



An-Najah National University
Faculty of Engineering
Electrical Engineering Department
Programmable Logic Controller



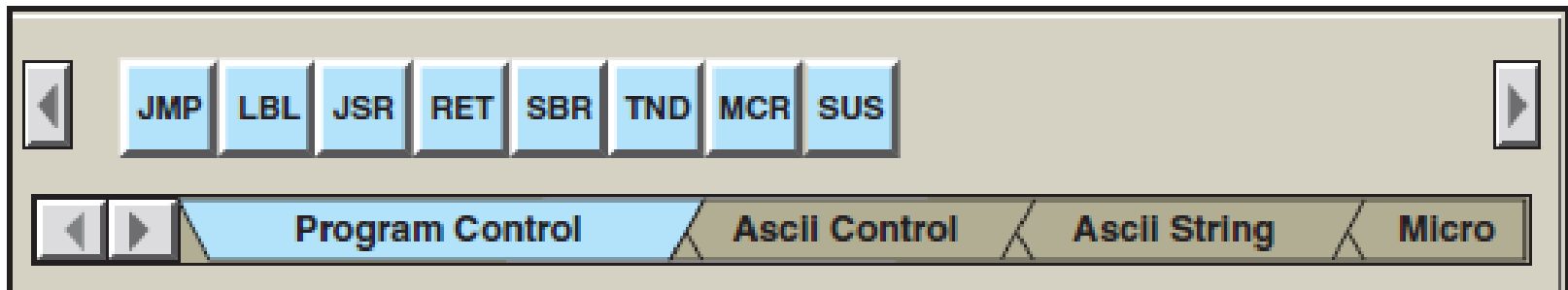
➤ Chapter 9

Program Control Instructions



❑ Master Control Reset Instruction

- *Program control instructions are used to enable or disable a block of logic program or to move execution of a program from one place to another place.*
- *Figure shows the Program Control menu tab for the Allen-Bradley SLC 500 PLC and its associated RSLogix software.*
- *The program control commands can be summarized as follows:*





❑ Master Control Reset Instruction

➤ **JMP (Jump to Label)** —Jump forward/backward to a corresponding label instruction.

➤ **LBL (Label)** —Specifies label location.

➤ **JSR (Jump to Subroutine)** —Jump to a designated subroutine instruction.

RET (Return from Subroutine) —Exits current subroutine and returns to previous condition.

SBR (Subroutine) —Identifies the subroutine program.

TND (Temporary End) —Makes a temporary end that halts program execution.

MCR (Master Control Reset) —Clears all set nonretentive output rungs between the paired MCR instructions.

SUS (Suspend) —Identifies conditions for debugging and system troubleshooting.



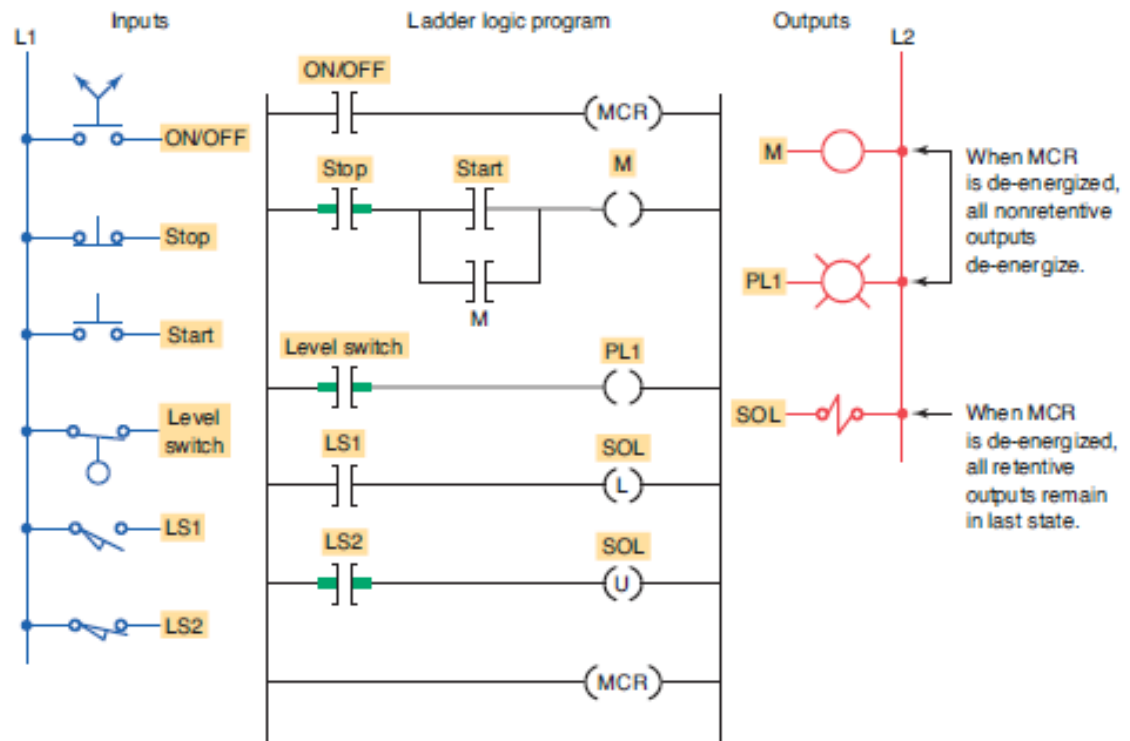
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❑ Master Control Reset Instruction

Master Control Reset (MCR) instruction is an output coil instruction that functions like a master control.

