Reference to Figure 22 Electrical Network Basic Schematic & Controls

ATA 24 ELECTRICAL POWER

24–00 ELECTRICAL POWER GENERAL

SYSTEM DESCRIPTION

AC POWER SOURCES

The electrical network of the A320/321 is normally supplied by two engine driven AC generators, IDGs 1/2.

The drive unit (for constant speed) and the generator are integrated in one unit (Integrated Drive Generator; IDG).

TECHNICAL DATA AND DESCRIPTION

1 Main Generator (GEN 1/2)

Nominal power: 90 kVA

Nominal voltage: 115/200 V AC, three-phase

Nominal speed/frequency: 12000 rpm/400 Hz

2 Auxiliary Generator (APU GEN)

The APU drives a third generator which can replace either GEN 1 and/or GEN 2 in case of failures.

The APU generator also serves as an independent AC power supply on ground.

Nominal power: 90 kVA

Nominal voltage: 115/200 V AC, three-phase

Nominal speed/frequency: 24000 rpm/400 Hz

3 Emergency Generator (CSM/G)

In case of emergency configuration (loss of GEN 1,2 and APU) in flight, an AC generator driven by a hydraulic motor (CSM/G; Constant Speed Motor/Generator) supplies the systems required for aircraft control.

Nominal power: 5 kVA

Nominal voltage: 115/200 V AC, three-phase

Nominal speed/frequency: 12000 rpm/ 400 Hz

4 External Power

An external power receptacle, in front of the nose wheel well, enables to connect a ground power source to the electrical network during ground operation.

DC POWER SOURCES

The DC electrical system is normally supplied from the AC electrical system via Transformer Rectifiers.

TECHNICAL DATA AND DESCRIPTION

5 Transformer Rectifier Unit

Nominal current: 200 A DC (output)

Nominal voltage: Input 115/200 V AC, three-phase
output 28 V DC

6 Batteries

Two airborne nickel-cadmium batteries are installed.

The main functions of the batteries are:

- to start the APU in flight and on ground and
- to supply the essential network in some configurations.

Nominal capacity: 23 Ah

Nominal voltage: 24V DC

7 Static Inverter

One static inverter of 1000 VA nominal power transforms the direct current voltage from battery 1 into a single phase 115 V, 400 Hz, alternating current. The static inverter is automatically activated in the event of loss of all AC power sources and supplies the AC essential network.

8 Maintenance Bus Switch

Supply selection for ground service network is controlled from panel 2000VU, MAINT BUS switch:

- one position corresponds to the normal supply configuration.
- the other position controls the ground service network supply from the ground power unit, if available and if the ”COMMERCIAL” pushbutton switch (commercial load shed on enhanced system) is pressed.

This position is electromagnetically latched.

The switch returns to the normal position in case of voluntary or automatic unlatching of the ground power unit.

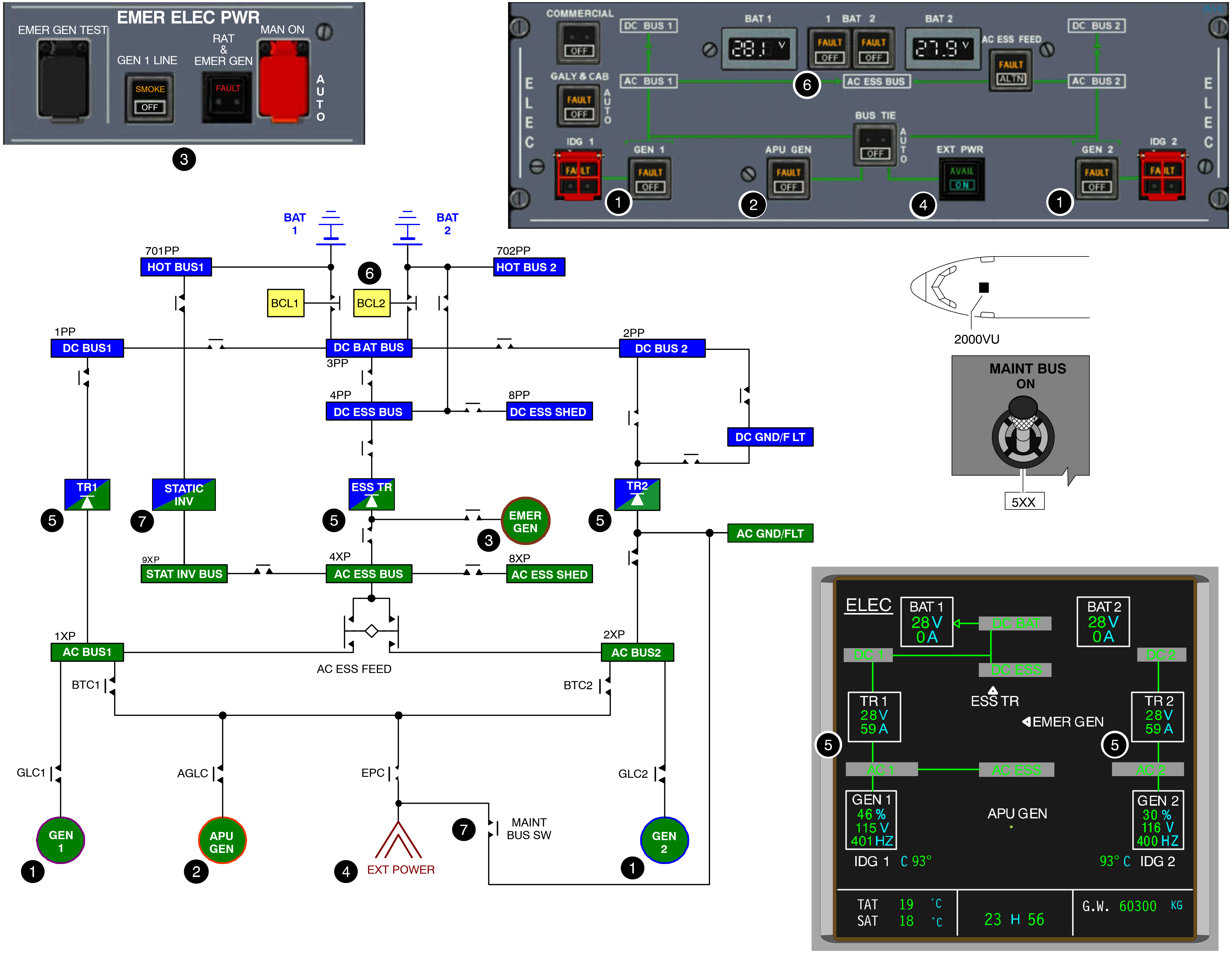


Figure 22 Electrical Network Basic Schematic & Controls

Reference to Figure 23 Power Supply Configurations (Case1–4)

24–20 AC GENERATION

NETWORK CONFIGURATIONS DESCRIPTION

1 Ground Service Configuration

AC ground/flight distribution network can be supplied:

- either normally from the aircraft network,
- or directly by the ground power unit upstream of the external power contactor, in ground service configuration.

In ground service configuration this network can be supplied without energizing the whole aircraft network.

Supply selection for ground service network is controlled from panel 2000VU, MAINT BUS switch:

- one position corresponds to the normal supply configuration.
- the other position controls the ground service network supply from the ground power unit, if available and if the "COMMERCIAL" pushbutton switch (commercial load shed) is pressed. This position is electromagnetically latched.

The normal supply configuration takes precedence over the ground service configuration.

NOTE: Overheat of TR2 results in the automatic unlatching of MAINT BUS switch.
This entails the cut–off of the ground distribution network.

DC ground flight distribution network can be supplied:

- either normally from the aircraft network,
- or directly by the ground power unit upstream of the external power contactor. This is via the TR2 in ground service configuration, without energizing the whole aircraft network.

3 Loss of TR Unit No.1

In the event of TR1 loss, DC BUS 1 and DC BAT BUS are automatically restored from TR2 through

- DC NORM BUS 2 SWITCHING contactor (1PC2) and
- DC NORM BUS 1 SWITCHING contactor (1PC1).

DC ESS and SHED ESS BUSSES are automatically transferred to ESS TR through ESS TR contactor.

ESS TR supply is provided from AC BUS 1 through AC ESS BUS SWITCHING contactor and AC ESS BUS contactor in succession.

2 Normal Ground Supply

The aircraft network can be supplied by a ground power unit. For this, an external power receptacle is provided forward of the nose landing gear well.

By pressing the External Power pushbutton switch the EPC closes, both BTCs are closed and the AC Bus 1 and AC Bus 2 are supplied. The whole network is available.

4 Normal Flight Configuration

When the two engines run in normal conditions, generator 1 and generator 2 supply their own network.

Generator 1 supplies network 1, including:

- AC BUS 1,
- AC ESSENTIAL BUS,
- AC SHEDDABLE ESSENTIAL BUS.

Generator 2 supplies network 2, corresponding to AC BUS 2.

Networks 1 and 2 are supplied in priority order:

- by their generator,
- by the electrical ground power unit,
- by the auxiliary generator,
- or by the other generator.

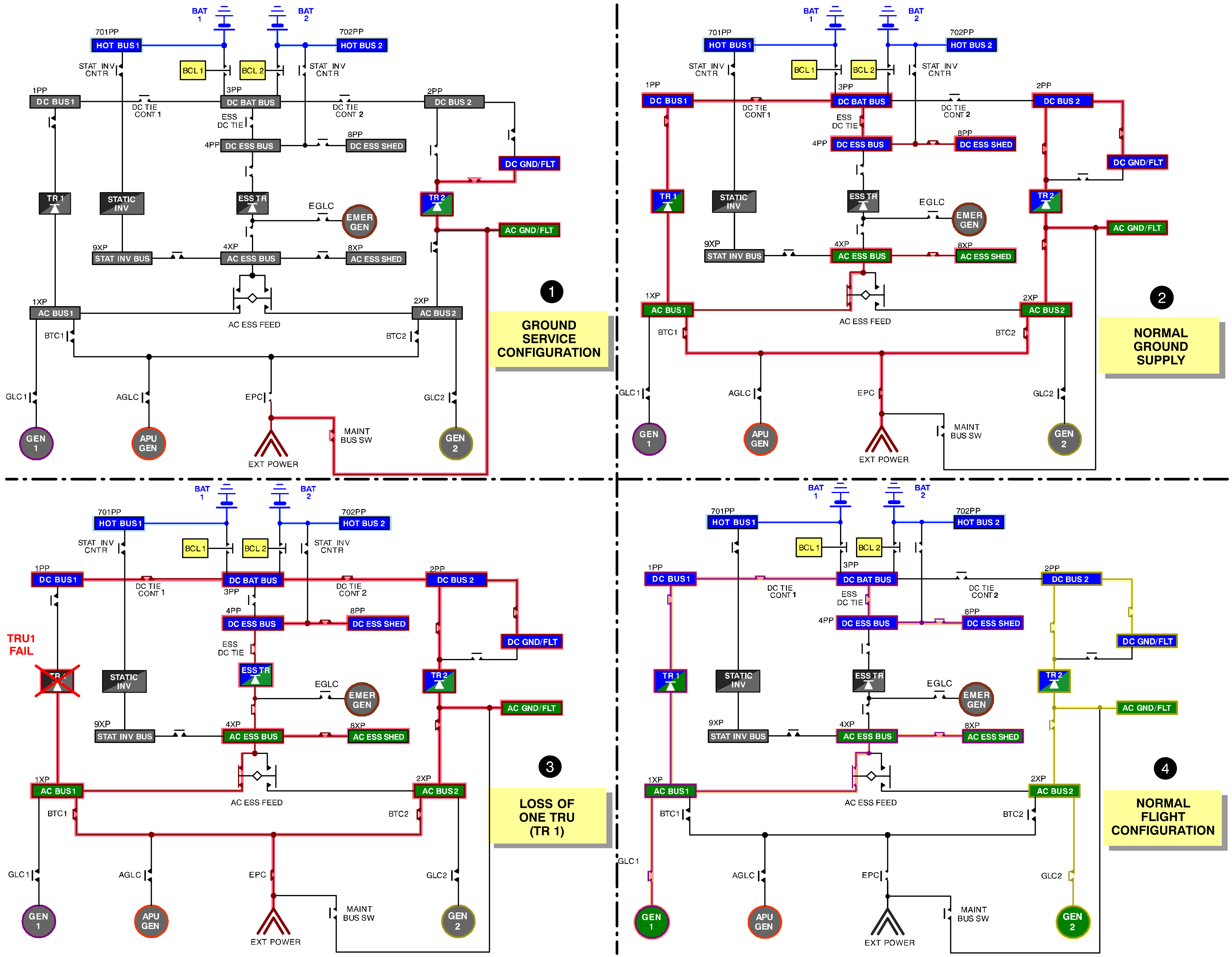


Figure 23 Power Supply Configurations (Case1–4)

Reference to Figure 24 Power Supply Configurations (Case 5–8)

24–24 AC EMERGENCY GENERATION

EMERGENCY CONFIGURATIONS DESCRIPTION

LOSS OF ALL MAIN GENERATORS

1 Emergency Generator running

The AC emergency generation enables part of the distribution network to be recovered in case of:

- loss of the two main generation sources and,
- unavailability of the auxiliary generation.

