

A330-200
TECHNICAL TRAINING MANUAL
MECHANICS / ELECTRICS & AVIONICS COURSE
24 ELECTRICAL POWER
GE Metric

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ELECTRICAL SYSTEM INTRODUCTION

AC Electrical System
DC Electrical System
Emergency Electrical System
APU Start System

AC ELECTRICAL SYSTEM

The entire Alternating Current (AC) Electrical System can be supplied by two generators or by the Auxiliary Power Unit (APU) generator or by external power A and B.

Part of the AC network can be supplied via the static inverter or the emergency generator in abnormal or emergency condition.

DC ELECTRICAL SYSTEM

The DC Electrical System is supplied from the AC network via transformer rectifiers.

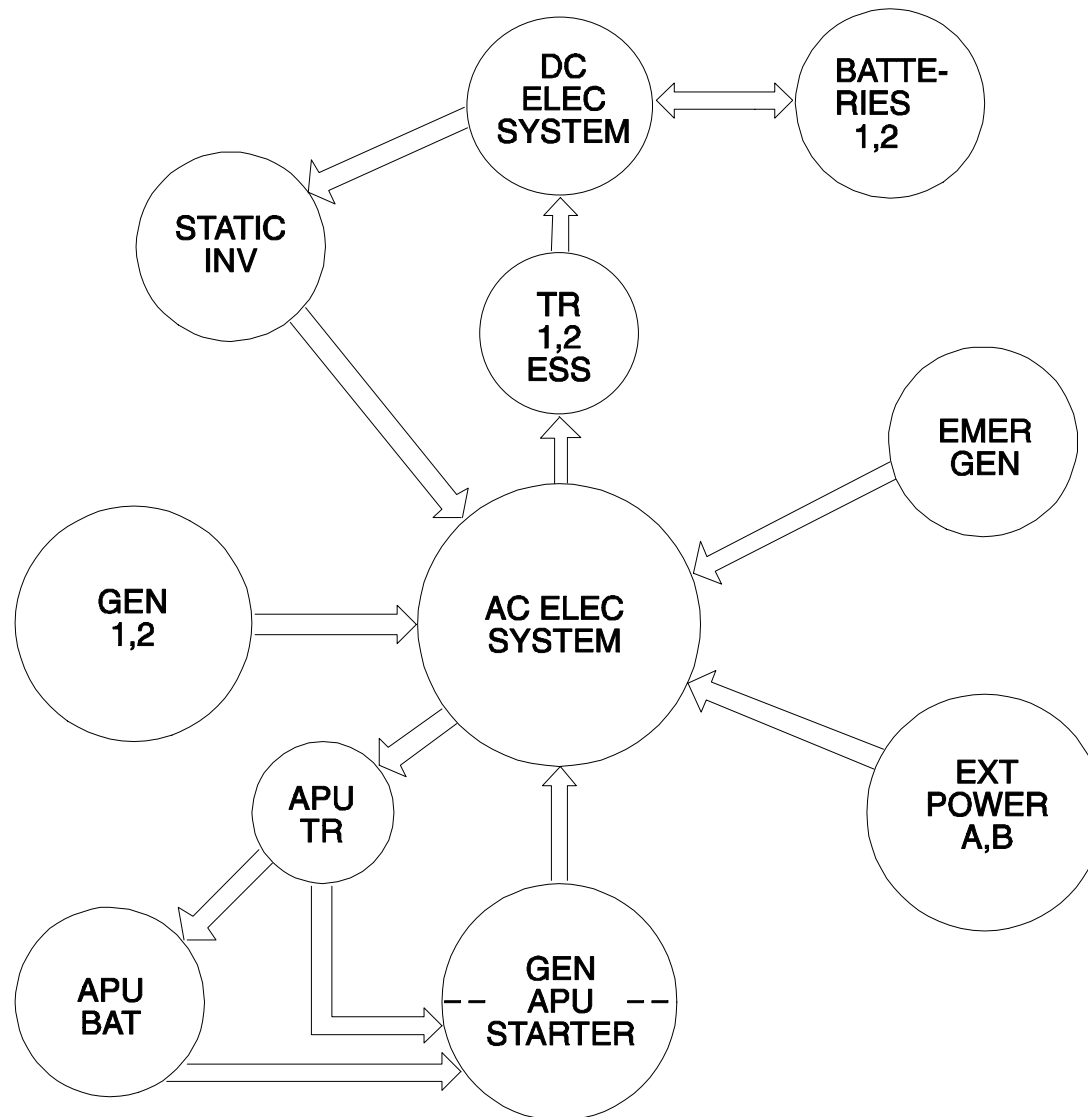
Part of the DC network can be supplied from the batteries as a back-up source.

EMERGENCY ELECTRICAL SYSTEM

The emergency generator is hydraulically driven by the green system and can supply part of the Electrical System in case of loss of normal supply.

APU START SYSTEM

The Auxiliary Power Unit (APU) can be started by using the APU battery or the APU transformer rectifier or both at the same time.



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STUDENT NOTES

ELECTRICAL SYSTEM LOCATION

AC Normal Generation
AC Emergency Generation
Static Inverter
DC Normal Generation
DC Essential Generation

AC NORMAL GENERATION

There are 2 engine driven Integrated Drive Generators (IDGs).

The IDG is an assembly with two parts :

- the drive : Constant Speed Drive (CSD)
- and the generator.

Each IDG is installed on the associated engine gearbox pad.

The Auxiliary Power Unit generator is located in the APU compartment.

The external power receptacles are fitted behind the nose landing gear bay.

AC EMERGENCY GENERATION

The AC Emergency Generation consists of a Constant Speed Motor (CSM) and an AC generator which form an assembly called Constant Speed Motor/Generator (CSM/G).

The CSM/G is located in the main landing gear wheel well.

STATIC INVERTER

The static inverter is located in the avionics compartment.

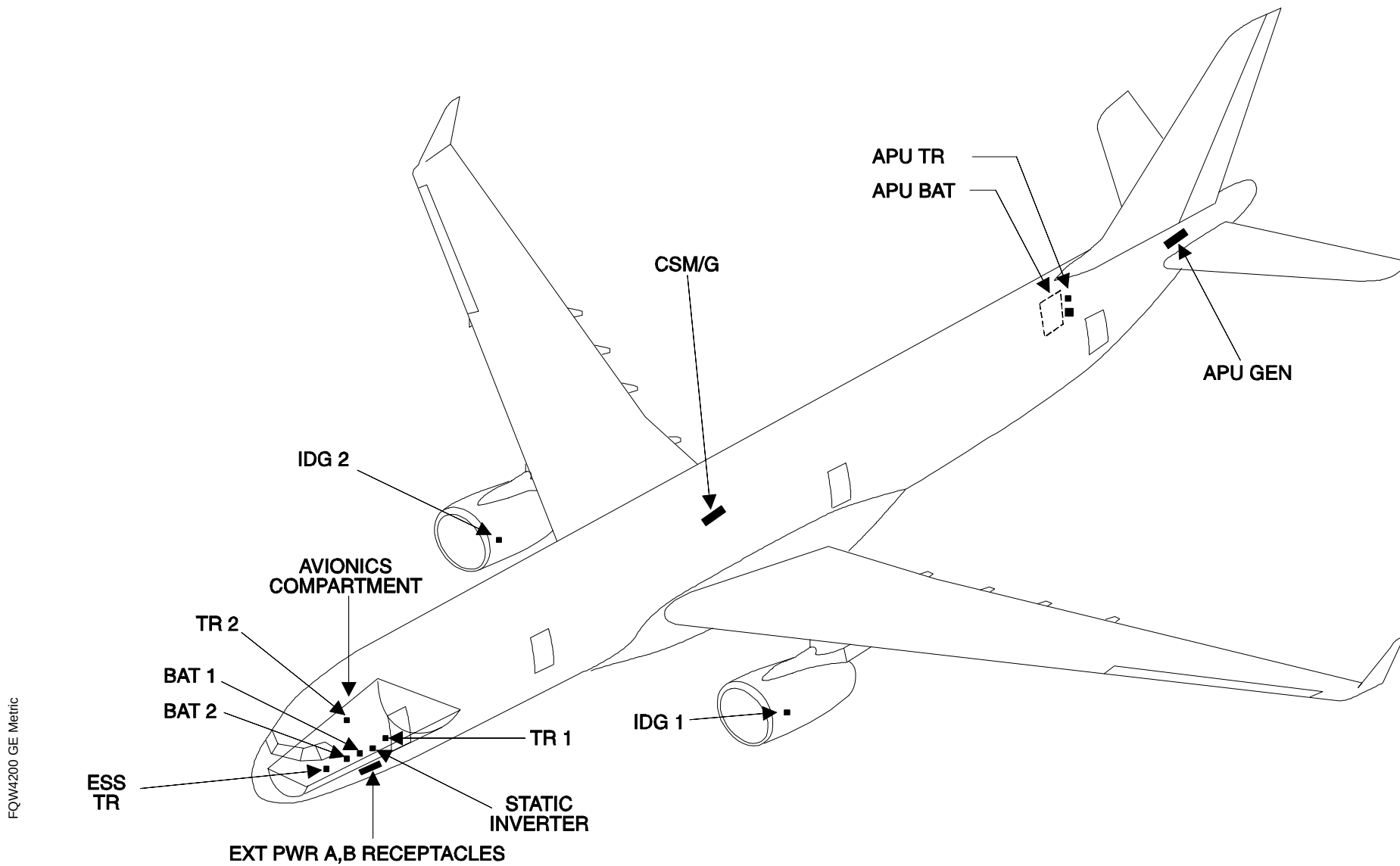
DC NORMAL GENERATION

The two main Transformer Rectifiers (TR1 and TR2), and the two main batteries (BAT1 and BAT2), are located in the avionics compartment.

The APU TR and the APU battery are located in the bulk cargo compartment.

DC ESSENTIAL GENERATION

The ESSential TR is located in the forward left hand side of the avionics compartment.



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STUDENT NOTES

ELECTRICAL SYSTEM PRESENTATION

- AC Generation
- AC Emergency Generation
- AC Transfer
- AC Distribution
- DC Generation
- DC Distribution
- Static Inverter
- External Power
- Service Buses
- Galleys

AC GENERATION

The main Alternating Current (AC) Generation is provided by two Integrated Drive Generators (IDG), one Auxiliary Power Unit (APU) generator and two external power units.

Each IDG is normally connected to its own busbar.

The entire aircraft network can be supplied by one of the two engine driven generators or by the APU generator or by the external power units.

	POWER	VOLTAGE	FREQUENCY	PHASES
Integrated Drive Generator	115KVA	115V	400Hz	3
APU Generator	115KVA	115V	400Hz	3
External Power Unit	90KVA	115V	400Hz	3

AC EMERGENCY GENERATION

The emergency generator driven by the green hydraulic system provides AC power in case of loss of AC BUS 1 and AC BUS 2.

	POWER	VOLTAGE	FREQUENCY	PHASES
Emergency Generator	5.5KVA	115V	400Hz	3

AC TRANSFER

AC transfer is automatically achieved by the transfer circuit and the corresponding contactors.

AC DISTRIBUTION

Note:

In abnormal configuration (loss of AC BUS 1), the AC BUS 2 automatically supplies the AC ESsential buses.

DC GENERATION

The Direct Current (DC) Generation is provided by four identical Transformer Rectifiers (TRs 1, 2, ESsential and APU) and three identical batteries (battery 1, 2 and APU).

The APU TR and APU battery are only used to start the APU.

Note :

In abnormal configuration (loss of AC BUS 1), the AC BUS 2 automatically supplies the ESsential TR.

DC DISTRIBUTION

Note:

In normal configuration there is no connection between DC BAT BUS and DC BUS 2.