MCR coil instructions are used in pairs and can be programmed to control an entire circuit or to control only selected rungs of a circuit





❑ Master Control Reset Instruction

✓ Jump Instruction

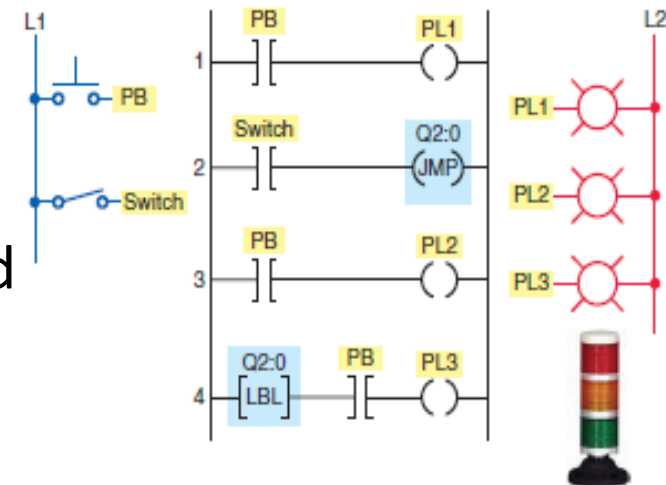
- The *jump (JMP) instruction* is an output instruction used for this purpose.
- When the jump instruction is used, the PLC will not execute the instructions of a rung that is jumped.
- The jump instruction is often used to jump over instructions not pertinent to the machine's operation at that instant.



❑ Master Control Reset Instruction

✓ Jump Instruction

- The program of Figure 9-6 illustrates the use of a jump instruction.
- Addresses Q2:0 through Q2:255 are the addresses used for the *jump (JMP)* instructions.
- The *label (LBL)* instruction is a target for the jump instruction.
- In addition, the jump instruction with its associated label must have the same address.
- The area of the program that the processor jumps over is defined by the locations of the jump and label instructions in the program.
- If the jump coil is energized, all logic between the jump and label instructions is bypassed and the processor continues scanning after the LBL instruction.



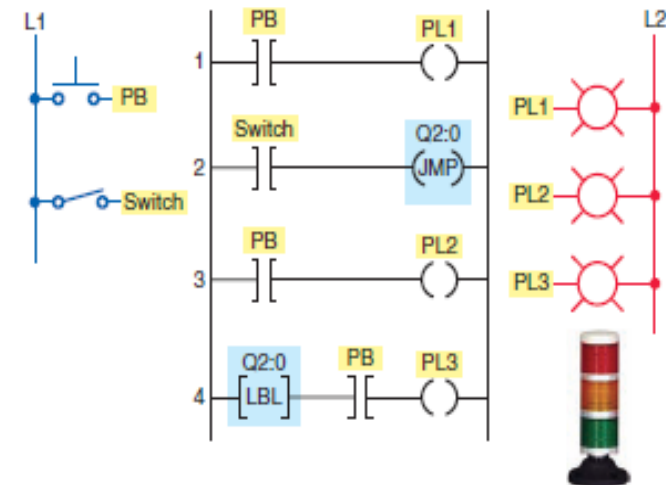


❑ Master Control Reset Instruction

✓ Jump Instruction

The operation of the program can be summarized as follows:

- When the switch is open the jump instruction is not activated.
- With the switch open, closing PB turns on all three pilot lights.
- When the switch is closed the jump (JMP) instruction will activate.
- With the switch closed, pressing PB turns on pilot lights PL1 and PL3 only.
- Rung 3 is skipped over during the PLC program scan so PL2 is not turned on.





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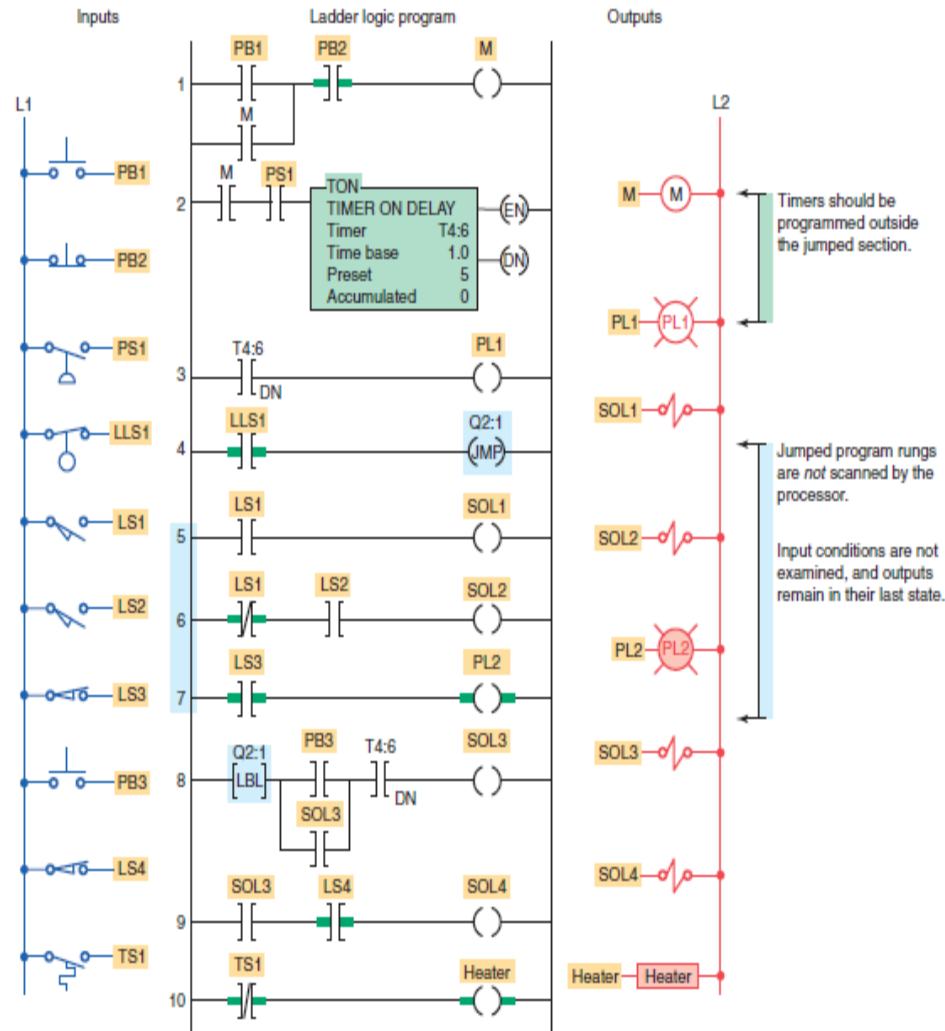
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❑ Master Control Reset Instruction

