CHAPTER 24

ELECTRICAL POWER

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ELECTRICAL POWER – DESCRIPTION

1. General

This chapter describes the electrical power system and its operation. This covers the battery system, alternator system, and external power system.

The battery system consists of the battery, battery relay, and associated wiring. The alternator system consists of the alternator, voltage regulator, and alternator overvoltage protection diode. The external power system consists of the external power receptacle and associated wiring.

On AA5A-0523 and subsequent and AA5B-0693 and subsequent, the overvoltage diode is replaced by an overvoltage relay. Also an alternator warning light has been added to the instrument panel.

GENERAL ELECTRICAL INFORMATION - DESCRIPTION

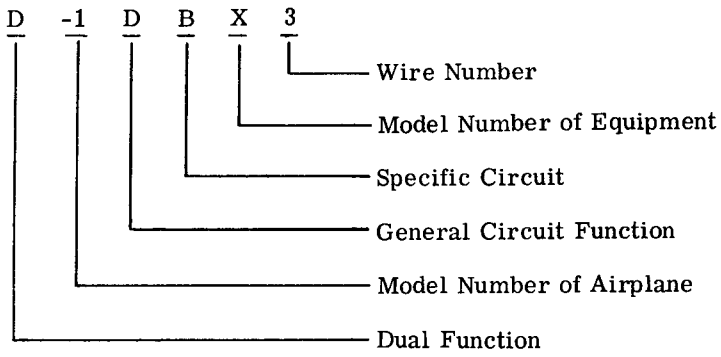
1. General

This section covers general aspects of design and construction common to all AA-5, AA-5A and AA-5B electrical systems. Details of actual systems are discussed in their appropriate section of this manual. The following information is intended to lay the ground work for a basic understanding of the overall electrical systems design so that maintenance personnel can better troubleshoot those systems causing difficulty.

2. Wire Identification

There are two schemes employed in assigning electrical wire codes. One scheme is used when several wiring diagrams are used. Another is used for color coding wires in the circuits specified in all radio systems and/or autopilots as applicable.

A. When multiple wiring diagrams are used for a model, the code is as follows:



(1) Dual Function: In the case of duplicate circuits performing the same function having the same circuit codes, wire sequence numbers are assigned in consecutive order for one of the circuits and then begin again at the source of power with the same circuit codes preceded by the coded letter "D".

(2) Model Number of Aircraft: A number is used to represent the aircraft model. In the case where a wire is used on both aircraft, both model numbers will be present.

(3) General Circuit Function: An alphabetical character used to indicate general system in which the wire is used.

(4) Specific Circuit: An alphabetical character used to indicate specific systems in which the wire is used.

(5) Model Number of Equipment: When required, a third letter will be used to designate model number of equipment.

(6) Wire Number: Wire sequence numbers are assigned to each individual wire within a circuit at the time of preparation of the wiring diagram. The sequence number shall be assigned in numerical order, beginning with the number one (1) for each specific circuit. Number of individual wires should begin at the source of power and run in consecutive order throughout the circuit.

CIRCUIT FUNCTION AND SPECIFIC CIRCUIT CODE LETTERS:

A - Unassigned

B - Photographic

C - Control Surface

- CA - Automatic Pilot
- CB - Not Used
- CC - Wing Flaps
- CD - Elevator Trim

D - Instrument (Other than Flight or Engine Instrument)

- DA - Ammeter
- DB - Flap Position Indicator
- DC - Clock
- DD - Voltmeter
- DE - Outside Air Temperature
- DF - Flight Hour Meter

E - Engine Instrument

- EA - Carburetor Air Temperature
- EB - Fuel Quantity Gage and Transmitter
- EC - Cylinder Head Temperature
- ED - Oil Pressure
- EE - Oil Temperature
- EF - Fuel Pressure
- EG - Tachometer
- EH - Torque Indicator
- EJ - Instrument Cluster

F - Flight Instrument

- FA - Bank and Turn
- FB - Pitot Static Tube Heater and Stall Warning Heater
- FC - Stall Warning
- FD - Speed Control System

N - Unassigned

O - Not Used

P - D. C. Power

- PA - Battery Circuit
- PB - Generator Circuits
- PC - External Power Source

Q - Fuel and Oil

- QA - Auxiliary Fuel Pump
- QB - Oil Dilution
- QC - Engine Primer
- QD - Main Fuel Pumps
- QE - Fuel Valves

R - Radio (Navigation and Communication)

- RA - Instrument Landing
- RB - Command
- RC - Radio Direction Finding
- RD - VHF
- RE - Homing
- RF - Marker Beacon
- RG - Navigation
- RH - High Frequency
- RK - UHF
- RL - Low Frequency
- RM - Frequency Modulation
- RP - Audio System and Audio Amplifier
- RR - Distance Measuring Equipment (DME)

S - Radar

T - Unassigned

U - Miscellaneous Electronic

V - Unassigned

W - Warning and Emergency

FE - Indicator Lights

G - Landing Gear

GA - Actuator

GB - Retraction

GC - Warning Device (Horn)

GD - Limit Switches

GE - Indicator Lights

H - Heating, Ventilating and De-icing

HA - Anti-icing

HB - Cabin Heater

HC - Cigar Lighter

HD - De-ice

I - Not Used

J - Ignition

JA - Magneto

K - Engine

KA - Starter

L - Lighting

LA - Cabin

LB - Instrument

LC - Landing

LD - Navigation

LE - Taxi

LF - Rotating Beacon

LG - Radio

LH - De-ice

LJ - Fuel Selector

M - Miscellaneous

MA - Cowl Flaps

MB - Electrically Operated Seats

X - A. C. Power

Y - Unassigned

Z - Unassigned

B. When color coding is employed, colors shall be assigned as tabled below:

FUNCTION CIRCUITS	GAUGE	BASE COLOR (or solid)	STRIPE COLOR
A+ Power	16	Red	None
	18	Red	Black
		Red	White
	20	Red	Green
	22	Red	Yellow
Ground	16	Black	None
	18	Black	White
Mike Ground	22	Black	None
Radio Lights Dim	18	Yellow	None
Mike Audio	22	Tan	None
		Tan (shielded)	None
Mike Key	22	White	Black
Radio Speaker	20	Green	None
Headphones	22	Blue	None
Dev +1	22	Gray	Red
Dev -1	22	Gray	Green

NOTES:

1. "Dev +" and "Dev -" circuits are for use in autopilots and any associated omni indicator circuit to which it connects.

2. All other color coded wires are for general use in multi-conductor radio and autopilot harness assemblies.

ELECTRICAL LOAD ANALYSIS

	CURRENT DRAIN AMPS	
CONTINUOUS LOADS		
Oil Temperature Gauge	0.50	
Fuel Gauge Light Left	0.03	
Fuel Gauge Light Right	0.03	
Fuel Gauge Left	0.10	
Fuel Gauge Right	0.10	
Battery Relay	0.60	
Flashing Beacon	11.00	
Pitot Heat	6.50	
Navigation Lights	4.52	
Instrument Lights	2.31	
Turn and Bank Indicator	0.30	
Hour Meter	0.50	
TOTAL	26.49	
SHORT TERM LOADS		
Stall Warning System	0.40	
Electric Fuel Pump	0.65	
Electric Flap Motor	15.00	max.
Courtesy Lights (2)	0.66	
Cigar Lighter	6.50	
Landing Light	7.30	
TOTAL	30.51	

ELECTRICAL LOAD ANALYSIS (Continued)

AVIONICS EQUIPMENT

Genave	REC	TRANS
Alpha-200 Transceiver	2.10	2.82
Alpha-200A Transceiver	2.10	2.82
Alpha-300 Transceiver	2.10	2.82
Alpha-360 Transceiver	1.18	3.10
Theta-100/200 ILS Converters	0.43	— —
Beta-500 X-Ponder	1.40	2.40
Beta-4096 X-Ponder	1.40	2.40
Tau-81 Audio Amp	1.00	— —
Delta-202 Marker Rec.	0.08	— —
Phi-20 Glideslope Rec.	0.15	— —

Narco	REC	TRANS
Escort-110 Transceiver	2.10	2.80
Com-10 Transceiver	0.66	2.16
Nav-10 Rec/Converter	0.82	— —
Com-11 Transceiver	0.66	2.16
Nav-11 Rec/Converter	0.62	— —
Nav-12 Rec/Converter/ILS	0.62	— —
Nav-14 Rec	0.92	— —
DGO-10DG/ILS/Converter	1.20	— —
ADF-31 ADF Receiver/Indicator	0.64	— —
ADF-32 ADF Receiver/Indicator	0.90	— —
U. G. R.-2 Glideslope Rec.	0.23	— —
MBT Marker Rec.	0.19	— —
AT-50 X-Ponder	1.10	1.10
Com-10A	0.96	2.50
Com-11A	0.96	2.50
Com-11B	0.76	3.50
Com-111	0.96	2.50
Com-111B	0.76	3.50
Nav-111	0.62	— —
Nav-112	0.62	— —
Nav-114	0.92	— —
PDF-35	0.93	— —
ADF-140	1.12	— —
UGR-2A	0.23	— —
UGR-3	0.23	— —
CP-25	0.41	— —
CP-25B	0.41	— —
CP-125	0.41	— —
AT-50A	1.60	1.60
DME-190	3.00	3.00
Com-120	.76	3.50
Nav-121	.55	— —
Nav-122	.55	— —
CP-135	.41	— —
AT-150 X-Ponder	1.60	1.60
ADF-141	1.12	— —

King	REC	TRANS
KX-170 Transceiver	1.00	3.00
KI-201C Omni Converter	0.10	— —
KI-211C ILS System	0.20	— —
KR-85 ADF Rec.	1.00	— —
KT-225 ADF Indicator	0.16	— —
KN-60C DME	3.00	3.00
KT-75 X-Ponder	1.80	1.80
KX-170A	1.26	4.50
KX-170B	1.38	4.50
KX-170BE	1.38	4.50
KX-175	1.26	4.50
KX-175BE	1.38	4.50
KT-76	1.30	1.30
KT-78	1.30	1.30
KI-214	0.34	— —
KMA-20/with Marker	1.40	— —
KR-86	0.66	— —
KX-175B	1.38	4.50
KI-203	0.10	— —
KI2-204	0.20	— —
KI-208	0.10	— —
KI-209	0.20	— —

Collins	REC	TRANS
VHF-150	.50	4.50
VHF-251	0.84	5.10
VIR-352	1.00	— —
VIR-351/IND-350/VHF-251	1.83	5.10
VHF-251/VIR-351/ IND-351/GLS-350	2.33	5.10
RCR-650/IND-650/ANT-650	1.10	— —
TDR-950	— —	— —
AMR-350	— —	— —

Edo-Aire Mitchell	REC	TRANS
Century I Autopilot	1.25	— —
Century IIB Autopilot	2.00	— —

GENERAL ELECTRICAL – MAINTENANCE PRACTICES

1. Diode Test

NOTE: Whenever a solenoid or switch is replaced that has a diode used with it, the corresponding diode should be checked. For accurate test, the diode must be disconnected from circuit.