The RAT and CSM/G are:

- automatically controlled by AC BUS 1 and AC BUS 2 loss and V > 100 kts,
- or manually by means of the EMER ELEC PWR/MAN ON guarded pushbutton switch on the EMER ELEC PWR section of the overhead panel.

When a failure of the AC BUS 1 and 2 occurs, simultaneously:

- the RAT is automatically extended,
- the emergency generator is automatically coupled to AC and DC ESS busbars after time delay of appr. 10 sec.

3 Speed <50 kts

When the BAT pushbutton switches are pressed in, no generator is available and the A/C speed < 50 kts,

the static inverter turns on and supplies the AC STATIC INVERTER BUS and the DC ESS BUS will be supplied by battery 2.

The DC BAT BUS will be available too.

2 Emergency Generator not running
Speed >100 kts

As long as the emergency generator is not running in case of all main generator failure and A/C speed > 100 kts, the battery 1 will supply the static inverter. The static inverter supplies then the AC ESS BUS.

Battery 2 will supply the DC ESS BUS.

4 Avionic Smoke Configuration

The figure shows the configuration after second step of smoke drill procedure. The crew has initiated the RAT extension, has released out the GEN 1 LINE pushbutton switch and switched off the GEN 2.

Thereafter the LH wing fuel pump No. 1 and the RH wing fuel pump No. 1 is energized by GEN 1.

The essential busses are supplied as like as in emergency electrical configuration.

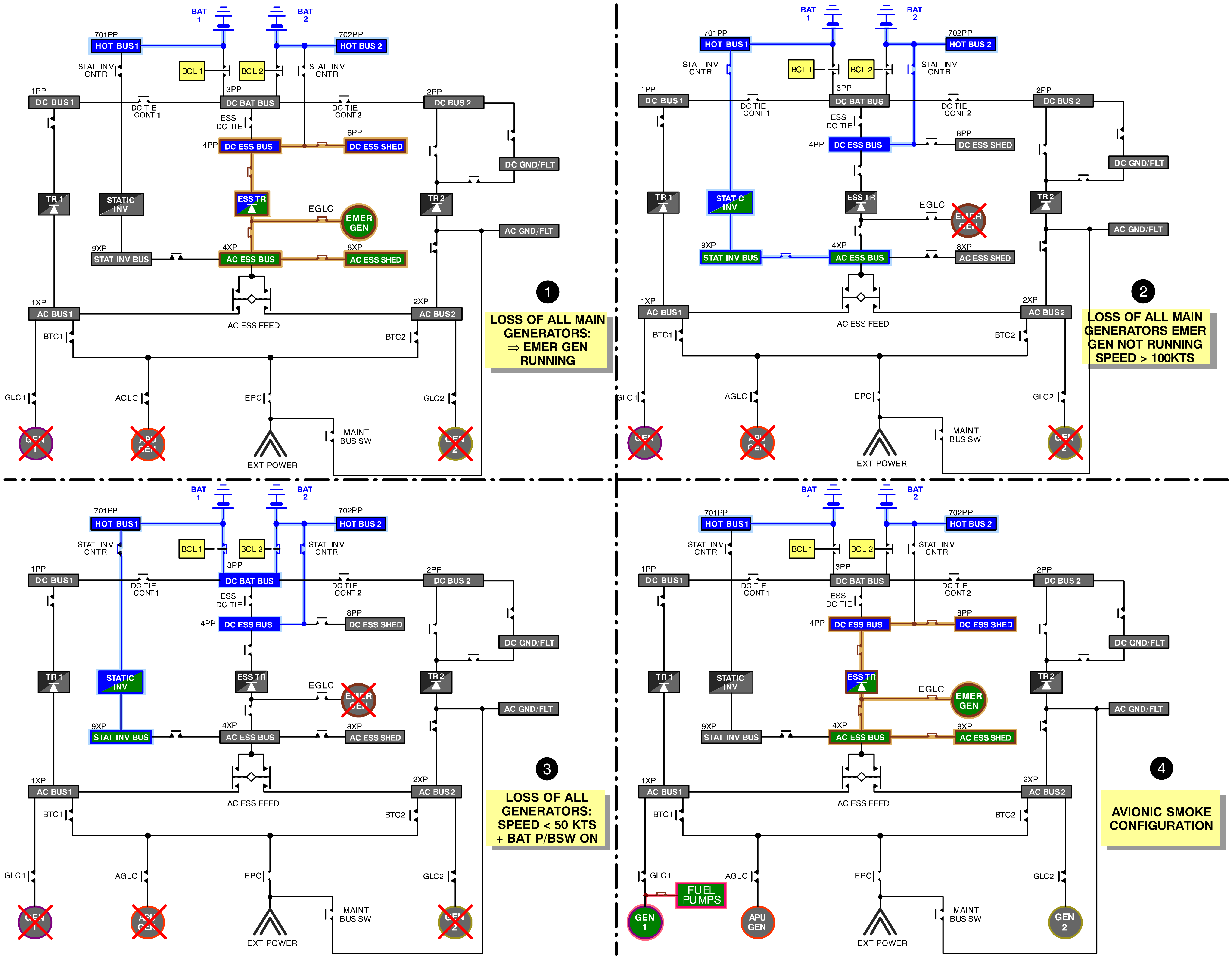


Figure 24 Power Supply Configurations (Case 5–8)

Reference to Figure 25 AC/DC Generation And Distribution Schematic

AC/DC GENERATION AND DISTRIBUTION

AC GENERATION AND DISTRIBUTION

Main Generator and APU GEN Drive

Each main generator is driven by an engine HP compressor via an accessory gearbox and an integrated hydromechanical speed regulator which transforms the engine variable speed into constant speed for the generator.

In the event of mechanical failure, the IDG pushbutton switch protected by a guard and located on the ELEC panel on the overhead panel, serves to disconnect the IDG.

The APU directly drives the APU GEN at constant speed. This maintains the generator frequency constant.

Each generator is controlled, via a GCU, by a GEN pushbutton switch located on the ELEC panel on the overhead panel. The leading particulars of the generator are nominal power: 90 KVA, voltage: 115 V/200 V, three–phase, 400 Hz.

The main functions of the GCU are:

- to regulate the generator voltage by the field current,
- to protect the network and the generator by control of the associated GLC and the generator field current,
- to provide BITE information to the Ground [and Auxiliary] Power Control Unit (G[A]PCU),
- to control the warnings associated with the corresponding channel.

CSM/G Drive

In emergency conditions, a hydraulic motor speed–controlled by a servo–valve speed regulator drives the CSM/G. The regulator uses the oil flow from the Blue Hydraulic system to maintain the CSM/G at a constant speed.

Static Inverter

The static inverter, with a 1000 VA nominal power, transforms the direct current from the battery 1 into a single phase, 115 V 400 Hz, alternating current.

The static inverter is automatically activated if AC BUS 1 and AC BUS 2 are lost and the CSM/G is unavailable.

AC Distribution

The alternating current distribution network comprises three independent parts.

The network 1 mainly comprises the AC BUS 1, the AC ESS BUS and the AC SHED ESS BUS which are three–phase, 115 V/400 Hz busses.

The AC BUS 1 supplies the essential busses in series.

In the event of AC BUS 1 loss, AC ESS BUS and the AC SHED ESS BUS can be restored by the transfer of power supply directly from the AC BUS 2.

The network 2 includes the AC BUS 2 which is a three–phase, 115 V/400 Hz bus.

AC External Power Control Supply

An external power receptacle located in front of the nose landing gear well enables power supply of the aircraft network. This is performed by means of the three–phase, 400 Hz, 115/200 V ground power unit.

External power supply is controlled from the ELEC panel on the cockpit overhead panel and via the GP(A)CU.

DC GENERATION AND DISTRIBUTION

DC Power Sources

The power sources of direct current are three identical transformer rectifiers and two identical batteries.

In normal configuration, the two normal TRs (TR 1 and TR 2) and possibly the batteries supply direct current.

In the event of loss of one or both TR, part of the DC network is transferred to the ESS TR.

TR1 and TR2

Upon energization, the two normal TRs operate and supply the DC network via a contactor controlled by the internal TR logic.

Essential TR

When energized, the essential TR operates and supplies only the DC ESS network via a contactor.

Batteries

Each of the two batteries has a nominal 23 AH capacity and a 24 VDC voltage. The main functions of the batteries are to start the APU in flight and on the ground and to supply the essential network in some configurations.

A BCL controls each battery contactor when the BAT pushbutton switch is in the AUTO configuration.

DC Distribution

The direct current distribution network is divided into two parts.

The network 1 comprises the DC BUS 1, the DC BAT BUS, the DC ESS BUS and the DC SHED ESS BUS. The TR 1 supplies the network 1.

The network 2 comprises the DC BUS 2. The TR 2 supplies the network 2.

In the event of TR 1 loss, the TR 2 automatically restores supply to the DC BUS 1 and the DC BAT BUS. The DC ESS BUS and the DC SHED ESS BUS are automatically transferred to the ESS TR.

The AC BUS 1 supplies the ESS TR.

The TR 2 loss leads to the symmetrical recovery of the DC BUS 2 from the TR 1 and the same transfer for the DC ESS BUS and the DC SHED ESS BUS.

In the event of TR 1 and TR 2 loss (DC BUS 1 and 2 loss), the DC ESS BUS and the DC SHED ESS BUS are supplied from the ESS TR.