✓ Jump Instruction

- When rung 4 has logic continuity, the processor is instructed to jump to rung 8 and continue to execute the main program from that point.
- Jumped rungs 5, 6, and 7 are not scanned by the processor.
- Input conditions for the jumped rungs are not examined and outputs controlled by these rungs remain in their last state.





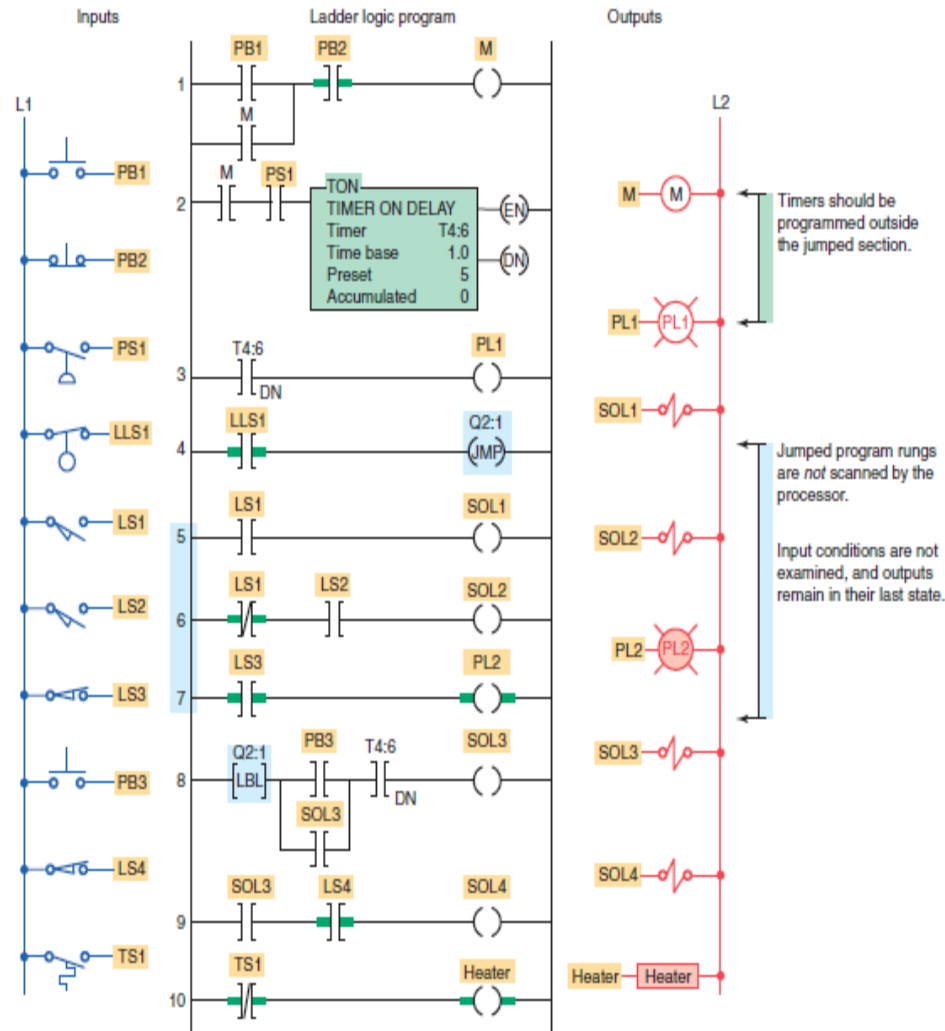
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❑ Master Control Reset Instruction

✓ Jump Instruction

- Any timers or counters programmed within the jump area cease to function and will not update themselves during this period.
- For this reason they should be programmed outside the jumped Section in the main program zone.

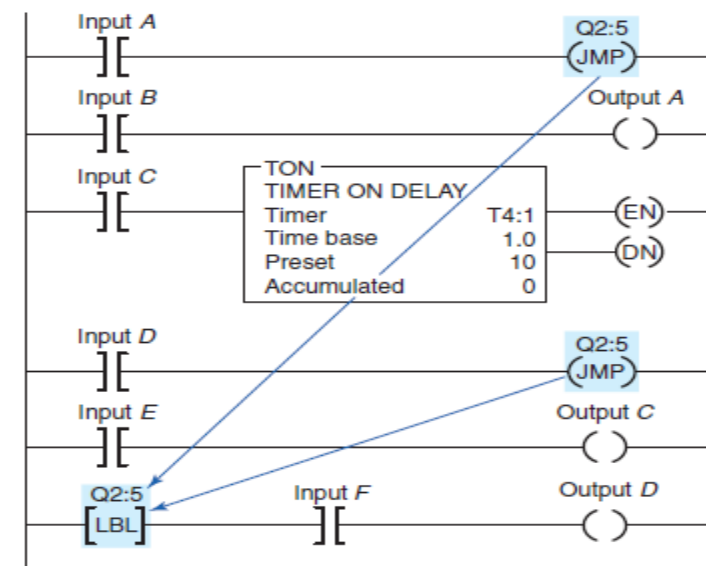




❑ Master Control Reset Instruction

✓ Jump Instruction

- You can jump to the same label from multiple jump locations, as illustrated in the program of Figure .
- In this example, there are two jump instructions addressed Q2:20.
- There is a single label instruction addressed Q2:20.
- The scan can then jump from either jump instruction to label Q2:20, depending on whether input *A* or input *D* is true..

