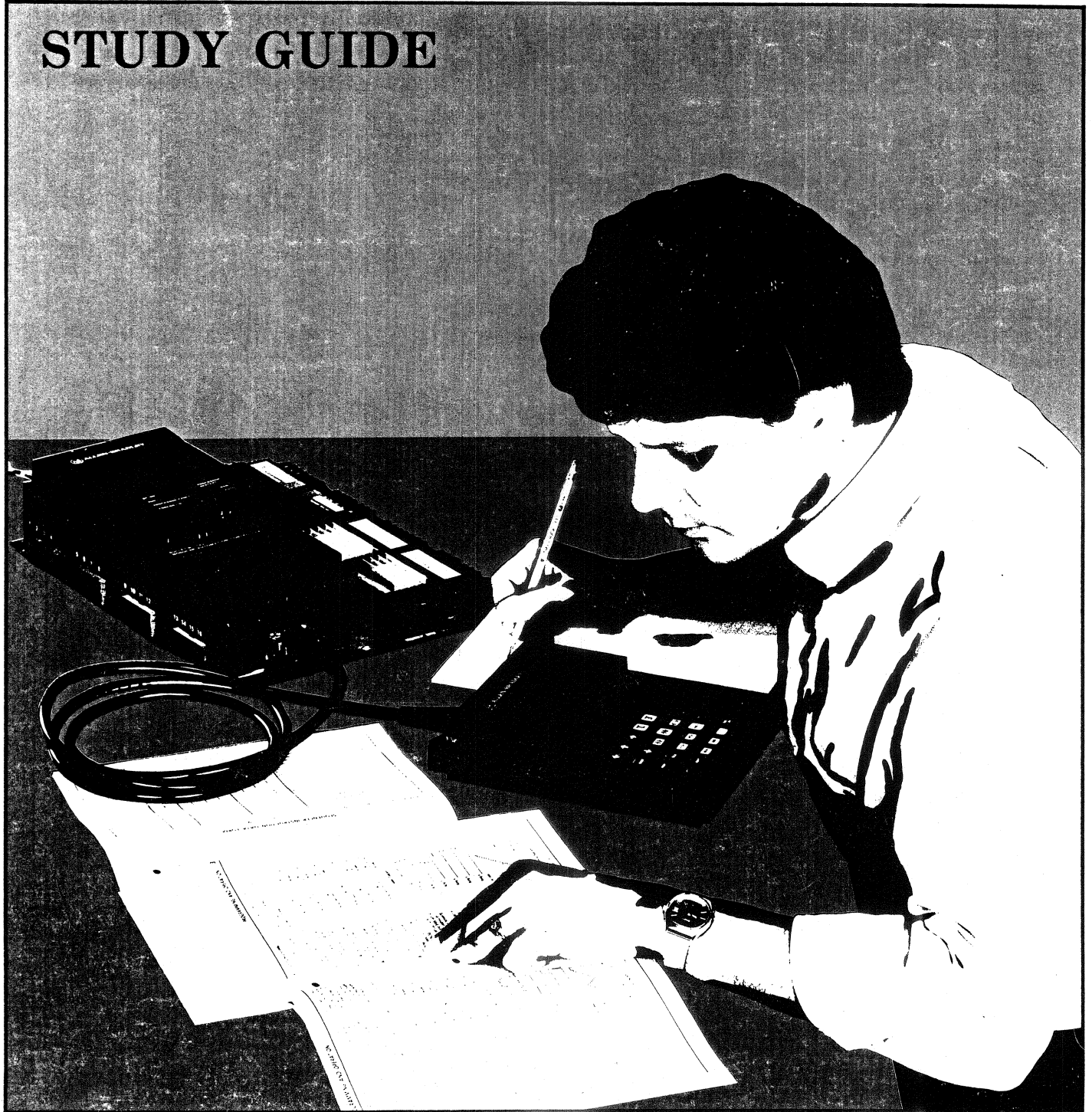




# SELF-TEACH MANUAL

Allen-Bradley Bulletin 1742  
Modular Automation Controller

## STUDY GUIDE



## **IMPORTANT INFORMATION**

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Because of this, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Allen-Bradley Company be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Allen-Bradley Company cannot assume responsibility or liability for actual use based on the examples and diagrams.

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## INTRODUCTION

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### HOW TO USE THIS MANUAL

This is the Study Guide portion of the Self-Teach Manual. It is designed for use with the accompanying text.

Sections 2 and 3 of the text, entitled **EQUIPMENT OVERVIEW** and **PROGRAMMING AND OPERATION** are basically the same as Sections 2 and 3 of the User's Manual. We have divided these sections into 13 study units that correspond with the 13 Question/Exercise units indicated at the right.

The Study Guide consists of Question/Exercise Units corresponding to the 13 study units of the text. Question/Exercise Units include questions, a summary of key terms and concepts, and in some cases additional programming details, examples, and exercises.

We suggest that you read the study units in numerical sequence. Read each study unit two times or more. Use a controller practice set-up or a factory demonstrator to familiarize yourself with programming procedures. Then refer to the corresponding Question/Exercise Unit to review the terms and concepts introduced in the study unit and answer the questions. Check your answers with the answers in the back of the Study Guide. If you have answered any questions incorrectly, go back and review the text material associated with these questions.

Set your own pace. Later, when you are satisfied that you have a good grasp of the entire text material, use the manual as a handy reference to refresh your memory from time to time.

### QUESTION/EXERCISE UNITS

1. Equipment Overview	P. Q1-1
2. Programming Basics – I (para. 3.1–3.1.3)	P. Q2-1
3. Programming Basics – II (para. 3.1.4–3.1.7)	P. Q3-1
4. Operator Terminal	P. Q4-1
5. Hands-On Introduction To Programming	P. Q5-1
6. Relay Type Instructions	P. Q6-1
7. Timer Instructions	P. Q7-1
8. Counter Instructions	P. Q8-1
9. Sequencer Instructions	P. Q9-1
10. Special Instructions	P. Q10-1
11. Program Editing	P. Q11-1
12. On-Line Data Control	P. Q12-1
13. Using the EEPROM Memory Module	P. Q13-1

## Question/Exercise Unit 1

### EQUIPMENT OVERVIEW

Text Reference: Para.2.0 thru 2.2.5

#### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Processor Module 2.2.1

I/O Modules 2.2.2

Operator Terminal 2.2.3

EEPROM Module 2.2.4

Mounting Plates 2.2.5

#### QUESTION GROUP A

1. The maximum number of I/O modules the Modular Automation Controller will accept is:
  - a. 4
  - b. 6
  - c. 8
  - d. 10
  - e. 32
2. The operator terminal must remain connected in order to operate the controller. True or False?
3. The EEPROM memory module must be inserted in order to operate the controller. True or False?
4. The processor module memory is retained when processor power is removed. True or False?
5. Which of the following statements are true?
  - a. The operator terminal plugs directly into the processor module.
  - b. The operator terminal can communicate directly with the processor module with no cable connections at distances up to 6.6 feet.
  - c. The operator terminal must be wired to the processor module by means of a 3-wire power cord.
  - d. A 6.6 ft. interconnect cable is used to connect the operator terminal to the processor module.
6. The EEPROM memory module is used to:
  - a. Duplicate the contents of the processor RAM.
  - b. Copy the contents of EEPROM memory to the processor RAM.
  - c. Override the contents of processor RAM.
  - d. All of the above.
  - e. None of the above
7. There are two optional mounting plates that simplify mounting procedures for the Modular Automation Controller. True or False?
8. The processor module processes and manipulates programmed information, causing output devices to be energized and de-energized in response to the ON/OFF status of input devices. True or False?
9. The processor module has an internal power supply that converts your line power to the necessary 5 VDC operating power for the operator terminal and I/O modules as well as the EEPROM module. True or False?
10. The incoming power terminals on the processor module have self-lifting pressure plates for easy wire insertion and secure connections. True or False?
11. There are five I/O ports on each side of the processor module. True or False?
12. You can plug an input or output module into any port of the processor module. True or False?
13. AC and DC I/O modules can be used with the same processor module. True or False?
14. Each I/O port is associated with a module group number which represents four external I/O addresses. True or False?
15. A hinged cover protects the EEPROM port when the EEPROM module is not in use. True or False?
16. There are four LED diagnostic indicators on the processor module that aid in monitoring and troubleshooting the Modular Automation Controller. True or False?
17. The processor restart switch gives you a choice of two restart procedures. True or False?
18. I/O modules interface the logic level voltage of the processor with the voltage levels of external input and output devices. True or False?
19. Input modules sense whether external input devices are ON or OFF and relay this information to the processor module. True or False?
20. Output modules control the ON/OFF status of external output devices, based on commands received from the processor module. True or False?

# Q1 EQUIPMENT OVERVIEW

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21. Input modules have four LED status indicators that are lit when a corresponding input circuit is energized. True or False?
22. Output modules have five neon lamp status indicators. True or False?
23. Four output module neon lamp status indicators will be lit when a blown fuse condition for their corresponding output circuit exists. True or False?
24. Each I/O module has four wiring terminals for connection to external I/O devices and two terminals for connection to I/O source voltage. True or False?
25. I/O wiring terminals have self-lifting pressure plates for easy wire insertion and secure connections. True or False?
26. I/O modules are color-coded for easy identification. True or False?
27. The operator terminal is your means of communicating with the processor module. True or False?
28. The keyboard is used to enter your program information, and the display shows you this information and data as you enter it. True or False?
29. The keyboard has 32 keys color-coded according to function. True or False?
30. The EEPROM memory module is an optional device that can be used to duplicate the contents of the processor RAM. True or False?
31. You can copy the contents of the EEPROM memory module to the processor RAM memory. True or False?
32. The EEPROM module has a write-on area for use in identifying its contents. True or False?
33. There is one mounting plate that will allow you to mount up to four I/O modules and another mounting plate that will allow you to mount up to eight I/O modules. True or False?
34. The 16 I/O mounting plate will allow you to mount eight I/O modules and the processor module. True or False?
35. The 16 I/O mounting plate has a keyhole and two slots on both the top and bottom of the plate. This allows you to mount I/O modules to the right or left of the processor module. True or False?
36. The EEPROM memory module requires a special mounting plate that will hold up to four memory modules and a reserve battery. True or False?
37. The processor module, I/O modules, operator terminal, EEPROM module and mounting plates comprise a system called the Modular Automation Controller. True or False?

# Question/Exercise Unit 2

## PROGRAMMING BASICS – I

Text Reference: Para. 3.1 thru 3.1.3

### MATCHING EXERCISE

Each of the following terms can replace one of the callout letters in the figures below. Fill in the correct letter for each term.

1. Processor Memory \_\_\_\_\_
2. Address \_\_\_\_\_
3. User Program \_\_\_\_\_
4. Instruction \_\_\_\_\_
5. Data Table \_\_\_\_\_
6. Relay ladder rung \_\_\_\_\_
7. Status Bit \_\_\_\_\_
8. Word \_\_\_\_\_
9. PC ladder rung \_\_\_\_\_

### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Relay Ladder Rung 3.1.1

PC Ladder Rung 3.1.1

Electrical Continuity 3.1.1

Logical Continuity 3.1.1

Processor Memory 3.1.2

User Program 3.1.2

Instructions 3.1.2

Word 3.1.2

Data Table 3.1.3

Addresses 3.1.3

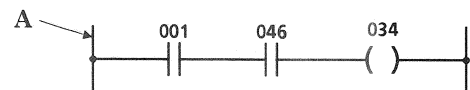
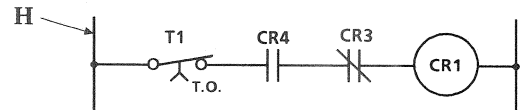
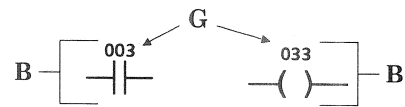
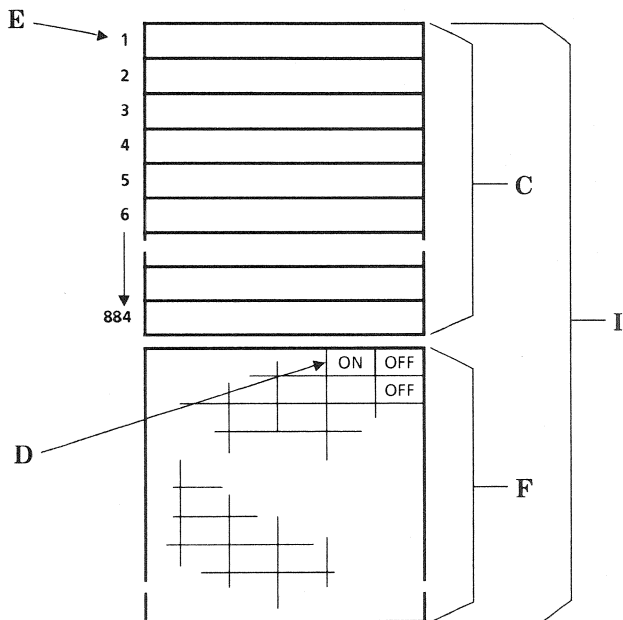
Status Bits 3.1.3

ON (logic 1), OFF (logic 0) States  
3.1.3

TRUE/FALSE Status (Instructions)  
3.1.3

External I/O Addresses 3.1.3

Internal Addresses 3.1.3



### QUESTIONS

1. Instructions are either
  - a) TRUE or FALSE
  - b) ON or OFF
2. Status bits are either
  - a) TRUE or FALSE
  - b) ON or OFF
3. Status bits tell us exactly where an instruction is located in the user program. True or False?
4. The address number of an instruction tells us
  - a) Whether the instruction is internal or external.
  - b) Whether the instruction represents an input or an output device.
5. An address number of 024 indicates that the address is associated with an internal instruction. True or False?
6. How many external addresses are available for programming?
7. The memory storage unit for instructions is called
  - a) the BYTE
  - b) the word
  - c) the bit
8. The data table portion of memory stores the list of instructions you enter. True or False?
9. The instruction address links the instruction to a particular status bit in the data table portion of the memory. True or False?
10. Relay-type instructions are used internally and externally. True or False?

## Question/Exercise Unit 3

### PROGRAMMING BASICS – II

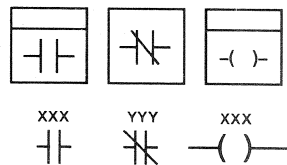
Text Reference: Para. 3.1.4 thru 3.1.7

#### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Condition Instructions 3.1.4	TRUE 3.1.5, 3.1.6
Output Instructions 3.1.4	FALSE 3.1.5, 3.1.6
Instruction Set 3.1.4	External I/O 3.1.6
Examine ON 3.1.5	Operating Cycle 3.1.7
Examine OFF 3.1.5	I/O Scan 3.1.7
Output Energize 3.1.5	Program Scan 3.1.7
Logical Continuity 3.1.5	

#### SYMBOLOLOGY

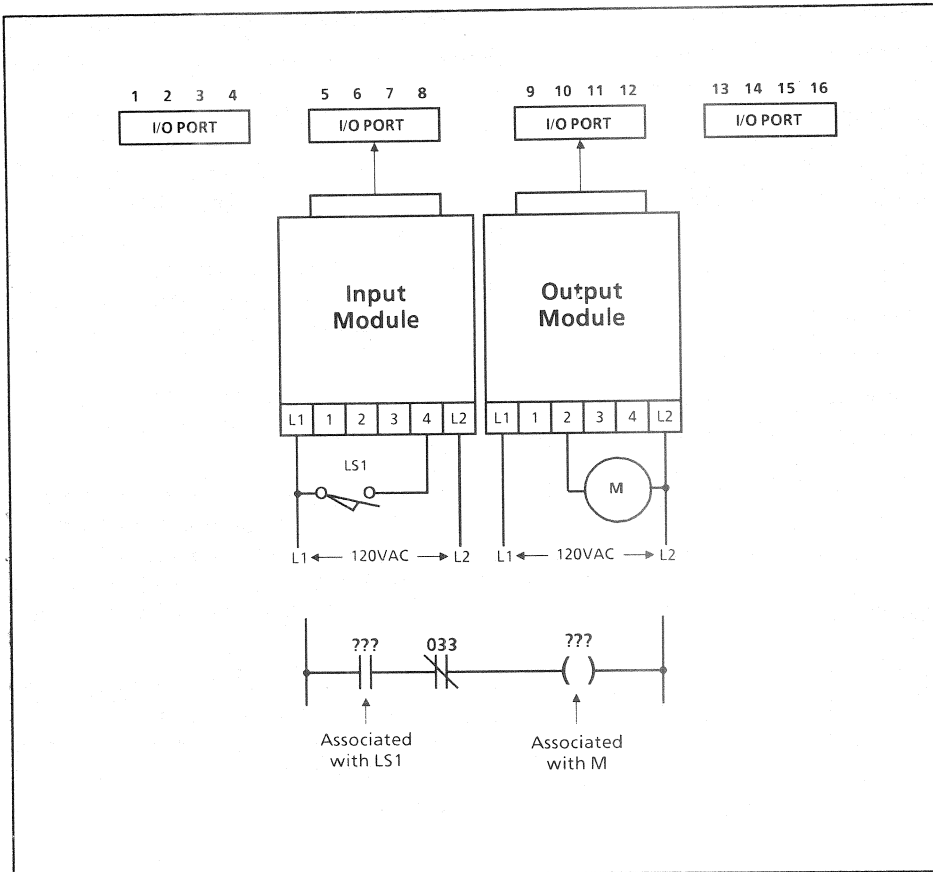


#### QUESTION GROUP A

- Instructions are classified into two groups, input instructions and output instructions. True or False?
- The branching instructions are classified in the output instruction group. True or False?
- Examine ON and Examine OFF instructions are classified as \_\_\_\_\_ instructions.
  - input
  - output
  - condition
  - unconditional
- The Examine ON instruction means "examine the status bit for an ON condition". True or False?
- With the Output Energize instruction, the status bit of the addressed Output Energize instruction is set ON when the conditional instructions in that rung are TRUE. If there are no conditional instructions, the status bit is always ON. True or False?
- Logical continuity exists in a rung if:
  - The Examine ON instructions in the rung are TRUE.
  - The Examine OFF instructions in the rung are FALSE.
  - A continuous path of TRUE conditional instructions exists.
  - Only one conditional instruction in the rung is FALSE.
- If an Examine ON instruction is used to represent a limit switch contact, a closed condition for the limit switch makes this instruction logically TRUE. True or False?
- The controller operating cycle is divided into two parts, the I/O scan and the Program scan. True or False?
- If an external input device changes state during the program scan, which of the following is true?
  - The change of state will be recognized immediately during that program scan.
  - The change of state will be recognized during the next I/O scan.
  - The user program scan will be reset to 0.
  - The program scan will start over again.

