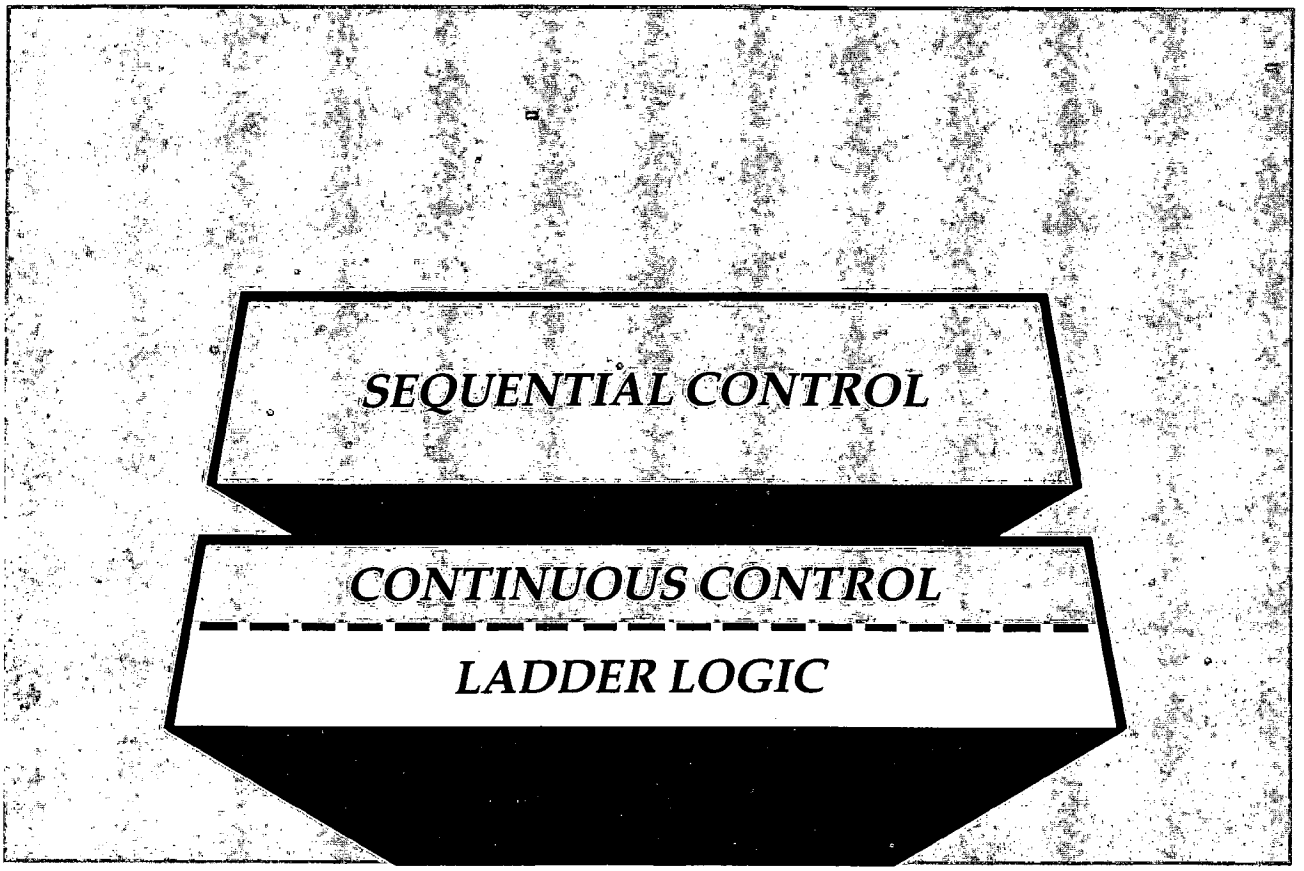
Intelligent Automation Series Ladder Logic

Replaced by 1287 Version of PSS 21S-3B1 B3



Ladder logic provides on/off control, counting, and timing capabilities.

Ladder Logic Overview

Ladder logic lets you design modular solutions to logic control problems in familiar, easy-to-use relay ladder symbols.