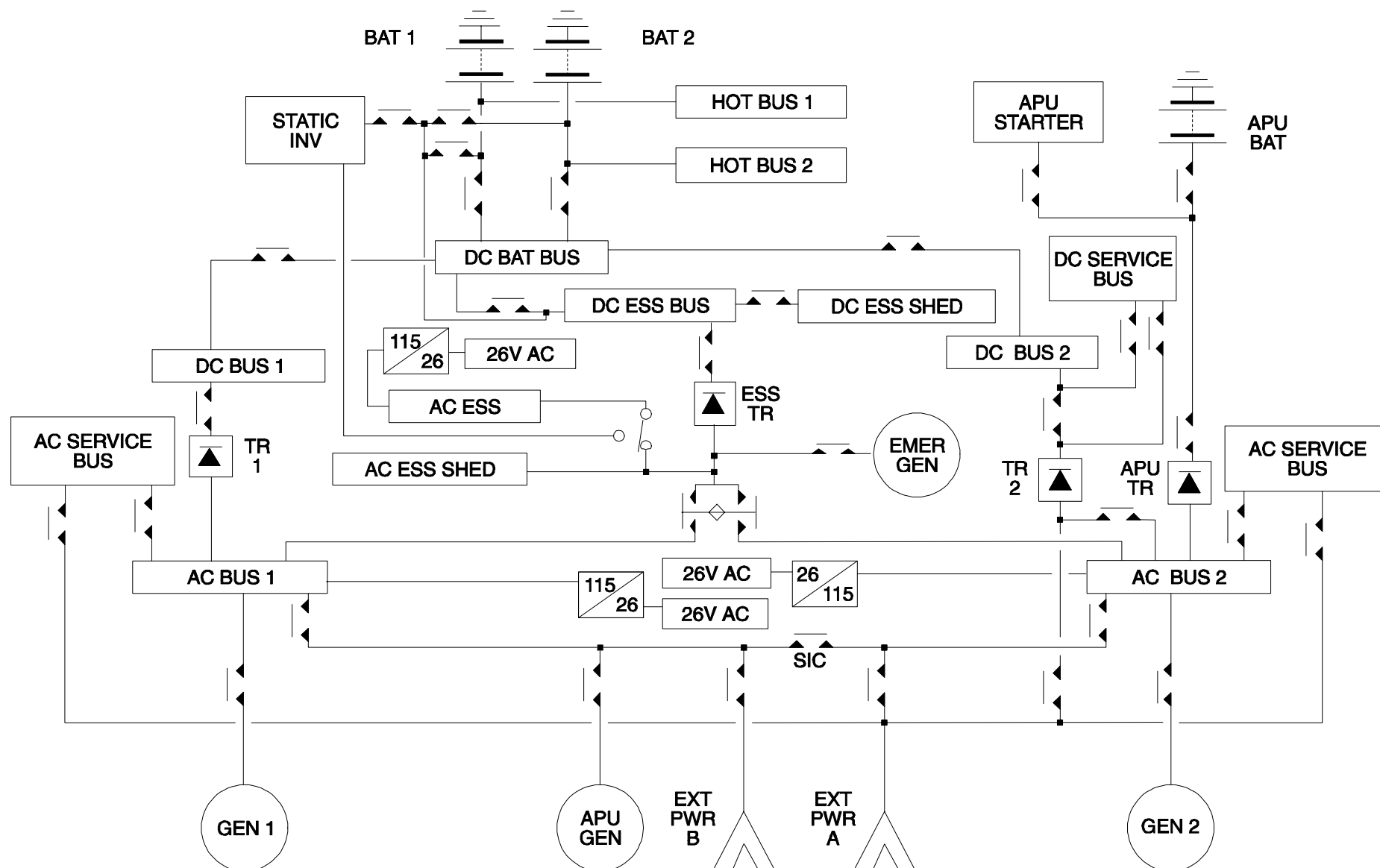
The batteries are connected to the network through DC BAT BUS only when the batteries need to be charged.

The batteries are only used for back-up.

STATIC INVERTER

The static inverter is supplied from battery 1 and battery 2 and automatically supplies the AC essential bus if no other power source is available.

	POWER	VOLTAGE	FREQUENCY	PHASES
Static Inverter	2.5KVA	115V	400 Hz	1



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EXTERNAL POWER

Two external power units can supply the entire network via the transfer circuit.

Note:

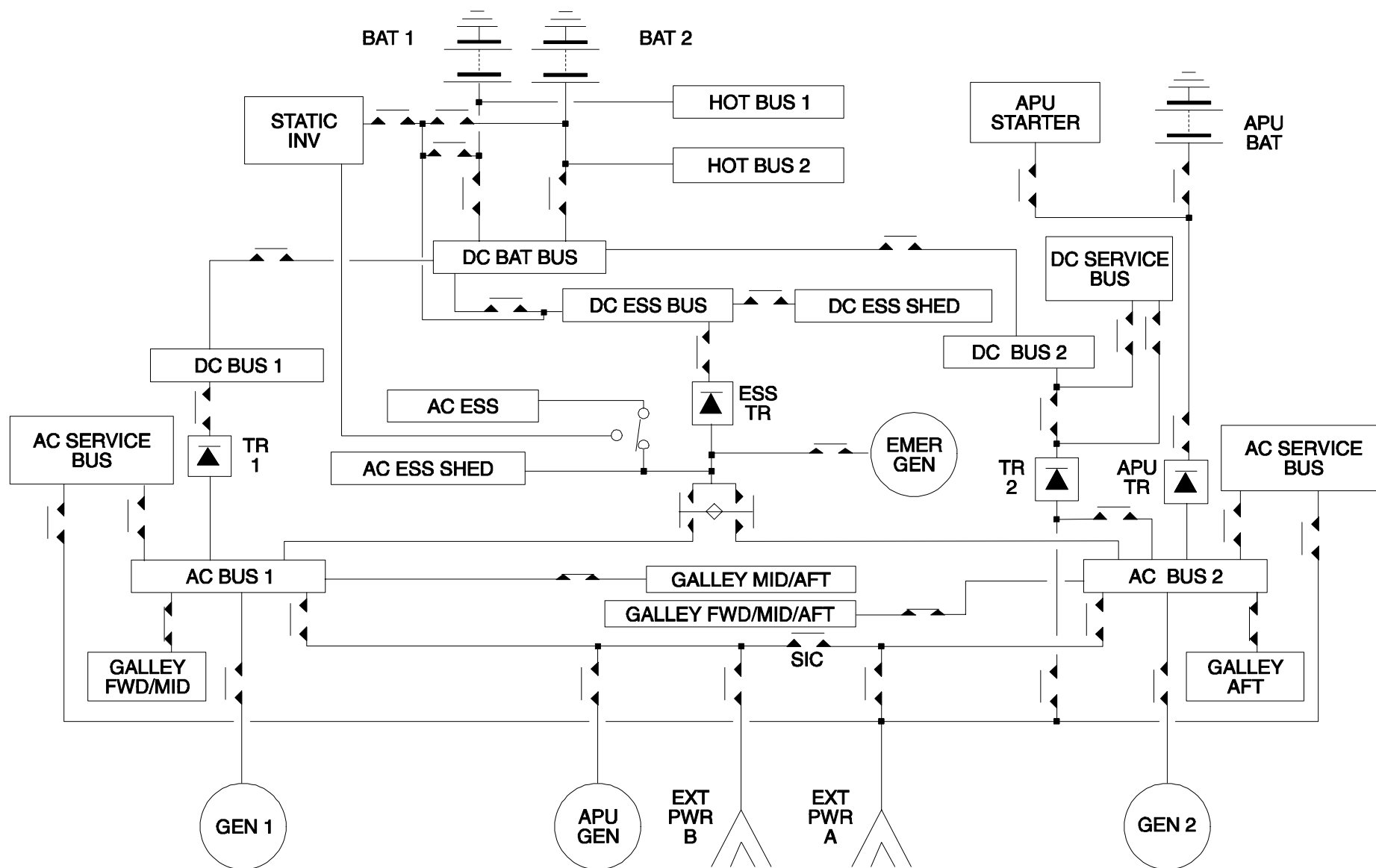
With one External Power (EXT. PWR) connected, the System Isolation Contactor (SIC) is closed.

SERVICE BUSES

The AC and DC service buses can be directly supplied from external power A only.

GALLEYS

The galleys are supplied from the AC main buses.



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STUDENT NOTES:

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AC AND DC ECAM PAGE PRESENTATION

AC Power Sources
AC Busbars
Transformer Rectifiers (TRs)
Galleys
AC Emergency
DC Power Sources
DC Busbars
Batteries
DC Emergency

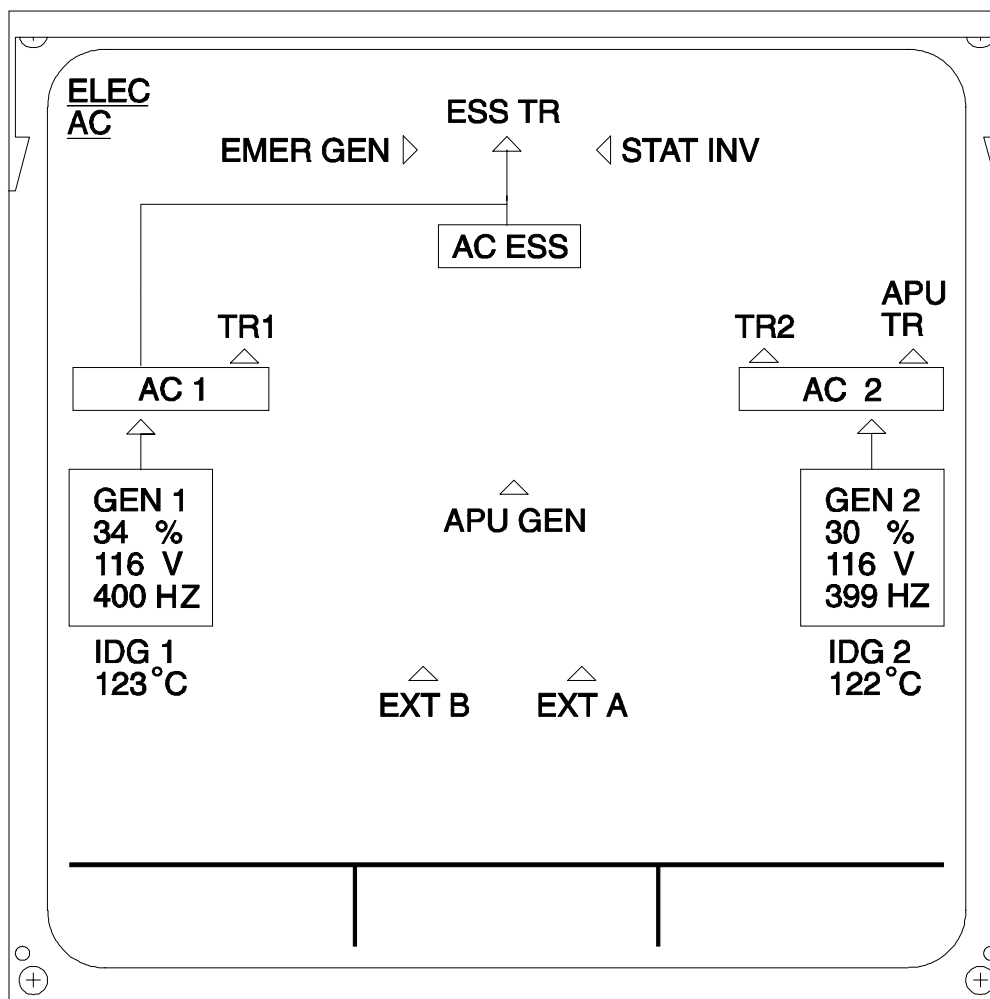
AC POWER SOURCES

All the sources used for AC generation are represented and provide the following information:

- percentage of load
- voltage
- frequency and
- Integrated Drive Generator (IDG) oil outlet temperature.

