PART 1

CHAPTER 3 — ELECTRICAL SYSTEM

Contents

DESCRIPTION

1 DC Supplies

(*a*) Two 6000 watt engine-driven generators supply the electrical system and charge two 24 volt batteries, in the radio bay, connected in parallel. The minimum RPM to keep the batteries fully charged are 3700 with both generators running or 4000 if one generator has failed.

(*b*) An external ground supply socket is accessible via the radio bay door and is for use when a ground battery is necessary for servicing purposes.

2 Standby DC Supplies

(*a*) A pair of series-connected 12 volt batteries, in the radio bay, provide standby supplies for the turn and slip indicators, the cockpit emergency lighting and the E2B compass lighting.

(*b*) A 24 volt battery, also in the radio bay, provides a standby supply for the standby UHF set.

3 AC Supplies

(*a*) Four type 100A inverters, divided into two groups,

provide AC power at 115 volts, 3-phase, 400 Hz. No 1 group comprises No 1 (main) and No 4 (standby) inverters which supply the G4FT compass, the cabin temperature amplifier, the autostabiliser and the top temperature controller. No 2 group comprises No 2 (main) and No 3 (standby) inverters which supply the artificial horizons, the altimeter vibrators (pre-mod 1378) and the oil pressure gauge.

(*b*) When the engine master switch is set to ON, both standby inverters start up. When the engine is started and the generators are on line the two main inverters take over the supply.

(*c*) A type 108 inverter provides AC power for Tacan, IFF/SSR and, post-mod 1378, a standby supply for the Mk 30A altimeter. The inverter starts up when the weight of the aircraft is taken off the main wheels. The inverter cannot be switched off in flight and continues to run after landing until the RESET button is pressed or both generators come off line after the engine is shut down. A ground test switch is provided on the generator control panel for servicing purposes.

(*d*) Post-mod 1378, a type FI-45E static inverter provides AC power for the Mk 30A altimeter; control is by the engine master switch.

4 Inertia Switches

In the event of a crash landing, the generators and batteries are automatically isolated by the operation of four inertia switches. Each generator is isolated by its own inertia switch so that only one generator is lost in the event of accidental operation of a switch. The remaining two switches are connected in series and when operated isolate the main batteries and automatically discharge the fire extinguisher.

CONTROLS AND INDICATORS

5 Generator Controls and Indicators

(*a*) The generators each have a separate control panel in the radio bay. No pilot-operated controls are fitted.

(*b*) A warning light for each generator, below the port instrument panel, comes on when its associated generator is not supplying power.

6 Main Battery Control

The battery master switch below the port instrument panel, when set to OFF, isolates the aircraft main batteries from all electrical services except the engine fire extinguisher inertia switch circuit, the canopy switch circuit, the refuelling circuits (post-mod 1381) and the telebriefing facilities.

7 Standby Battery Controls

(*a*) The supply to each turn and slip indicator is controlled by the TURN & SLIP — NORMAL/EMERGY switch below each instrument. When set to EMERGY the instrument is powered by the standby batteries.

(*b*) The supply to the three cockpit emergency lamps from the standby batteries is controlled by the EMERGY LIGHTS — ON/OFF switch on the centre instrument panel.

(*c*) The E2B compass lamp is supplied by the standby batteries through the normal dimmer switch when the NORMAL/off/EMERGENCY switch forward of the throttle box on the centre pedestal is set to EMERGENCY.

(*d*) Selecting EMERGENCY on the UHF NORMAL/EMERGENCY switch on the cockpit port wall connects the standby UHF to the standby battery.

8 AC Supply — Controls and Indicators

(*a*) The engine master switch normally controls the circuit to the inverters, but No 1 and No 2 inverters do not come into circuit until the engine is started and the generators are on line. Two indicators on the centre pedestal, one for each group, give the following indications:

OFF (red)	No inverter running
STANDBY (amber) ...	Standby inverter running, main inverter not running
MAIN (green) ...	Main inverter running, standby inverter not running

Adjacent to the pupil's artificial horizon is a STANDBY INVERTER ON magnetic indicator which shows black

when No 2 inverter is supplying power and white when it is not.

(*b*) On the centre pedestal are two NORMAL/STAND-BY switches, one for each group. They can be used to test either standby inverter on the ground when the engine is running, or in flight. They can also be used to attempt to reset a main inverter (see para 11).

(*c*) A TACAN POWER SPLYS — FAILURE indicator on the centre instrument panel, shows black when the type 108 inverter is running and black/white stripes when it is not. An adjacent RESET button can be used to attempt to restart the inverter in flight and is used to shut down the inverter after landing.