**QUESTION GROUP B**

In the figure below, an input module and an output module are plugged into the processor module I/O ports indicated by the arrows. A limit switch is wired to the input module and a starter coil is wired to the output module. Programmed instructions associated with these devices are shown in the ladder rung. Answer the following questions.



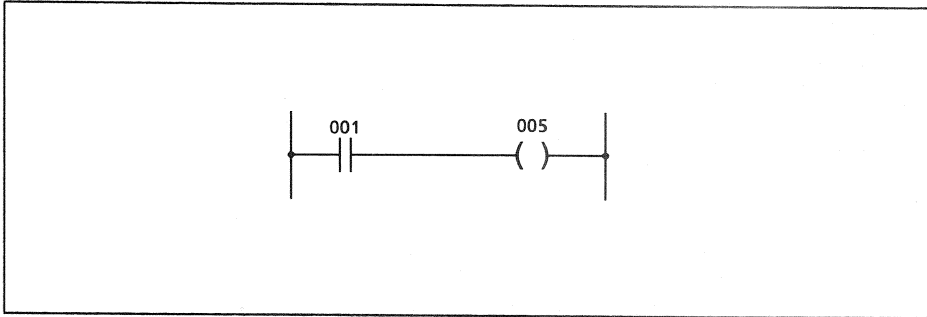
1. What is the 3-digit address number of the instruction associated with N.O. limit switch LS1?
2. Which of the two classifications does this instruction belong to?
3. What is the name of the instruction?

4. Assume that the controller is energized and operating (Run mode), and the limit switch is in the closed position. Will this instruction be TRUE or FALSE?
5. Will the corresponding status bit be ON or OFF?
6. What is the 3-digit address number of the instruction associated with coil M?

7. Which of the two classifications does this instruction belong to?
8. What is the name of the instruction?
9. What rung conditions are necessary to make this instruction TRUE?
10. When this instruction is TRUE, will the associated status bit be ON or OFF?
11. The instruction at address 033 is associated with an external I/O device. True or False?
12. What is the name of the instruction?
13. When this instruction is TRUE, will the corresponding status bit be ON or OFF?
14. When the rung is TRUE, the status bits associated with each of the instructions will be ON. True or False?
15. If a N.C. limit switch were substituted for LS1, the instruction representing it would have to be changed to an Examine OFF instruction in order to energize coil M for the closed position of the switch. True or False?

## QUESTION GROUP C

In the figure below, a simple programmed rung is shown. Answer the following questions.



1. In what part of the operating cycle does the status bit of instruction 001 change from OFF to ON or vice versa?
2. In what part of the operating cycle does the status bit of instruction 005 change from OFF to ON or vice versa?
3. Does the output module terminal go ON or OFF during this part of the operating cycle?
4. The time period beginning when the input module terminal representing instruction 001 goes ON and ending when the output module terminal associated with instruction 005 goes ON is
  - a) Fixed, at approximately 25 milliseconds.
  - b) Variable, but never longer than one operating cycle.
  - c) Variable, depending on the location of this rung in the program.
  - d) Variable, depending on what point in the operating cycle the processor happens to be at when the input module terminal goes ON.
  - e) Variable, depending on program length (how many instructions in the program) and content (the various *types* of instructions in the program).

Which of the above statements are true?

# Question/Exercise Unit 4

## OPERATOR TERMINAL

Text Reference: Para.3.2 thru 3.2.4

### KEY TERMS AND CONCEPTS.

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Operator Terminal 3.2

Error Codes 3.2.3

Keyboard 3.2.1

Internal Processor Errors 3.2.3

Display 3.2.2

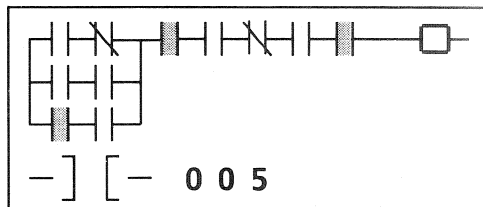
Programming Errors 3.2.3

Cursor 3.2.2

Modes of Operation 3.2.4

Message Data Area 3.2.2

### SYMBOLOLOGY



					A 7	B 8	C 9
REMOVE INSERT		-]I[- 		-(IOT)- -( )	D 4	E 5	F 6
MODE	SEARCH SSCN	-(CTD)- -(CTU)-	-(RTF)- -(RTO)-	-(RST)-	FRC ON 1	EVENT 2	TIME 3
SHIFT	PRT UNPRT	-(ZCL)- -(MCR)-	-(SQI)- -(SQQ)-	-(U)- -(L)-	CANCEL CMD	FRC OFF 0	ENTER

### QUESTION GROUP A

1. The operator terminal is only used to enter your program. True or False?
2. The cursor keys are red in color. True or False?
3. The operator terminal keys are grouped into three functional groups. True or False?

4. The operator terminal has an LCD display which will show a maximum of 3 parallel branches, each having 7 series instructions. True or False?
5. The cursor is a blinking black rectangle on the display. True or False?

6. The cursor indicates exactly where on the display an error is located. True or False?
7. The cursor is a "pointer" that gives a visual indication to the operator exactly what part of the display is being controlled. True or False?
8. Error codes must be converted to binary code before they can be interpreted. True or False?
9. When any error code from 01 thru 08 appears on the display:
  - a. An internal processor error has occurred.
  - b. The Processor Fault LED will light.
  - c. All outputs will be disabled.
  - d. All of the above.
  - e. None of the above.
10. The processor module will function in only two modes. Programming and Run. True or False?
11. There is a table fixed to the back of the operator table with information on Error codes, modes of operation and instruction addressing. True or False?
12. If you enter mode 09 on the operator terminal the display will read ERROR 40. True or False?
13. In the TEST and RUN modes, TRUE instructions in a rung are displayed in reverse video and appear darkened. True or False?
14. Mode 20 will clear the processor RAM memory but has no effect on the EEPROM memory module. True or False?

## QUESTION GROUP B

1. Examine the operator terminal keyboard and press one of the keys. As you press down on the key you can feel the key give under the pressure of your finger. As you let up on the key, it will return to its original position. This tactile feedback feature makes it easy to program the Modular Automation Controller. You can feel the key and know that the information is entered.
2. Turn the operator terminal over so that you can see the table that is fixed to the back side. This table can be very useful whenever you are using the operator terminal. Mode numbers and descriptions, acceptable addresses for programming various instructions, and error code descriptions are featured on this table. Refer to this table when you need information on any of these items.
3. If you look to the left of the information table you will notice the contrast adjustment knob. Rotate the knob upward until you notice a positive click. Moving the adjustment knob this way when the operator terminal is powered-up will reset the operator terminal. Moving the knob between the positive stop and the end stop will adjust the contrast to your viewing preference.
4. Above the information table is the socket for the interconnect cable. One end of the interconnect plugs in to this socket and the other end of the interconnect cable plugs in to a socket on the processor module. Notice the metal boot on each side of the connection socket on the operator terminal. The spring latches on the interconnect cable will latch over the side of these boots and secure the cable to the operator terminal. The processor module also has these boots so the cable will be secure at both ends.

## Question/Exercise Unit 5

# A HANDS-ON INTRODUCTION TO PROGRAMMING

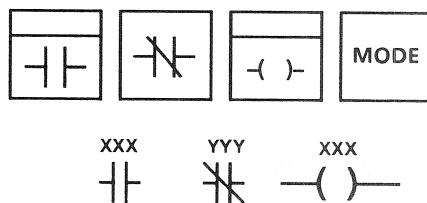
Text Reference:  
Para.3.3 thru 3.3.3

### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Operator Terminal 3.3	DC ON 3.3.1
Ladder Rung 3.3	Clear Memory 3.3.1
Relay-Type Instructions 3.3	Contrast Adjustment 3.3.2
Key Sequence 3.3	Program Mode 3.3.2
Display 3.3	884 Words 3.3.2
Interconnect Cable 3.3.1	Prompt 3.3.3

### SYMBOLOGY



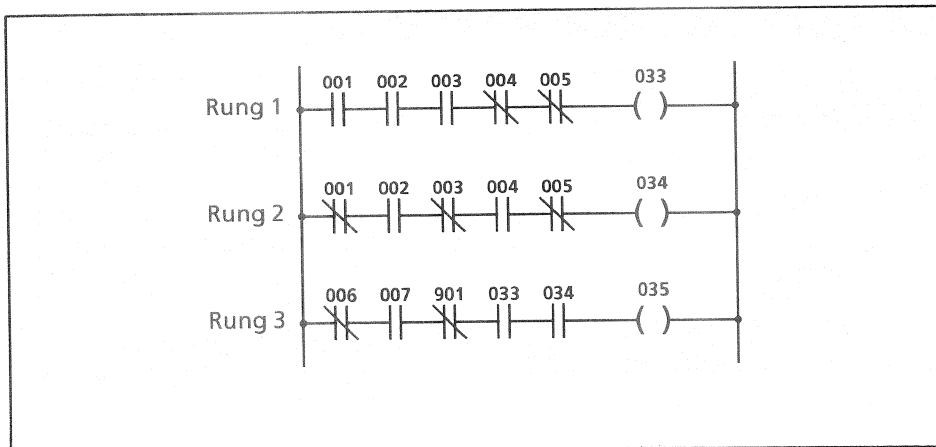
11. If you enter the wrong address for an instruction, you can change it by pressing the "ZERO" key until 000 appears on the display. The correct address can then be entered. True or False?
12. It is possible to have two output instructions in the same rung. True or False?
13. The output instruction completes the ladder rung. After entering the instruction and its address, pressing the ENTER key enters the whole rung in memory. True or False?
14. Ladder rungs are numbered as they are entered in memory. After the rung is entered, the display tells you what the next rung number will be. True or False?
15. The instruction keys are all color-coded white for easy identification. True or False?
16. When you press an instruction key, the instruction will be displayed in the lower part of the display, followed by three stars (\*\*\*) , which are actually prompting you for an address for the instruction you have just entered. True or False?
17. The instruction address is entered with the numeric keys that are color-coded blue. True or False?
18. If you wanted to assign address 001 to an instruction, you need not enter the leading zeros of the address. Pressing numeric key 1, is all you must do to enter this address. True or False?

### QUESTION GROUP A

1. The Modular Automation Controller operates from a 5 VDC power source and should not be connected to 120 VAC power. True or False?
2. The operator terminal operates from a Lithium power battery and can communicate with the processor module with no cable connection at a distance of up to 6.6 ft. True or False?
3. When power is applied to the processor module, the DC ON indicator should light. True or False?
4. When power is first applied to the operator terminal, it will automatically go thru a series of diagnostic checks. True or False?
5. The interconnect cable is equipped with spring latches that secure the cable to the modules. True or False?
6. When using a three-wire power cable to connect the processor module, connect the black wire to the terminal marked GND. True or False?
7. The interconnect cable connectors are keyed to guard against improper insertion. True or False?
8. The display contrast is factory adjusted for easy reading at any angle. True or False?
9. When the processor memory has been cleared, there are 884 words of memory available for programming. True or False?
10. Rungs begin with one or more condition instructions and end with a single output instruction. True or False?

## QUESTION GROUP B

Program the rungs below and answer the questions that follow. Refer to the keystroke sequences in Figure 3.16 if you need help entering this sample program. Make sure that you have cleared the processor memory before you begin to program these rungs.



1. After you have entered this program there are \_\_\_\_\_ words of memory available.
  - a. 878.
  - b. 872.
  - c. 866.
  - d. 463.
  - e. None of the above.
2. It is possible to examine an input address more than once in your program. True or False?
3. It is possible to examine an output address for an ON or OFF condition. True or False?
4. The output instruction completes the ladder rung. After entering the instruction and address, pressing the ENTER key enters the whole rung in memory. True or False?
5. The rungs you have just entered have the maximum of five series instructions not including the output instruction. True or False?
6. Enter the Run mode and cursor to the Examine ON instruction at address 003 in rung 1. Does the instruction appear normal or darkened?
7. Cursor right to the Examine OFF instruction at address 004. Does the instruction appear normal or darkened?
8. Since you have no external I/O devices connected, you cannot turn any inputs ON or OFF. Without using the Force Function, all Examine ON instructions should be FALSE and Examine OFF instructions should be TRUE. True or False?

## Question/Exercise Unit 6

### RELAY TYPE INSTRUCTIONS

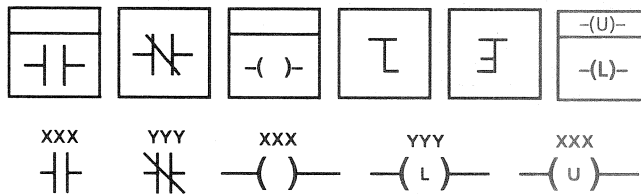
Text Reference: Para. 3.4 thru 3.4.3

#### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

External I/O Points 3.4	Hard-Wired Circuit 3.4.1
Internal Control 3.4	Branch Open 3.4.2
Examine ON 3.4.1	Branch Close 3.4.2
Examine OFF 3.4.1	OR Logic 3.4.2
Output Energize 3.4.1	Output Latch 3.4.3
Internal Control Addresses 3.4.1	Output Unlatch 3.4.3

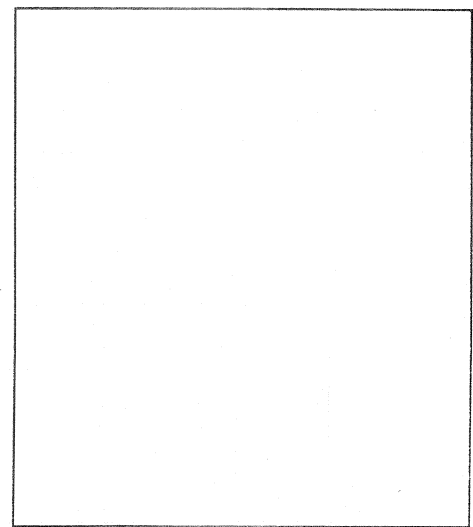
#### SYMBOLOLOGY



#### QUESTION GROUP A

- In a relay ladder rung, output devices are represented by relay coils or pilot lights. In a PC ladder rung, these output devices are represented by which instruction?
  - EXAMINE ON
  - EXAMINE OFF
  - OUTPUT ENERGIZE
  - BRANCH CLOSE
- Relay type instructions are used for external I/O points only. True or False?
- The EXAMINE ON instruction examines for an ON or OFF condition. True or False?
- Since the Examine ON instruction examines for an ON condition, it can be used to represent a normally open or a normally closed set of contacts if you want to know when your input device is ON. True or False?
- Since the Examine OFF instruction examines for an OFF condition, it can be used to represent a normally open or a normally closed set of contacts if you want to know when your device is OFF. True or False?
- It is possible to program a rung consisting only of an Output Energize instruction. Since there are no conditional instructions associated with this output instruction, the output will be continuously ON. True or False?
- The instruction in question 6 will always be TRUE and the output will always be energized when in the RUN mode. True or False?
- The unconditional output energize instruction is generally an undesirable programming procedure. True or False?

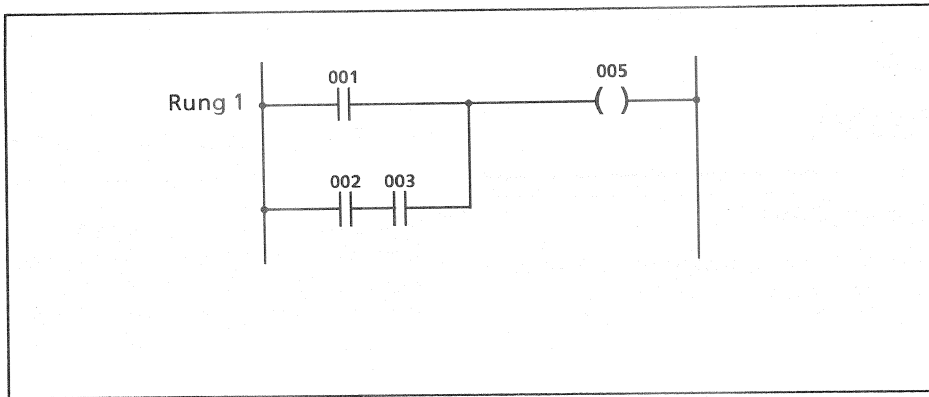
- If you have a normally open limit switch and you want a pilot light to go on when the limit switch is open, programming a rung using an output energize instruction to represent the pilot light and an EXAMINE OFF instruction to represent the limit switch could accomplish this. True or False?
- The example in Figure 3.17 compares a hard-wired circuit to a user program. We used internal control bits to represent coils 1 and 2. Program execution calls for pilot light 1 to be ON when coil 1 is energized and coil 2 is de-energized. Pilot light 2 should be ON when the exact opposite conditions occur. Pilot light 3 should be ON only when both coils are energized. If you let Examine On and Examine Off instructions represent the contacts associated with coils 1 and 2, you could turn pilot lights 1, 2, and 3 ON when the appropriate conditions occur and simplify this program. Try to re-write this program in the space below and compare your answer with the answer in the back of the book.



# Q6 RELAY TYPE INSTRUCTIONS

## QUESTION GROUP B

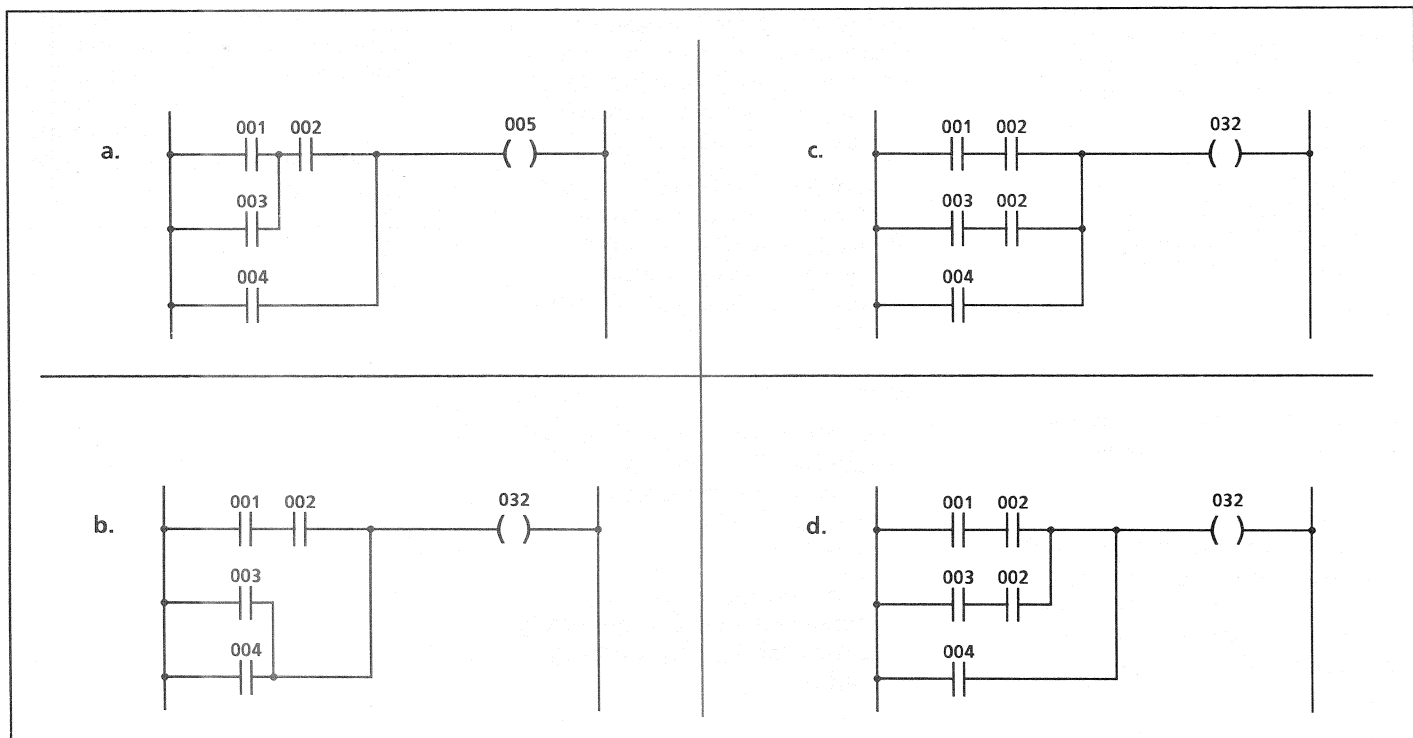
Study the rungs below and answer the questions that follow.