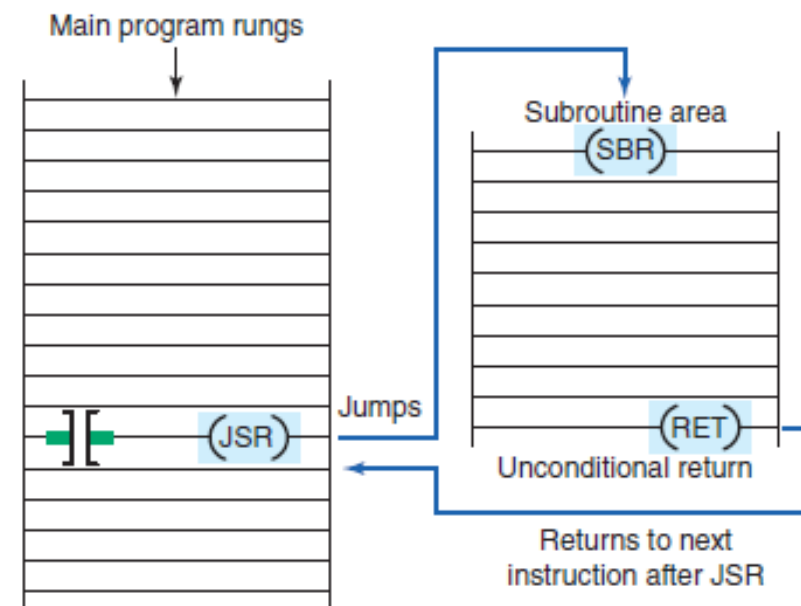




❑ Master Control Reset Instruction

✓ Subroutine Functions

- A subroutine is a short program that is used by the main program to perform a specific function.
- Large programs are often broken into subroutine program files, which are called and executed from the main program.
- In the SLC 500 series PLCs, the main ladder logic program is in program file two (shown as LAD 2).
- Ladder logic programs for subroutines can be placed in file number three (LAD 3) through file number 255 (LAD 255).





❑ Master Control Reset Instruction

✓ Subroutine Functions

- The subroutine instructions can be summarized as follows:

- **Jump to Subroutine (JSR)** —The JSR instruction is an output instruction that causes the scan to jump to the program file designated in the instruction.
- It is the only parameter entered in the instruction.
- When rung conditions are true for this output instruction, it causes the processor to jump to the targeted subroutine file.
- Each subroutine must have a unique file number (decimal 3–255).



❑ Master Control Reset Instruction

✓ Subroutine Functions

- The subroutine instructions can be summarized as follows:

- **Subroutine (SBR)** —The SBR instruction is the first input instruction on the first rung in the subroutine file.
- It serves as an identifier that the program file is a subroutine.
- This file number is used in the JSR instruction to identify the target to which the program should jump.
- It is always true, and although its use is optional, it is still recommended.



❑ Master Control Reset Instruction

✓ Subroutine Functions

- The subroutine instructions can be summarized as follows:

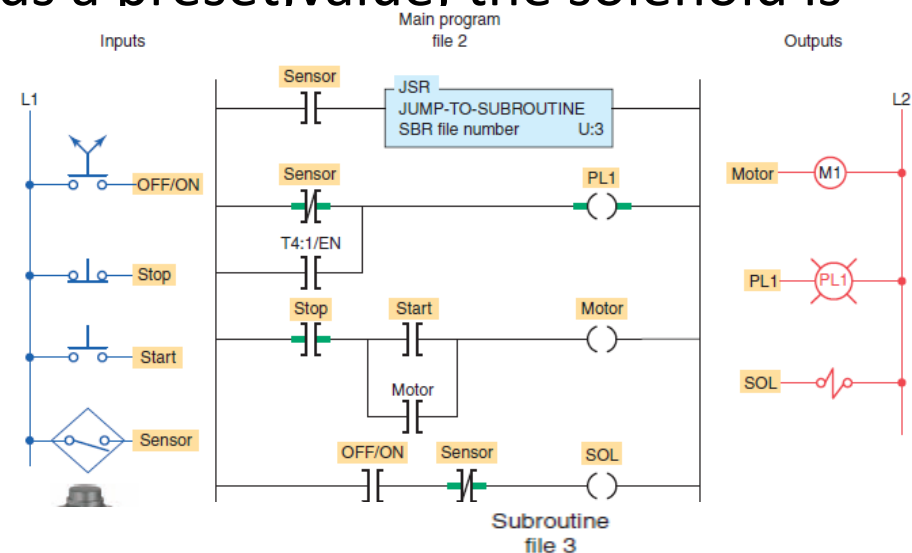
- **Return (RET)** —The RET instruction is an output instruction that marks the end of the subroutine file.
- It causes the scan to return to the main program at the instruction following the JSR instruction where it exited the program.
- The scan returns from the end of the file if there is no RET instruction.
- The rung containing the RET instruction may be conditional if this rung precedes the end of the subroutine.
- In this way, the processor omits the balance of a subroutine only if its rung condition is true.



❑ Master Control Reset Instruction

✓ Subroutine Functions

- If the weight on the conveyor exceeds a preset value, the solenoid is de-energized and pilot light PL1 will begin flashing.
- When the weight sensor switch closes, the JSR is activated and directs the processor scan to jump to the subroutine U:3.
- The subroutine program is scanned and pilot light PL1 begins flashing.
- When the weight sensor switch opens, the processor will no longer scan the subroutine area and pilot light PL1 will return to its normal on state.