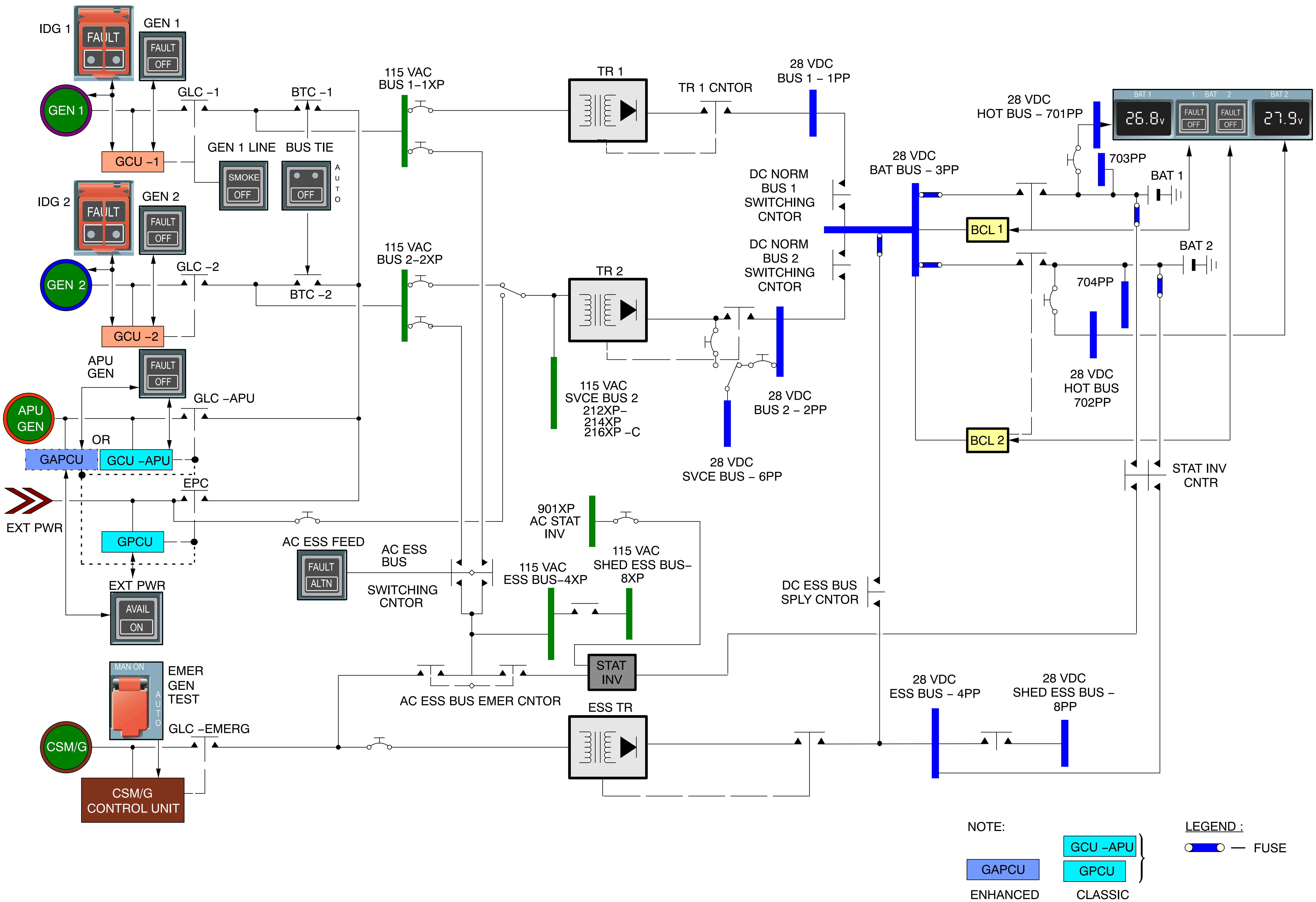


Figure 25 AC/DC Generation And Distribution Schematic

Reference to Figure 26 IDG/GCU Operation Schematic (Non-Enhanced Technology)

24–21 IDG SYSTEM

IDG CONTROL AND REGULATION (NON ENHANCED TECHNOLOGY)

GENERATOR CONTROL UNIT

The GCU has four different functions:

- voltage regulation,
- control and protection of the network and the generator,
- control of the various indications,
- system test and self–monitoring.

Voltage regulation is performed in the analog form, whereas the other functions are digital.

The GCUs are supplied:

- directly from the PMG (Permanent Magnetic Generator), for generator excitation and 28VDC internal and external supply,
- from the aircraft normal network (28 VDC BAT BUS) for the internal and external supply.

This dual supply constitutes a back up supply.

Voltage Regulation

The voltage regulation is performed by regulating the generator excitation current: the voltage is kept at the nominal Point Of Regulation (POR).

The POR is located in the electrical power center at the end of the generator feeder, upstream of the line contactor.

Analog circuits achieve the regulation. The PMG provides directly the excitation supply via the Generator Control Relay (GCR). The excitation supply is rectified. Then a chopper amplifier (pulse width modulation), protected by a freewheeling diode, controls the excitation supply.

The regulation is achieved using a signal proportional to the average of the three line to neutral voltages at the input.

Generator Control and Protection Functions

These functions are mainly the generator excitation and line contactor control.

The excitation is controlled via the GCR.

The line contactor is controlled via the Power Ready Relay (PR) which is energized when:

- the speed is more than 4730 rpm and,
- the GCR is closed.

Signals received or generated by the GCU control these two relays. The following control or fault signals cause generator shutdown or de–energization:

IDG disconnection,

- GLC failure (BTC is only locked out),
- engine shutdown with the ENG FIRE pushbutton switches (IDG position),
- PMG short circuit,
- over/under voltage,
- over/under frequency,
- open cable (IDG position),
- APU ready (APU position),
- differential protection (Zone 1 & 2):
  - Zone 1 : monitoring of the generator 1 or 2 and feeders,
  - Zone 2 : monitoring between the line contactor and the primary circuit breakers related to the channel. Monitoring between the BTC of the applicable channel and the primary circuit breakers.
- GEN pushbutton switch,
- short circuit of the rotating diodes,
- phase sequence (in this case, the GCU opens the PR relay only).

Except in some particular cases, the system may be reset by setting the GEN pushbutton switch to OFF.

The PR is also controlled by the IDG drive underspeed. This prevents the generator from being energized.

Each time the generator is de–energized because of a fault signal, do a GCU reset. To do this, push (ON) then release (OFF) the related GEN pushbutton switch.

NOTE: After: an activation of a differential pressure, or an activation of a GLC fault the system can be reset only two times via the GEN pushbutton switch.

Control of the various indications

The GCU controls the warnings and annunciators related to the IDG channel.

Generator FAULT comes on when the protections come into operation (PR opening)

Generator FAULT also comes on:

- for the main generators whenever the GLC is open,
- for the APU generator whenever the GLC is open or the EPC opens with the APU ready.

Galley FAULT when an overload is detected

IDG FAULT for a low pressure or high temperature of the cooling and lubrication oil system.

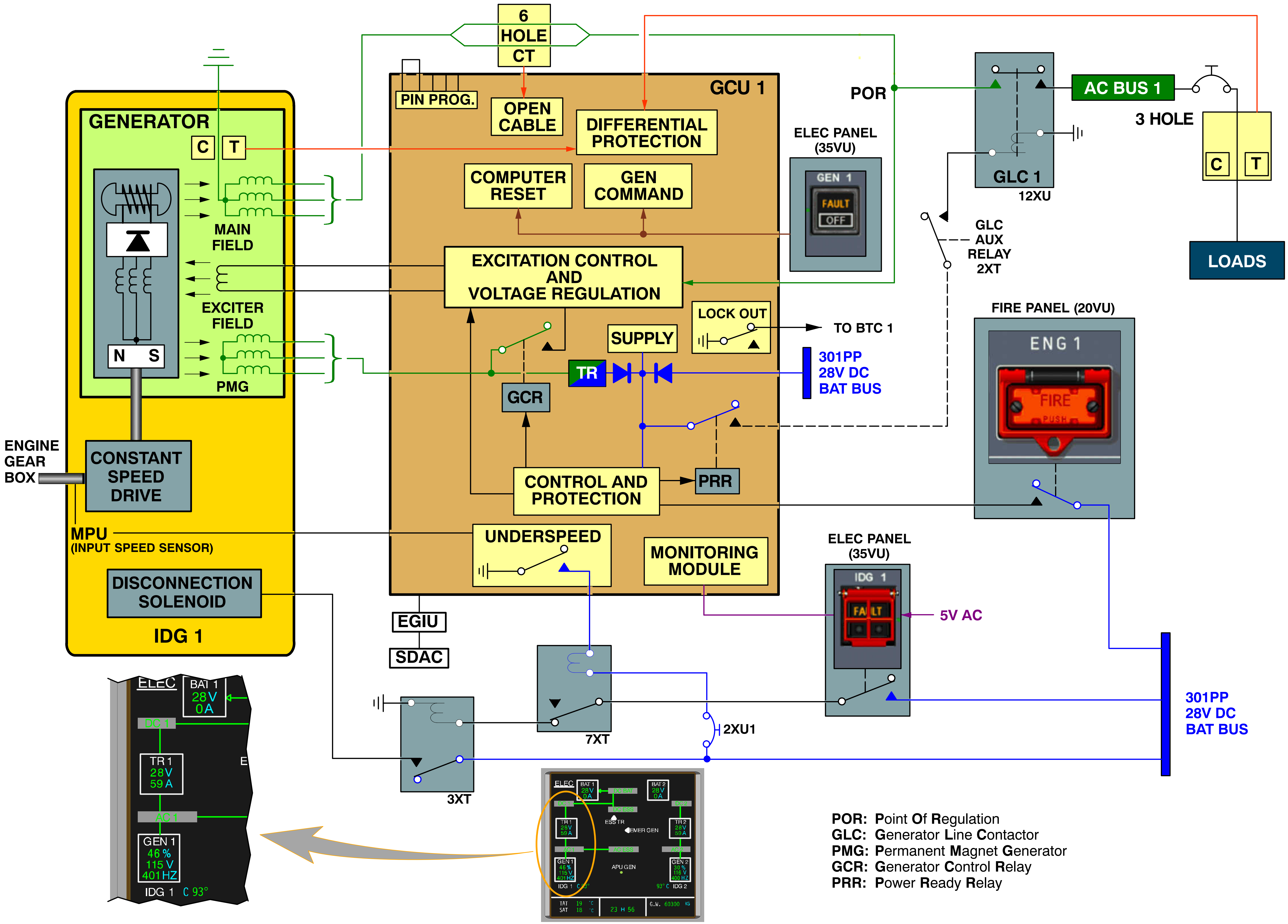


Figure 26 IDG/GCU Operation Schematic (Non-Enhanced Technology)

Reference to Figure 27 IDG Oil System/Disconnect & Indications (Non-Enhanced Technology)

IDG OPERATION/CONTROL AND INDICATING (NON ENHANCED TECHNOLOGY)

Monitoring of the Oil System Operation

Oil temperature sensors monitor oil−in and oil−out temperatures:

They allow overheat detection.

A pressure switch operates in the event of a loss of charge oil pressure.

In both cases (overheat and loss of pressure), a warning is provided to the cockpit, (FAULT legend and ECAM warning).

The oil−out temperature is displayed on the ECAM electrical page.

NOTE: When the oil temperature reaches a predetermined value, an advisory mode is shown on the ECAM

There is a differential pressure indicator to show when the filter element is clogged.

Oil filter

A clogged filter indication is provided by a local visual pop out indicator. The indicator is installed opposite the drive end of the IDG.

Disconnection of the IDG

In case of:

- Oil overheat (high oil−out temperature) and
- oil pressure drop when not because of drive underspeed.

The amber FAULT legend of the ELEC/IDG1 or 2 pushbutton switch comes on, the master warning system is triggered.

In this case, the IDG must be disconnected manually. For this, the PUSH−TO−DISC IDG1(2) safety−guarded pushbutton switch, installed on the panel 35VU, must be pushed.

NOTE: IDG disconnection is irreversible in flight.
Connection of the system is then possible only on the ground with engines shut down.

