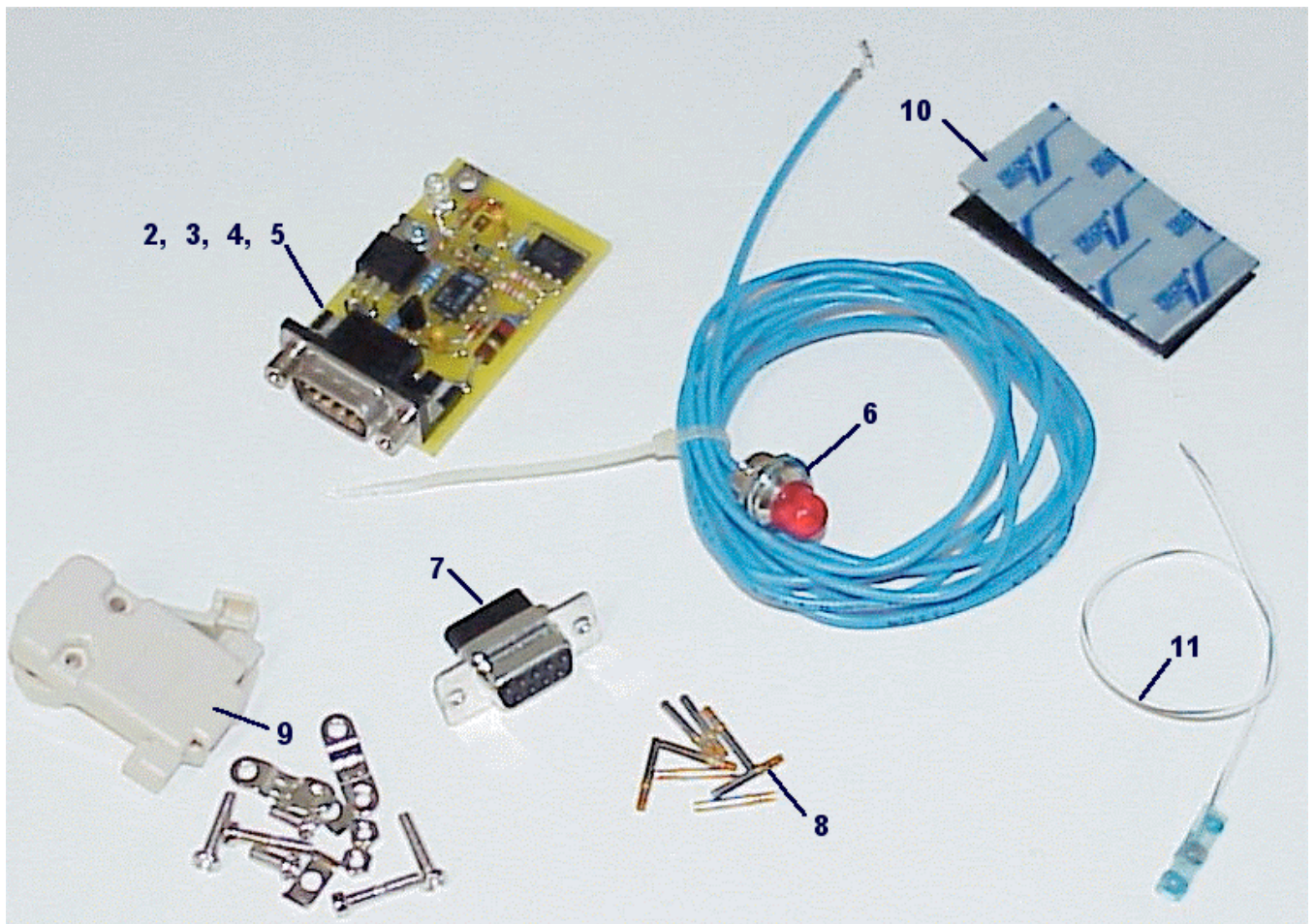




Bob Nuckolls
6936 Bainbridge Road
Wichita, Kansas 67226-1008
Voice/Fax: 316-685-8617
E-mail: <http://www.aeroelectric.com/bob.nuckolls>

Installation and Operation Manual AEC9005 Series Low Voltage Warning and Auxiliary Battery Management Modules



1. INTRODUCTION

Most pilots suffering alternator failures are unaware of the event until the panel goes black. This is because contemporary electrical system instruments (voltmeter and ammeter) are among those gages that display exactly the same thing for hundreds of hours of operation and tend to be noticed less and less.

When the panel goes black, the battery has been carrying normal ship's electrical loads for some period of time. Once the battery is depleted, the pilot is out of options for judicious utilization of stored electrical energy. The AEC9005 Series Low Volts Warning and Auxiliary Battery Management modules detect and annunciate alternator failure within seconds of the event. Timely notification of alternator failure offers the pilot better options for en route utilization of a limited resource . . . battery capacity.

Notice

The AEC9005 Series Low Voltage Warning/Aux Battery Management Modules are not FAA approved and not offered for use on any type certified aircraft.

Do not order this product with intent to install on a type certified aircraft before you contact the local offices of the FAA for guidance and a commitment to assist you with a field approval.

Some AEC9005 series devices include an Auxiliary Battery Management function for automatic isolation of an auxiliary battery from the rest of ship's electrical system as soon as the alternator failure event is detected. This feature ties an auxiliary battery to the bus during normal alternator operation while assuring that auxiliary battery capacity is automatically reserved to power critical items should the alternator be shut down for any reason.

2. FEATURES

- 2.1 Low Bus Voltage Warning:** The AEC9005 series devices monitor ship's bus voltage and flashes a LOW VOLTS WARN annunciator any time the bus is below 13.0 (26.0) volts.
- 2.2 Auxiliary Battery Management:** The AEC9005-101/102 LV Warn/ABMM kits features an open-drain, power transistor rated at 2.0 amps and configured to automatically close an auxiliary battery contactor or relay whenever bus voltage is greater than 13.0 (26.0) volts.
- 2.3 LOW VOLTS WARN Annunciator:** The AEC9005-101/102 LV Warn/ABMM installation kits include a LOW VOLTS WARN annunciator lamp fixture featuring a light emitting diode suited for use with the warning module LED output driver.
- 2.4 LV Warn/ABMM Module:** All electronics for the AEC9005 series modules are mounted on an etched circuit board fitted with a 9-pin, D-subminiature connector. The module is calibrated at assembly using precision resistors and a precision voltage reference diode. No calibration is required over the service life of the product.
- 2.5 LV Warn Module – Open Drain Pull Down Option:** The AEC9005-201/202 LV Warn Modules rewire the power field effect transistor normally used for auxiliary battery management as a pull-to ground switch suitable for controlling incandescent lamps. This option is offered for designs where the builder wishes to annunciate LOW VOLTS on an incandescent lamp annunciator array. Auxiliary battery management is not offered on these models

2.6 LV Warn / Aux Battery Management Module Options				
Kit Part. No.	System Voltage	LED Annunciator Supplied	Pull Down Incandescent Output	Aux Battery Management
AEC9005-101	14	X		X
AEC9005-102	28	X		X
AEC9005-201	14		X	
AEC9005-202	28		X	