A. Check diode as follows:

(1) Obtain an ohmmeter and set up on OHMS.

(2) Position the test leads across the diode and record the ohmic reading.

(3) Reverse the test leads and again record the ohmic reading.

(4) The first reading must be ten times greater or less than the second reading.

(5) Replace diodes not meeting (4) above.

ELECTRICAL POWER SUPPLY SYSTEM – DESCRIPTION/OPERATION

1. General

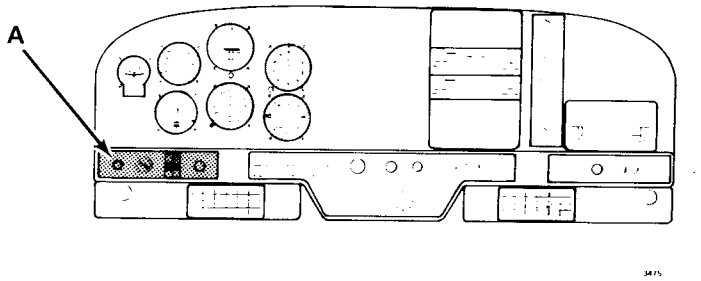
Power for the electrical system is provided by an alternator and/or battery. The alternator serves as the main component to power the electrical system and charge the battery during normal conditions. The battery is used for starting the engine and powering the electrical system when alternator power is not available (engine not running). The battery also powers the electrical system in case of alternator system failure.

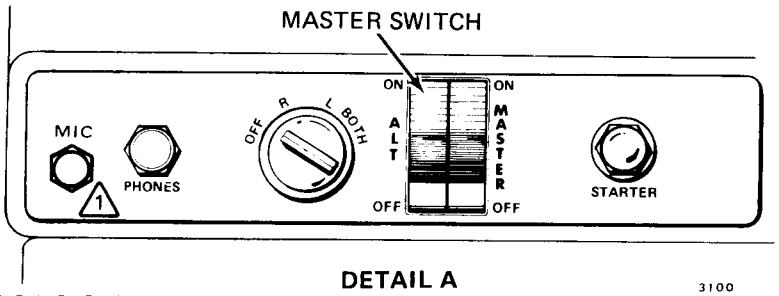
A split rocker type master switch is used which performs two functions. The right side energizes the battery relay and the left side supplies power to the voltage regulator. The battery relay, when energized, connects power to the electrical system and the starting system. The voltage regulator, receiving power from the battery via the master switch, energizes the alternator field. With the alternator field energized, the operating alternator will produce an output to the electrical system. The voltage regulator varies the output voltage of the alternator to meet the requirements of the electrical system loads. An ammeter is installed into the system to provide an indication of current flow from or to the battery.

An external power receptacle is offered as optional equipment to supplement the battery system for starting and ground operation.

Diodes are used in the aircraft electrical system across some relays and switches (including the master switch) to dissipate back EMF and provide extended relay life. These relays and switches will function with defective diodes, but their life will be shortened.

The negative side of the battery is connected to the aircraft structure (negative ground). This provides a ground for system through use of aircraft structure. The positive side of the battery is connected to the coil of the battery relay. This relay remains in a relaxed state until the master switch is placed to the ON position.





⚠1 1978 MODELS AND SUBSEQUENT
AA5A-0523 AND SUBSEQUENT
AA5B-0693 AND SUBSEQUENT

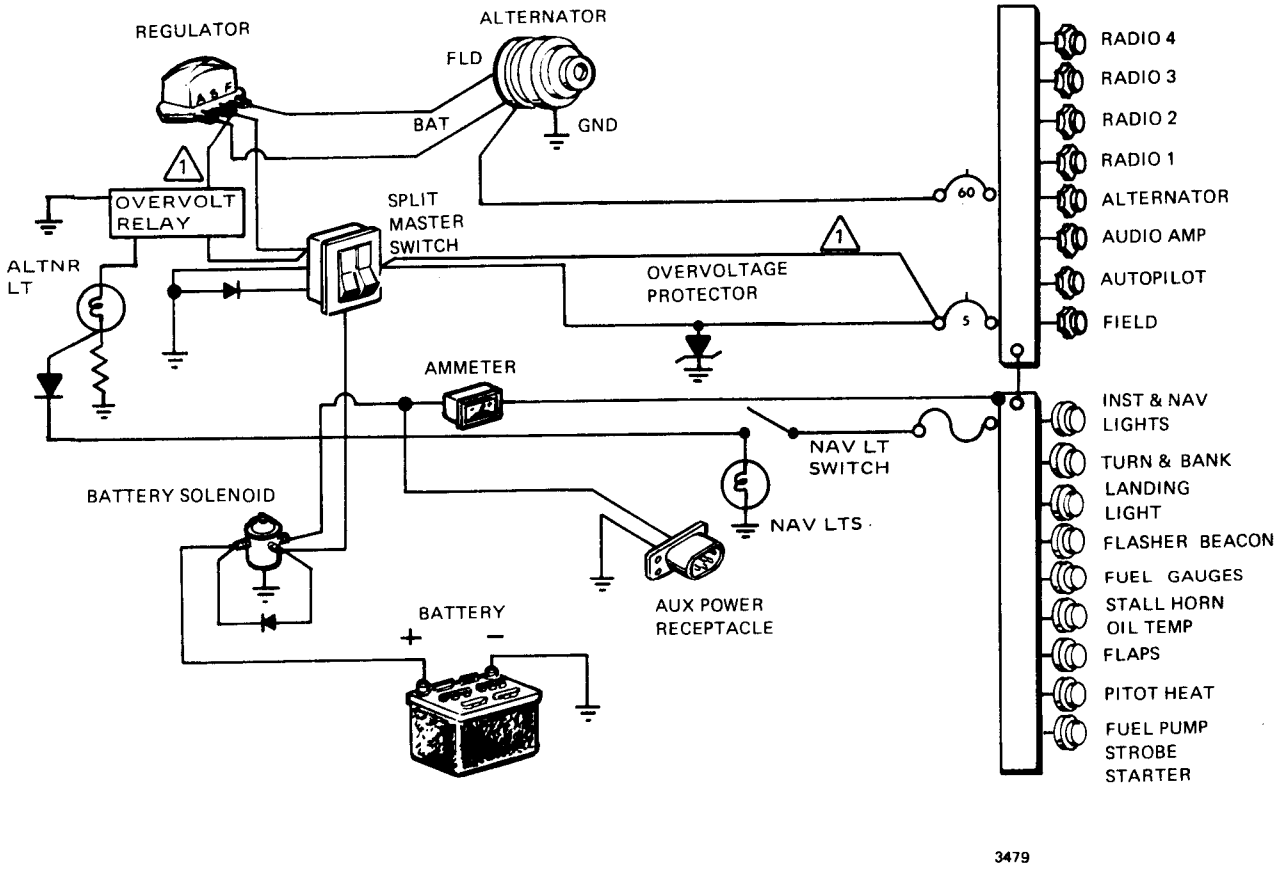
Master Switch
Figure 1

Placing the MASTER side of the split master switch in the ON position provides a ground for the battery relay energizing this relay. With the battery relay energized, a circuit exists from the battery through an ammeter to the bus bar.

The bus bar powers the electrical equipment and accessories furnished on the aircraft (excluding hourmeter, dome light, and clock). The energized relay will also allow power from the battery to the starter solenoid.

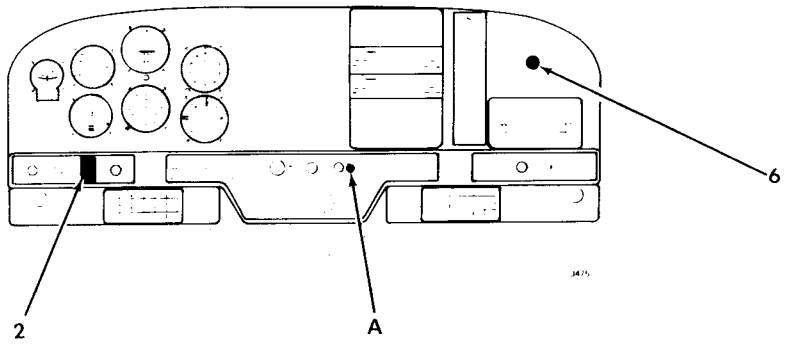
Placing the ALT side of the split master switch to the ON position will provide a circuit from the bus bar through a 5 amp alternator field circuit breaker to the voltage regulator. The voltage regulator will supply and regulate voltage to the alternator field. With the alternator operating (engine running) and the field energized, the alternator will develop electrical power. The alternator supplies power to the bus bar through a 60 amp alternator circuit breaker. An overvoltage diode in the alternator load protects the alternator against damage due to overload. With alternator power available, the battery will be charged by the alternator. The ammeter, which is in series with the battery and bus bar will indicate the current flow to the battery. When the battery reaches a state of full charge, the ammeter will show an indication of minimum rate.

AA5A-0523 and subsequent and AA5B-0693 and subsequent, the overvoltage diode is replaced by an overvoltage relay and an indicator light is placed on the instrument panel to alert the pilot of an overvoltage condition.