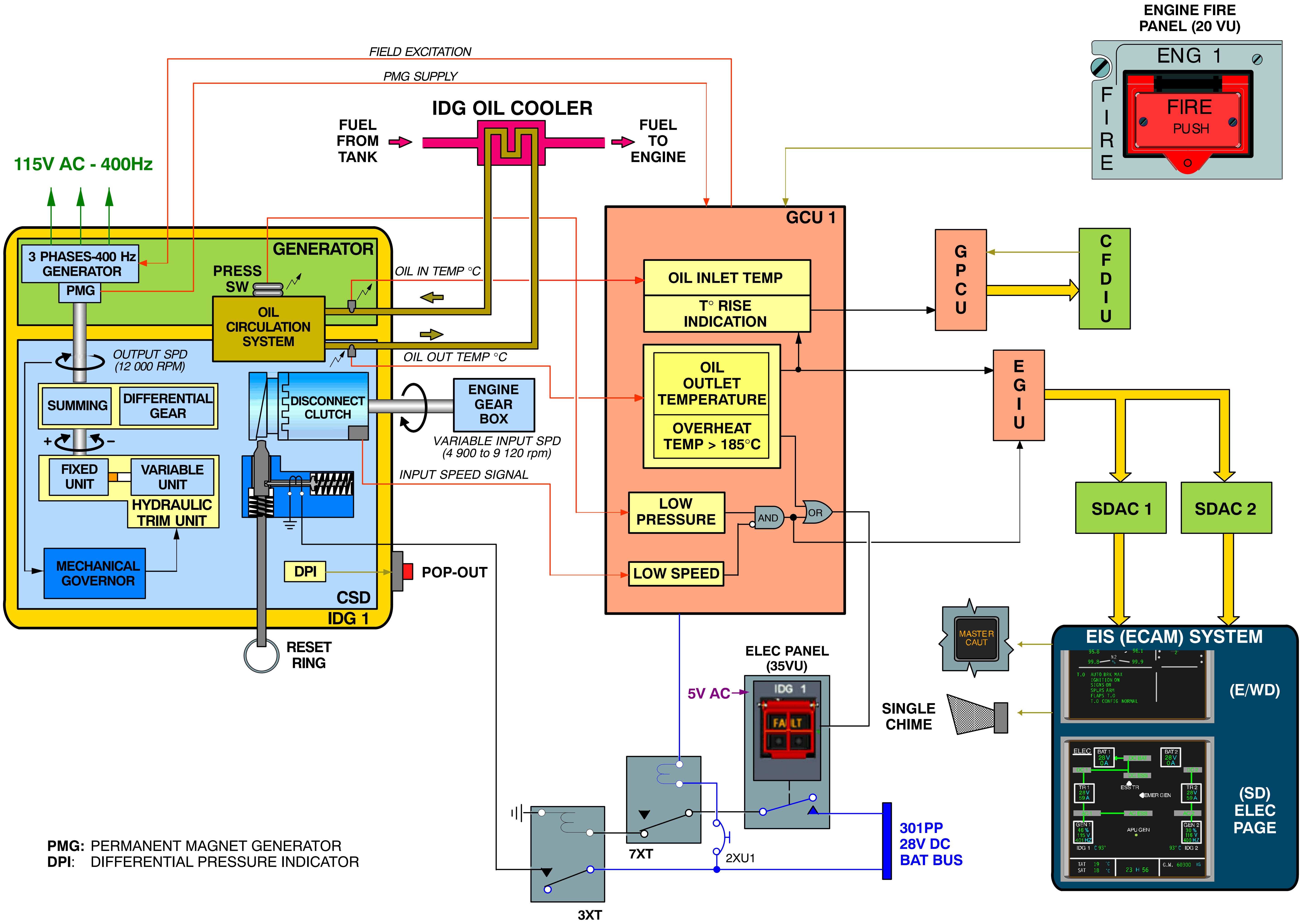
NOTE: Illumination of IDG FAULT legend is inhibited at engine shut down (under speed) in particular.
In case of overheat or oil pressure drop, the legend goes off because a disconnection occurs (speed below 2000 rpm).

NOTE: The IDG must not operate for more than 50 hours in the disconnected mode.
If the IDG operates for more than 50 hours in the disconnected mode, it will be necessary to replace it and send the removed IDG for a shop inspection.
This is because there is a risk of damage to the ball bearing assembly on the input shaft.

Re-Connection of the IDG

A mechanical reset handle is fitted to the IDG.

The handle is used to reconnect the drive while the engine is stationary on the ground.



PMG: PERMANENT MAGNET GENERATOR
DPI: DIFFERENTIAL PRESSURE INDICATOR

Figure 27 IDG Oil System/Disconnect & Indications (Non-Enhanced Technology)

Reference to Figure 28 IDG/GCU Operation Schematic (Enhanced Technology)

IDG CONTROL AND REGULATION (ENHANCED TECHNOLOGY)

ATTENTION: ***The enhanced functions are written in cursive type!***

GENERATOR CONTROL UNIT

The GCU has four different functions:

- voltage regulation
- frequency regulation
- control and protection of the network and the generator,
- control of the various indications,
- system test and self−monitoring.

All these functions are performed in the digital form.

The GCUs are supplied:

- directly from the PMG, for generator excitation and 28VDC internal and external supply,
- from the aircraft normal network (28 VDC BAT BUS) for the internal and external supply.

This dual supply constitutes a back up supply.

Voltage Regulation

The voltage regulation is achieved by controlling the current through the exciter field. The voltage is kept at nominal value (115 VAC) at the Point of Regulation (POR).

Regulation of the generator speed

The regulation of the generator speed is accomplished by means of a servo valve located in the IDG. The GCU controls the servo valve position.

Control and protective functions

The GCU controls the connection and disconnection of the power provided by the generator to and from the aircraft electrical system. This control is provided by means of 3 relays:

- the Generator Control Relay (GCR) which controls the generator excitation,
- the Power Ready Relay (PRR) which controls the generator line contactor and the FAULT warning light in the cockpit,
- *the Servo Valve Relay (SRV) which controls the generator speed by means of the servo valve.*

Generator control and protection functions

The following control or fault signals cause generator shutdown or de−energization:

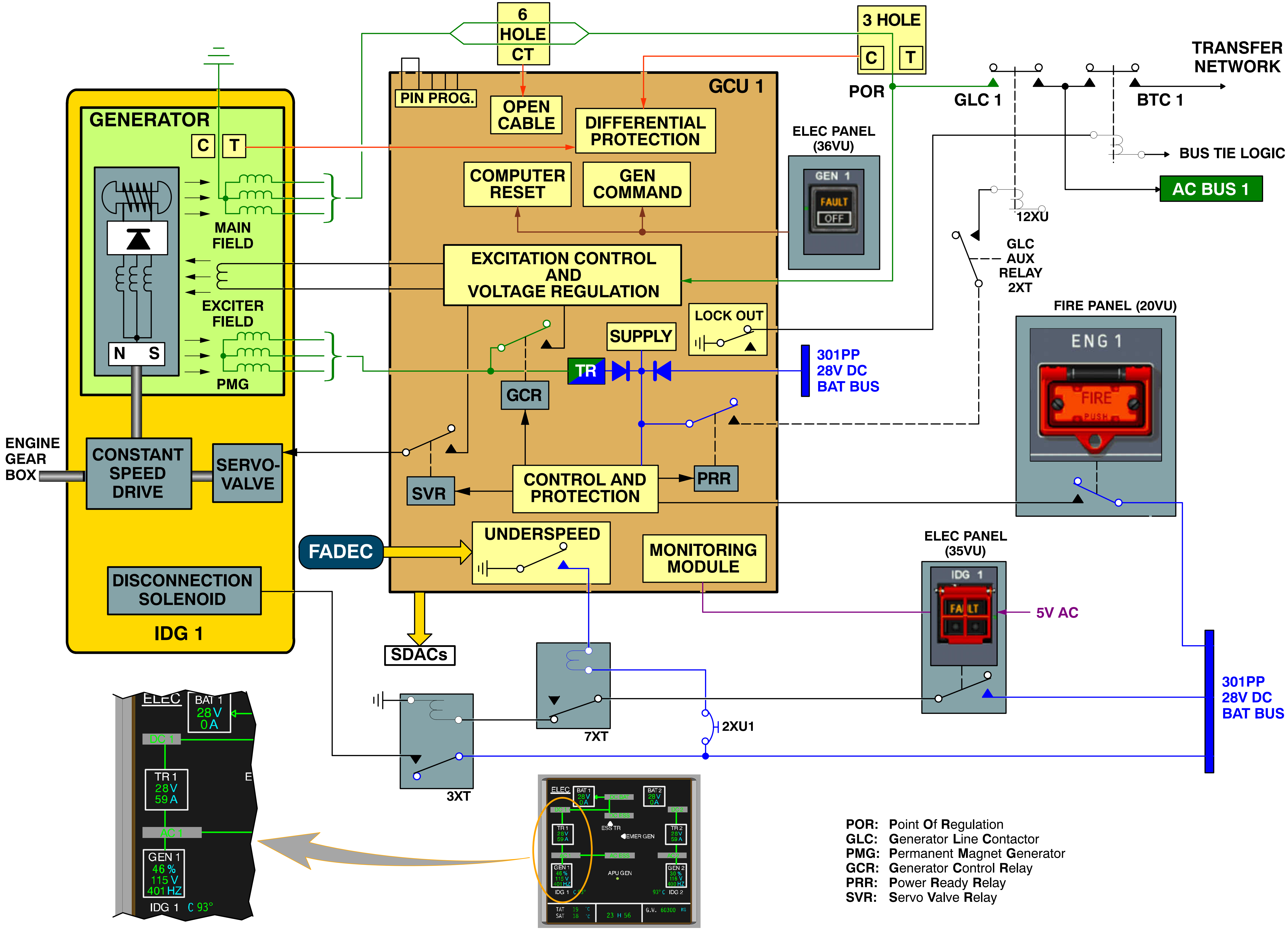
- no controlled Shutdown recognized upon power−up of the control unit
- Overvoltage Fault
- Undervoltage 1 Fault
- *Undervoltage 2 Fault*
- Overfrequency 1 Fault
- *Overfrequency 2 Fault*
- *Overfrequency 3 Fault*
- Underfrequency 1 Fault
- *Underfrequency 2 Fault*
- Underspeed
- Shorted Rotating Diode (PMG to chassis short) Fault
- Open Cable Fault
- *Differential Protection without Zone 1 & 2 differentiation*
- *Overcurrent Fault*
- *Delta Overcurrent Fault*
- Phase Sequence Fault with the Power Ready Relay ”absent”
- *Servo Valve Deterioration Fault*
- Disconnect Trip Fault
- (Welded) GLC Fault
- *GLC Control Circuit Fault*
- Shorted/Open PMG Fault with the Power Ready Relay ”absent”
- *Pin Programming Error detected on GCU power−up.*

The generator shall be ”reset” when the protective faults (identified above) are still not present and one of the following occurs:

- Cold Start (which is defined as POWER−UP RESET or the application of 28 volts to the control unit) occurs,
- Generator Control Switch (GCS) is toggled (OFF to ON).

The following functions shall be limited to a total of 2 resets after which a cold start will be required for reset:

- *Overvoltage Fault*
- *Overfrequency 2 Fault*
- Differential Protection Fault
- *Overcurrent 2 Fault*
- *Servo Valve Deterioration Fault*
- Welded GLC Fault
- *GLC Control Circuit Fault*



POR: Point Of Regulation
GLC: Generator Line Contactor
PMG: Permanent Magnet Generator
GCR: Generator Control Relay
PRR: Power Ready Relay
SVR: Servo Valve Relay

Figure 28 IDG/GCU Operation Schematic (Enhanced Technology)

Reference to Figure 29 IDG Oil System/Disconnect & Indications (Enhanced Technology)

IDG OPERATION/CONTROL AND INDICATING (ENHANCED TECHNOLOGY)

General

Each engine (HP rotor) drives its associated Integrated Drive Generator (IDG) through the accessory gearbox.

The drive speed varies according to the engine rating.

The IDG provides a 115/200VAC, 3–phase, 400 Hz AC supply. The IDG has two parts: the Constant–Speed Drive (CSD) and the generator.

The hydromechanical Constant–Speed Drive (CSD) drives the AC generator at constant speed.