3. PARTS SUPPLIED

3.1 AEC9005 Series Installation Kits Contents						
		1	1		11	Solder Sleeve for Shield Pigtail
1	1	1	1		10	Self Adhesive Velcro Pair
1	1	1	1	D9H	9	Hood, 9-Pin D-sub
9	9	9	9	D20F	8	Socket, Machined, 20AWG D-sub
1	1	1	1	D9F	7	Connector, 9-Pin D-sub Female
		1	1	9005-200-1	6	Lamp Assembly, LED
1				9005-110-3	5	LV Warn Module, Incandescent Pull-Down, 28V
	1			9005-110-1	4	LV Warn Module, Incandescent Pull-Down, 14V
		1		9005-100-3	3	LV Warn / Aux Batt Management Module, LED, 28V
			1	9005-100-1	2	LV Warn / Aux Batt Management Module, LED, 14V
1	1	1	1	9005-701A	1	Manual, Instruction/Installation
				AEC9005-202		LV Warn Module, Pull-Down Incandescent, 28V (Kit)
				AEC9005-201		LV Warn Module, Pull-Down Incandescent, 14V (Kit)
				AEC9005-102		LV Warn / Aux Batt Management Module, LED, 28V (Kit)
				AEC9005-101		LV Warn / Aux Batt Management Module, LED, 14V (Kit)
-202	-201	-102	-101	Part No.	#	Description
Quantity/Assembly						

3.2 Materials Not Supplied Depending on the kit purchased, the installer may need to supply some additional installation materials as follows:

- 3.2.1 **-202 and -201 kits** do not include a LOW VOLTS annunciator fixture. This version of the LV Warn module is intended for use with user supplied incandescent lamp annunciator wherein one side of the lamp is tied to suitable bus supply and illuminates by grounding the annunciator signal lead.
- 3.2.2 **-102 and -101 kits** contain no hardware associated with the optional auxiliary battery management feature. The installer may have to supply an auxiliary battery, auxiliary battery contactor or relay, AUX BAT annunciator lamp, AUX BAT MASTER switch and inline fuse or fusible link for the AUX BAT annunciator circuit.. See wiring diagrams for exemplar parts suited to these tasks.
- 3.2.3 None of the kits will supply 22AWG lead wire recommended for connection the LV Warn / Aux Battery Management Module to ship's systems.

4. INSTALLATION TOOLS

4.1 Aside from ordinary hand tools you will need a crimping tool (B&C Specialty Products RCT-3 or equivalent) to install the machined D-sub connector pins supplied with these kits. In case you put a pin into the wrong hole and need to remove it, you may also wish to purchase a rear-release extraction tool for these pins (B&C Catalog # DSE-1). D-sub connectors are widely use in many aviation products and these tools are good additions to your toolbox. If prefer you may substitute a solder type, 9-pin, female D-sub connector from a local supplier.

5. INSTALLATION INSTRUCTIONS

5.1 Etched Circuit Board Assembly: The ECB assembly (Items 2, 3, 4, 5) is supplied with a Velcro strip (10) installed on the underside surface. The primary reason is to provide nearly total coverage of the solder side of the ECB for protection from inadvertent contact with conductors. Bonding qualities of adhesive used for Velcro mounting is time dependent.

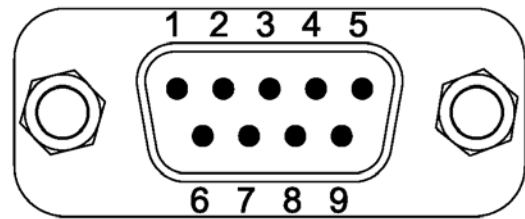
Clean the surface where the ECB is to be mounted using lacquer thinner or acetone to make sure it's grease free. Peel the protective backing from the mating Velcro strips and press firmly into place. You can press the ECB onto its mating Velcro strips right after they're installed but allow 24 hours for the adhesive to reach full strength before de-mating.

5.2 The ECB Assembly should be mounted inside the fuselage and not in the engine compartment. There are no field adjustments or controls on the ECB Assembly so it can be tucked away without regard to convenience of accessibility.

5.3 Low Voltage Warning Light (supplied with –101/-102 kits): The light emitting diode warning light assembly (6) comes with a length of single conductor shielded wire already mounted to the light. The lamp's small size is favorable to a mounting location right in front of the pilot . . . even if the lamp needs to be tucked between existing panel hardware. Use spot-facer or Unibit to drill 13/32” mounting hole for lamp fixture. Install lamp fixture leads-first through the mounting hole and secure with nut from the back side. A large/long tie-wrap or piece of cable lace can be used to tie leadwire behind the panel to an adjacent instrument case so that inadvertent tugs on the lamp's leadwires don't break the fixture. Adjacent photos show how to terminate the warning light assembly to connector (7) using solder sleeve (11) and pins (8). The solder sleeve is installed using a heat gun.

5.4 Wiring Diagrams: Figures 7 and 8 show an exemplar power distribution diagram (black) in addition to wiring needed to install a 9005 Series device (red).

5.5 Wiring –101/-102 Kits: Wiring for these kits is illustrated in Figure 7. Installation of the auxiliary battery management feature is optional. 22AWG wire is recommended for all interconnections.

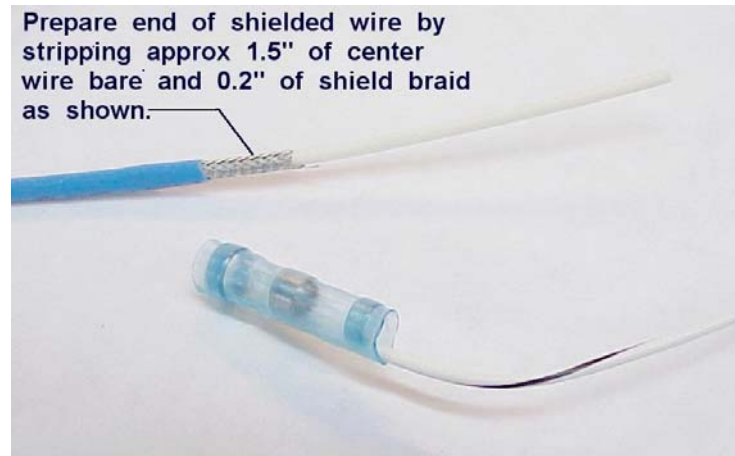


PIN LOCATIONS LOOKING INTO REAR OF FEMALE CONNECTOR

9005 Series Modules - Connector Pin-out List		
Pin #	9005-100-1/3 Modules	9005-110-1/3 Modules
1	Aux Battery Relay (-)	Incandescent LV Warn Annunciator (-)
2	LED LV Warn Annunciator (+)	LED LV Warn Annunciator (+)
4, 5, 9	(+) Bus Volts in/out	(+) Bus Volts in/out
3, 6, 7, 8	Ground	Ground

5.6 Wiring –201/-202 Kits: Wiring for these kits is illustrated in Figure 8. 22AWG wire is recommended for all interconnections.