The sources are the two Integrated Drive Generators (IDGs), Auxiliary Power Unit generator (APU GEN), EXternal power A and B (EXT A, EXT B), emergency generator (EMER GEN) and static inverter (STAT INV).

EXT A and EXT B are only displayed on ground.



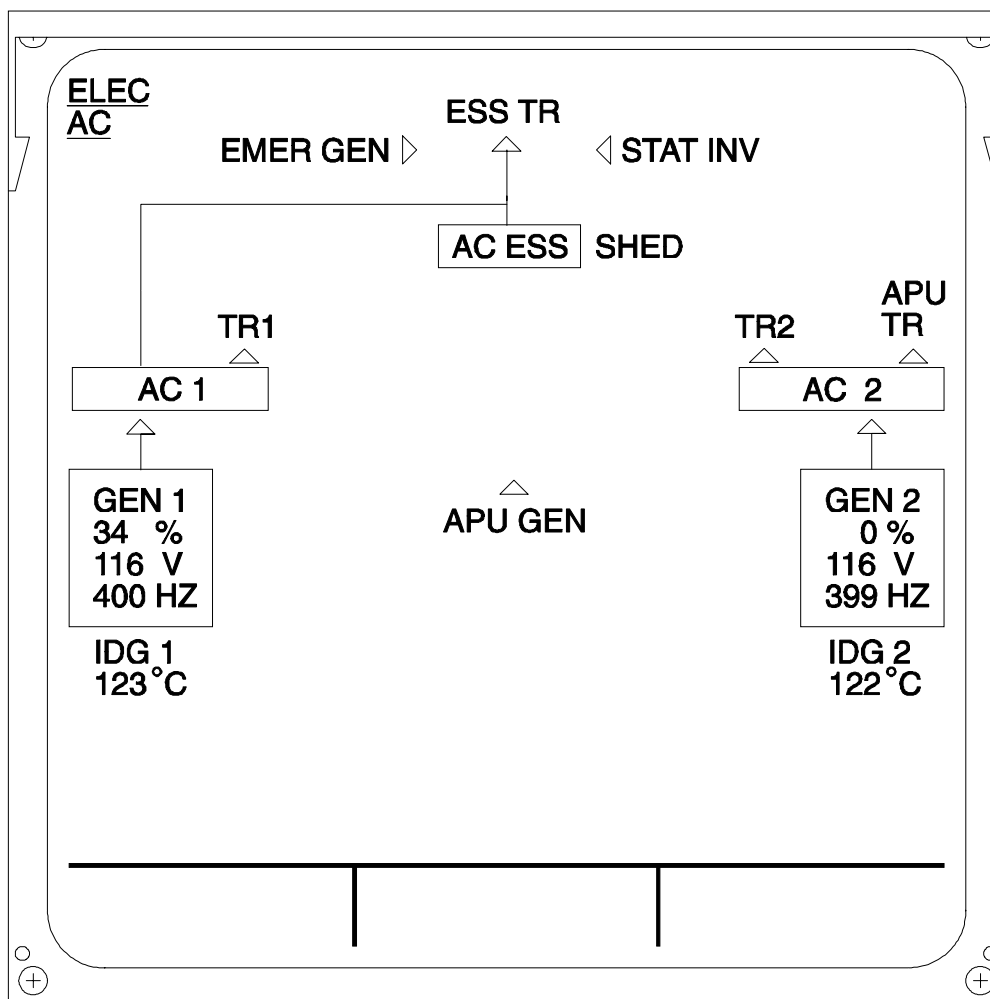
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AC BUSBARS

The main and essential busbars are displayed and connected according to the aircraft supply configuration.

The busbars are displayed in green when supplied or in amber when not supplied.

Note: SHED in amber comes into view if the AC ESS SHED BUS is no longer supplied.

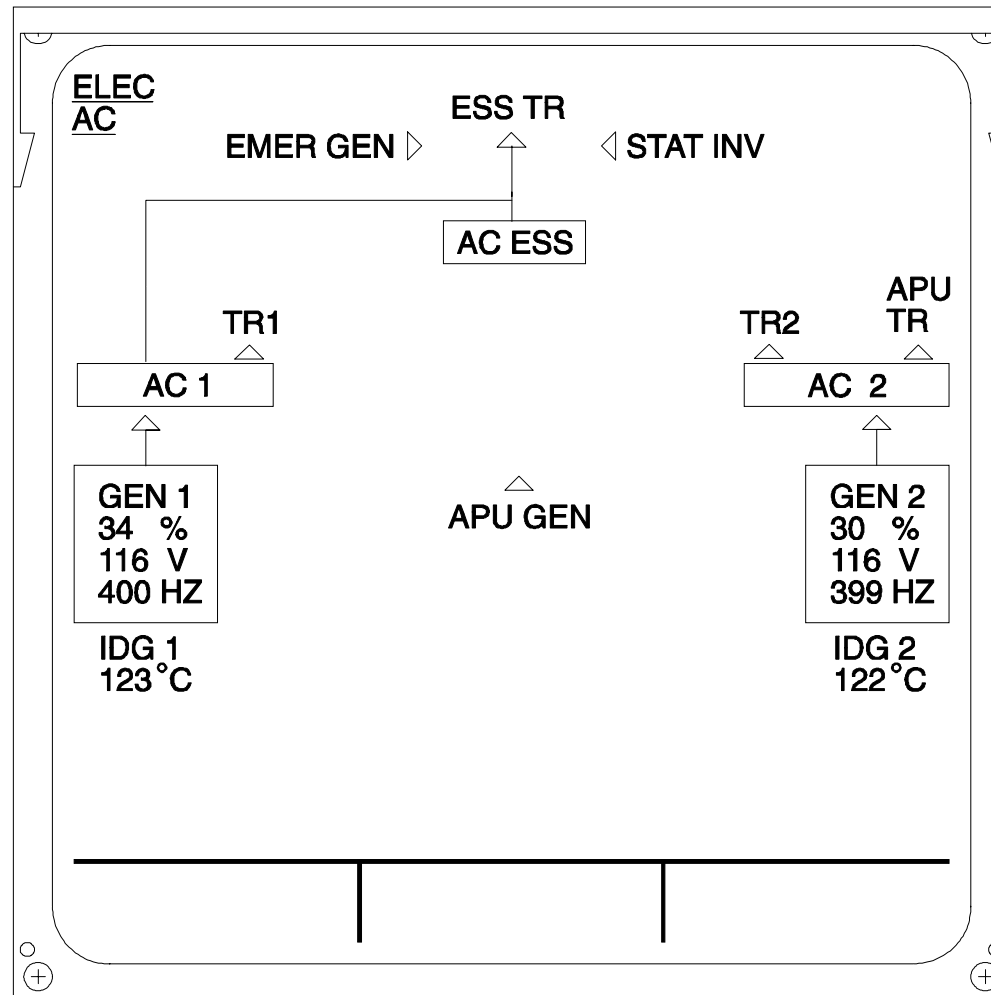


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TRANSFORMER RECTIFIERS (TRs)

The Transformer Rectifiers (TRs) are supplied by their related AC busbars.

They are normally displayed in white, or in amber when failed.



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GALLEYS

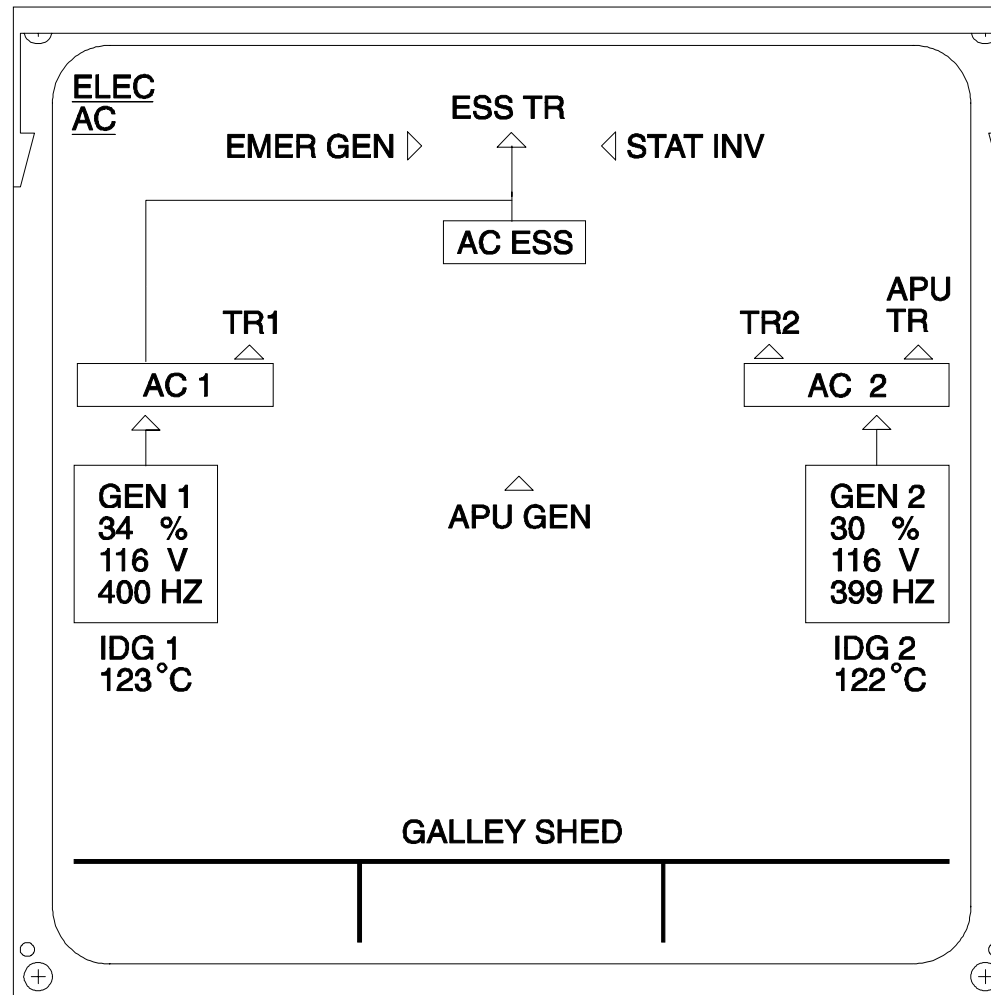
Galley and commercial indications on the bottom of the page provide information about the galley and commercial supply status.

Indications:

GALLEY PARTIALLY SHED means "some galleys switched off"

GALLEY SHED means "all galleys off"

COMMERCIAL OFF means "all galleys off and Service Bus not supplied".