1. If the EXAMINE ON instruction at address 001 is TRUE, output 005 will also be TRUE. True or False?
2. If the EXAMINE ON instruction at address 002 is TRUE, output 005 will also be TRUE. True or False?
3. If the EXAMINE ON instructions at addresses 002 and 003 are TRUE, output 005 will also be TRUE. True or False?
4. If the EXAMINE ON instructions at addresses 001 and 003 are TRUE, output 005 will also be TRUE. True or False?
5. If the EXAMINE ON instructions at addresses 001 and 002 are TRUE, output 005 will also be TRUE. True or False?
6. If the Examine ON instructions at addresses 001, 002 and 003 are all TRUE, the output at address 005 will be OFF (de-energized). True or False?

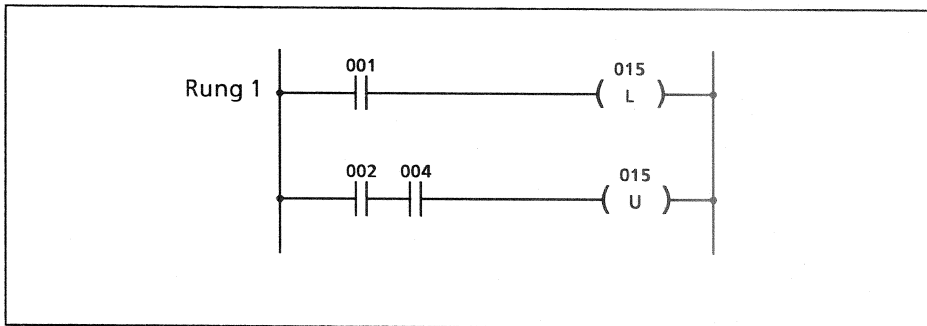
## QUESTION GROUP C

1. Which of the rungs below follow the proper branching procedure for the bulletin 1742 programming format?



## QUESTION GROUP D

Study the rungs below and answer the questions that follow. Refer to Page 3-12 if you need help.



1. When input 001 is ON, output 015 is ON. True or False?
2. When input 001 makes a transition from TRUE to FALSE, output 015 remains ON. True or False?
3. When input 002 is ON, output 015 will unlatch and turn OFF. True or False?
4. When input 001 is ON output 015 is latched ON. Output 015 will unlatch only when inputs 002 and 004 are ON. True or False?
5. The Latch instruction electronically holds output 015 in its last state even if AC power is removed and restored. True or False?
6. If the Examine ON instructions at addresses 001, 002 and 004 are all TRUE, the output at address 015 will be OFF (de-energized). True or False?

## Question/Exercise Unit 7

### TIMER INSTRUCTIONS

Text Reference: Para. 3.5 thru 3.5.4

#### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Accumulated Value (AC) 3.5.1, Fig. 3.22 Timing Range Fig 3.22

Retentive Timer On-Delay (RTO) 3.5.1 Status Bit Fig 3.22

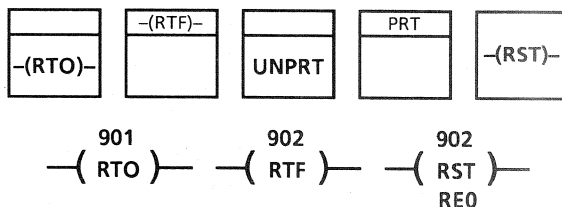
Retentive Timer Off-Delay (RTF) 3.5.2 Overflow Bit Fig. 3.22

Preset Value (PR) 3.5.1, Fig. 3.22 Reset (RST) Fig.3.22

Reset Value (RE) 3.5.1, Fig. 3.22 Rung Order 3.5.2

Time Delay Fig. 3.22 Cascading Timers 3.5.3

#### SYMBOLOLOGY



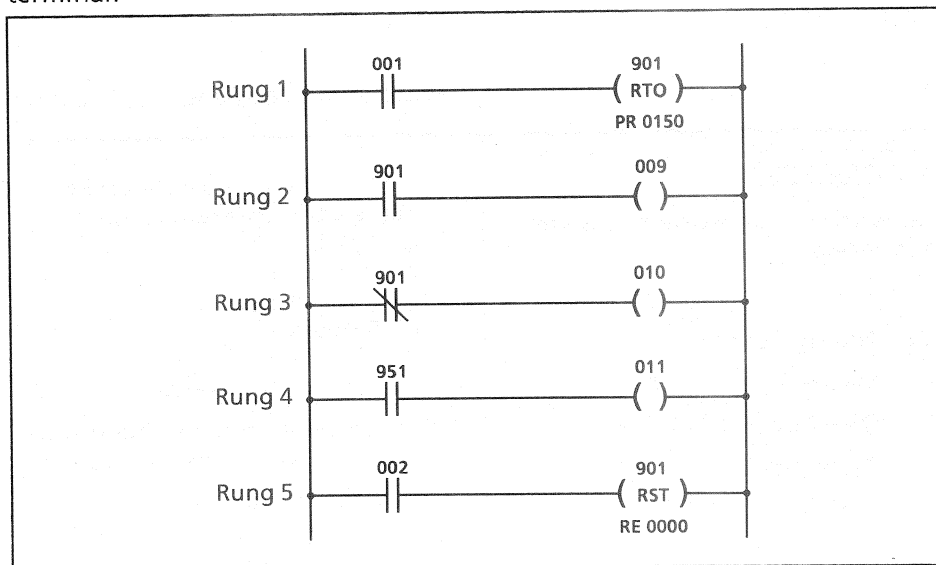
#### QUESTION GROUP A

1. The RTO and RTF instructions both require a reset instruction. True or False?
2. Address assignments for timers must be from 901 thru 932. True or False?
3. The timer instruction counts 0.01 second time intervals. True or False?
4. The number of intervals counted while the timer is timing is called the accumulated value. True or False?
5. Because of the retentive nature of these timers, their AC value is retained when power is lost and when switching from the Run mode. True or False?
6. For RTO instructions, the timer starts timing when rung conditions are TRUE. When the rung conditions are FALSE, the timer stops counting but the AC value is retained so that timing is resumed from that point when rung conditions are TRUE again. True or False?
7. An RTF timer starts timing when rung conditions change from TRUE to FALSE. The accumulated value represents the cumulative time that the rung has been FALSE. True or False?
8. The time delay for timer instructions is actually the AC value minus the PR value. True or False?
9. A PR value of 500 with an RE value of 0 represents a time delay of:
  - a. 500 seconds.
  - b. 5 minutes.
  - c. 5 hours.
  - d. 50 seconds.
  - e. none of the above.
10. Once a PR value has been set, it cannot be changed. True or False?
11. In order to change a preset value in the run mode, the preset value must be protected. True or False?
12. AC values cannot be changed. True or False?
13. The timing range for timer instructions is from 0.1 to 999.9 seconds. True or False?
14. Timer status bits can be assigned addresses from 951 thru 982. True or False?
15. Timer overflow bits must be assigned an address that equals the timer address plus 50. True or False?
16. The overflow bit is set ON when the AC value "overflows" from a count of 9999 to 0000. Examine ON instructions at the overflow address are then TRUE. True or False?
17. The RESET -(RST)- instruction is given an address that is the same as the timer address. True or False?
18. When the reset instruction is TRUE, status bits and overflow bits return to their previous state and their AC value is reset to the programmed RE value. True or False?

# Q7 TIMER INSTRUCTIONS

## QUESTION GROUP B

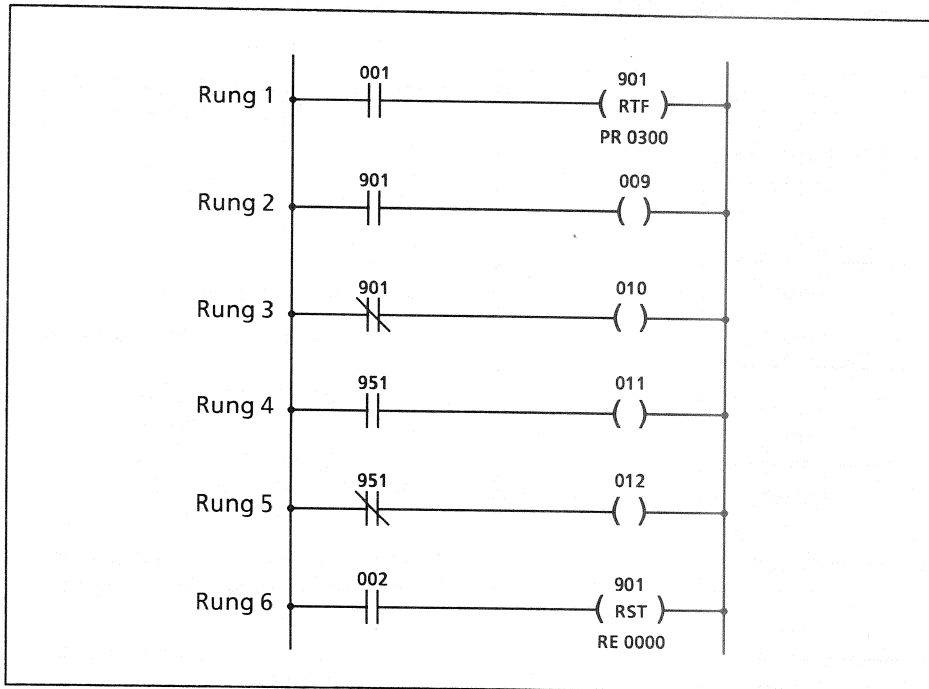
Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal.



- When input 001 is first turned ON, which of the following is TRUE?
  - Rung #2 is TRUE.
  - Rung #3 is TRUE.
  - Rung #4 is TRUE.
  - Rung #5 is TRUE.
  - None of the above.
- When the AC value of timer 901 reaches 0150 and rung 1 remains TRUE, which other rungs are TRUE?
  - 1,2.
  - 1,3.
  - 1,4.
  - 1,2,4.
  - 1,3,4.
- Rung 4 will be TRUE as soon as the AC value exceeds the PR value. True or False?
- When rung 5 is TRUE, what will the AC value be reset to?
  - 0150.
  - 901.
  - 0.
  - The AC value minus 50.
  - None of the above.
- Address 951 is the address of:
  - The Examine instruction in rung 4.
  - The overflow status bit of timer 901.
  - Both of the above.
  - None of the above.
- Suppose that rung 1 is TRUE for ten seconds and then power is lost. What will the AC value of counter 901 be when power is restored?
  - 1100.
  - 0100.
  - 0010.
  - 1000.
  - 0001.
- When will rung number 2 be TRUE?
  - As soon as rung 1 is TRUE.
  - When timer 901 has an AC value of 0150 or more.
  - Until timer 901 has an AC value of 0150.
  - While the RST instruction is TRUE.
  - None of the above.
- If the RTO instruction in rung 1 had an address of 925, what would the address of the Examine ON instruction in rung 4 have to be to examine the overflow bit of timer 925?
  - 901.
  - 951.
  - 925.
  - 975.
  - None of the above.
- When the AC value of timer 901 exceeds 9999, what output will be energized?
  - 901.
  - 009.
  - 010.
  - 011.
  - None of the above.
- What initiates the timing function for timer 901?
  - Examine ON at address 001 is TRUE.
  - Examine ON at address 002 is TRUE.
  - Examine ON at address 951 is TRUE.
  - All of the above.
  - None of the above.
- What is the address of the Examine instruction that will reset timer 901?
  - 001.
  - 901.
  - 951.
  - 002.
  - None of the above.
- The RTO instruction will start timing when its rung conditions are TRUE. True or False?

**QUESTION GROUP C**

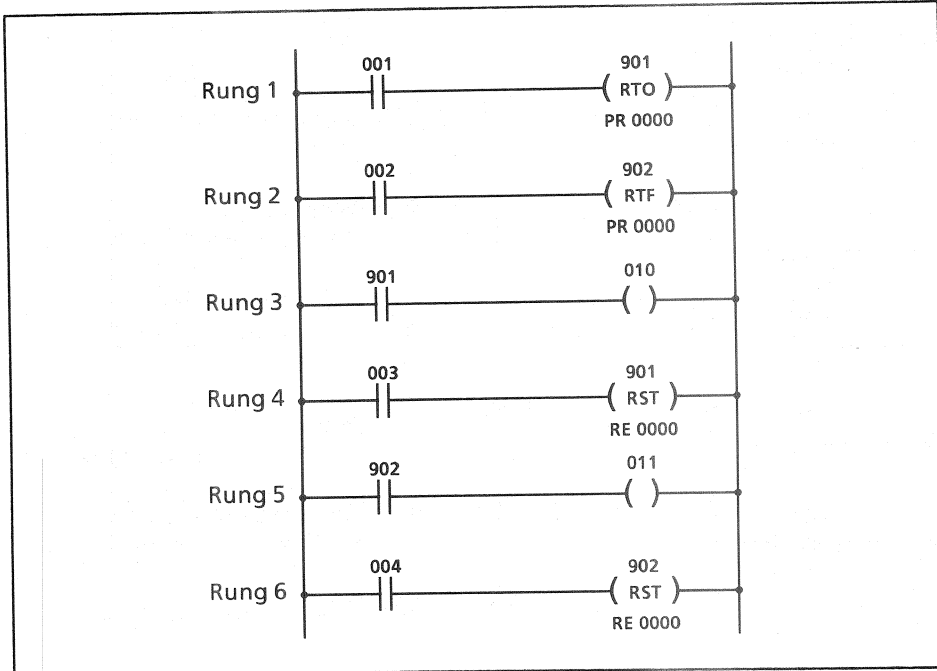
Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal.



1. When rung 1 goes TRUE, input 001 must be ON.  
True or False?
2. When rung 1 goes TRUE, Timer 901 will start timing.  
True or False?
3. Rung 2 will be TRUE when:
  - a. Rung 1 has been FALSE for 30 seconds.
  - b. Rung 1 has been TRUE for 30 seconds.
  - c. Input 002 is ON.
  - d. Input 002 is OFF.
  - e. None of the above.
4. Rung 4 will be TRUE as soon as the AC value exceeds the PR value.  
True or False?
5. Rung 3 is TRUE:
  - a. After the AC value exceeds 0300.
  - b. Until the AC value exceeds 0300.
  - c. When rung 2 is TRUE.
  - d. Upon power-up only.
  - e. None of the above.
6. For an RTF timer, the AC value represents the cumulative time that the RTF rung has been FALSE. True or False?
7. If your accumulator value is up to 0250 and power to your system is lost, what will your accumulator value be when power is restored?
  - a. 0000.
  - b. 0300.
  - c. 9999.
  - d. 0250.
  - e. None of the above.
8. When will output 010 be energized?
  - a. Never.
  - b. Always.
  - c. When rung #3 is TRUE.
  - d. When rung#1 is FALSE.
  - e. None of the above.
9. When will output 011 be energized?
  - a. Never.
  - b. Always.
  - c. When timer 901 AC value exceeds 9999.
  - d. When input 002 is ON.
  - e. Until timer 901 AC value exceeds 9999.
10. When will output 012 be energized?
  - a. Never.
  - b. Always.
  - c. When timer 901 AC value exceeds 9999.
  - d. When input 002 is ON.
  - e. Until timer 901 AC value exceeds 9999.
11. It is possible for status bit 901 and status bit 951 to be TRUE at the same time. True or False?
12. When your AC value is at 500, status bit 901 will be OFF. True or False?

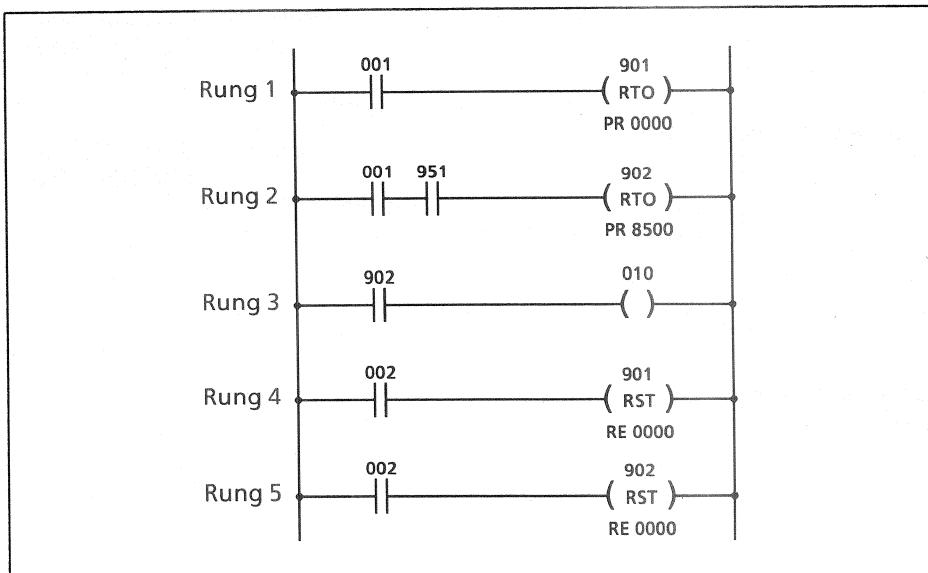
**QUESTION GROUP D**

The following rungs are not in correct order for the Bulletin 1742 programming format. Reconfigure these rungs and place the timer and reset rungs in correct order. Refer to the answer section after you have re-arranged these rungs. Re-read the information in Figure 3.24b if you need help.



