A PLC Overview for Non-I&C Engineers
PLC Session Outline

- What is a PLC?
- What are the types of PLCs?
- History of the PLC
- What is Ladder Logic?
- What is Function Block Programming?
- What functions are there in a PLC?
- Review current major manufacturers
  - Allen Bradley
  - GE Fanuc
  - Siemens
  - Modicon
- Demonstration
What is a PLC?

• PLC = Programmable Logic Controller
• Major components: power supply, processor, I/O, and network connection
• Processor uses its own operating system and application development software
• I/O cards interface with standard real-world electrical signals
  - 110 VAC inputs and outputs for motor starters
  - 24 VDC inputs for switches
  - 4-20mA for levels, pressures and flows
  - RTD and thermocouple cards for temperatures
  - 4-20 mA outputs to control valves and VFD speeds
• Ethernet networking available
What is a PLC?
(Continued)

- In general, each manufacturer offers two PLC types:
  - Modular design for larger applications
  - Integrated “brick” design with fixed I/O for smaller applications
Typical Modular PLC Design
Typical “Brick” PLC Design

- I/O Connections
- Network Connection
- Embedded Processor and Power Supply
History of the PLC

• Invented in the early 1970s by Modicon Corporation
• Based originally on a General Motors Specification to replace relays
• Meant to reduce capital and changeover costs
• Analog capability was added by the early 1980s
What is Ladder Logic?

• Graphic language meant to look like Relay Logic Diagrams
• Primarily comprised of:
  - Relay coils and contacts
  - Timers
  - Compares
  - Math functions
  - Program control
  - File functions
Graphic Language meant to look like Relay Logic Diagrams

Primarily Comprised of:
- Relay Coils and Contacts
- Timers
- Comparators
- Math Functions
- Program Control
- File Functions

Sample of Ladder Logic
What is Function Block Programming?

- Graphic language meant to look like flow diagrams
- Preferred by chemical/process types
- Primarily comprised of:
  - Input and Output control
  - Logic functions (AND, OR, XOR)
  - Scaling, filters and control functions (PID)
  - Math functions
  - Compare functions (< > =)
  - Timers
  - Program control
PLC programming is similar to learning chess: It does not take long to learn the moves but it can take a lifetime to get good at the game.
# RSLogix 5000 Instruction Set

For information about an instruction, click on the category or mnemonic. You can also use the alphabetical listing to find more information on a particular instruction.

**Note:** For more information on Structured Text programming syntax, refer to [Structured Text Syntax](#).

## Instruction Categories

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<th>Instruction Categories</th>
<th>Supported Instructions by Language</th>
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<tr>
<td><a href="#">LH</a></td>
<td>Same as Relay Ladder</td>
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<td><a href="#">LH</a></td>
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<td><strong>Array (File)/Shift Instructions</strong></td>
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<tr>
<td><a href="#">BSL</a></td>
<td>Not available</td>
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<tr>
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<tr>
<td><strong>ASCII Conversion Instructions</strong></td>
<td><a href="#">CTOS</a> <a href="#">STCD</a> <a href="#">RTCS</a> <a href="#">STDR</a> <a href="#">UPER</a> <a href="#">LOWR</a></td>
</tr>
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<td><a href="#">STCD</a></td>
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<td><strong>ASCII Serial Port Instructions</strong></td>
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</tr>
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<td><a href="#">PUT</a></td>
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<tr>
<td><a href="#">RUN</a></td>
<td>Same as Relay Ladder</td>
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</tr>
<tr>
<td><a href="#">FIND</a></td>
<td>Not available</td>
</tr>
<tr>
<td><a href="#">INS</a></td>
<td>Same as Relay Ladder</td>
</tr>
<tr>
<td><strong>Bit Instructions</strong></td>
<td><a href="#">+1</a> <a href="#">-1</a> <a href="#">+L</a> <a href="#">-L</a> <a href="#">OIS</a> <a href="#">OSR</a> <a href="#">OSF</a></td>
</tr>
<tr>
<td><a href="#">OSR</a></td>
<td>Same as Function Block</td>
</tr>
<tr>
<td><a href="#">OSF</a></td>
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</table>
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Math Conversion Instructions
- DEG, RAD, TOC, FRO, TRY
- Same as Relay Ladder
- DEG, RAD, TRU, TRX

Motion Configuration Instructions
- HARR, HRET, HRD, FHD
- Not available
- Same as Relay Ladder

Motion Coordinated Instructions
- MOS, XCLN, XCCN, XCD, XCSD, XCSR
- Not available
- Same as Relay Ladder