❑ Master Control Reset Instruction

✓ Subroutine Functions

- The Allen-Bradley SLC 500 controller main program is located in program file 2 whereas subroutines are Assigned to program file numbers 3 to 255

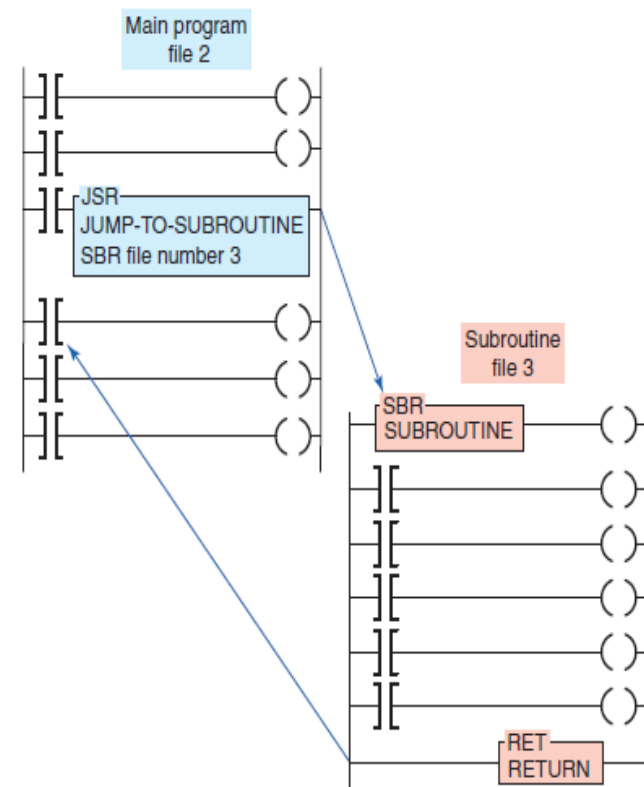
- Each subroutine must be programmed in its own program file by assigning it a unique file number

- Figure illustrates the procedure for setting up a subroutine and can be summarized as follows:

- Note each ladder location where a subroutine should be called.

- Create a subroutine file for each location.

Each subroutine file should begin with an SBR instruction.

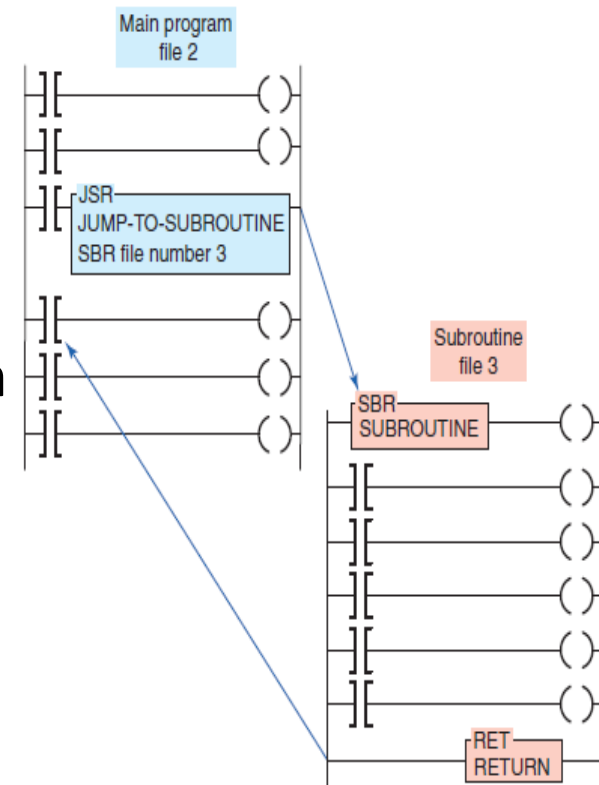




❑ Master Control Reset Instruction

✓ Subroutine Functions

- At each ladder location where a subroutine is called, program a JSR instruction specifying the subroutine file number.
- The RET instruction is optional.
 - The end of a subroutine program will cause a return to the main program.
 - If you want to end a subroutine program before it executes to the end of program file, a condition return (RET) instruction may be used.

