TWIN-ENGINE AIRCRAFT
ELECTRICAL SYSTEM
mod. AQ-1/EV

THEORY AND EXERCICES

TEACHER/STUDENT handbook

ElettronicaVeneta

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SAFETY REQUIREMENTS

PLEASE READ THE FOLLOWING DIRECTIONS CAREFULLY BECAUSE THEY GIVE IMPORTANT INFORMATION ABOUT THE SAFETY OF INSTALLATION, USE AND MAINTENANCE.

Keep this handbook with care so that is can be consulted in any time.

INSTALLATION

After unpacking the equipment, make sure of the integrity of its components.
In detail, make sure that the equipment and its accessories are sound, without visible damages provoked by the transport.
Before connecting the equipment with the mains, check that its rating corresponds to that of the mains.
Arrange the power cables so that they cannot be trodden, nor squeezed by some object. If the mains socket and the plug of the equipment do not match, the socket or the plug must be replaced with a compatible one by a skilled electrician. This technician must also check that the wires have the right section for bearing the power absorbed by the equipment. It is better not to use any adapter nor multiple outlet.
However, if any simple or multiple adapter or extension will be used, they must comply with the safety rules in force; but take care not to exceed the limit value of current carrying capacity, marked on simple adapters and on extensions, nor the value of maximum power marked on multiple adapters.
Any installation must comply with the manufacturer's instructions and it must be carried out with recommended accessories.

ADVICE OF USE

Use this equipment exclusively for the aims which it has been expressly conceived for, that is for educational purposes; furthermore its operation must take place under the direct supervision of a skilled staff.
Any different use is not proper, therefore it is dangerous. The manufacturer is not responsible for any damage due to improper, erroneous and irrational uses.

PRECAUTIONS

Take care not to open this equipment, not to tamper with nor remove protection covers (high voltages, high temperatures, case-protected moving parts...), so that the operator's safety and the correct operation of the apparatus are ensured.

Before replacing fuses disconnect the equipment from the mains.

When some objects or liquids penetrate into the equipment, disconnect the power cord and before switching the equipment on again make it be checked by a skilled technician.

In case of trouble and/or malfunction, switch the equipment off immediately and do not tamper it. For possible repairs refer to the nearest after-sales centre or require original spare parts exclusively. Not complying with these instructions could compromise the equipment's safety.

Take care not to provoke any vibration, nor shocks.

CLEANING THE EQUIPMENT

Clean the case of the equipment and the panel of schematic diagram, with a dry and soft cloth. Never use insecticides nor chemical products nor solvents, for cleaning.

These apparatuses and all their parts will be disposed of separately from the other wastes. At the end of their lifetime, these apparatuses will be conveyed to the proper centres of separate collection of waste.

A proper separate collection ensures that the eliminated apparatuses will undergo the necessary treatment and recycling for preventing any negative effect on the environment and on men's health.

Illegal disposal of the product by the user involves the application of administrative sanctions referred to Italy, in D.Lgs. no. N. 152/2006 art. 255 and 256, as amended; and directive 2008/98/EC of the european parliament and of the council of 19 November 2008

For states outside the European Union comply with local laws.

1 INTRODUCTION TO THE SIMULATOR

1.1 Training program

The electric system system structure knowledge of a twin engine aircraft is essential for basic training on technical solutions currently operating in aeronautical systems.

The simulator AQ-1/EV is constituted by a panel with color silkscreen synoptic managed by computer.

The technical characteristics described correspond to the Airbus A320, world's most popular mono corridor aircraft with the Boeing B727 using similar technologies.

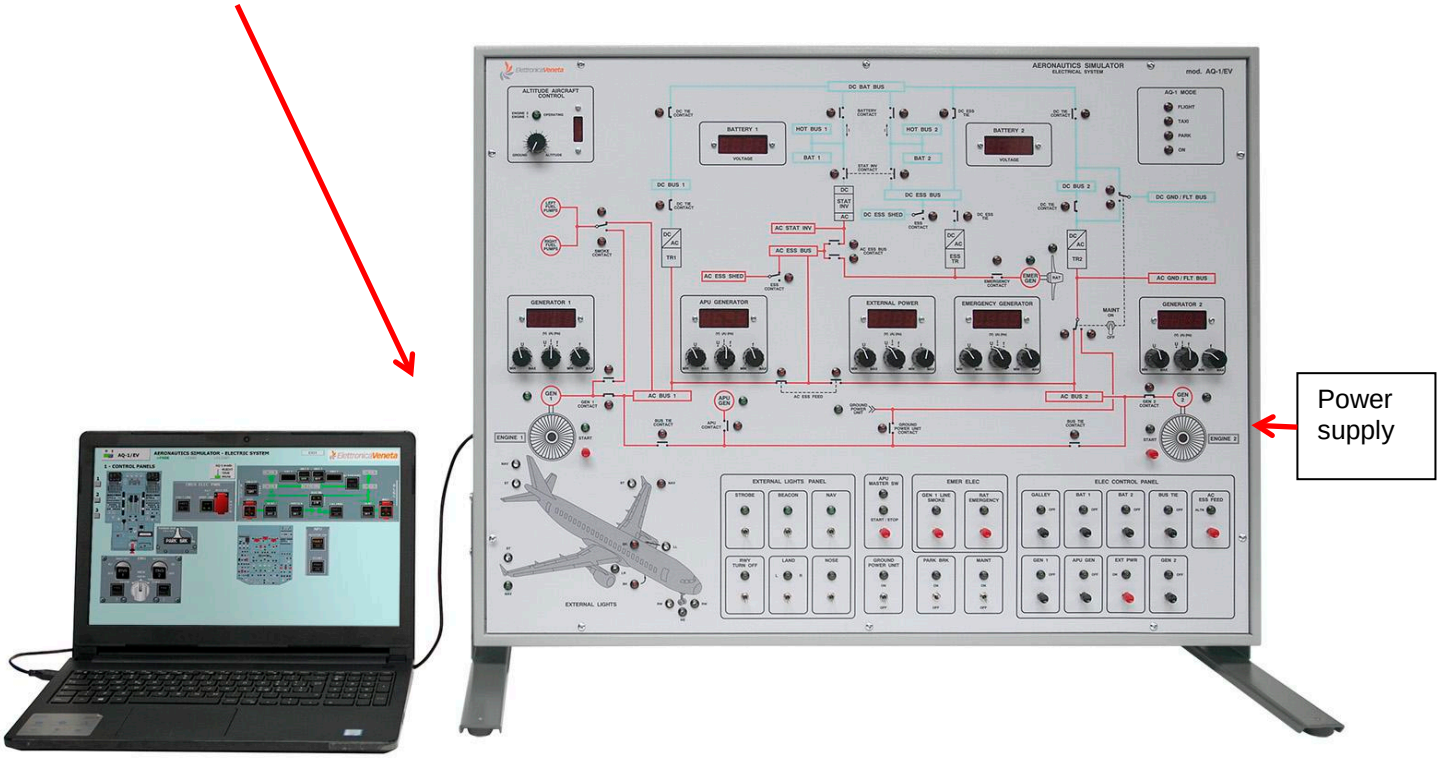
Training program
- Electrical power generation
- Operations
- Nornmal configuration
- Abnormal configurations
- External power
- APU power generation
- Electrical overhead panel
- ECAM display

1.2 Trainer description

- The simulator is managed by computer with the following features:
  - Personal Computer with USB port.
  - mod.AQ-1/EV trainer panel with USB port.
  - Simulator management software (CDROM)
  - Labview software environment

- Connect the power supply according with the voltage indicated on the right side of the panel.

USB cable



2. ELECTRICAL SYSTEM

2.1 Electrical power generation

- The aircraft's engines mechanically transmit the rotational movement to various organs as shown below.

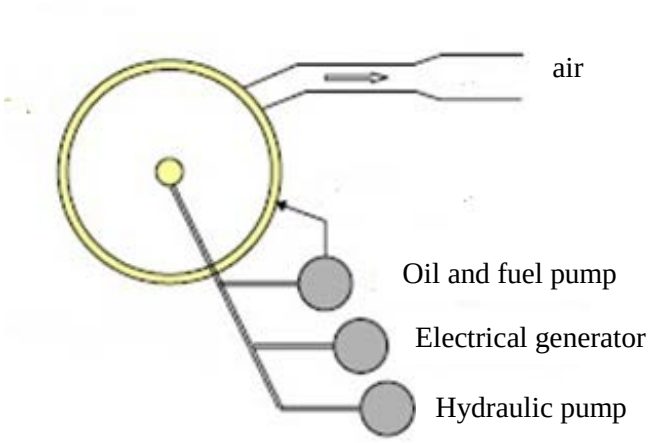
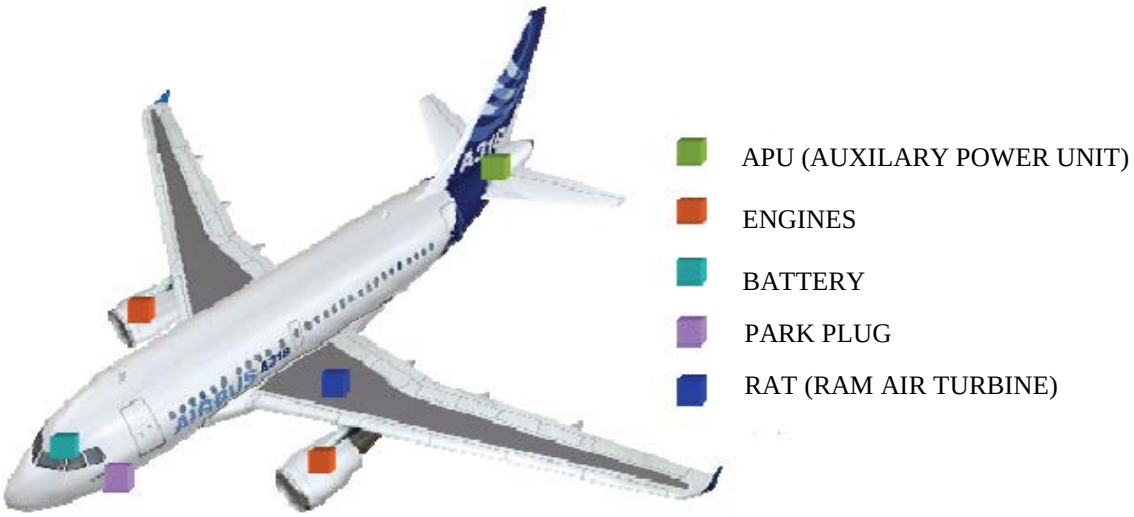


Fig. 2.1 Energy generation

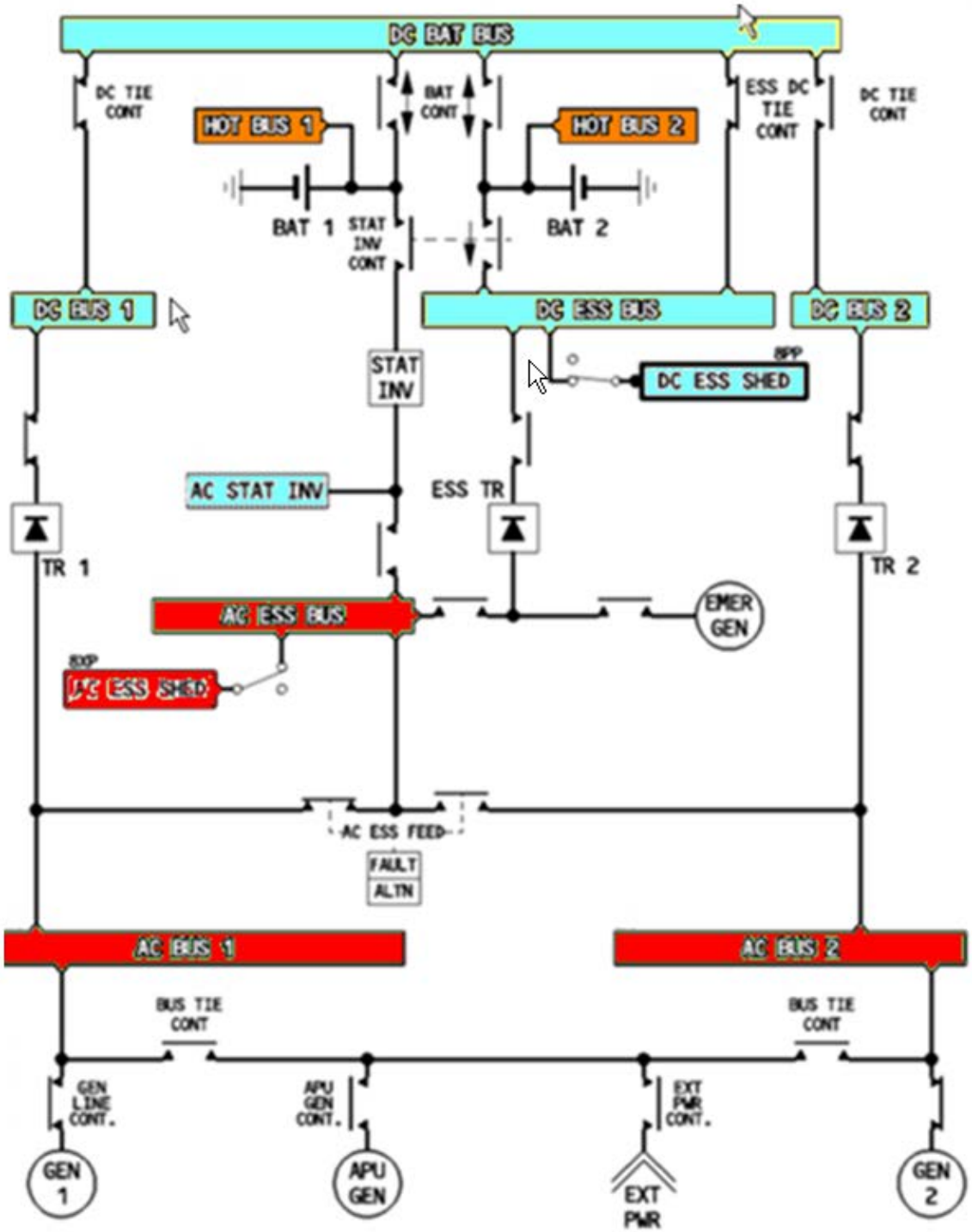
- The aircraft generators produces electricity to each equipments
  - Egine ignition
  - Computers
  - Navigation instruments
  - Actuators
  - External and internal lighting
  - Commercial services

- The energy generation is produces according to the aircraft state by:
  - Battery
  - External Ground Power Unit
  - Engines
  - Emergency RAT (Ram Air Turbine)

The following picture localized energy sources:



- The electrical power system consists of a three-phase 115/200 V 400 Hertz constant frequency AC system and 28 V DC system
- Commercial supply has secondary priority.
- Normally, the system produces alternating current, some of which it then transforms into direct current for certain applications.
- Each of the aircraft's three generators (GEN1, GEN2 and APU) can supply the whole network.
- If all normal AC generation is lost, an emergency generator can supply AC power.
- If all AC generation is lost, the system can transform DC power from the batteries into AC power.


DC BAT BUS
DC TIE CONT
HOT BUS 1
BAT CONT
HOT BUS 2
ESS DC TIE CONT
DC TIE CONT
BAT 1
STAT INV CONT
BAT 2
DC BUS 1
DC ESS BUS
DC BUS 2
STAT INV
DC ESS SHED
AC STAT INV
ESS TR
TR 1
TR 2
AC ESS BUS
EMER GEN
AC ESS SHED
AC ESS FEED
FAULT
ALTN
AC BUS 1
AC BUS 2
BUS TIE CONT
BUS TIE CONT
GEN LINE CONT.
APU GEN CONT.
EXT PWR CONT.
GEN 1
APU GEN
EXT PWR
GEN 2

2.2 AC generators

MAIN GENERATORS

- Two three-phase AC generators (GEN 1, GEN 2), one driven by each main engine through an integrated drive, supply aircraft electrical power. Each generator can supply up to 90 KVA of power at 115 and 200 volts and 400 hertz.

- A third generator (APU GEN), driven directly by the APU and producing the same output as each main engine generator, can replace either or both main engine generators at any time.

- A Generator Control Unit (GCU) controls the output of each generator. The main functions of each GCU are :
  - Control the frequency and voltage of the generator output.
  - Protect the network by controlling the associated Generator Line Contactor (GLC).

EXTERNAL POWER

- A ground power connector near the nose wheel allows ground power to be supplied to all bus bars.

- A Ground Power Control unit (GPCU) protects the network by controlling the external power contactor.

EMERGENCY GENERATOR

- The blue hydraulic circuit drives an emergency generator that automatically supplies emergency AC power to the aircraft electrical system if all three main generators fail. This generator supplies 5 KVA of three-phase 115/200-volt 400-hertz power.

  A Generator Control Unit (GCU) :
  - Keeps the emergency generator at a constant speed
  - Controls the generator's output voltage
  - Protects the network by controlling the emergency generator line contactor
  - Controls the emergency generator start-up

STATIC INVERTER

- A static inverter transforms DC power from Battery 1 into one KVA of single-phase 115-volt 400-hertz AC power, which is then supplied to part of the AC essential bus. When the aircraft speed is above 50 knots, the inverter is automatically activated, if nothing but the batteries are supplying electrical power to the aircraft, regardless of the BAT 1 and BAT 2 pushbutton positions.

- When the aircraft speed is below 50 knots, the inverter is activated, if nothing but the batteries are supplying electrical power to the aircraft, and the BAT 1 and BAT 2 pushbuttons are both on at auto

2.3 DC Generation

TRANSFORMER RECTIFIERS (TRs)

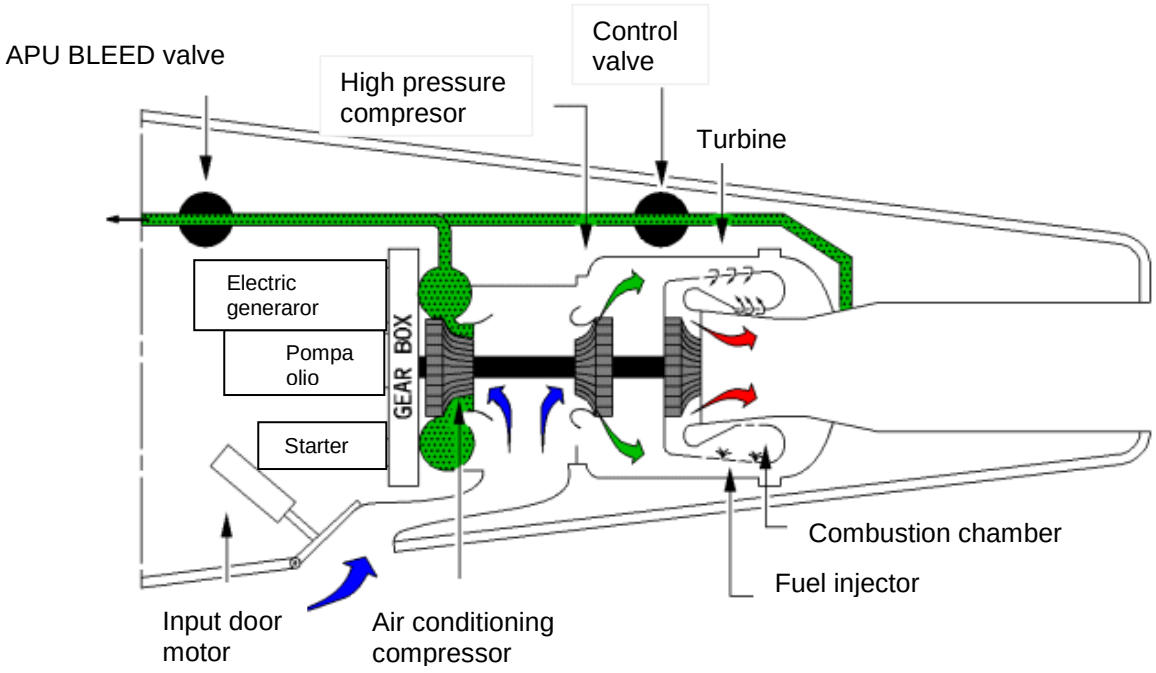
- Two main transformer rectifiers, TR 1 and TR 2, supply the aircraft's electrical system, with up to 200 amperes of DC current.
- A third (identical) transformer rectifier, the ESS TR, can power the essential DC circuit from the emergency generator, if the engine and APU generators all fail, or if TR 1 or TR 2 fails. Each TR controls its contactor by internal logic.

