TECH TIME

Helpful tips for the Avionics Technician

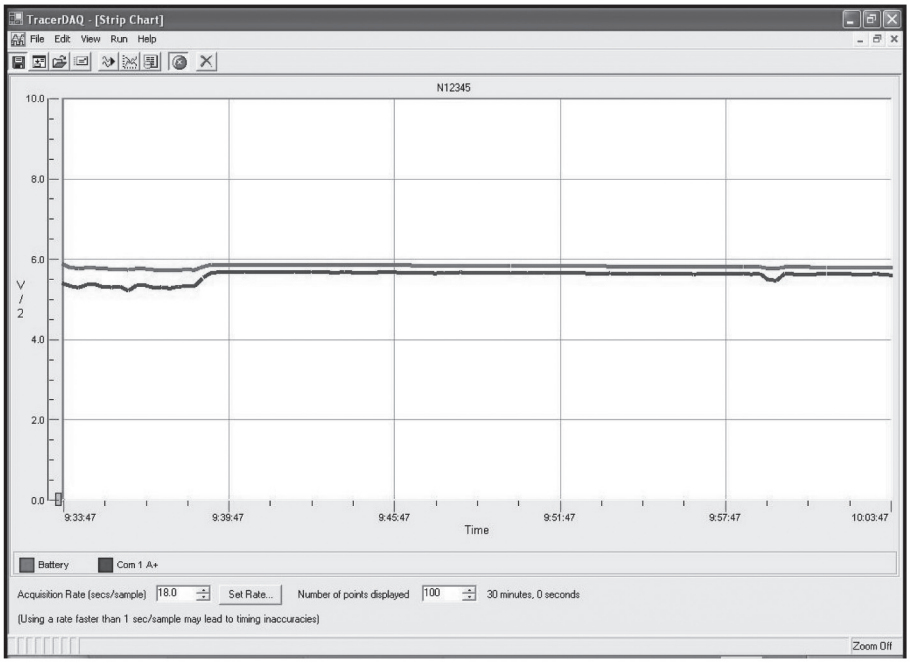
BY AL INGLE

This month we conclude our study of electrical load analysis, a subset of *wiring systems,* by testing a single engine piston airplane's electrical system.

The total, encompassing concept of an Electrical Load Analysis has been presented in previous articles. It may be necessary under some circumstances to perform this analysis to the greatest extent possible, however, for many installations of new equipment, a less documented report may be created. The electrical load analysis shown here is an example that ensures FAA compliance after performing a modification to an aircraft's electrical system i.e. an installation of avionics equipment. The installing agency must ensure: §23.1351 five (5) minutes on battery at maximum certificated altitude, including restart capabilities; §23.1353 thirty (30) minutes powering loads essential for flight with the complete loss of the electrical power generating system (allowing 5 minutes for pilots to recognize and shed unnecessary loads); §23.1529 Instructions for Continued Airworthiness where applicable and AC 43.13-1B Paragraph 11-33 …total continuous electrical load cannot exceed 80% output load limits of the generator or alternator…

A calibrated Fluke® clamp-on type DC ammeter was used in this analysis by measuring the current from the battery terminal to the master/starter relay. External power was applied to keep the system voltage in a normal range (13.75 VDC) during the tests. The emergency battery operating time was calculated from values obtained during these tests. We assumed the battery capacity, at room temperature, to be 75% of the data sheet rated capacity, at the one-hour rate. Prior to performing the analysis, voltage probes were placed at the battery and circuit breaker load side of a Garmin® GNS-430 comm. The aircraft engine was run briefly to ensure a charged battery, then the alternator was turned off. Five (5) minutes elapsed with full loading for night IFR operations, then the unneeded loads were turned off. The measured voltages were graphed below, stopping after thirty (30) minutes total. It has been calculated that 112 minutes of additional operation remained after allowing for the 5 minute shed and 5 minute landing loads.

The voltages measured are one-half of actual, therefore, the battery under load initially was less than 12 volts. Note the voltage drop between the battery and the Com1 A+ input. The slight dip in voltage at 9:58:30 is due to the keying of Com 1. The analysis for a more complex aircraft may follow this same format. The FAA should be presenting future guidance similar to that provided in this series.