Integrated Drive Generator (IDG)

The IDG converts the variable–speed shaft power directly into constant frequency 400 Hz AC electrical power.

The Constant Speed Drive (CSD), in the IDG, drives the AC generator at constant speed. Thus, the AC generator produces constant frequency power.

Fuel–Cooled IDG Oil Cooler

The fuel–cooled IDG oil cooler cools the IDG oil and limits the IDG inlet temperature. As the oil goes through the oil cooler, heat is transferred from the oil to the fuel. Then the cooled oil returns to the IDG.

The normal IDG oil–inlet temperature is between 70°C and 105°C.

Generator Control Unit (GCU)

Each GCU controls its dedicated IDG:

IDG 1: GCU 1

IDG 2: GCU 2

The GCU has these main functions:

- regulation of the generator voltage at Point Of Regulation (POR)
- monitoring and protection of the system.

IDG Pushbutton Switches

If an IDG is faulty (overheat or abnormal oil low pressure), the FAULT legend of the IDG pushbutton switch and an ECAM caution message comes on. The pilot must then open the safety guard and push the IDG pushbutton switch. This action results in the mechanical disconnection of the faulty IDG.

Monitoring of the Oil System Operation

An oil temperature sensor monitors the oil inlet temperature and an other one, the oil outlet temperature.

The second provides ADVISORY oil temperature and oil overheat detection. A pressure switch operates in the event of a low charge oil pressure.

In case of abnormally low oil–pressure or IDG oil overheat (outlet temperature > or = 185 C), the warnings are provided to the cockpit (FAULT legend on the corresponding IDG pushbutton switch, MASTER CAUT light, single chime and messages on the ECAM upper display unit and ECAM lower display unit.

The oil outlet temperature is displayed on the ELEC page on the lower ECAM display unit.

Disconnection

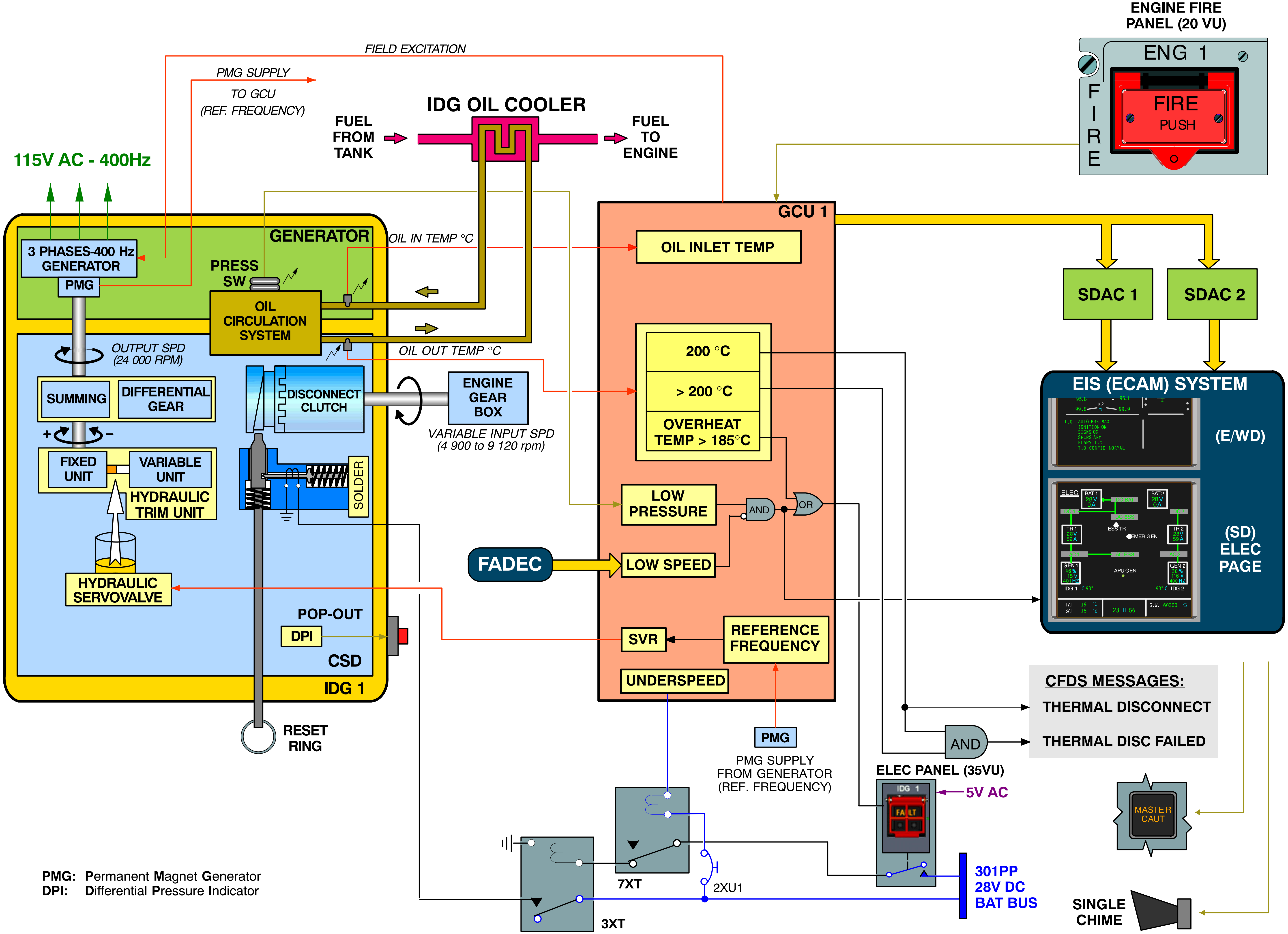
To disconnect a faulty IDG manually, it is necessary to open the safety guard and push the ELEC/IDG pushbutton switch.

- The DISC indication is also displayed on the ELEC page on the lower ECAM display unit.
- The IDG disconnection is irreversible in flight.
- The IDG cannot be disconnected below the underspeed threshold.
- The IDG must not operate for more than 50 hours in the disconnected mode. If the IDG operates for more than 50 hours in the disconnected mode, it will be necessary to replace it and send the removed IDG for a shop inspection. This is because there is a risk of damage to the ball bearing assembly on the input shaft.

If an manual disconnect is not performed, an automatic thermal disconnect appears, when the oil temperature reaches 200 °C. The ECAM caution message will not change but there will be a “thermal disconnect“ message on the post flight report.

With engine stopped, the IDG cannot be disconnected. An underspeed condition inhibits the disconnection.

A mechanical reset handle is fitted to the IDG. The handle enables the drive to be reconnected while the engine is shut down and stationary on the ground. This reset is not possible in case of an thermal IDG disconnect.



PMG: Permanent Magnet Generator
DPI: Differential Pressure Indicator

Lufthansa Technical Training

ELECTRICAL POWER INTEGRATED DRIVE GENERATOR SYSTEM (IDG, GCU)

Figure 29 IDG Oil System/Disconnect & Indications (Enhanced Technology)

Reference to Figure 30 Emergency Generator Operation and Indication

24–24 AC EMERGENCY GENERATION

CSM/G ENGAGEMENT OPERATION

Description

The extension of the RAT (**R**am **A**ir **T**urbine), for supplying the blue hydraulic system in electrical emergency configuration, can be done via two solenoids.

The control of the solenoids is as follows:

- Solenoid 1
  - automatically dependent on the configuration of the electrical network and aircraft
  - manually by operating of the HYD RAT MAN ON pb?sw. on the hydraulic panel 40VU.
- Solenoid 2
  - manually by operating of the RAT & EMER GEN MAN ON pb?sw. on the EMER ELEC PWR panel 21VU.

The automatic control of solenoid 1 happens, when:

- AC BUS 1 and 2 are not supplied
- A/C speed >100 kts (ADIRU 1) and
- battery 1 installed (Bus 703 PP supplied).

During the operational test of the CSM/G the above described control logic is simulated by operating of the EMER GEN TEST P/BSW, without extension of the RAT.

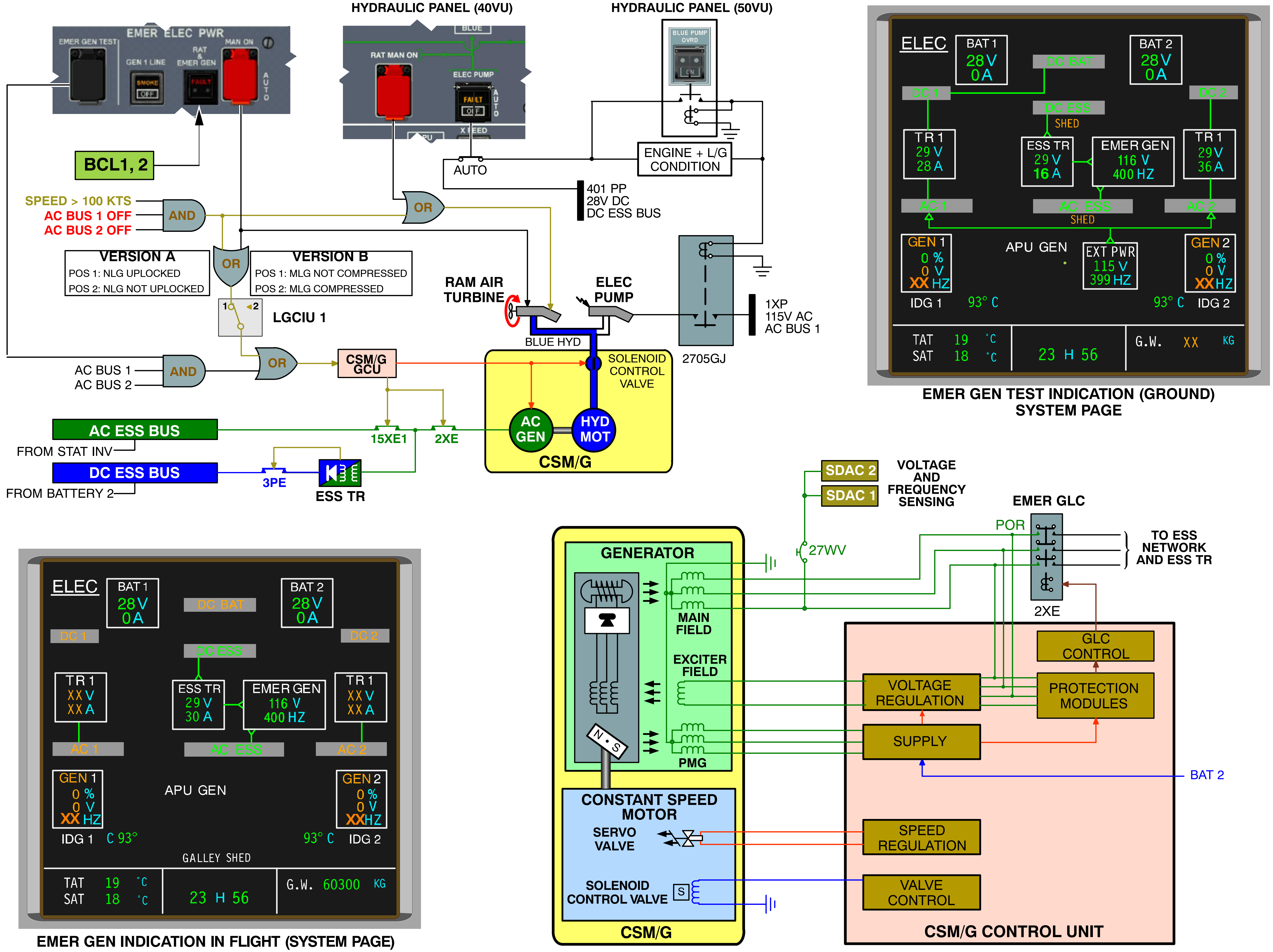


Figure 30 Emergency Generator Operation and Indication

Reference to Figure 31 AC Essential Switching Examples

24–25 AC ESSENTIAL GENERATION SWITCHING

SUPPLY OF AC ESS BUS - EXERCISE

1 NORMAL CONFIGURATION

1. What is the pre-condition to supply the AC ESS BUS in normal configuration?
2. Which relays and/or contactors are energized/not energized?
3. Is the AC ESS SHED BUS supplied?