BATTERIES

- Two main batteries, each with a normal capacity of 23 ampere-hours, are permanently connected to the two hot buses.
  Each battery has an associated Battery Charge Limiter (BCL).
- The BCL monitors battery charging and controls

2.4 APU Auxiliary Power Unit

- The auxiliary power unit (APU) is constituted by a small turbine positioned in the tail of the plane. It allows the aircraft to be independent for the electrical and pneumatic energy.
- The APU provides the air for starting the engines and for air conditioning and drives a generator for electricity generation.
- Starting is carried out by using the START button.
- At takeoff provides air conditioning in order to avoid the reduction of engine power.
- The APU can be used on the ground or in flight.
- The inlet air enters in the high pressure compressor and is mixed with fuel.
- After starting, the expulsion of the hot gases to throught the turbine mounted on the same axis keeps the cycle of the compressor.
- The function check is performed by the control unit FADEC (Full Authority Digital Electronic Control) used for jet engine management.



2.5 Operations

GENERAL

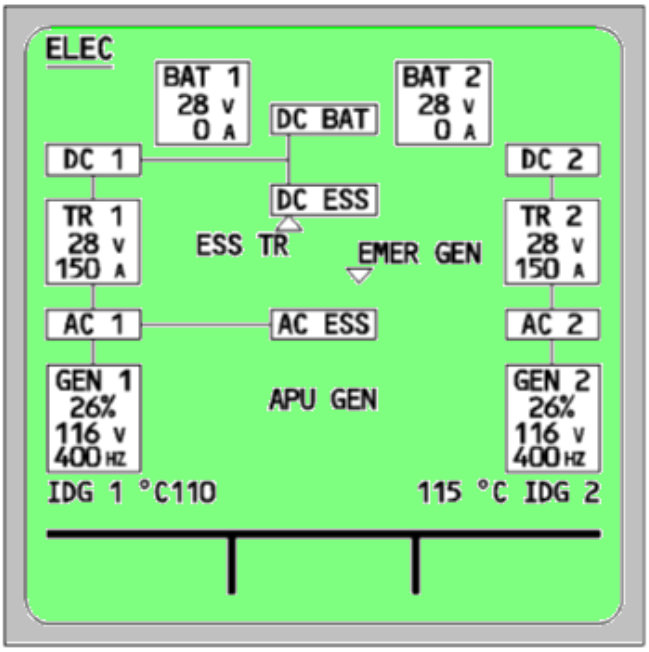
- GEN 1 and 2 when operating have priority over the APU generator and over external power. External power has priority over the APU generator when the EXT PWR pushbutton switch is ON.
- The APU generator or external power can supply the entire network.
- One engine generator can supply the entire network.
  The generators cannot be connected in parallel.

NORMAL CONFIGURATION

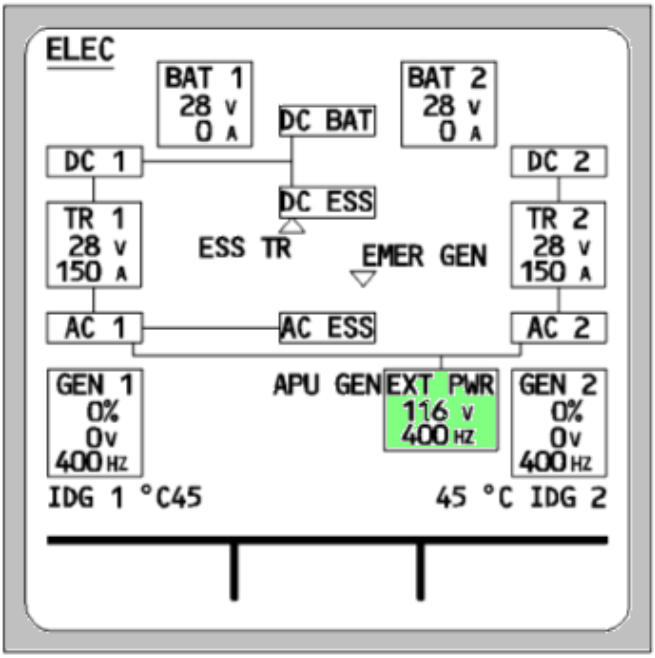
IN FLIGHT

- Each engine-driven generator supplies its associated AC BUS (1 and 2) via its generator line contactor (GLC 1 and GLC 2).
- AC BUS 1 normally supplies the AC ESS BUS via a contactor.
- TR 1 normally supplies DC BUS 1, DC BAT BUS, and DC ESS BUS.
- TR 2 normally supplies DC BUS 2.

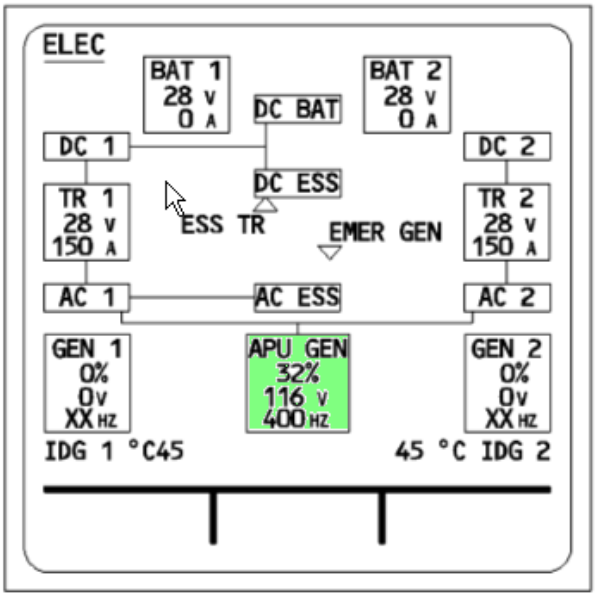
- The two batteries are connected to the DC BAT BUS if they need charging. When they are fully charged the battery charge limiter disconnects them.



ON GROUND

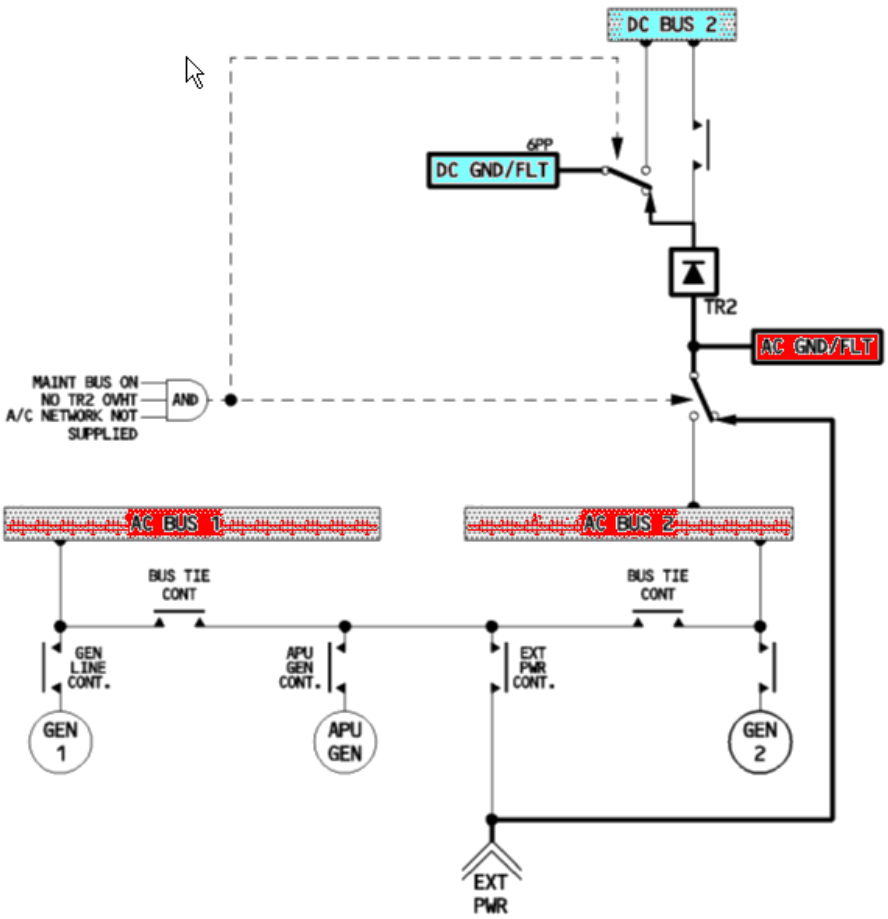


EXTENAL POWER ONLY



APU GEN ONLY

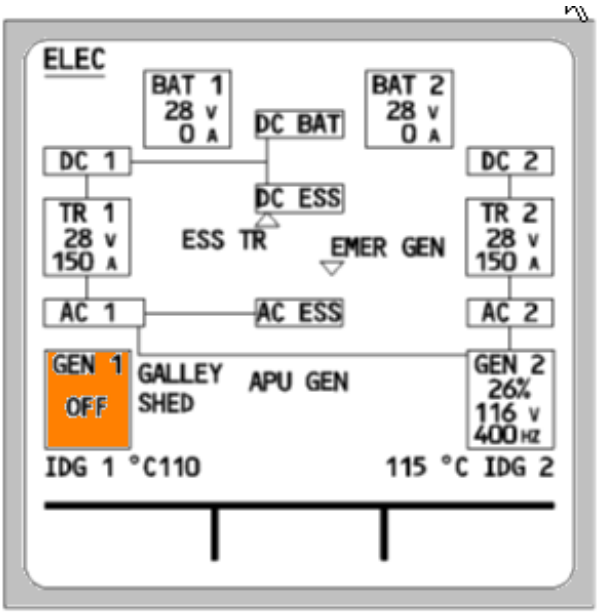
- On ground, when only ground services are required, external power can supply the AC and DC GND/FLT BUSES directly without supplying the entire aircraft network. Personnel select this configuration with the MAINT BUS switch in the forward entrance area.



2.6 Abnormal configuration

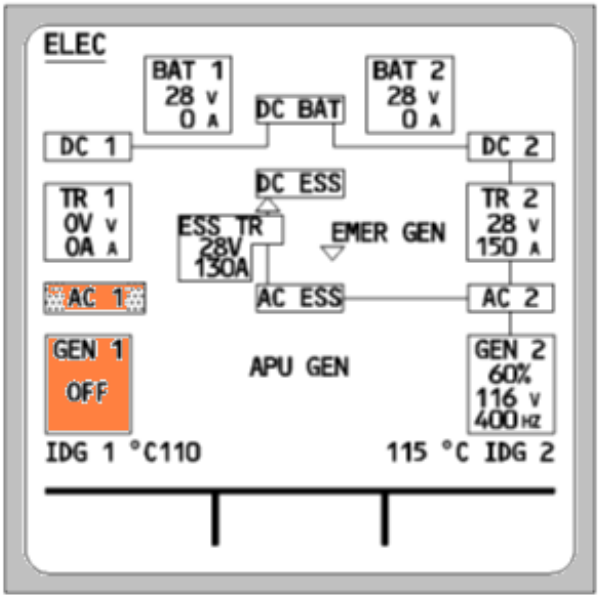
- **Failure of on engine generator**

The system automatically replaces the failed generator with:
- The APU GEN if available
- The other engine generator (autolatically shedding part of the galley load).



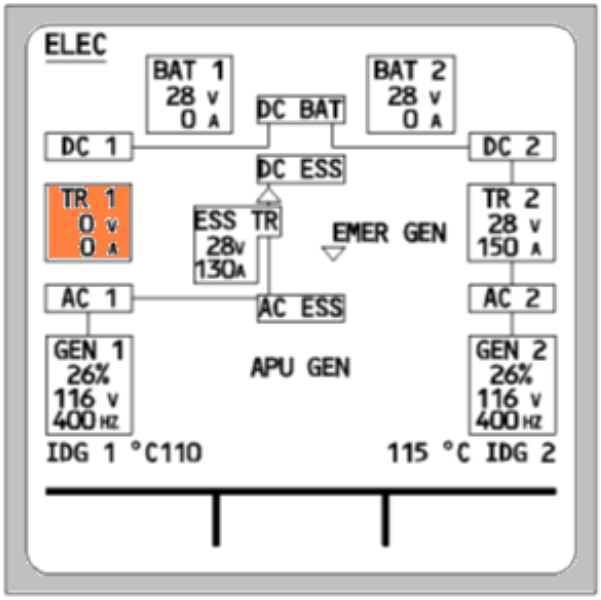
- **Failure of AC BUS 1**

- The AC BUS 2 can supply the the AC ESS BUS and the ESS TR can supply the DC ESS BUS, both through the AC ESS FEED button.
- The DC BUS2 supplies te DC BUS 1 and DC BAT BUS automatically



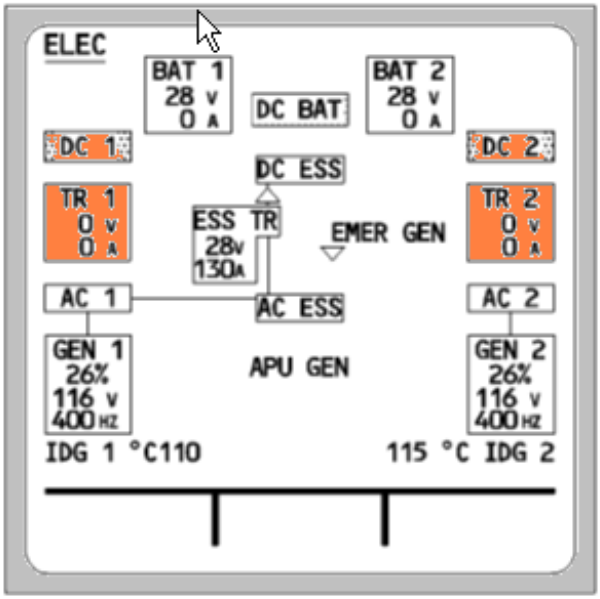
- **Failure of one TR**

  - The contactor of each TR opens automatically in case of:
    - Overheat
    - Minimum current
  - The other TR automatically replaces the faulty one.
  - The ESS TR supplies the DC ESS BUS



- **Failure of TR 1 and TR 2**

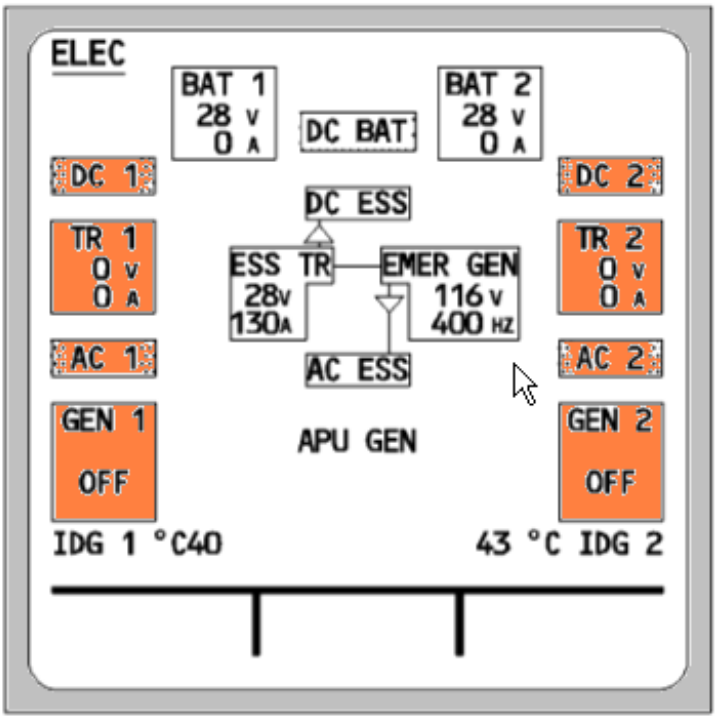
  - If TR 1 and TR 2 are lost, DC BUS 2 and DC BAT BUS are lost. The DC ESS BUS is supplied by ESS TR.

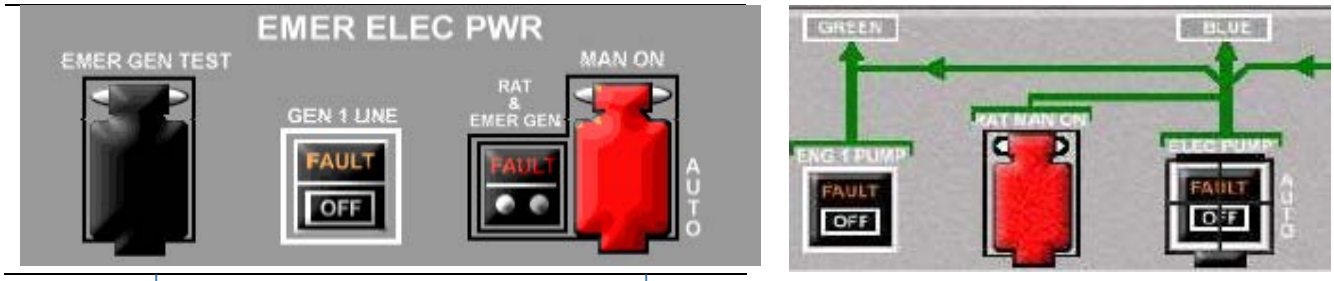


- **Emergency generation after loss of all main generators**

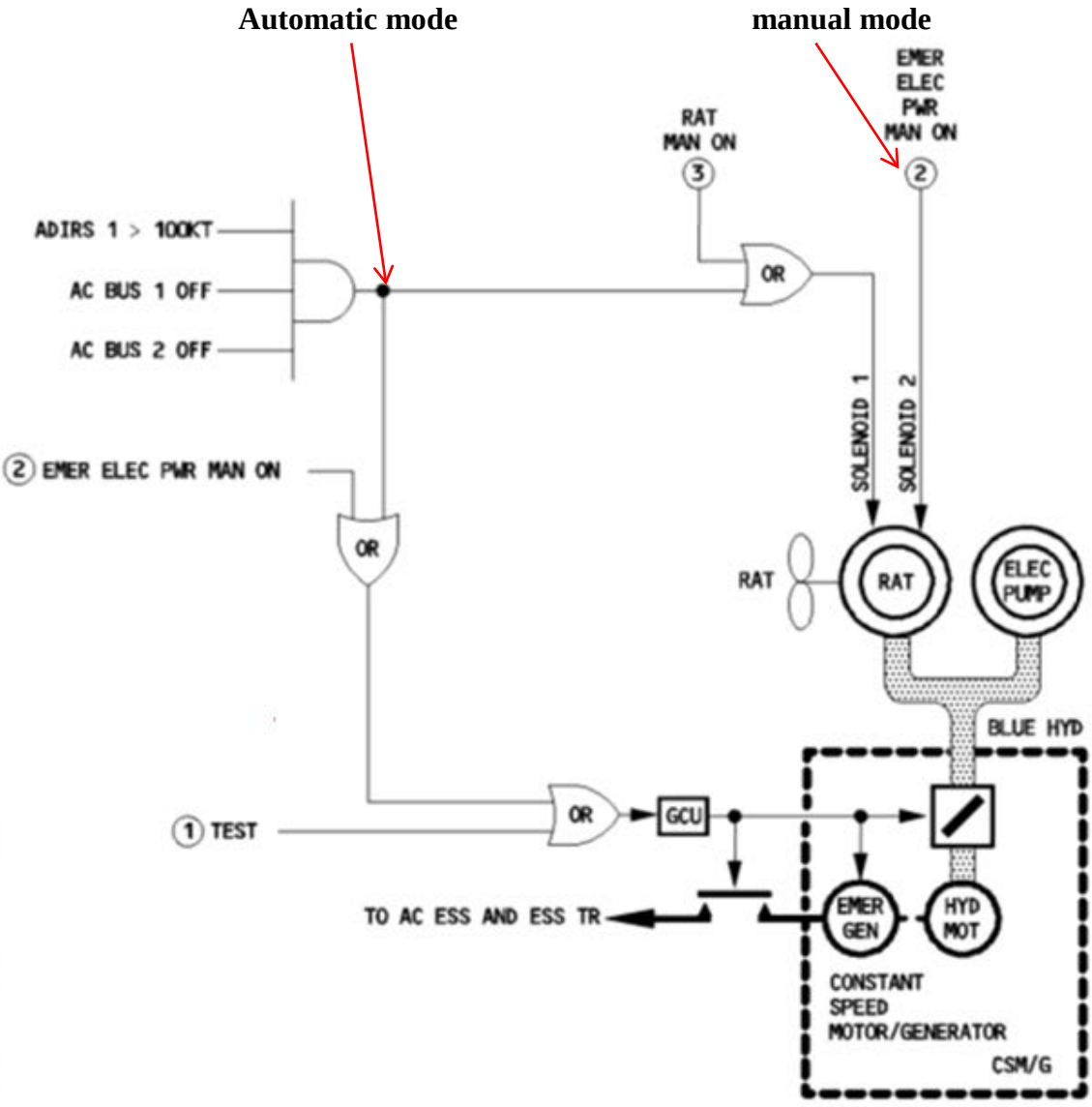
  - If both the AC BUS 1 and AC BUS 2 buses are lost and the aircraft speed is above 100 knots, the Ram-Air Turbine (RAT) extends automatically. This powers the blue hydraulic system, which drives the emergency generator by means of a hydraulic motor. This generator supplies the AC ESS BUS, and the DC ESS BUS via the ESS TR.
  - If the RAT stalls or if the aircraft is on the ground with speed below 100 knots, the emergency generator has nothing to drive it. The emergency generation network transfers automatically to the batteries and static inverter, and the system automatically sheds the AC SHED ESS and DC SHED ESS buses.
  - When the aircraft is on the ground :
    - Below 100 knots the DC BAT BUS is automatically connected to the batteries.
    - Below 50 knots the AC ESS BUS is automatically shed, leading to the loss of all CRTs.
  - During RAT extension and emergency generator coupling (about 8 seconds), the batteries power the emergency generation network.