By itself, ladder logic performs simple relay-type operations. Ladder logic used in conjunction with a control processor's continuous and sequential control blocks can implement sophisticated control strategies. Through the communication capabilities of the process management and control network, ladder logic executing in one Fieldbus Module can be coordinated with other ladder logic and with continuous and batch processes in any network control processor.

Ladder logic interface blocks provide connections between a ladder diagram and user tasks, other blocks, and other ladder diagrams. Connection is made through interface block input and output parameters. These parameters map to user-configured external flag references within a ladder diagram division called a segment.

FOXBORO

Each ladder logic Interface block can represent a segment of a ladder diagram. The name of the segment is the block name. Multiple ladder logic interface blocks can be connected to a single Fieldbus Module to support a diagram consisting of multiple segments.

Creating a ladder logic Interface block establishes a ladder diagram source file. Using these source files, ladder logic configurator software lets you construct a ladder diagram in segments, check for syntax errors, and produce a printed copy for documentation. You can compile the ladder diagram and install the code in a digital Fieldbus Module or save the source files for later use. You can develop a library of ladder diagrams and retrieve (copy) segments for inclusion in other ladder diagrams. You can also save ladder diagram source files (as part of a compound) on diskette.

You can monitor the status of ladder logic contacts, timers, counters, and coils through a ladder diagram display, which uses industry standard symbols, or through graphic displays that you create. User-generated displays access the status of ladder logic elements through external flag parameters.

You can isolate the ladder logic from the process and force contacts and coils on or off to verify correct operation of the logic under simulated process conditions.

Ladder Logic Features Summary

The ladder logic provides:

- Simplified programming of control logic as a relay ladder diagram, using industry standard symbols
- A user-definable label, up to 14 characters, for each Fieldbus Module coil table address. (Multiple ladder elements referring to the same coil table address have the same user label.)
- Menu-oriented displays for configuration and operation
- On-line help screens and prompt messages for assistance during interactive program development and maintenance
- Dynamic process monitoring through graphic ladder display
- Hard copy documentation of ladder logic diagrams
- A user-developed library of ladder logic diagrams
- Ladder logic source files that are protected from unauthorized or accidental change (editing allowed only from process engineer's environment)
- A logic test mode that lets you force contacts and coils and assign timer/counter preset and reset values for dynamic verification of program operation

Ladder Logic I/O Capability

Ladder diagrams sense digital process input status and control digital process outputs.

Inputs come from physical input points connected to the field terminals of the Fieldbus Module or from external input flags supplied by control processor blocks. Physical inputs present process status information from devices such as limit switches, push buttons, and pressure switches. External input flags allow continuous and sequential blocks and user tasks to initiate or control ladder logic action.

Outputs go to physical output points connected to the field terminals of the Fieldbus Module or to external output flags supplied to control processor blocks. Physical outputs control devices such as solenoids, motor starters, and indicator lamps. External output flags allow continuous and sequential blocks and user tasks to monitor ladder logic action.

Ladder Logic Interface Block

The ladder logic interface block (see Figure 1) supports external flag references to/from ladder logic executing in a discrete (digital) Fieldbus Module. The interface block translates between ladder logic external flag assignments and I/O parameter assignments. The block reads each ladder logic output flag reference from the Fieldbus Module and updates the appropriate output parameter value. The block writes each input parameter value to the appropriate ladder logic input flag reference in the Fieldbus Module.