9 Warning Indicators

Service	*Indication*	*Function*
Fire warning	One red light	Gives warning when temperature in engine bay exceeds a predetermined level
Fuel pressure warning	One red light	Indicates fuel pressure below 3 to 3·5 PSI at engine inlet
Fuel transfer warning	Two white magnetic indicators	Indicate failure of transfer system
Fuel, outboard tanks	Two white magnetic indicators	Indicate transfer from outboard drop tanks complete
Booster pumps warning	Two amber lights	Indicate failure of associated pump or pump switched off
HP pump isolation	One red light	Indicates isolation in use
Engine anti-icing	One window	Indicates: Red, OPEN Green, SHUT Amber, de-energised

Service	*Indication*	*Function*
Generator failure warning	Two red lights	Indicate generator(s) not on line
Oxygen	Three striped magnetic indicators	Indicate respective pilot inhaling (two indicators for the instructor)
Tacan power supplies	One black/white striped magnetic indicator	Indicates AC or DC failure
Inverters	One magnetic indicator (standby)	Black, No 2 on line White, No 3 on line or both failed
	Two windows	Indicate state of inverters Red, OFF Amber, STBY Green, MAIN
Arrester hook warning	One red light	Indicates hook not locked up
Brake parachute	Red STREAM caption panel	Indicates parachute streamed
Hydraulic failure warning	One red light (plus audio warning)	Indicates hydraulic pressure below 600 PSI
Landing gear position	Three red or green lights	Indicate position of each landing gear unit separately. No light, unit locked up or no power supply Red light, unit between locks Green light, unit locked down

Service	*Indication*	*Function*
Landing gear warning	One red light	Indicates when throttle less than one-third open and landing gear not locked down
Powered controls	Two pairs of white magnetic indicators	Indicate separately disengagement of aileron or elevator power or electrical fault
Airbrake position	One white magnetic indicator	Indicates airbrake not fully in
Cockpit pressure warning	One red light	Indicates drop of 0·5 PSI in cockpit pressure differential
Telebriefing	One amber light	Indicates telebriefing in use
Canopy	One green light	Indicates canopy locked closed with landing gear down
Grimes light	One white light	Indicates Grimes light switched on

NORMAL USE OF THE SYSTEM

10 Pre-Flight Procedures

(*a*) Before starting the engine, switch on the battery master switch and check the functioning of all DC operated instruments and indicators.

(*b*) When the engine master switch is on, check that the No 3 and No 4 inverters start up (indicators STBY), that the standby inverter indicator shows white and that the instruments are functioning.

(*c*) After start up, check generator warnings lights out, main inverters start up (indicators MAIN) and standby

inverter magnetic indicator black. Then select STANDBY on each inverter changeover switch checking that the associated inverter indicator shows STBY. Also check that the standby inverter magnetic indicator shows white when the No 2 group changeover switch is at STANDBY. Reselect each changeover switch to NORMAL and check that the inverter indicators are at MAIN and that the standby inverter magnetic indicator is black.

Note: The changeover check can be carried out in the air. There is a distinct noise change when inverter changeover takes place.

MALFUNCTIONING OF THE SYSTEM

11 Inverter Failure

If either main inverter fails, the standby inverter takes over the load automatically. An attempt can be made either on the ground or in the air, to reset a main inverter by setting the appropriate NORMAL/STANDBY changeover switch to STANDBY and then returning it to NORMAL. If the associated indicator then shows MAIN, and in the case of the No 2 group, the standby inverter magnetic indicator reverts to black, resetting has been accomplished. If the indicators show that the standby inverter is in operation, resetting is not possible.

12 Single Generator Failure

If one generator fails, the other provides sufficient output for all electrical services provided engine RPM are kept above 5000. To avoid overloading the remaining generator however, the tailplane interconnection should be switched off. Except for operational reasons, a return to base should be made as soon as possible in case the remaining generator fails.

13 Double Generator Failure

(a) With both generators off line, all electrical services are supplied by the batteries with the exception of the type 108 inverter which is automatically off-loaded; the average load is then about 100 amperes. The batteries, which should normally be fully charged about 20 minutes

after take-off, should provide the following output before they are discharged:

Output (*amperes*)	180	150	125	100	75	50
Time (*minutes*)	5	7	10	15	20	30

Note: Post-mod 1407 (Mk 8C only), the total battery capacity is reduced and the above times should be reduced by one-third.

(*b*) In the event of a double generator failure, all electrical loads should be reduced to a minimum to conserve enough power to operate the fire extinguisher and brake parachute. The turn and slip indicator (either or both) should be operated from the standby batteries for greater reliability in the final stages and the E2B compass used as far as possible because of the unreliability of the G4FT compass with dropping battery voltage. If the engine has failed, windmilling RPM provide little or no generation.

14 Load Shedding

To assist in deciding which loads should be shed if generator failure occurs, the following table lists the major services and the current they require:

Service	*Load (amperes)*
*Type 108 inverter	35
Booster pumps (both)	30
Grimes light	30
UHF	17
*Type 100A inverters (each)	7·5
Tailplane actuator	12
Anti-collision lights	8
IFF/SSR	6
Pressure head heater	6
RP firing	5
Engine relighting	5

* The type 108 inverter cannot be switched off in flight but it is automatically off-loaded if both generators fail. Normally, the minimum number of type 100A inverters operating is two.

15 Double Generator and Battery Failure

Once the batteries are discharged, no electrical services can be operated, eg trim tab actuators, tailplane motors, electro-hydraulic selectors, etc. In addition the fuel gauges and electrically-operated flight instruments become inoperative. The fuel booster pumps cease operation, which may entail reduction in altitude and engine RPM to ensure satisfactory engine running (see Part 1, Chapter 1, para 16). No relight or fire extiguisher facilities are available when the batteries are fully discharged.

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