

E230 Aircraft Systems

Blackout

6th Presentation

School Of
Engineering



Function of Aircraft Electrical System

- To generate, regulate and distribute electrical power throughout the aircraft
- Systems that requires electrical power:
 - Electronic Flight Indicating System (EFIS)
 - Communication and navigation systems
 - Passenger Services
 - Cabin lighting
 - Operation of entertainment system
 - Preparation of food in galley
 - Many more...

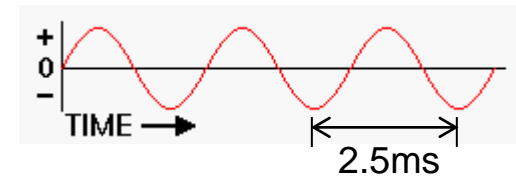
Types of electrical power required

- Following are the common electrical power used by aircraft systems:
 - 115 VAC @ 400 Hz
 - 28 VDC

- VAC stands for Volts (Alternating Current)

Frequency = 400 Hz

Period = $1/400 = 0.0025 \text{ s} = 2.5 \text{ ms}$



- VDC stands for Volts (Direct Current)



Power sources for aircraft

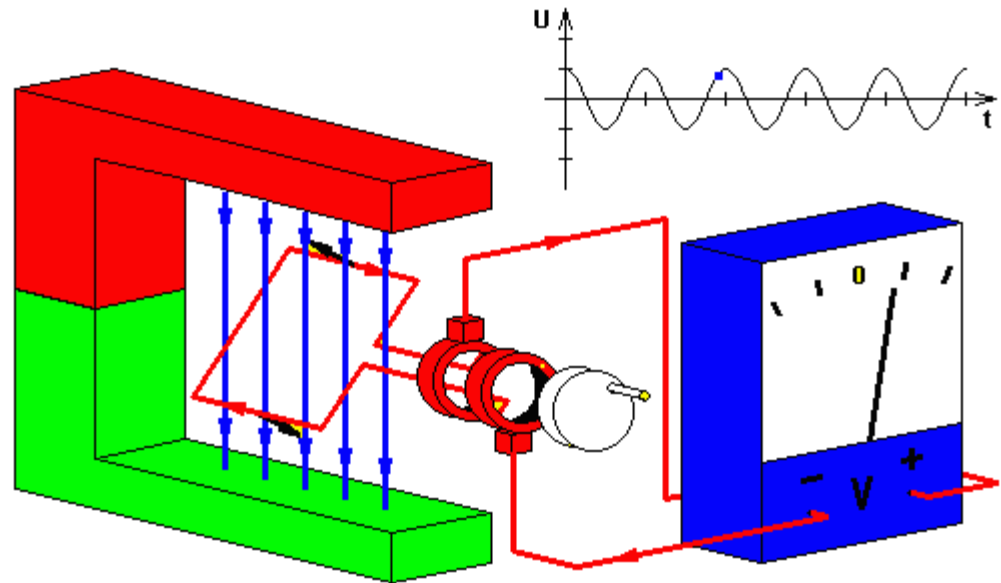
- Engine-driven AC generator
- Auxiliary Power Unit (APU)
- Ram Air Turbine (RAT)
- Ground Power Unit (GPU)
- Batteries
- Hydraulic Motor Generator (HMG)

Engine Driven AC Generators

- Each of the engines on an aircraft drives an AC generator
- The electrical power produced by the generator is used in normal flight to supply the entire aircraft

How Generators Work

- When a coil of wire is rotated inside a magnetic field, electric current is “generated”.



APU Power

- APU used on the ground for
 - Starting the engines
 - Maintenance
- Can also be used during flight as backup power



Ground Power Unit (GPU)

- Provide AC power through an external plug on the aircraft
- GPUs may be either portable or stationary units



Ram Air Turbine

- Emergency power source in case of
 - Generator failure
 - APU failure
 - Engine failure