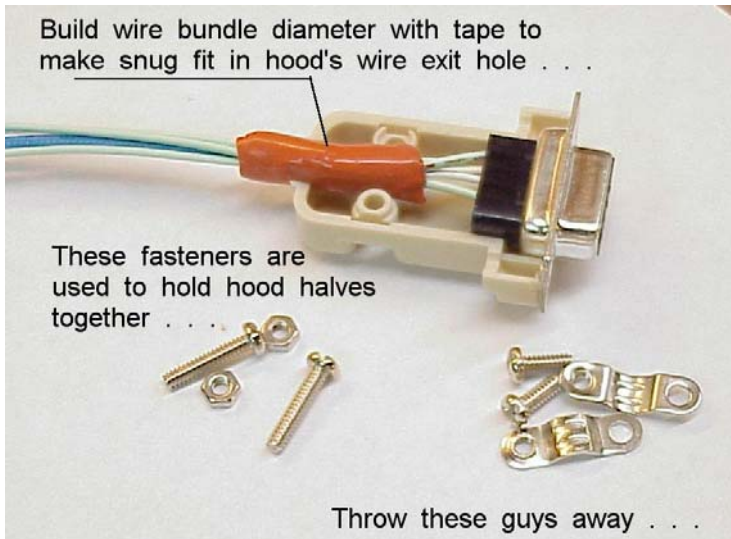
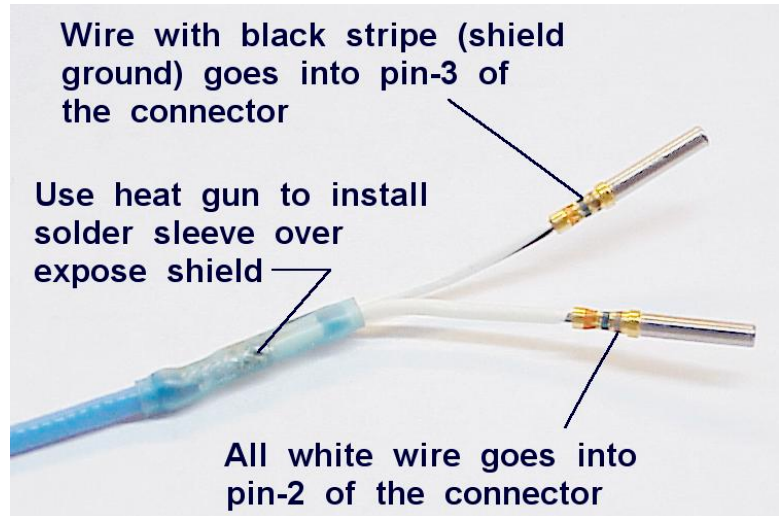
5.7 D-sub Connector: All kits are supplied with a 9-pin, crimped pins style connector housing (7) and a quantity of female, machined pins (8). These pins can be installed on wires ranging from 20 to 24AWG using a 4-quadrant crimp tool as called out in Section 4.



Prepare end of shielded wire by stripping approx 1.5" of center wire bare and 0.2" of shield braid as shown.

5.8 Pin numbers layout for the connector is illustrated in the adjacent figure.

5.9 When all wiring is installed in the connector, wrap the wire bundle with silicon or plastic tape to build its diameter to a snug fit in the cable exit hole on the connector hood (9).

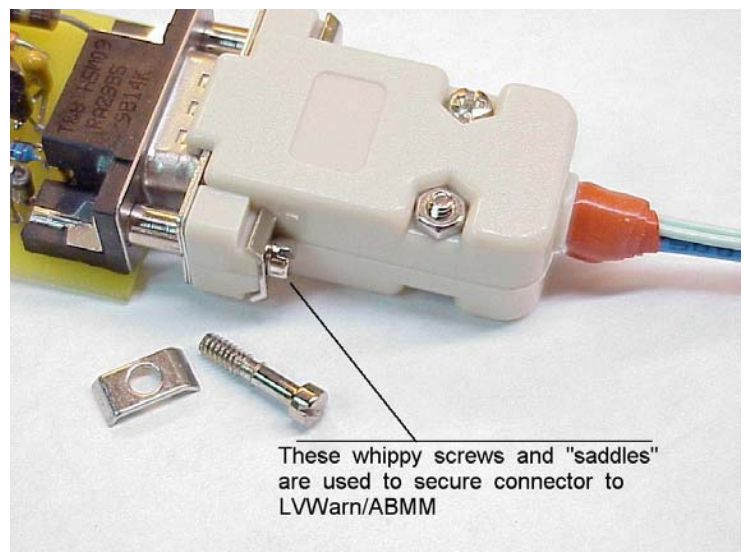


5.10 Assemble hood over connector as shown in adjacent photo.

5.11 Attach connector to LVWarn/ABMM using jackscrews as shown in adjacent photo.

6. OPERATIONAL CHECKOUT

- 6.1 Set DC PWR MASTER switch ON, bus voltage powered with battery only will be somewhere below 13.0 (26.0) volts.
- 6.2 The LOW VOLTS annunciator flashes.
- 6.3 Start engine and move DC PWR MASTER switch to BAT+ALT.
- 6.4 Bus voltage should be above 13.0 (26.0) volts. The LOW VOLTS warning lamp is dark.



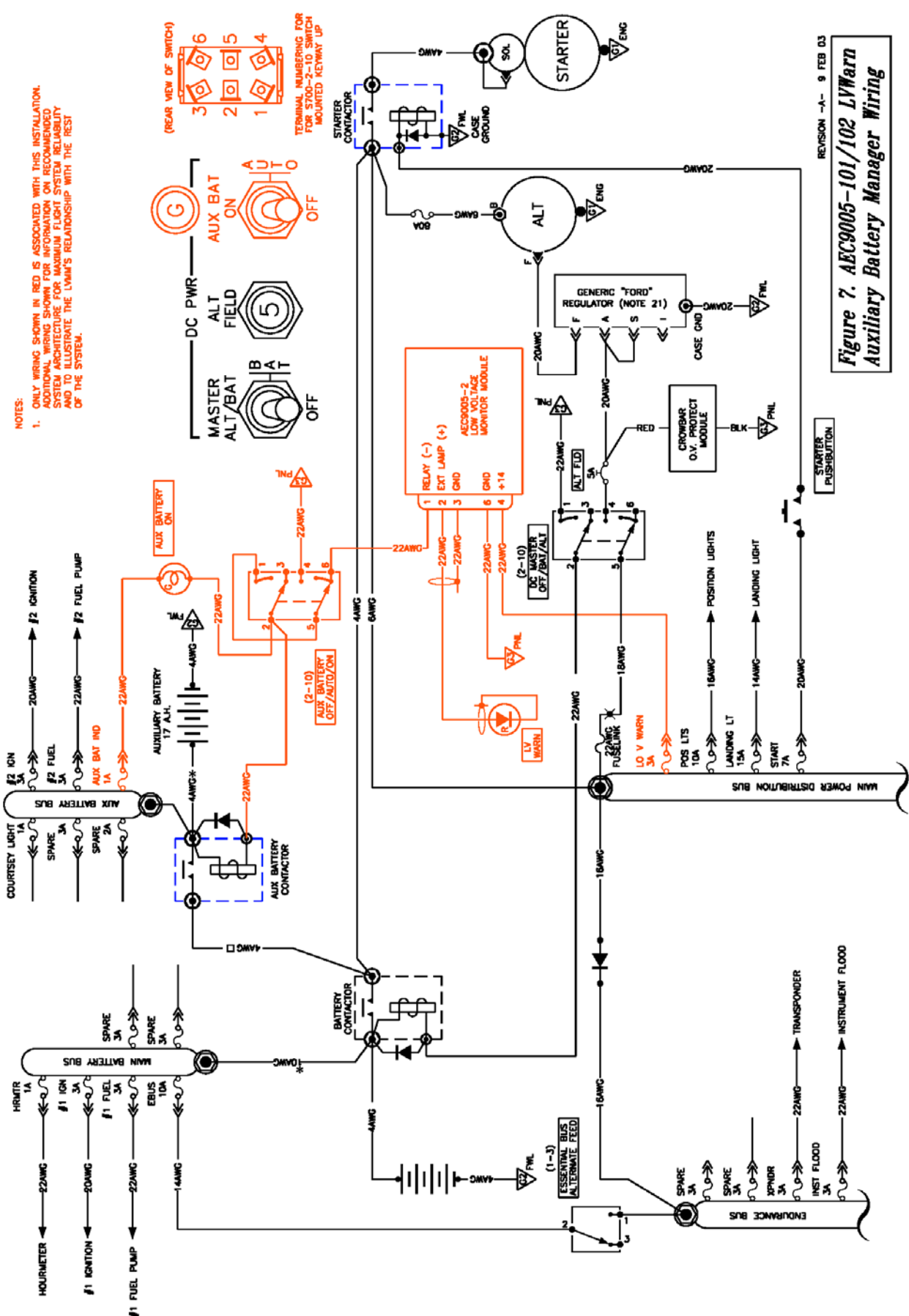
- 6.5 If the Auxiliary Battery Management feature is installed, moving the AUX BAT MASTER switch to auto should close the auxiliary battery contactor and illuminate the AUX BAT annunciator lamp.
- 6.6 With the engine running, move DC PWR MASTER switch to BAT. Bus voltage drops showing alternator is off line. In a few seconds, the LOW VOLTS annunciator begins to flash. If the auxiliary battery management feature is installed – AND- the AUX BAT MASTER switch is in AUTO, the AUX BAT annunciator lamp will go dark indicating that the auxiliary battery contactor has opened