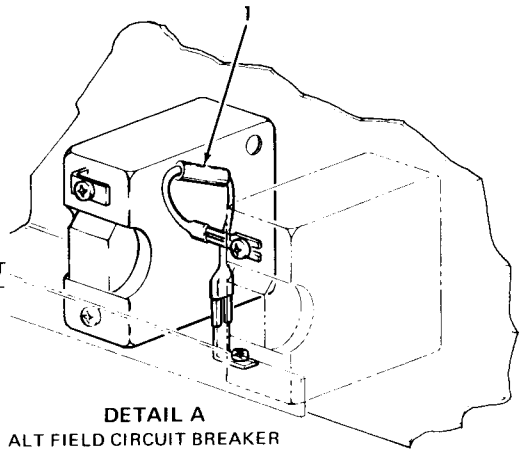


⚠1 1978 MODELS
AA5A-0523 AND SUBSEQUENT
AA5B-0693 AND SUBSEQUENT

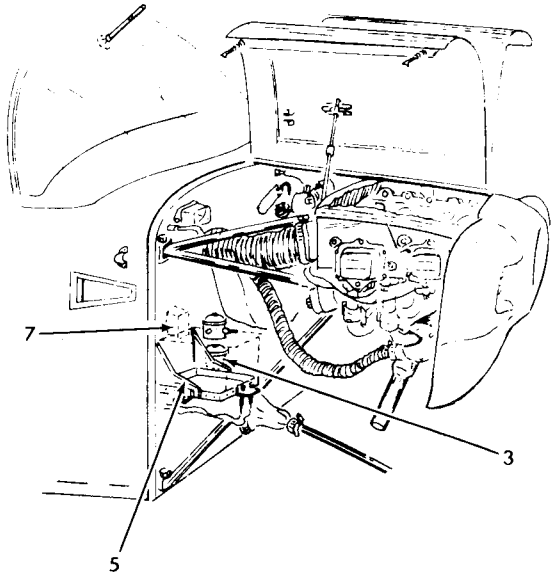
DC Power System
Figure 2

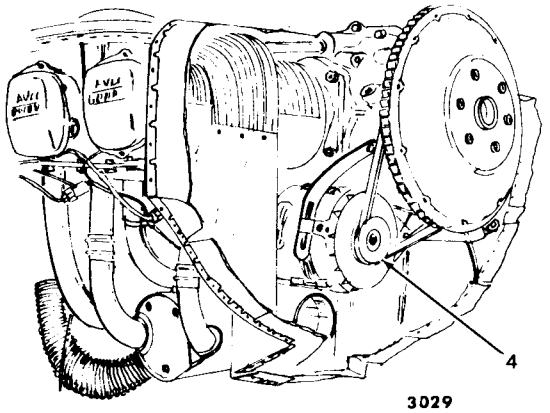


1. OVERVOLTAGE PROTECTION DIODE
2. MASTER SWITCH
3. BATTERY SOLENOID
4. ALTERNATOR
5. BATTERY
6. ALTERNATOR LIGHT } AA5A-0523 AND SUBSEQUENT
7. OVERVOLTAGE RELAY (INSIDE FIREWALL) } AA5B-0693 AND SUBSEQUENT

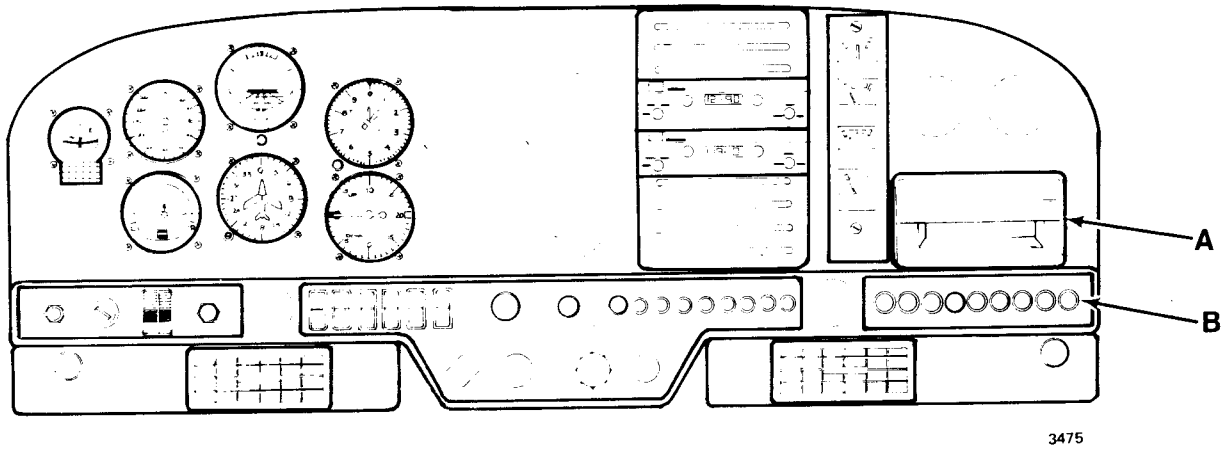


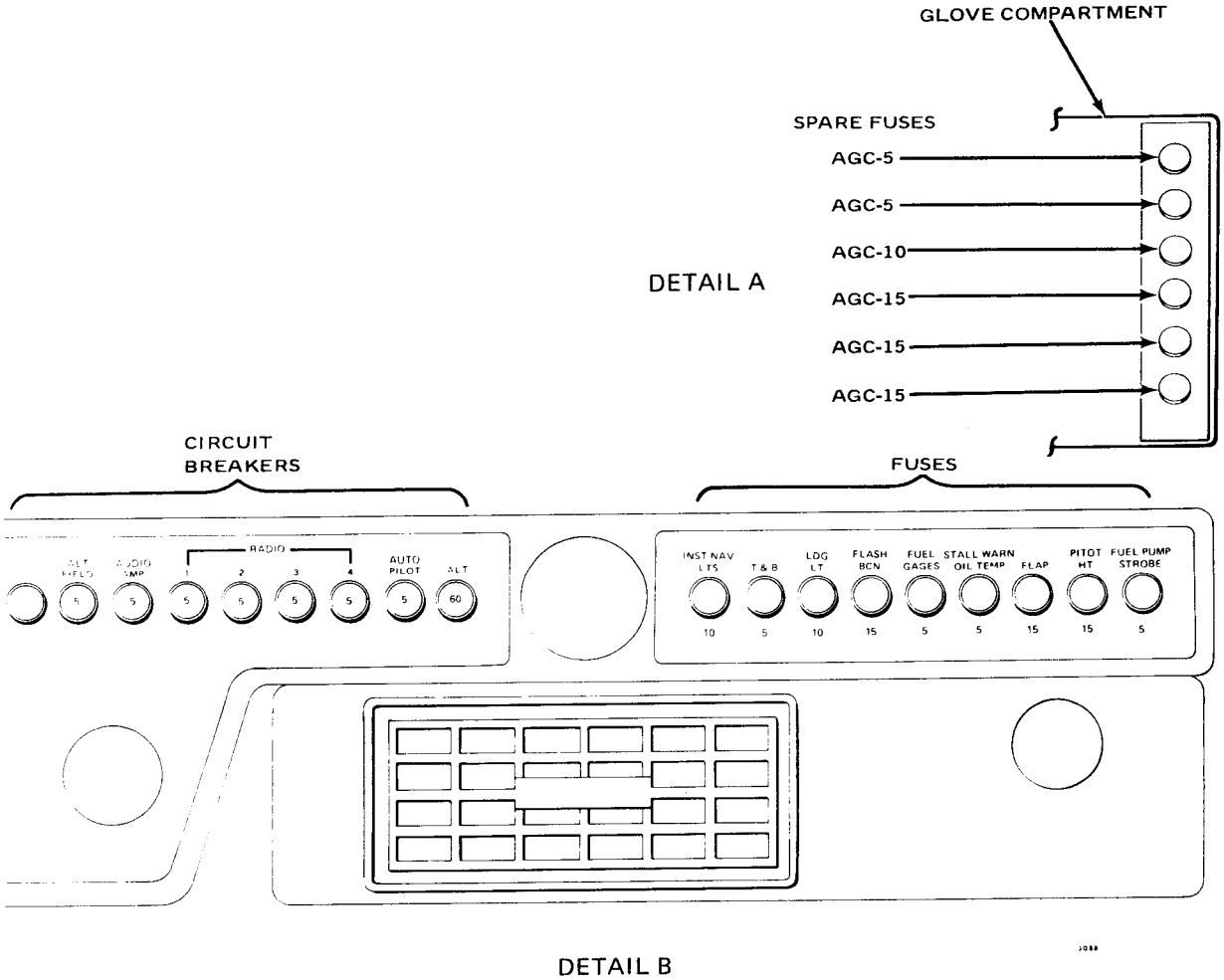
DETAIL A
ALT FIELD CIRCUIT BREAKER
(REAR OF INSTRUMENT PANEL)





Electrical Component Location Chart
Figure 3





DETAIL B

Circuit Breaker and Fuse Panel — Locations
Figure 4

BATTERY SYSTEM – DESCRIPTION/OPERATION

1. General

The battery system consists of the battery, a battery relay, ammeter, switch, circuit breakers and wiring.

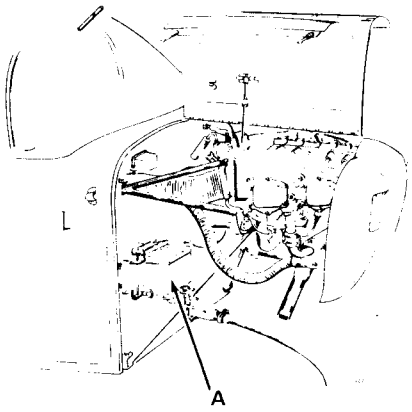
2. Battery (See Figure 1.)

