSetting := FALSE;
1046   END_IF;
1047 END_IF;
```



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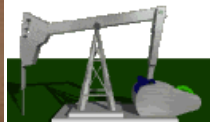
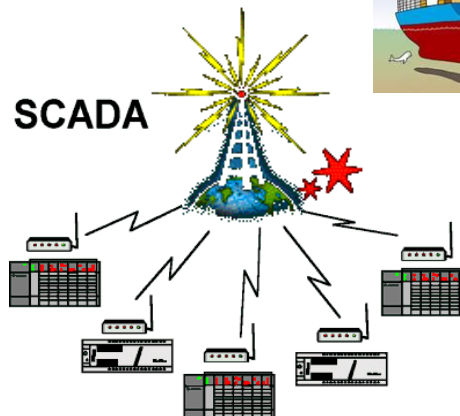
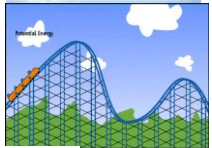
Application Examples

Hands-on Lab



So where could you use a PLC?

- Conveyor control
 - Printed circuit board handling equipment
- SCADA(Supervisory Control And Data Acquisition)
 - Remote pump/lift station (water/wastewater)
 - Flow monitoring for leak detection (Oil & Gas)
 - Strapping machinery / trash compactors
 - Palletizers
 - Compressor control
- Amusement park rides and attractions
 - Hard-wired relay panels or Single Board Computers
 - Many, many more...



Application Animations

Virtual demo of our application includes voiceover and CC solution drawing

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Solar Tracking



Adhesive Labeler



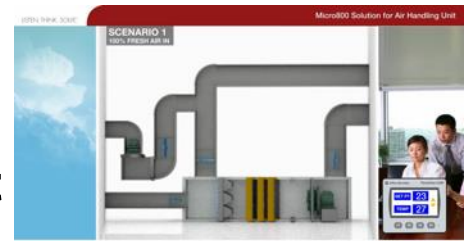
VFFS



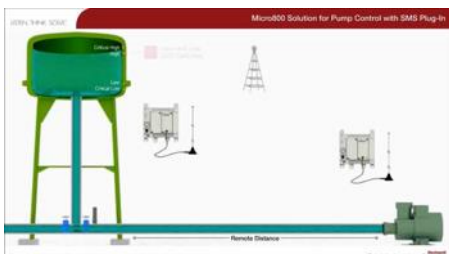
Stretch Wrapper



Shearing Machine



Air Handling Unit



Water Pump



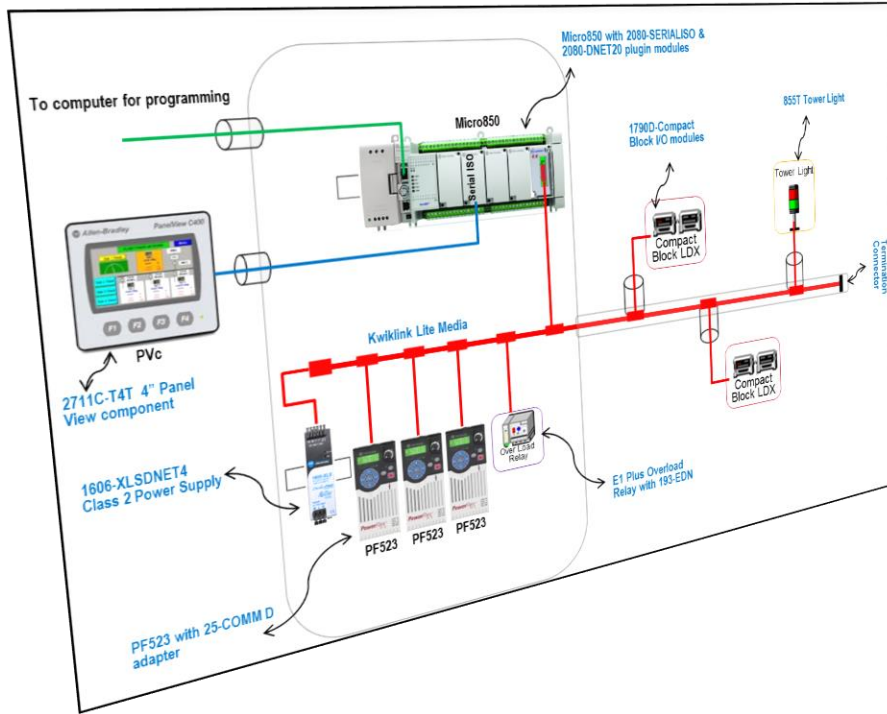
Material Handling Unit

CC Popular Drawings

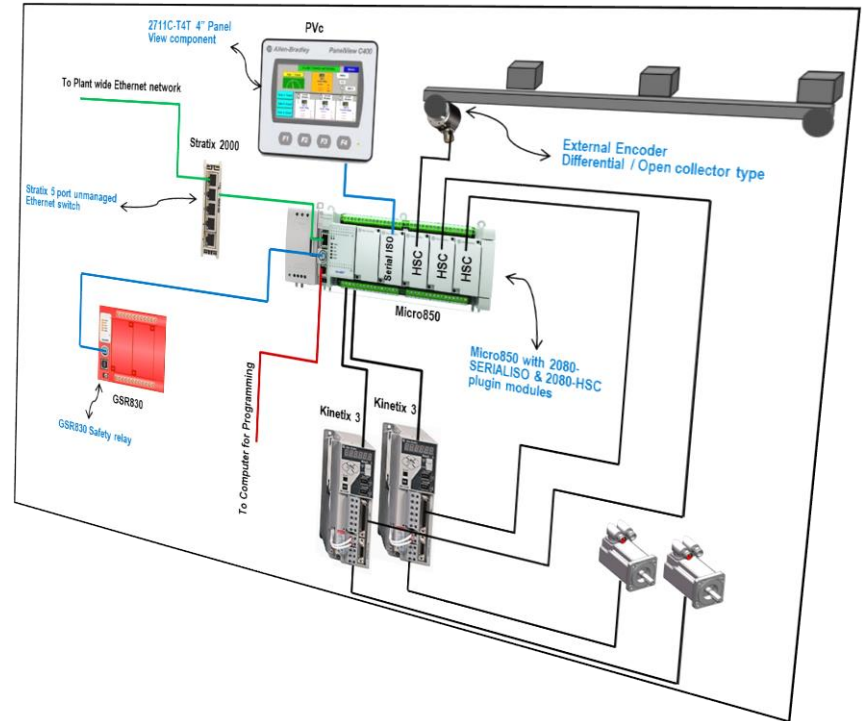
Helps OEMs size & design their machines to avoid issues before they happen

**Rockwell
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Drives and I/O on DeviceNet



Safety and Motion



**Typical Configurations including
Test Data to highlight
Performance Limitations**

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