7 System operating instructions

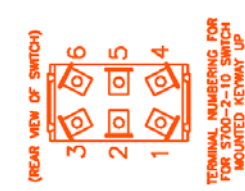
- 7.1 The following information should be incorporated at appropriate places into your checklist, normal and abnormal operating procedures:
- 7.2 When the DC PWR MASTER switch is first turned on, the LOW VOLTS WARN light should be flashing.
- 7.3 If the optional auxiliary battery management feature is installed and the auxiliary battery is capable of aiding the main battery for engine starting, the AUX BAT MASTER switch should be ON during engine cranking.
- 7.4 If the optional auxiliary battery management feature is installed and the auxiliary battery is not rated for aiding the main battery for engine starting, the AUX BAT MASTER switch should be OFF during engine cranking.
- 7.5 When the engine is running and the alternator is on line, the LOW VOLTS WARN annunciator should be dark.
- 7.6 If the LOW VOLTS WARN light should illuminate in flight, steps should be taken to configure your system for alternator-out operations. Depending on your systems features, this may include setting the E-BUS ALT FEED switch to ON, setting DC PWR MASTER switch to OFF and setting AUX BAT MASTER switch to OFF for continued flight in the maximum endurance mode for battery only operations.

8 SYSTEM MAINTENANCE

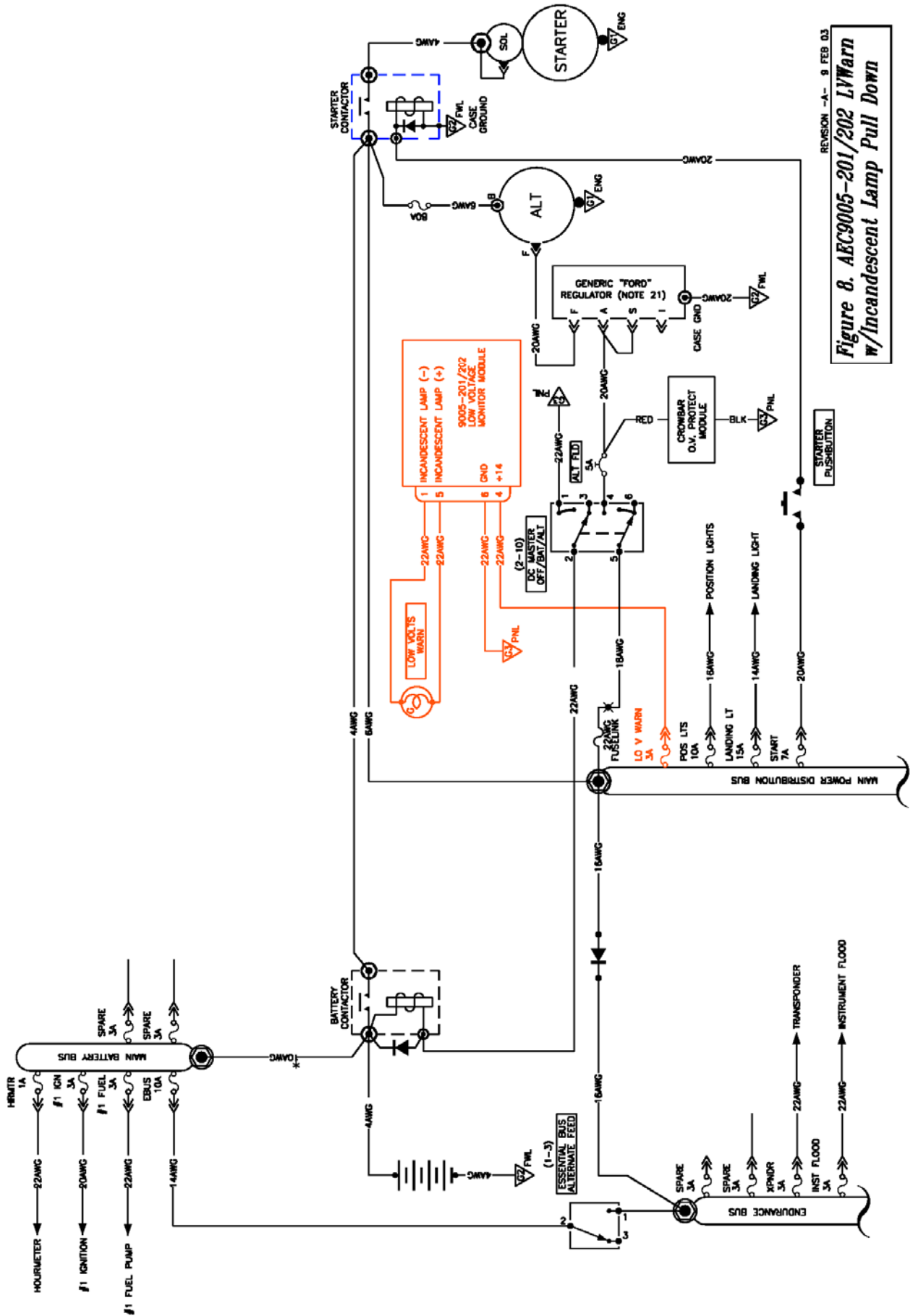
All products installed with these instructions are free of any adjustments requiring periodic re-calibration. Components that control calibration of the LV Warn trip point are precision devices with very low drift and long service life. The system is well with every flight cycle so that abnormal behavior is readily detected. Therefore, no periodic or preventative maintenance activities are recommended for the AEC9005 series products.



NOTES:
 1. ONLY WIRING SHOWN IN RED IS ASSOCIATED WITH THIS INSTALLATION. ADDITIONAL WIRING SHOWN FOR INFORMATION ON RECOMMENDED SYSTEM ARCHITECTURE FOR MAXIMUM FLIGHT SYSTEM RELIABILITY AND TO ELABORATE THE LVMM'S RELATIONSHIP WITH THE REST OF THE SYSTEM.