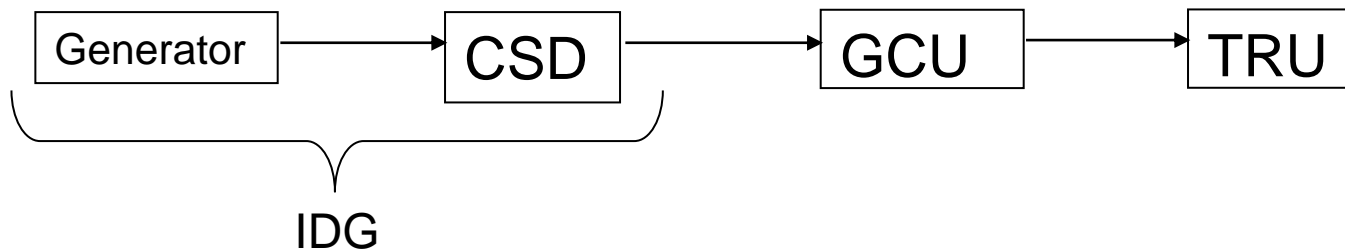
Aircraft Batteries

- Nickel Cadmium (NiCad) battery
- DC voltage
- Backup power source
- Inverters can convert DC from batteries to AC



Electrical Generation System

- AC Generator
- Constant Speed Drive (CSD)
- Integrated Drive Generator (IDG)
- Generator Control Unit (GCU)
- Transformer Rectifier Unit (TRU)



Constant Speed Drive (CSD)

- Rotates the generator coil at a constant speed, regardless of changes in engine speed
- This is necessary because the generator output must be 400Hz



Integrated Drive Generator (IDG)

- An IDG is simply a CSD and generator combined into one unit

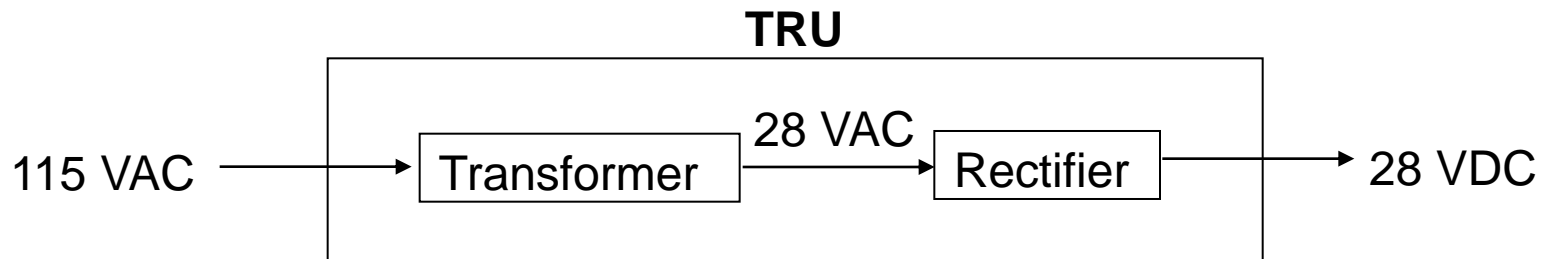


Generator Control Unit (GCU)

- Used to regulate generator voltage output
- Protects against the following faults:
 - Over-voltage
 - Under-voltage
 - Over-current
 - Under-current
 - Short circuit

Transformer Rectifier Unit (TRU)