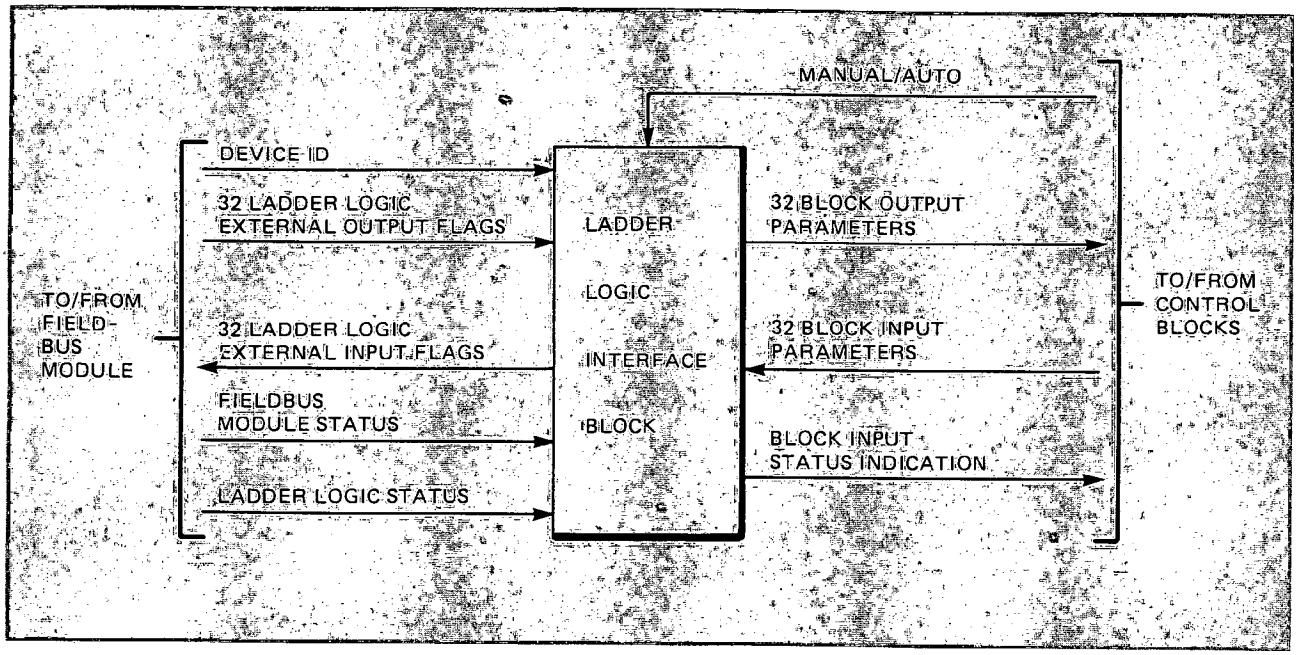


Figure 1.
Ladder Logic Interface Block

Ladder Logic Interface Block Features Summary

The ladder logic interface block provides:

- A mapping parameter and an output parameter for each of 32 ladder logic external output flags for monitoring ladder logic
- A mapping parameter and an input parameter for each of 32 ladder logic external input flags for activating or controlling ladder logic
- Manual/Auto mode for manually updating block outputs to allow simulation of flag outputs normally provided by the ladder logic
- A connectable status parameter to alert other blocks to abnormal Fieldbus Module or ladder logic status