2 AC BUS 1 LOST - AUTO SWITCHING FUNCTION (POST SB 24–1120)

4. What happens if AC BUS 1 is lost?
5. Which relays and/or contactors are energized/not energized?
6. Is the AC ESS SHED BUS supplied?

3 AC BUS 1 LOST - MANUAL SWITCHING

7. Which component is used to switchover?
8. Which relays and/or contactors are energized/not energized?
9. Is the AC ESS SHED BUS supplied?

4 AC BUS 1 AND 2 LOST

10. What happens in Emergency Elec Configuration related to AC ESS BUS?
11. Which relays and/or contactors are energized/not energized?
12. Is the AC ESS SHED BUS supplied?

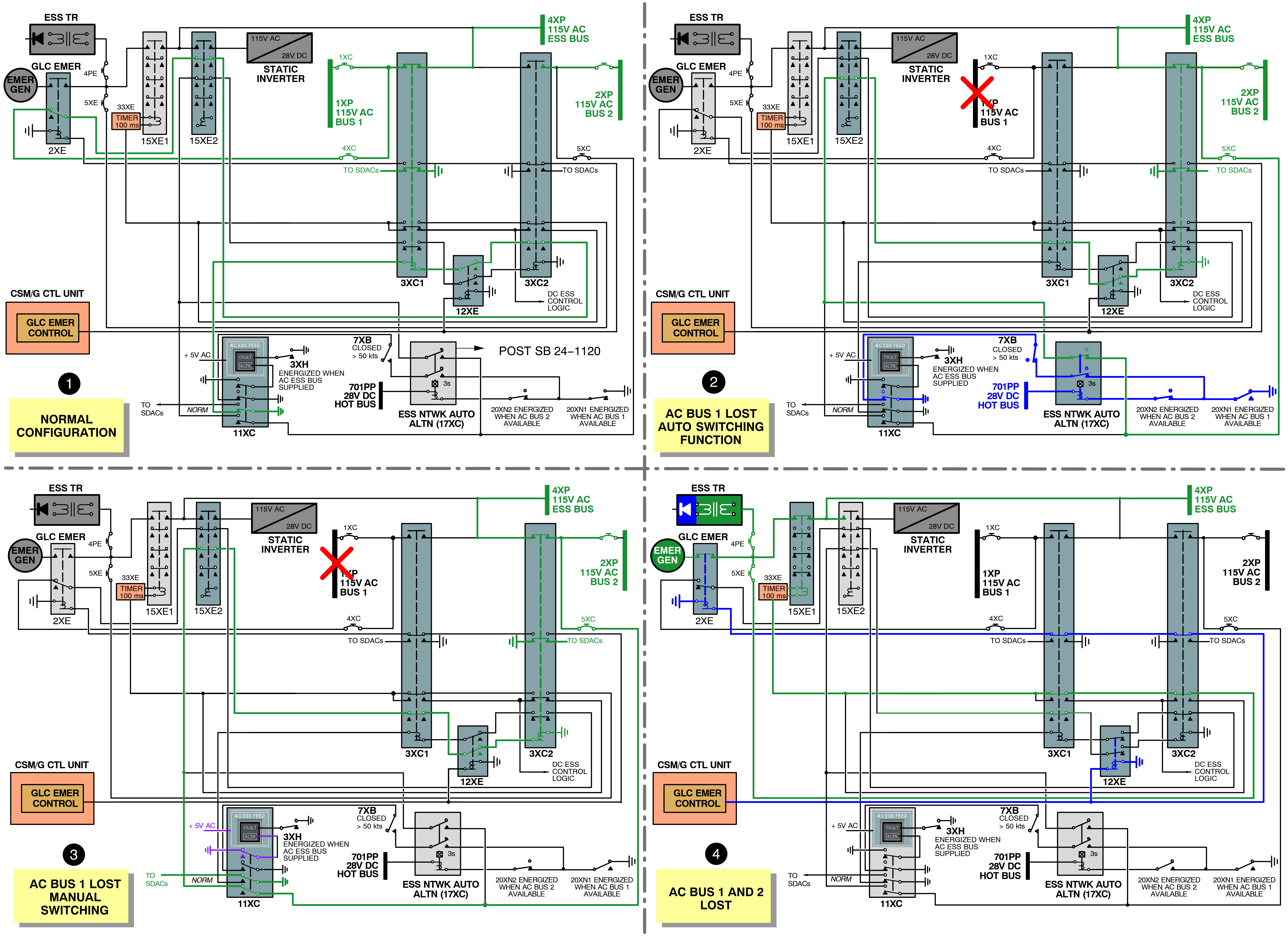


Figure 31 AC Essential Switching Examples

Reference to Figure 32 Static Inverter Operation >50 kts (On Ground)

24–28 STATIC INVERTER

DESCRIPTION AND OPERATION

General

The 1000 VA nominal–power static inverter transforms the direct current voltage from battery 1 into a single–phase 115 VAC/400 Hz alternating current.

The static inverter is used in these cases:

- APU start (supply of fuel pump),
- engine start on batteries (ignition),
- RAT (**R**am **A**ir **T**urbine) deployment (< 10s) (supply of ECAM display units),
- on ground, on batteries only (pushbutton switch supply),
- in emergency configuration after landing, when the CSM/G is switched off (supply of the 115 VAC ESS BUS 4XP instead of the CSM/G).

Operation/Control and Indicating

The static inverter starts automatically if:

- the AC BUS 1 and 2 are lost,
- the CSM/G is not available, and
- speed is more than 50 Kts.

When the static inverter is faulty, it generates a permanent ground signal to the BCL1.

The presence of the ground signal means:

- overheat,
- output overvoltage,
- input undervoltage,
- input overvoltage.

Test

On the ground, the static inverter can be checked applying the following procedure (aircraft supplied by EXT POWER or APU GEN):

- EMER GEN TEST: ON
- BUS TIE: OFF
- On the ECAM ELEC page, check voltage and frequency of static inverter.

EXERCISE

Please, explain the illustration:

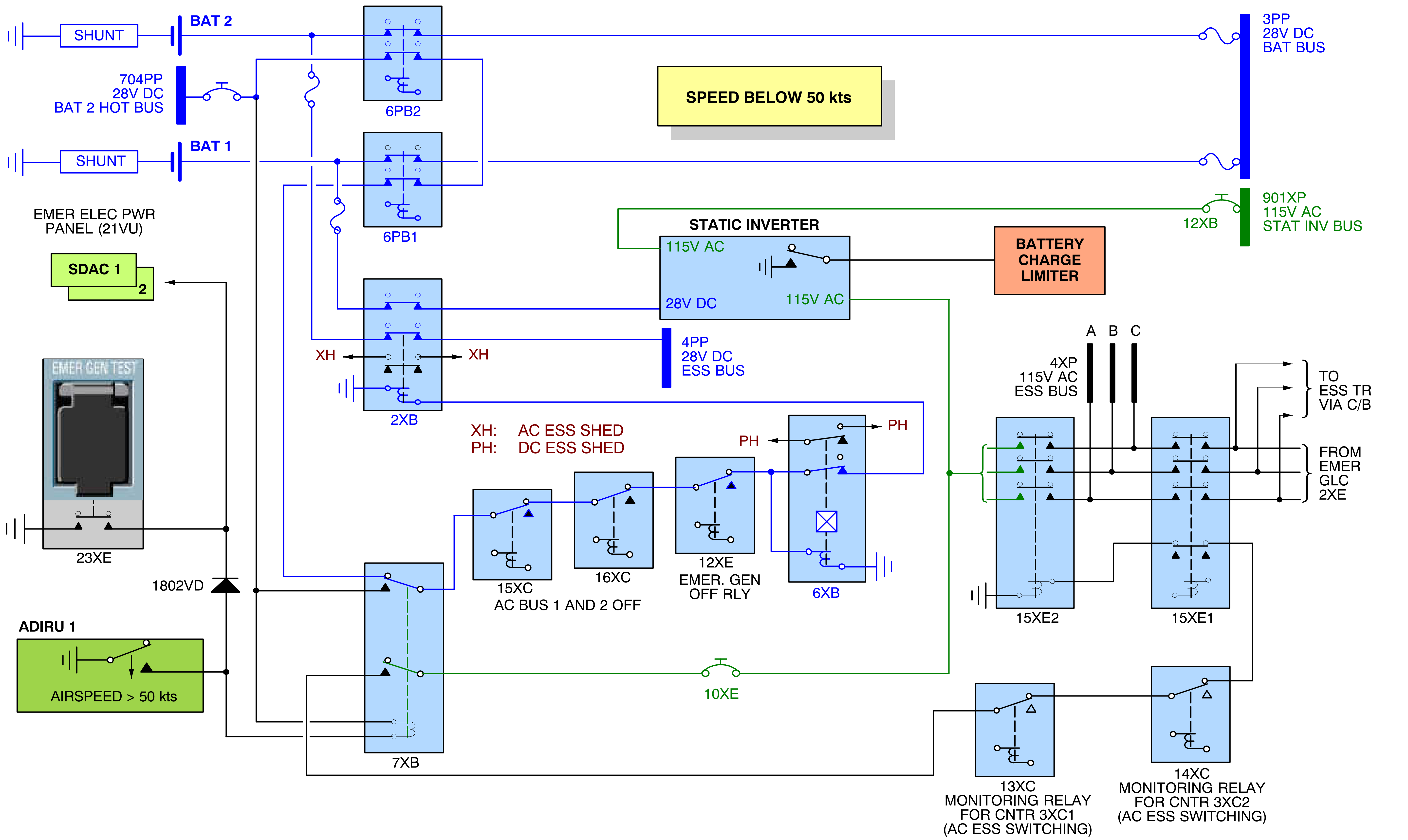


Figure 32 Static Inverter Operation >50 kts (On Ground)

Reference to Figure 33 Static Inverter Operation >100 kts and between 50 and 100 kts

FURTHER CONFIGURATIONS OF STATIC INVERTER OPERATION

Upper part of figure

In the event of:

- AC BUS 1 and AC BUS 2 fail and
- the aircraft speed > 100 kts and
- the emergency generator is not yet available,

the relay 7XB will be energized and the static inverter is turned on independent of BAT contactor 1 and BAT contactor 2 position.