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AC EMERGENCY

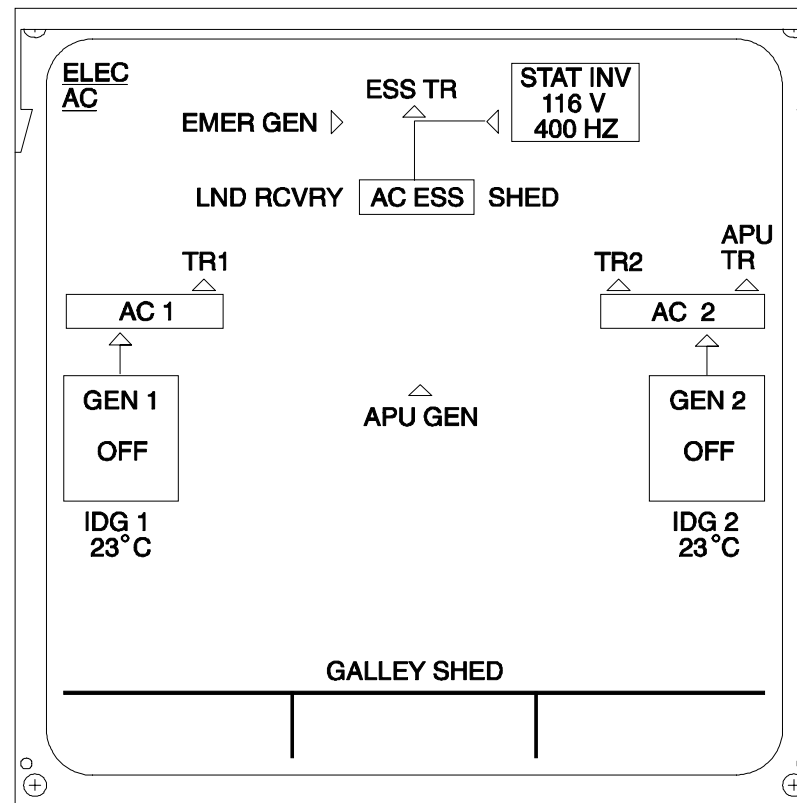
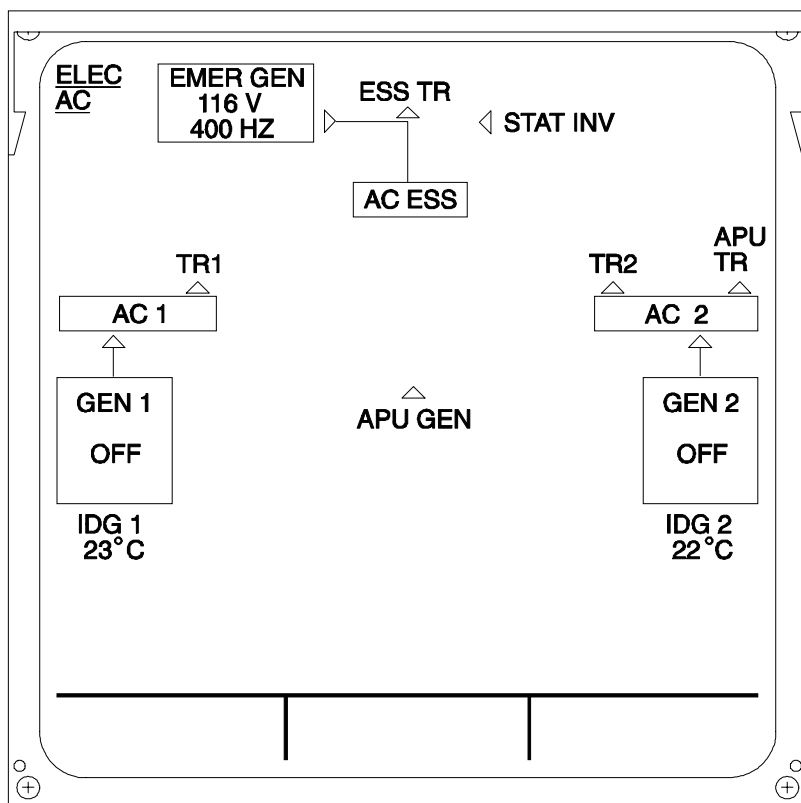
In emergency configuration, the emergency generator is represented and provides voltage and frequency information.

The EMERgency GENerator is displayed in white or in amber when faulty.

In emergency configuration (loss of the emergency generator), the static inverter is represented and provides voltage and frequency information.

The STATic INVerter is displayed in white or in amber when faulty.

The LND RCVRY indication appears in green when the land recovery P/B switch is pressed in.



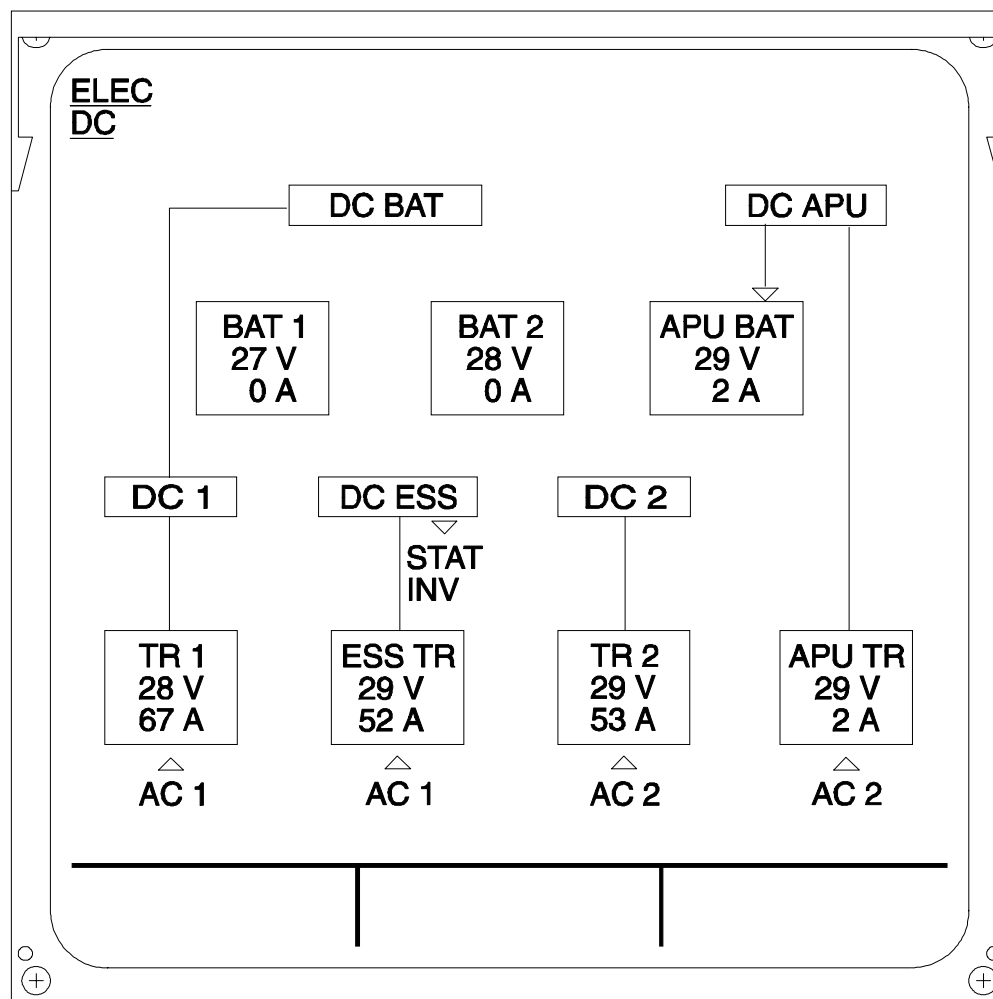
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DC POWER SOURCES

All the sources used for the DC generation are represented and provide DC voltage and load information.

The sources are the main Transformer Rectifiers (TR1 and TR2), the essential TR (ESS TR) and APU TR all powered by the AC sources.

Note: ESS TR can also be supplied by AC BUS 2 or the emergency generator.



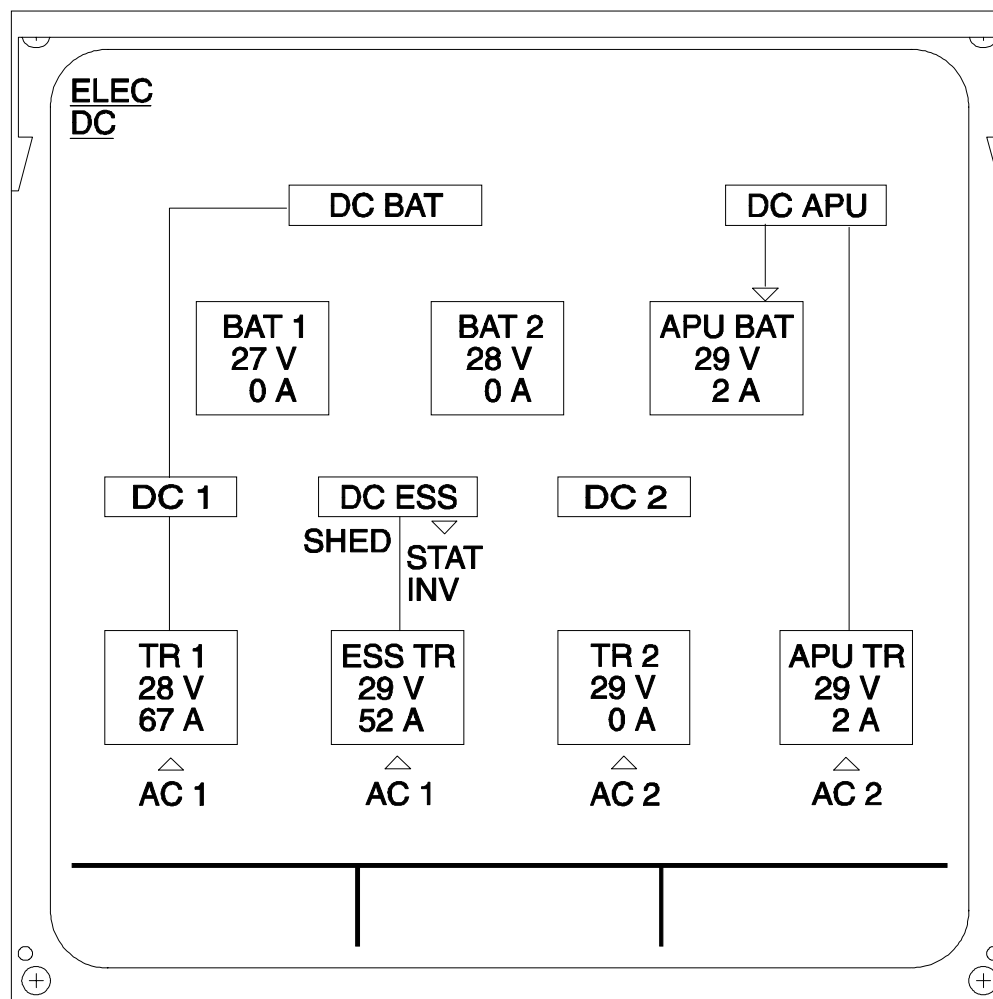
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DC BUSBARS

The main and essential busbar, as well as the APU and battery busbars, are displayed and connected according to the aircraft supply configuration.

They are displayed in green when supplied, otherwise in amber.

Note: SHED in amber comes into view when the DC ESS SHED BUS is no longer supplied.



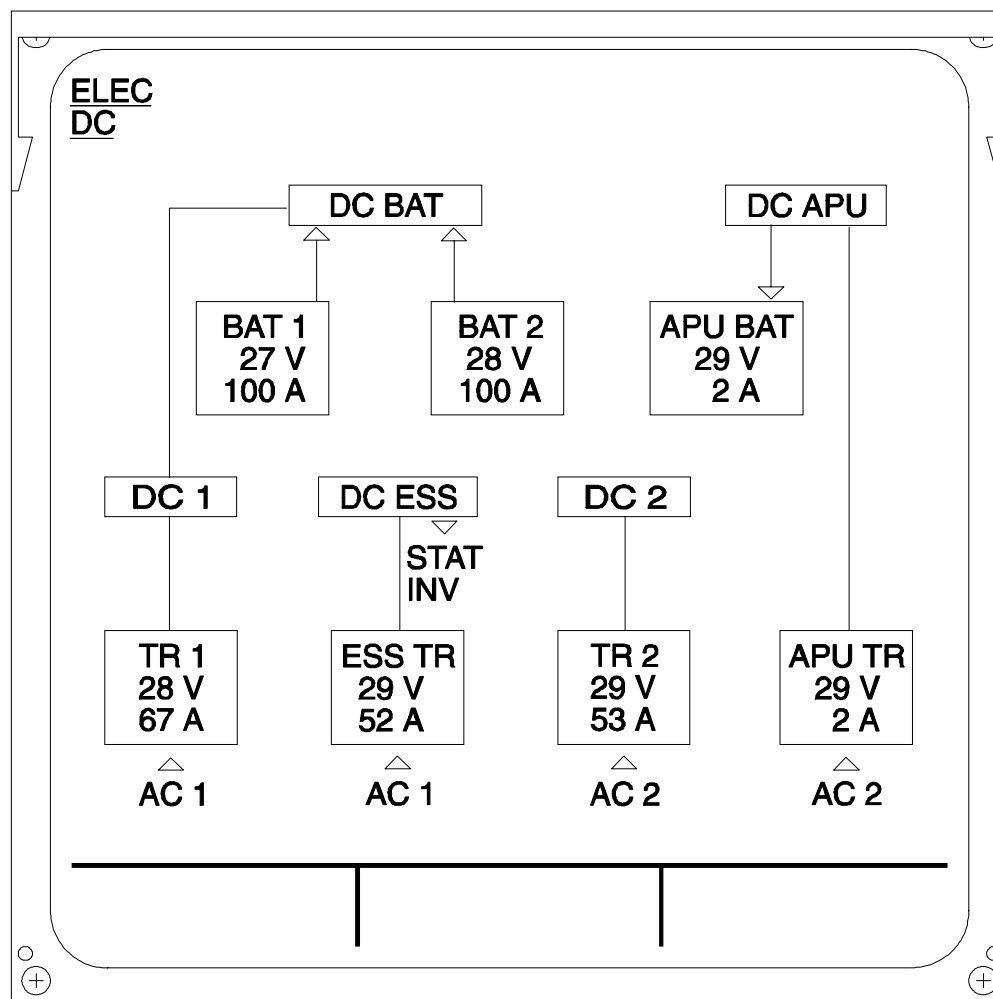
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BATTERIES

The three batteries indicate voltage and load.