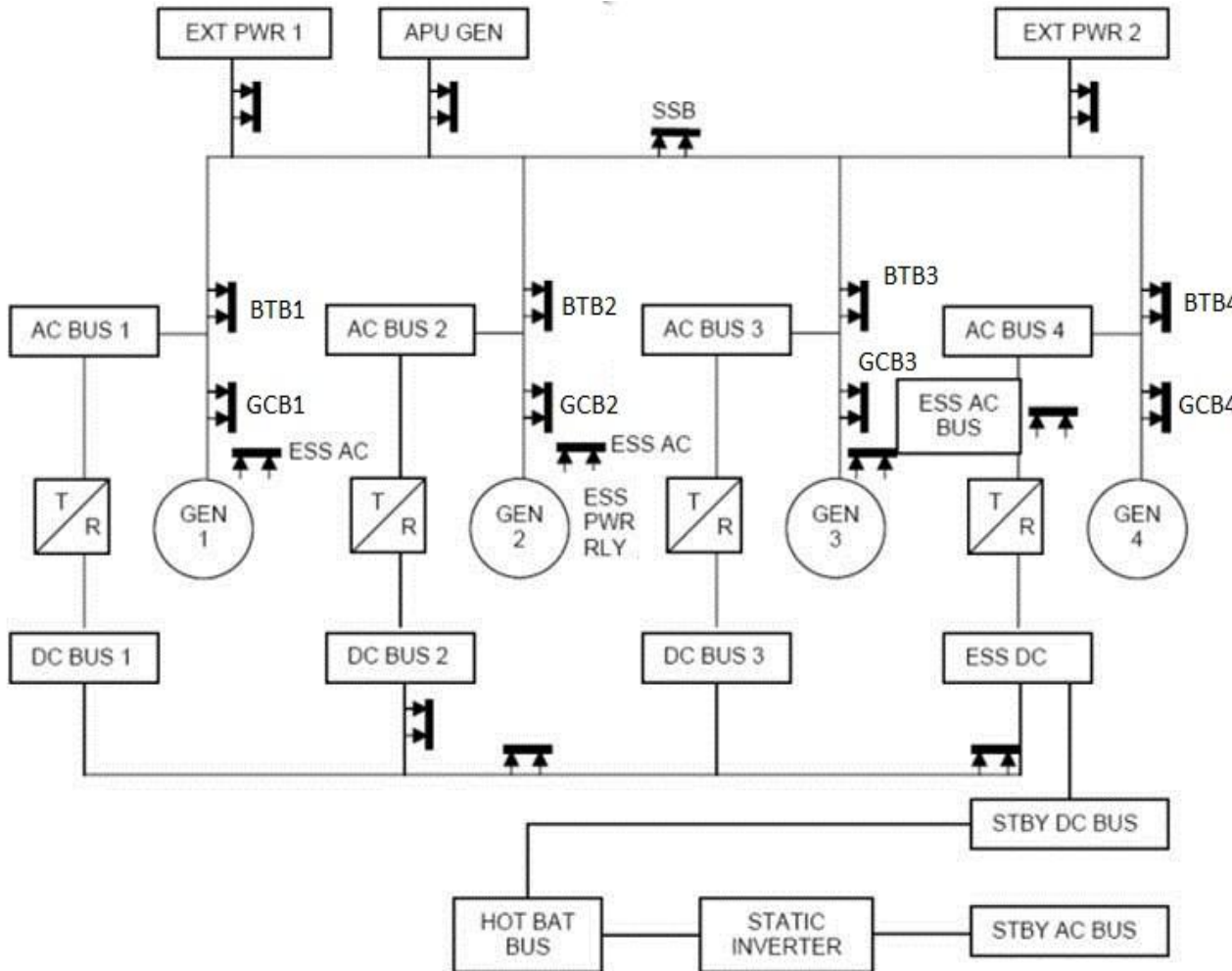
- Used to convert 115 VAC, 400Hz power into 28 VDC so that aircraft systems can use the electrical power generated



Electrical Load Parallel

- In a multiple engine aircraft, the electrical power is shared among the generators.
- This is done by connecting the generators on a split bus system with load parallel to generators.
- Electric current needs to be at the same voltage, frequency and phase.
- In event that one generator fails, the electrical power system of the aircraft is still functioning as a whole.

Electrical System schematic



SSB-split system breaker
BTB- bus tie breaker
GCB- generator circuit breaker
TR/TRU- Transformer Rectifier unit
ESS – Essential (i.e. Captain/FO instrument)

Electrical Load Sharing

	4 Engines operating	Engine 1,2,3 operating. Engine 4 fail	Only Engine 4 operating	All Engines off On Ext Pwr 1 & Ext Pwr 2
SSB	Close	Close	Close	OPEN*
GCB1	Close	Close	OPEN	Open
GCB2	Close	Close	OPEN	Open
GCB3	Close	Close	OPEN	Open
GCB4	Close	OPEN	Close	Open
BTB1	Close	Close	Close	Close
BTB2	Close	Close	Close	Close
BTB3	Close	Close	Close	Close
BTB4	Close	Close	Close	Close

* SSB opens because Ext 1 and Ext 2 cannot synchronise

Learning objectives

- Describe the principle of electrical power generation.
- List the various electrical power sources available to an aircraft and explain when they are used
- Describe the functions of CSD, IDG, TRU and GCU
- Interpret a schematic of aircraft electrical system.