The Ins and Outs of Basic SCHEMATIC SYMBOLS

A practical approach to reading and understanding the schematic diagrams used to explain how HVACR systems operate.

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The previous article discussed several components that are used on schematic diagrams. Part 2 will incorporate these elements into individual circuits. There are three basic circuits used in all schematics; they are series, parallel and series/parallel.

SERIES CIRCUITS

Whenever devices are connected together in a circuit and one is drawn after another, this is called a series circuit. Figure 1 illustrates three resistors connected in series. Note that the voltage or current flows through each resistor one after the other and then returns back to the battery.

If several light bulbs are wired in series and if one burns out, all of them will not light, as Figure 2 illustrates. The burned out light has broken the circuit and no current can return to the battery.

The series circuit is generally used for safety controls. If any control switch opens, power to the unit will be cut off to protect the unit from harm. To understand the application of the series circuit, look at Figure 3, which depicts three controls—the freeze protection (FP 1), and the low- and high-pressure controls (LPS 1 and HPS 1, respectively)—that are in series with the contactor coil (C1). If the FP 1, LPS 1 or HPS 1 opens, C1 will be de-energized. Any number of controls or switches may be placed in series to control a circuit.

PARALLEL CIRCUITS

The next most-common circuit that a technician will need to troubleshoot is the parallel circuit. This circuit is one in which components get the same voltage or current at the same time.

Parallel circuits are designed so that the same voltage or current is applied to all the branches simultaneously. The ex-
ample in Figure 4 shows that 100 V would be impressed on circuit A and B, and C and D at the same time. If one of the bulbs burns out in a parallel circuit, the rest of the bulbs in the circuit will stay illuminated. Figure 5 is an example of this circuit. In this diagram, 100 V is simultaneously delivered to A, B, C, D, E and F, but only the first and last bulb will stay illuminated, as there is a broken filament between C and D.
Figure 6 illustrates a parallel circuit that shows the two motors will get the same voltage when the contactor closes. Both motors will start at the same time because the voltage is impressed simultaneously. There are numerous versions of parallel circuits; however they all will function the same way.

SERIES/PARALLEL CIRCUITS

The next circuits are combined versions of series and parallel. They are used when there needs to be more than one action in a control circuit. A very simple version of the series/parallel circuit is illustrated in Figure 7. The voltages and currents are divided up according to each circuit. Bulbs A and B only will receive one-half of the current, and the voltage will be divided through them; while bulb C will receive the full voltage and draw the full amount of the current.

Figure 8 illustrates a circuit series/parallel. Circuit A and B each will receive about 25% of the current. Therefore, circuit C will receive the other 50% of the current. Note the subtle differences between Figures 7 and 8. These circuits are useful in control lock-out and timing controllers discussed later in more detail.

Figure 9 is a time delay for a low-pressure switch. It allows a condensing unit to operate for three minutes while there is a possibility of low back pressure. The switch will close for three minutes and then open again. The L logic circuit receives its power from the common side of the power supply and the other side of the LPS. This delay will make the switch close for three minutes and then open again. This in turn bypasses the LPS. This circuit is a series/parallel.

Figure 10 illustrates a series/parallel control circuit for fans controlled by a temperature switch. Figure 11 is a series/parallel circuit designed to stop and start a contactor or starter by the use of a remote push-button. Note how the normally open (N/O) and the normally closed (N/C) switches are wired in series. Then the N/O switch is wired in parallel with a set of contacts on the starting device.

Figure 12 illustrates another form of series/parallel circuit, which in this case is a lockout circuit. Note the impedance relay coil (IRC) is in parallel with all of the safety controls. It also is in series with contactor coil (CC).

Part 3 of Basic Schematic Symbols will incorporate the elements discussed in both Parts 1 and 2 of this series into complete schematic diagrams. It will appear in the April 2011 issue of RSES Journal.
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