



Greetings ...

This file contains the answers to our "Email PLC Quiz" Number 110. This edition is a "**Beginner Level**" quiz which focuses on basic processor scan sequences. It also covers some of the scan-related differences between the Allen-Bradley PLC-5, SLC-500, and ControlLogix platforms.

If you'd like to discuss the information contained in any of our quizzes, please feel free to contact us. We'll be glad to answer any questions you might have.

The following equipment was used during the research and development of this edition of the Email PLC Quiz. Other configurations might possibly give different results.

PLC-5/20E Processor; Series E; Revision D.2
RSLogix5 Software; Version 6.00.00

SLC-5/04 Processor; Series C; OS401
RSLogix500 Software; Version 6.00.00

Note: Most MicroLogix1000 Processors will duplicate the SLC's operation

ControlLogix5555 Processor; Revision 15.4
RSLogix5000 Software; Version 15.00.00

Communication through DF1 Serial Port Connection; 19,200 Baud;
RSLinx Lite Software; Version 2.50.00.20 (CPR 7)

Microsoft Windows 2000 Software; Version 5.00.2195

A number of readers have responded to previous editions of our Email PLC Quizzes with requests for any books that we might have available covering this type of material. At this point in time, we are providing training mainly through our five-day PLC Boot Camp classes. So far we haven't found a satisfactory way to effectively present the same amount of detail in any format other than through face-to-face hands-on training. So no, we're sorry that we don't have any books or other types of training materials to offer - but we thank you very much for asking.

Answers for the Beginner Level Quiz - Number 110

For an SLC-500 system ...

Question 1: Will VALVE_B in the field be ON, OFF, or CHATTERING?

Answer 1: G - VALVE_B in the field will be OFF ... although the status of the bit for VALVE_B will definitely change rapidly back and forth between ONE and ZERO, the SLC-500 processor will only send the contents of the bit to the output module after ALL of the ladder rungs have been executed ... rung 0003 is the last rung in the ladder - and each time the processor executes this rung, the rung's FALSE condition causes a ZERO to be written into the output bit ... in simplest terms, each time the output module receives the contents of the output bit, the bit has always just been changed to a ZERO status by rung 0003 ... specifically, the output module never gets a chance to see the contents of the output bit while the bit has a status of ONE in it ...

For a PLC-5 system ...

Question 2: Will VALVE_B in the field be ON, OFF, or CHATTERING?

Answer 2: G - VALVE_B in the field will be OFF ... for exactly the same reasons covered for the SLC-500 system described above ... specifically, although the status of the output bit does actually change from ONE to ZERO to ONE to ZERO as the processor executes the rungs, the contents of the bit are only sent to the output module after the LAST rung (0003) has been executed ... since rung 0003 is FALSE, the output module always receives a ZERO status from the output bit ... specifically, the output module never sees the contents of the bit while the bit contains a status of ONE ...

For a ControlLogix system ...

Question 3: Will VALVE_B in the field be ON, OFF, or CHATTERING?

Answer 3: E - VALVE_B in the field will CHATTER ... the normal scanning operation of a newer ControlLogix processor is different from the operation of an older SLC-500 or PLC-5 processor ... one major difference is that the status of the output bits may be sent to the output modules at ANY RANDOM POINT during the ControlLogix processor's execution of its ladder logic rungs ... this means that with our poorly written quiz program, sometimes the output module will see the status of the output bit as a ONE - and sometimes it will see the status as a ZERO ... so if we use our "quiz" wiring and our "quiz" ladder program with a ControlLogix system, VALVE_B will not always be OFF - and it won't always be ON ... instead, at random points in time, it will CHATTER briefly between OFF and ON ...