EMER GEN RUNNING

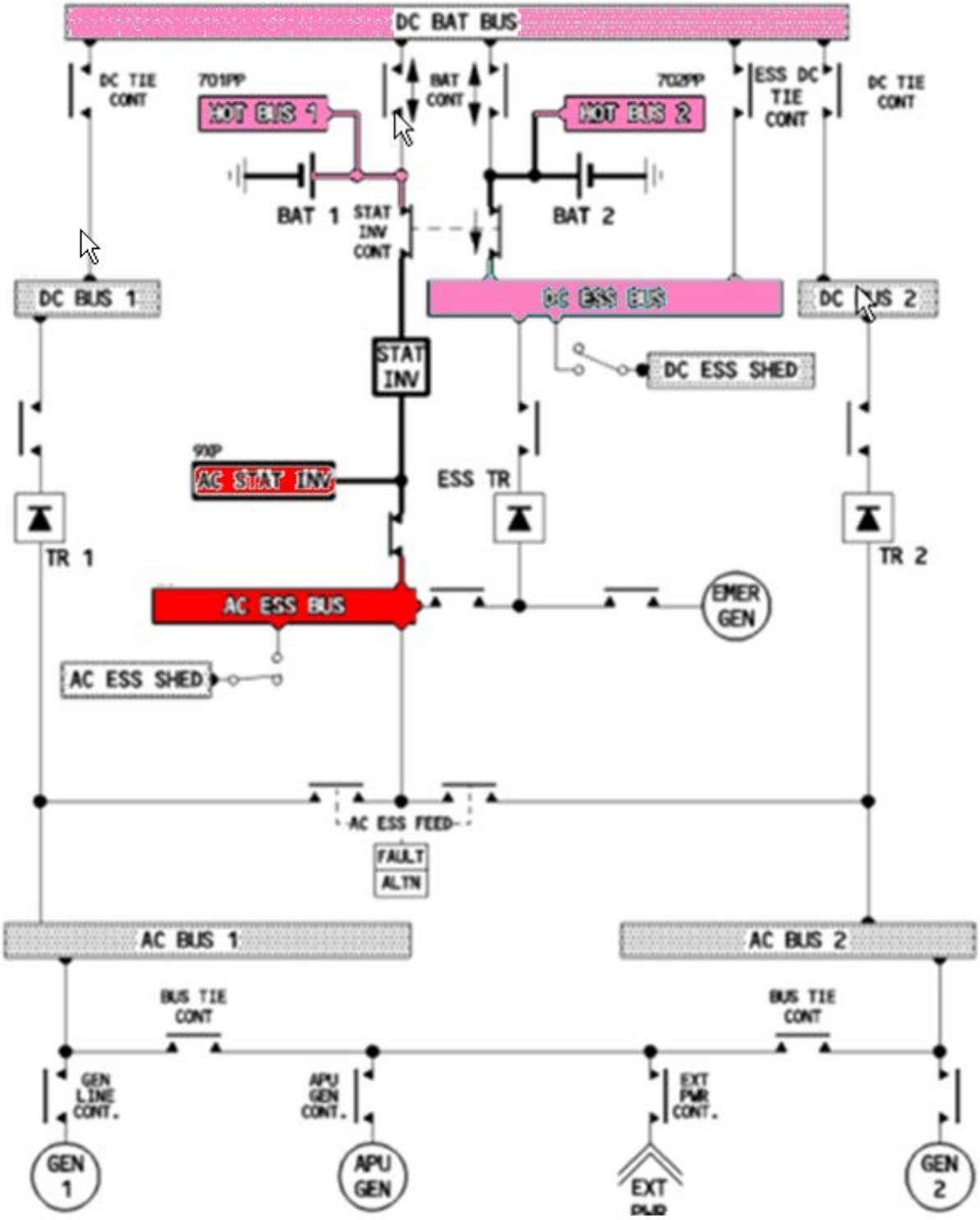



EMER ELEC PWR
EMER GEN TEST
GEN 1 LINE
FAULT
OFF
RAT
&
EMER GEN
FAULT
MAN ON
AUTO
GREEN
BLUE
ENG 1 PUMP
FAULT
OFF
RAT MAN ON
ELEC PUMP
FAULT
OFF
AUTO

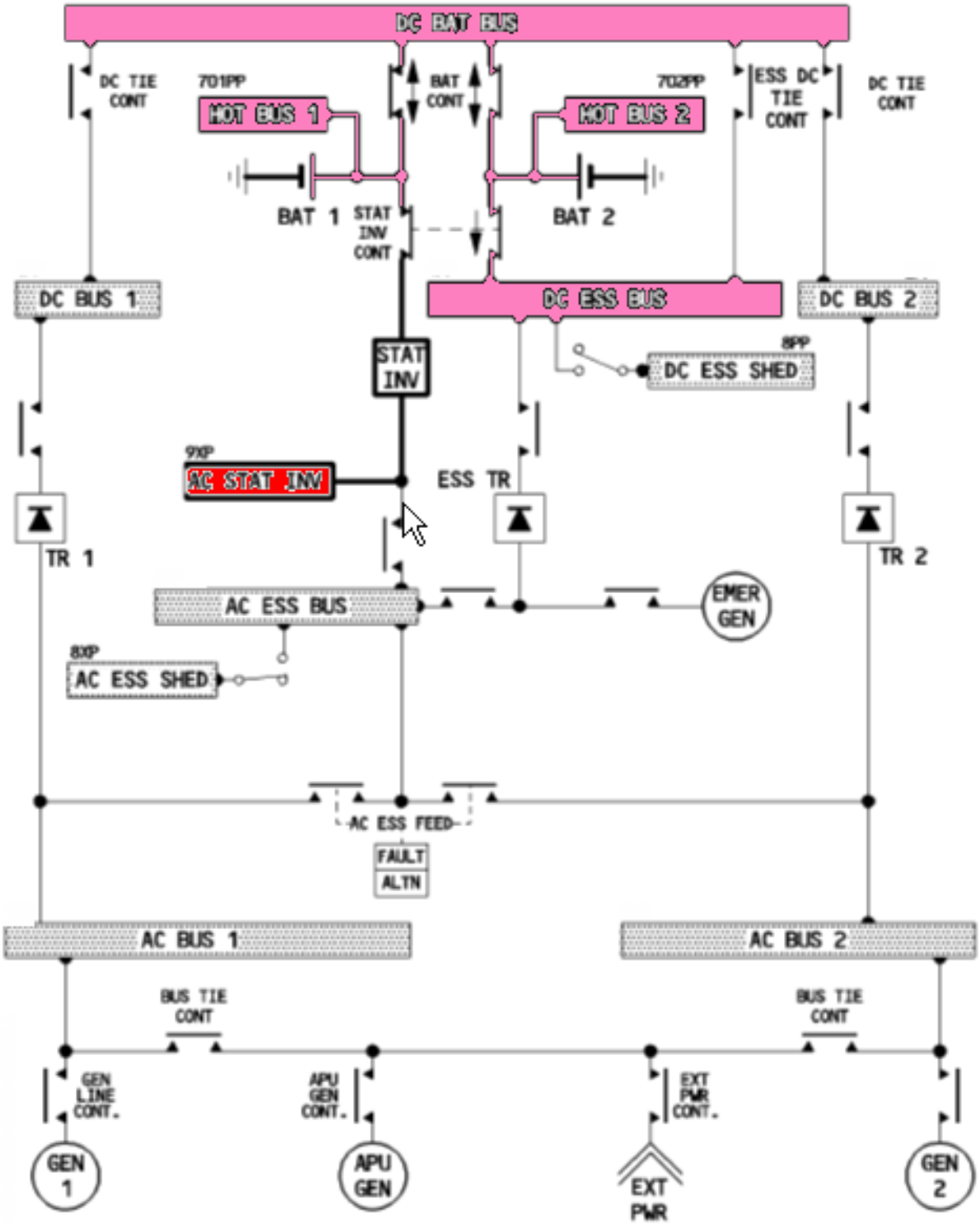
1 **2** **3**


Automatic mode
manual mode
EMER
ELEC
PWR
MAN ON
RAT
MAN ON
3
2
ADIRS 1 > 100KT
AC BUS 1 OFF
AC BUS 2 OFF
OR
SOLENOID 1
SOLENOID 2
2 EMER ELEC PWR MAN ON
OR
RAT
RAT
ELEC
PUMP
BLUE HYD
1 TEST
OR
GCU
TO AC ESS AND ESS TR
EMER
GEN
HYD
MOT
CONSTANT
SPEED
MOTOR/GENERATOR
CSM/G

- **Flight with battery only**

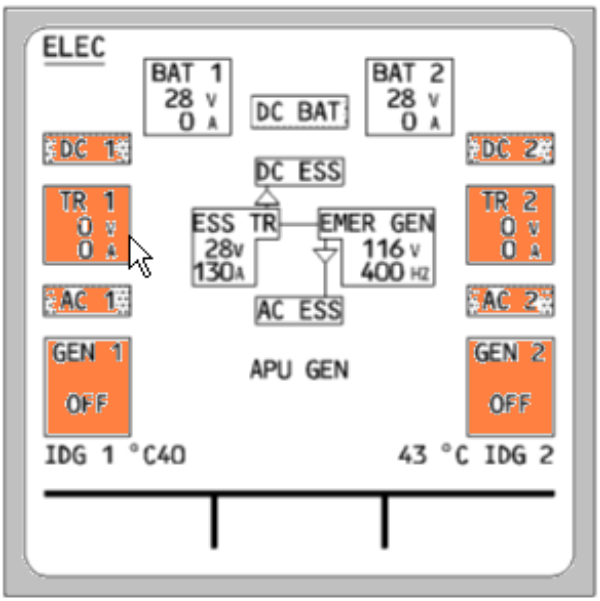


- **On ground, battery only (speed < 50 kt)**

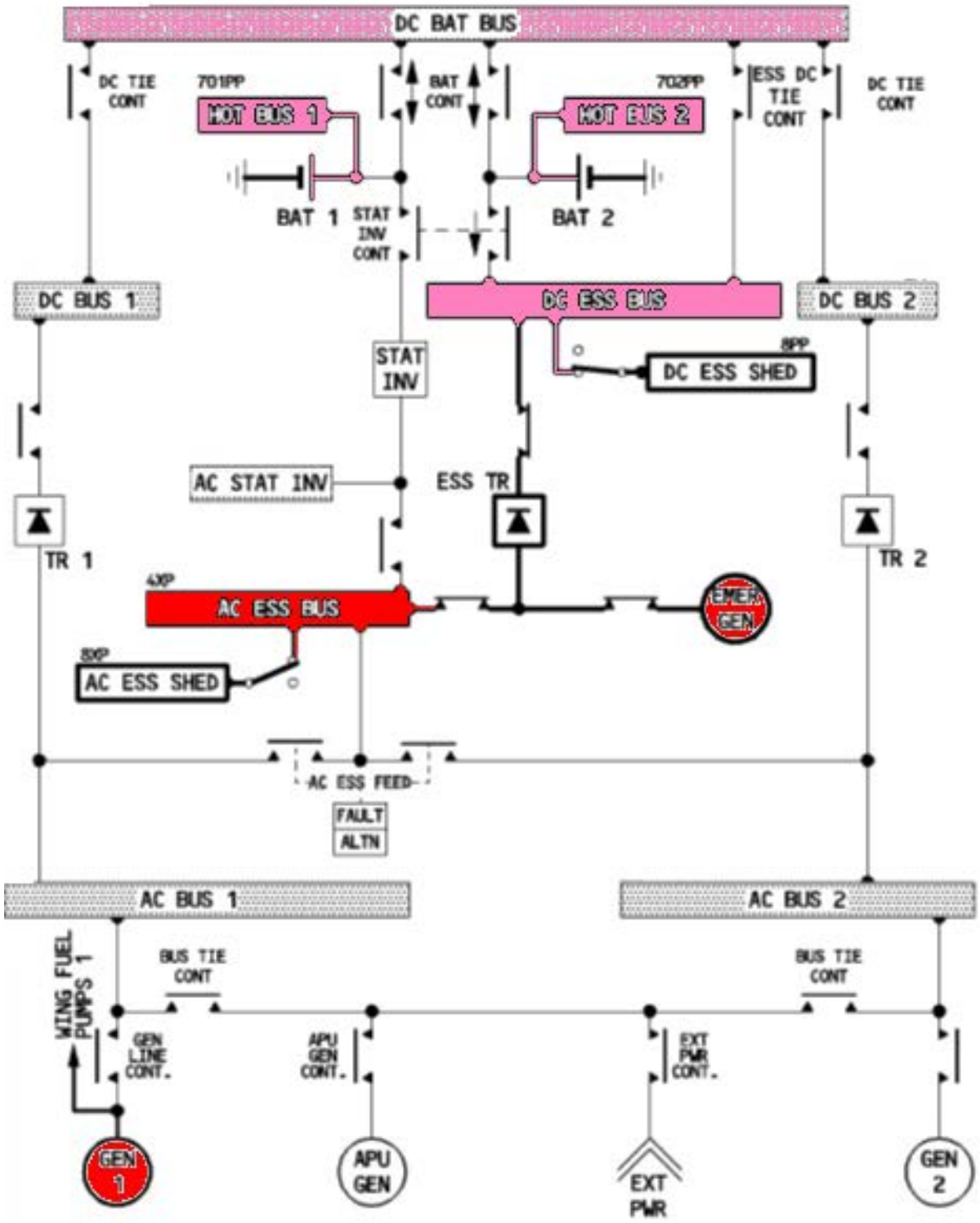


- **SMOKE configuration**

  - In this configuration the main bus bars are shedded. The electrical distribution is the same as it is in the emergency configuration (loss of main generators, except that the fuel pumps are connected upstream of the GEN 1 line connector.
  - The procedure sheds about 75 % of electrical equipment. All equipment that remains powered is supplied through C/Bs on the overhead panel (except for that which is supplied R by hot buses ▸.



- **Smoke configuration**



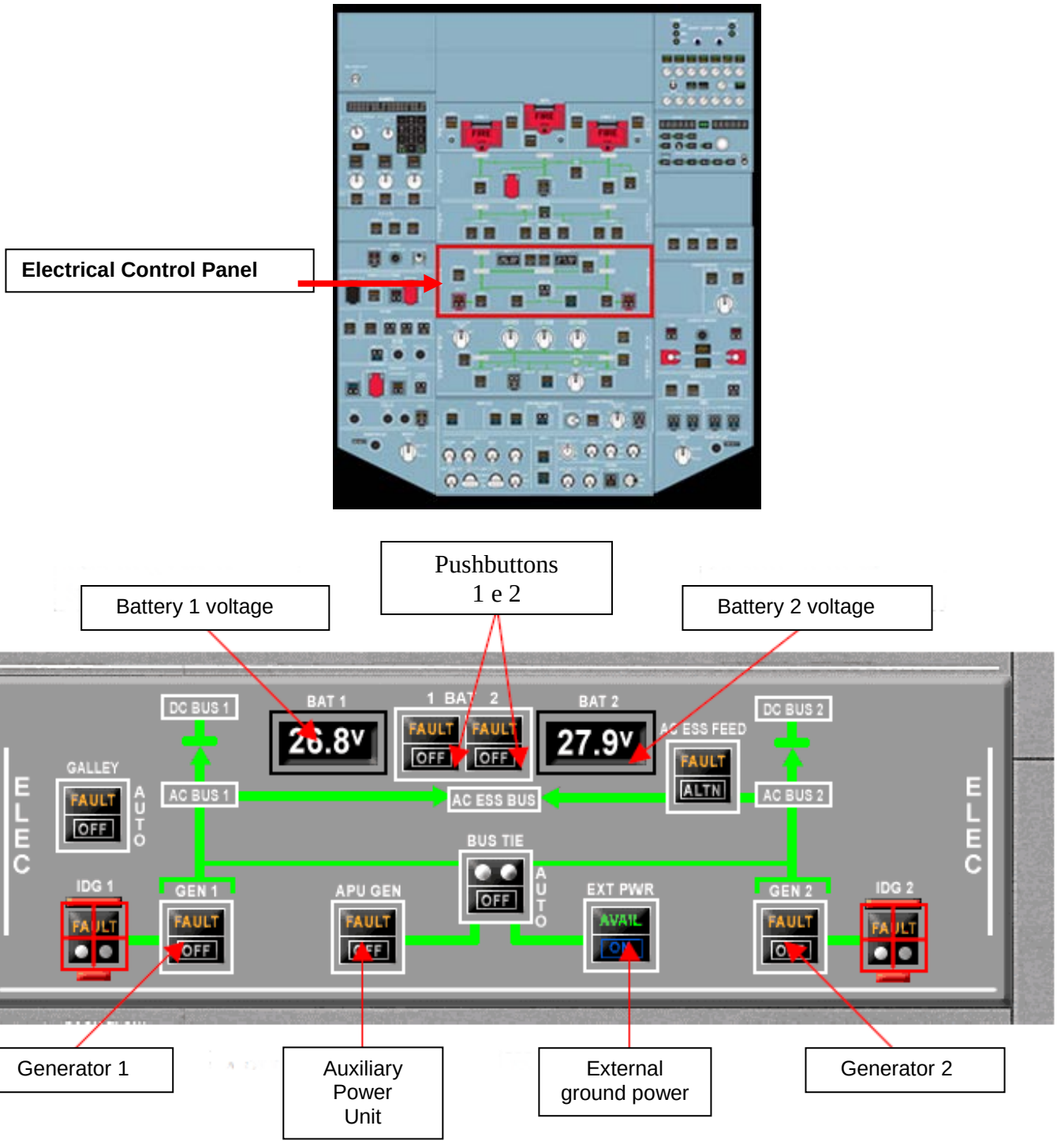
- **Electric distribution table**

	AC BUS 1	AC BUS 2	AC ESS BUS	AC SHED ESS	AC STAT INV	TR1	TR2	ESS TR	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC SHED ESS	HOT BUS 1	HOT BUS 2
NORM CONF	GEN1	GEN2	GEN1	GEN1	–	GEN1	GEN2	–	TR1 GEN1	TR2 GEN2	TR1 GEN1	TR1 GEN1	TR1 GEN1	BAT1	BAT2
ONE GEN INOP AVAIL-X- (1,2 or APU)	GENX	GENX	GENX	GENX	–	GENX	GENX	–	TR1 GENX	TR2 GENX	TR1 GENX	TR1 GENX	TR1 GENX	BAT1	BAT2
EMER CONF · BEFORE EMER GEN AVAILABILITY (about 8 sec)	–	–	ST INV BAT1	–	ST INV BAT1	–	–	–	–	–	–	BAT2	–	BAT1	BAT2
· EMER GEN RUNNING	–	–	EMER GEN	EMER GEN	–	–	–	EMER GEN	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	BAT1	BAT2
TR1 FAULT	GEN1	GEN2	GEN1	GEN1	–	–	GEN2	GEN1	TR2 GEN2	TR2 GEN2	TR2 GEN2	ESS TR GEN1	ESS TR GEN1	BAT1	BAT2
TR2 FAULT	GEN1	GEN2	GEN1	GEN1	–	GEN1	–	GEN1	TR1 GEN1	TR1 GEN1	TR1 GEN1	ESS TR GEN1	ESS TR GEN1	BAT1	BAT2
TR1 + 2 FAULT	GEN1	GEN2	GEN1	GEN1	–	–	–	GEN1	–	–	–	ESS – TR GEN1	ESS – TR GEN1	BAT1	BAT2

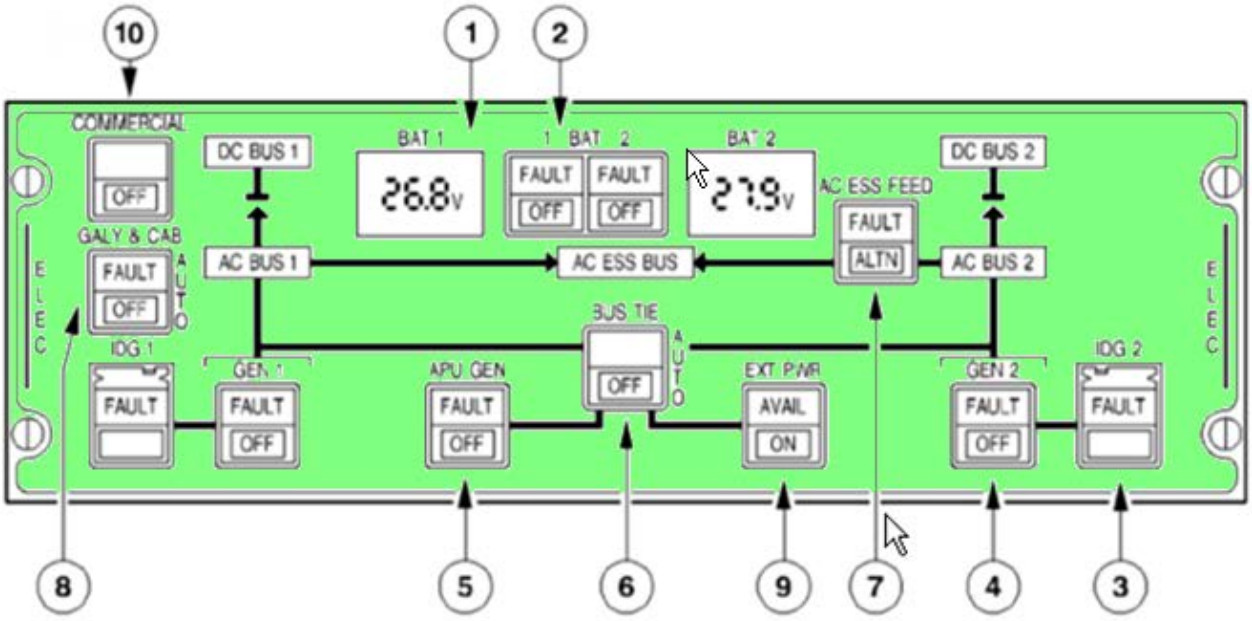
ON GROUND BAT. ONLY	AC BUS 1	AC BUS 2	AC ESS BUS	AC SHED ESS	AC STAT INV	TR1	TR2	ESS TR	DC BUS 1	DC BUS 2	DC BAT BUS	DC ESS BUS	DC SHED ESS	HOT BUS 1	HOT BUS 2
Speed > 100kt	–	–	EMER GEN	EMER GEN	–	–	–	EMER GEN	–	–	–	ESS TR EMER GEN	ESS TR EMER GEN	BAT1	BAT2
rat stall or 50 kt ≤ speed ≤100 kt	–	–	ST INV BAT1	–	ST INV BAT1	–	–	–	–	–	BAT 1-2	BAT2	–	BAT1	BAT2
speed < 50 kt	–	–	–	–	ST INV BAT1	–	–	–	–	–	BAT 1-2	BAT2	–	BAT1	BAT2

2.7 Controls and indicators

Overhead Panel AIRBUS A320



ELECTRIC PANEL: DESCRIPTION



1 <u>BAT 1(2) ind.</u>

Shows battery voltage in white.