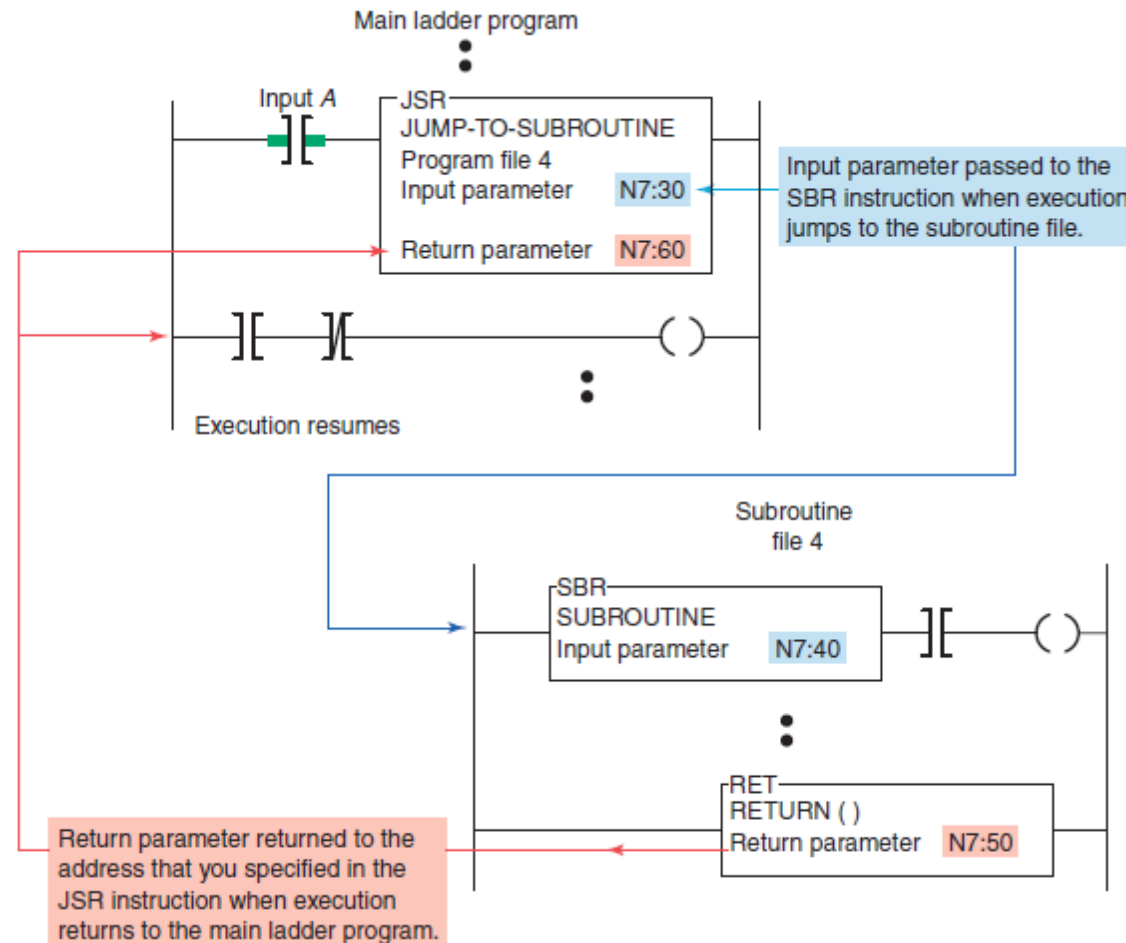




❑ Master Control Reset Instruction

✓ Subroutine Functions

- the program shown in Figure will cause the scan to jump from the main program file to program file 4 when input *A* is true.
- When the scan jumps to program file 4, data will also be passed from N7:30 to N7:40.
- When the scan returns to the main program from program file 4, data will be passed from N7:50 to N7:60.

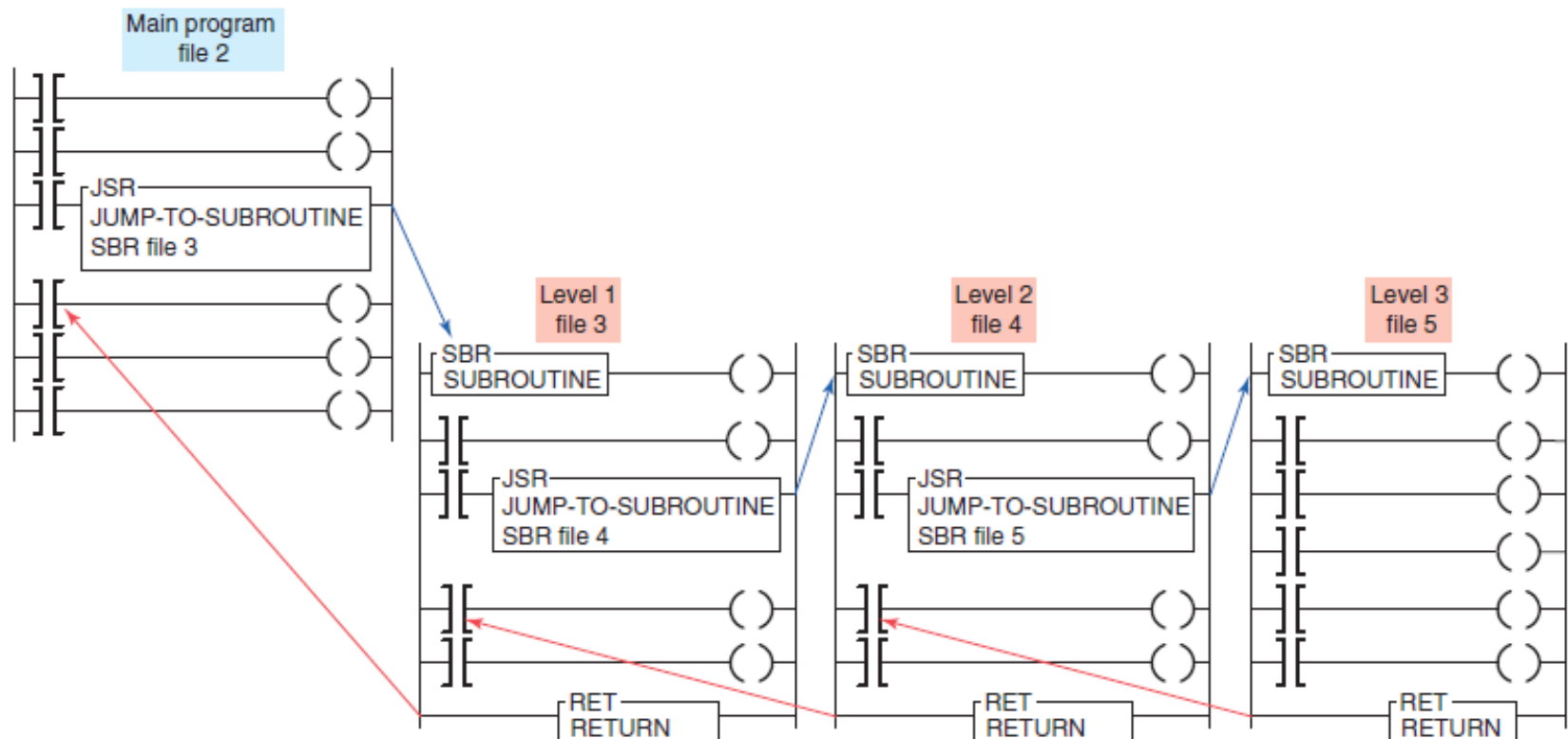




❑ Master Control Reset Instruction

✓ Subroutine Functions

- Nesting subroutines allows you to direct program flow from the main program to a subroutine and then to another subroutine, as illustrated in Figure