Arrows provide information about the charge or discharge status of the batteries.

The arrow appears in green when the battery is in charge configuration or in amber when the battery is in discharge configuration.



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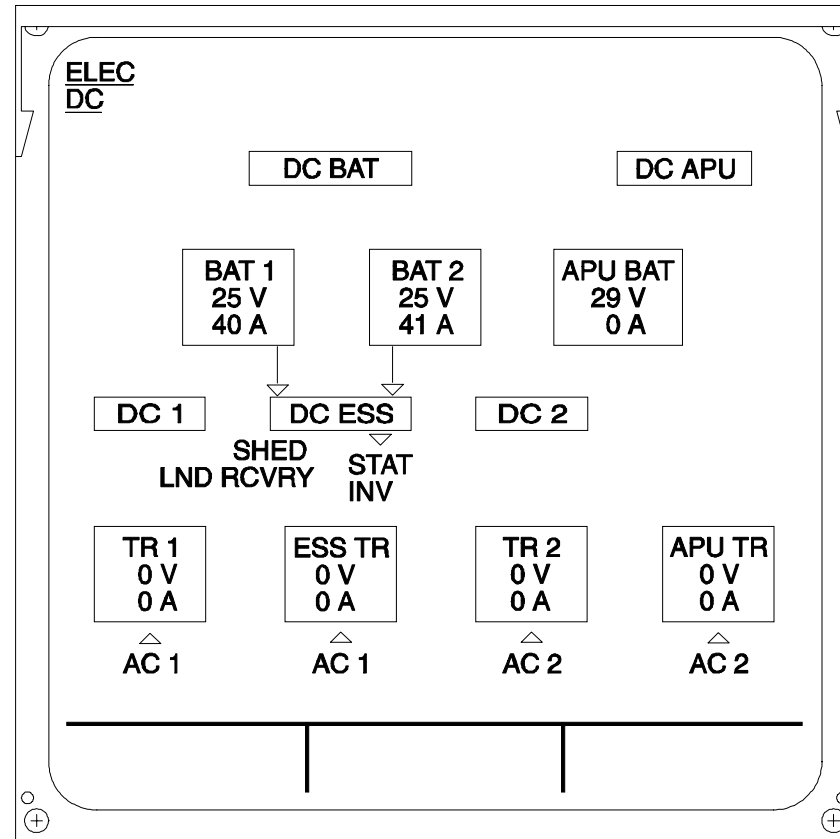
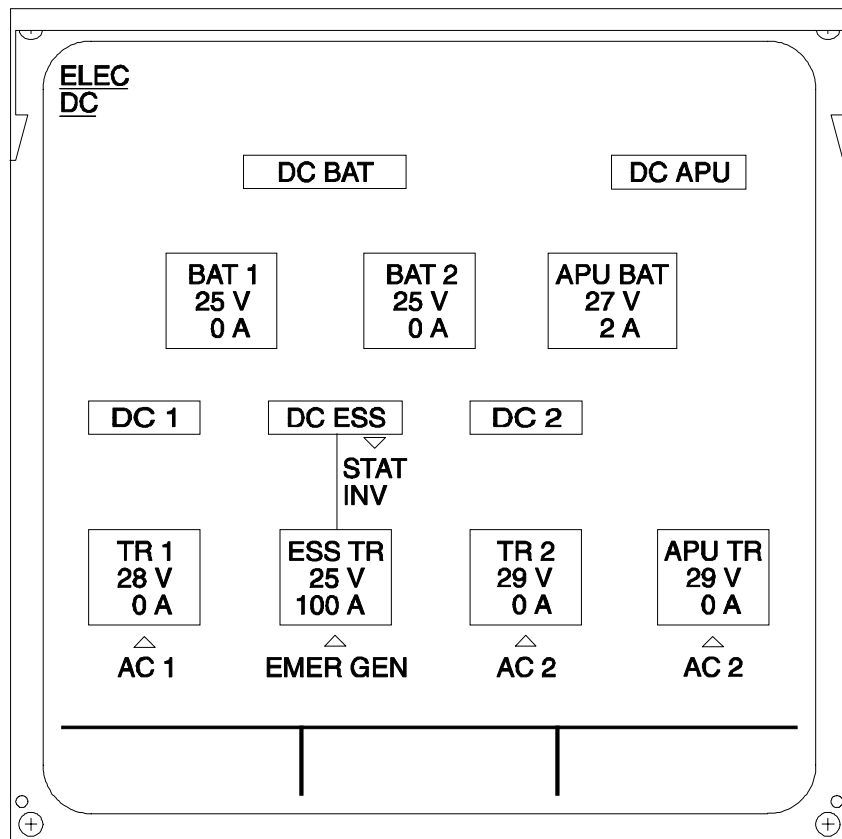
DC EMERGENCY

In emergency configuration, the emergency generator supplies the essential transformer rectifier.

EMER GEN is normally displayed in white, or in amber when faulty.

In batteries only configuration, the static inverter is supplied from the batteries.

STAT INV is normally displayed in white, or in amber when faulty.



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STUDENT NOTES

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SYSTEM CONTROL AND INDICATING

BAT 1(2 or APU) Selector Switch
BAT 1(2) Pushbutton Switch
APU BAT Pushbutton Switch
AC ESS FEED Pushbutton Switch
Galley Pushbutton Switch
Commercial Pushbutton Switch
IDG 1(2) Pushbutton Switch
GEN 1(2) Pushbutton Switch
APU GEN Pushbutton Switch
BUS TIE Pushbutton Switch
EXT Power Pushbuttons

BAT 1(2 or APU) SELECTOR SWITCH

The displayed battery voltage corresponds to the battery selector position (battery 1 or battery 2 or APU battery).

The selected voltage is always displayed.

BAT 1(2) PUSHBUTTON SWITCH

In normal configuration, the batteries are automatically connected or disconnected according to the DC electrical configuration.

The FAULT light comes on amber in case of thermal runaway or short circuit.

The OFF light comes on white if the BAT pushbutton is released out (battery disconnected).

APU BAT PUSHBUTTON SWITCH

In normal configuration, the APU battery is automatically connected or disconnected for battery charge or APU start.

The FAULT light comes on amber in case of thermal runaway or short circuit.

The OFF light comes on white if the BAT pushbutton is released out (battery disconnected).

AC ESS FEED PUSHBUTTON SWITCH

In normal configuration, the AC ESSential BUS is supplied by AC BUS 1. In abnormal configuration (AC BUS 1 lost), the AC ESS BUS is automatically supplied from AC BUS 2.

The FAULT light comes on amber when the AC ESS BUS is no longer supplied.

In case of an automatic transfer failure, the safety guarded AC ESS FEED pushbutton must be released out, ALTN light comes on white and the AC ESS BUS supply is transferred from AC BUS 1 to AC BUS 2.

GALLEY PUSHBUTTON SWITCH

In automatic mode, switch pressed in, the galleys are automatically supplied or shed according to the electrical configuration. The commercial switch must also be pressed in.

The FAULT light comes on amber in case of generator overload detection and automatic shedding not operating.

The OFF light comes on white when the galley pushbutton is released out, so all the galleys are shed.

COMMERCIAL PUSHBUTTON SWITCH

The commercial pushbutton allows commercial loads (galleys, cabin lights,...) to be shed when it is released out.

The OFF legend comes on white.

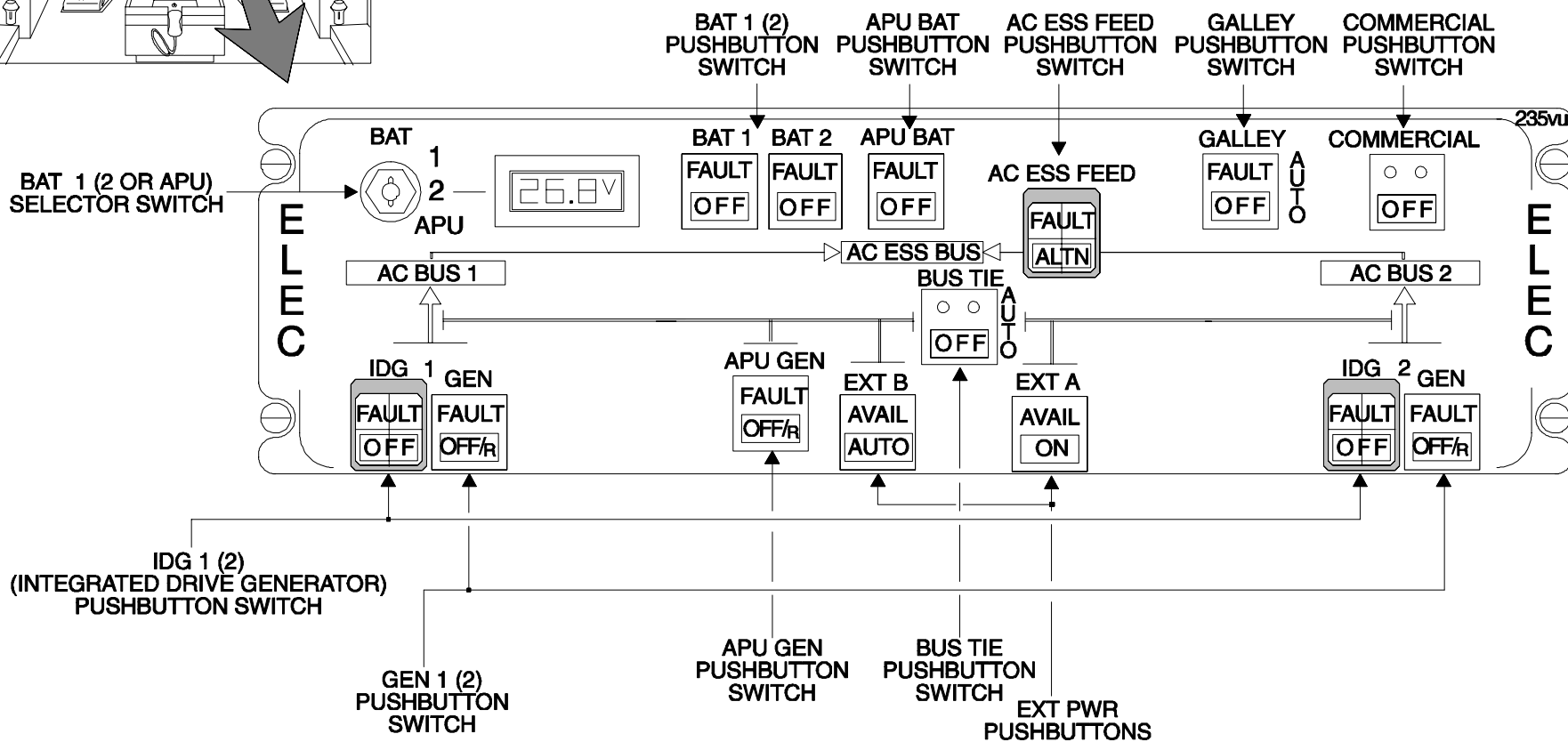
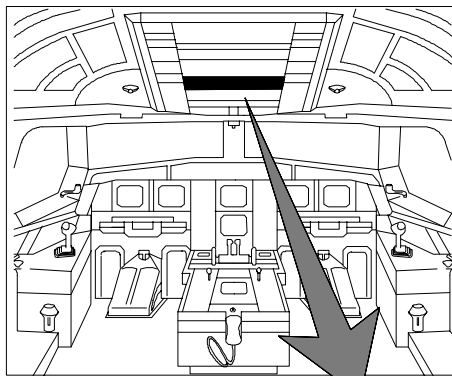
IDG1(2)(INTEGRATED DRIVE GENERATOR) PUSHBUTTON SWITCH

The safety guarded IDG pushbutton allows the associated IDG to be disconnected from the engine accessory gearbox.