**QUESTION GROUP E**

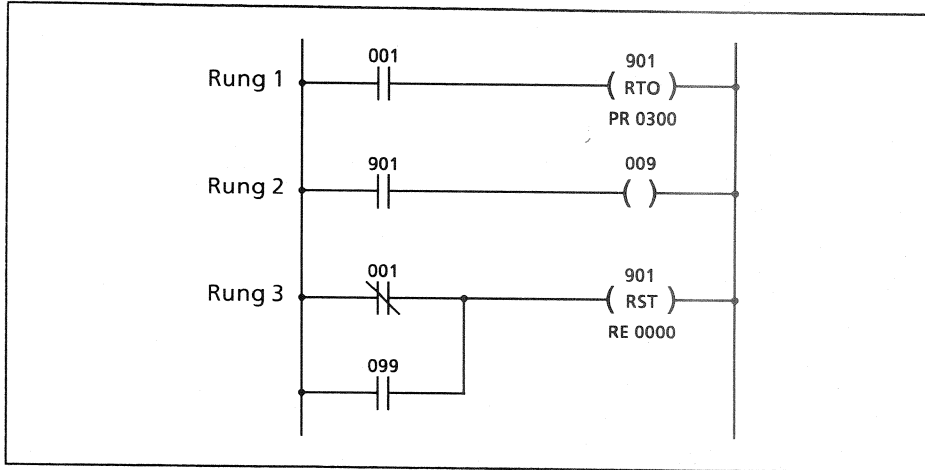
Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal. Re-read section 3.5.3 if you have any trouble with these questions.



1. How much time must elapse before output 010 is energized?
  - a. 850 seconds.
  - b. 999.9 seconds.
  - c. 1850 seconds.
  - d. 1000 seconds.
  - e. None of the above.
2. Which rung(s) must be TRUE in order for output 010 to be energized?
  - a. 1.
  - b. 1&2.
  - c. 1&2&4.
  - d. 3.
  - e. None of the above.
3. When input 002 is ON, what will happen?
  - a. Timer 901 will be reset.
  - b. Timer 902 will be reset.
  - c. Rung 4 will be TRUE.
  - d. Rung 5 will be TRUE.
  - e. All of the above.
4. What two conditions must be satisfied in order for timer 902 to start timing?
  - a. Input 001 and status bit 901 must be ON.
  - b. Input 001 and status bit 951 must be ON.
  - c. Input 002 must be ON.
  - d. All of the above.
  - e. None of the above.
5. Timer 901 starts timing when the rung conditions for rung 1 are FALSE. True or False?

**QUESTION GROUP F**

Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal.



7. When will output 009 be energized?
  - a. Never.
  - b. Always.
  - c. When rung #1 is TRUE.
  - d. When rung#1 is TRUE for at least 30 seconds.
  - e. None of the above.
8. The rungs in the figure at left are improperly labeled. There should be a label for rung 4 which begins with the Examine On instruction at address 099. True or False?

1. When power is first applied, the Reset instruction in rung 3 is TRUE. True or False?
2. When input 001 is ON, Timer 901 starts timing. When will status bit 901 be ON?
  - a. As soon as input 001 is ON.
  - b. After input 001 goes OFF.
  - c. When rung 3 is TRUE.
  - d. After 30 seconds.
  - e. After 300 seconds.
3. What happens when rung 1 goes FALSE?
  - a. Timer 901 stops timing.
  - b. Timer 901 is reset.
  - c. Input 001 is OFF.
  - d. All of the above.
  - e. None of the above.
4. Timer 901 starts timing when input 001 is ON. The accumulator reaches a value of 0250 and power is lost. When power is restored, what will the AC value be?
  - a. 0250.
  - b. 0100.
  - c. 0000.
  - d. 9999.
  - e. None of the above.
5. Timer 901 starts timing when input 001 is ON. The accumulator reaches a value of 0250 and input 001 is turned OFF. When input 001 is turned ON again, what will the AC value be?
  - a. 0250.
  - b. 0100.
  - c. 0000.
  - d. 9999.
  - e. None of the above.
6. Since the AC value is changed when power is lost and restored, this type of timing example is classified as a(n) \_\_\_\_\_ Timer.

## Question/Exercise Unit 8

### COUNTER INSTRUCTIONS

Text Reference: Para. 3.6 thru 3.6.3

#### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Up Counter -(CTU)- 3.6

Down Counter -(CTD)- 3.6

FALSE-to-TRUE Transition Fig. 3.27

Accumulated Value (AC) Fig. 3.27

Up-Down Counter Fig. 3.27

Preset Value (PR) Fig. 3.27

Reset Value (RE) Fig. 3.27

Counter Range Fig. 3.27

Status Bit Fig. 3.27

Overflow Bit Fig. 3.27

Underflow Bit Fig. 3.27

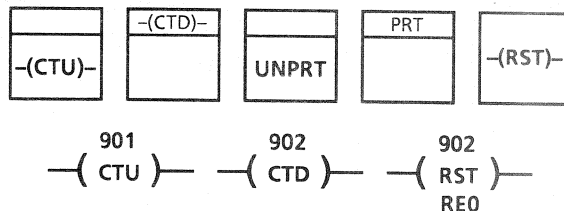
Reset Instruction Fig. 3.27

Retentive Fig. 3.27

Unprotect Key Fig. 3.27

Protect Key Fig. 3.27

#### SYMBOLY



#### QUESTION GROUP A

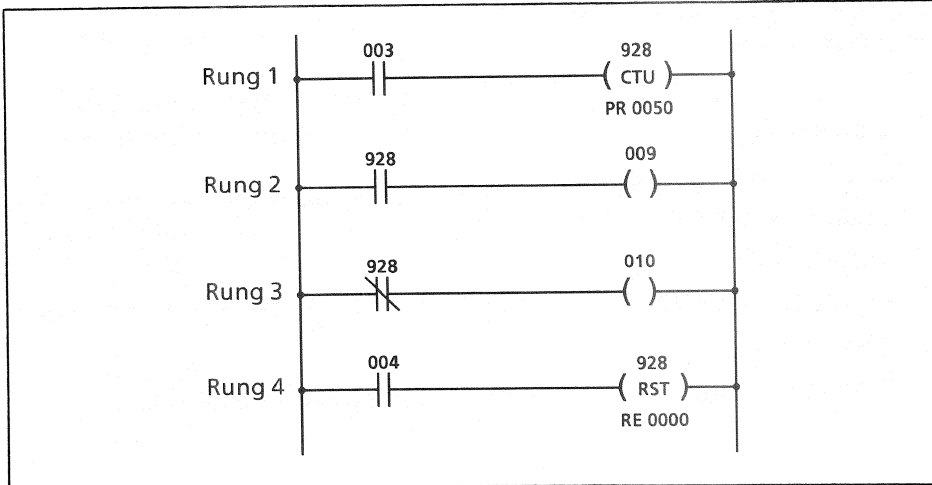
- CTU counters start counting when rung conditions are TRUE. True or False?
- CTU counters count FALSE to TRUE transitions of the rung containing the CTU instruction. True or False?
- A CTU counter's AC value increases by 1 count for each FALSE to TRUE transition of rung conditions. True or False?
- If a CTU counter rung is False and then goes TRUE, its AC value will increase by 1. When the rung goes FALSE again, the AC value will increase by 1 again. True or False?
- CTD counters start counting when rung conditions are TRUE. True or False?
- CTD counters count FALSE to TRUE transitions of the rung containing the CTD instruction. True or False?
- A CTD counter's AC value will decrease by 1 for each FALSE to TRUE transition of rung conditions. True or False?
- Counters can produce an output when their AC value equals their PR value. True or False?
- The counter status bit has an address that is:
  - The same as the counter instruction.
  - The counter address plus 50.
  - The counter address minus 50.
  - Automatically assigned when the instruction is entered.
  - None of the above.
- The counter overflow status bit has an address that is:
  - The same as the counter instruction.
  - The counter address plus 50.
  - The counter address minus 50.
  - Automatically assigned when the instruction is entered.
  - None of the above.
- The counter overflow bit is set ON when:
  - The AC value equals or exceeds the PR value.
  - The AC value exceeds 9999.
  - The AC value exceeds the PR value minus the RE value.
  - All of the above.
  - None of the above.
- The counter underflow bit is set ON when:
  - The AC value exceeds 9999.
  - The AC value goes below 0000.
  - The AC value is less than the PR value.
  - The AC value equals the PR value minus the RE value.
- The Reset instruction is given the same address as the counter instruction. True or False?
- When the Reset instruction is TRUE, status, overflow and underflow bits are reset to OFF. True or False?
- When the Reset instruction is TRUE, the AC value is reset to the PR value. True or False?
- The reset instruction is displayed in reverse video on the operator terminal when its rung conditions are TRUE. True or False?

## Q8 COUNTER INSTRUCTIONS

17. PR and AC values can be monitored and changed only in the programming mode. True or False?
18. Your PR values can be protected from changes in the Run and Test modes by using the PRT/UNPRT key. True or False?

### QUESTION GROUP B

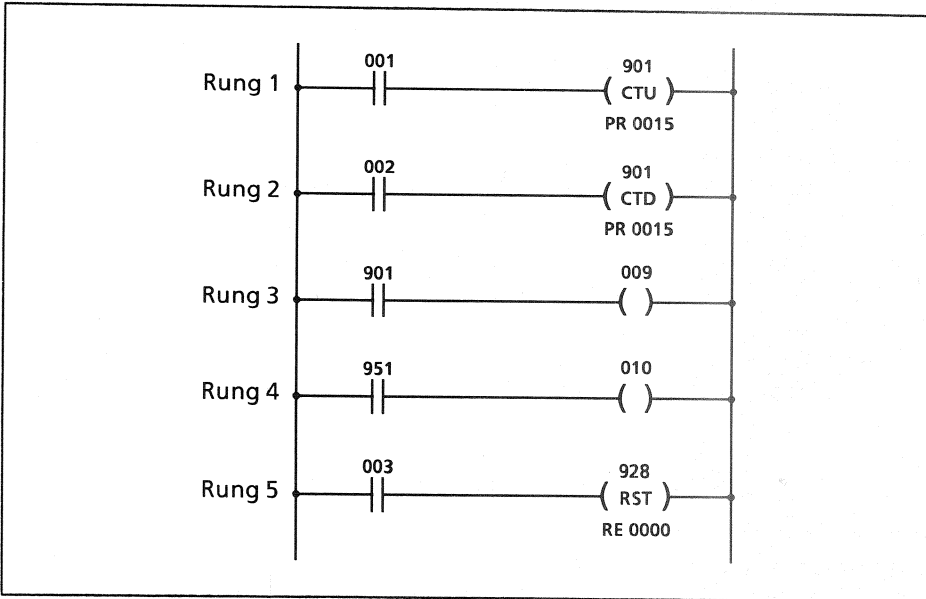
Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal.



1. The address for the CTU instruction in rung 1 is an acceptable address for a counter instruction. True or False?
2. If you wanted to examine the overflow status bit of the counter in rung 1, what address would you assign to the Examine instruction?
  - a. 901.
  - b. 951.
  - c. 952.
  - d. 978.
  - e. None of the above.
3. When would output 009 be energized?
  - a. Until the AC value equals the PR value.
  - b. When the AC value equals or exceeds the PR value.
  - c. Only when the AC value exceeds 9999.
  - d. Only when the AC value goes below 0000.
  - e. None of the above.
4. When would output 010 be energized?
  - a. Until the AC value equals the PR value.
  - b. When the AC value equals or exceeds the PR value.
  - c. Only when the AC value exceeds 9999.
  - d. Only when the AC value goes below 0000.
  - e. None of the above.
5. Suppose your AC value is at 0048 and you lose AC line power to the controller. When power is restored to your controller, what will your AC value be?
  - a. 0000.
  - b. 0048.
  - c. 0049.
  - d. 0050.
  - e. None of the above.
6. Rung 4 goes TRUE and while it is TRUE rung 1 goes thru 5 FALSE to TRUE transitions of rung conditions. After that, rungs 1 and 4 go FALSE at the same time. What is the AC value of counter 928 at this time?
  - a. 0005.
  - b. 0004.
  - c. 0000.
  - d. 0001.
  - e. None of the above.
7. Suppose you were running a production line and you were using a counter to keep track of the number of parts produced. If you wanted to subtract the number of rejected parts, so your counter would count only good parts, you could program an up/down counter. True or False?

**QUESTION GROUP C**

Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal.

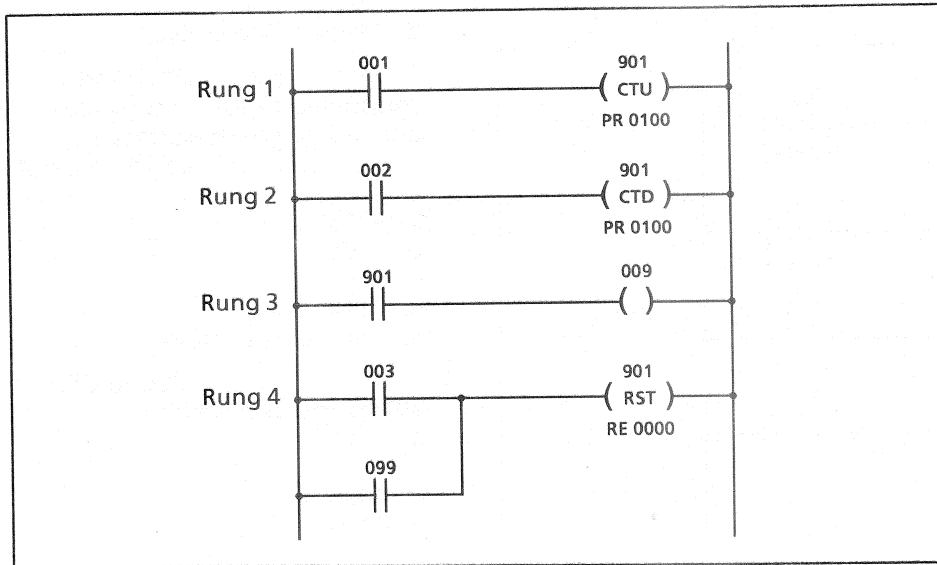


1. What is the address of the Examine instruction that will cause the counter to increment?
  - a. 001.
  - b. 002.
  - c. 901.
  - d. 951.
  - e. 003.
2. What is the address of the Examine instruction that will cause the counter to decrement?
  - a. 001.
  - b. 002.
  - c. 901.
  - d. 951.
  - e. 003.
3. What is the address of the Examine instruction that will preset the counter to a count of 0 when TRUE?
  - a. 001.
  - b. 002.
  - c. 901.
  - d. 951.
  - e. 003.
4. When would output 009 be energized?
  - a. When the up-counter reaches a count of 0015.
  - b. When the down-counter goes below 0000.
  - c. When status bit 901 is ON.
  - d. All of the above.
  - e. None of the above.
5. When would output 010 be energized?
  - a. When the up-counter exceeds a count of 9999.
  - b. When the down-counter goes below 0000.
  - c. When status bit 951 is ON.
  - d. All of the above.
  - e. None of the above.
6. When input 003 is ON, which counter(s) would be reset?
  - a. CTU 901.
  - b. CTD 901.
  - c. Both of the above.
  - d. None of the above.
7. Suppose rung 5 is TRUE and counters are reset. Inputs 001 and 002 are both actuated 5 times. What will the AC value of CTU 901 be?
  - a. 0015.
  - b. 0005.
  - c. 0000.
  - d. 0010.
  - e. None of the above.
8. What will the AC value of CTD 901 be in question 7?
  - a. 0015.
  - b. 0005.
  - c. 0000.
  - d. 0010.
  - e. None of the above.
9. From that point input 001 is actuated 9 times. What will the new AC value of CTU 901 be?
  - a. 0001.
  - b. 0019.
  - c. 0009.
  - d. 0011.
  - e. None of the above.
10. The AC value of CTU 901 will always be the same as CTD 901 during normal operation. True or False?
  - a. True
  - b. False
11. While the reset instruction is TRUE, both counters are disabled and the inputs 001 and 002 will not enable the counters. True or False?
  - a. True
  - b. False

# Q8 COUNTER INSTRUCTIONS

## QUESTION GROUP D

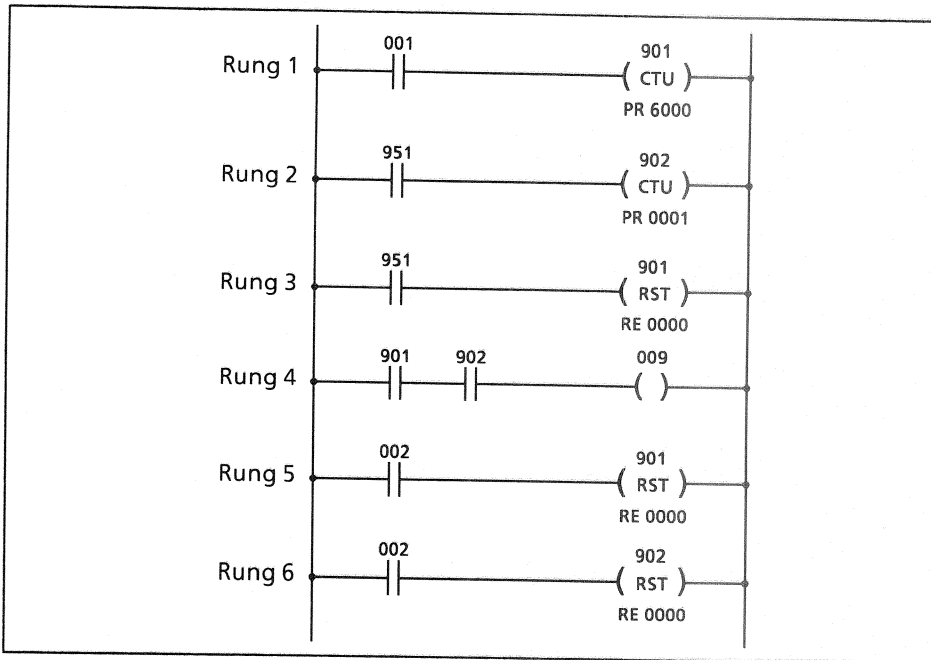
Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal.



1. What is the address of the Examine instruction that will cause the counter to increment?
  - a. 001.
  - b. 002.
  - c. 901.
  - d. 951.
  - e. 003.
2. On power-up, rung 4 will be TRUE and both counters will be reset to 0. True or False?
3. If power is lost and then restored, the AC values of the counters will be:
  - a. The same as they were before power was lost.
  - b. Equal to the programmed preset values.
  - c. Reset to 0100.
  - d. Reset to 0000.
  - e. None of the above.
4. What is the address of the Examine instruction used to reset the counters during program execution?
  - a. 003.
  - b. 901.
  - c. 001.
  - d. 002.
  - e. 099.
5. What makes this up-down counter different from the up-down counter in question group C?