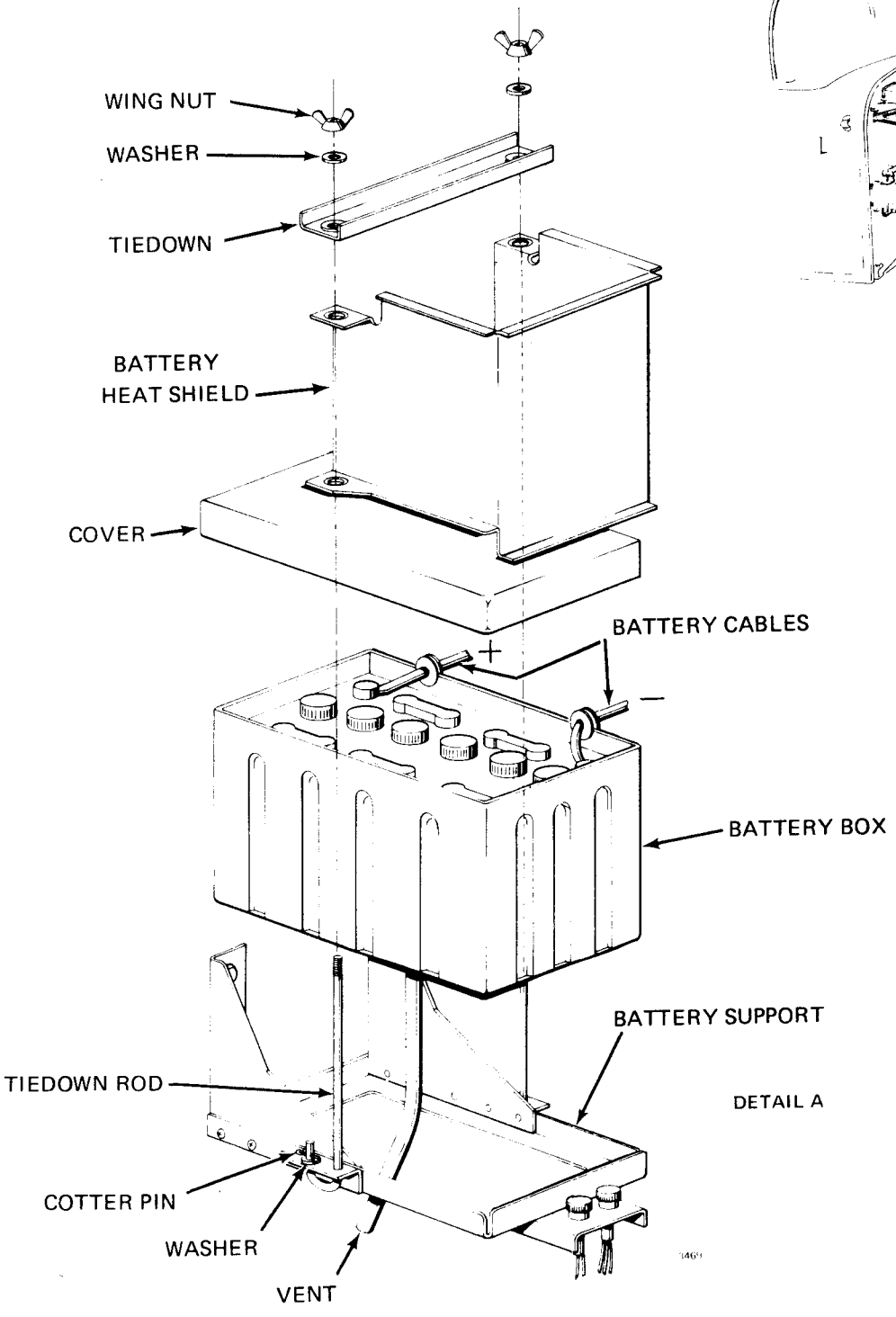
The battery is a 12V, 25 ampere hour, dry-charge type. The battery is located on the right forward side of the firewall. The battery is used to provide engine starts and supply power to the electrical system when alternator power is not available. The battery is also used as an emergency supply in the event of alternator failure.

Under normal use, a battery being charged and discharged will decompose the water from the electrolyte by electrolysis. When the water is decomposed, hydrogen and oxygen gases are formed which escape into the atmosphere through the battery vent system. The low water level is caused by this decomposition of water from the electrolyte. Distilled water should be added as necessary to maintain the electrolyte level. An ammeter is incorporated into the battery system to indicate the current flow either to or from the battery. The ammeter is wired in series from the battery to the bus. Current will flow from the battery to the bus to power the electrical system when alternator power is not available. This will give a negative indication on the ammeter. With the alternator on the line, the flow of current will be to the battery. This will show a positive indication on the ammeter. The rate of charge (positive indication) will vary at the demand of the battery.

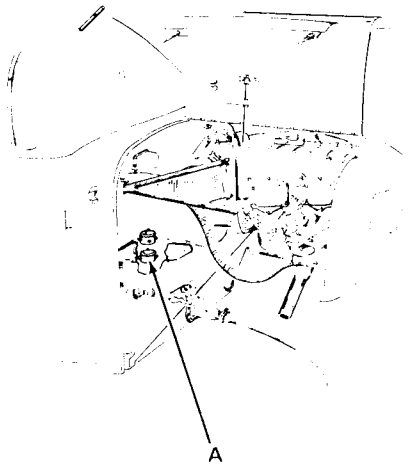
3. Battery Relay (See Figure 2.)

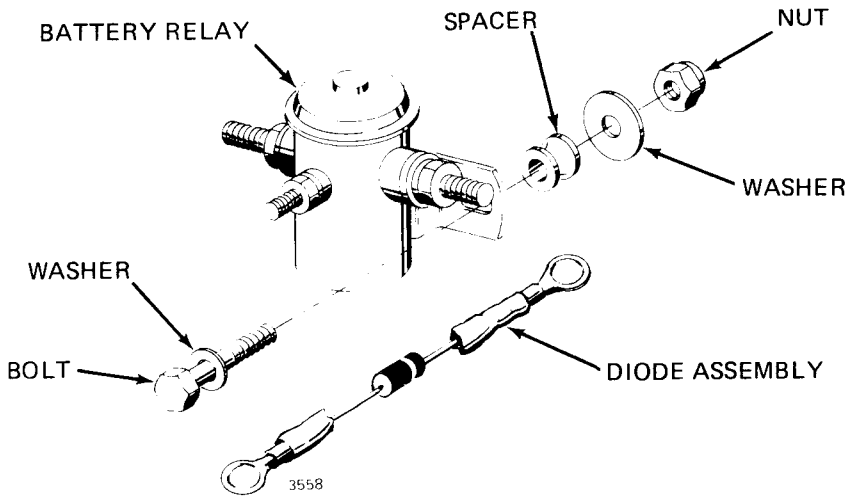
The battery relay is located on the right side of the forward firewall. The relay is a plunger type which is actuated when the master switch is placed to the ON position. With the master switch in the OFF position, the relay isolates the battery from the electrical system. A diode is used across the relay to dissipate back EMF and provide extended relay life. The relay is energized when the master switch is placed to the ON position. A circuit is completed between the battery, through an ammeter to the bus bar. The relay, when energized, also provides a circuit to the starting system.





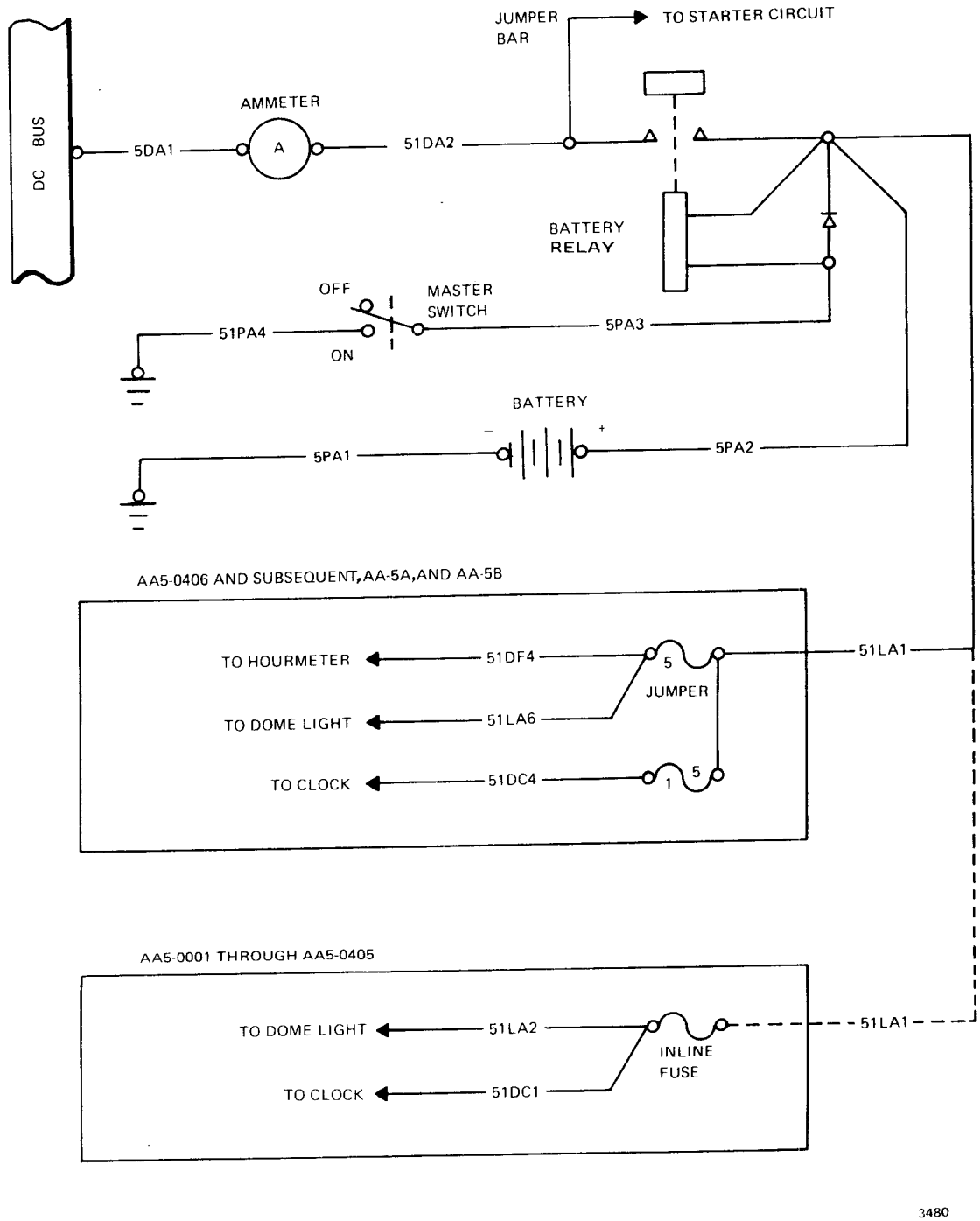
Exploded View of Battery & Battery Box
Figure 1





DETAIL A

Exploded View of Battery Relay
Figure 2



Battery Circuit
Figure 3

BATTERY SYSTEM – TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
System not energized when master switch is turned on.	Dead battery.	Recharge or replace.
	Defective wiring.	With master switch OFF, check entire DC power system for an open circuit with a continuity tester.
	Defective battery relay.	Connect, in sequence, a voltmeter to each battery relay terminal and check voltage with master switch on. If no voltage is indicated from either terminal, check and/or replace relay.
	Defective master switch.	Remove switch from aircraft and check with continuity tester. Replace switch if defective.
Battery discharge.	Charging rate too low.	Replace voltage regulator.
	Battery left standing too long.	Recharge or replace.
	Equipment left on accidentally.	Recharge battery.
	Impurities in electrolyte.	Replace battery.
	Cell separator broken.	Replace battery.
	Short circuit in wiring.	Check wiring.
	Loose or broken alternator belt.	Tighten or replace.
	Corroded or loose battery connections.	Clean and tighten.
Short battery life.	Low charging rate.	Replace voltage regulator.
	Impurities in electrolyte.	Replace battery.
	Battery left standing too long.	Recharge or replace.
	Sulfation due to nonuse.	Replace.
	Level of electrolyte being below top of plates	Maintain electrolyte at proper level.
Battery uses excessive amount of water	Charging rate too high	Correct charging rate.
	Cracked case	Replace battery.
	Shorted cell	Replace battery.

