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All Electric Airplane on a Budget

There has been increasing interest in the construction of all-electric airplanes. To be sure, vacuum driven gyro systems are not the builder's favorite task to install (unless perhaps he's a plumber). The weight of vacuum system components, clutter behind the panel and impediments to maintenance access are compelling reasons for seeking alternatives to the warmed over, 60+ years old technology that provides attitude reference for most single engine airplanes. In recent discussions on the internet, builders have raised concerns about the reliability of an all-electric architecture. I'm planning some expansion of the power distribution diagrams in the next update to the AeroElectric Connection to speak to these concerns. In the interim, I'll offer the following discussion on the minimalist approach to reliable power for the all-electric airplane.

All electric airplanes have been with us for quite some time. Traditionally, only the high-dollar ships have enjoyed the flexibility and utility of plumbing-free instrument panels. Obviously, if one has the dollars, the technology is there for the buying. I'll suggest there are reasons to believe that an all-electric airplane is within the financial reach of more builders than most people assume. Let's see if I can make my point:

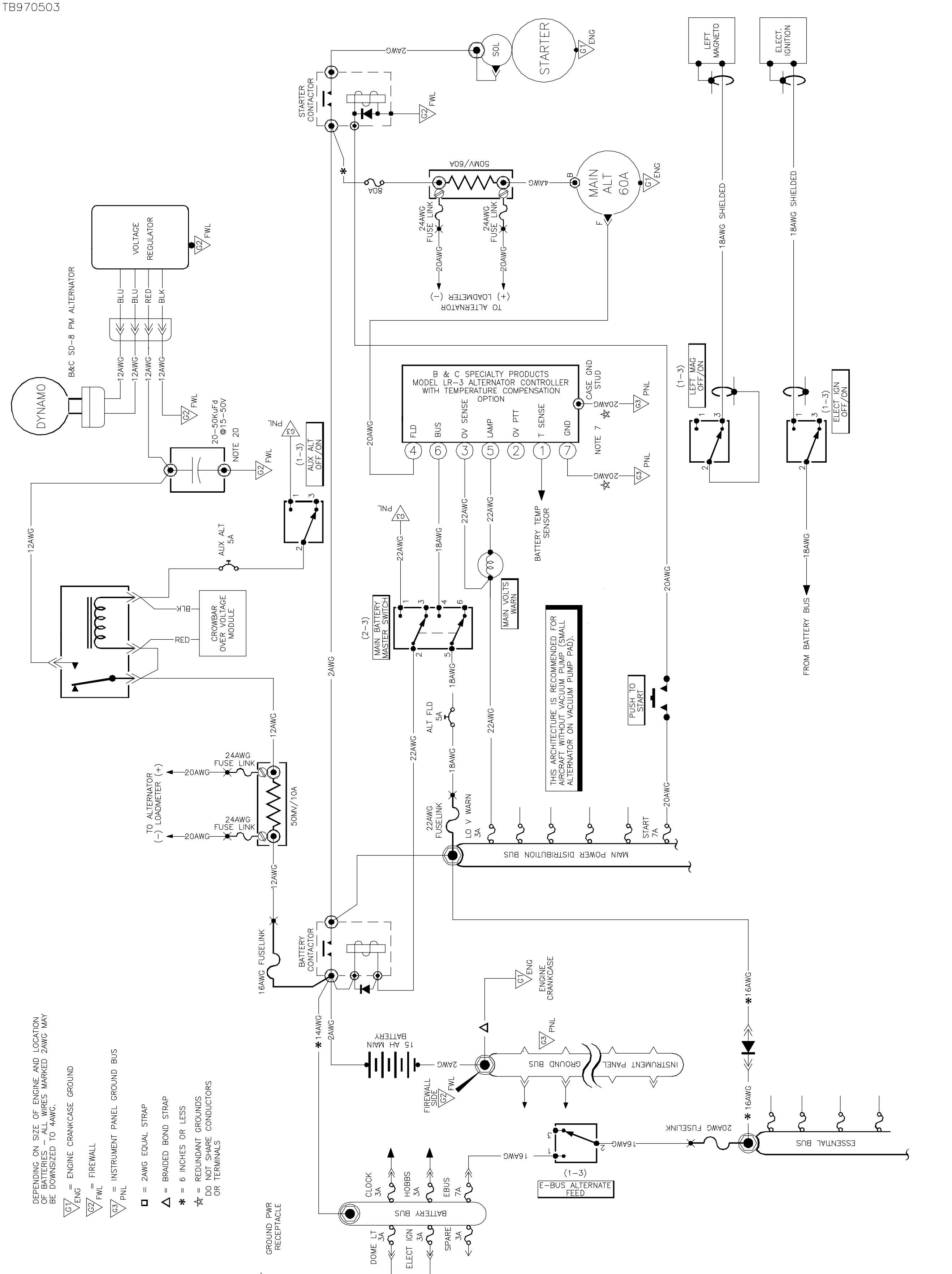
First, let's talk about reliability. For years now, we've been building single engine aircraft with failure-tolerant electrical systems. The goal is to architecture an electrical system wherein no single failure raises the pilot's pucker-factor and to decrease failure rates of high-responsibility items by judicious selection and maintenance of those components. I'll suggest that the modern automotive alternator has a demonstrable failure rate that is a tiny fraction of the numbers produced by the majority of certified alternators flying today. Further, RG batteries have proven their superior performance capabilities for decades. The major hurdle to cross with batteries has been gaining acceptance of the idea that a battery should be replaced when it's capacity has fallen below some value needed to support minimum equipment for endurance of remaining fuel. It really jerks some people's chain to consider throwing away a "perfectly good battery." Assuming you accept my suggestion that both chemical and engine driven power sources have reached a very high degree of performance and reliability, let's focus on how we might assemble these new components into a system.