❑ Master Control Reset Instruction

✓ Forcing External I/O Addresses

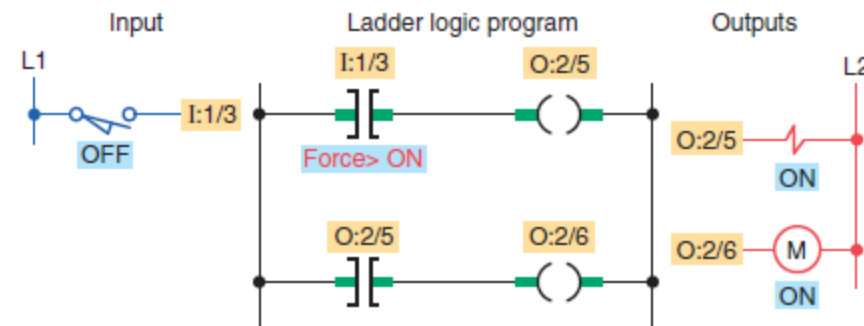
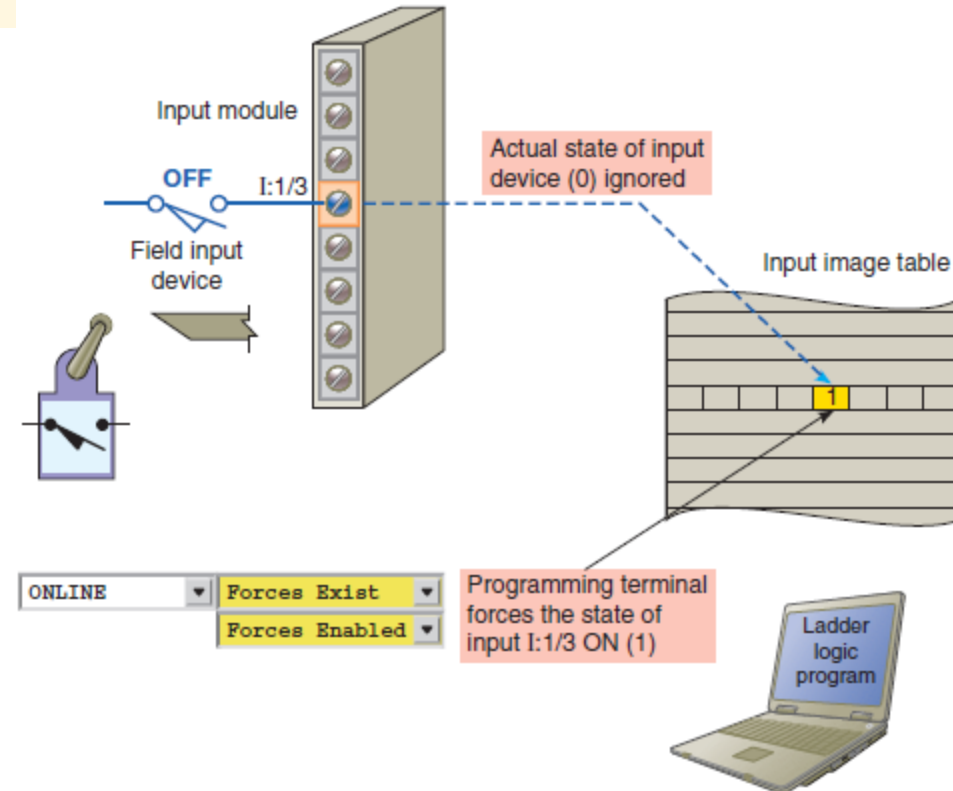
- The force function is essentially a manual override control function.
- Forcing allows the PLC user to turn an external input or output on or off from the keyboard of the programming device.
- This is accomplished regardless of the actual state of the field device.
- The forcing capability allows a machine or process to continue operation until a faulty field device can be repaired.
- It is also valuable during start-up and troubleshooting of a machine or process to simulate the action of portions of the program that have not yet been implemented.
- Forcing inputs manipulates the input image table file bits and thus affects *all areas of the program that use those bits*.



❑ Master Control Reset Instruction

✓ Forcing External I/O Addresses

- The forcing of inputs is done just after the input scan.
- When we force an input address, we are forcing the status bit of the instruction at the I/O address to an on or off state.





❑ Master Control Reset Instruction

✓ Forcing External I/O Addresses

- Forcing outputs affects *only the addressed output terminal*.
- Therefore, since the output image table file bits are unaffected, your program will be unaffected.
- The forcing of outputs is done just before the output image table file is updated.
- When we force an output address, we are forcing only the output terminal to an on or off state.
- The status bit of the output instruction at the address is usually not affected