REVISION -A- 9 FEB 03
Figure 7. AEC9005-101/102 LVWarn Auxiliary Battery Manager Wiring



REVISION -A- 9 FEB 03

Figure 8. AEC9005-201/202 LVWarn w/Incandescent Lamp Pull Down



Bob's Shop Notes: Low Voltage Warning and Aux Battery Management Module (ABMM)

This issue of Bob's Shop Notes will describe a technique for assembling your own low voltage warning module with an auxiliary battery management option. **The schematic and parts list can be viewed by [Clicking here](#)**. This circuit is designed to use the very long lived, robust light emitting diode as a LOW VOLTS warning light. Working with these little marvels can be a challenge . . . they're not especially user friendly with respect to mounting on an instrument panel.

The comic-book below will describe some techniques used here in our shop to mount these critters.

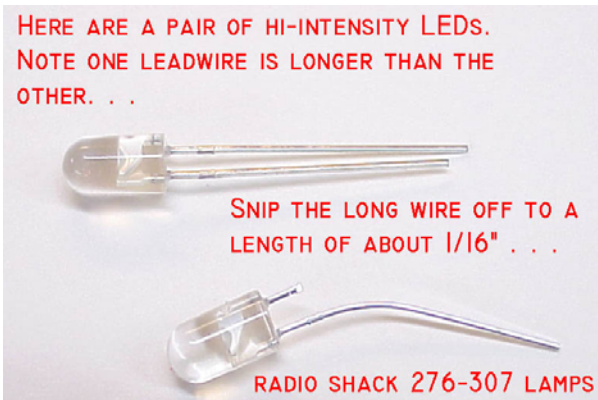
Leadwire Attachment Option 1 . . .

[Click here for larger image.](#)

LED's offer some really neat, solid state alternatives for illumination and annunciation. Unlike the classic filament-inside-the-glass-bulb, LEDs run cooler, they offer several colors without having to filter the light, and they will probably run the lifetime of the airplane without need for replacement. In recent years, very high light output LEDs have become available for very attractive prices. I purchased a bag of 250 high intensity red LEDs out of a surplus catalog for \$25.00 . . . that's 10-cents each!

The problem with LEDs is the fact that they generally supplied as a glob of plastic with two solid wire leads. You need need a robust method for both attaching leadwires -AND- mounting on your instrument panel. This document will present several variations on a theme for making both an electrical and mechanical connection to the common light emitting diode.

Our first task is to attach stranded wires to the lamp in such a manner that the joint is robust and ultimately protected from stresses of installation and operation. The (+) leadwire of an LED is slightly longer than the (-) leadwire. Let's begin by clipping the longest wire down to about 1/16" of an inch.



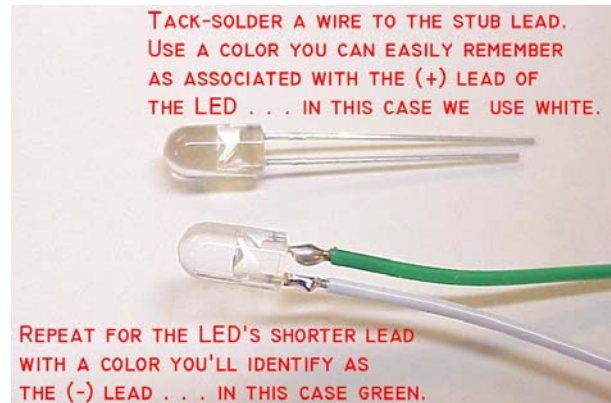
[Click here for larger image.](#)

LEDs are polarity sensitive so pick different colors of wire for the two leads. In this example I used a white wire for (+) and a green wire for (-). These colors happened to be handy scraps on the bench when I built the assemblies for photographing. Red and black are commonly used for (+) and (-) leadwires. Using colors that run with common conventions will make them easy to remember. Use any other colors you like but keep track of them.

Consider making these wires long enough to reach from the indicator's roost on the panel all the way to their future attach points. It's a good idea to limit the number of connections in any wire to those NECESSARY for installation and maintenance.

Strip the ends of each wire to be soldered to the LED to 1/16" and tin the exposed strands with solder. Tack solder the wire you've chosen for a (+) lead to the stub of the (+) we trimmed off above. Then cut the LED (-) lead to a 1/16" stub and tack-solder the selected (-) leadwire to the stub.

What we have now is an LED with very long but very fragile leads. It wouldn't take much vibration to break these fellers off the lamp . . . but we're going to fix that. At this point, you might wish to cover up these joints with short segments of small heat-shrink. Heat shrink will offer some relief from bending strain on the finished assembly leadwires but if you don't have any really small heatshrink, don't worry about it.



[Click here for larger image.](#)

One of my favorite ways to extend connections on and LED is with shielded wire. NOTE: There is no performance advantage for using shielded versus un-shielded wires, there is only a mechanical convenience which will become apparent to you.

I begin by preparing the end of the shielded wire to expose 1/16" of center conductor, 1/16" of center insulation and 1/8" of shield braid. Tin the center conductor strands with solder as shown.



TACK-SOLDER CENTER CONDUCTOR TO STUB OF "LONG" LEAD. THEN WRAP "SHORT" LEAD AROUND EXPOSED SHIELD BRAID AS SHOWN . . .



SOLDER LED'S "SHORT" LEAD TO SHIELD BRAID.

[Click here for larger image.](#)

Clip the LEDs longest (+) lead to 1/16" and tack-solder the center conductor of the shielded wire to it. Hold the lamp in with the tip of needle nosed pliers so that you have a grip on about 1/8" of exposed leads right up next to the lamp's base.

Wrap the LED's full length (-) lead around the shield braid as shown and solder it as well.

[Click here for larger image.](#)

If you've got some 1/8 or 3/32" heatshrink handy, shrink an inch or so piece of it down over the finished joints.



COVER JOINTS WITH SHORT PIECE OF HEAT SHRINK.

Fixture Option A . . .

[Click here for larger image.](#)

FILL REAR CAVITY ABOUT 2/3 FULL OF 5-MINUTE EXOXY. PUSH LED INTO THE CAVITY AND FIXTURE TO KEEP THE LEAD WIRE CENTERED WHILE THE EPOXY SETS.



THIS IS A RADIO SHACK 272-340 FIXTURE (2 TO A PKG). DISCARD THE LAMP SOCKET AND WHITE DOMES. INSTALL TRANSPARENT RED DOMES AND INSTALL LED AS DESCRIBED ABOVE.

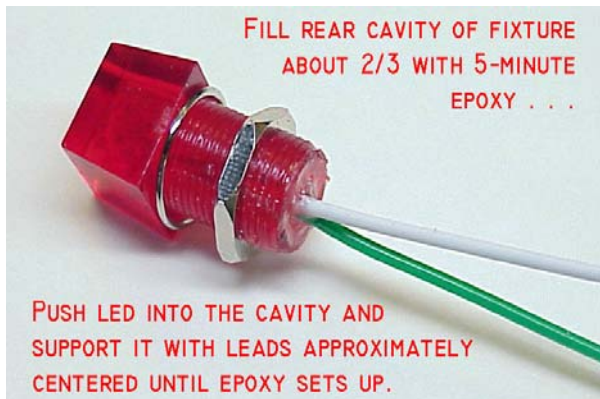
Here's one way to finish your LED indicator assembly. A Radio Shack 272-340 blister pack will get you a pair of lamp fixtures that come with your choice of translucent white or clear red domes. I've removed and discarded the socket for a screw-based incandescent lamp leaving us just bright metal, threaded mounting bushing and a clear red dome.

Fill the fixture about 2/3 full of 5-minute epoxy and then push your new long-lead LED into the epoxy. Fixture until the epoxy sets up. Our previously fragile leadwire connections are completely enclosed and firmly supported by the epoxy.