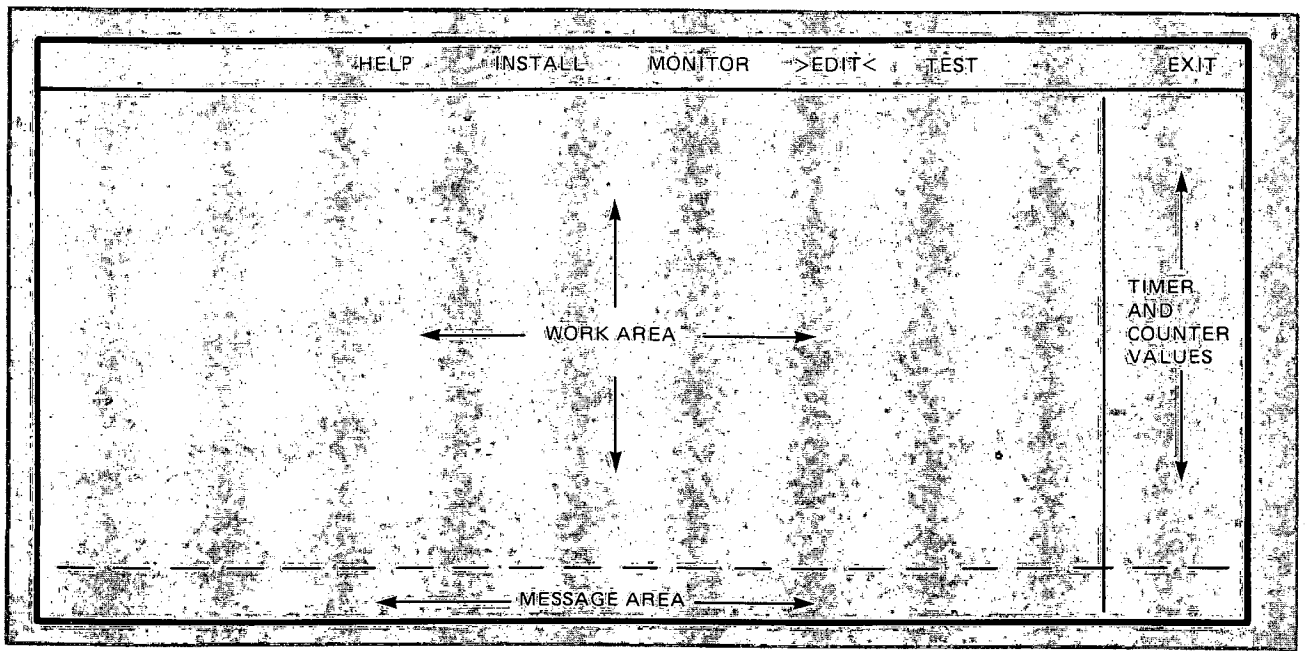


Figure 2.
Ladder Diagram Work Area

Ladder Diagram Construction

The ladder logic software in a Fieldbus Module performs logical operations based on the placement of the contacts and coils in the ladder diagram. These configurations consist of series, parallel, or series/parallel paths. Series paths provide ANDing of the conditions; parallel paths provide ORing of conditions.

The ladder diagram is constructed within a work area bounded by the menu bar at the top of the screen, the configurator message line at the bottom, and a column at the right for preset, reset, and accumulated values (see Figure 2). The work area is reserved for placing the ladder rungs and logic symbols.

The ladder logic configurator lets you create ladder diagrams from a set of predefined symbols, preset and reset values for counters and timers, and your choice of text labels for symbols and rungs. A ladder diagram row accepts up to seven series-contacts and a coil.

You can select the HELP function from the main menu bar to display the symbols, instruction set, and technical identifiers that the CREATE/MODIFY function offers for constructing a ladder.

Symbols

Table 1 shows the ladder instruction set used to implement ladder logic.

Table 1. Ladder Logic Instruction Summary

Symbol	Name	Description
—| |—	Normally Open Contact	Provides logic value continuity (power flow) from left to right when the named signal is present (true state).
—| \ |—	Normally Closed Contact	Provides logic value continuity (power flow) from left to right when the named signal is absent (false state).
———	Connector	Provides logic value continuity through a symbol position.
—( )—	Energize Coil	Sets Boolean value representing coil status true if any rung path has continuity. If logic continuity is lost, Boolean value is set false.
—(\ )—	Write Not Coil	Sets Boolean value representing coil status false if any rung path has continuity. If logic continuity is lost, Boolean value is set true.
	Vertical Connector (up)	Joins two rows when used with a down connector.
	Vertical Connector (down)	Joins two rows when used with an up connector. Used in pairs, vertical connectors provide logic value continuity (power flow) vertically within a ladder diagram.
" "	Blank	Inserts blanks in a symbol position, interrupting logic value continuity.
—(L)—	Latch Coil	Sets Boolean value representing coil status true if any rung path has continuity. If logic continuity is lost after the coil is set, Boolean value remains true until associated unlatch coil is set.
—(U)—	Unlatch Coil	Unlatches an output that was previously set by a latch coil instruction.
—(RTO)–	Retentive Timer-On Delay	Provides a delayed action on a rung transition from false to true.
—(RTF)–	Retentive Timer-Off Delay	Provides a delayed action on a rung transition from true to false.
—(RST)–	Counter/Timer Reset	Resets a counter or timer having the same technical identifier as this symbol.
—(CTU)–	Up Counter	Increments a counter accumulated value on off-to-on transitions.
—(CTD)–	Down Counter	Decrements a counter accumulated value on off-to-on transitions.
—(MCR)–	Master Control Relay	Enables the rungs between this symbol and the NCR symbol to execute normally if the MCR rung condition is true. If MCR is false, the area rungs are not executed and the nonretentive outputs within the area are deenergized.
—(NCR)–	End of Master Control Relay	Marks the end of the MCR conditional group of rungs.
—(ZCL)–	Zone Control Logic	Enables the rungs between this symbol and the NCL symbol to execute normally if the ZCL rung condition is true. If ZCL is false, the rungs in the zone are not executed and the outputs are held at their last state.
—(NCL)–	End of Zone Control Logic	Marks the end of the ZCL conditional group of rungs.