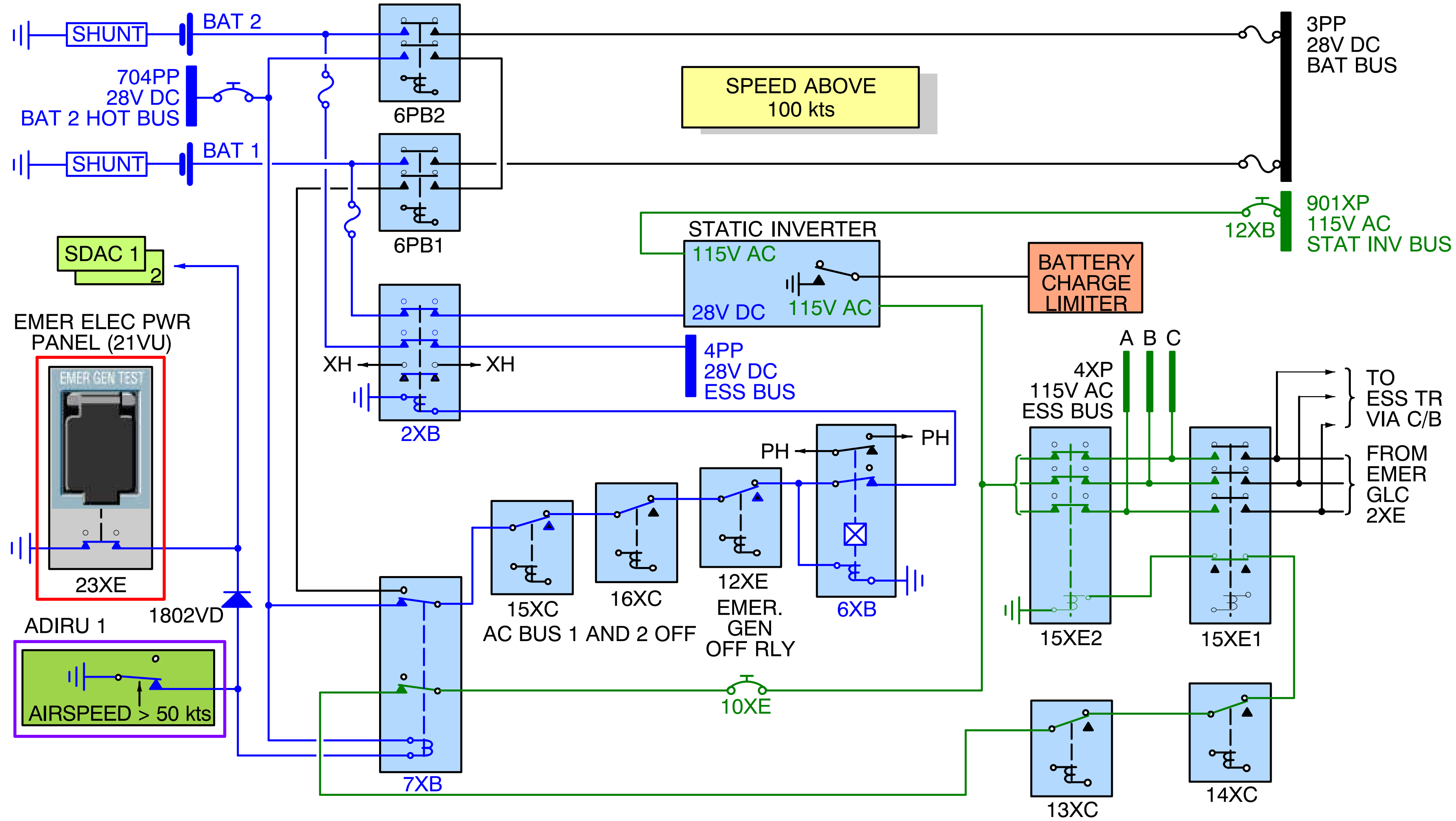
The EMER GEN TEST pushbutton switch can also be used for energizing of relay 7XB and will simulate an airspeed of > 50 kts during an active static inverter test.

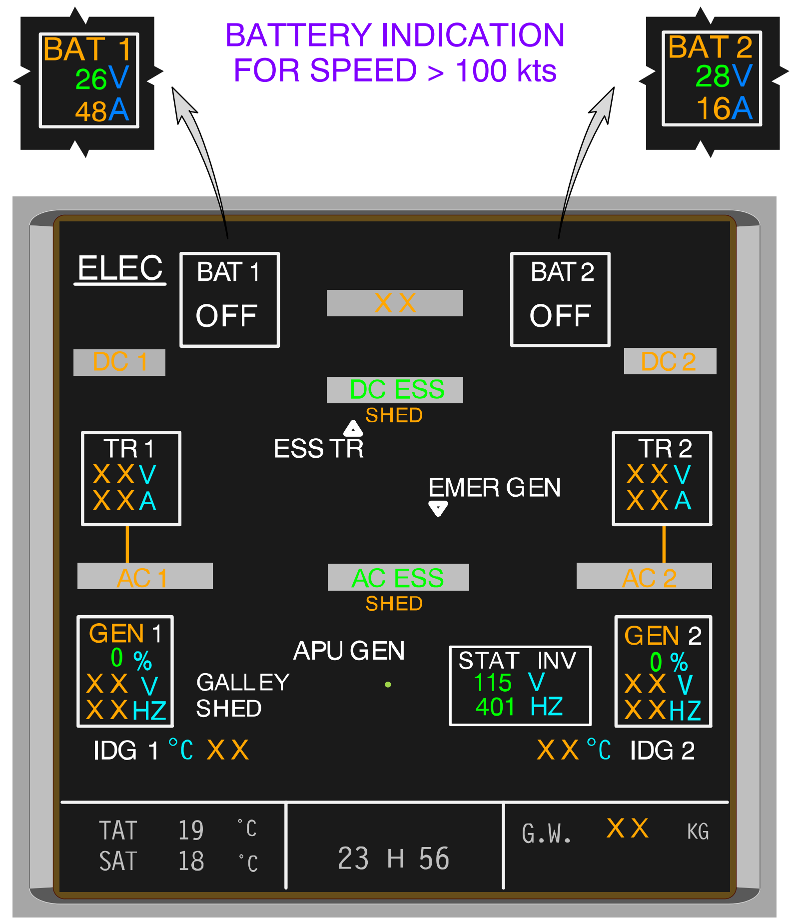
Lower part of figure

The supply of static inverter in the speed range from 50 kts to 100 kts is two−times ensured:

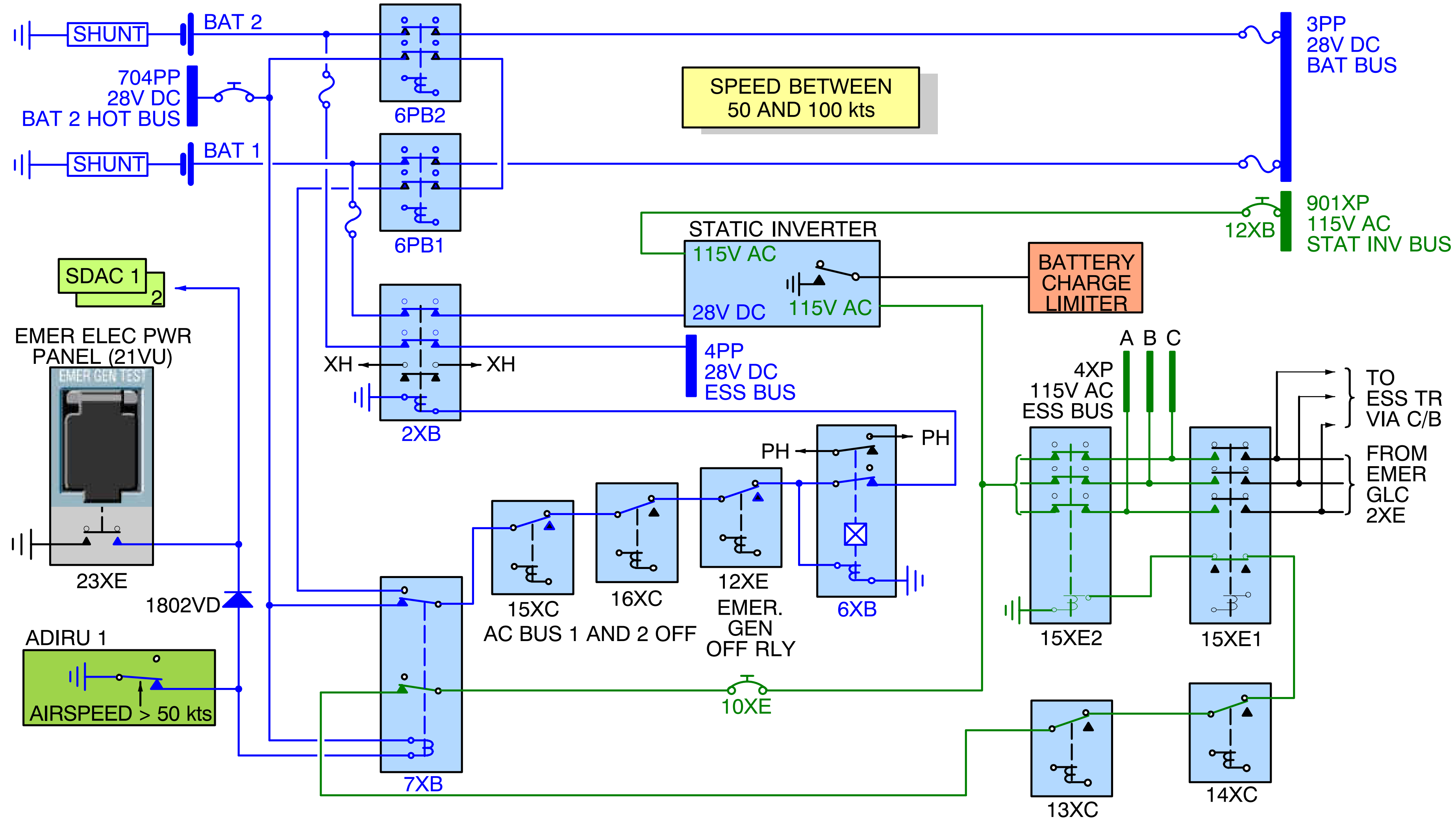
- by airspeed > 50 kts discrete to energize relay 7XB and
- by automatically closed BAT contactor 1 and BAT contactor 2

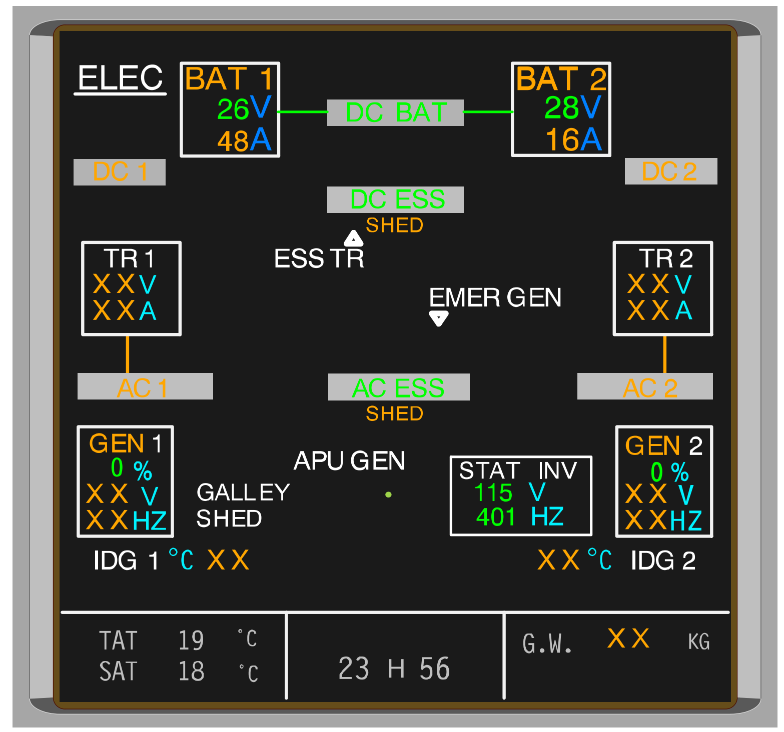
NOTE: Only if the relay 7XB is energized, the AC ESS BUS can be recovered by use of static inverter.





INDICATION IN CASE OF STATIC INV.
TEST ON GROUND





ECAM INDICATION FOR SPEED
BETWEEN 50 AND 100 kts

Figure 33 Static Inverter Operation >100 kts and between 50 and 100 kts

Reference to Figure 34 Battery Charge Limiter Schematic

24–38 DC GENERATION–BATTERIES

DESCRIPTION AND OPERATION

General

The batteries are mainly used to:

- start the APU in flight and on ground,
- supply AC/DC essential network in emergency configuration during RAT deployment and when the emergency generator is not available (CSM/G switched off after landing).