Fixture Option B . . .

[Click here for larger image.](#)

A Radio Shack 272-704 blister pack gets you a pair of plastic indicator lamps with neon bulbs. The assembly includes a resistor so that the 65v neon lamps can be operated from 115VAC. Use a hack-saw or hobby-saw to cut the smooth barrel portion of the fixture from the threaded portion.



[Click here for larger image.](#)

Fill the fixture about 2/3 full of 5-minute epoxy and then push your new long-lead LED into the epoxy. Fixture until the epoxy sets up.

Finished Product . . .

[Click here for larger image.](#)

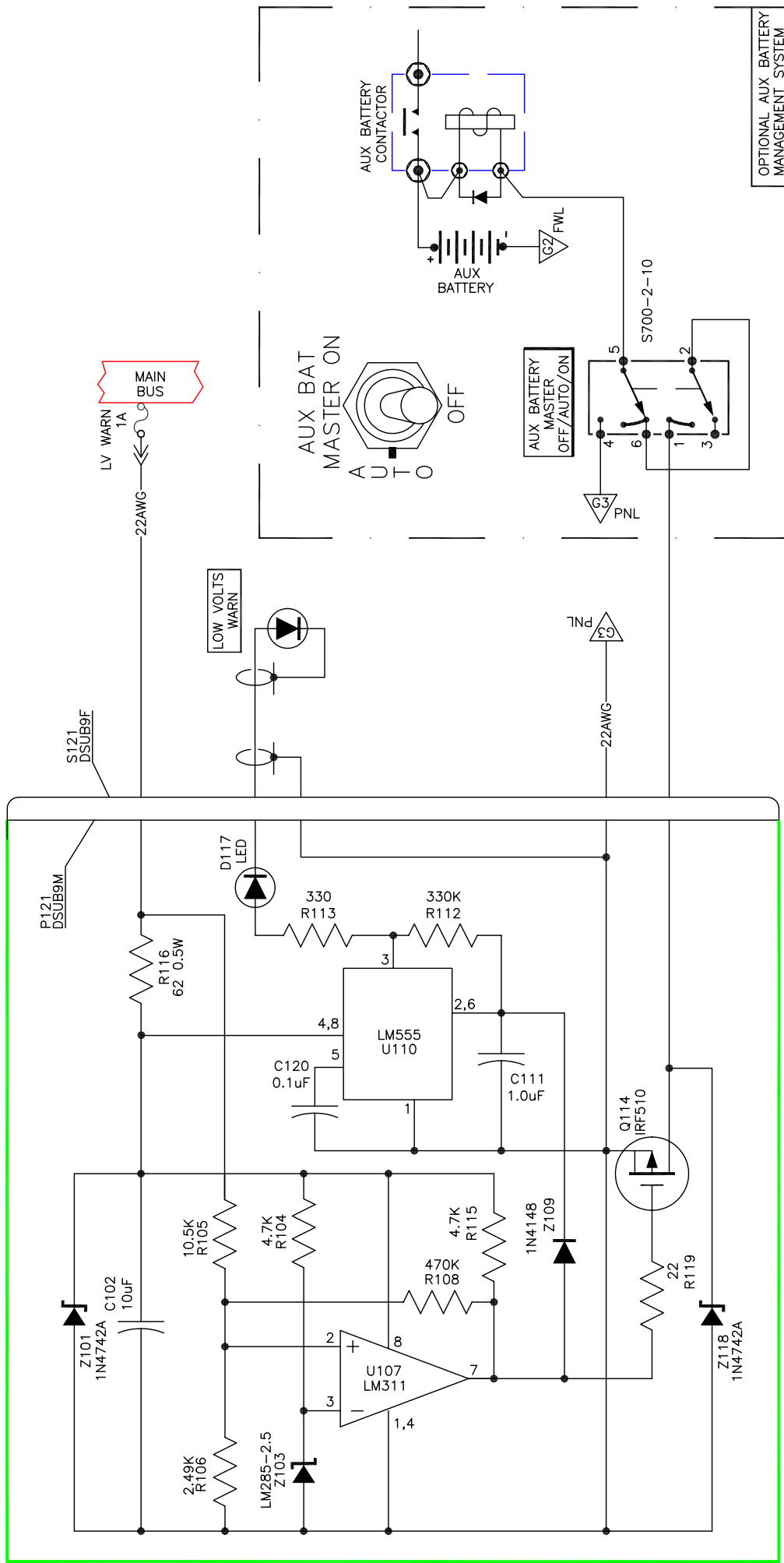
These basic techniques can be applied to many combinations of off-the-shelf lamp fixtures and LEDs. The technique is in-expensive and easy to try out for combinations other than those shown here.



Questions or comments about this site?



[Click here to contact Bob at AeroElectric Connection](#)



UNLESS OTHERWISE SPECIFIED		DATE	
DIMENSIONS ARE IN INCHES		9/14/2	
TOLERANCES ARE:		NUCKOLLS	
DECIMAL 0.XX = ±0.03		9/14/2	
DECIMAL 0.XXX = ±0.005		NUCKOLLS	
ANGLES = ±2 DEGREES		9/14/2	
DRAWN	CHECK	PROJECT	APPROVED
NUCKOLLS	NUCKOLLS	NUCKOLLS	NUCKOLLS
TITLE		DRAWING NO.	
AeroElectric Connection		9021-620	
www.aeroelectric.com		REVISION A	
TITLE		DATE	
SCHEMATIC DIAGRAM -		10/2/3	
LOW VOLTAGE WARNING AND		PAGE 1 OF 2	
AUX BATT MANAGEMENT MODULE		JOB NO.	
SCALE		NOTED	