**QUESTION GROUP E**

Study the rungs below and answer the questions that follow. You may want to program these rungs and observe what happens on the operator terminal.



1. It is possible to energize an output after a count of something greater than 9999 by cascading counters together. True or False?
2. When does counter 902 start counting?
  - a. When the AC value of CTU 901 reaches 3000.
  - b. When the AC value of CTU 901 reaches 6000.
  - c. When the AC value of CTU 901 exceeds 9999.
  - d. When the AC value of CTU 901 reaches 0001.
  - e. None of the above.
3. When will output 009 be energized?
  - a. When the AC value of CTU 901 reaches 6000.
  - b. When CTU 901 is reset.
  - c. When CTU 902's AC value equals or exceeds 0001 *and* CTU 901's AC value equals or exceeds 6000.
  - d. When CTU 901's AC value exceeds 9999 *and* CTU 902's AC value equals or exceeds 0001.
  - e. None of the above.
4. When output 009 is energized, how many counts have occurred?
  - a. 13,000.
  - b. 10,000.
  - c. 0001.
  - d. 16,000.
  - e. None of the above.
5. The AC value of counter 901 must reach 6,000 twice before output 009 will energize. True or False?

6. If you wanted output 009 to go ON after a count of 10,500, what would you change the PR value of counter 901 to?
  - a. 9999.
  - b. 0500.
  - c. 0501.
  - d. 0001.
  - e. None of the above.
7. If power is lost when the AC value of counter 901 is 9999, what will the AC value be when power is restored?
  - a. 9999.
  - b. 0500.
  - c. 0501.
  - d. 0001.
  - e. None of the above.

# Question/Exercise Unit 9

## SEQUENCER INSTRUCTIONS

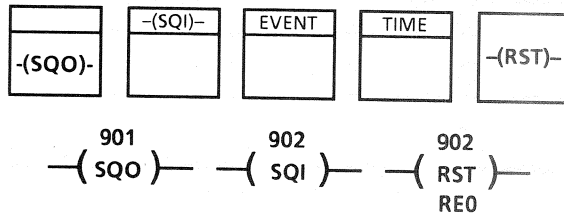
Text Reference: Para. 3.7 thru 3.7.4

### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Sequencer Output <b>-(SQQ)-</b> 3.7	Preset Value (PR) Fig. 3.31
Sequencer Input <b>-(SQI)-</b> 3.7	Input-Satisfied Status Bit Fig. 3.31
Reset Instruction 3.7	Completion Bit Fig. 3.31
Steps 3.7	Group Numbers Fig. 3.31, 3.7.1
Time-Driven Fig. 3.31	Masking Data Fig. 3.31, 3.7.1
Event-Driven Fig. 3.31	Dwell Time Fig. 3.32
Accumulated Value (AC) Fig 3.31	Sequencer Data Form 3.7.1

### SYMBOLOLOGY



### QUESTION GROUP A

- The Sequencer Output instruction (SQQ) is retentive and requires a reset instruction, however the Sequencer Input instruction (SQI) is non-retentive and requires no reset instruction. True or False?
- Sequencer instructions are typically used with machines or processes involving repeating operating cycles which can be segmented into steps. True or False?
- Sequencer instructions must be assigned an address from \_\_\_\_\_ thru \_\_\_\_\_.
- Sequencers can have up to \_\_\_\_\_ steps and can be \_\_\_\_\_ driven or \_\_\_\_\_ driven.
- When using a Time-Driven Sequencer, what advances the sequencer to the next step?
  - When the AC value equals 999.
  - When the AC value equals the PR value.
  - When the AC value equals the RE value.
  - When the input satisfied bit is ON.
  - None of the above.
- Time-Driven sequencers count 1.0 second intervals. True or False?
- Event-Driven Sequencers count FALSE to TRUE transitions of the Sequencer rung. True or False?
- Event-Driven Sequencers move to the next step when their AC value equals the RE value. True or False?
- Sequencer Output instructions set the ON/OFF status of up to 8 external outputs for each step. True or False?
- After the final step, the sequencer continues with step 1. True or False?
- The Sequencer Input instruction examines the ON/OFF status of up to 8 external inputs for each step. An input satisfied status bit is set ON, when the status of external inputs matches programmed data. True or False?
- The SQI sequencer input-satisfied status bit is assigned an address that is equal to the SQI instruction plus 50. True or False?
- The completion bit of SQQ and SQI sequencers is assigned the same address as the sequencer. True or False?
- The completion bit goes ON when the sequencer completes its final step. True or False?
- The reset (RST) instruction is given the same address as the sequencer. True or False?
- When the reset instruction goes TRUE, which of the following statements are TRUE?
  - The SQI input satisfied status bit is reset to OFF.
  - The completion bit is reset to OFF.
  - Sequencer instruction is reset to step 1.
  - All of the above.
  - None of the above.
- The RST instruction must go FALSE before the sequencer can resume operation. True or False?

# Q9 SEQUENCER INSTRUCTIONS

18. When programming Sequencer data for the 8 inputs or outputs, a two-digit code is used to represent the ON/OFF status for each step. Instead of entering eight 1's or 0's only 2 digits are entered for each step.  
True or False?
19. If AC power is lost during sequencer operation and then restored, the sequencer will start over from step 1.  
True or False?
20. Sequencer status will be retained when switching from one mode to another.  
True or False?

## QUESTION GROUP B

### 1. Sequencer Programming Example.

Use the Sequencer Instruction Data Form to document an SQO time-driven sequencer at address 901. You want to control outputs 17 through 24 for a simple 4-step sequence.

- Step 1 has only output 24 ON for 15 seconds.
- Step 2 has outputs 17, 19, 21, and 23 ON for 30 seconds.
- Step 3 has outputs 18, 20, 22, and 24 ON for 1 minute.
- Step 4 has all outputs ON for 1 minute and 30 seconds.

Try not to look at the answer section until you have completed the form.

SEQUENCER CLASSIFICATION:  -(SQI)-  -(SQO)-  ADDRESS: \_\_\_\_ TIME DRIVEN  EVENT DRIVEN

SEQUENCER DATA						PROGRAM ENTRY CODE		PRESET	
SEQUENCER DATA GROUP →	SECOND			FIRST			2nd Grp		1st Grp
MODULE GROUP NUMBER →									
I/O TERMINAL ADDRESS →									
MASK DATA →									
STEP NO. 1									
2									
3									
4									

**Sequencer Instruction Data Form**  
(Use this form as a worksheet. Use form below for your final answer.)

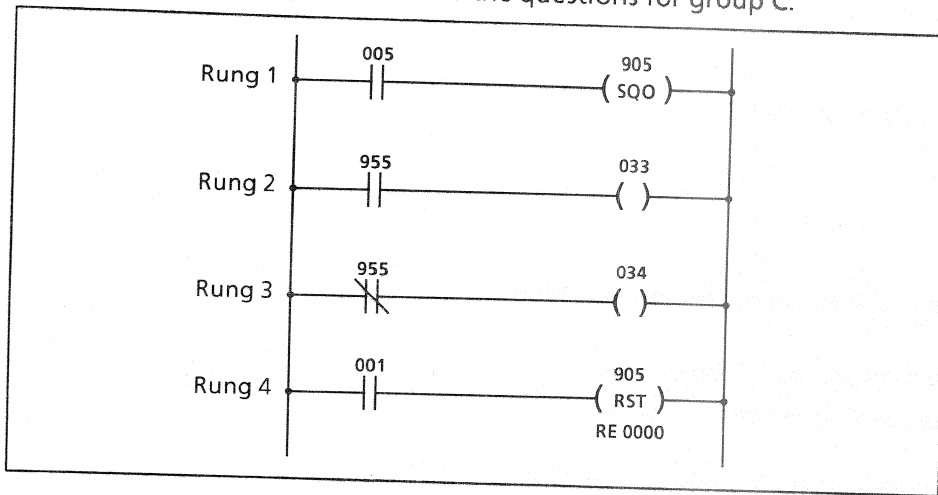
SEQUENCER CLASSIFICATION:  -(SQI)-  -(SQO)-  ADDRESS: \_\_\_\_ TIME DRIVEN  EVENT DRIVEN

SEQUENCER DATA						PROGRAM ENTRY CODE		PRESET	
SEQUENCER DATA GROUP →	SECOND			FIRST			2nd Grp		1st Grp
MODULE GROUP NUMBER →									
I/O TERMINAL ADDRESS →									
MASK DATA →									
STEP NO. 1									
2									
3									
4									

**Sequencer Instruction Data Form**  
(Use this form for your final answer. Additional forms in back of text portion of Self-Teach Manual.)

QUESTION GROUP C

Study the rungs below and the sequencer data form that follows. This information will help you to answer the questions for group C.



SEQUENCER CLASSIFICATION:  - (SQO)  ADDRESS: 905 TIME DRIVEN

SEQUENCER DATA									PROGRAM ENTRY CODE		PRESET			
SEQUENCER DATA GROUP →	SECOND				FIRST				2nd Grp	1st Grp				
MODULE GROUP NUMBER →	4				3									
I/O TERMINAL ADDRESS →	016	015	014	013	012	011	010	009						
MASK DATA →	1	1	1	1	1	1	1	1	F	F				
STEP NO. 1	0	0	0	0	0	0	0	1	0	1	0	0	1	0
2	0	0	0	0	0	0	1	1	0	3	0	0	1	0
3	0	0	0	0	0	1	1	1	0	7	0	0	1	0
4	0	0	0	0	1	1	1	1	0	F	0	0	1	0
5	0	0	0	1	1	1	1	1	1	F	0	0	1	0
6	0	0	1	1	1	1	1	1	3	F	0	0	1	0
7	0	1	1	1	1	1	1	1	7	F	0	0	1	0
8	1	1	1	1	1	1	1	1	F	F	0	0	1	0
9	0	0	0	0	0	0	0	0	0	0	0	0	1	0
10	1	1	1	1	1	1	1	1	F	F	0	0	1	0

- How many outputs are controlled by this sequencer?
  - 4.
  - 6.
  - 8.
  - 10.
  - 12.
- What is the mask data code for these outputs?
  - FF.
  - FE.
  - 0F.
  - CE.
  - 01.
- What initiates the sequencer operation?
  - Sequencer starts on power-up.
  - Sequencer starts when input 005 is ON.
  - Sequencer starts when Examine ON instruction at address 955 is TRUE.
  - Sequencer starts when input 001 is ON.
  - None of the above.
- If you wanted to control only outputs 011, 012, 013, and 014, what would the program entry code for your mask data be?
  - C3.
  - 3C.
  - 2B.
  - B2.
  - None of the above.
- What is the preset value for each step?
  - 10 seconds.
  - 0.1 seconds.
  - 1.0 seconds.
  - 100 seconds.
  - None of the above.
- When will rung 2 be TRUE?
  - For 1.0 seconds after each step.
  - For 10 seconds after each step.
  - After the 10th step is completed.
  - All of the above.
  - None of the above.

## Q9 SEQUENCER INSTRUCTIONS

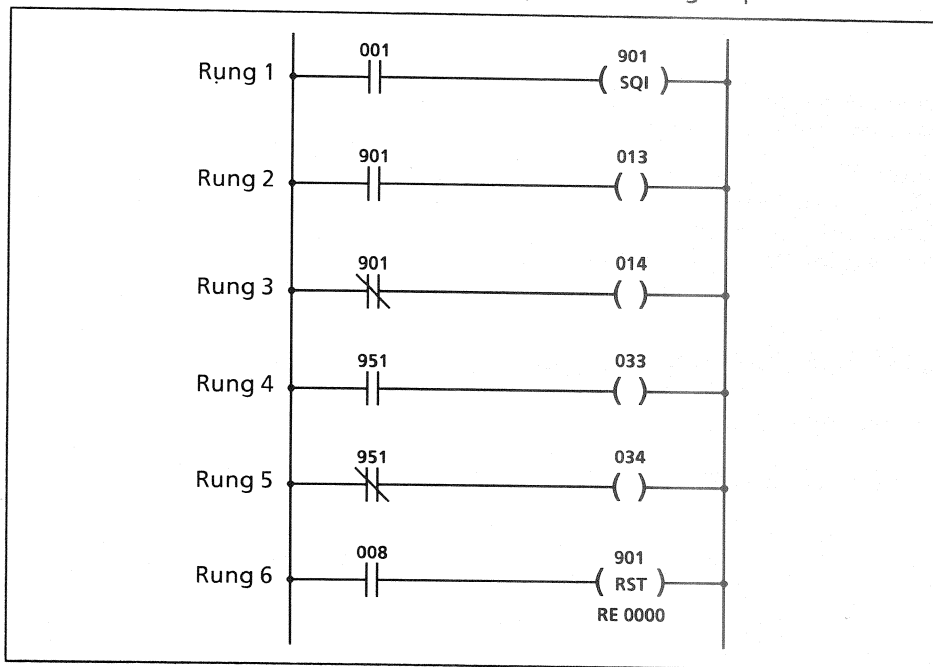
7. For what step(s) of the sequence will all outputs be ON?
  - a. 1.
  - b. 5.
  - c. 8.
  - d. 10.
  - e. 16.
8. For what step(s) of the sequence will all outputs be OFF?
  - a. 1.
  - b. 5.
  - c. 8.
  - d. 9.
  - e. 16.
9. The PR and AC values can be changed in the Run and Test modes. True or False?
10. The sequencer RE value should always be set to 0. True or False?
11. The reset instruction will reset the sequencer to the first step of the sequence. True or False?
12. The reset instruction is the only way to reset the sequencer to step 1. True or False?
13. When input 001 is ON, the sequencer will be reset to step 1 and the completion bit will be reset to OFF. True or False?
14. While rung 4 is TRUE, the sequencer will be inactive. True or False?
15. If an output is controlled by your sequencer, it may not be used elsewhere in your program. True or False?

### QUESTION GROUP D

1. If you wish to energize an output only after a certain sequence of input conditions have been satisfied, a sequencer input instruction (SQI) can be used. True or False?
2. A typical application for a sequencer input instruction might be a packaging application where certain limit switches must be tripped before the conveyor can cycle to its next position. True or False?
3. How many inputs can the SQI instruction examine?
  - a. 1.
  - b. 2.
  - c. 4.
  - d. 6.
  - e. 8.
4. What happens when all input conditions for a given step are satisfied?
  - a. The sequencer advances to the next step.
  - b. The sequencer is reset to step 1.
  - c. The input satisfied bit is set ON.
  - d. The sequencer completion bit is set ON.
  - e. None of the above.

**QUESTION GROUP E**

Study the rungs below and the sequencer data form that follows. This information will help you to answer the questions for group E.



SEQUENCER CLASSIFICATION:  -(SQI)-  ADDRESS: 901 EVENT DRIVEN

SEQUENCER DATA								PROGRAM ENTRY CODE		PRESET				
SEQUENCER DATA GROUP →	SECOND				FIRST				2nd Grp		1st Grp			
MODULE GROUP NUMBER →	2				1									
I/O TERMINAL ADDRESS →	008	007	006	005	004	003	002	001						
MASK DATA →	0	1	1	1	1	1	1	0	7	E				
STEP NO. 1	0	0	1	1	1	0	0	0	3	8	0	0	0	1
2	0	0	0	0	0	1	1	0	0	6	0	0	0	1
3	0	0	0	1	1	0	0	0	1	8	0	0	0	1
4	0	1	1	0	0	0	0	0	6	0	0	0	0	2
5	0	1	1	1	1	1	1	0	7	E	0	0	0	1

- How many inputs are examined by this sequencer?
  - 2.
  - 4.
  - 6.
  - 8.
  - None of the above.
- What two module groups are controlled by this sequencer?
  - 1&2.
  - 1&3.
  - 1&4.
  - 2&3.
  - 2&4.
- When will the input-satisfied bit be ON for step number 1?
  - When inputs 3&8 are ON.
  - When inputs 4,5,& 6 are ON.
  - When rung 1 makes a FALSE - TRUE transition.
  - When the sequencer advances to step 2.
  - None of the above.
- When will output 014 be energized?
  - Always.
  - Never.
  - When the AC value exceeds 9999.
  - Until the input satisfied conditions for a particular step are met.
  - For the first second of each step.
- When will output 033 be energized?
  - When input conditions for each step have been satisfied.
  - After the sequencer has completed the last step whether input conditions have been satisfied or not.
  - When input conditions for the last step have been met.
  - All of the above.
  - None of the above.
- The SQI sequencer will advance to the next step whenever a FALSE to TRUE transition of the SQI rung occurs. True or False?

## Q9 SEQUENCER INSTRUCTIONS

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7. If input conditions have not been met but the SQI rung goes through a FALSE to TRUE transition, the sequencer will advance to the next step. True or False?
8. The reset instruction must be used to return the sequencer to step 1. True or False?
9. The reset instruction will reset the sequencer to step 1, reset the input satisfied bit to 0, and reset the completion bit to 0. True or False?
10. When will the sequencer advance to step 5?
  - a. When rung 1 goes through one FALSE to TRUE transition at step 4.
  - b. When rung 1 goes through two FALSE to TRUE transitions at step 4.
  - c. When the input-satisfied bit for step 4 goes ON.
  - d. When rung 5 is TRUE.
  - e. None of the above.
11. What conditions must be met for the input-satisfied bit to be ON for step 5?
  - a. Inputs corresponding to program entry code 7E must be ON.
  - b. Inputs 2 through 7 must be ON.
  - c. All inputs controlled by this sequencer must be ON.
  - d. All of the above.
  - e. None of the above.