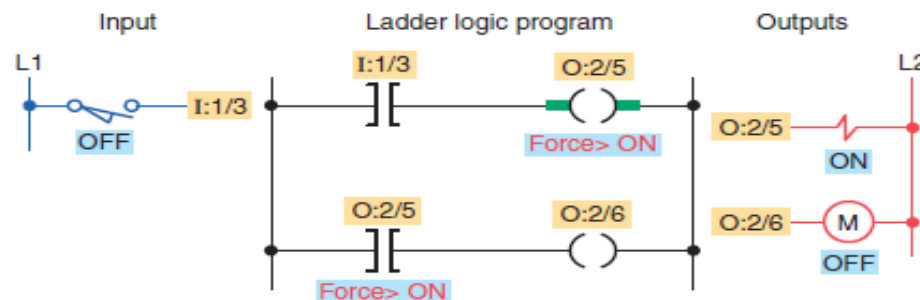
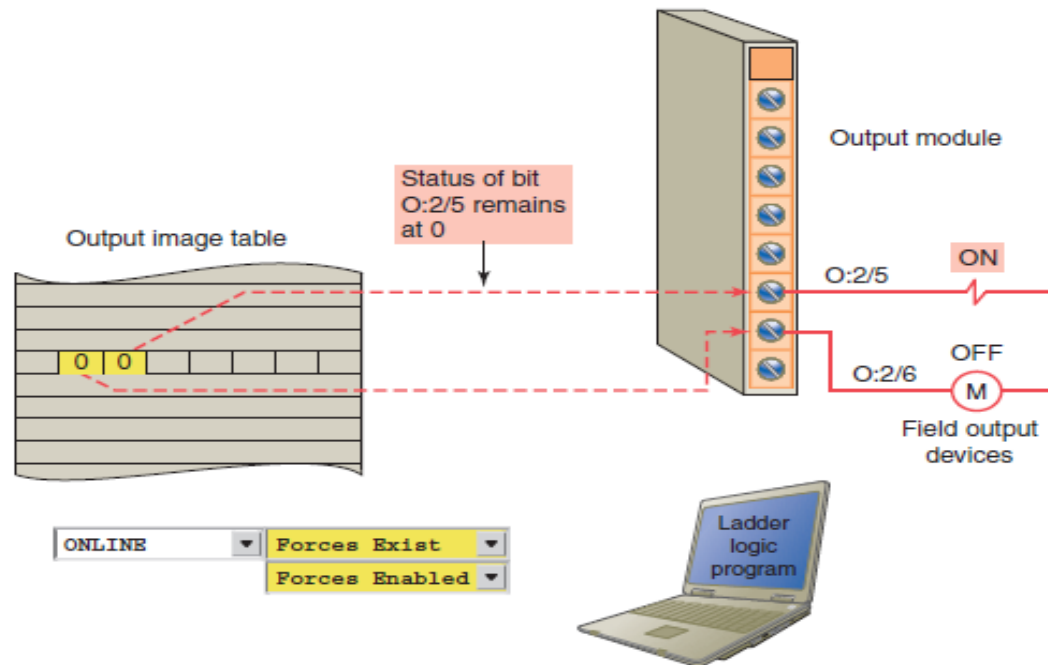


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❑ Master Control Reset Instruction

✓ Forcing External I/O Addresses





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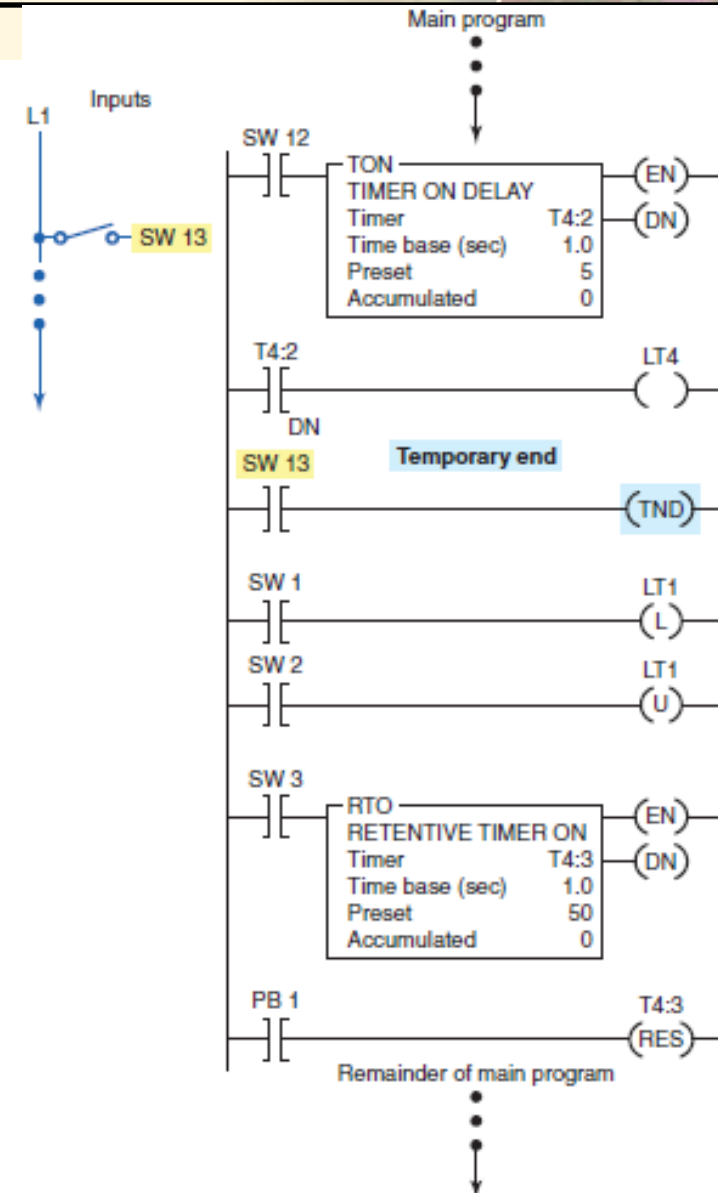


❑ Master Control Reset Instruction

✓ Temporary End Instruction

➤ The *temporary end (TND)* instruction is an output instruction used to progressively debug a program or conditionally omit the balance of your current program file or subroutines.

➤ When rung conditions are true, this instruction stops the program scan, updates the I/O, and resumes scanning at rung 0 of the main program file.





❑ Master Control Reset Instruction

✓ Suspend Instruction

- ✓ The suspend (SUS) instruction is used to trap and identify specific conditions during system troubleshooting and program debugging.
- ✓ Figure shows a suspend instruction in a ladder logic rung
 - When you program the SUS instruction, you must enter a suspend ID number (number 100 is used in this example).
 - When the rung is true, the SUS output instruction places the controller in the suspend mode and the PLC immediately terminates scan cycling.
 - The SUS instruction writes the suspend ID number (100) to S:7 as it executes.
 - You can include several SUS instructions in a program, each with a different suspend ID and read S:7 to determine which SUS instruction caused the PLC to halt.
 - Status file S:8 will contain the number of the program file that was executing when the SUS instruction executed.