2 <u>BAT 1 (2) pb sw</u>

Controls the operation of the corresponding battery charge limiter.

AUTO: The battery charge limiter controls automatically the connection and the disconnection of the corresponding battery to the DC BAT BUS (3 PP) by closing and opening of the battery line contactor.
- The batteries are connected to the DC BAT BUS in the following cases :
- APU starting (MASTER SW at ON and N < 95%).

<u>Note</u> : The connection is limited to 3 minutes when the emergency generator is running.

- Battery voltage below 26.5 V (battery charge). The charging cycle ends when battery charge current goes below 4 amperes.
  - on ground, immediately
  - in flight, after a time delay of 30 minutes.
- Loss of AC BUS 1 and 2 when below 100 knots (EMER GEN not supplying).
- If AC BUS 1 and 2 are not energized and emergency generator is not supplying :
- Battery 1 supplies the AC STAT INV BUS, and, if speed is greater than 50 kt, the AC ESS BUS.
- Battery 2 supplies the DC ESS BUS.

<u>Note</u> : In normal configuration the batteries are disconnected most of the time.

Note: A battery automatic cut-off logic prevents the batteries from discharging completely when the aircraft is on the ground (parking).

Automatic battery contactors open when :
- The aircraft is on the ground.
- The BAT pushbutton switches are at AUTO.
- The main power supply (EXT PWR + GEN) is cut off
- Battery voltage is low.

The flight crew can reset the contactors by switching the BAT pushbutton switch to OFF then to AUTO.

OFF: The battery charge limiter is not operating : the battery line contactor is open.
OFF comes on white if the DC BAT BUS is supplied. Hot buses remain supplied.

FAULT lt: Comes on amber, accompanied by an ECAM caution, when the charging current for the corresponding battery is outside limits.
In this case yhe battery contactor opens.

3 IDG 1 (2) (Integrated Drive Generator) pb sw (guarded)

CAUTION

1. Holding this pusbutton switch in for more than about 3 seconds may damage the disconnection mechanism.
2. Do not disconnect the IDG when the engine is not running, because starting the engine after having done so will damage the IDG.

The IDG switches are normally springloaded out.
Pressing this switch disconnects the IDG from its driveshaft : only maintenance personnel can reconnect it.

FAULT lt Lights up amber, and ECAM caution comes on, if :
- IDG oil outlet overheats (above 185°C), or
- IDG oil pressure is low (inhibited at low engine speed : N2 below 14 %) It extinguishes when the IDG is disconnected.

4 GEN 1 (2) pb sw

ON: The generator field is energized and the line contactor closes if electrical parameters are normal.

OFF: The generator field is de-energized and the line contactors opens.
the fault circuit is reset.

FAULT lt : Lights up amber, and an ECAM caution comes on, if :
- The associated generator control unit (GCU) trips it.

Note : If a differential fault trips the protection, reset action has no effect after two attempts.

- Opening of the line contactor (except if the GEN pushbutton switch is selected OFF)

5 APU GEN pb sw

ON: The APU generator field is energized and the line contactor closes if parameters are normal and the EXT PWR line contactor is open. The bus tie contactor 1 (2) closes automatically if GEN 1 (2) is not operating.

OFF: The generator field is de-energized and the line contactor opens. The fault circuit is reset.

FAULT lt : Same as GEN 1 or 2 FAULT
The APU GEN FAULT light is inhibited when APU speed is too low or if the APU GEN line contactor opens after EXT PWR or ENG GEN takes over.

6 **BUS TIE pb sw**

AUTO: The bus tie contators (BTCs) open or close automatically in order to maintain power supply to both AC BUS 1 and AC BUS 2.

- One contactor is closed when :
  - One engine generator supplies the associated AC BUS, and
  - The APU generator or external power supplies the other side.
- Both contactors are closed during single-engine operation, or operation on the APU generator or external power supply.

OFF: Both bus tie contactors open.

7 AC ESS FEED pb sw

The AC ESS BUS is normally supplied from AC BUS 1.
It may be supplied by AC BUS 2 through the AC ESS FEED pushbutton switch.
NORM: The AC ESS BUS is supplied from AC BUS 1.
ALTN: The AC ESS BUS is supplied from AC BUS 2.
FAULT lt: Comes on amber, and ECAM caution comes on, when the AC ESS BUS is not electrically supplied.

Note : In case of total loss of main generators, the AC ESS BUS is automatically supplied by the emergency generator, or by the static inverter if the emergency generator is not available.

8 **GALY and CAB pb sw**

AUTO: Main galley, secondary galley and in-seat power supply <I are supplied. The main galley and in-seat power supply <I are shed automatically when :
- In flight : only one generator is operating.
- On the ground : only one engine generator is operating. (All galleys are available when the APU GEN or EXT PWR is supplying power.)

OFF: The main galley, secondary galley and in-seat power supply <I are not supplied.

FAULT lt Comes on amber, and ECAM caution comes on, when the load on any generator is more than 100 % of rated output.

9 EXT PWR pb (momentary action)

AVAIL light comes on green if :

- external power is plugged in, and
- external power parameters are normal.

Pressed momentarily :

If the AVAIL light was on :

- The external power line contactor closes.
- The AVAIL light goes off.
- The ON light comes on blue.

If the ON light was on :

- The external power line contactor opens.
- The ON light goes off.
- The AVAIL light comes on.

Note : 1.External power has priority over the APU generator. The engine generators have priority over external power.
2.The ON light stays on even when the engine generators supply the aircraft.

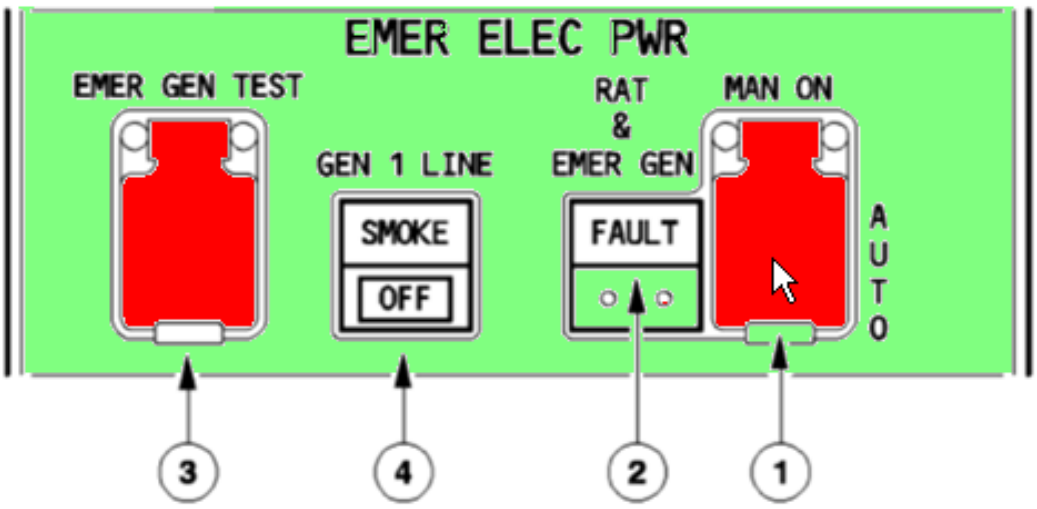
10 COMMERCIAL pb sw

ON: All aircraft commercial electrical loads are supplied :

- cabin and cargo lights
- water and toilet system
- drain mast ice protection
- galley
- passengers' entertainment
- semi-automatic cargo loading (il installed)

OFF: Switches off all airgrsft commercial electrical loads

ELECTRIC EMERGENCY



1 <u>MAN ON pb (guarded)</u>

AUTO : When the following conditions are met :
- AC BUS 1 is not electrically supplied.
- AC BUS 2 is not electrically supplied.
- Aircraft speed is greater than 100 knots.
- The RAT extends.
- The blue hydraulic system drives the emergency generator.
- As soon as the emergency generator electrical parameters are within tolerance the emergency generator is connected to the aircraft network.

Pressed: This selects manual RAT extension.
Emergency generator coupling occurs 3 seconds after the RAT is supplying the emergency generator.

2 <u>FAULT lt</u>

This light comes on red if the emergency generator is not supplying power when AC BUS 1 and AC BUS 2 are not powered.

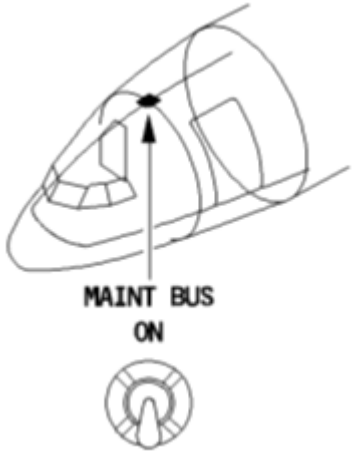
3 <u>EMER GEN TEST pb (guarded)</u>

Pressed and held :
- If AC NORMAL BUSES are supplied :
  - The EMER GEN is driven hydraulically if the blue electric pump is running. The AC ESS BUS and the DC ESS BUS are connected to the emergency generator. (The DC ESS SHED and AC ESS SHED buses are not powered.)
  - ECAM displays the ELEC page automatically (only on the ground).
- If only the batteries supply the aircraft :
  - The static inverter powers the AC ESS BUS.

4 GEN 1 LINE pb sw

OFF: GEN 1 line contactor opens.
The AC BUS 1 channel is supplied from GEN 2 through bus tie contactors. This is used for smoked drill.
SMOKE lt: Smoke contact is closed.

FORWARD CABIN



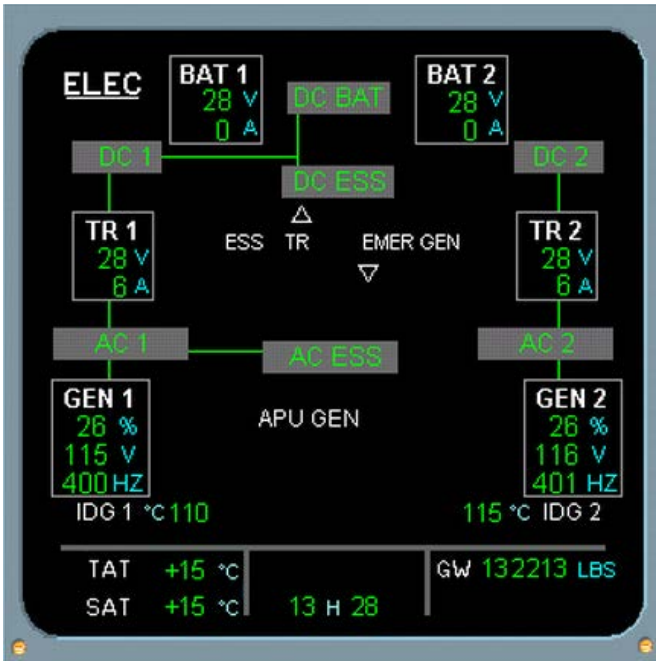
This switch allows personnel to energize electrical circuits for ground servicing without energizing the entire aircraft electrical system.

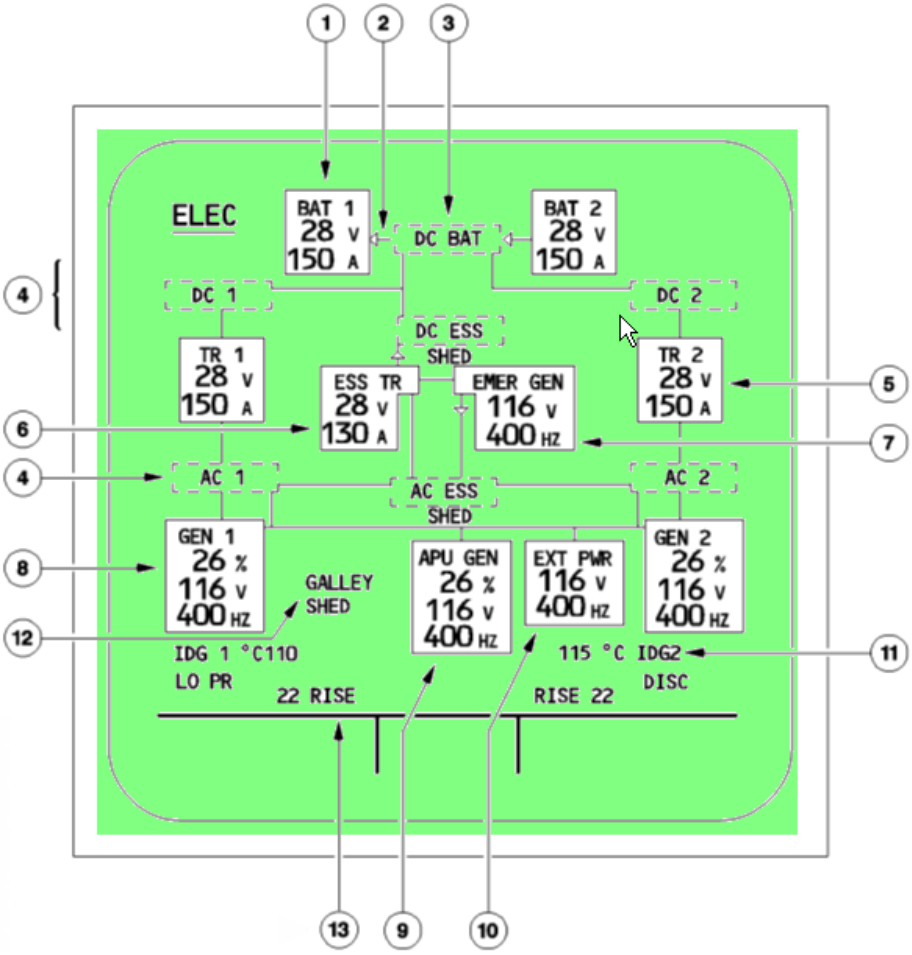
ON: The switch latches magnetically if external power is connected and normal (AVAIL light on).
The AC and DC GND/FLT buses have power and the following loads can be energized :
- passenger compartment lighting
- galley lighting
- entrance area lights
- lavatory lighting and service
- vacuum cleaner sockets
- flight compartment service outlets
- hydraulic pump (yellow system)
- flight compartment flood lighting
- fuel quantity indications
- refueling
- cargo hold lighting
- main and nose landing gear compartment lighting
- belly fairing panel service outlets
- ground call
- equipment compartment lights and service outlets
- navigation lights.

The switch trips when the external source is removed.

OFF: The AC and DC GND/FLT buses are connected to AC BUS 2 and DC BUS 2.

2.7 ECAM DISPLAY (Electronic Centralized Aircraft Monitor)

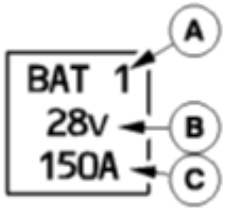




1 Battery indications

- BAT pushbutton switch at OFF :
  Legend is in white.

- BAT pushbutton switch at AUTO:

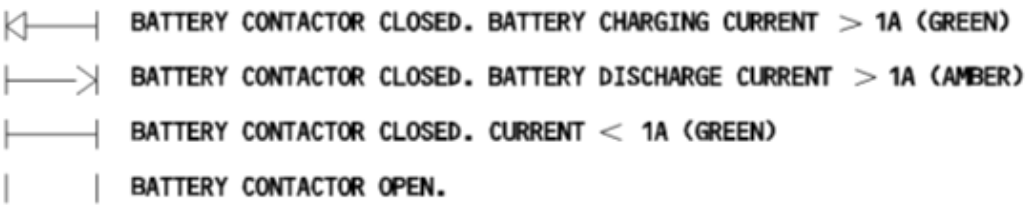


A Legend is normally white, but becomes amber
- when voltage and current indications change to amber, or
- in case of a BAT FAULT warning.

B Battery voltage is normally green, but becomes amber if V > 31 V or V < 25 V.

C Battery current is normally green, but becomes amber if discharge current > 5 A.

2 Battery charge/discharge indication



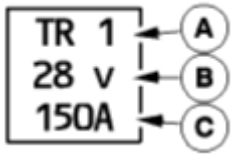
3 DC BAT indication

This legend is normally green, becomes aber if DC BAT voltage < 25 V.

4 Bus indication

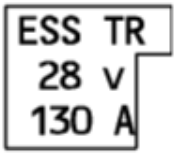
This label normally green, becomes amber when the corresponding bus is OFF.
SHED aperars in amber when AC or DC SHED ESS BUS is OFF.

5 TR 1 (2) indication



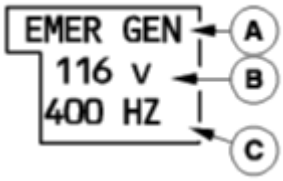
A Normally white, this legend becomes amber when the corresponding bus is OFF.
B The TR voltage, normally green, becomes amber if V > 31 V or V < 25 V.
C The TR current, normally green, becomes amber when the TR current < 5 A.

6 ESS TR indication



This legend follows the logic described above for the TR 1(2) legend.
His voltage and current are not displayed when the essential TR contactor is OPEN.

7 EMER GEN indication



A This legend, normally white, becomes amber when either the voltage or frequency legend becomes amber.

B This legend, normally green, becomes amber:
- if V > 120 V or
- if V < 110 V.

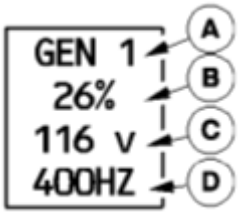
C This legend, normally green, becomes amber
- if F > 410 Hz or
- if F < 390 Hz.

Voltage and frequency indications are not displayed when the EMER GEN line contactor is open.

8 GEN 1/2 indications

- GEN pushbutton switch is OFF:
  GEN is amber
  OFF indication is white
  1 or 2 indication is white if the associated engine is running, amber if it is not.

- GEN pushbutton switch is ON.



A GEN1 or GEN2, normally white, becomes amber if any of the following legends become amber.

B The load legend, normally green, becomes amber if load > 100 %.

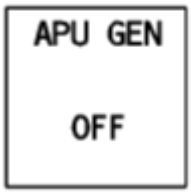
C The voltage legend, normally green, becomes amber if V > 120 V or V < 110 V.

D The frequency legend, normally green, becomes amber if F > 410 Hz or F < 390 Hz

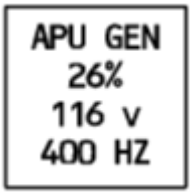
9 APU GEN indications

- When the APU MASTER switch is OFF this legend is white regardless of the position of the APU GEN pushbutton switch.