Table 2. Text and Numeric Elements

Text and Numeric Elements	Description
Label	Two rows of up to seven characters each.
Technical Identifier	A single row of up to six characters that identifies a symbol by type and number (see Table 3).
Preset Value	For timer or counter symbol, maximum value, up to 65 535. Timer values represent tenths of seconds; counter values represent counts.
Reset Value	For timer or counter symbol, minimum value, up to 65 535. Timer values represent tenths of seconds; counter values represent counts.
Accumulated Value	Current value accumulated in a timer or a counter.
Rung Descriptor	Up to 3 lines of text with up to 60 characters in each. Used for documentation (see Figure 3).

Text and Numeric Entries

Table 2 describes the text and numeric entries associated with the ladder diagram. A technical identifier is placed above each symbol and a label for it is placed below; an optional rung descriptor can be placed beneath each rung (see Figure 3). Table 3 shows the format for technical identifiers.

A ladder line consists of five screen lines: two lines allocated for the label, one line for the symbol, one line for the technical identifier, and one blank line for separation. You can scroll the ladder diagram up or down, one ladder line at a time.

Table 3. Technical Identifiers

Technical Identifiers	Meaning
CIN__01 through CIN__32	Physical Inputs
CO__01 through CO__16	Physical Outputs
IFL__01 through IFL__32	External Input Flags
OFL__01 through OFL__32	External Output Flags
TC01__x through TC16__x	Timer/Counters
CL__001 through CL__107	Internal Flags

where x designates a timer/counter parameter as follows:

x VALUE	MEANING
O	Overflow
S	Status

Ladder Logic Configurator Capabilities

The ladder logic configurator lets you:

- Create or modify a ladder logic diagram
- Check for syntax errors within existing ladder diagram source code
- Transform a ladder diagram into ladder logic to be installed and executed in a Fieldbus Module
- Print a copy of either the entire ladder diagram or selected segments
- Test the ladder logic in an active mode of operation
- Monitor the execution of the ladder logic within a Fieldbus Module through an active display

You can run the ladder logic configuration/operation process from any workstation equipped with an alphanumeric keyboard and picking device. The picking device (such as a mouse, touchscreen, or keyboard horizontal arrow keys) is used to select the ladder logic mode of operation from the main menu bar. In the ladder logic edit mode of operation, you use function keys to designate the symbols required to create this diagram. You enter the desired text through the alphanumeric keyboard.