The FAULT light comes on amber in case of oil low pressure or oil overheat.. Immediate disconnection is required to avoid IDG damage.

The OFF light comes on white when the IDG is disconnected.

NOTE : The white OFF legend remains on until IDG reset is done.



GEN 1(2) PUSHBUTTON SWITCH

The GENERator pushbutton allows the associated generator to be connected or disconnected from the aircraft network.

The FAULT light comes on amber in case of generator failure or engine not running.

When the GEN pushbutton is released out, the OFF/R light comes on white, the generator is disconnected and the fault circuit is reset.

Note : /R stands for Reset.

APU GEN PUSHBUTTON SWITCH

The APU GENERator pushbutton allows the APU generator to be connected or disconnected from the aircraft network.

The FAULT light comes on amber in case of generator failure.

When the APU GEN pushbutton is released out, the OFF/R light comes on white, the generator is disconnected and the fault circuit is reset.

NOTE : When the APU is not running or in underspeed, the FAULT light is inhibited.

BUS TIE PUSHBUTTON SWITCH

The BUS TIE pushbutton switch controls the System Isolation Contactor (SIC) and the two Bus Transfer Contactors (BTCs).

In automatic mode, the SIC and the two BTCs automatically control the supply transfer of the AC network according to the priority logic.

When released out, the OFF light comes on white and the SIC and the two BTCs open.

CAUTION : The OFF light does not come on if the aircraft is on batteries only.

In this case the message "BUS TIE P/B OFF" is displayed on the upper ECAM.

EXT PWR PUSHBUTTONS

The EXTERNAL power pushbuttons A and B allow the external power sources A or B to be connected or disconnected. If the mechanical connection is correct and the external power parameters are normal, the AVAIL light comes on green.

When an EXT A or B springloaded pushbutton is pressed in, the associated (ON or AUTO) light comes on blue. The AVAIL light goes off. The external power A is in use, B is in use or available depending on the priority logic.
NOTE : The APU generator has priority over the EXT PWR B.

When pressed again, the light goes off and the AVAIL light comes on green. The external power is disconnected.

NOTE : If one of the external power parameters is abnormal, the external power is disconnected and the ground power source is also switched off.

EMERGENCY ELECTRICAL SYSTEM CONTROL AND INDICATING

Emer Gen Test Pushbutton (Guarded)
Land Recovery Pushbutton Switch
Emer Gen Fault Light
Man On Pushbutton (Guarded)

EMER GEN TEST PUSHBUTTON (GUARDED)

Two tests can be performed using the EMER GEN TEST pushbutton :

1- If the green hydraulic system is pressurized and the EMER GEN TEST pushbutton switch is pressed in, the emergency generator runs and supplies the ESSential network.

2- If the green hydraulic system is not pressurized and no electrical power is connected and the EMER GEN TEST pushbutton switch is pressed in, the static inverter is operative and supplies the AC ESSential bus only.

Check the results on the ECAM for both tests.

LAND RECOVERY PUSHBUTTON SWITCH

In case of electrical power emergency configuration, certain busbars are no longer supplied.

When the LAND RECOVERY pushbutton switch is pressed in, the ON legend comes on, the associated AC and DC land recovery sub-busbars are recovered to supply systems for safe landing.

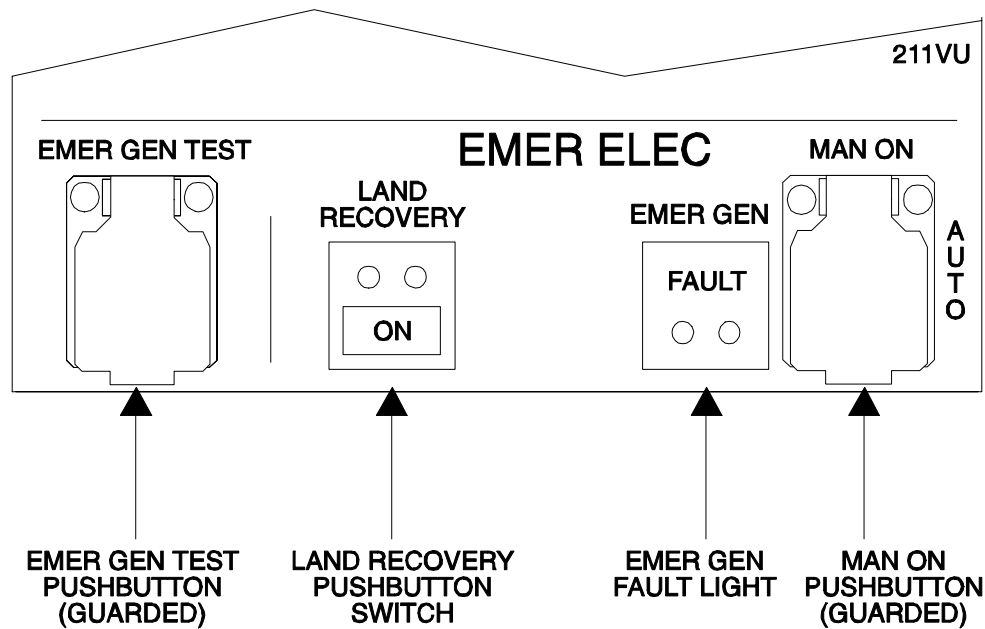
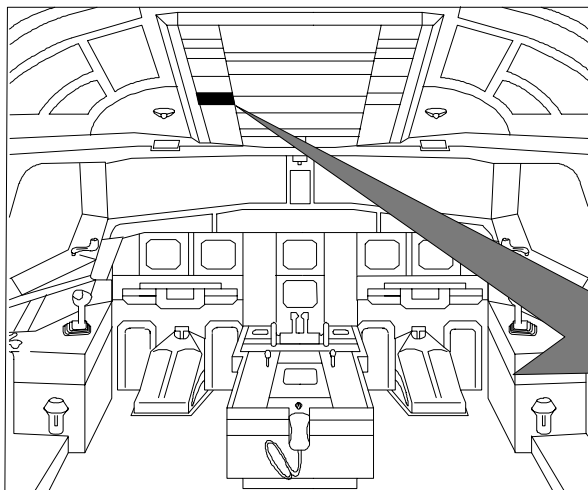
EMER GEN FAULT LIGHT

In case of electrical power emergency configuration, the FAULT light comes on red in case of emergency generator shutdown.

MAN ON PUSHBUTTON (GUARDED)

The emergency generator automatically starts when AC BUS 1 and AC BUS 2 are lost.

In case of failure of this automatic function, the MAN ON guarded pushbutton must be pressed in to start the emergency generator.



STUDENT NOTES

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ELECTRICAL SYSTEM AND CIRCUIT IDENTIFICATION

- General
- System Identification
- Circuit Identification
- Component Identification
- Busbar Identification
- Sub Busbar Identification
- ARINC Bus Identification
- Connector Identification

GENERAL

An alpha numeric reference code called Functional Item Number (FIN) is used to identify system, circuit and components.

Example :

The Function Item Number (FIN) of Generator Control Unit 2 (GCU2) is 1XU2.

SYSTEM IDENTIFICATION

The first letter of the reference is used for system identification.

Example :

The system identification of GPCU 1XG or GCU1 1XU1 is X, X = AC generation.

CIRCUIT IDENTIFICATION

The second letter of the FIN is used for circuit identification within the system.

Example :

The circuit identification of GCU APU 1XS is S.

S = Auxiliary generation.

XS = AC auxiliary generation.

The circuit identification of GCU2 1XU2 is U.

U = main generation.

XU = AC main generation.

COMPONENT IDENTIFICATION

The numeric characters in front of the system and circuit identification, identify the component within the circuit.

Example :

The component identification of GCU2 1XU2 is 1

1 = GCU.

The component identification of GLC1 9XU1 is 9.

9 = GLC.

BUSBAR IDENTIFICATION

A busbar is identified by a digit and two letters.

The digit indicates the busbar number.

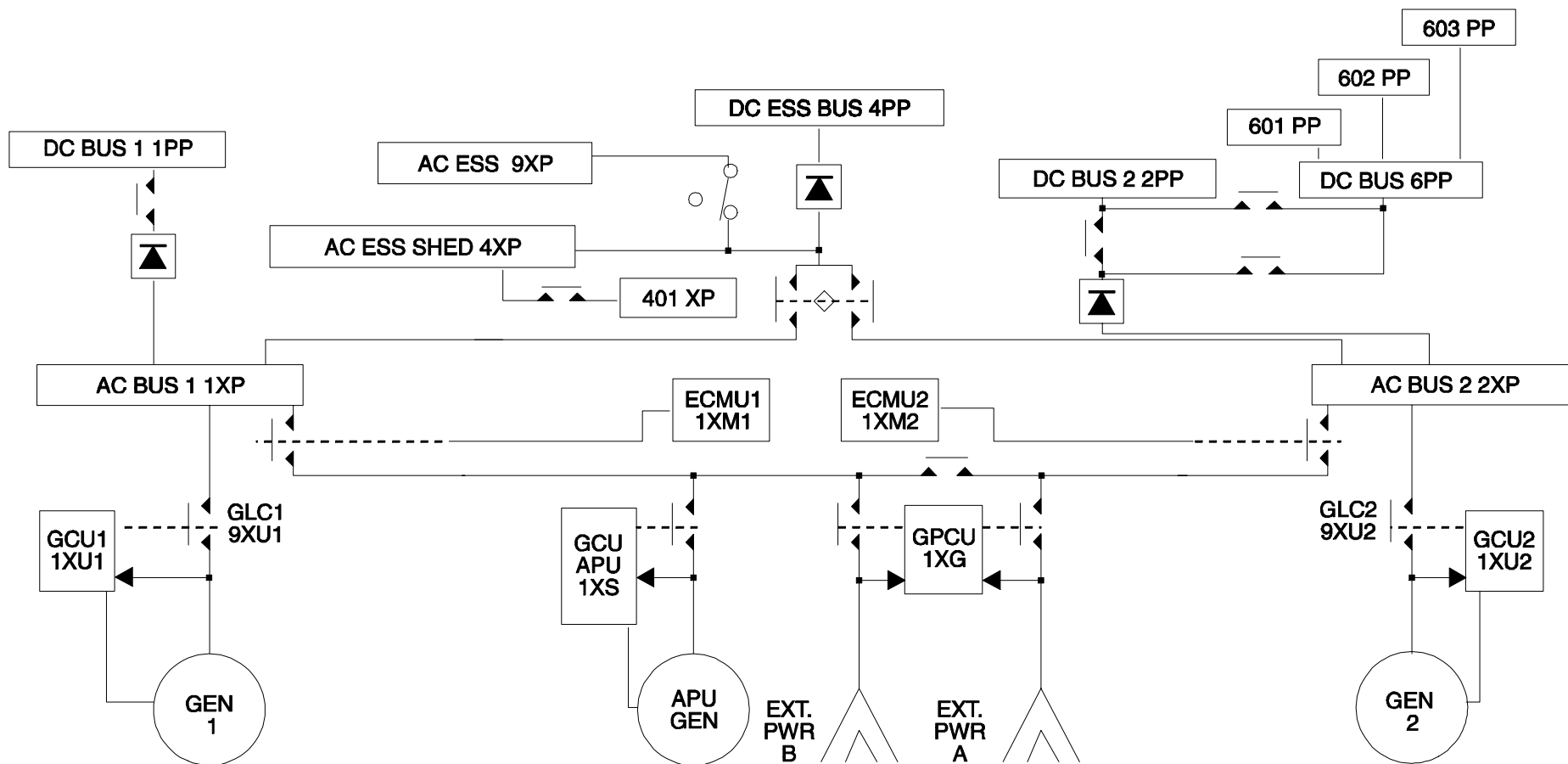
The two letters are :

XP for AC busbar

PP for DC busbar.