## Question/Exercise Unit 10

### SPECIAL INSTRUCTIONS

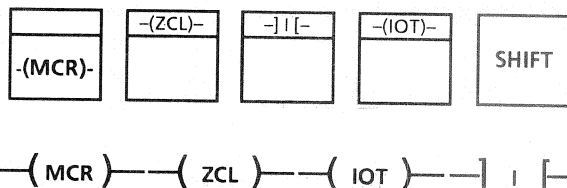
Text Reference: Para. 3.8 thru 3.8.3

#### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Master Control Reset <b>-(MCR)-</b> 3.8	End Rung 3.8.1
Zone Control Last State <b>-(ZCL)-</b> 3.8	Enable 3.8.1
Immediate Input <b>-] I [-</b> 3.8	Disable 3.8.1
Immediate Output <b>-(IOT)-</b> 3.8	Adjacent I/O Sets 3.8.2
Zone 3.8.1	Program Scan 3.8.2
Start Rung 3.8.1	I/O Scan 3.8.2

#### SYMBOLOLOGY



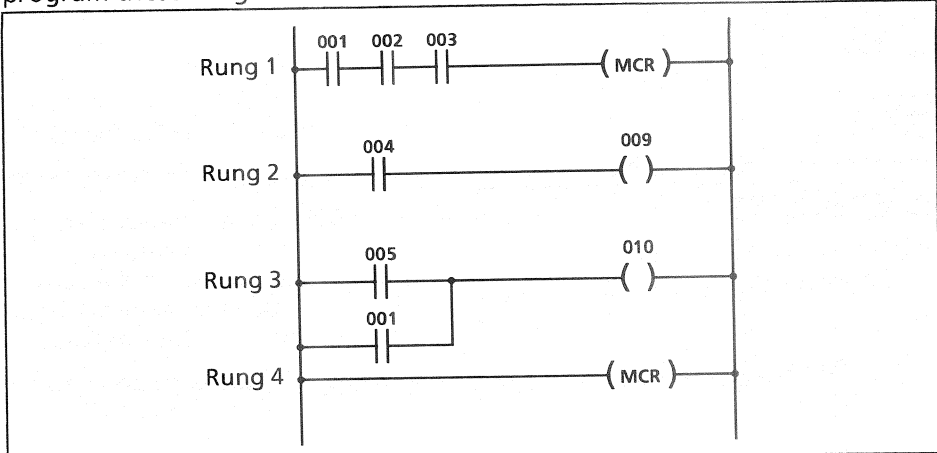
#### QUESTION GROUP A

- The master control reset instruction (MCR) allows you to use one set of condition instructions to control multiple outputs. True or False?
- The master control reset instruction (MCR) consists of a start rung which contains the condition instructions that enable and disable the zone, and an end rung which contains no conditional instructions and marks the end of the zone. True or False?
- All outputs between the MCR start and end rungs are controlled by the MCR instruction. True or False?
- Any number of rungs may be programmed between the MCR start and end rungs providing memory space is available. True or False?
- When the MCR start rung is TRUE, all non-retentive outputs within the zone are de-energized. True or False?
- In an MCR zone when the start rung is FALSE, latch/unlatch instructions remain in their last state regardless of whether they were ON or OFF. True or False?
- A timer or counter in an enabled MCR zone (start rung FALSE) will have its AC value reset to the RE value. True or False?
- A sequencer instruction in an enabled MCR zone will have its step number retained. AC value stops incrementing and will be retained. Completion and input satisfied bits will remain in their last states. True or False?
- A reset instruction in an enabled MCR zone will remain in its last state. Instructions cannot be reset. True or False?
- An MCR instruction is assigned an address that is between 033 and 099. True or False?
- When the MCR rung is TRUE, the MCR instruction will be displayed in reverse video. True or False?

# Q10 SPECIAL INSTRUCTIONS

## QUESTION GROUP B

Study the rungs below and answer the questions that follow. You should program these rungs and observe how the MCR instruction functions.

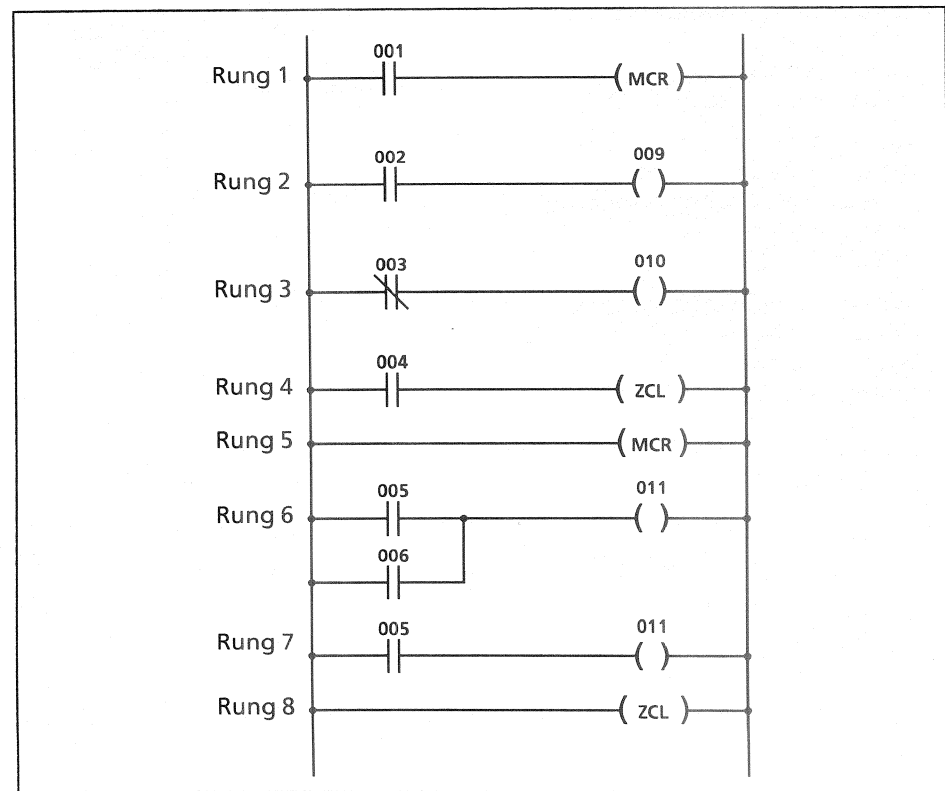


1. Turn inputs 1 through 7 ON. Outputs 9 and 10 will be ON. True or False?
2. Turn input 6 OFF. Outputs 9 and 10 will be ON. True or False?
3. Turn input 1 OFF. Outputs 9 and 10 will be OFF. True or False?
4. Turn input 1 back ON and input 2 OFF. Outputs 9 and 10 will be OFF. True or False?
5. Inputs 1, 2, and 3 are the condition instructions that control the MCR zone. True or False?
6. When inputs 1, 2, and 3 are ON, the outputs in the MCR zone operate normally. True or False?

1. It is possible to place a ZCL and MCR instruction in the same program. True or False?
2. The two zones may overlap so that the ZCL start rung is controlled by the MCR zone. True or False?
3. If input 005 is ON, output 011 will be ON when the zone is operating normally. True or False?
4. If input 006 is ON, output 011 will be ON when the zone is operating normally. True or False?
5. If inputs 005 and 006 are ON, output 011 will be OFF when the zone is operating normally. True or False?
6. The MCR and ZCL zones are placed incorrectly. Re-configure these rungs so that the two zones can function properly. Refer to the answer section only after you have rearranged these rungs. If you need help turn to page 3-30 and review the material on MCR and ZCL instructions.

## QUESTION GROUP C

Study the rungs below and answer the questions that follow.



## QUESTION GROUP D

1. The ZCL instruction operates quite similar to the MCR instruction. True or False?
2. The ZCL instruction does not require an address. True or False?
3. The ZCL zone is defined as the rungs between the ZCL start and end rungs. True or False?
4. When the ZCL start rung is TRUE, non-retentive outputs are de-energized. True or False?
5. When the ZCL start rung is FALSE, timers and counters function the same as they would in an MCR zone. True or False?
6. When the ZCL start rung is FALSE, sequencers function the same as they would in an MCR zone. True or False?

**QUESTION GROUP D**

7. When the ZCL start rung is FALSE, latch/unlatch instructions operate the same as they would in an MCR zone. True or False?
8. More than one ZCL instruction may be used in your program. True or False?
9. If two ZCL zones are used, one zone must end, before another can begin. True or False?
10. A ZCL or MCR instruction may be used instead of hard-wiring a Master Control Relay for emergency shut-down. True or False?
11. A Master Control Relay provides emergency shut-down capability for the operator of a machine. This system should be hard-wired to shut your controller down in the event of an emergency. A ZCL or MCR instruction cannot provide this degree of protection. True or False?
4. All external I/O data table bits are updated when either immediate instruction is used. True or False?
5. The immediate instruction speeds the updating of bits, but its scan time interruption increases the total scan time. True or False?
6. With an Examine ON statement associated with an external input device that will energize an output when rung conditions are TRUE, a state change of that input device during the program scan will not be recognized until the I/O scan. True or False?
7. Suppose you have programmed a rung with an Examine ON associated with a limit switch and an Output Energize associated with a pilot light. If your limit switch goes from OFF to ON just after the I/O scan, your pilot light will go ON during the first I/O scan that follows. True or False?
8. Suppose you have programmed a rung with an Immediate Input associated with a limit switch and an Output Energize associated with a pilot light. If your limit switch goes from OFF to ON just after the I/O scan, your pilot light will go ON during the first I/O scan that follows. True or False?
9. The Immediate Output instruction is a special version of the Output Energize instruction. True or False?
10. If an Immediate Input instruction is used with an Immediate Output instruction in the same rung, the input changing state just after the I/O scan will cause the output to be energized during that program scan. True or False?
11. When the Immediate Output instruction is updated, all output addresses within the same set are also updated. True or False?
12. Immediate instructions should only be used when the updating of an input or an output is critical to your operation. True or False?
13. The Immediate Output instruction is executed regardless of whether rung conditions are TRUE or FALSE. True or False?
14. If rung conditions are FALSE, the output associated with the Immediate Output instruction will be energized for at least 25 ms. True or False?

**QUESTION GROUP E**

1. The immediate instructions, (-) I [- , -(IOT)-), provide a way of temporarily interrupting the program scan to allow selected bits in the data table to be updated. True or False?
2. If you wanted to assign Immediate Input instructions to two input devices at address 001 and 008, you could assign an Immediate Input instruction to input 001 and an Examine ON instruction to input 008 and achieve an immediate update for both instructions. True or False?
3. Immediate instructions can only be assigned an address from 001 thru 032. True or False?

# Question/Exercise Unit 11

## PROGRAM EDITING

Text Reference: Para. 3.9 thru 3.9.4

### KEY TERMS AND CONCEPTS

You should become thoroughly familiar with the following terms and concepts. Re-read the referenced text if necessary.

Cursor Control 3.9.1

Access Data 3.9.1

Search Function 3.9.2

Remove 3.9.3

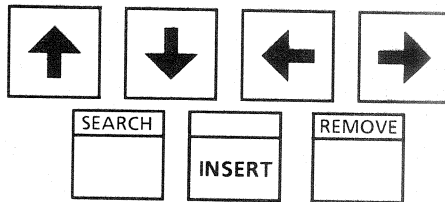
Insert 3.9.3

Clear Memory Mode 3.9.4

Start of Program 3.9.2

End of Program 3.9.2

### SYMBOLOLOGY



### QUESTION GROUP A

1. The four cursor keys allow you to move through your program and stop at any instruction you wish to see on the display. True or False?
2. Since the operator terminal can display only one rung at a time, the cursor keys are necessary to help you move through your program for editing or troubleshooting purposes. True or False?
3. The cursor keys function in which of the following modes of operation?
  - a. RUN.
  - b. TEST.
  - c. LOAD EEPROM MODULE.
  - d. PROGRAM.
  - e. CLEAR MEMORY

4. When you cursor down (↓) to the next rung in your program, the first instruction in that rung will be blinking. This blinking indicates the position of the cursor. True or False?
5. While in that rung, if you cursor right (→), the instruction to the immediate right of the first instruction will be blinking. True or False?
6. If you are in the last rung of your program and you cursor down (↓), the operator terminal will display:

**END  
XXXX WORDS  
REMAINING**

True or False?

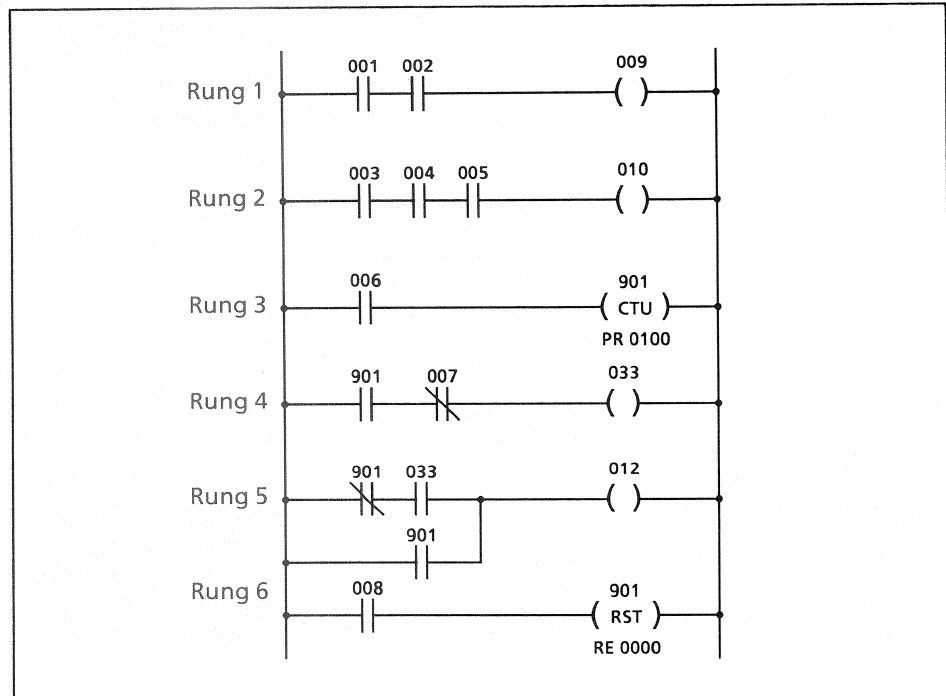
7. If you are in the last rung of your program and you cursor up (↑), your cursor will move to the first instruction in the first rung. True or False?
8. If you cursor to a sequencer instruction, the instruction name and its address will be displayed. By using the cursor right key (→), you can step through the instruction and access other data associated with that instruction. True or False?
9. If you have a lengthy program, the SEARCH function can be used to find a specific instruction and the start or end of your program. True or False?
10. If you are cursor to a point in the middle of your program and are searching for a specific instruction, the search will start at the beginning of your program and search until the instruction is found. True or False?
11. To locate the start of your program, the correct keystroke sequence is: SHIFT, SEARCH ↑, ENTER. True or False?
12. If you are searching for a specific instruction and the operator terminal displays the message NOT FOUND, you are now at the end of your program and the instruction you were searching for was not in the part of the program you just searched. True or False?
13. You can add and delete entire rungs in your program with the Remove/Insert key only in the program mode. True or False?

14. If you want to add a rung to your program, you must cursor to the rung that will follow the rung you are about to insert and press INSERT, -( )-, ENTER. After this key sequence you can enter the new rung. True or False?
15. A new rung may only be added in the Program mode. True or False?
16. When you Remove or Insert an Examine instruction, this change is automatically recorded in RAM memory. True or False?
17. If you cursor to an output instruction in a rung of your program and Remove that output instruction, the conditional instructions will be automatically removed so that the whole rung is removed. True or False?
18. By entering mode 20 and following the prompting messages on the operator terminal, you can clear the processor RAM memory. True or False?
19. Mode 20 can also be used to clear the memory of an EEPROM module. True or False?
20. Once RAM memory is cleared, the controller automatically enters the Program mode. True or False?
21. Sequencer data can only be changed in the program mode. True or False?
22. Adding or deleting steps of a sequencer instruction can be performed through an editing function in the Program mode. True or False?
23. When you cursor to a sequencer instruction, each time you press the → key, one of the values programmed as sequencer data will be displayed. True or False?

24. If you want to change a sequencer parameter in the Program mode you must cursor to the sequencer instruction and press the sequencer key associated with that instruction and then press the ENTER key. From that point you are able to change any data or preset value. True or False?
25. Changes that you make to sequencer data are entered into a temporary storage register. When you have finished editing the sequencer, you must press ENTER to register the last change you have made. These changes will not be permanently recorded in RAM memory until the ENTER key is pressed again. True or False?

## Question Group B

Program the following rungs and complete the program editing exercises that follow.



1. After you have entered this program, stay in the program mode. An additional rung must be entered in this program that will follow rung 4. The rung you want to insert will examine status bit 951 for an ON condition and energize output address 011 when rung conditions are TRUE. See Figure 3.44 if you need help inserting the new rung. After you have entered this rung, cursor through your program and verify that the rung you have just entered has been inserted between rungs 4 and 5 of your original program. Your edited program will now contain 7 rungs. Check your final program with the answer for Question/Exercise 1, group B, in the answer section.
2. For this exercise you will remove an examine instruction from rung 2. You must remove the instruction that examines address 005 for an ON condition. Refer to Figure 3.44b if you need help removing this examine instruction. Check the new configuration of rung 2 in the answer section and make sure that it matches your edited rung.

3. The Examine ON instruction that you removed in exercise 2 should now be placed in rung 1. Insert this examine instruction between the Examine ON at address 001 and the Examine ON at address 002. If you need help inserting this instruction, refer to figure 3.44a. Check the answer section for the correctly edited rung and compare this with the rung you have just edited.
4. For this editing exercise, you will remove the rung that you have inserted in exercise 1. Refer to Figure 3.44b if you need help removing this rung. Note that when you remove the output instruction from the rung, the conditional instructions associated with that rung are automatically removed. Verify that there are only 6 rungs left in the modified program.
5. Before you move on to the questions and exercises in group 12, you must clear the processor RAM memory. Enter mode 20 and follow the prompting messages on the operator terminal. If you need help, follow the keystroke example in Figure 3.45. After memory is cleared, you will have 884 words of memory available for your next exercise.

## Question/Exercise Unit 12

### ON-LINE DATA CONTROL

Text Reference: Para. 3.10 thru 3.10.3

#### KEY TERMS AND CONCEPTS

You should become familiar with the following terms and concepts. Re-read the referenced text if necessary.