- When the APU MASTER switch is ON, and the APU GEN pushbutton switch is OFF:
  The APU GEN legend is amber.
  The OFF legend is white.



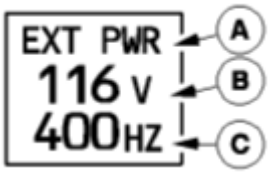
- When the APU MASTER switch is ON and the APU GEN pushbutton switch is ON :
  The indications are the same as for GEN 1 (2).



10 EXT PWR indications

- External power is not available.

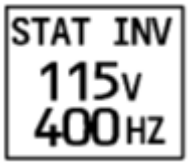
- When external power is available :



A This legend is normally white, but becomes amber, if either of the following legends turns amber.

B This legend is normally green, but becomes amber, if V > 120 V or if V < 110 V.

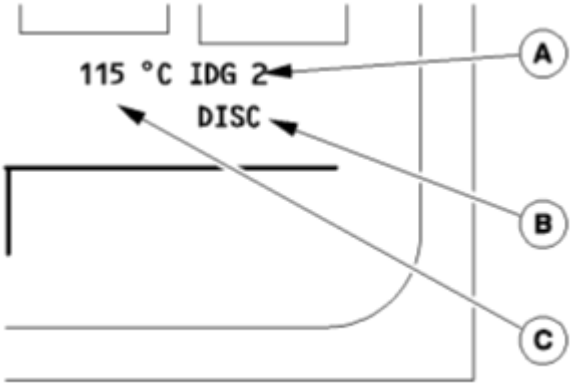
C This legend is normally green, but becomes amber, if F > 410 Hz or if F < 390 Hz.



- This legend appears during the static inverter test, and when pressing the ELEC pushbutton on the ECAM control panel while ESS BUSES are supplied by the batteries. It is normally green, but becomes amber, if:

V < 110 V or V> 120V.
F < 390 Hz or F > 410 hz.

11 IDG indications



A **IDG1 (2) legend**

The IDG legend, normally white, becomes amber if:
- Oil outlet temperature > 185° C.
- Oil pressure gets too low.
- IDG becomes disconnected.

The 1 or 2 is white if the corresponding engine is running, amber if it is not and the FADEC is powered.

B DISC/LO PR indication

The DISC legend appears in amber when the IDG is disconnected.

LO PR appears in amber when IDG low pressure is detected and the associated engine is running.

C Oil outlet temperature

This legend, normally green, appears amber if T > 185° C. It flashes if:
147° C < T < 185° C (advisory).

12 GALLEY SHED indication

This legend appears in white when :

- GALLEY pushbutton switch is OFF, or

- the main galleys are shed, meaning :
  - In flight, only one generator is operating.
  - On the ground, the aircraft is being supplied by one engine generator only.

The legend is not displayed when the aircraft is in its normal configuration.

13 RISE indication

This number, displayed in green, is the difference between the temperature at the IDG inlet and that at the IDG outlet.

2.9 Airbus A320 alternator

- The power generation is provided by two 90 kVA generators generating a three-phase system voltages of 115/200 V, 400 Hz.

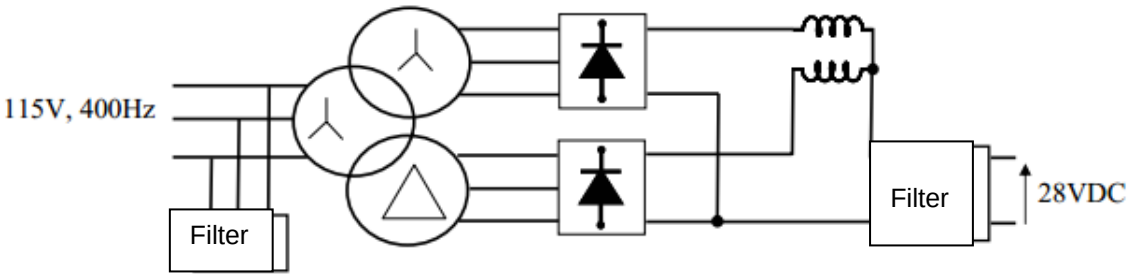
- Frequency is kept constant via an electro-hydraulic adjustment of the rotation speed of the alternators. The alternator group CSD (Constant Speed Drive) is called IDC (Integrated Drive Generator).

TNominal voltage V_N/U_N	115 V /200 V
Phase number	3
Nominal apparent power S_N	90 kVA
Nominal frequancy f_N	400 Hz
Rotation speed n_N	12,0 x 13^3 tr/mn
Power factor	0,75 <cos φ < 1
Armature resistor (per pahse) R_S	10 mΩ

- The electronic unit GCU (Generator Power Control Unit) has for main funtions:
  - Generator output frequency and voltage control.
  - Supervised the network, checking the GLC (Generator Line Contactor)

- A transformer rectifier (TR) converts alternating current into direct 28 dc current.

- The structure consists of an input filter, a transformer, two bridges of diodes, and one interphase inductance and an output filter.



2.910 Battery

- The two batteries have a capacity of 23 Ah (x 20 cells), with 28 V voltage.

- Each battery is associated with a BCL (Battery Charger Limiter), which controls the charging of the battery and the battery switch.

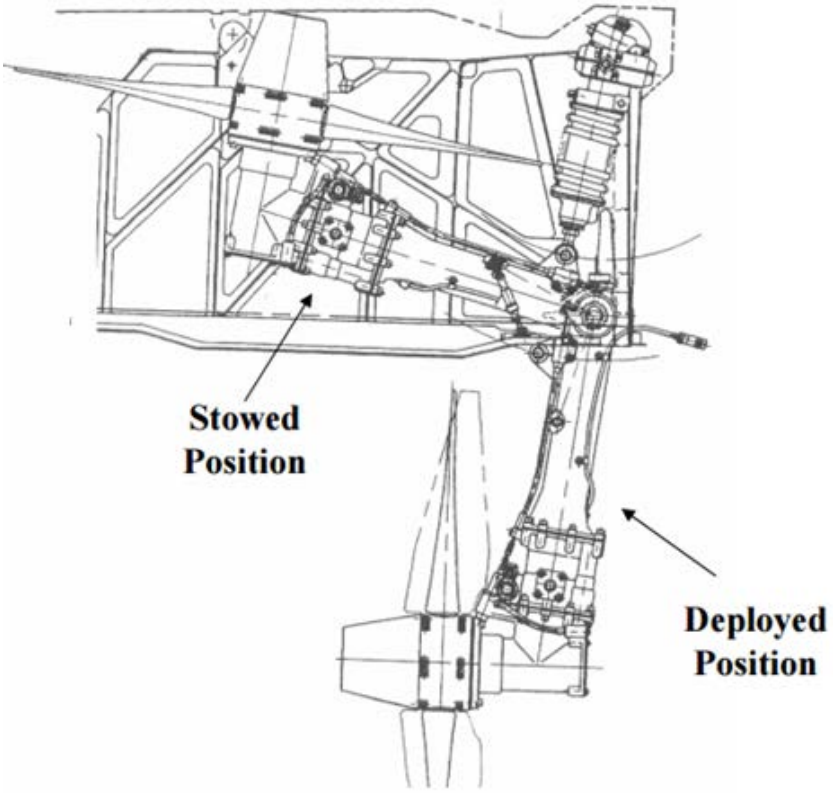
- The current aviation batteries are rechargeable Nickel Cadmium type.

- These batteries provide two vital functions:
  - Stand-alone power supply for engine start with the APU auxiliary group.
  - Electric emergency supply in case of the electric power generation failure.

- Advantages of the Nickel Cadmium technology (Ni-Cd)
  - Easy charge even with cold temperature
  - Stable characteristics in a wide temperature range (-50 ° C to + 70 ° C)
  - Very low internal resistance

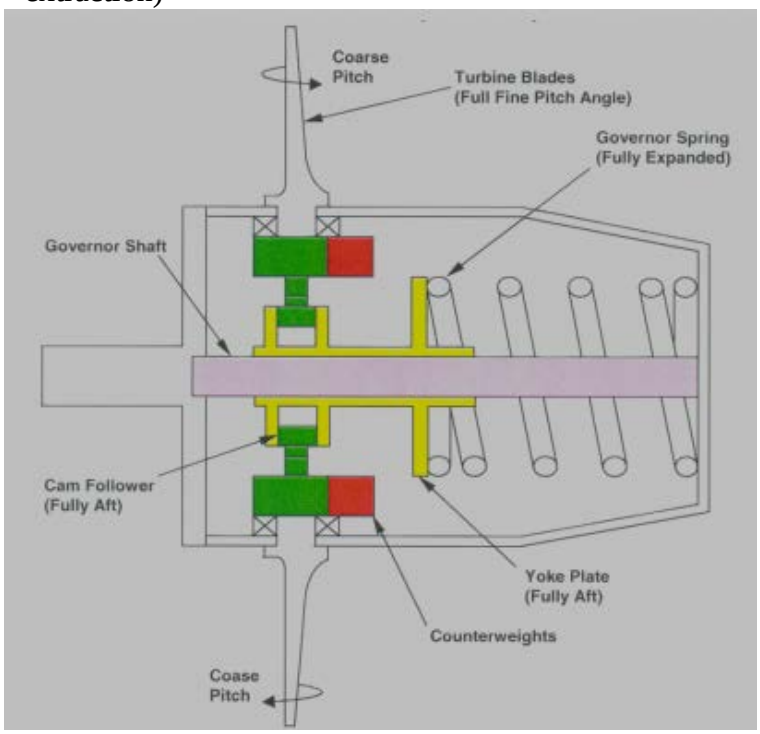
- Battery limitations
  - Low energy density, high weight
  - Auto-download (20% per month)
  - Sensitive to the memory effect
  - Hazardous Substances (6% Cadmium) with recycling requirements
  - High Cost

2.11 RAT (Ram Air Turbine)

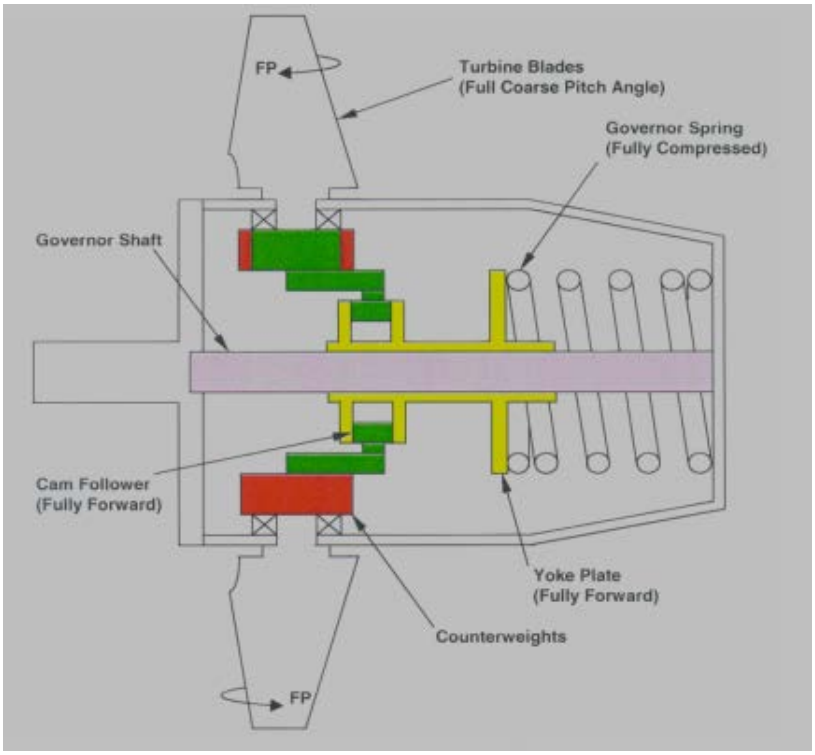


RAT Speed Governor Mechanism

- At low speed Spring holds blades in fine pitch position (high power extraction)



- At high speed Counterweights act to compress spring and rotate blades to coarse pitch position (low power extraction)

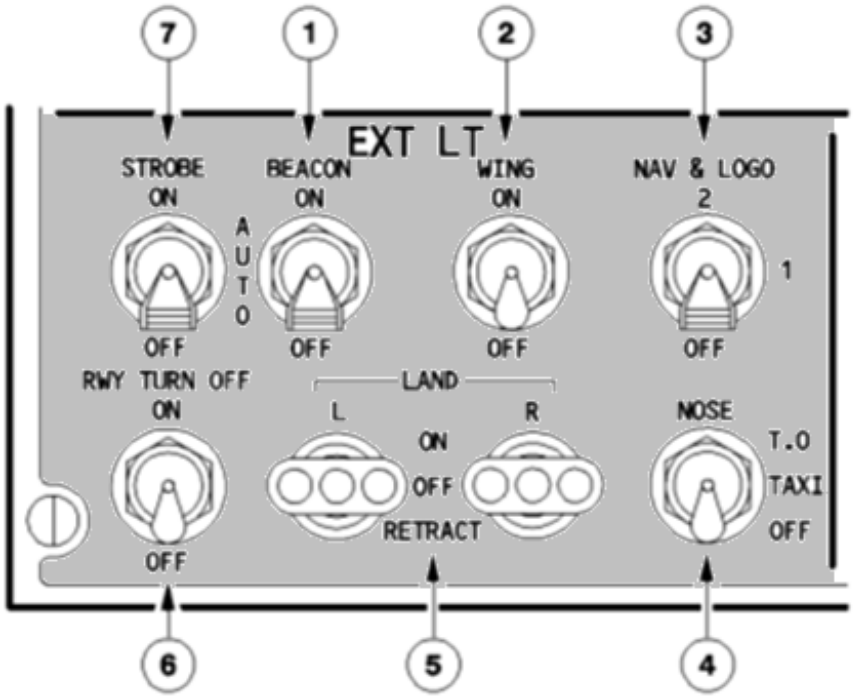


2.12 Exterior Lighting System

Exterior lighting includes :
- Navigation lights
- Landing lights
- Runway turn off lights
- TO and TAXI lights
- Logo lights
- Anticollision lights
- Wing and engine scan lights

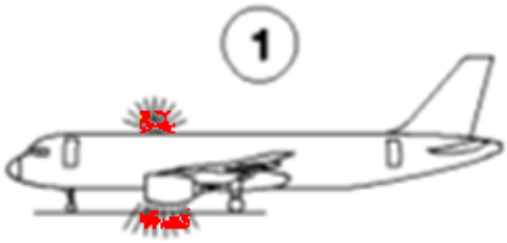
Switches on the overhead panel control the exterior lighting.

EXTERIOR LIGHTING OVERHEAD PANEL



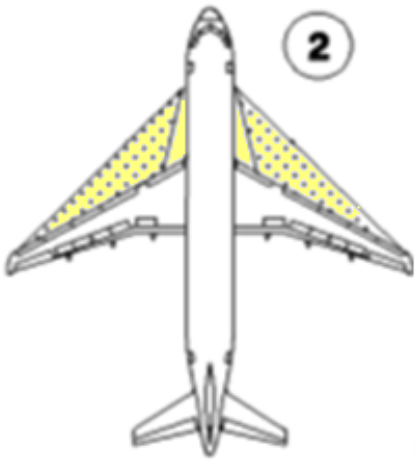
1 BEACON sw

This switch turns on and off the two flashing red lights, one on top and one on the bottom of the fuselage.



2 WING sw

This switch turns on and off two beam lights on each side of the fuselage. These lights illuminate the leading edge of the wing and the engine air intake to show if ice is accumulating there.

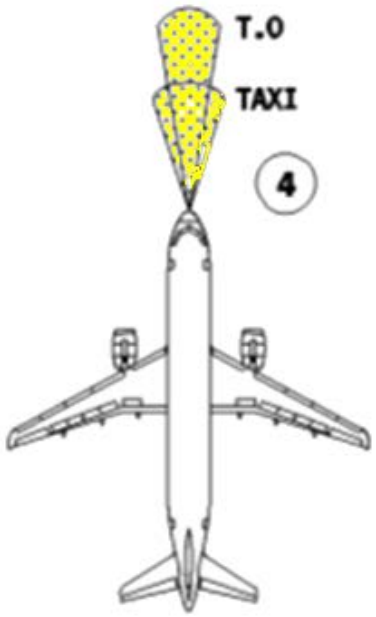


3 NAV and LOGO sw

This switch turns the navigation lights on and off.
There are dual navigation lights on each wing tip and in the APU tail cone.
Navivation left light is red
Navigation right ligt is red
Navigation tail light is white

Logo lights are installed in the upper surface of each horizontal stabilizer to illuminate the company logo on the vertical stabilizer provided the main gear struts are compressed or the slats are extended.

1: Turns on the logo lights and the first set of navigation lights.
2: Turns on the logo lights and the second set of navigation lights.
OFF : All lights are off.



4 NOSE sw

This switch turns the taxi and takeoff lights on and off.
T.O. : Turns on both taxi and takeoff lights.
TAXI : Turns on only taxi light.
OFF : Taxi and takeoff lights off.

Note : These two lights, attached to the nose gear strut, go off automatically when landing gear is retracted.

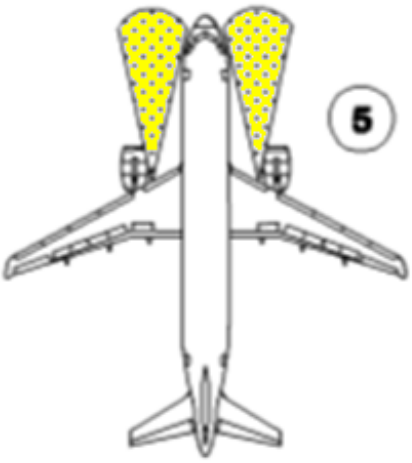
5 L and R LAND sel

These selectors control the landing light.

ON: Extends the (left or right) landing light which comes on automatically when fully extended.

OFF: Shut off the landing light but leaves it extended.

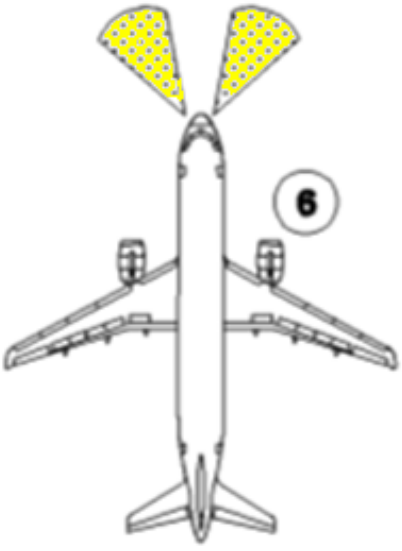
RETRACT : Retracts the landing light and shuts it off.



6 RWY TURN OFF sw

This switch turns the runway turn-off lights on and off.

Note : These lights go off automatically when landing gear is retracted.



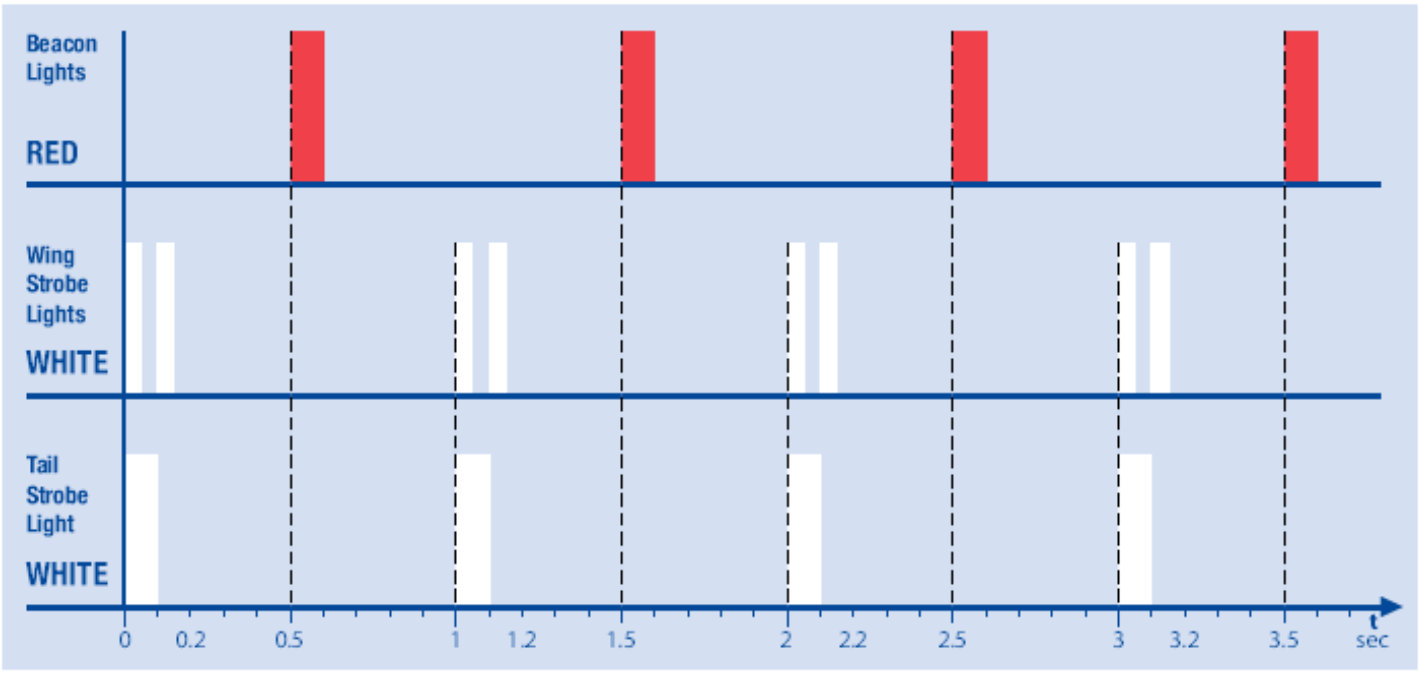
7 STROBE sw

This switch turns on and off the three synchronized strobe lights, one on each wing tip and one below the tail cone.