BILL OF MATERIALS

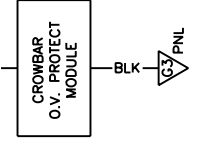
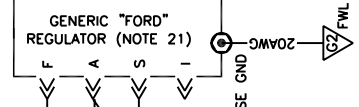
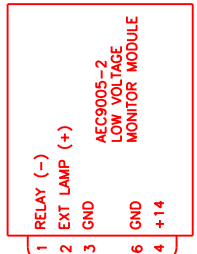
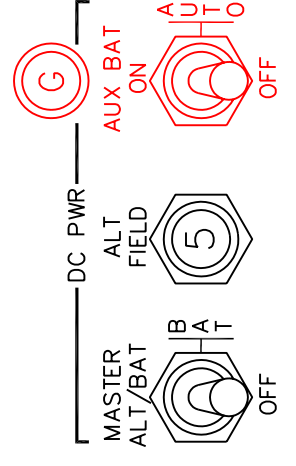
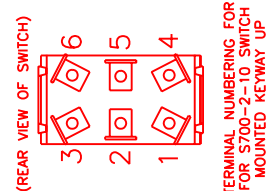
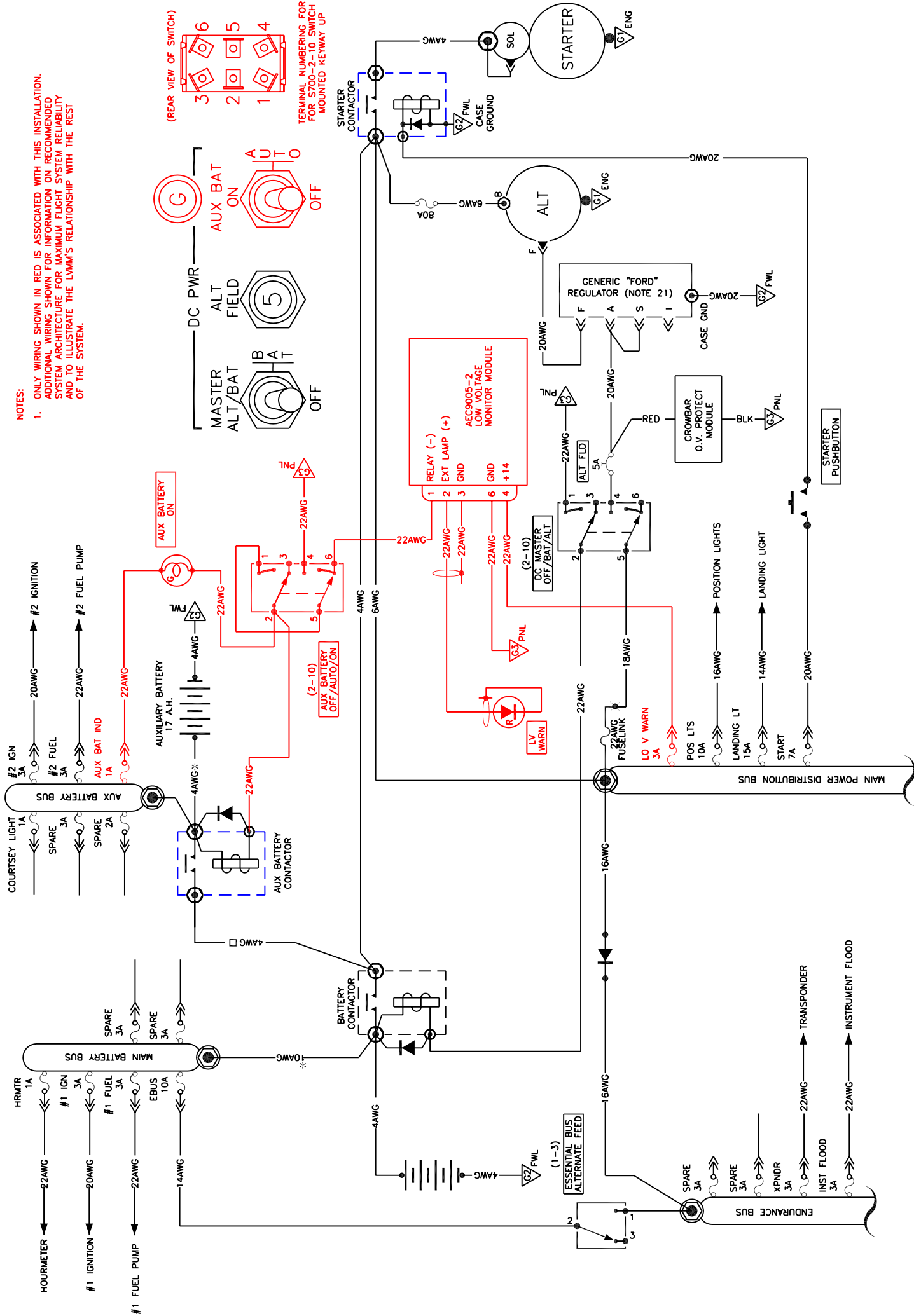
REF	P/N	DESCRIPTION	DIGIKEY CATALOG NUMBER
Z101	1N4742A	12V, 1W ZENER DIODE	1N4742AMSCT
C102		10uF, 16V TANTALUM CAP	P2038
Z103	LM285Z-2.5	2.5V REFERENCE DIODE	LM285Z-2.5
R104		4.7K, 1/4W, 5% RESISTOR	4.7KQBK
R105		10.5K, 1/4W, 1% RESISTOR	10.5KXBK
R106		2.49K, 1/4W, 1% RESISTOR	2.49KXBK
U107	LM311N	COMPARATOR, 8-DIP	LM311NNS
R107		470K, 1/4W, 5%	470KQBK
D109	1N4148	SMALL SWITCHING DIODE	1N4148DICT
U110	LM555	TIMER, 8-DIP	LM555CNNS
C111		1.0uF, 16V TANTALUM CAP	P2015
R112		330K, 1/4W, 5% RESISTOR	330KQBK
R113		330 OHM, 1/4W, 5% RESISTOR	330QBK
Q114	IRF510	N-CHANNEL, 100V, 5A PWRMOS	IRF510
R115		4.7K, 1/4W, 5% RESISTOR	4.7KQBK
R116		62 OHM, 1/2W, 5%, RESISTOR	62H
D117		HIGH BRIGHT LED	276-307 (RADIO SHACK)
Z118	1N4742A	12V, 1W, 5% ZENER DIODE	1N4742AMSCT
R119		22 OHM, 1/4W, 5% RESISTOR	22QBK
C120		0.1uF, 50V CERAMIC CAP	P4924
P121		9-PIN, DSUB MALE	A23139
S122	276-1428	9-PIN, DSUB FEMALE	276-1428 (RADIO SHACK)