Each battery is associated with a Battery Charge Limiter (BCL) and a battery shunt.

It should be noted that, in normal configuration, the batteries are most of the time uncoupled from the network during the flight.

Operation/Control and Indicating

The operation of each battery charge limiter is controlled from the ELEC panel 35VU in the cockpit by means of BAT1(2) pushbutton switches. These pushbutton switches have two stable positions:

- The pushbutton switch is released

  The battery charge limiter is not operating and the battery is uncoupled from the network.

  The status of this control is indicated by illumination of the white OFF legend on the pushbutton switch. The same indication is displayed on the ELEC page of the lower ECAM Display Unit and generates a warning if one or both engines are running.
- The pushbutton switch is pressed

  The battery charge limiter is operating and controls the coupling and uncoupling of the battery.

  No light comes on on the pushbutton switch in normal operation. However white BAT1 and BAT2 and green indication of voltage and current are displayed on the ELEC page of the lower ECAM DU, as well as the green symbol when battery is charging and the amber symbol when battery is discharging.
  FAULT amber legend comes on on the pushbutton switch if a thermal runaway or internal short–circuit is detected. Simultaneously, the ELEC page is displayed on the lower ECAM DU with corresponding warnings (MASTER CAUT light + single chime + amber message on the upper ECAM display unit). A BAT OVHT fault causes automatic lock out of the battery line contactor.

NOTE: An OFF/ON (Released/Pressed) action on the pushbutton switch allows to reset the BCL.

Battery Charge Limiter

The functions of battery charge limiter are as follows:

- Control of the battery contactor
- RAT & EMER GEN control
- Inhibition of the APU start sequence
- BAT–Fault warning control

Furthermore, the BCL delivers battery–related parameters and warnings to the ECAM display units, through busses.

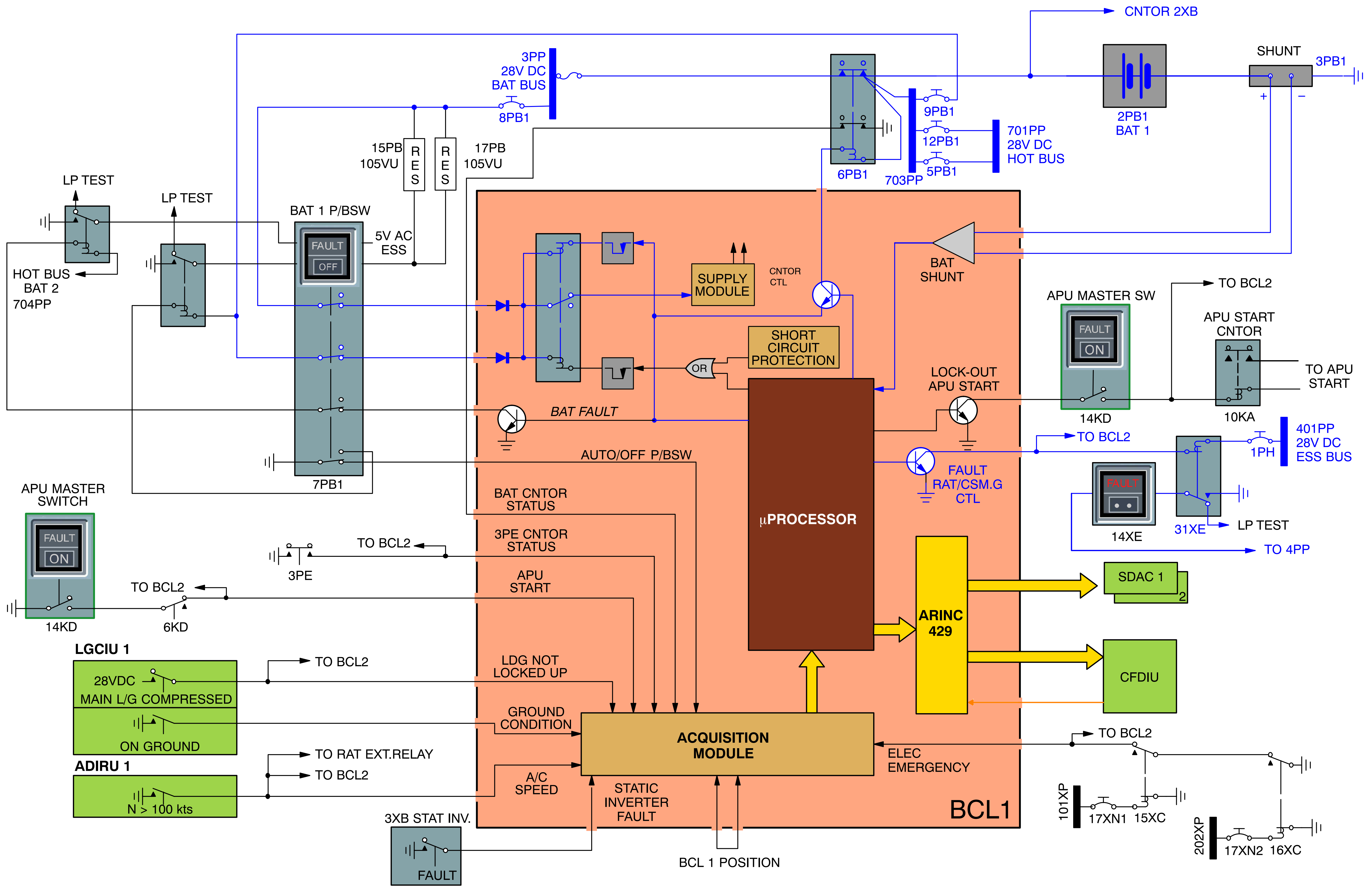


Figure 34 Battery Charge Limiter Schematic

Reference to Figure 35 Galley Feeding Operations

24–26 GALLEY SUPPLY CONTROL

OPERATION (EXAMPLE A321)

General

The power supply provides the galley assemblies with 115 V AC through the three phase normal busbars 1XP and 2XP. Six triple core wires (feeders A, C, D, E and F) distribute the power to terminal blocks in the forward, mid and aft galley area. Vendor wiring distributes the power to the galley units. The wiring is connected to the terminal blocks with cable lugs.

The maximum available load for all galleys is 70kVA. The load is distributed as follows:

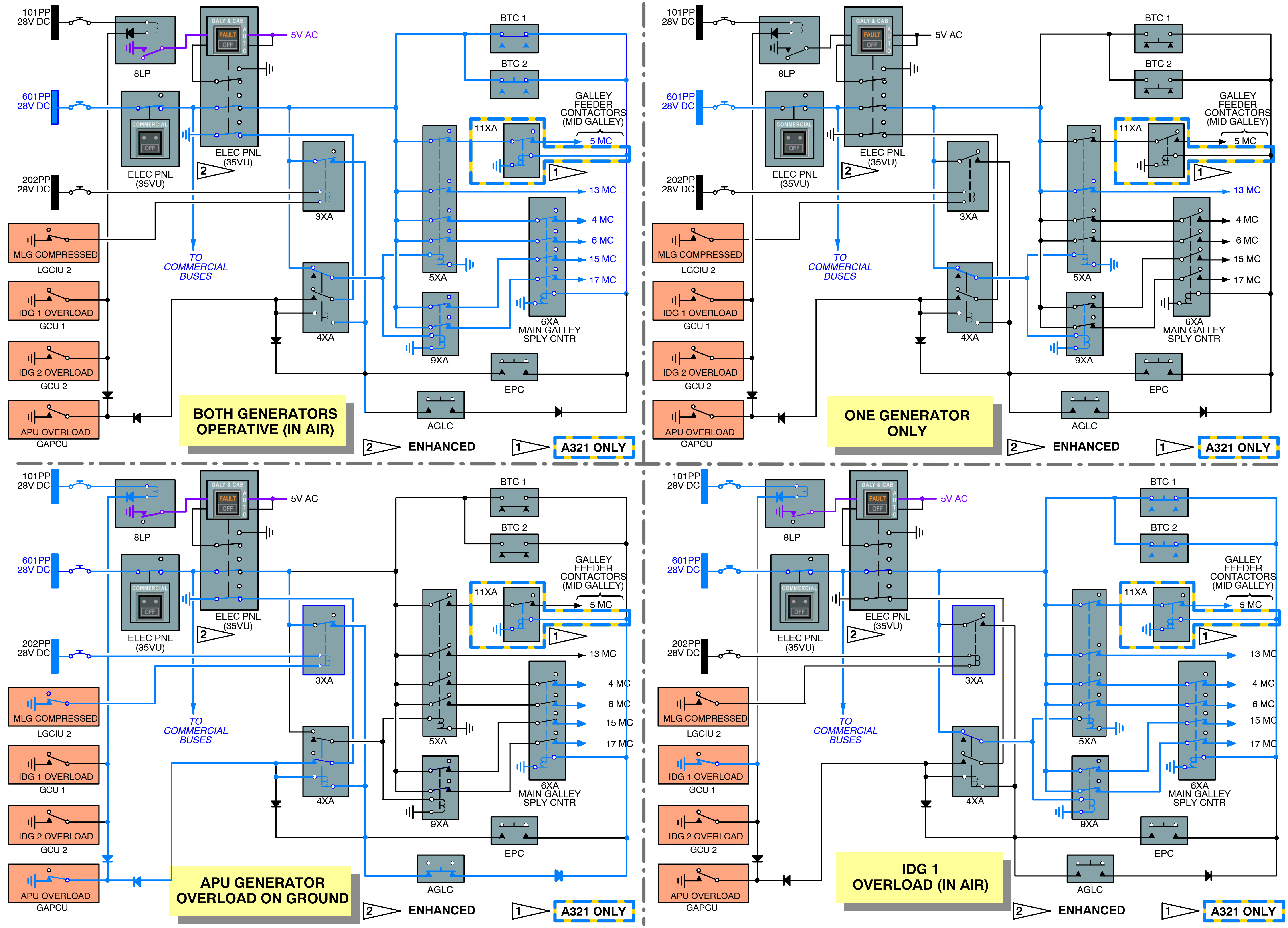
- FWD feeder = 40kVA or 25kVA or 25kVA
- MID feeder = 0kVA or 15kVA or 0kVA
- AFT feeder = 30kVA or 30kVA or 45kVA

Circuit breakers protect the feeders. Power contactors switch the power.

Operation/Control and Indicating

The power contactors for the galleys are controlled through control relays as follows:

- With the APU generator running or with external power supplied you can supply all feeders with power (on the ground).
- With both engine driven generators running, you can supply all feeders with power (on the ground or in flight).
- With only engine 1 driven generator running, the galleys are partly supplied only (feeder D). Feeders A, C, E and F are shed automatically (on the ground or in flight).
- You can manually shed all the feeders to the galley with the pushbutton switch 2XA GALLEY OFF in the cockpit (on the overhead panel 35VU).


BOTH GENERATORS OPERATIVE (IN AIR)
ONE GENERATOR ONLY
APU GENERATOR OVERLOAD ON GROUND
IDG 1 OVERLOAD (IN AIR)
101PP 28V DC
601PP 28V DC
202PP 28V DC
8LP
GALY & CAB
FAULT
OFF
AUTO
5V AC
COMMERCIAL
OFF
ELEC PNL (35VU)
MLG COMPRESSED
LGCIU 2
IDG 1 OVERLOAD
GCU 1
IDG 2 OVERLOAD
GCU 2
APU OVERLOAD
GAPCU
TO COMMERCIAL BUSES
3XA
4XA
5XA
9XA
11XA
6XA MAIN GALLEY SPLY CNTR
BTC 1
BTC 2
EPC
AGLC
GALLEY FEEDER CONTACTORS (MID GALLEY)
5 MC
13 MC
4 MC
6 MC
15 MC
17 MC
2 ENHANCED
1 A321 ONLY