Motion Event Instructions
- MAR, NDM, MAR, NDR, HRDC, HCC
- Not available
- Same as Relay Ladder

Motion Group Instructions
- MGS, MGD, MGR, MGSP
- Not available
- Same as Relay Ladder

Motion Move Instructions
- MRR, MRT, MAJ, MHI, MRS, NCP, HCMP, HCSV, HFC, HATC
- Not available
- Same as Relay Ladder

Motion State Instructions
- MSO, MSF, MSED, MSER, NDO, NDF, NDFR
RSLogix 5000 Online Help

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Move/Logical instructions
- MOV, MUL, AND, OR, XOR, NOT, SWPB, CLR, BTD
- MVI, AND, OR, XOR, NOT, ETOT, BAND, BOR, SXOR, ENOT, DFF, JKFF, SETO, RESD
- MVI, SWPB, ETOT, DFF, JKFF, SETO, RESD

Process Control instructions
- ALM, SCL, FFIDE, RMPS, POSP, SRTP, LIDL, FGEN, TOT, DIET, D2SD, D3SD
- ALM, SCL, PID, IDE, RMPS, POSP, SRTP, LIDL, FGEN, TOT, DIET, D2SD, D3SD

Program Control instructions
- JMF, LBL, JSR, JSR, RET, SBR, TND, MCR, UID, UIE, SFR, SFP, EVENT, EOT, AFI, NOP
- JSR, SBR, RET
- JSR, RET, SBR, TND, UID, UIE, SFR, SFP, EOT, EVENT

Select/Limit instructions
- SEL, ESEL, SSUM, SNES, MLV, HLL, RLIM
- ESEL, SSUM, SNES, HLL, RLIM

Sequencer instructions
- SQI, SQO, SQL
- Not available
- Not available

Special instructions
- FBC, DOT, DTR, PID
- Not available
- Not available
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Statistical Instructions
- These instructions are not available in relay ladder.
  - HAYE
  - HSTD
  - HIN
  - HAX
  - Same as Function Block

Timer/Counter Instructions
- TON
- TOF
- RTD
- CTU
- CTD
- RES
- TONR
- TOF R
- RTD R
- CTU R
- CTD R
- Same as Function Block

Trigonometric Instructions
- SIN
- COS
- TAN
- ASH
- ACS
- ATN
- Same as Relay Ladder
- Same as Relay Ladder

* Programming languages are designated as follows:
  - [ ] - Relay Ladder Logic
  - [ ] - Function Block
  - [ ] - Structured Text
Current Major US PLC Brands

- Allen Bradley
- GE Fanuc
- Siemens
- Modicon
Leading Suppliers of Programmable Logic Controllers for North America

2008 = 1,921.2 Million US Dollars

- Rockwell Automation: 51.1%
- Siemens: 11.0%
- Schneider Electric: 7.7%
- GE Fanuc: 7.2%
- B&R Industrial Automation: 2.6%

Other = 10.4%
Allen Bradley Company

- Headquarters: Milwaukee, WI
- Manufacturing: Highland Heights, OH
- Company history
  - Offering industrial control equipment for over 100 years
  - One of first makers of PLCs
  - Currently the most dominant US PLC manufacturer: 61% of market share
  - Worldwide: second behind Siemens
GE Fanuc Company

- Headquarters: Charlottesville, VA
- Manufacturing: Charlottesville, VA
- Company history
  - 1970s started as GE & Fanuc joint venture
  - Currently has 7.5% of US market share
  - Part of the GE Infrastructure Group (considered to be the core growth area for GE)
Siemens Company

- Headquarters: Germany
- Manufacturing: worldwide
- Company history
  - One of world’s oldest electrical component manufacturers
  - Currently the most dominant worldwide
  - Currently has 11% of US market share
  - Claims double digit sales growth in the US over the last 5 years
A Warning When Using Siemens

Achtung!

ALLES LOOKENSGEPEEPERS: Dieses computermachine is nicht für gefinger pokken und mittengraben. Ist is easy schnappen der springenwerks, blowen fusen, und poppencorken mit spitzensparken. Es ist nicht für gewerken by das Dummkopf. Das rubbernechen sightseeren keepen hands in dem pockets—relaxen und watchen dem lights blinken.
Modicon

- Headquarters: Andover, MA
- Manufacturing: Andover, MA
- Company history
  - Inventor of the PLC
  - Purchased by Groupe Schneider
  - Currently has 8% of US market share
PLC Demonstration

PLC-5/20E

A Thermocouple Module with 2 Type T Thermocouples

A I/O Simulator Module

A 120VAC Digital Output Module

RS View SE as the HMI
Questions?