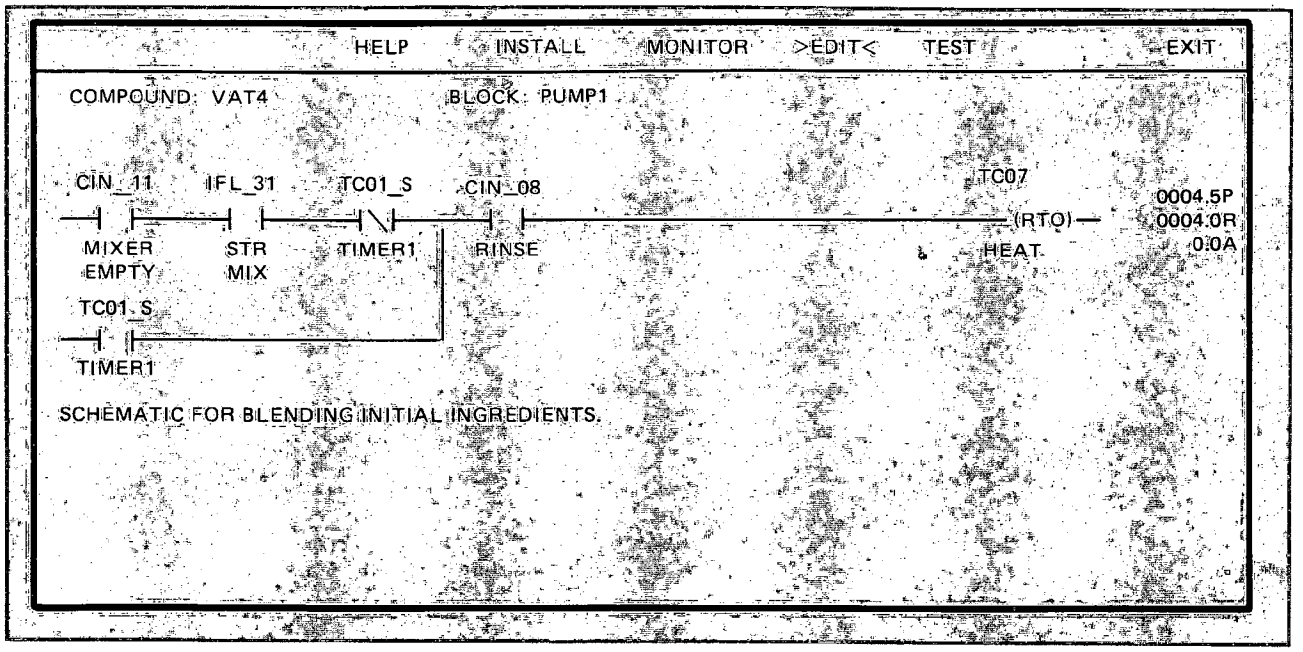


Figure 3. Sample Ladder Diagram

SPECIFICATIONS FOR LADDER LOGIC COMPONENTS

Fieldbus Module

MEMORY SPACE AVAILABLE FOR A LADDER DIAGRAM	1k bytes
NUMBER OF PHYSICAL INPUTS	Up to 32 per Fieldbus Module and expander
NUMBER OF PHYSICAL OUTPUTS	Up to 16 per Fieldbus Module and expander
SCAN RATE	Average of 300 ladder logic symbols scanned in 20 to 25 ms

Ladder Logic Interface Block

UPDATE INTERVAL	Updated at 1 of 9 user-specified intervals from 100 ms to 1 hour; default period is 500 ms
NUMBER OF INPUT PARAMETERS	32 external input flags
NUMBER OF OUTPUT PARAMETERS	32 external output flags

(Continued)

SPECIFICATIONS FOR LADDER LOGIC COMPONENTS (Cont.)

Ladder Diagram	
NUMBER OF FLAGS	
External Input	32 flags
External Output	32 flags
Internal Input/Output (Combined)	107 flags
Timer/Counter	32 flags
Special Purpose	
Initialization, Power Failure, Communication Failure, Fail/Safe:	4 flags
COUNTERS AND TIMERS	
Combined Total of Counters and Timers (In Any Combination)	Up to 16 per Fieldbus Module
Maximum Accumulation	65 535 counts or tenths of seconds
Ladder Diagram Display	
LADDER ROW	Up to eight symbols
USER LABEL FOR A SYMBOL	Up to 14 characters (2 lines)
TECHNICAL IDENTIFIER FOR A SYMBOL	Up to 6 characters
RUNG COMMENT LINE LENGTH	Up to 3 rows of up to 60 characters each
LADDER LINE	4 rows
DISPLAY SCROLL SEGMENT SIZE	One ladder line

Printed in USA

MB 021
0387