Example :

2XP is AC busbar 2, 6PP is DC busbar 6.



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SUB BUSBAR IDENTIFICATION

The sub-busbars are identified in the same way as the busbars, but with three digits.

The first digit indicates to which bus it is connected.

The two following digits are the sub-busbar numbers.

Example :

401XP is the first sub-busbar of AC busbar 4.

603PP is the third sub-busbar of DC busbar 6.

Exception : 131XP-A → 26VAC → single phase A

CONNECTOR IDENTIFICATION

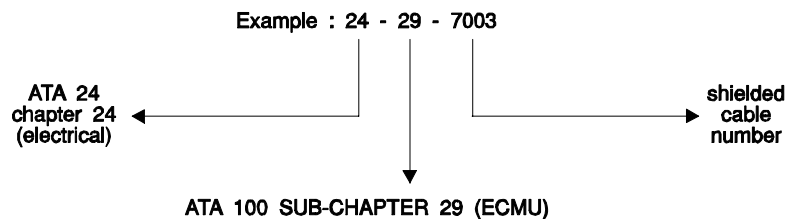
Connections to components are identified by a suffix letter (or two for multiple connection parts) following the circuit identification.

Example :

1XM2 AA is connector A part A of ECMU2.

ARINC BUS IDENTIFICATION

ARINC 429 buses are numbered from 7000 to 7999 with the ATA 100 prefix of the corresponding system.



AC MAIN GENERATION

Main Generator
Generator Control Unit
Control and Indication
Distribution

MAIN GENERATOR

The Integrated Drive Generator consists of a constant speed drive part and a generator.

Power	115 KVA
Voltage	115 VAC
Frequency	400 Hz
Speed	24000 RPM
Phases	3

GENERATOR CONTROL UNIT

The Generator Control Unit (GCU) fulfills several functions.

The main functions of the GCU are :

- Voltage and frequency regulation
- GLC control in accordance with Electrical Contactor Management Unit (ECMU)
- Control and protection
- No Break Power Transfer (NBPT)
- BITE function
- Interface with the SDACs.

The BITE signals are connected via the Ground Power Control Unit (GPCU) to the Central Maintenance Computers (CMCs).

CONTROL AND INDICATION

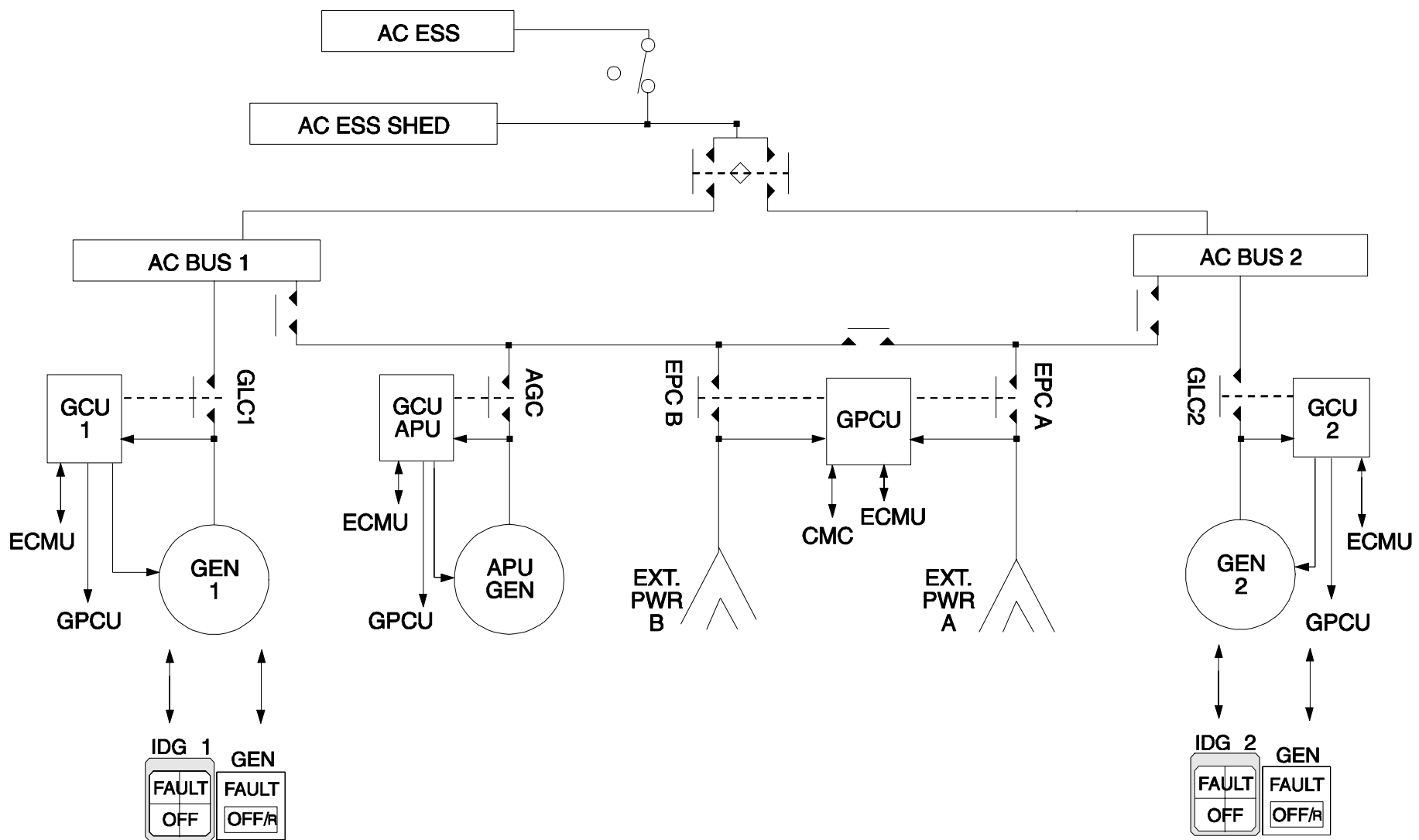
The Integrated Drive Generators (IDGs) are controlled by pushbutton switches located on the overhead ELEC panel.

DISTRIBUTION

There are two distribution networks :

- Network 1 consists of AC BUS 1, AC ESSential BUS and AC ESS SHED BUS.
- Network 2 consists of AC BUS 2.

Network 2 is also a backup supply for AC ESS BUSes.



STUDENT NOTES:

AC MAIN GENERATION D/O

Integrated Drive Generator
Generator Control Unit
Generator Control Switch
GLC / BTC Control And Monitoring
ECMU
Feeder Line
Transfer Circuit
Operation

INTEGRATED DRIVE GENERATOR

Two identical Integrated Drive Generators (IDGs) are used to supply the main AC network.

Each IDG is a two pole high speed (24000 RPM) brushless spray oil cooled unit.

It comprises in a common housing:

- the drive part with the monitoring and control items,
- the generator part which consists of a Permanent Magnetic Generator (PMG), the exciter generator with the rotating diodes and the main generator.

Each IDG is controlled and monitored by its own Generator Control Unit (GCU).

GENERATOR CONTROL UNIT

Each GCU is supplied by the PMG of its related IDG and as a back-up supply by the battery bus 301 PP.

The main functions of the GCU are:

- 1 - control of the field excitation via the Generator Control Relay (GCR),
- 2 - voltage regulation,
- 3 - speed regulation through the Servo-Valve Relay (SVR),
- 4 - control of the GLC (via the Power Ready Relay (PRR) and the BTC in conjunction with the ECMU,
- 5 - control and protection of the IDG and the network,
- 6 - interface to the ECAM (via the SDACs) and to the CMS (via the GPCU). The status or fault information is sent to the ECAM and to the CMS.

GENERATOR CONTROL SWITCH

The GENERATOR control switch is used to connect or disconnect the generator and to reset the GCU.

The FAULT legend comes on when the switch is pressed in and, when the related engine is shutdown or during operation if any parameter is not correct. The fault information is sent via the SDACs to the ECAM.

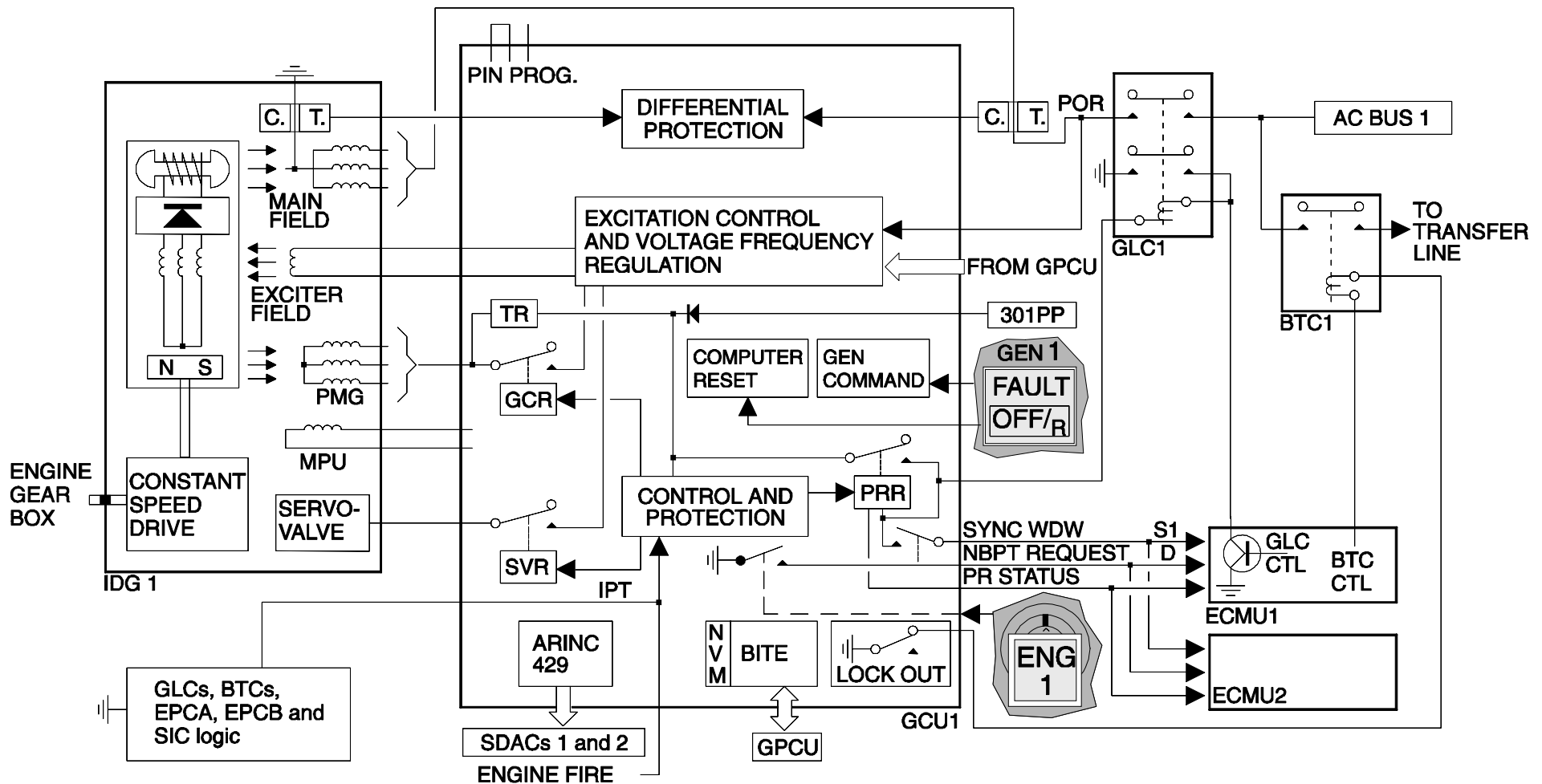
The OFF legend comes on when the switch is released out.