TROUBLE	PROBABLE CAUSE	REMEDY
	Shorted diode in alternator	Test diodes and replace as required.
Battery polarity reversed	Connected backwards on airplane or charger	Battery should be slowly discharged completely and then charged correctly and tested.
Battery freezes	Undercharged or discharged battery	Replace.
	Water added and battery not charged immediately	Always recharge battery for 1/2 hour following addition of water in freezing weather.
Ammeter indicates discharge with engine operating	Alternator belt loose or broken	Tighten or replace belt.
	Open circuit between alternator and bus bar	Check wiring for clean, secure connections and repair as necessary.

BATTERY SYSTEM — MAINTENANCE PRACTICES

1. Servicing

A. Visual Check

(1) Remove battery cover — (see Battery — Removal/Installation).

(2) Inspect battery terminals for corrosion. If corrosion exists, terminal should be cleaned as described in Cleaning Battery.

(3) Inspect for a low water level condition. Distilled water should be added as required to bring the level up to the split rings.

(4) Inspect for plugged vents and clean if necessary.

(5) Replace battery cover (see Battery — Removal/Installation).

B. Cleaning Battery

WARNING: ENSURE THAT EXTERNAL POWER IS DISCONNECTED BEFORE REMOVING BATTERY.

(1) Remove battery from aircraft (see Battery — Removal/Installation).

(2) Tighten filler caps to prevent cleaning solution from entering battery.

(3) Wipe down entire battery with a clean cloth dampened with a solution of bicarbonate of soda (baking soda) and water.

(4) Wipe battery cable ends with same solution used in Step (3).

(5) Rinse areas being cleaned with clear water and wipe off excess water. Allow battery to dry before installation.

(6) Use a brass wire brush or emery cloth to finish cleaning battery cable ends and battery terminals.

C. Determining State of Charge

To determine the state of battery charge, the specific gravity of the battery is checked using a hydrometer. A reading of 1.260 indicates a fully charged battery whereas a reading of 1.225 or below indicates that the battery should be recharged.

D. Battery Charging

WARNING: ALWAYS KEEP SPARKS OR ANY FORM OF IGNITION AWAY FROM BATTERY BEING CHARGED BECAUSE EXPLOSIVE GASES ARE BEING GENERATED DURING THE CHARGING PROCESS.

(1) Remove battery from aircraft (see Battery — Removal/Installation).

(2) Place battery in well ventilated area.

(3) Remove vented caps and check the level of electrolyte. Distilled water should be added as needed to bring level to top of split rings.

(4) Charge battery as required.

(5) Replace vent caps and reinstall battery (see Battery — Removal/Installation).

E. Battery Box

WARNING: BE CAREFUL WHEN WORKING AROUND BATTERY ACID DEPOSITS. SERIOUS ACID BURNS COULD RESULT IF CONTACT IS MADE WITH ACID DEPOSITS. IF CONTACT IS MADE, WASH IMMEDIATELY WITH SOAP AND WATER.

The battery box, cover, and drain tube should be inspected and cleaned when the battery is removed. The battery box, cover, and drain tube can be cleaned with a strong solution of bicarbonate of soda (baking soda) and water. After cleaning box, cover, and drain tube, flush them thoroughly with water. Inspect box, cover, and drain tube for physical damage. If badly damaged, they should be replaced.

2. Battery Removal/Installation (See Figure 1.)

A. Battery Removal

(1) Open right half top engine cowl.

(2) Remove the two wing nuts. Withdraw the battery hold-down bracket.

(3) Remove the battery box lid (cover).

CAUTION: REMOVE THE GROUND (NEGATIVE) CABLE FIRST TO PREVENT ACCIDENTAL SHORT.

(4) Disconnect the battery cables.

(5) Remove the battery heat shield.

(6) Remove the battery and battery box by lifting and sliding forward

B. Battery Installation

CAUTION: WHEN INSTALLING THE BATTERY, BE SURE TO CHECK FOR CORRECT POLARITY (NEGATIVE TO GROUND) TO PREVENT DAMAGE TO THE ELECTRICAL SYSTEM.

(1) Install battery into battery box and slide battery box onto battery box support bracket.

(2) Install battery heat shield.

CAUTION: CONNECT GROUND (NEGATIVE CABLE) LAST TO PREVENT ACCIDENTAL SHORT CIRCUITING DURING INSTALLATION.

(3) Connect battery cables and coat terminals with petroleum jelly to reduce corrosion.

(4) Replace the battery box lid (cover).

(5) Replace the battery hold-down bracket.

(6) Replace the two wing nuts.

(7) Close right half top engine cowl.

(8) Perform Operational Check.

3. Battery Relay Removal/Installation (See Figure 2.)

A. Battery Relay Removal

(1) Open upper cowl and remove lower cowl.

(2) Remove ground (negative) cable from battery terminal. Pull cable clear of battery and battery box (see Battery — Removal Steps 2 through 4).

(3) Pull rubber insulators clear of battery terminal on battery relay. Remove hardware and remove cable 5PA2 from battery terminal on relay.

(4) Remove attaching hardware and wire 5PA3 from center terminal. Remove diode from battery terminal and center terminal. Retain for future use.

(5) Remove attaching hardware and remove battery solenoid.

B. Battery Relay Installation

CAUTION: ENSURE GROUND (NEGATIVE) CABLE IS DISCONNECTED AND CLEAR OF BATTERY TERMINAL BEFORE INSTALLING RELAY.

NOTE: Diode used on relay should be tested and replaced if necessary before installing relay. (See Diode — Maintenance.)

(1) Secure battery relay on firewall and install attaching hardware.

(2) Place diode between battery terminal and center terminal. Ensure proper polarity on diode.

(3) Install wire 5PA3 and attaching hardware on center terminal.

(4) Install cables 5PA2 and attaching hardware on battery terminal. Slide rubber insulators over the terminal.

(5) Connect ground (negative) cable to battery (see Battery Installation Steps (3) through (6)).

(6) Replace lower cowl and close upper cowl.

(7) Perform operational check per Operational Check.

4. Operational Check of Battery

NOTE: Ensure all fuses are good and all circuit breakers are in.

A. Operational Check

(1) Place Master switch to ON position.

(2) Place a heavy drain on the battery (this can be accomplished by turning on the flashing beacon and/or landing light).

(3) Check for correct operation of flashing beacon and/or landing light.

(4) Turn flashing beacon and/or landing light off.

(5) Turn Master switch off.

ALTERNATOR SYSTEM — DESCRIPTION/OPERATION

1. Alternator

The 60 ampere alternator is three phase, delta connected with integral silicon diode rectifiers. It is rated at 14 volts, 60 amperes continuous output. The rotor consists of an axial winding with radial interlocking poles which surround the winding. The stator windings are three phase, delta connected and are attached to two diode plates, each of which contain three silicon diodes.

The alternator is susceptible to reverse polarity current because of the silicon diodes. The diodes, having a very high resistance to reverse current flow, are used without a cutout relay such as used on a generator system. The alternator diodes are arranged with their cathodes connected to the bus bar, which is positive, and no back current will flow. If the polarity of the battery is reversed, the diodes will offer no resistance to current flow. If the current rating of the diodes is exceeded, diode failure may result.

The diode plates are connected to the stator windings to accomplish full-wave rectification of AC. The resulting DC output is applied to the bus and sensed by the voltage regulator. The regulator controls the excitation applied to the alternator field thus controlling the output of the alternator. A five amp Alt Field circuit breaker, located on the instrument panel, is placed in series with the bus and the voltage regulator to protect the alternator field circuit.

2. Alternator Overvoltage Protection -- (AA5-0605 and subsequent, and AA5A-0001 through 0522, AA5B-0001 through 0692)

Alternator charging system is susceptible to overvoltage due to a malfunction of the voltage regulator. To protect the aircraft electrical system against this condition, an avalanche overvoltage diode has been shunted across the load side of the ALT. FIELD circuit breaker to ground. This diode will withstand the aircraft's normal bus voltage, but will break down under excessive voltages and eventually short the ALT. FIELD circuit breaker to ground. This will cause the breaker to open, deenergizing the alternator field, disabling the alternator. Reactivation of the field circuit breaker cannot be accomplished until the electrical failure has been corrected and the avalanche diode replaced.

3. Alternator Overvoltage Protection (AA5A-0523 and subsequent and AA5B-0693 and subsequent.)

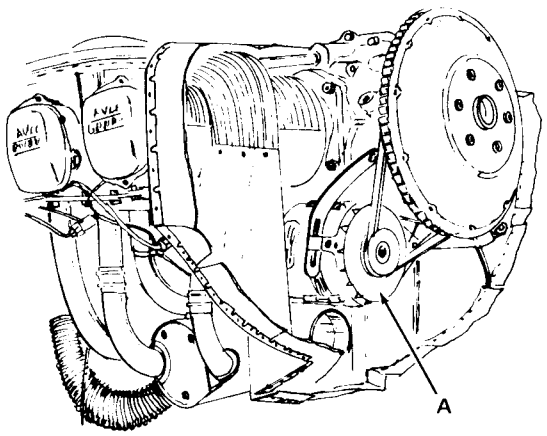
The aircraft electrical system is protected by an overvoltage relay. The aircraft bus voltage is applied to the overvoltage relay when the alternator side of the split Master switch is placed to the ON position. The relay is designed to withstand the normal bus voltage and allows the voltage to be applied to the voltage regulator. The relay will energize under excessive voltage and remove the input to the voltage regulator. This, in turn, will deenergize the alternator field and the output of the alternator will drop to zero. With the overvoltage relay energized, the alternator indicator light, on the instrument panel, will be illuminated and alert the pilot to the alternator failure. The light will also be illuminated when the alternator side of the split Master switch is in the OFF position, if power is applied to the aircraft bus. To deenergize the overvoltage relay, place the alternator side of the split Master switch to the OFF position. The alternator warning light will glow dimly when the navigation lights are ON and an alternator failure occurs.

