

## Chapter Eight

### ELECTRICAL SYSTEM THEORY

If you are reading this chapter with the hopes of answering the question “What is electricity?” you are going to be disappointed. In many ways, electricity is still a mystery. Our knowledge has significantly increased about the subject since we discovered that lightning is electricity, and at least most of us no longer believe lightning is a sign of the displeasure of some god. But electricity, like lightning, still evokes uneasiness in most and fear in many.

#### Electrical Circuits

Perhaps what makes electricity so mysterious is that it is intangible. We can't hold it in our hand or, for the most part, even see it. Electricity is a name for a collection of laws found in a physics book. But we do know about how it behaves and how we can get it to perform ever increasingly complex tasks. For the pilot, the important issue is not so much how electricity works but rather how electrical circuits manage to do the kinds of things they do in an aircraft.

#### Series Circuits

Perhaps the easiest way to understand circuitry is to think of it as rivers of electricity. Figure 8-1 illustrates the three basic types of circuits: series, parallel, and series-parallel. In the series circuit, current flows from the primary bus to the 5-amp circuit breaker (CB), then to the fuel quantity indicator. Therefore CBs are always placed upstream, and in series with, the circuit or accessory they are to protect. If the CB fails, all electric current is cut off from anything “downstream.” It was precisely this type of system that evoked the cheers and jeers of my sisters and me each Christmas as we would try to find the burned-out bulb in our ancient Christmas tree lights. One burned-out bulb in a series circuit would prevent the whole string from lighting and officially beginning the Lombardo family Christmas season. Those under thirty may not be able to relate to that time-honored tradition because modern tree lights are parallel-wired.

#### Parallel Circuits

In parallel circuits, current flows from the primary bus simultaneously to both 5-amp CBs and then on to both the landing light and fuel quantity indicator. Failure of one circuit, say the landing light, will in no way affect the fuel quantity indicator circuit. This is the ideal situation in an aircraft, and certainly all critical electrically driven components operate in parallel with other components. Unfortunately, there are many electrical circuits in modern aircraft, and individual protection of each item is not always practical or necessary.

#### Series-Parallel Circuits

In the series-parallel circuit, a number of items may be put in parallel with each other, such as the taxi and landing lights, but in series with a single CB. If one of the lights burns out, the other will continue to work. Should a short circuit somehow develop in one of the lights, which could endanger the electrical system, both lights will be isolated from the system when the CB fails.