ON: The strobe lights flash white.
AUTO: The strobe lights come on automatically when the nose gear shock absorber is not compressed.
OFF: The strobe light are off.

REDUNDANT CONFIGURATION OF WHITE AND RED ANTICOLLISION LIGHTING SYSTEMS WITH LED TECHNOLOGY

FLASHING SEQUENCES AND SYNCHRONIZATION



3. SIMULATIONS

3.1 INTRODUCTION

The simulator has three purposes:

- Describe which are and how to operate the different sections present in an electrical system of an aircraft.

- Allowing a simple and intuitive hands-on learning of the control and supervision of an aircraft electrical system by means of display controls and tools on the panel and in the software.

- Allowing a simple and intuitive learning of the dynamics of an airplane.

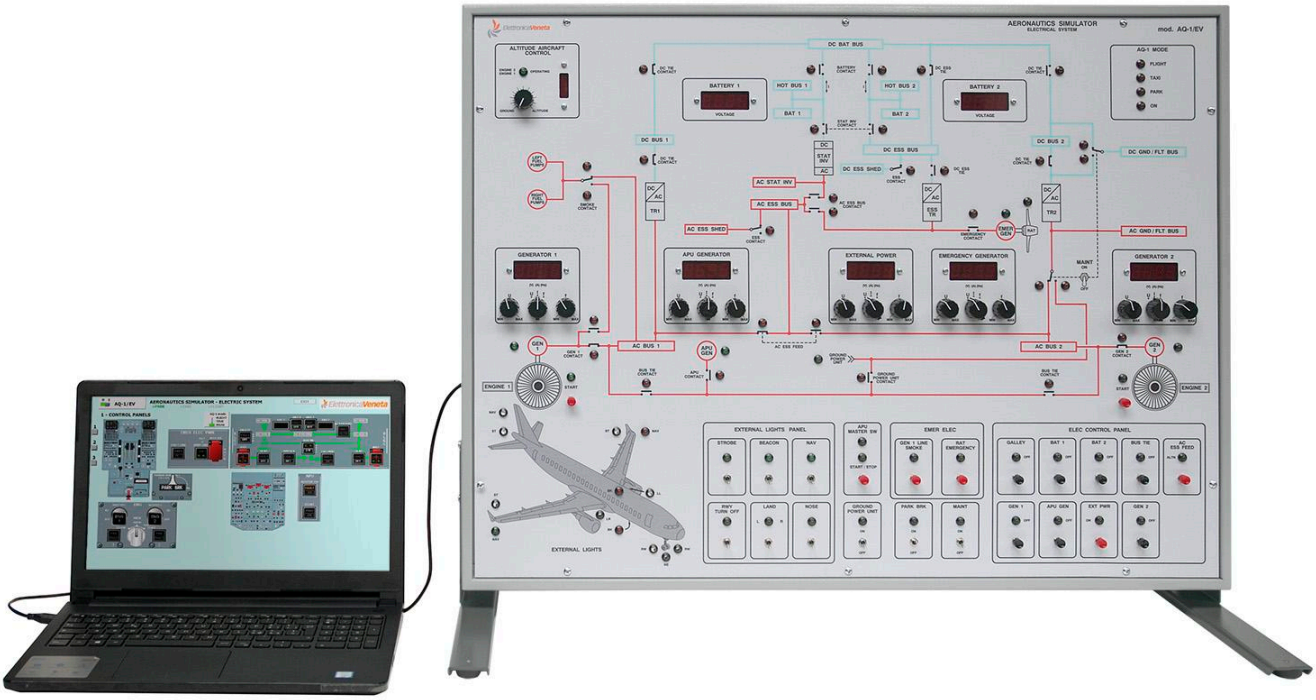
It is constituted by a synoptic panel where are represented the various operating areas that make up the system to be studied.

- The plane view with the external lights. The 5 sources of electrical power GEN1, GEN2, APU, GPU, EMER GEN with the relevant instruments to display the electrical voltage, current and frequency available. Tools to view the voltages of BAT1 and BAT2 batteries. The controls for the management of the generators and the electric power distribution to the whole plane.

- The supplied software is required for the operation of the simulator and allows supervision and control of the parameters of the panel.

- The simulator must be connected to the computer via the USB cable.

- AQ-1/EV trainer with computer control



PUSHBUTTONS AND SWITCHES IDENTIFICATION

STROBE
- Switch which turns on or off the flashing lights ST. ST lights only work in FLIGHT MODE.

BEACON
- Switch which turns on or off the flashing lights BK. BK lights only work in PARK and TAXI MODE.

NAV
- Switch which activates or deactivates the NAV lights. The NAV lights only work in FLIGHT MODE.

RWY TURN OFF
- Switch which activates or deactivates the lights RW. The RW lights work in PARK and TAXI MODE, while in FLIGHT MODE light are enable only if the aircraft altitude is less than 1000 m.

LAND
- Switch which turns on or off the LR and LL lights. The LR and LL lights work in PARK and TAXI MODE, while in FLIGHT MODE lights are enable only if the aircraft altitude is less than 1000 m.

NOSE
- Switch which activates or deactivates the NS light. The NS light work in PARK and TAXI MODE, while in FLIGHT MODE lights are enable if the aircraft altitude is less than 1000m.

PARK BRK
- Switch which turns on or off the aircraft's parking brake.

GROUND POWER UNIT
- Switch which turns on or off the electrical connection of the GPU.

MAINT
- Switch which enables or disables the power supply for the maintenance and cleaning of the plane in PARK MODE.

APU START / STOP
- Button to turn on or turn off the APU.

GEN1 SMOKE LINE
- Button which activates the SMOKE CONTACT if SMOKE EMERGENGY alarm .

RAT EMERGENCY
- Button with which you activate the RAT if RAT EMERGENCY alarm.

GALLEY
- Button with which it connects the power to the service ans cooking appliances.

BAT1 and BAT2
- Buttons with which you disconnect or connect the battery to the electric charging circuit.

BUS TIE
- Button with which yon connect the power source to the AC BUS.

AC ESS FEED
- Buttons with which you switch from AC BUS1 to AC BUS2 the AC ESS BUS connection.

GEN1 and GEN2
- Buttons with which you connect generators to the AC BUS.

APU GEN
- Button which APU GEN to the AC BUS .

EXT PWR
- Button to connect the Ground Power Unit to the AC BUS.

POWER SUPPLY DISPLAYS
- Each display can show one of the electrical parameters U, I, f, selected by this switch.
The U potentiometer serves to set the voltage available from 80V to 160V, the valid range is from 110V to 120V. The “f” potentiometer is used to set the frequency of the power source available from 385Hz to 425Hz, the valid range is from 395Hz to 405Hz.

ENGINE 1 ENGINE 2 START Buttons
- Buttons with which you turn on ENGINE 2 and ENGINE 1.

SOFTWARE

The Labview software allows the simulator inputs and outputs management control.

The package is composed by:
- 1 trainer panel mod. AQ-1/EV with USB cable.
- 1 CD with software
- Power network cable

The CD contains:

- Drivers folder, with USB Driver installation software for controlling the Simulator.
- LV_Runtime82 folder with the installation of the runtime software **LabView** program.
- Folder AQ1_nn, with the installation of the software application program AQ-1

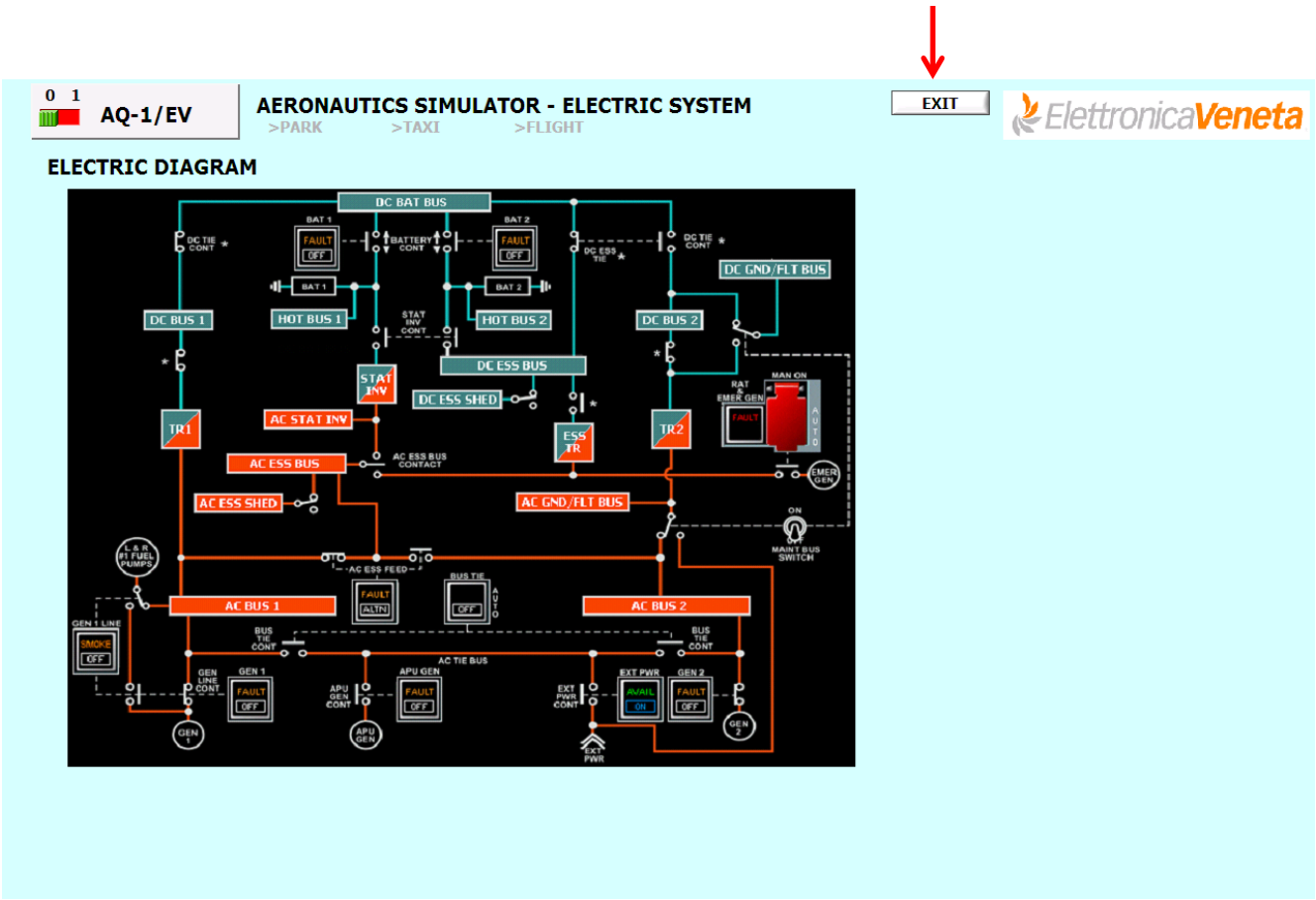
SOFTWARE INSTALLATION

Turn on the computer.
Set the screen resolution to 1280x800 pixels.
Insert the CD containing the AQ-1 software.
→ Open the Drivers folder and start the appropriate program for the version of Windows installed on the computer: SetDrv98, SetDrv2K, SetDrvXP, SetDrvVI, SetDrvV7, SetDrvV8 (Also available Windows 10).
Connect with the USB cable, simulator and computer.
The computer will automatically find the USB device.
Follow the instructions on the screen.
→ Open the \ LV_Runtime82 \ Volume \ SETUP.exe and start the program. This will
install the LabView program run-time.
→ Open the folder AQ1_nn, SETUP.exe start the program.
This installs the application program of the AQ-1 panel

STARTING THE SIMULATOR

- Turn on the computer.
- Turn on the simulator power switch located on the right side.
- Connect with the USB cable, simulator and computer.
- The computer will automatically find the USB device.
- Start the application program of the simulator, according with the operating system version.

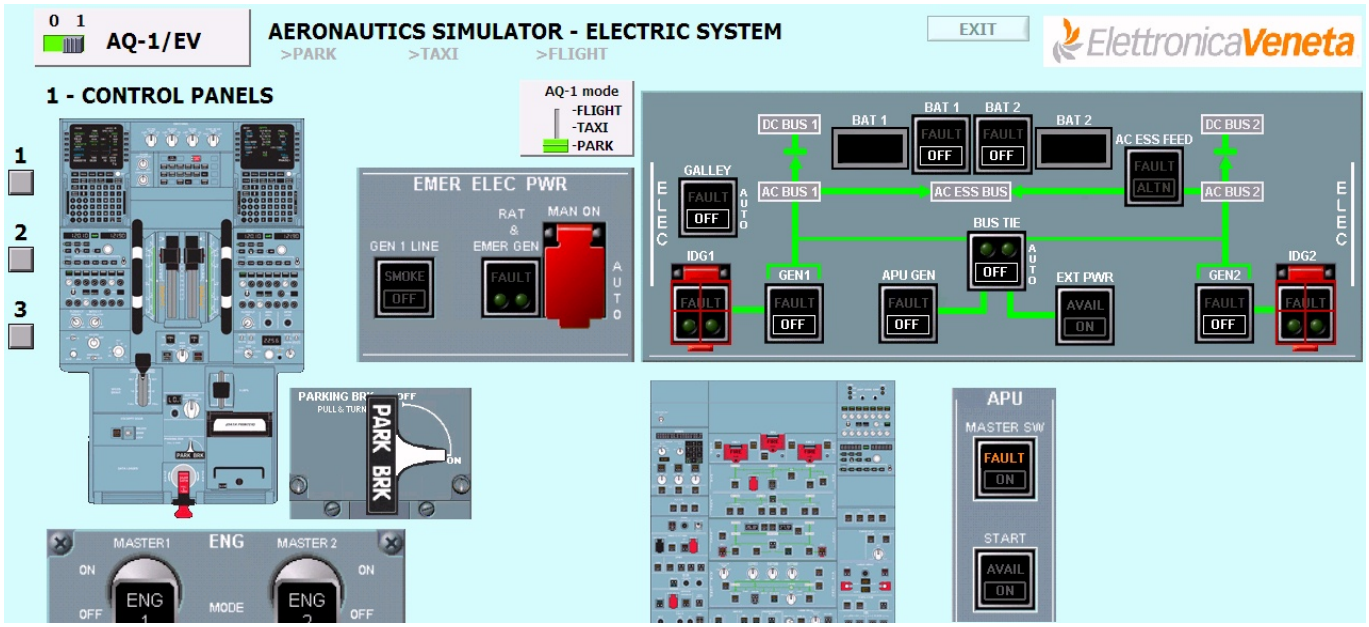
On the screen the following main image appears with the layout of the electrical circuits:



EXIT button in order to close the program.

SIMULATOR CONTROL AND SUPERVISION

- Set the AQ-1 switch to 1 to enable the control and supervision of the parameters.



In this condition, all operating controls are the switches, and potentiometers on the simulator panel. The electrical parameters are displayed through the displays, lights and bargraph.

USING THE SOFTWARE

- The main page of the software (BUTTON 1) shows the main areas of the aircraft control panels, with 1 to 3 buttons that allow you to view 3 different pages for the control and supervision of the aircraft parameters in the various operating functions.

BUTTON 1: CONTROL PANELS

Displays the main commands the selection and connection of the aircraft power sources.

The operating mode configuration switch of the simulator:

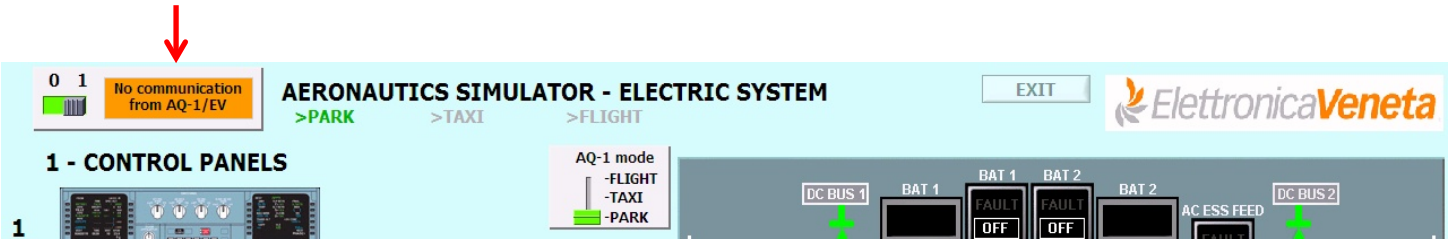
- PARK
- TAXI
- FLIGHT

- BUTTON 2: ELECRIC SYSTEM on ECAM (Electronic Centralized Aircraft Monitor)

  The power supply circuits are displayed with the status of the power sources, the electrical parameter values, and consumption.

- BUTTON 3: EXTERNAL LIGHTS
  The controls of the aircraft's exterior lights, the indicator instrument of aircraft altitude are displayed.

- Starting the AQ-1 program if there is no communication between simulator and computer through the USB port orange message appears:
  "No communication from AQ-1/EV" (Verify USB cable link and USB driver compatibility).



- Ih this case close the program and restart.

3.2 PARK MODE

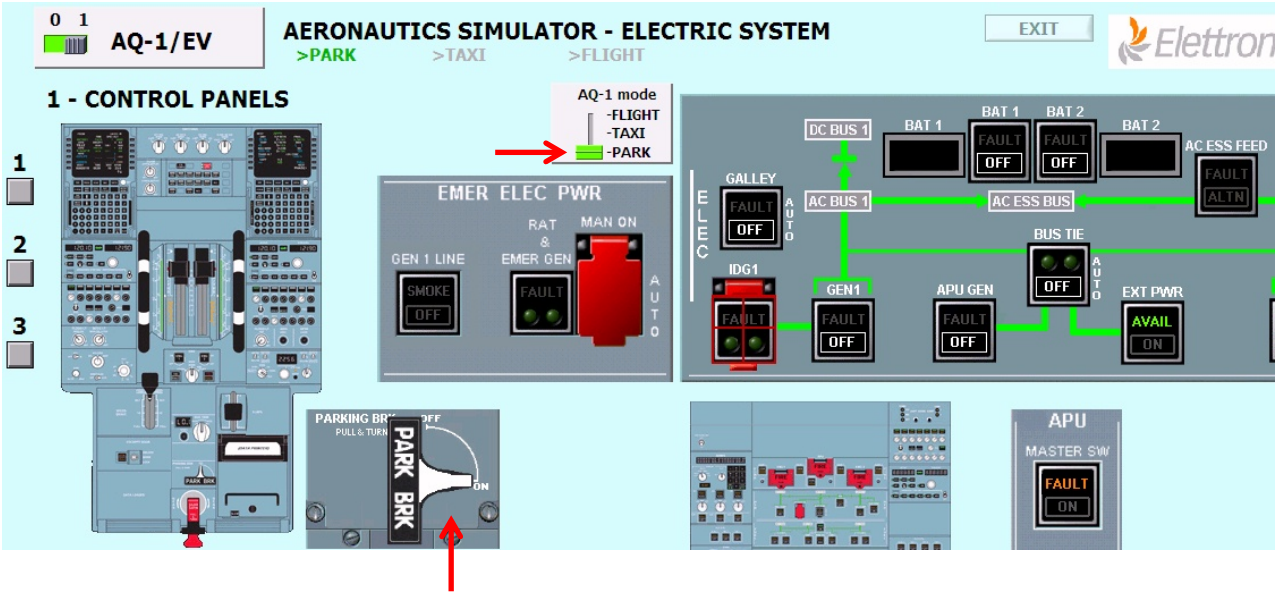
- Start the AQ-1 program
- Place the AQ-1 switch to 1 to enable the control and supervision of the parameters and the hydraulic and electrical parameters of the simulator with your computer.

- The starting page with BUTTON 1.
- AQ-1 mode
  PARK, TAXI, FLIGHT (Uper part of the screen)
  According to the aircraft conditions just one mode flashes with green color, in order to inform that is the possible condition on which you must place the AQ-1 mode slider of the software page. When the mode position coincides with the aircraft state the writing stops flashing and remains steady green.