On-Line Data Control 3.10

Forcing 3.10

Monitoring 3.10

FRC ON 3.10.1

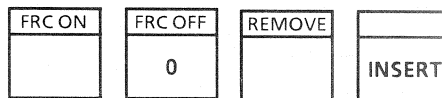
FRC OFF 3.10.1

Reverse Video 3.10.1

Retained 3.10.1

Protected 3.10.2

#### SYMBOLOGY

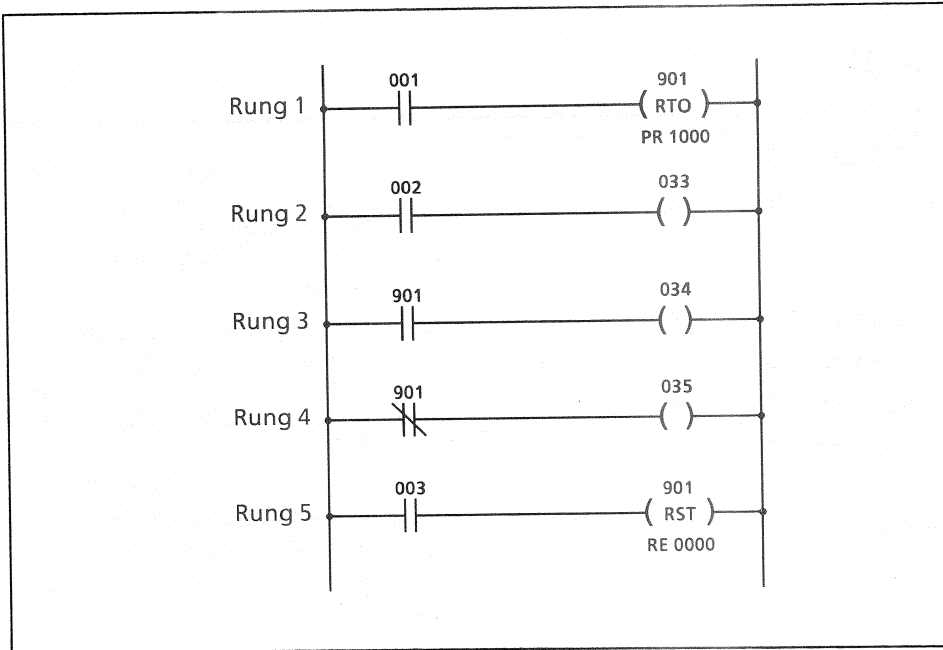


#### QUESTION GROUP A

- When the processor is in the Run mode, the operator terminal can be used to change certain instructions in your program. True or False?
- Timer and counter data can be changed in the Run mode with the operator terminal. True or False?
- Sequencer data may also be changed in the Run mode. True or False?
- Timer, counter, and sequencer data may only be monitored in the Run mode. True or False?
- By using the Force Function, you can force an external I/O address into an ON or OFF state in the Run mode regardless of the actual state of the I/O device. True or False?
- When you Force an input device to an ON or OFF state, you are forcing the status bit at the I/O address and not the input module terminal. True or False?
- When you Force an output device to an ON or OFF state, you are forcing the status bit at the I/O address and not the output module terminal. True or False?
- If you are monitoring an Examine ON instruction with the operator terminal and that instruction is Forced ON, the display will show the letter F in reverse video at the lower right corner of the display. True or False?
- The only way to remove a Force On function is with a Force OFF function. True or False?
- When an input is Forced into an ON or OFF condition, the Forced I/O indicator on the processor module will be lit. True or False?
- When an input is Forced ON, the program is executed as if the input device were actually ON. True or False?
- A forced I/O address will not be retained if you enter the Program mode and make a change or if a processor fault is detected. True or False?
- It is possible to remove all forces within your program without removing each forced instruction individually. True or False?
- Forced I/O addresses may be removed individually by cursoring to the forced instruction and pressing SHIFT, REMOVE, ENTER. True or False?
- The operator terminal allows you to view timer, counter, and sequencer data in the Run and Test modes. True or False?
- To view data associated with timer or counter instructions you must cursor to the instruction you wish to view. Once you are positioned on that instruction, pressing the → key will display the Preset value. Pressing the → key again will display the Accumulated value. Pressing the → key one more time will display the Preset value again. True or False?
- If you are monitoring the AC value and you press the ← key, the PR value will be displayed. True or False?
- Timer and Counter PR and AC values can only be changed in the Program mode. True or False?
- If a PR value is protected, it cannot be changed without deleting the instruction and re-entering it. True or False?

## QUESTION GROUP B

Program the following rungs and complete the exercises that follow. When programming the timer instruction, leave the Preset value unprotected.



1. Enter the Run mode and turn input 001 ON. Cursor to the counter instruction in rung 1 and observe the AC value as it increments. Refer to Figure 3.50 if you need help monitoring this timer data. As you cursor through the timer instruction, repeated pressing of the cursor right key will alternately display Preset and Accumulator values.
2. While in the Run mode, change the Preset value of RTO 901 to 0100. If you need help changing this preset value, refer to Figure 3.51 and re-read paragraph 3.10.3.
3. The reset instruction should be changed to make the RE value equal to 10 instead of 0. Re-read paragraph 3.10.3 if you need help changing the RE value.
4. Enter the Run mode and turn input 001 ON. Cursor to the RTO instruction and monitor the AC value as it increments. Next, cursor to the Examine On instruction at address 001 in that rung. Force input 001 to an OFF condition. If you need help implementing the Force OFF condition, refer to Figure 3.49. When you have forced input 001 OFF, cursor to the RTO instruction and monitor the AC value. Verify that turning input 001 OFF and ON has no effect on the rung conditions. Remove the Force OFF condition and verify that the rung will now function normally.
5. Cursor to the Examine ON instruction at address 003 in rung 5. Force input 003 to an ON condition. If you need help implementing the Force ON function, refer to Figure 3.49. After you have forced input 003 ON, turn input device 003 ON and OFF and verify that the reset instruction remains TRUE even though the condition instruction that will enable the reset instruction is FALSE. Cursor to rung 1 and try to enable the RTO instruction by turning input 001 ON. Verify that the timer AC value is reset to the RE value and will not increment even though the rung conditions are TRUE.
6. Remove all forces in this program before you move on to the next exercise.

## Question/Exercise Unit 13

### USING THE EEPROM MEMORY MODULE

Text Reference:  
Para. 3.11 thru 3.11.3

#### KEY TERMS AND CONCEPTS

You should become familiar with the following terms and concepts. Re-read the referenced text if necessary.

EEPROM 3.11

Load 3.11.1

Non-volatile 3.11

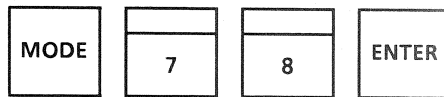
Copy 3.11.2

Termination Strip Figure 3.52

Operating From EEPROM 3.11.3

Program 3.11.1

#### SYMBOLOLOGY



- The EEPROM memory module uses the same battery the processor uses to retain memory contents. True or False?
- The EEPROM memory module has the same memory capacity as the processor RAM memory, (884 words) so your complete program can be duplicated in the EEPROM module. True or False?
- Before the EEPROM can be inserted into the processor module, AC line power to the processor must be removed. This helps to guard against possible damage to the EEPROM due to sudden voltage surges at its terminations. True or False?
- When the lip on the EEPROM access door is in position over the EEPROM module, the LED status indicator will be ON. True or False?
- The EEPROM is housed in a small plastic case with a large white write-on area to help you identify EEPROM contents. True or False?
- To load the EEPROM or duplicate the contents of the processor RAM in the EEPROM, you must use mode 07. True or False?
- When you enter mode 07, prompting messages that appear on the operator terminal display will guide you through the loading process. True or False?
- The LED status indicator on the front of the EEPROM module will be lit during loading. True or False?
- If a program is in the EEPROM module and you want to load a new program, you must erase the old program in the EEPROM module by entering mode 10. True or False?
- If you clear memory (mode 20), and then enter mode 07 and go through the loading process, the contents of the empty RAM will be duplicated in the EEPROM module, leaving the EEPROM blank. True or False?
- After you have loaded the EEPROM with the contents of the processor RAM, you should enter the Test or Run mode before you power down to remove the EEPROM module. True or False?
- If you want to copy the contents of the EEPROM to the processor RAM you must enter mode 08. True or False?
- When the EEPROM contents are copied to RAM memory, a program already in the processor RAM will be automatically erased. True or False?
- It is possible to have the program in the EEPROM control the processor module. True or False?
- If you want to operate directly from the EEPROM module you must clear the processor RAM memory first. True or False?
- If you operate directly from the EEPROM module you can force I/O and edit instructions exactly as if you were operating directly from the processor RAM. True or False?
- The program in the processor RAM will be ignored when the EEPROM module is inserted and the processor is in the Run mode. True or False?
- When you enter mode 08, prompting messages on the operator terminal will guide you through the copying process. True or False?

## ANSWERS

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### QUESTION/EXERCISE UNIT 1

#### Answers to Group A Questions

- |                                                                       |                                                                                                                                                              |                                                                                                  |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1. (c.)                                                               | 14. True.                                                                                                                                                    | 26. True.                                                                                        |
| 2. False.                                                             | 15. True.                                                                                                                                                    | 27. True.                                                                                        |
| 3. False.                                                             | 16. True.                                                                                                                                                    | 28. True.                                                                                        |
| 4. True.                                                              | 17. True.                                                                                                                                                    | 29. True.                                                                                        |
| 5. (d.)                                                               | 18. True.                                                                                                                                                    | 30. True.                                                                                        |
| 6. (d.)                                                               | 19. True.                                                                                                                                                    | 31. True.                                                                                        |
| 7. True.                                                              | 20. True.                                                                                                                                                    | 32. True.                                                                                        |
| 8. True.                                                              | 21. True.                                                                                                                                                    | 33. True.                                                                                        |
| 9. True.                                                              | 22. True.                                                                                                                                                    | 34. False. The 32 I/O mounting plate will allow you to mount up to eight I/O modules.            |
| 10. True.                                                             | 23. False. There is one neon lamp indicator for a blown fuse condition. This indicator will light when an output circuit that is energized has a blown fuse. | 35. True.                                                                                        |
| 11. False. There are four ports on each side of the processor module. | 24. True.                                                                                                                                                    | 36. False. There is no mounting plate needed for the EEPROM module. The EEPROM needs no battery. |
| 12. True.                                                             | 25. True.                                                                                                                                                    | 37. True.                                                                                        |
| 13. True.                                                             |                                                                                                                                                              |                                                                                                  |

# ANSWERS

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## QUESTION/EXERCISE UNIT 2

## Answers to Questions

### Answers to Matching Exercise

1. (I)
2. (G)
3. (C)
4. (B)
5. (F)
6. (H)
7. (D)
8. (E)
9. (A)

1. (a.)
2. (b.)
3. False. Status bits will be ON or OFF telling you whether the instruction is TRUE or FALSE.
4. (a.)
5. False. Addresses 001 thru 032 are external addresses.
6. 32.
7. (b.)
8. False.
9. True.
10. True.

## QUESTION/EXERCISE UNIT 3

## Answers to Group A Questions

1. False. Instructions are classified as conditional and output instructions.
2. False. Branching instructions are classified as conditional.
3. (c.)
4. True.
5. True.
6. (c.)
7. True.
8. True.
9. (b.)

## Answers to Group B Questions

1. 008
2. conditional.
3. Examine ON.
4. TRUE.
5. ON.
6. 010.
7. Output.
8. Output energize.
9. A continuous path of TRUE condition instructions must exist. In this case, instructions 008 and 033 must be TRUE.
10. ON.
11. False. External I/O devices have address numbers from 001 to 032.
12. Examine OFF.

13. OFF.
14. False. When the rung is TRUE, Examine ON instruction 008 is TRUE and its status bit is ON; Examine OFF instruction 033 is TRUE and its status bit is OFF; Output energize instruction 010 is TRUE and its status bit is ON.
15. False. If the closed position of the switch is to energize coil M, the switch must be represented by an Examine ON instruction. This is true whether the switch is N.O. or N.C.

## Answers to Group C Questions

1. I/O scan.
2. Program scan.
3. No.
4. a) False. The time period is variable, as explained in d) and e).  
b) False. The time period can be longer than one cycle, as explained in d).  
c) False. After the input module terminal goes ON (any point in the operating cycle), the I/O scan must be reached before the status bit of instruction 001 goes ON, *no matter where the rung is located in the program*. Similarly, the following I/O scan must be reached before the output module terminal goes ON, *no matter where the rung is located in the program*.

d) True. If the input module terminal goes ON early in the program scan, it will take longer to reach the next I/O scan than if the input module terminal went ON late in the program scan.

Shortest time period: The input module terminal goes ON just at the beginning of the I/O scan. The output module terminal goes ON one operating cycle later.

Longest time period: The input module terminal goes ON just at the beginning of the program scan. The status bit of instruction 001 does not go ON until the I/O scan is reached, one operating cycle later. The output module terminal does not go ON until a second operating cycle has passed.

Note: We are neglecting I/O scan length here, since it is very short compared to the total operating cycle length.

e) True. Obviously, the more instructions in the program, the longer the program scan. This means that after the input module terminal goes ON, it takes longer to get to the I/O scan (when the status bit of instruction 001 goes ON), and it takes longer to get to the next I/O scan (when the output module goes ON).

Program content also has an effect on program scan length, since some instructions take a longer time to execute than others.

# ANSWERS

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## QUESTION/EXERCISE UNIT 4

### Answers to Group A Questions

1. False. The operator terminal can also be used for monitoring your program and trouble-shooting.
2. True.
3. True.
4. True.
5. False.
6. False.
7. True.
8. False. There is a table fixed to the back of the operator terminal with a description of the error codes.
9. (d.)
10. False. The processor will function in all modes of operation.
11. True.
12. True.
13. True.
14. True.

**QUESTION/EXERCISE UNIT 5****Answers to Group A Questions**

1. False.
2. False. The operator terminal receives power from the processor module by means of the interconnect cable.
3. True.
4. True.
5. True.
6. False. Connect the green wire to the terminal marked GND.
7. True.
8. False. You can adjust the display contrast to suit your own viewing preference by using the contrast adjustment knob located at the upper right edge of the operator terminal, accessible from the underside.

9. True.
10. True.
11. True.
12. False. Only one output instruction per rung.
13. True.
14. True.
15. True.
16. True.
17. True.
18. True.

**Answers to Group B Questions**

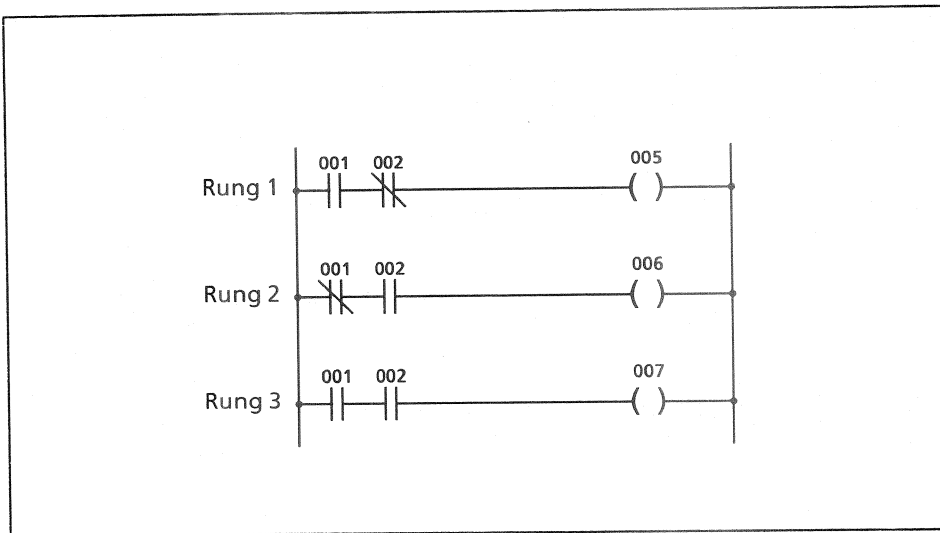
1. (c.)
2. True.
3. True.
4. True.
5. False. You can enter a maximum of seven series instructions not including the output instruction.
6. Normal.
7. Normal.
8. True.

# ANSWERS

## QUESTION/EXERCISE UNIT 6

### Answers to Group A Questions

1. (c.)
2. False. Relay type instructions are used internally also.
3. False. The Examine ON instruction examines for an ON condition only.
4. True.
5. True.
6. True.
7. True.
8. True.
9. True.
10. Simplified program appears in box below.



### Answers to Group B Questions

1. True.
2. False. A continuous path of TRUE condition instructions does not exist. Input 001 OR inputs 002 and 003 must be ON for output 005 to be energized.
3. True.
4. True.
5. True.
6. False.

### Answer to Group C Question

1. (c.)

### Answers to Group D Questions

1. True.
2. True.
3. False.
4. True.
5. True.
6. True.

**QUESTION/EXERCISE UNIT 7**

**Answers to Group A Questions**

1. True.
2. True.
3. False. Timers count 0.1 second intervals.
4. True.
5. True.
6. True.
7. True.
8. False. The time delay is actually the PR value minus the RE value.
9. (d.)  $500 \times 0.1 = 50$  seconds.
10. False. PR values can easily be changed in the Run mode.
11. False.
12. False. AC values can be changed as easily as PR values.
13. True.
14. False. The address assignments from 951 to 982 are reserved for overflow status bits.
15. True.
16. True.
17. True.
18. True.

**Answers to Group B Questions**

1. (b.) The status bit does not go ON until the AC value reaches the PR value.
2. (a.)
3. True.
4. (c.)
5. (b.)
6. (b.)  $100 \times 0.1 = 10$ . RTO timer status is retentive.
7. (b.)
8. (d.)  $925 + 50 = 975$ .

9. (d.) The Examine ON instruction at address 951 examines the overflow status bit of timer 901 for an ON condition.
10. (a.)
11. (d.)
12. True.

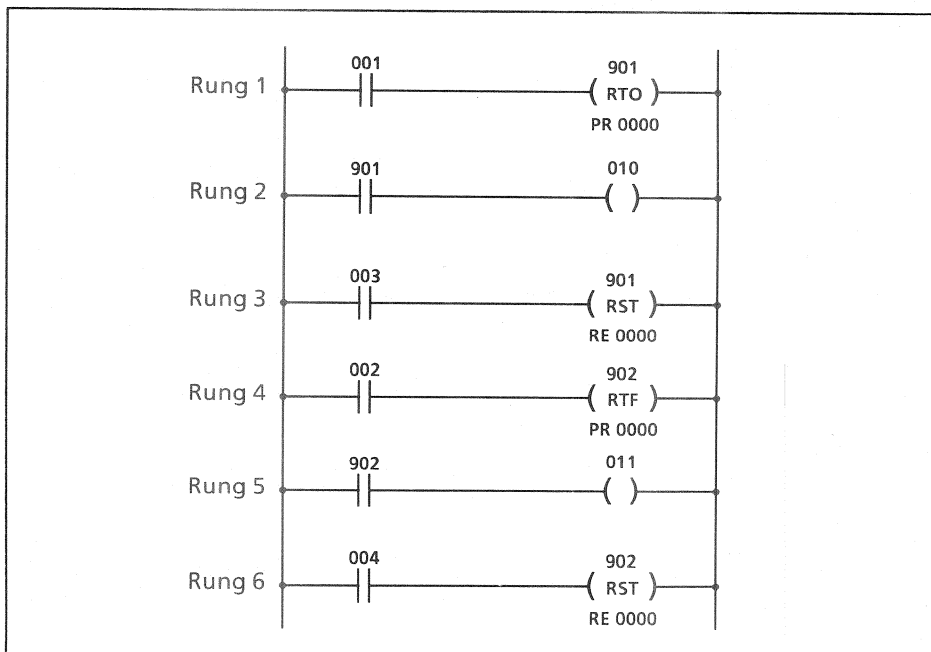
**Answers to Group C Questions**

1. True.
2. False. RTF timers start timing when their rung conditions are FALSE.
3. (b.)
4. False. Rung 4 will be TRUE when the AC value exceeds 9999.
5. (b.)
6. True.
7. (d.) RTF timer status is retentive.
8. (c.)
9. (c.)
10. (e.)
11. True.
12. False. Status bit 901 will be ON when the AC value reaches 300 and it will stay ON until the timer is reset.