4. Voltage Regulator

The alternator voltage regulator is located on the upper right side of the firewall. It contains two relays. One relay is actuated by the aircraft Master switch and connects the regulator to the battery. The second relay is a two-stage, voltage sensitive unit which is used to control the current applied to the field winding of the alternator. When the upper set of contacts on the voltage regulator relay are closed, full bus voltage is applied to the field. This condition will exist when the battery is being heavily charged or when a heavy load is applied to the system. When the upper contacts open and the voltage begins to rise toward normal bus voltage, the voltage to the alternator field is reduced through a resistor network in the base of the regulator, thus reducing the output from the alternator. As the voltage continues to rise, assuming a very light load on the system, the lower contact will close and ground the alternator field, shutting the alternator completely off. Under lightly loaded conditions, the voltage relay will vibrate between the intermediate charge rate and the upper (full output) contacts.

The voltage regulator is temperature compensated so that the battery is supplied with the proper charging voltage for all operating temperatures. With the battery fully charged (aircraft ammeter indicating at or near zero) and a moderate load applied to the system (landing light turned on) the voltage at the bus bar should be within the range shown, according to the air temperature, on the following chart.

TEMPERATURE	BUS VOLTAGE
60 - 74°F	13.8 - 14.1
75 - 90°F	13.7 - 14.0
91 - 100°F	13.6 - 13.9



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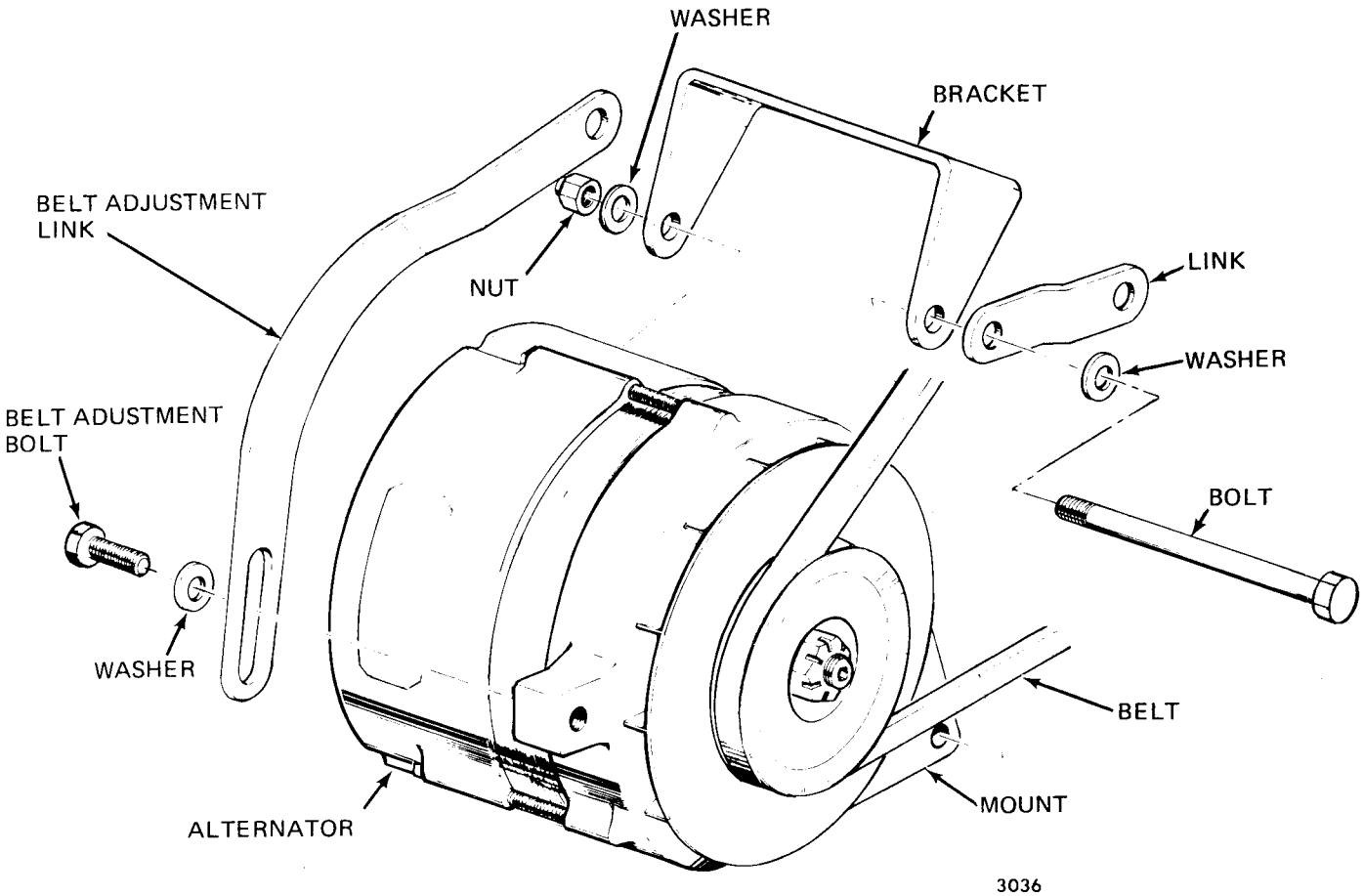

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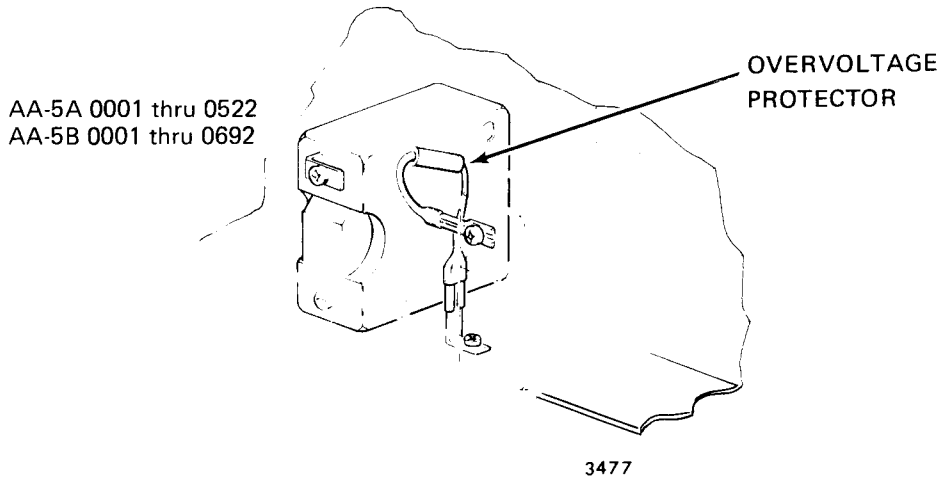
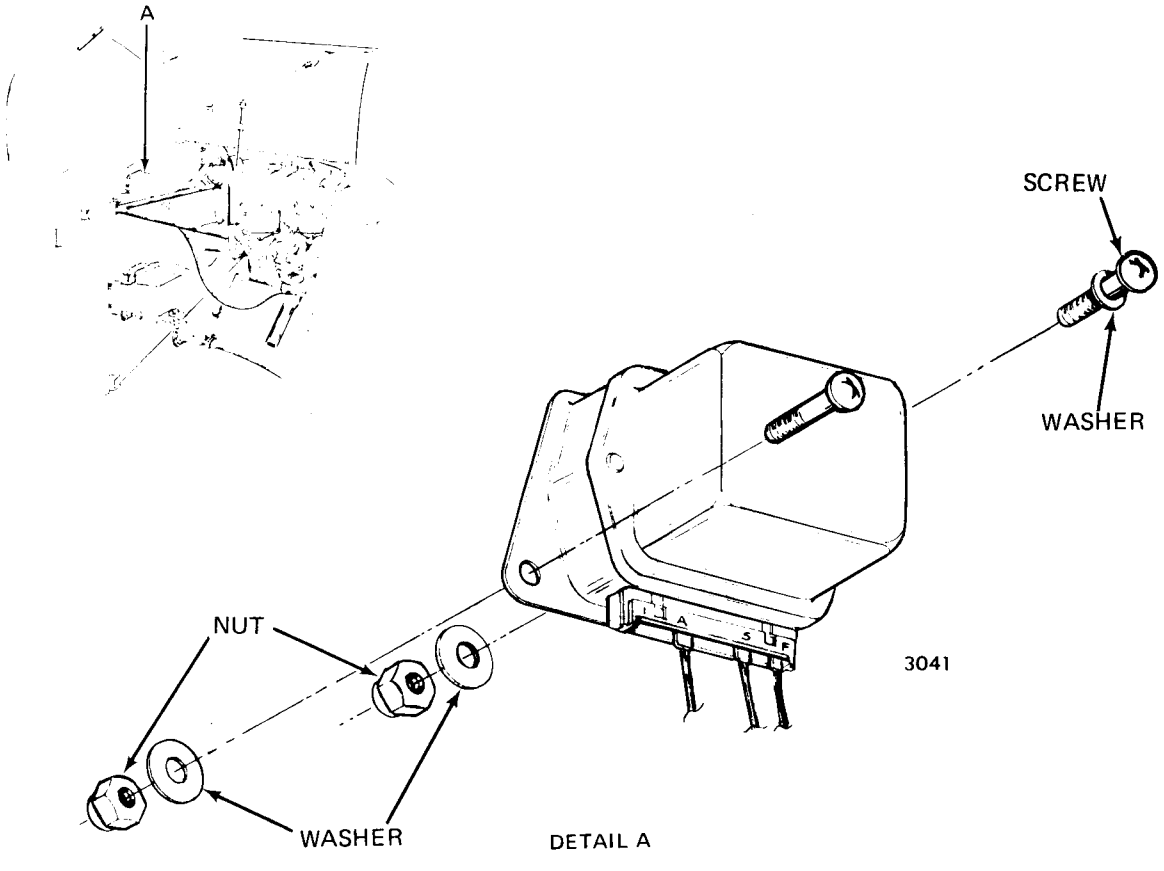
DETAIL A