- On the panel SET PARK BRK ON
- Using the software select BUTTON 1 and select PARK mode

3.3 MAINTENANCE

- Using the software set mode **PARK**
- On the panel set **GROUND POWER UNIT** ON



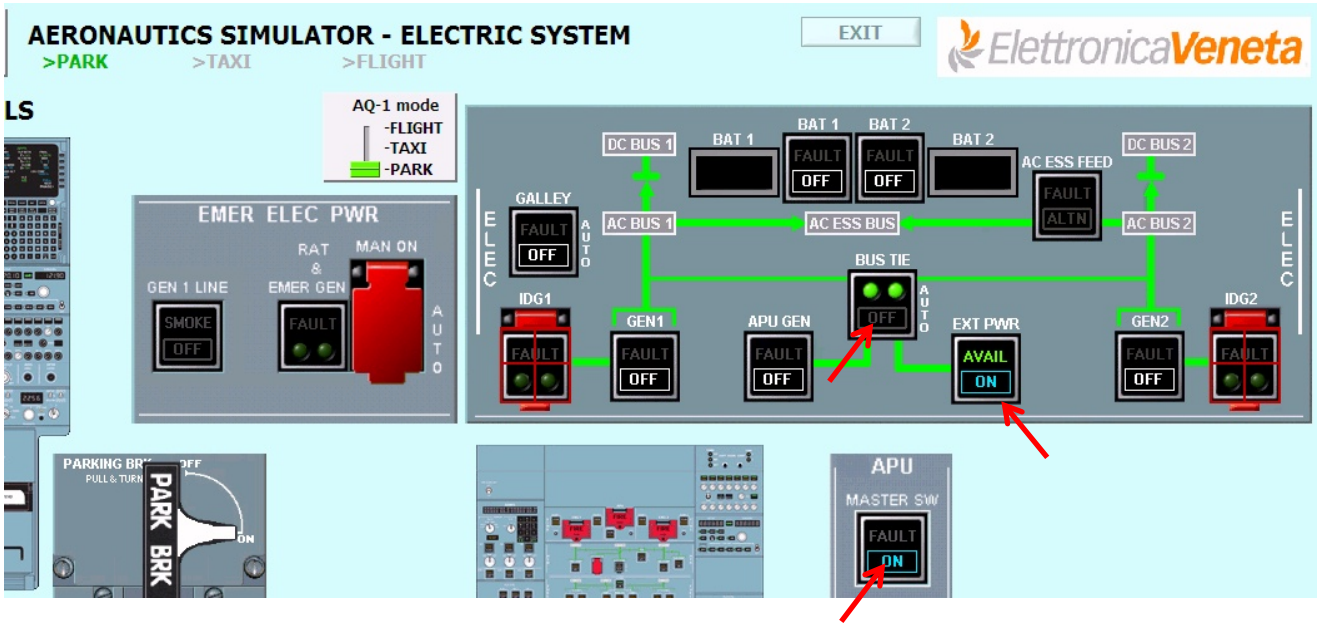
- On the panel
- On the **EXTERNAL POWER** instrument the values of the electrical parameters U, I, f are displayed.
- Whith the switch select position U (voltage), turn the potentiometer, the minimum voltage is 80 V, the maximum value is 150V, note that the green LED of the GPU unit flashes when the measured voltage is <110V and > 120V, in these conditions, the electrical connection of the GPU is interrupted. With voltages between 110V and 120V, the green LED is on. The nominal value of the voltage is 115V
- Set the selector to f, rotate his frequency potentiometer, the minimum is 385Hz, the maximum value is 425Hz, note that the green LED of the GPU unit flashes when the measured frequency is <395Hz and> 405Hz, in these conditions the electrical connection of the GPU with the plane is interrupted. With frequency values between 395Hz and 405Hz, the green LED is on. The nominal value of the frequency is 400Hz.
- Set the switch **MAINT** ON . In this way the power supply is available in the aircraft, and it can connect the various electrical devices for maintenance and cleaning.
- Using the software
  Select the BUTTON 2 screen and on ECAM ELEC monitor you can control the electrical power of the GPU EXT PWR.
- Move the sliders of the MAINTENANCE MAINTENANCE AC and DC LOAD LEVEL to simulate the consumption of the devices connected for maintenance and cleaning.
- On the panel set the selector on the EXTERNAL POWER I position to display the current value supplied by the GPU according with the maintenance electric power request.

3.4 GPU POWER SUPPLY GENERATOR

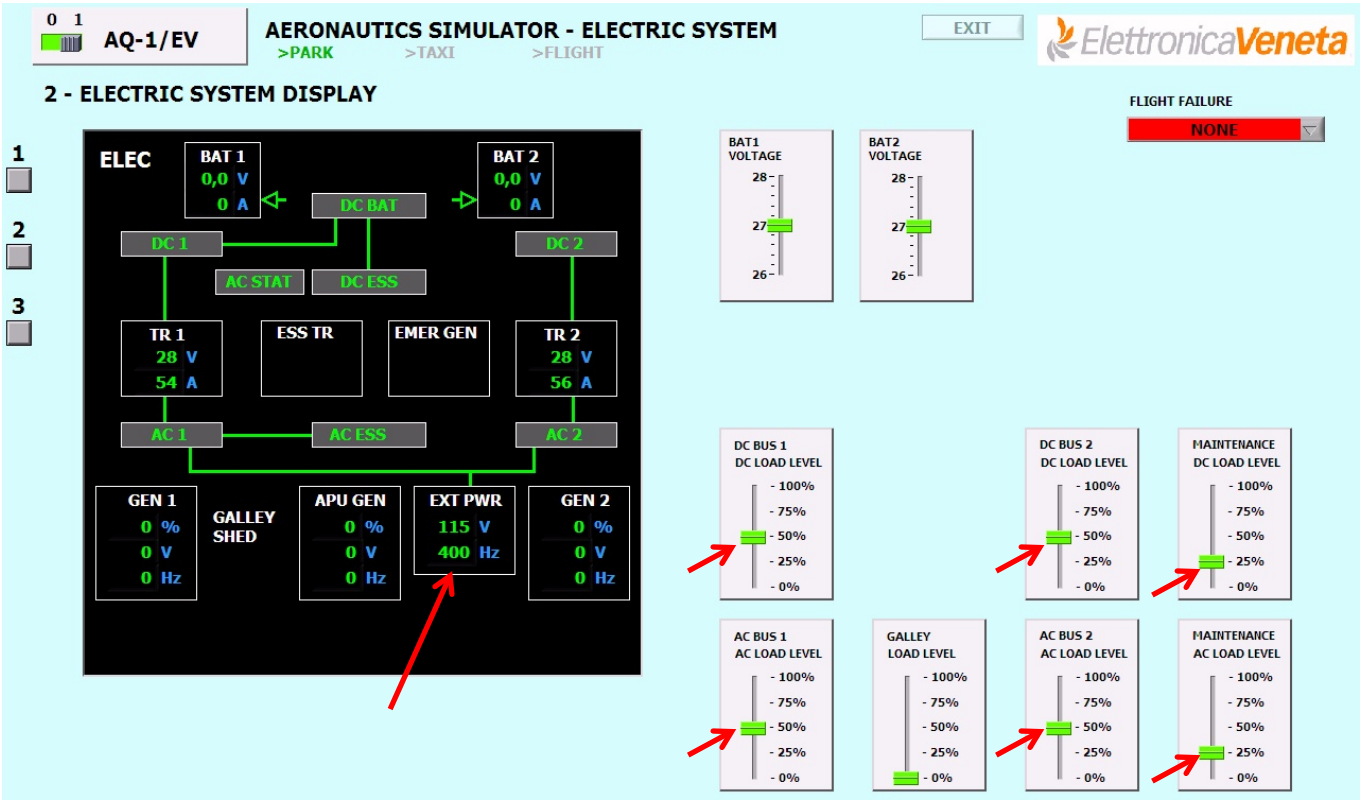
- Using the software
  Select BUTTON 1 screen, the PARK mode is written fixed.

- On the PANEL
  - Press the EXT PWR button, the green LED lights.
  - Press the BUS TIE button, the green LED goes off.
  - MAINT switch is RESET automatically if ON.

- Automatically, the electrical contacts are closed and LEDs turned ON
  - AC ESS FEED, CONTACT ESS
  - DC CONTACT TIE (BUS1), DC TIE CONTACT (BUS1 DC), DC TIE ESS (DC BUS BAT), ESS CONTACT
  - DC CONTACT TIE (DC BUS 2)
  - APU MASTER SW.



- Using the software
  - Select BUTTON 2, the screen displays ECAM ELEC electrical parameters of the system.



- Move the sliders of the DC BUS 1, AC BUS 1, DC DC BUS 2, AC BUS 2, MAINTENANCE DC and MAINTENANCE AC (LOAD LEVEL) to simulate the power consumption of the system aircraft equipments.

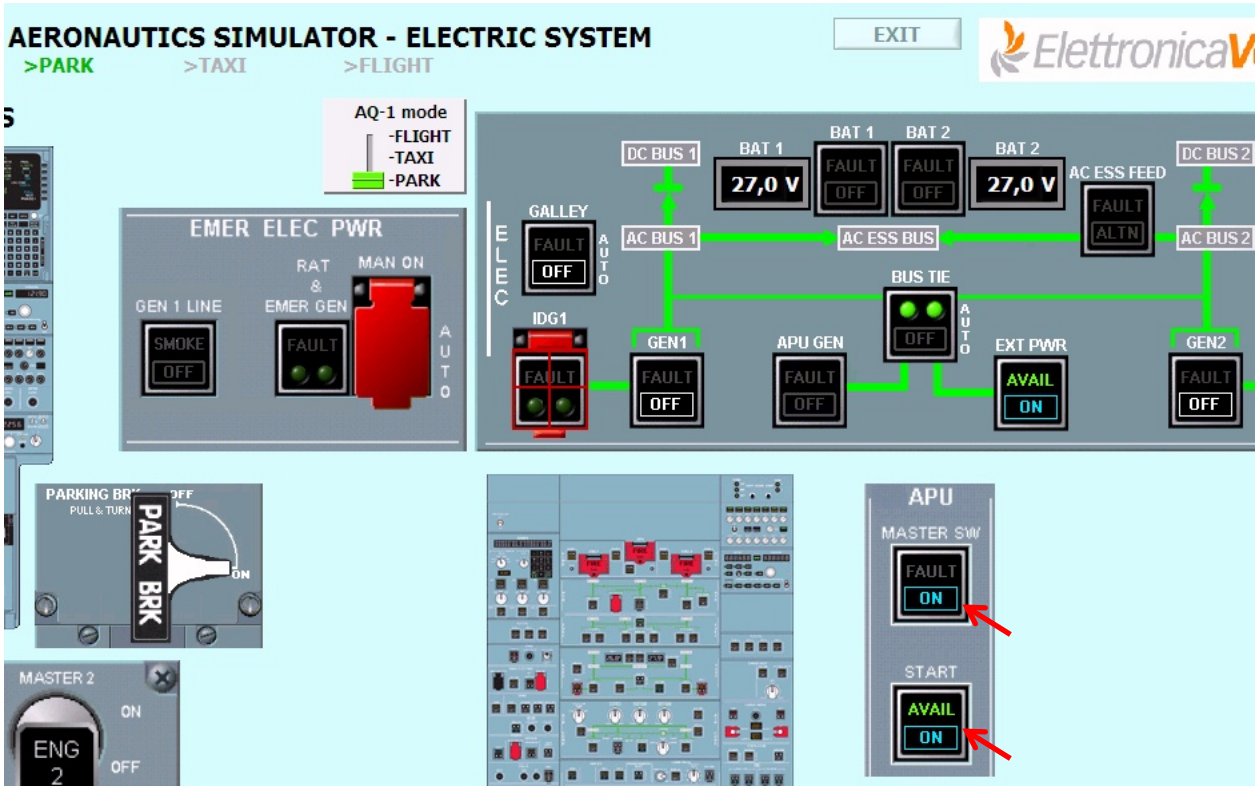
3.5 APU POWER SUPPLY GENERATOR

- Using the software
  - Select BUTTON 1 screen, the PARK mode is written fixed.

- On the panel
  - To start the APU the LED APU MASTER SW shoul be ON.
  - This LED is ON in the following cases:
    . The GPU provides energy to the aircraft
    . At least one battery is connected and supplies power to the DC BAT BUS.
    . If both sources are available the energy to start the APU is taken from the GPU.

- Press the START/STOP button of the APU and wait until the LED of the button turns ON.
  - On the APU GENERATOR instrument are measured the values of the electrical parameters U, I, f with the same characteristics and modalities seen for the EXTERNAL POWER supply instrument.

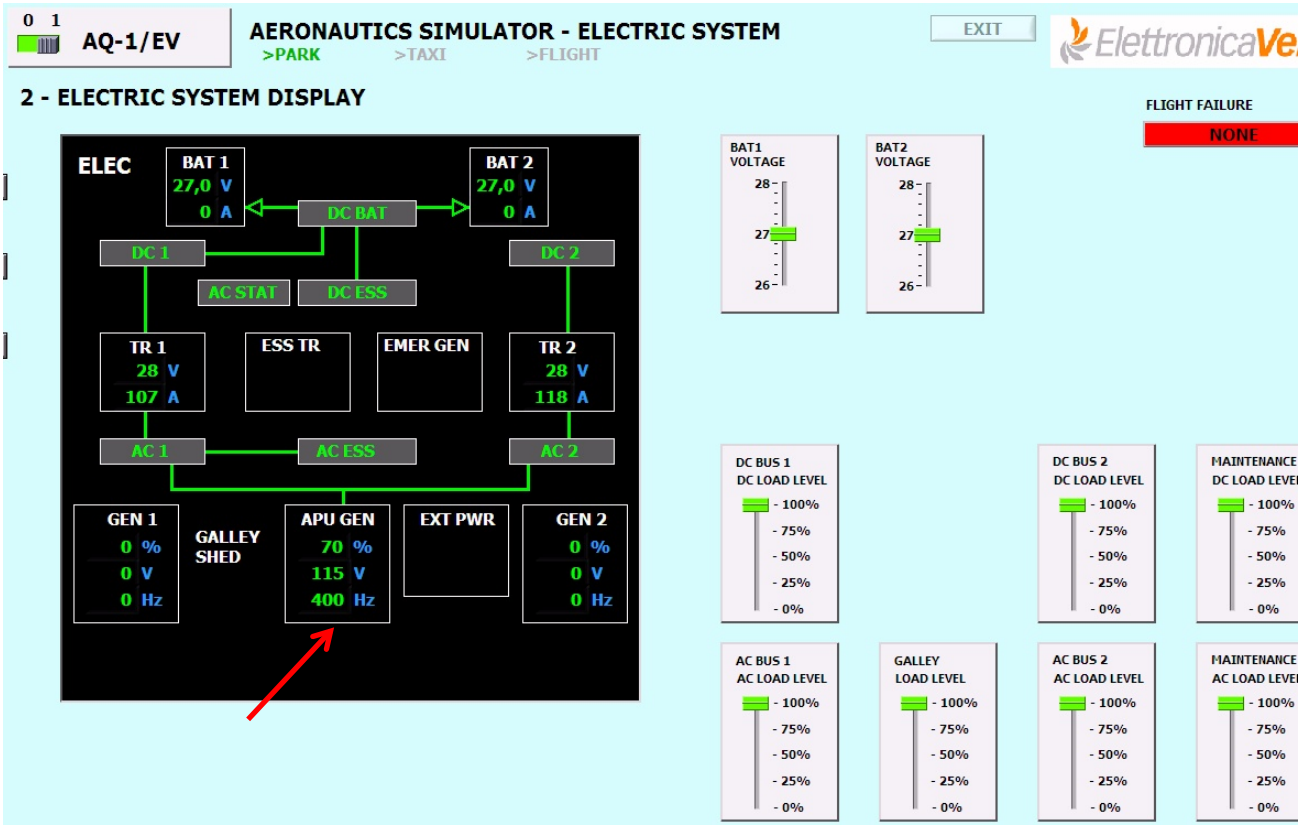
- Using the software
  - The START button illuminates the written APU ON and after few seconds it also illuminates the message AVAIL.



- On the panel
  - Press the APU GEN, the green LED goes OFF but the APU CONTACT contact does not close because the GPU has priority on the APU.

  - You should disconnect the GPU through the EXT PWR button or reduce the GROUND POWER UNIT voltage, in order to close automatically the APU CONTACT.

- Using the software
  - Select the BUTTON 2, to display ECAM ELEC parameters of the system.



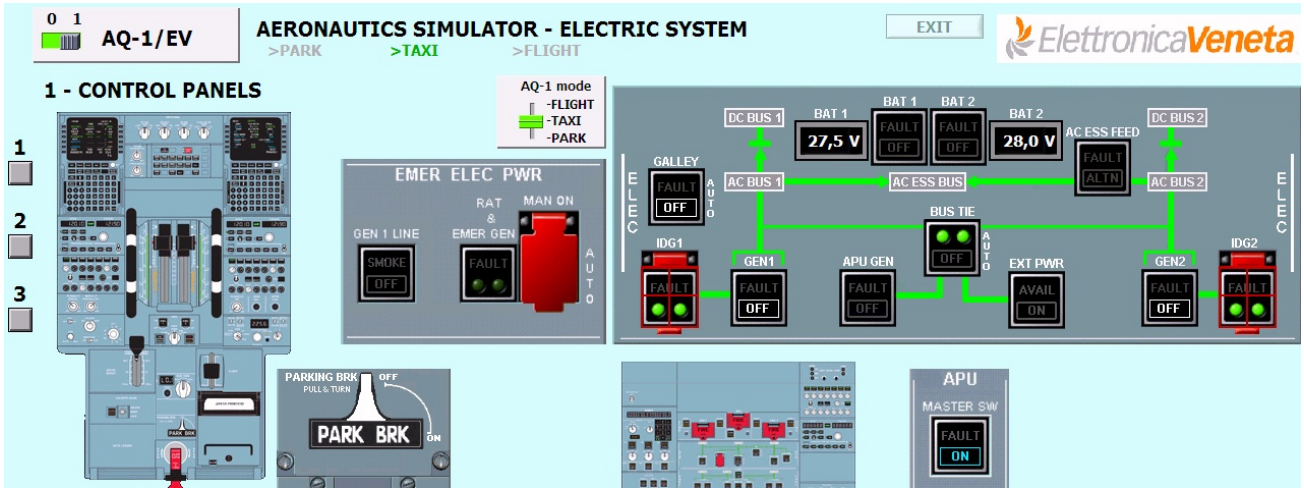
  - Move the sliders of the DC BUS 1, AC BUS 1, BUS 2 DC, AC BUS 2, MAINTENANCE DC and MAINTENANC AC (LOAD LEVEL) to simulate the power consumption of the system aircraft devices.

3.6 STARTING ENGINE 2 and ENGINE 1

- Using the software
  - Select the BUTTON 1 screen, the PARK mode is written fixed.

- On the panel
  - Set PARK BRK OFF
  - Insert APU START/STOP
  - Insert APU GEN
  - Insert BUS TIE
  - Check the position of the ALTITUDE AIRCRAFT CONTROL potentiometer should be turned counterclockwise to GROUND position
  - The sequence to start the jet engines is fixed: before ENGINE 2 then ENGINE 1. Press the START button ENGINE 2, the green LED lights up. Press the START button ENGINE 1, the green LED lights up.

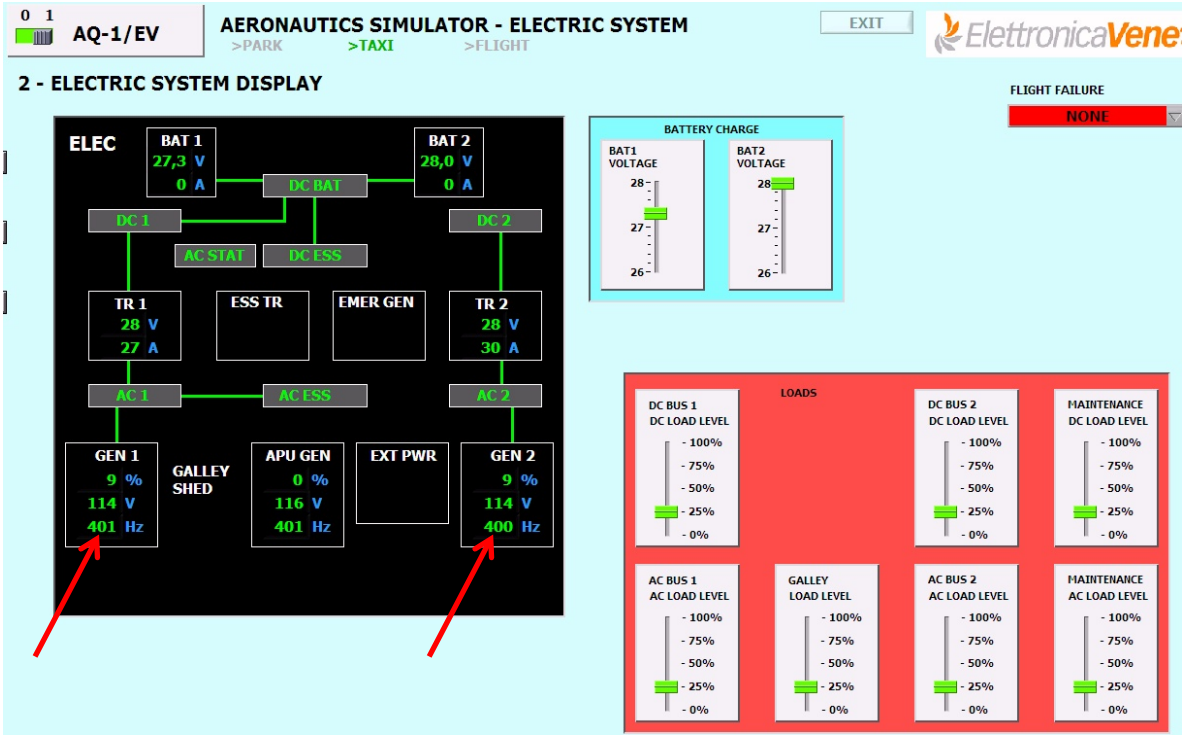
- Using the software
  - When the two engines are running TAXI and FLIGHT blink, this means that you can enable either of these two modes with the AQ-1 mode cursor.