This concludes the answers for the Beginner Level quiz - Number 110

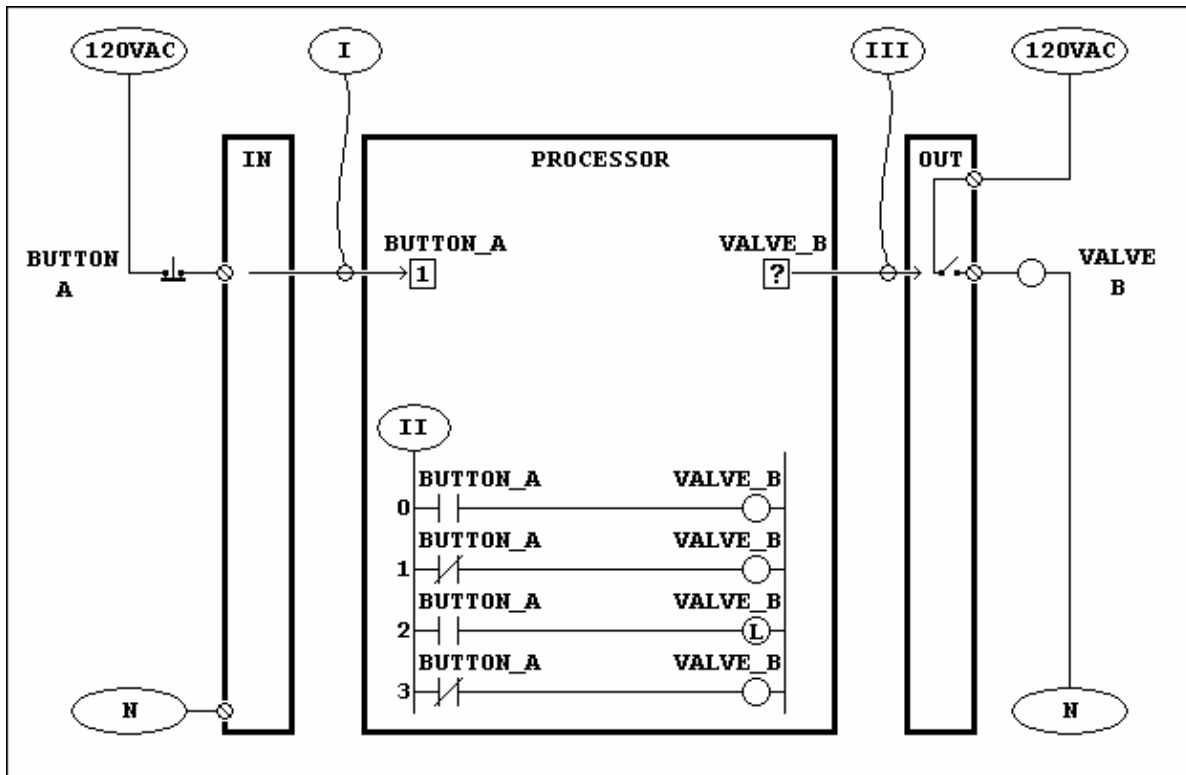


Figure 5 - Sample "PLC Boot Camp" sketch for a PLC-5 or SLC-500 system

The following abbreviated lesson demonstrates how the PLC-5 and SLC-500 processors scan their programs. (Note: the ControlLogix is different and is not covered here.) The approach used in our "PLC Boot Camp" classes breaks the scan sequence down into the following three separate steps:

- Step I - Update the status of the input bits
- Step II - Solve the ladder rungs
- Step III - Send the bit status to the output modules

In most cases, a sketch like Figure 5 will be drawn on the whiteboard and the students will then take turns leading the rest of the class through a step-by-step analysis of the program. Working through the scan sequence this way gives the students a much better grasp of the concepts involved than simply listening to a lecture-style presentation. The instructor uses these exercises to demonstrate and explain the same types of problems that the students will eventually face while working in the field. This unique training method not only improves the students' troubleshooting and problem-solving skills, it also builds confidence in their new abilities.

Step I - Update the status of the input bits

Leader points to BUTTON_A wiring in field: "Do we have current here?"
Class answers: "Yes."
Leader points to bit/box for BUTTON_A: "What goes in the bit?"
Class answers: "A one."
Leader marks a one into the bit/box for BUTTON_A.

Step II - Solve the ladder rungs

Solving rung 0

Leader points to XIC on rung 0: "This tells the processor to _?"
Class answers: "Go look for a one."
Leader points to bit/box for BUTTON_A: "Does it see a one?"
Class answers: "Yes."
Leader points to XIC on rung 0: "Then this is _?"
Class answers: "True."
Leader points to OTE on rung 0: "Then this is _?"
Class answers: "True."
Leader points to OTE on rung 0: "True here tells the processor to _?"
Class answers: "Go write a one."
Leader marks a one into the bit/box for VALVE_B.

Solving rung 1

Leader points to XIO on rung 1: "This tells the processor to _?"
Class answers: "Go look for a zero."
Leader points to bit/box for BUTTON_A: "Does it see a zero?"
Class answers: "No."
Leader points to XIO on rung 1: "Then this is _?"
Class answers: "False."
Leader points to OTE on rung 1: "Then this is _?"
Class answers: "False."
Leader points to OTE on rung 1: "False here tells the processor to _?"
Class answers: "Go write a zero."
Leader marks a zero into the bit/box for VALVE_B.

Solving rung 2

Leader points to XIC on rung 2: "This tells the processor to _?"
Class answers: "Go look for a one."
Leader points to bit/box for BUTTON_A: "Does it see a one?"
Class answers: "Yes."
Leader points to XIC on rung 2: "Then this is _?"
Class answers: "True."
Leader points to OTL on rung 2: "Then this is _?"
Class answers: "True."
Leader points to OTL on rung 2: "True here tells the processor to _?"
Class answers: "Go write a one."
Leader marks a one into the bit/box for VALVE_B.