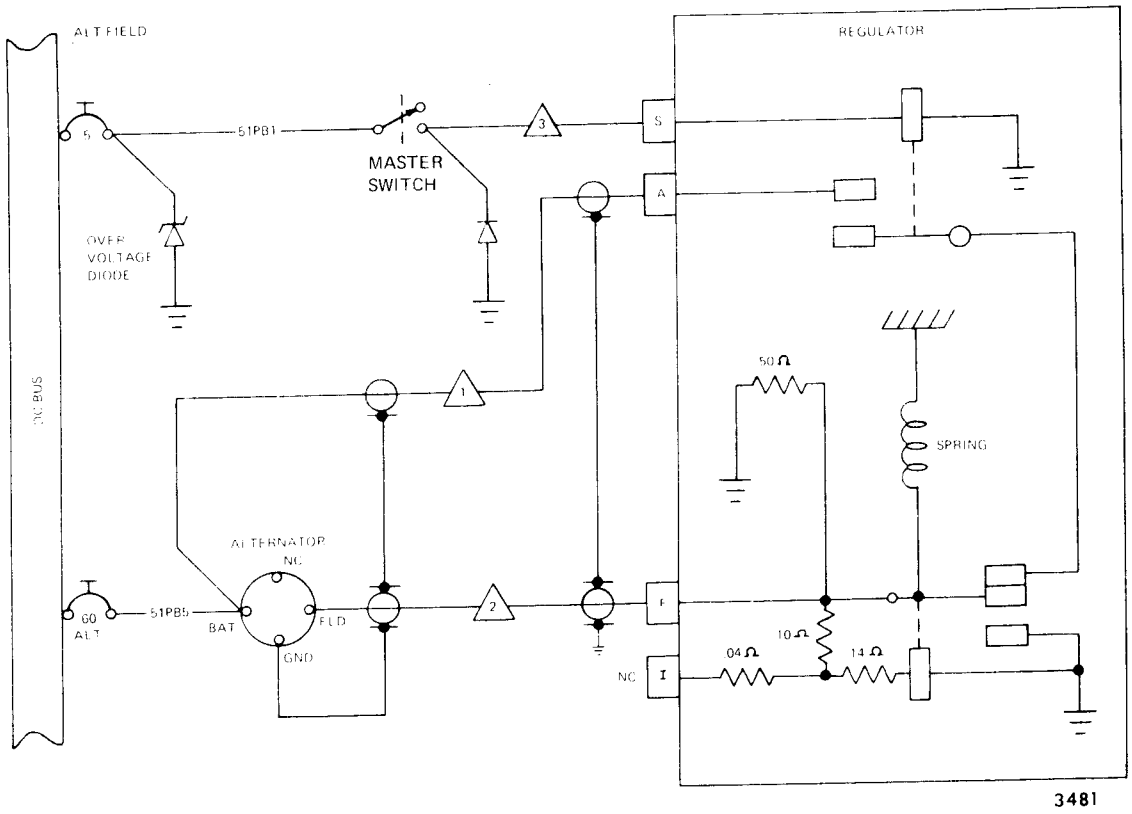
Alternator - Exploded View
Figure 1



Protection Diode
Figure 2



Voltage Regulator - Exploded View
Figure 3



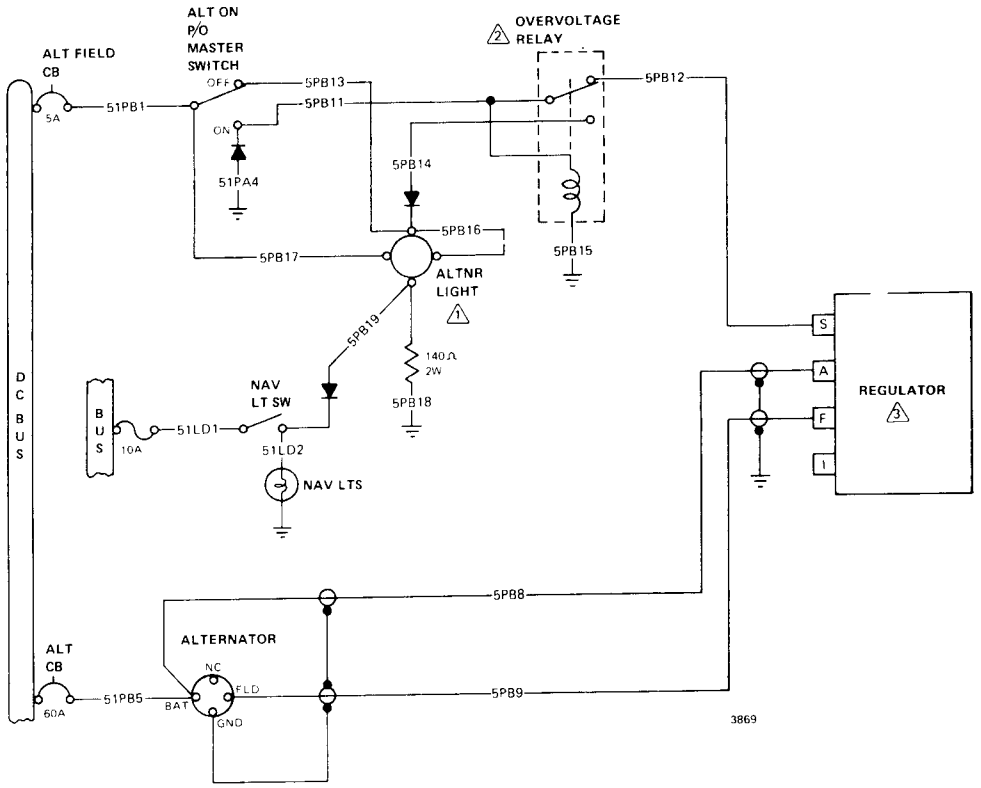
NOTES

1. AA5-0001 THROUGH AA5-0491, WIRE NO. 5PB6; AA5-0492 AND SUBSEQUENT, AA-5A AND AA-5B, WIRE NO. 5PB8.

2. AA5-0001 THROUGH AA5-0491, WIRE NO. 5PB7; AA5-0492 AND SUBSEQUENT, AA-5A, AND AA-5B, WIRE NO. 5PB9

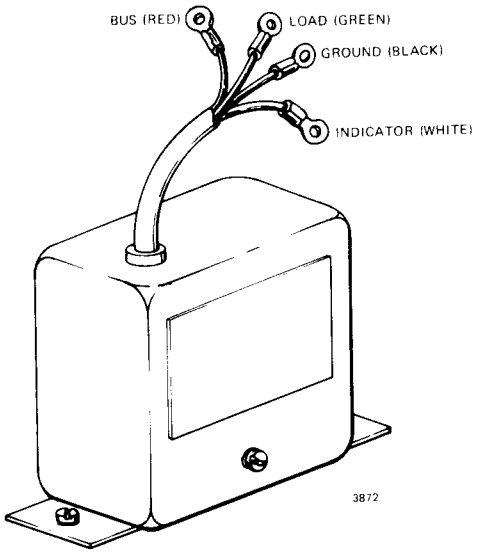
3. AA5-0001 THROUGH AA5-0491, WIRE NO. 5PB2; AA5-0492 AND SUBSEQUENT, AA-5A, AND AA-5B, WIRE NO. 5PB10

Alternator Circuit - Wiring Diagram
Figure 4



1 Located on instrument panel.
2 Located on firewall.
3 See Figure 4 for diagram

Alternator Circuit — Wiring Diagram
(1978 AA5A-0523 and sub., AA5B-0693 and sub.)
Figure 5



Overvoltage Relay
Figure 6

ALTERNATOR SYSTEM – TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Alternator overcharges battery; battery uses excessive water.	Regulator faulty.	Check bus voltage with engine running. voltage should agree with voltage vs temperature chart. Observe aircraft ammeter. Ammeter should indicate near zero after ten minutes of engine operation. Replace voltage regulator if defective.
ALT FIELD circuit breaker trips.	Circuit shorted to ground through overvoltage diode. (AA5-603 and sub., AA5A-0001 through 0692)	Check overvoltage diode by measuring its resistance in each direction. The front-to-back resistance shall be 10 to 1. Replace if defective.
	Circuit shorted through diode on Master switch.	Check diode by measuring its resistance in each direction. The front-to-back resistance shall be 10 to 1. Replace if defective.
	Circuit shorted in wiring.	Disconnect lead from pin S of regulator, and reset circuit breaker. If circuit breaker trips, check wiring. Repair as required. If breaker does not trip, replace regulator. Reconnect lead to pin S of regulator. Set MASTER switch to ON and check for 12V at pin S of regulator. Repair wiring if no voltage is present.
ALT circuit breaker trips.	Short circuit in wiring.	Disconnect lead from BAT post of alternator, and reset ALT circuit breaker. If circuit breaker trips, check wiring between alternator and circuit breaker.
	Short circuit in alternator.	Reconnect lead to BAT post of alternator. Disconnect leads from A and F terminals of regulator. Insulate disconnected leads. WARNING: ENSURE THAT MAGNETO SWITCH IS OFF WHEN TURNING PROPELLER.

TROUBLE	PROBABLE CAUSE	REMEDY
ALT circuit breaker trips (Continued)		Rotate propeller by hand to rotate alternator through 360 degrees of travel. If circuit breaker trips replace alternator.
	Defective regulator.	Reconnect leads at A and F of regulator. Reset circuit breaker. If breaker trips, replace regulator.
Alternator will not keep battery charged.	Battery malfunction.	1. Start engine and adjust for 1500 RPM. Ammeter should indicate a heavy charge rate with all electrical equipment turned off. Rate should taper off in 1 to 3 minutes. A voltage check at the bus should indicate a reading consistent with the voltage vs temperature chart. (See Voltage Regulator paragraph.) If charge rate tapers off very quickly and voltage is normal, check battery for malfunction. If ammeter shows a low charge rate or any discharge rate, and voltage is low, proceed to Step 3.
	Defective overvoltage relay. (1978 Models AA5A-0523 and sub. and AA5B-0693 and sub.	2. Check voltage at "S" terminal of regulator with Master switch closed. Meter should indicate bus voltage. If voltage is not present, check overvoltage relay. Check voltage at battery terminal of relay. If voltage is present, replace relay.
	Regulator faulty.	3. Remove "A" and "F" terminals from regulator and start engine. Momentarily jump the "A+" and "F" Terminals together on the plug. Aircraft ammeter should show heavy rate of charge. If heavy charge rate is observed, replace regulator. If heavy charge rate is not observed, proceed to Step 5.
	Defective wiring regulator to alternator.	4. Check resistance from "F" terminal of voltage regulator to FLD terminal on alternator. Normal indication is a very low resistance. If reading indicates no, or poor continuity, repair or replace wiring from regulator to alternator.

TROUBLE	PROBABLE CAUSE	REMEDY
	Defective alternator.	5. Check resistance from "F" terminal of alternator to alternator case. Normal indication is 3 - 4 ohms. If resistance is high or low, repair or replace alternator.

ALTERNATOR SYSTEM — MAINTENANCE PRACTICES

1. Alternator Removal/Installation (See Figure 1.)

   A. Alternator Removal

      (1) Remove upper and lower cowling. The propeller and forward cowl must also be removed.

      (2) On pre 1975 models, disconnect the heater inlet hose from forward engine baffle to provide access to the alternator.

      (3) Disconnect the ground (negative) cable from the battery terminal. Pull cable clear of battery and battery box. (See Battery removal — Steps 2 through 4).