- Position the cursor to AQ-1 in TAXI MODE, The TAXI indicator stops blinking and remains steady green.

3.7 GEN1 AND GEN2 POWER SUPPLY GENERATORS

- Start from the previous situation (Starting ENGINE 2 and ENGINE 1)
- Using the software
  - Select BUTTON 1 screen, TAXI mode is written fixed
- On the panel
  - Press the button GEN 1, the green LED turns off.
  - Press the button GEN 2, the green LED turns off.
  - The instruments GENERATOR GENERATOR 1 and 2 visualized the values of the electrical quantities U, I, f with the same characteristics and modalities seen for the EXTERNAL POWER instrument.
  - The green LEDs near the generators GEN 1 and GEN 2 inform on the correct functioning if they are ON or failure if blinking
  - The APU is disconnected from the AC BUS automatically.
- Using the software
  - Select BUTTON 2 screen, the screen displays ECAM ELEC connections and electrical parameters of the system.



  - If one of the two generators is faulty, the power is supplied by the APU.
  - If one of the generator is disconnected through the button GEN 1 or GEN 2, the other generator provides all the energy.

3.8 GALLEY POWER SUPPLY

- Using the software
  - Select BUTTON 1 screen, TAXI mode is written fixed

- On the panel
  - Press GALLEY button, the green LED OFF turns off.

- Using the software
  - Select BUTTON 2 screen, the screen displays ECAM ELEC connections and electrical parameters of the system. On the ECAM ELEC screen the message GALLEY SHED disappears .

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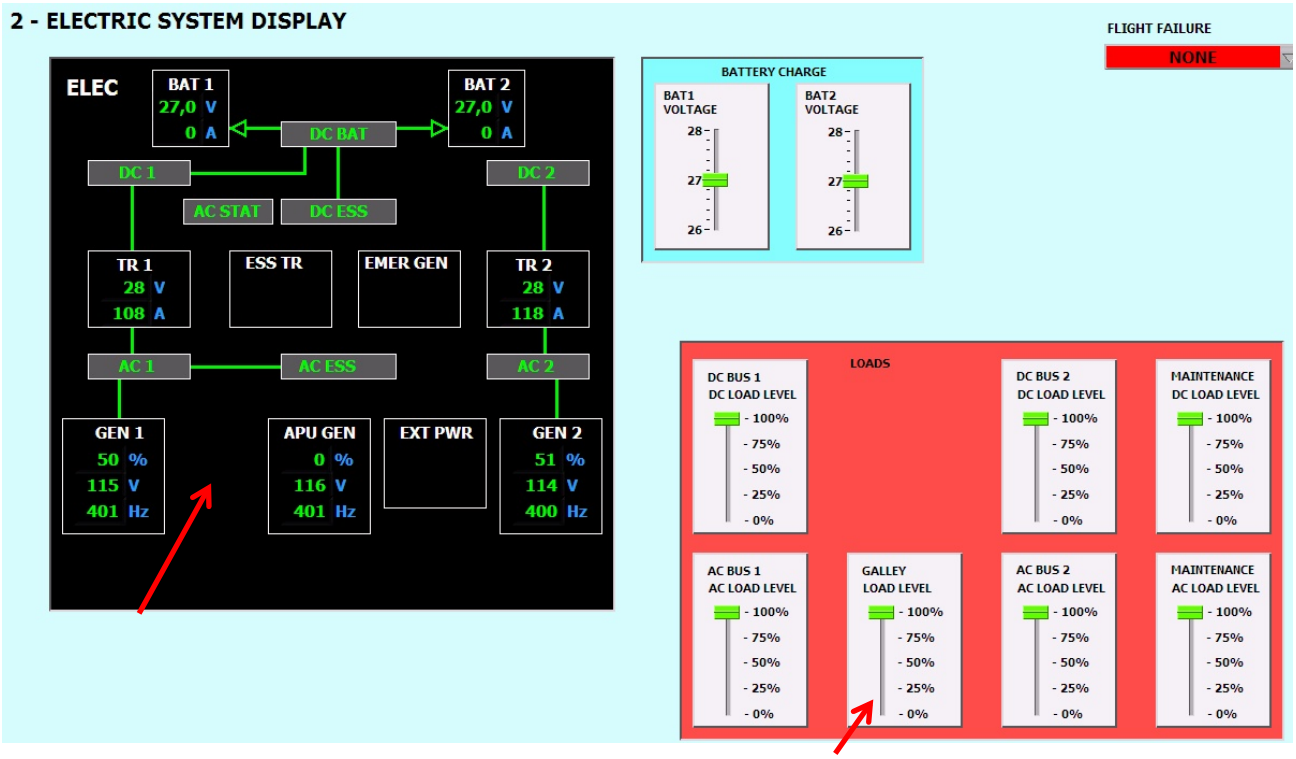


- Move the cursor to the GALLEY to simulate the power consumption of the devices connected to it.
- If one of the two generators has a fault or one of the generators is disconnected through the button on January 1 or January 2, automatically disconnects the GALLEY

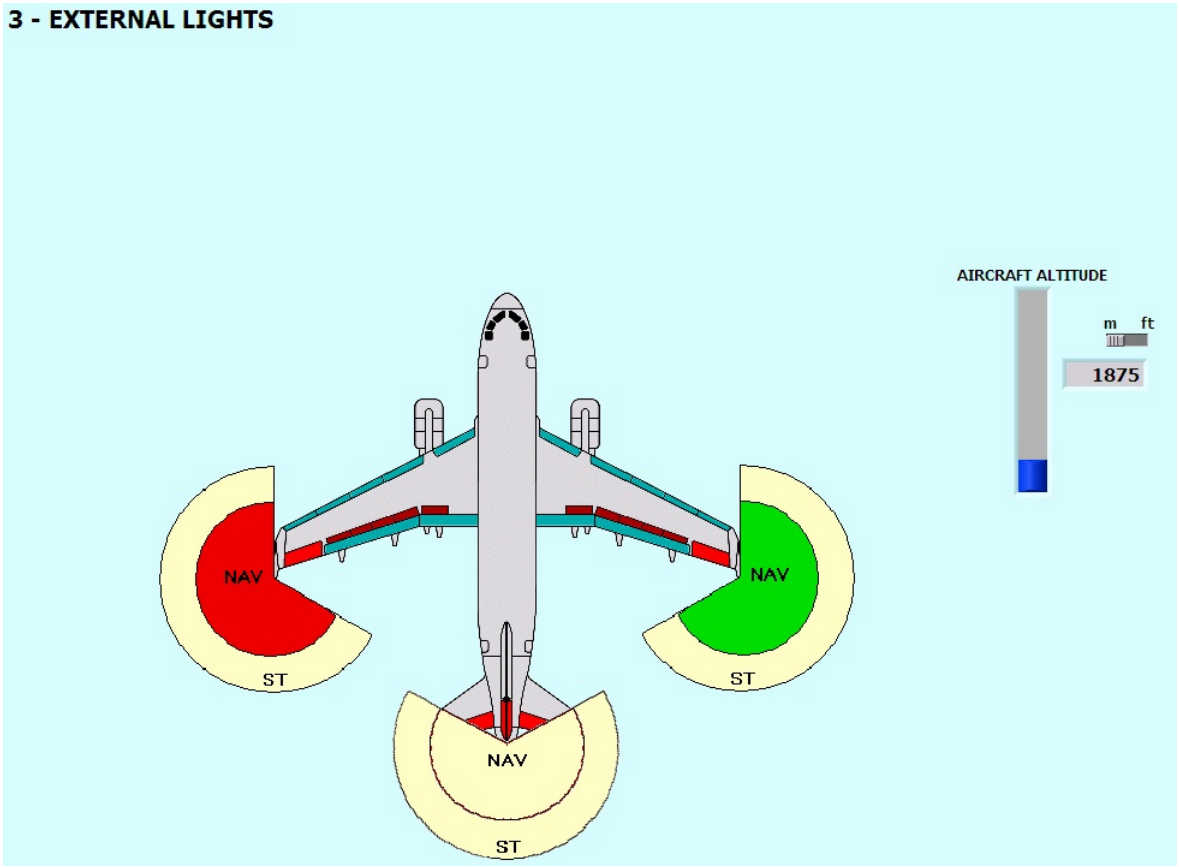
3.9 FLIGHT MODE

- Start from the previous state (Starting ENGINE 2 and ENGINE 1)

- Using the software
  - With the two jet engines switched ON FLIGHT flashes, this means that you can move on thes mode.
  - Set the AQ-1 mode cursor on FLIGHT mode, FLIGHT stops blinking, remains steady green.

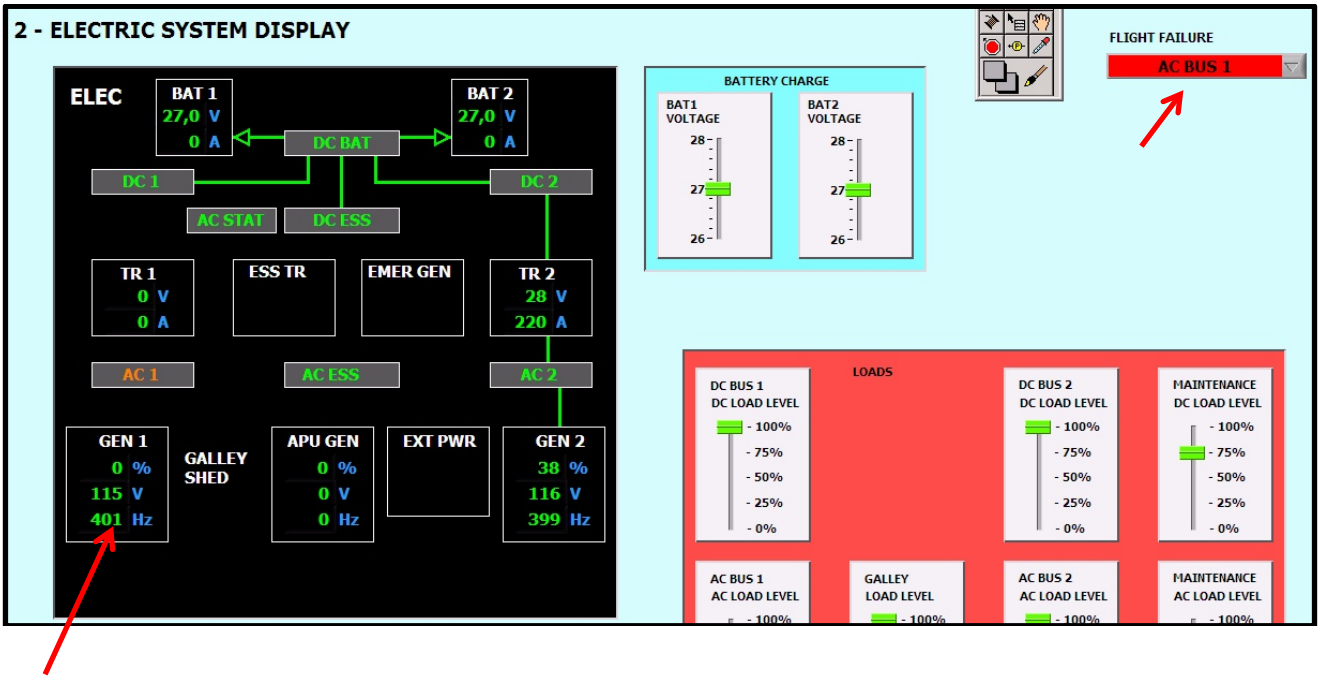
- On the panel
  - The green LED ENGINE 2, ENGINE 1 OPERATING is ON.
  - Now you can turn the potentiometer ALTITUDE
  - When climbing switch OFF the APU,
    Press the START /STOP button, its LED turns OFF
  - Switch ON the ST STROBE lights is now enable
  - Switch on the NAV lights.

- Using the software
  - Select BUTTON 3 screen



3.10 AC BUS 1 FAILURE

- Start from the previous state (FLIGHT MODE)
- Using the software
  - Select BUTTON 2 screen, open the window FLIGHT Failure and select the **AC BUS 1** failure.

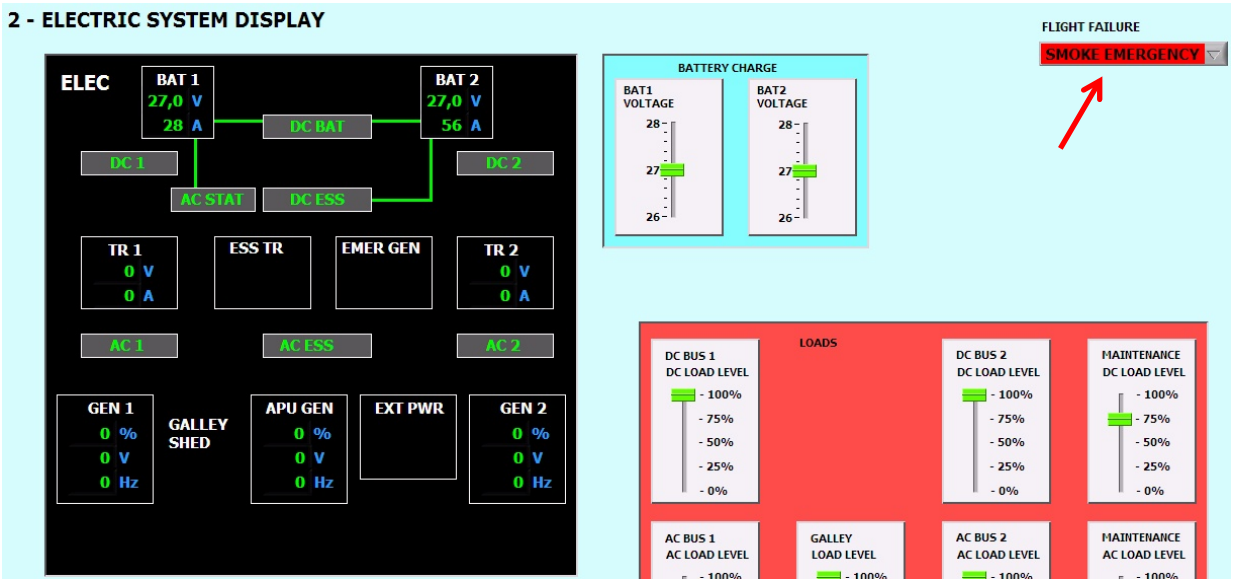


- On the panel
  - Press the AC ESS FEED button, the green LED lights and closes the contact ESS FEED AC powering via AC BUS 2 AC ESS BUS.
  - In this emergency status, you can perform the landing procedure by turning to the ALTITUDE 0 potentiometer.

- Using the software
  - Select BUTTON 2 screen, open the window FLIGHT FAILURE and select NONE to clear the fault.

3.11 SMOKE EMERGENCY

- Start from the previous state (FLIGHT MODE)
- Using the software
  - Select BUTTON 2 screen and open **FLIGHT FAILURE** window and configure **SMOKE EMERGENCY** failure



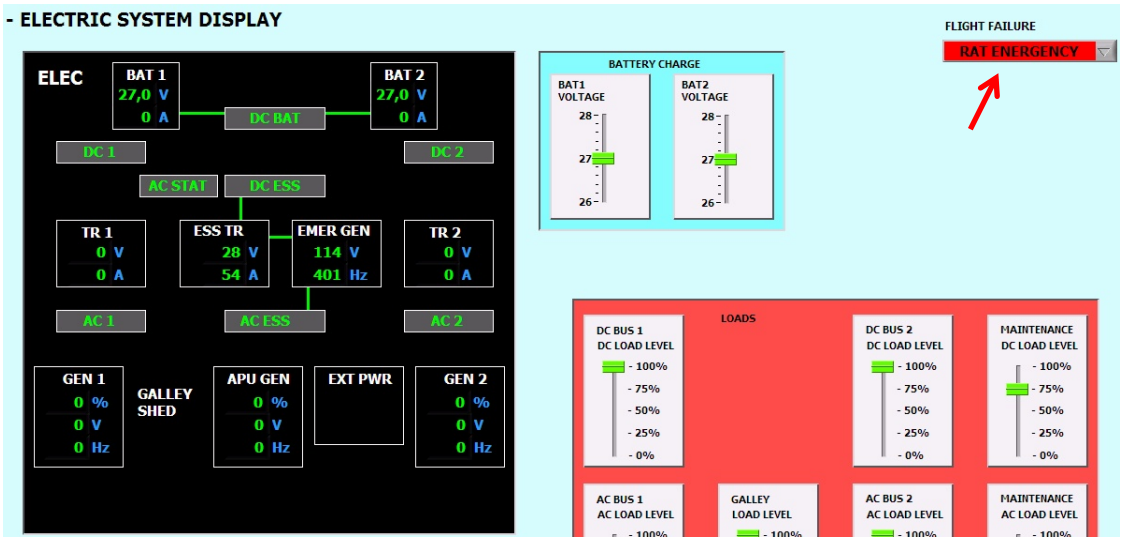
- On the panel
  - Press the switch **GEN1 LINE SMOKE**, the green led turns ON and **EMERGENCY CONTACT** is closed.
  - **EMER GEN** powered **ESS BUS**
  - **EMERGENCY GENERATOR** display electric parameters U, I, f with the same modalities
  - Generators GEN1 and GEN 2 are disconnected
  - In this emergency situation you have to perform LANDING procedure: Turn potentiometer to GROUND position.

- Using the software
  - Select BUTTON 2 screen open the window FLIGHT FAILURE and select NONE to clear the fault.

- On the panel
  - Select buttons **GEN 1** and **GEN 2** in order to connect the generators.

3.12 RAT EMERGENCY

- Start from the previous state (FLIGHT MODE)
- Using the software
  - Select BUTTON 2 screen and open **FLIGHT FAILURE** window and configure **RAT EMERGENCY** failure



- On the panel
  - Press the switch **RAT EMERGENCY**, the green led turns ON and **EMERGENCY CONTACT** is closed.
  - **EMER GEN** powered **ESS BUS**
  - **EMERGENCY GENERATOR** display electric parameters U, I, f with the same modalities
  - Generators GEN1 and GEN 2 are disconnected
  - In this emergency situation you have to perform LANDING Procedure: Turn potentiometer to GROUND position.

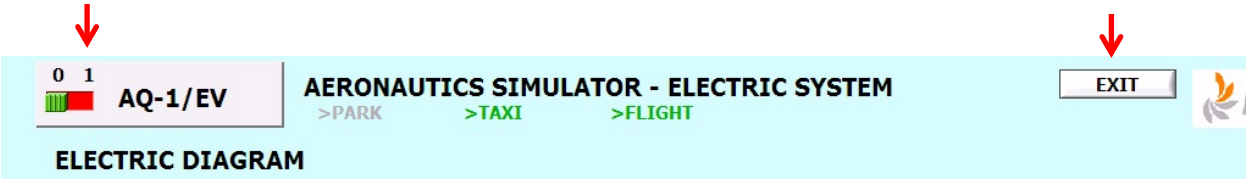
- Using the software
  - Select BUTTON 2 screen open the window FLIGHT FAILURE and select NONE to clear the fault.

- On the panel
  - Select buttons **GEN 1** and **GEN 2** in order to connect the generators.

3.13 QUIT THE SOFTWARE

- Potentiometer ALTITUDE on GROUND position

- Using the software
  - Select BUTTON 1 screen.
  - Select **AQ-1 mode PARK**.
  - Select the screen switch **AQ-1/EV** on position 0.



  - Select **EXIT**

- On the panel
  - Disconnect USB cable.
  - Switch OFF the power supply on the right side.

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