In the following power distribution diagram, I show a technique for assembling one battery and two alternators into what I'll suggest is the world's lightest and least expensive all-electric system offered to date. The main alternator could be a B&C L40 or equal (40 amps), the auxiliary alternator shown is a B&C, SD-8 (rated at 8 amps but really good for a tad more) and the battery could be a 17 a.h. RG battery for a total components weight of 25 pounds. You could get a couple more pounds out by considering a 10-12 a.h. battery. I selected the 17 because it's presently manufactured by a dozen suppliers and readily available in a lot of battery stores.

The basic system is configured along the lines of our best recommendations for all home built airplanes. In the following power distribution diagram, an essential bus provides goodies-to-get-us-home with energy from three power sources via two power paths. The new feature in this diagram is the SD-8 auxiliary alternator attached via it's own control relay directly to the ship's battery.

The system shown really two different systems, interwoven to provide the advantages of two systems yet provide the isolation needed to comfortably sustain flight in spite of major failures in any one system. Consider the active components when the DC power master switch is OFF and the auxiliary alternator and essential bus alternate feed switches are ON. Now you have a very simple system not unlike those flying in hundreds of Long and Vari-Ez aircraft that have used the SD-8 as the solitary engine driven power source for almost two decades.

In this condition, the SD-8 is not burdened with keeping a battery contactor closed (a waste of limited energy resources). In this configuration, I'll suggest that E-bus



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loads of minimal panel lighting, primary nav radio, turn coordinator, and electric attitude reference gyro can be supported indefinitely while placing no demands on the battery except:

(a) to help stabilize the alternator and . . .

(b) provide a reserve of energy in case of total loss of two alternators. Now that you've tapped into modern automotive alternators for your airplane, the latter condition is statistically insignificant.

Okay, let's turn the Aux Alternator and E-bus Alternate Feed switches OFF and set the DC Power Master switch ON. Now we're flying with a full up system that will support every electro-goody on the airplane.

I purposely left a directional gyro off of the essential bus list for two reasons. First, given the ability of GPS and/or Loran radios to give us accurate ground track information, I'll suggest that one can easily fly en route IFR without a directional gyro. If you accept this premise, then you have two choices with respect to installation of an electric DG.

(a) If you're budget limited, don't expect to fly IFR and would use the gyros only in unforseen circumstances, then you could consider not having an electric DG. An attitude gyro alone combined with data from other heading sources is quite adequate for doing limited blind flight.

(b) If you have the dollars and choose to include an electric directional gyro in your project, then I'll suggest it be wired to the main bus. My reasoning is that should you loose the main alternator, the first goal is comfortable sustained flight in the en route mode. The DG is not necessary to get into the vicinity of where you're headed for. Once your arrival is assured, then close the Master DC power switch and use both the battery and the SD-8 together to spin up the DG, display lights, lower landing gear, etc., etc.

Given a demonstrated and deduced reliability and performance an RG battery, L40, SD-8 suite of equipment, the system I've proposed here puts all-electric operations in reach of many builders who might not have considered it before now.

Leaving the vacuum system -AND- directional gyro out of the installation gives you some dollars to offset the cost of the attitude gyro. You can always have a covered hole in the panel reserved for later addition of a DG. This will get your all-electric project airborne on a smaller initial cash outlay.

Fly comfortably . . .