      (4) Cut the safety wire and remove the bolt attaching the alternator to the adjustment link.

      (5) Remove the nut from the support bolt and slide the main alternator support bolt forward out of the alternator from its mount, at the same time removing the drive belt.

      (6) Lower alternator and gain access to the leads. Remove and identify leads from alternator.

      (7) Remove the alternator.

      NOTE: Service work performed on the alternator should be in accordance with any manuals or bulletins published by the alternator manufacturers.

   B. Alternator Installation

      CAUTION: ENSURE GROUND (NEGATIVE) CABLE IS DISCONNECTED AND CLEAR OF BATTERY.

      NOTE: When a new belt has been installed, recheck the belt tension within 10 to 20 hours operation.

      (1) Place alternator near mount and connect leads to alternator.

      (2) Slide alternator into mount, at same time place belt on pulley of alternator.

      (3) Slide main alternator support bolt toward firewall and replace nut.

      (4) Replace bolt attaching the alternator to the adjustment link. Adjust the belt tension to yield a 3/8 inch deflection at the center of the belt when applying a pressure equivalent to 12 pounds.

      (5) Safety wire bolt attaching the alternator to the adjustment link.

      (6) Connect ground (negative) cable to the battery (see Battery Installation Steps 3 through 6).

      (7) On pre 1975 models, connect the heater inlet hose to the forward engine baffle.

      (8) Replace upper and lower cowling.

      (9) Perform operational check.

2. Alternator Overvoltage Protection Diode — Replacement

   A. Diode Replacement

      (1) Disconnect the ground (negative) cable from the battery terminal. Pull cable clear of battery and battery box. (See Battery Removal Steps 1 through 4.)

      (2) Locate diode on reverse side of circuit breaker panel and replace.

      (3) Connect the ground (negative) cable to battery terminal (see Battery Installation).

      (4) Perform an operational check, per Operational Check.

3. Alternator Overvoltage Protection Relay — Replacement (See Figure 6.)

A. Relay Replacement

(1) Disconnect ground (negative) cable from battery terminal. Pull cable clear of battery and battery box. (See Battery Removal.)

(2) Locate overvoltage relay behind instrument panel on right side of firewall.

(3) Disconnect the leads from the relay. Tag each lead to aid in reinstallation of relay.

(4) Remove the relay attaching hardware.

(5) Replace the relay and secure with attaching hardware.

(6) Reconnect the leads to the relay.

(7) Connect negative cable to battery. (See Battery Installation.)

4. Voltage Regulator Removal/Installation (See Figure 3.)

A. Regulator Removal

NOTE: The voltage regulator is a sealed unit; therefore, no field adjustments are possible.

(1) Open right half upper cowl.

(2) Disconnect ground (negative cable from battery terminal). Pull cable clear of battery and battery box. (See Battery Removal.)

(3) Disconnect and identify leads from voltage regulator.

(4) Remove the attaching hardware and remove voltage regulator from firewall.

B. Regulator Installation

NOTE: Ensure that the connections for grounding the alternator, wiring shields and the base of the regulator are clean before installation. This will eliminate the possibility of poor voltage regulator operation and/or excessive radio noise.

(1) Place regulator against firewall and install attaching hardware.

CAUTION: BEFORE CONNECTING WIRES TO VOLTAGE REGULATOR, ENSURE NEGATIVE CABLE IS DISCONNECTED FROM BATTERY.

(2) Connect leads to voltage regulator.

(3) Connect negative cable to battery. (See Battery Installation.)

(4) Perform operational check, per Operational Check.

5. Operational Check of Alternator

WARNING: BEFORE STARTING ENGINE, BE SURE PROPELLER AREA IS CLEAR.

A. Operational Check

(1) Start engine in accordance with the Owner's Manual or Pilot's Operating Handbook. Set engine at 1500 rpm.

(2) Ammeter should indicate a heavy charge rate (positive) with all electrical equipment off.

(3) Observe that charge rate (positive) tapers off in 1 — 3 minutes.

(4) Turn on flashing beacon. Ammeter should still show a charge rate (positive).

(5) Turn off flashing beacon.

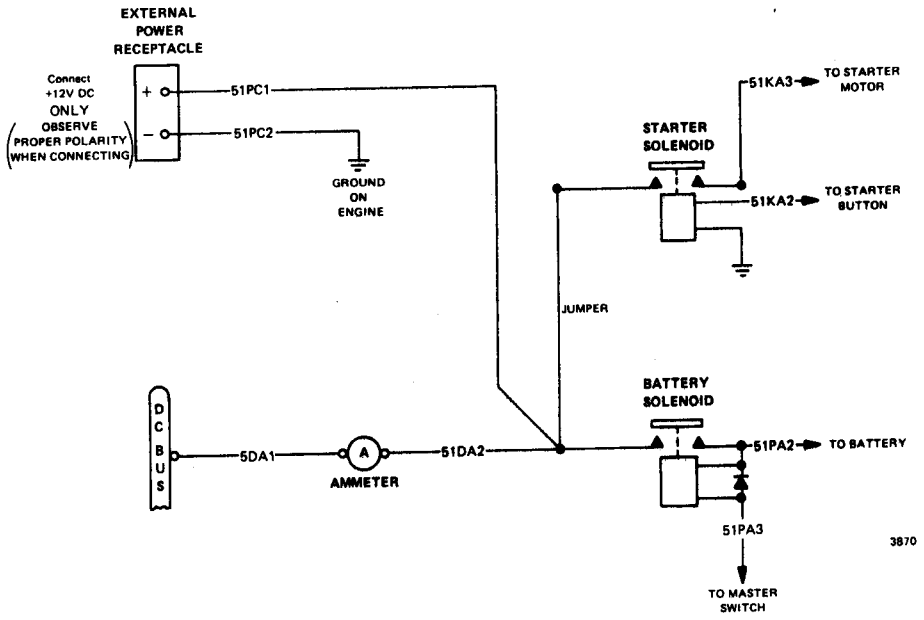
(6) Shut down engine in accordance with the Owner's Manual or Pilot's Operating Handbook.

EXTERNAL POWER – DESCRIPTION/OPERATION

1. General

A ground service receptacle is offered as optional equipment to provide a means of attaching an external power source for cold weather starting or when performing lengthy electrical maintenance.

When external power source is attached, power goes through the ammeter to the bus. The master switch should be placed in the OFF position, when external power is applied.



External Power Circuit
Figure 1

EXTERNAL POWER RECEPTACLE – MAINTENANCE PRACTICES

1. External Power Receptacle Removal/Installation (See Figure 201)

   A. External Power Receptacle Removal

      (1) Remove upper and lower cowl.

      (2) Disconnect ground (negative) cable from the battery terminal. (See Battery Removal.)

      (3) Remove cable attaching hardware and remove cables.

      (4) Remove receptacle attaching hardware and remove receptacle.

   B. External Power Receptacle Installation

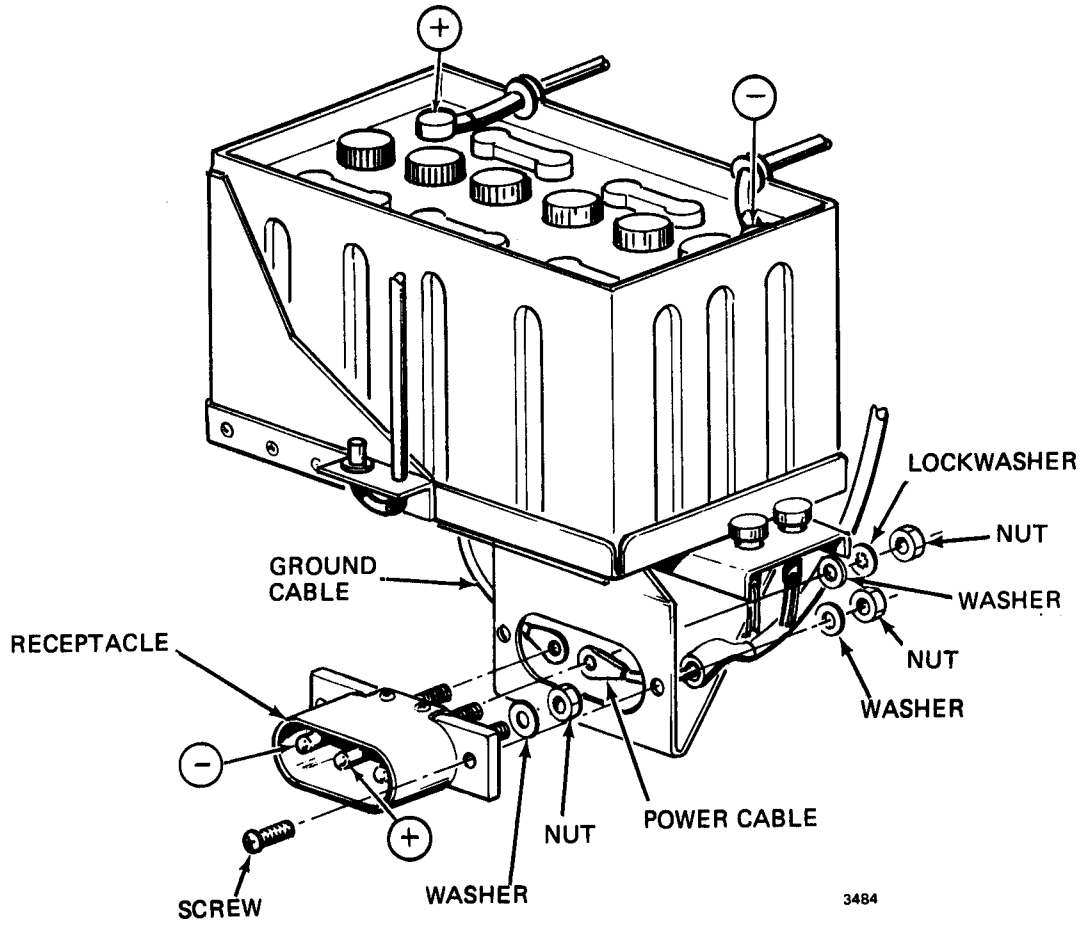
      CAUTION: ENSURE GROUND (NEGATIVE) CABLE IS CLEAR OF BATTERY TERMINAL.

      (1) Replace receptacle and attaching hardware.

      (2) Replace cables and attaching hardware. Place rubber insulator over positive terminal.

      (3) Connect ground (negative) cable to battery terminal. (See Battery Installation.)

      (4) Replace upper and lower cowl.



External Power Receptacle
Figure 201