Continued on following page

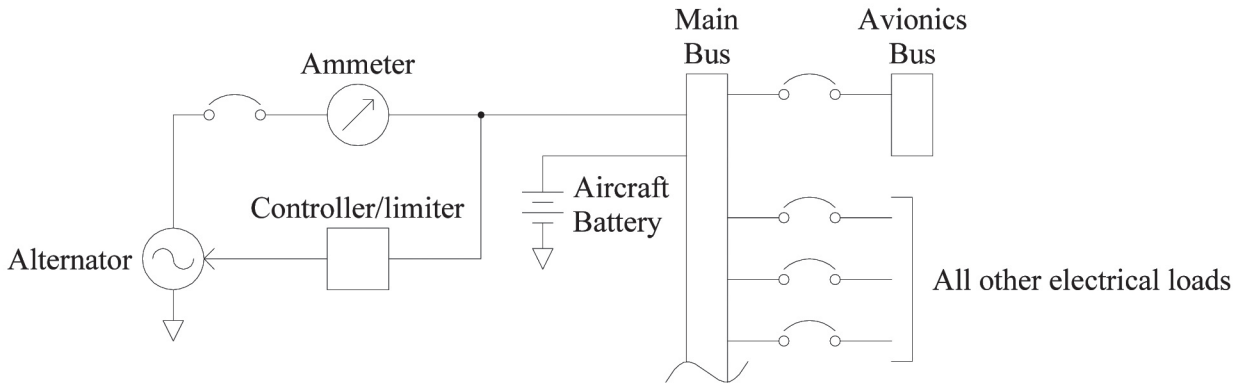
capital avionics

Electrical Load Analysis for Cessna 182 N9214G S/N: 1860754

Date: 23 February 2005
Performed By: Al Ingle
Certificate Number: 2294209

Introduction

N9214G is a piston powered, single engine, four place aircraft intended for personal use. The electrical source is provided by one 60 amp engine driven alternator with one 35 amp-hour lead acid battery. The system is diagrammed below or illustrated in figure 2-3, page 2-4 of the Pilot's Operating Handbook.



ITEM	DC Alternator	Inverter	Battery
Number of Units	1	0	1
Continuous Rating	60A	-	35Ah
Voltage	13.75	-	12Vdc
Manufacturer	Motorcraft	-	Gill
Model Number	DOFF10300J	-	G35

The alternator is regulated and automatically trips off-line during under/overvoltage conditions. Alternator failure is indicated by illumination of the EDM700 Engine Monitor voltage warning. The pilot is required to turn off unnecessary loads manually.

List of Installed Equipment

See Pilot's Operating Handbook and/or Equipment List.

Assumptions and Criteria

- Most severe operating conditions considered to be night IFR with pitot heat operating.
- Communications equipment operating at 2% transmit duty cycle.
- Motor load demands are shown for steady state operation and do not include inrush power.

Load Analysis – Tabulation of Values

The tabulation of measured values is for all equipment loads in the aircraft. The minimum non-selectable current consumption associated with *Master ON* and *Avionics Master ON* are summed as one load. The *Continuous* current consumption is less than 80% of alternator capacity. *5 Minute* and *5 Second* ratings exceed 80% alternator capacity with all equipment turned on but lighting loads are mutually exclusive and not continuous, complying with AC 43.13-1B.

Capital Avionics, Inc.
3248 Capital Circle SW • Tallahassee Regional Airport • Tallahassee, Florida 32310
Phone: 850-575-4028 • Fax: 850-575-7441 • info@capitalavionics.com

capital avionics

Electrical Load Analysis for Cessna 182 N9214G S/N: 1860754

Circuit Breaker		Usage		
Name	Amperage	Continuous	5 Minutes	5 Seconds
Strobe	10	(Strobe) 3.2A	3.2A	3.2A
		(Beacon) 1.4A	1.4A	1.4A
Stall Warning	5	-	-	0.2A
Turn Coordinator	5	Master ON	-	-
Alternator Regulator	5	Master ON	-	-
Audio	5	0.7A	0.7A	0.7A
Autopilot	8	3.2A	3.2A	3.2A
Com 1	10	0.8A	0.8A	0.8A
Radio 1	10	0.6A	0.6A	0.6A
GPS	5	1.6A	1.6A	1.6A
Radio 2	5	2.0A	2.0A	2.0A
Radio 3	10	Master ON	-	-
Flaps	15	-	-	3.1A
Cabin Lights	10	-	1.5A	1.5A
Instrument Lights	10	(post) 0.9A	0.9A	0.9A
		-	(overhead) 1.8A	1.8A
Pitot Heat	10	7.0A	7.0A	7.0A
Nav Lights	10	5.0A	5.0A	5.0A
Ldg Lights	20	(Taxi) 6.8A	6.8A	6.8A
		-	(Ldg) 7.2A	7.2A
Alternator	60	-	-	-
Stormscope	2	0.9A	0.9A	0.9A
Transponder	3	0.9A	0.9A	0.9A
Master ON	-	4.7A	4.7A	4.7A
Radio Master ON	-	2.0A	2.0A	2.0A
	Total Current:	41.7A	52.2A	55.5A

Emergency and Standby Power Operation

Equipment powered under Emergency Conditions: (1) GNS-430 Navigation System, (1) GMA-340 Audio Panel, (1) GTX330 Transponder with Altitude Encoder, (1) Turn Coordinator, (1) Clock, Engine Monitoring Instruments, Instrument Panel Dimmer

Nameplate capacity of the battery: 35 Ah, 75% of capacity = 26.25 Ah or 1575 Amp-Minutes
Normal or Preload Shed Consumption: 34.9 Amps or 175 Amp-minutes
Minimum Cruise Load Consumption: 11.6 Amps or 232 Amp-minutes
Landing Approach Load Consumption: 18.4 Amps or 92 Amp-minutes

Cruise Duration is: $\frac{\text{Battery Capacity} - (\text{Pre-Load Shed} + \text{Landing load})}{\text{Cruise Load}} = \frac{1575 - (175 + 92)}{11.6} = 112$ min.

Total Duration: Pre-Load Shed Cruise Time + Cruise Duration + Landing Time = 5 + 112 + 5 = 122 minutes. This meets the FAR requirements.

Summary and Conclusions

The alternator has adequate generating capacity for the electrical equipment installed and the battery, when properly maintained, provides adequate cruise duration under emergency conditions.

Capital Avionics, Inc.
3248 Capital Circle SW • Tallahassee Regional Airport • Tallahassee, Florida 32310
Phone: 850-575-4028 • Fax: 850-575-7441 • info@capitalavionics.com