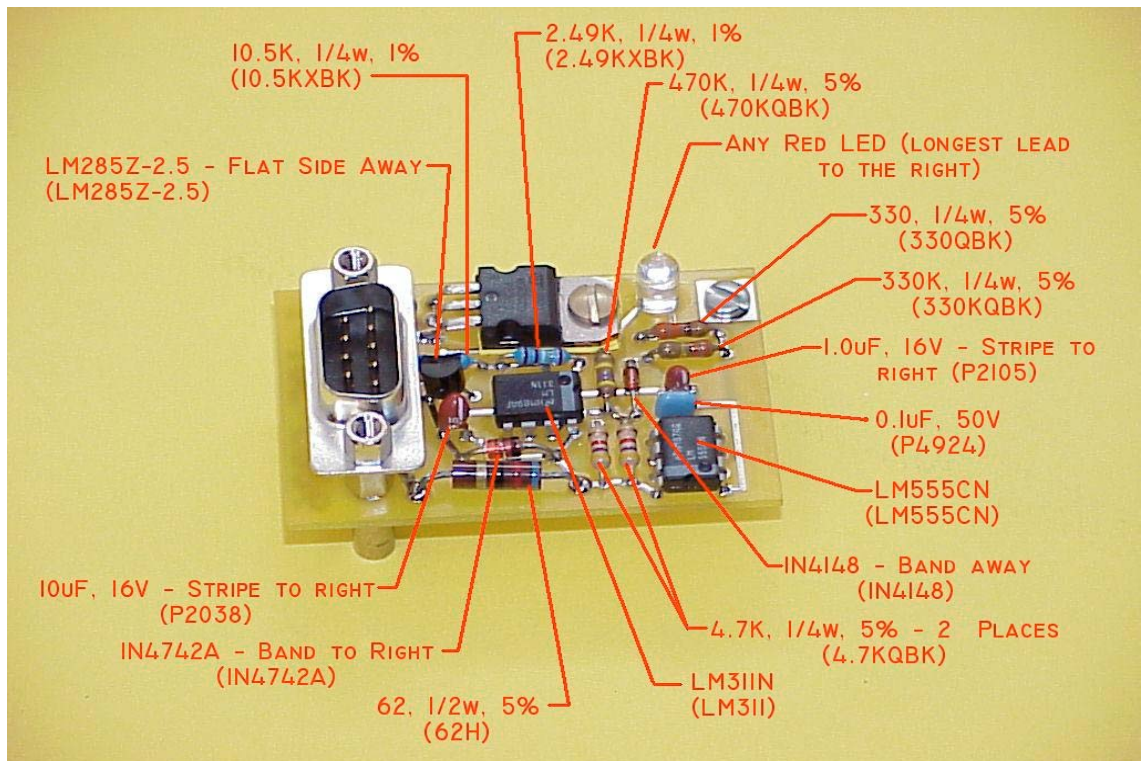
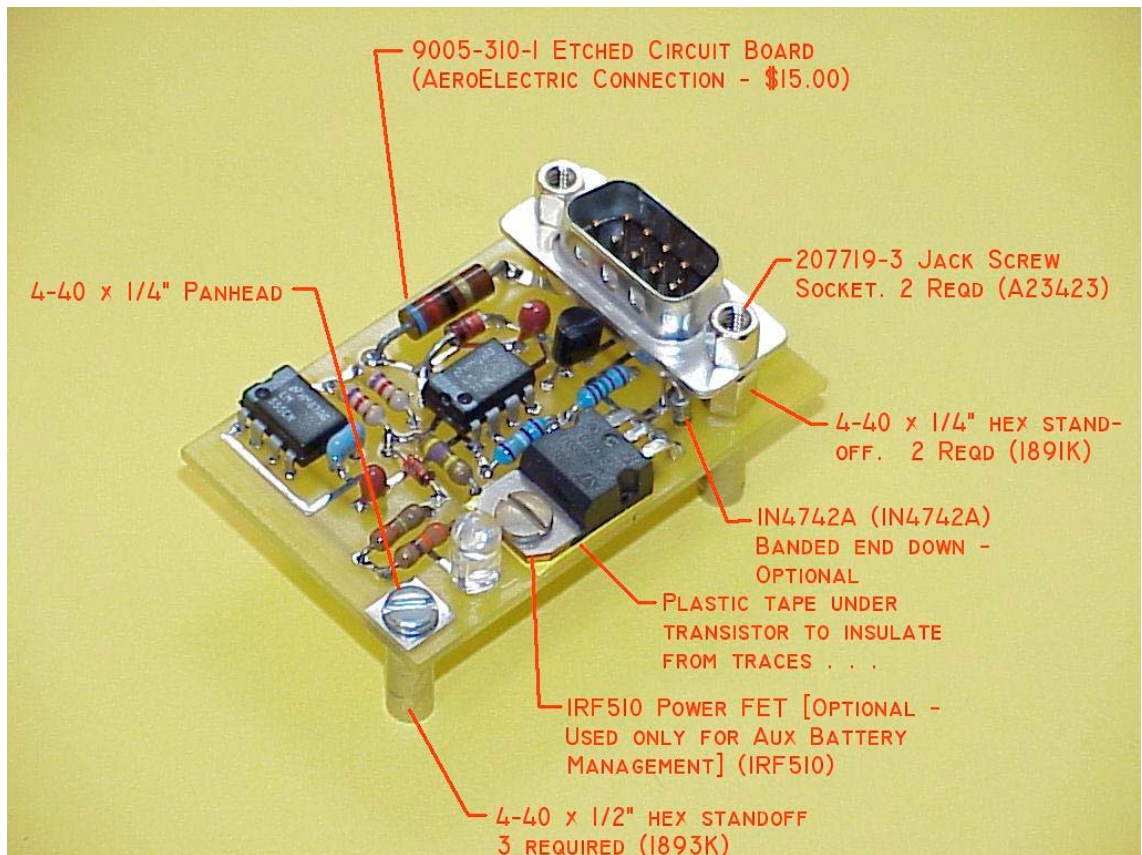
NOTES:

(1) IF YOU DO NOT PLAN TO USE THE AUX BATTERY MANAGEMENT FEATURE, Q114, R119 AND Z118 CAN BE OMITTED FROM THE ASSEMBLY.

UNLESS OTHERWISE SPECIFIED		AeroElectric Connection www.aeroelectric.com	
DIMENSIONS ARE IN INCHES		TITLE SCHEMATIC DIAGRAM -	
TOLERANCES ARE:		LOW VOLTAGE WARNING AND	
DECIMAL 0.XX = ± 0.03		AUX BATT MANAGEMENT MODULE	
DECIMAL 0.XXX = ± 0.005		DRAWING NO.	9021-620
ANGLES = ± 2 DEGREES		REVISION	A
DRAWN	NAME	DATE	10/2/3
CHECK	NUCKOLLS	9/14/2	
PROJECT	NUCKOLLS		
APPROVED	SCALE	NOTED	JOB NO.
			PAGE 2 OF 2

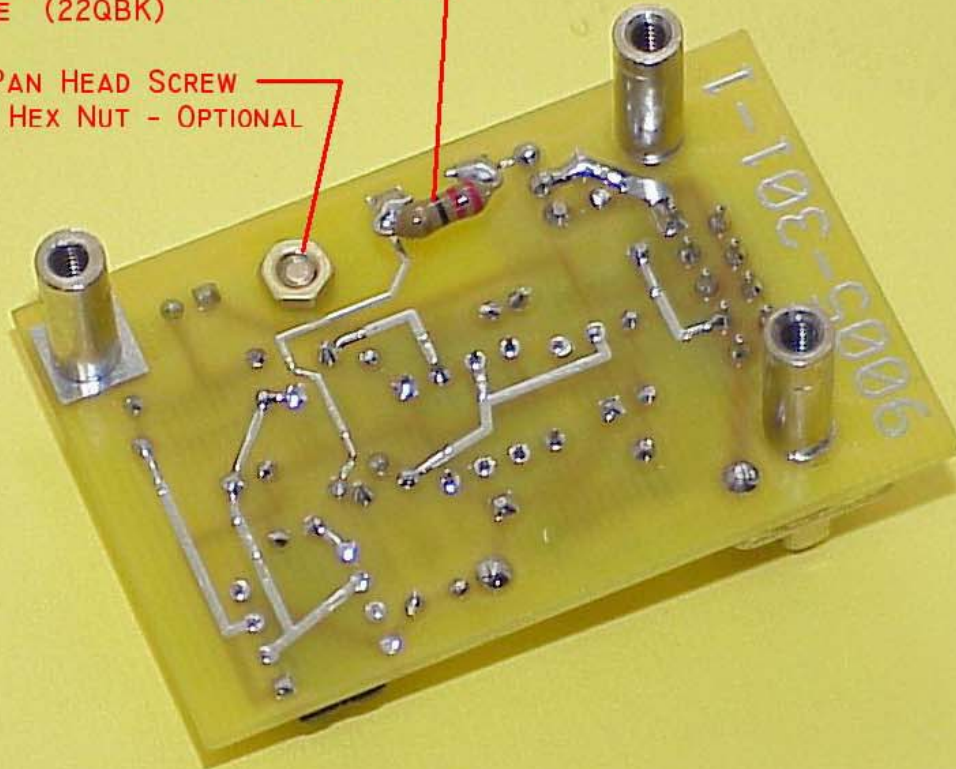
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22, 1/4W, 5% - OPTIONAL. USED ONLY ON AUX BATTERY MANAGEMENT MODULE (22QBK)

4-40 x 1/4" PAN HEAD SCREW
4-40 x 3/16" HEX NUT - OPTIONAL



VARIATION OF RESISTOR INSTALLATION FOR INCANDESCENT VERSION . . .

ANY 1/4W RESISTOR FROM 22 TO 220 OHMS. SLEEVE BARE LEADS WITH INSULATION STRIPPED FROM 22AWG TEFZEL WIRE

REMOVE SURFACE MOUNT RESISTOR BETWEEN THESE PADS . . .