Solving rung 3

Leader points to XIO on rung 3: "This tells the processor to _?"
Class answers: "Go look for a zero."
Leader points to bit/box for BUTTON_A: "Does it see a zero?"
Class answers: "No."
Leader points to XIO on rung 3: "Then this is _?"
Class answers: "False."
Leader points to OTE on rung 3: "Then this is _?"
Class answers: "False."
Leader points to OTE on rung 3: "False here tells the processor to _?"
Class answers: "Go write a zero."
Leader marks a zero into the bit/box for VALVE_B.

Step III - Send the bit status to the output modules

Leader points to bit/box for VALVE_B: "What do we have in the bit/box?"
Class answers: "A zero."
Leader points to output switch for VALVE_B: "So the switch _?"
Class answers: "Opens."
Leader points to output device VALVE_B in the field: "And the output _?"
Class answers: "Is off."

Following the simple step-by-step analysis shown above explains exactly why a PLC-5 or a SLC-500 processor will turn the VALVE in our quiz OFF. This same type of systematic analysis can be applied to any scan-related problem - regardless of how convoluted and difficult the ladder logic program might appear. This has obvious advantages when troubleshooting a malfunctioning system. Perhaps even more important is the confidence this approach gives to a technician by effectively removing the mystery of the PLC's inner workings.

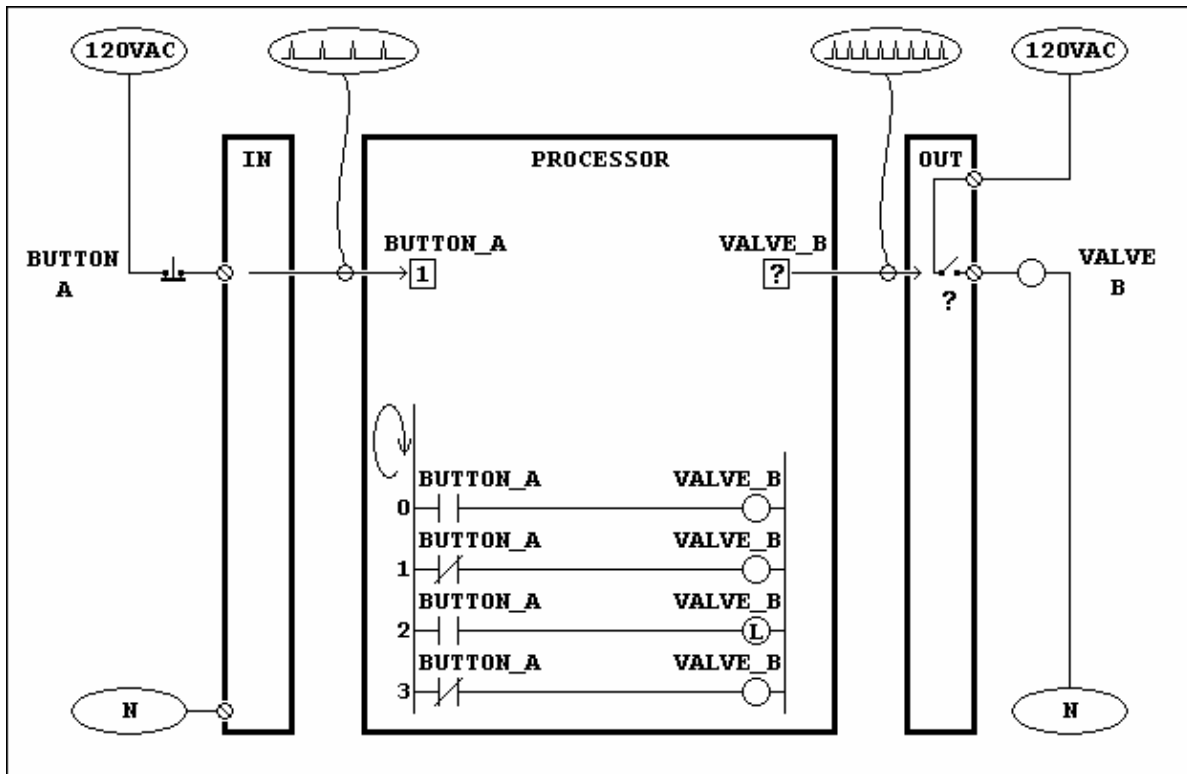


Figure 6 - Sample "PLC Boot Camp" sketch for a ControlLogix system

The ControlLogix processor uses a significantly different scanning method from the three-step sequence used by the PLC-5 and the SLC-500 systems. Figure 6 shows the basic ideas.

"Step I" and "Step III" have each been replaced by a series of pulses. These pulses represent the RPI (Requested Packet Intervals) for the input module and the output module. Notice that the ladder logic routine is not scanned as "Step II" - instead it is usually scanned in a continuous loop which is NOT synchronized with the input and output data transfers.

If you'd like more detail on the concepts involved, just contact us and we'll be glad to talk you through the process. Or better yet, let us know the next time when you'll be in our area. You're welcome to sit in on a class for an hour or so - and see our "PLC Boot Camp" training approach in action.