**Answers to Group E Questions**

1. (c.) 901 RTO overflows from 9999 to 10,000. 902 RTO times to an AC value of 8500.  
 $10,000 \times 0.1 = 1,000$   
 $8,500 \times 0.1 = \frac{850}{1,850}$  seconds
2. (d.) Rungs 1 and 2 could be TRUE without satisfying the timing conditions that would energize output O10. Output O10 will not energize until the AC value of timer 902 reaches 8500.
3. (e.)
4. (b.)
5. False. RTO timers start timing when rung conditions are TRUE.

**Answer to Group D Question**



# ANSWERS

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## Answers to Group F Questions

1. True. Address 099 is the program initialization bit. This bit will be ON during the first program scan for power-up.
2. (d.)  $300 \times 0.1 = 30$  seconds.
3. (a.) RTO timers start timing only when their rung conditions are TRUE.
4. (c.) RTO timer status is retentive but the program initialization bit is always ON for the first program scan on power-up. When this bit is ON, the Examine ON instruction at address 099 in rung 3 will enable the RESET instruction and the timer will be reset to 0.
5. (c.) Since the AC value has not reached the PR value, status bit 901 has not been set ON. When input 001 is turned OFF, the Examine OFF instruction at address 001 in rung 3 will reset timer 901 to the RE value.
6. Non-Retentive.
7. (d.)
8. False. The examine ON instruction at address 099 is a branch of rung 3.

**QUESTION/EXERCISE UNIT 8****Answers to Group A Questions**

1. False.
2. True.
3. True.
4. False. AC value will increment when the rung makes the next transition to TRUE.
5. False.
6. True.
7. True.
8. True.
9. (a.)
10. (b.)
11. (b.)
12. (b.)
13. True.
14. True.
15. False. When the reset instruction is TRUE, the AC value is reset to the RE value.
16. False.
17. False. Timer parameters can also be changed in the Run mode.
18. True. When the timer instruction is initially programmed, the operator terminal will prompt you with a U for an unprotected timer value. If you wish to protect this value from change, you can press the Protect key at this time. Re-read the information in Figure 3.26 for keystroke information.

**Answers to Group B Questions**

1. True. The address range for timers is from 901 thru 932.
2. (d.)  $928 + 50 = 978$ .
3. (b.)
4. (a.)
5. (b.) Counter instructions are retentive.
6. (c.) The timer is inactive while the reset instruction is TRUE.
7. True. An up-counter could be programmed to keep track of all parts made, and a down-counter could be programmed at the same address to subtract the bad parts from the total count.

**Answers to Group C Questions**

1. (a.)
2. (b.)
3. (e.)
4. (d.)
5. (d.)
6. (c.)
7. (c.)
8. (c.) CTU has incremented 5 times but CTD has decremented 5 times leaving the AC value at 0000.
9. (c.)
10. True. Since both counters share the same address they can have only one AC value.
11. True.

**Answers to Group D Questions**

1. (a.)
2. True. The program initialization bit is always ON for the first program scan and so the Examine ON instruction at address 099 will be TRUE causing the counter to be reset.
3. (d.) The counter status is retentive but the Examine ON at address 099 will reset the counters automatically upon power-up.
4. (a.)
5. The up-down counter in question group C will not be automatically reset upon power-up. The up-down counter in question group D will not retain counter status in the event of a power loss.

**Answers to Group E Questions**

1. True.
2. (c.)
3. (c.) Both of these conditions must be met. Counter 902 will not start counting until counter 901 has overflowed. When 901 overflows, the Examine instruction in rung 3 will reset counter 901 and it must reach the preset value again before the status bit is set ON again.
4. (d.)
5. True.
6. (b.)
7. (a.) Counter status is retentive.

# ANSWERS

## QUESTION/EXERCISE UNIT 9

### Answers to Group A Questions

1. False. Both instructions are retentive.
2. True.
3. 901 thru 932.
4. Sequencers can have up to 255 steps and they can be time-driven or event-driven.
5. (b.)
6. False. Time-driven sequencers count 0.1 second intervals.
7. True.
8. False. Event-driven sequencers move to the next step when their AC value matches their PR value.
9. True.
10. True.
11. True.
12. The SQI sequencer input-satisfied status bit has the same address as the SQI sequencer instruction.
13. The completion bit is assigned the sequencer address plus 50.
14. True.
15. True.
16. (d.)
17. True.
18. True.
19. False. Sequencer data is retentive. The sequencer will resume operation from the point where it left off.
20. True.

### Answer to Group B Question

### Answers to Group C Questions

1. (c.) Mask data is FF and so all 8 outputs are controlled by this sequencer.
2. (a.)
3. (b.)
4. (b.)
5. (c.)  $0010 \times 0.1 = 1$  second.
6. (c.)
7. (c.) and (d.)
8. (d.)
9. False. They can be changed in the Run or Test modes as well as the programming mode.
10. True.
11. True.
12. False. The sequencer will reset to step 1 automatically after it completes the final step of the sequence.
13. True.
14. True.
15. True.

### Answers to Group D Questions

1. True.
2. True.
3. (e.)
4. (c.)

### Answers to Group E Questions

1. (c.) Inputs 001 and 008 are not examined by this sequencer.
2. (a.)
3. (b.)
4. (d.)
5. (b.)
6. True.
7. True. The input-satisfied status bit will not go ON for that step.
8. False. After the last step, the sequencer will start over at step one.
9. True.
10. (b.) The preset value for step 4 is 2 and so two False-to-True transitions of rung conditions must occur before the sequencer will advance to the next step.
11. (d.)

SEQUENCER CLASSIFICATION:     $\text{-(SQI)-}$       $\text{-(SQO)-}$      ADDRESS: 901    TIME DRIVEN     EVENT DRIVEN

SEQUENCER DATA									PROGRAM ENTRY CODE		PRESET			
SEQUENCER DATA GROUP →	SECOND				FIRST				2nd Grp	1st Grp				
MODULE GROUP NUMBER →	6				5									
I/O TERMINAL ADDRESS →	24	23	22	21	20	19	18	17						
MASK DATA →	1	1	1	1	1	1	1	1	F	F				
STEP NO. 1	1	0	0	0	0	0	0	0	8	0	0	1	5	0
2	0	1	0	1	0	1	0	1	5	5	0	3	0	0
3	1	0	1	0	1	0	1	0	A	A	0	6	0	0
4	1	1	1	1	1	1	1	1	F	F	0	9	0	0

**QUESTION/EXERCISE UNIT 10**

**Answers to Group A Questions**

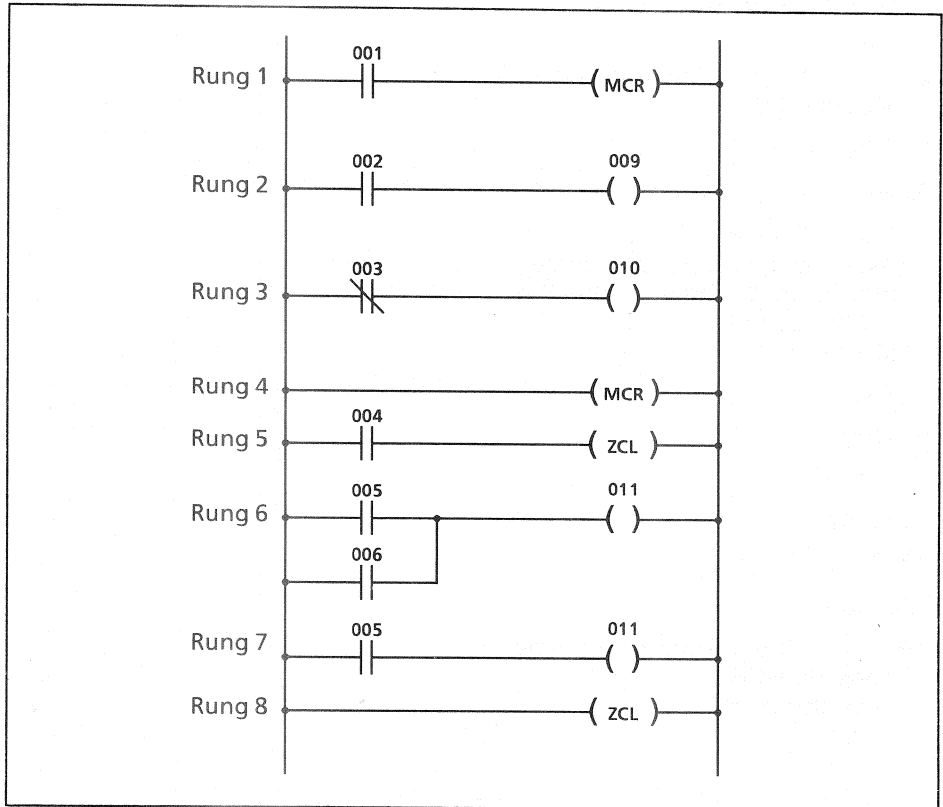
1. True.
2. True.
3. True.
4. True.
5. False. When the MCR start rung is FALSE, all non-retentive outputs within the zone are de-energized.
6. True.
7. False. A timer or counter functioning in an enabled MCR zone will have its status, underflow and overflow bits reset to OFF. The AC value will stop incrementing, but that value will be retained.
8. True.
9. True.
10. False. An MCR instruction is assigned no address at all.
11. False. The operator terminal does not display MCR or ZCL instructions in reverse video when they are TRUE.

**Answers to Group B Questions**

1. True.
2. True.
3. True. MCR start rung is now FALSE. All non-retentive outputs within the zone are de-energized. Outputs 009 and 010 are de-energized even though the condition instructions for their rungs are TRUE. These outputs are being controlled by the MCR zone.
4. True. All three conditional instructions in the MCR start rung must be TRUE for outputs in the zone to function normally.
5. True.
6. True.

**Answers to Group C Questions**

1. True.
2. False. The two zones may not overlap. They must be separate and distinct.
3. True.
4. True.
5. False. Output 011 will be ON under those conditions if the zone is functioning normally.
6. The figure below demonstrates correct rung placement for MCR and ZCL zones.



**Answers to Group D Questions**

1. True.
2. True.
3. True.
4. False. When the ZCL start rung is TRUE, all outputs within the zone function normally.
5. False. When the ZCL start rung is FALSE, Timer and counter AC values stop incrementing and their value is retained as in MCR zones, but their status, underflow, and overflow bits remain in their last state.
6. True.
7. True.
8. True.
9. True.
10. False. A hard-wired Master Control Relay must be used.
11. True.

# ANSWERS

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## Answers to Group E Questions

1. True. Address 099 is the program initialization bit. This bit will be ON during the first program scan for power-up.
2. True. Since adjacent I/O sets are also updated, input 008 which is in group 2 will be updated when input 001 is updated with the immediate instruction.
3. True. Immediate instructions can only be assigned external I/O addresses.
4. False. Only instructions in the adjacent I/O set will be updated.
5. True.
6. True.
7. False. The state change will be recognized in the first I/O scan that follows. The output will be energized in the first I/O scan after that.
8. True.
9. True.
10. True.
11. True.
12. True.
13. True.
14. False. The output will only be energized when rung conditions are TRUE.

**QUESTION/EXERCISE UNIT 11**

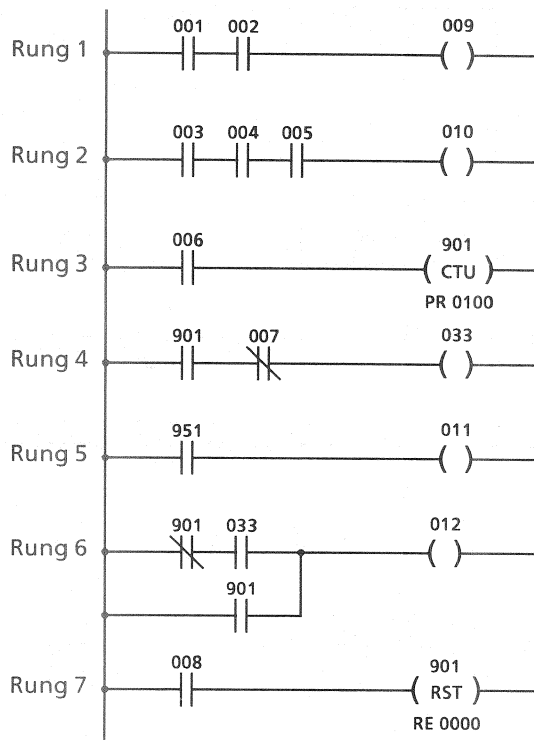
**Answers to Group A Questions.**

1. True.
2. True.
3. (a.), (b.), and (d.).
4. True.
5. True.
6. True. XXXX represents the actual number of words remaining in memory for your use.
7. False, The cursor will move to the first instruction in the rung directly above the last rung of your program.
8. True.
9. True.
10. False. The controller will search the program from the point of the cursored location to the end of the program.
11. True.
12. True.
13. True.
14. True.
15. True.
16. False. You must enter the Run, Test or PROM load mode or, you must press the cursor up ↑, or the cursor down ↓ key to permanently register the change in RAM memory. If you don't do one of these things and power to the controller is lost, the changes will not be recorded when power is restored.
17. True. The whole rung will be removed when the output instruction is removed. All conditional instructions will be automatically removed.
18. True.

19. False. Mode 20 has no effect on the EEPROM memory module.
20. False. You must select a new mode of operation.
21. True.
22. False. Sequencer steps cannot be added or removed. The sequencer instruction must be removed and re-programmed.
23. True.
24. True.
25. True.

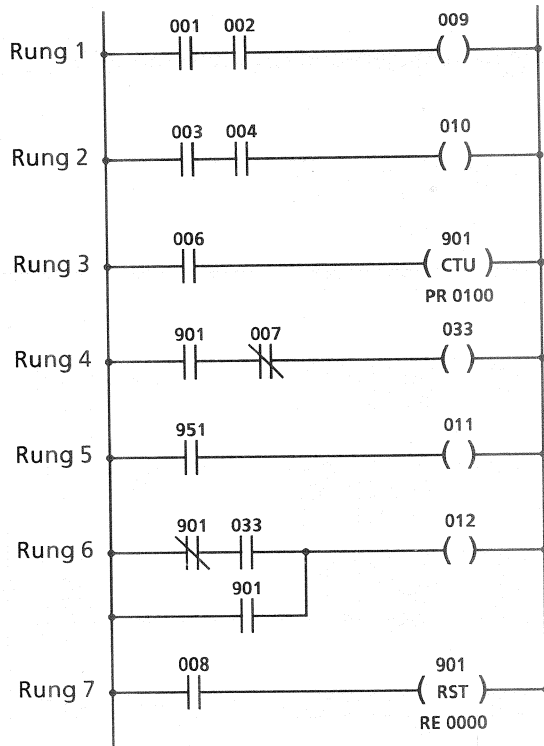
**Answers to Group B Questions.**

Answer for exercise 1.

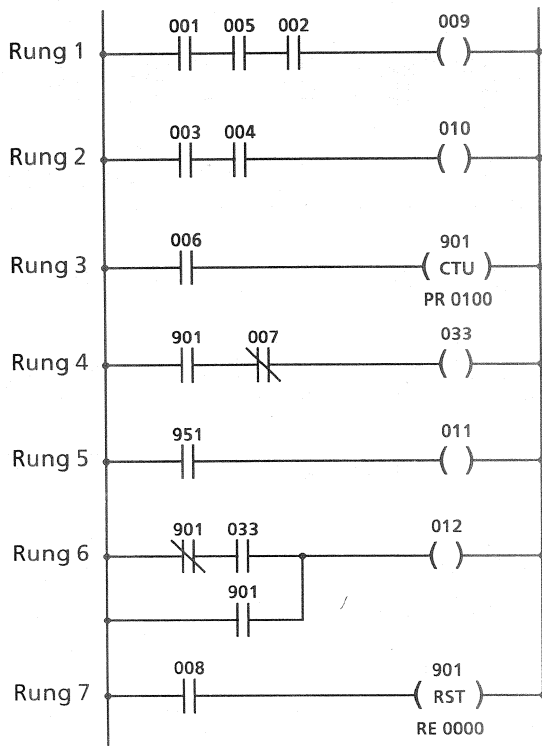


# ANSWERS

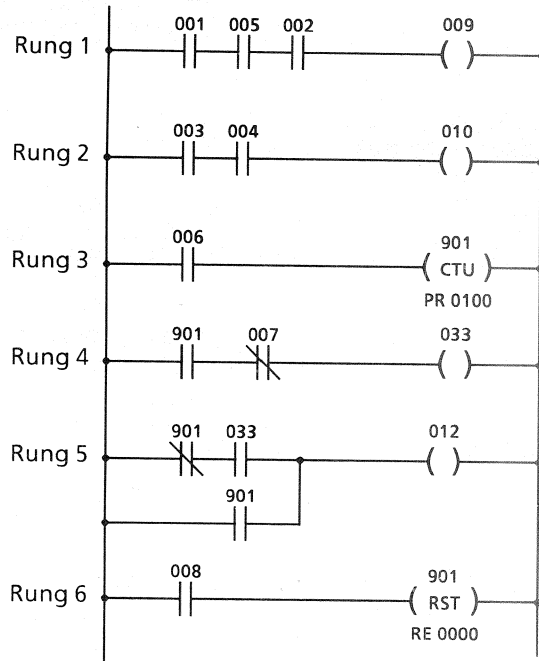
Answer to exercise 2 group B.



Answer to exercise 3 group B.



Answer for exercise 4 group B.



# ANSWERS

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## QUESTION/EXERCISE UNIT 12

### Answers To Group A Questions

1. True. Timer and counter parameters can be changed in the Run mode.
2. True.
3. False. Sequencer data may only be changed in the Program mode.
4. False. Data may also be monitored in the Test modes.
5. True.
6. True.
7. False. The status bit is not affected. Only the output terminal is Forced.
8. True.
9. False. The Force OFF function will force the instruction to an OFF condition. To remove the Force you must cursor to the forced instruction and press; SHIFT, REMOVE, ENTER.
10. True.
11. True.
12. True.
13. True. To remove all forces in your program you must cursor to the start or end of your program and press; SHIFT, REMOVE, ENTER.
14. True.
15. True.
16. True.
17. False. Pressing the ← key will take you to the timer or counter instruction.
18. False. Timer and counter PR and AC values can be changed in the Run mode also.
19. True.

**QUESTION/EXERCISE UNIT 13****Answers to Group A Questions**

1. False. The EEPROM requires no battery to retain memory contents.
2. True.
3. True.
4. False. The lip on the access door will secure the EEPROM in place. The LED on the EEPROM module will be lit only while EEPROM is being loaded.
5. True.
6. True.
7. True.
8. True.
9. False. The old program will be automatically erased when you load a new program.
10. True.
11. True.
12. True.
13. True.
14. True.
15. False. When the EEPROM is inserted, the contents of the processor RAM will be ignored.
16. False. Program editing and on-line data control can only be done on the processor RAM memory. If you wish to edit a program in the EEPROM you must first copy the program to RAM and then edit your program.
17. True.
18. True.



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