After a fault detection (tripping of the generator), the GCU must be reset by setting to OFF and back to ON.

GLC / BTC CONTROL AND MONITORING

The GLC and the BTC are under control of the related GCU and ECMU. If all parameters are correct, the GLC connects the generator to its own busbar.

The BTC connects the generator to the transfer line or another power source to the busbar (generator is off) depending on the priority logic and the No Break Power Transfer (NBPT) rules.



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ECMU

The main task of the ECMU in the AC main generation system is to control and monitor several contactors according to the priority logic and the NBPT rules.

ECMU 1 deals with:

GLC 1 BTC 1

APU GLC

External Power Contactor B (EPC B)

System Isolation Contactor (SIC)

ECMU 2 deals with:

GLC 2 BTC 2

External Power Contactor A (EPC A)

The priority logic of the main busbar supply is :

AC BUS 1 :

GEN 1 / APU GEN / EXT PWR B / EXT PWR A

AC BUS 2 :

GEN 2 / EXT PWR A / APU GEN / EXT PWR B

The NBPT allows two AC power sources to be connected in parallel during the transfer phase.

After transfer completion, a special protection in the ECMU and GCU (lock out circuit) avoids an Inadvertent Paralleling Trip (IPT) condition.

FEEDER LINE

A special 3 phase generator feeder cable and neutral (part of the engine) connects the generator terminal block to a terminal block located on the upper engine structure (disconnection for engine change).

The neutral line is also connected to the engine structure.

Another terminal block located in the pylon splits each phase into two cables. The feeder line (6 cables) is then sent through the wing leading edge and the cargo compartment to rack 700VU in the avionics compartment, where they are sent through the 6 hole Current Transformers (CTs) and then they are connected to the GLC.

The feeder line and the generator are protected by the differential and open cable protection circuits.

TRANSFER CIRCUIT

The transfer circuit consists of the transfer line, both BTCs and the SIC.

This circuit enables the seven power sources (GEN 1, 2, APU GEN, EXT Power A and B) to supply the entire or half of the network according to the priority logic and the NBPT rules.

OPERATION

With the engine MASTER switch and generator switch set to ON and the engine running, the generator is excited (GCR closed).

If all generator parameters are correct the Power Ready Relay (PRR) is closed.

The GCU sends the signals required for an NBPT (on ground only) to the ECMUs.

Then ECMU 1 receiving S1 signal supplies GLC 1 and BTC 1 to establish an NBPT with generator 1 and the power source which was previously supplying AC BUS 1.

After NBPT completion, ECMU 1 removes the power supply from BTC1. Due to GLC self holding, the GLC is only under control of its own GCU. It is independent of ECMU function or failure.

AC GENERATION TRANSFER CIRCUIT D/O

General
Operation

GENERAL

The transfer circuit consists of the 2 BTCs and the SIC. The SIC is controlled by ECMU 1 and via the BUS TIE switch on the electrical power control panel.

BTCs	CONTROL
1	ECMU 1 and GCU 1
2	ECMU 2 and GCU 2

OPERATION

During normal system operation, the BUS TIE switch remains in the latched-in position (AUTO). In this position, the SIC and the two BTCs are automatically commanded open or closed by the ECMUs and the GCUs (depending on the power source configuration and NBPT request).

In the unlatched off position, the OFF legend on the switch comes on; the SIC opens, the 2 BTCs open (due to switch status change sent to both ECMUs), and the switch status change is sent to both FWCs; the message "ELEC BUS TIE OFF" is displayed on the ECAM.



STUDENT NOTES

FQW4200 GE Metric

INTEGRATED DRIVE GENERATOR (IDG) D/O

General

DRIVE DESCRIPTION:

- IDG Drive Portion
- IDG Speed Control
- Servo-valve Control Loop
- Servo-valve
- Servo-valve Relay

DRIVE CONTROL AND MONITORING:

- Magnetic Pick-up
- Oil Temperature Sensing
- Pressure Differential Switch
- Oil Level Sensor
- Oil Pressure Switch
- IDG Disconnection
- Fire Switch

GENERAL

The Integrated Drive Generator (IDG) consists of a Constant Speed Drive (CSD) and an AC generator mounted side by side in a single housing.

The CSD components convert a variable input speed from the engine gearbox to a constant output speed of 24000 Rotations Per Minute.

The CSD portion of the IDG is a hydromechanical device that adds or subtracts from the variable input speed of the engine gearbox. The CSD performs this operation by controlled differential action to maintain the constant output speed required to drive the AC generator.

The IDG is cooled and lubricated by the oil circulation system.

IDG DRIVE CONTROL

The Constant Speed Drive converts the variable input speed (4500 to 9120 Rotations Per Minute) provided by the engine gearbox to the constant output speed (24000 Rotations Per Minute) through the CSD hydromechanical components.

The oil is cooled by an external mounted fuel/oil heat exchanger.

IDG SPEED CONTROL

The GCU performs the output speed control for the IDG via the servo-valve control loop whenever several conditions are met:

- The GCU is powered-up
- Engine input speed to the IDG is sufficient for speed control to begin
- No failure is present in the channel to trip the servo-valve control circuit.

SERVO-VALVE CONTROL LOOP

The loop is composed of a servo-valve in the IDG and control circuitry in the GCU which includes the Servo-Valve Relay (SVR).

The output speed control is performed as follows: the GCU control circuit monitors the Permanent Magnetic Generator (PMG) frequency to determine the generator frequency.

Note that the PMG is mounted on the IDG differential output gear.

The PMG frequency signal is compared with a reference frequency from the GPCU (Frequency Reference Unit signal for NBPT) or a GCU internal frequency reference. The difference, between the actual PMG frequency and the frequency reference, creates an error signal in the servo-valve control loop circuitry.

The frequency error signal is then used to control the servo-valve current flow via the SVR.

SERVO-VALVE

The servo-valve works by porting oil to an hydraulic control cylinder which determines the position of a variable displacement hydraulic unit.

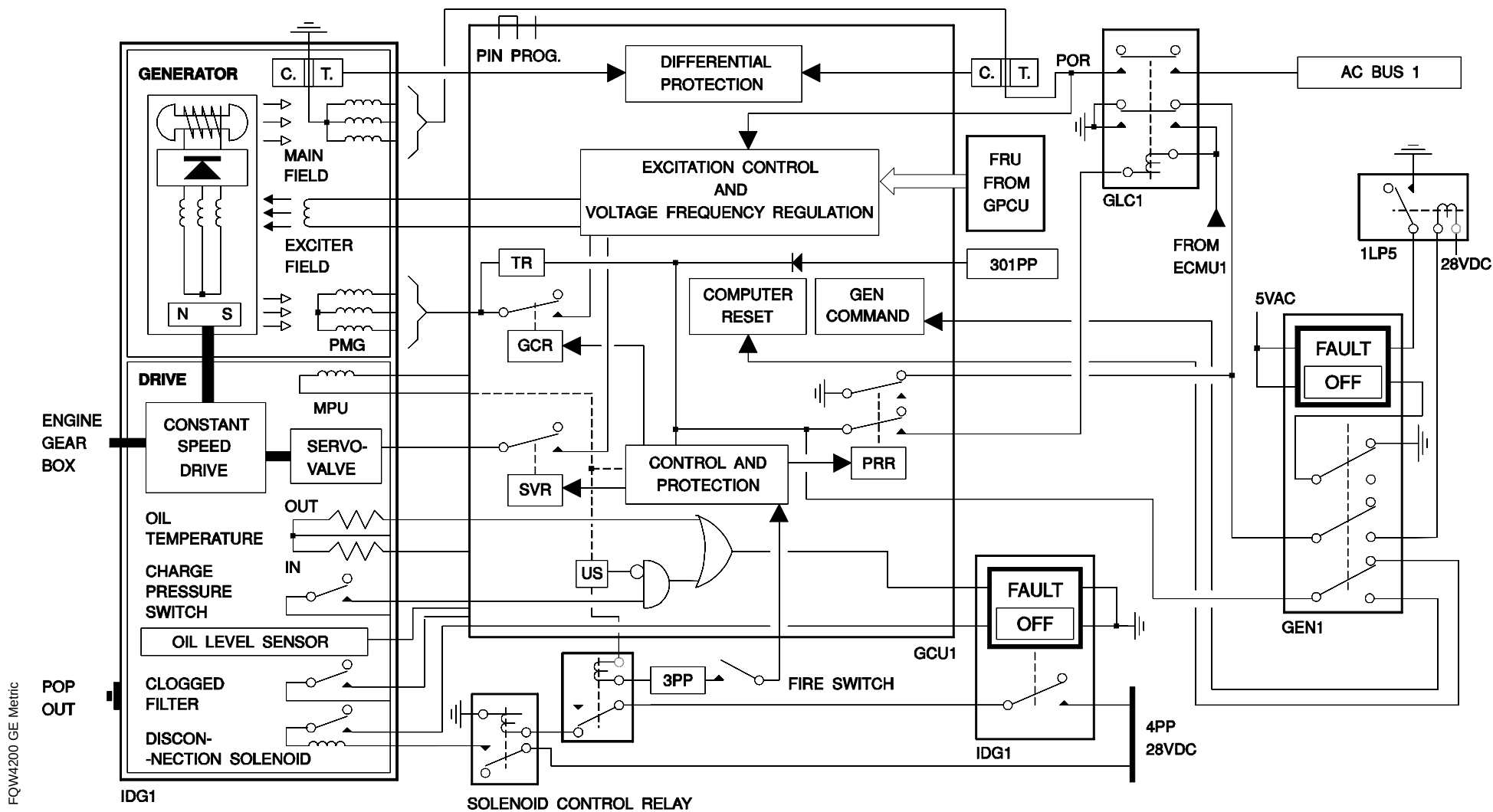
Depending on the error signal, the servo-valve ports more or less oil to the cylinder to maintain the desired generator frequency (IDG output speed).

As IDG speed (thus PMG frequency) decreases below the reference frequency setpoint, the servo-valve supply current increases, resulting in an IDG output speed increase.

SERVO-VALVE RELAY

During normal operation, the SVR is closed to allow current flow in the servo-valve control loop.

Under certain channel failure conditions, the SVR is opened to make sure that servo-valve drive current from the GCU is completely removed.



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MAGNETIC PICK-UP

The Magnetic Pick-Up (MPU) is used to sense the drive input speed. This speed signal (low level voltage) is transmitted to the GCU for underspeed (U/S) protection (UnderSpeed setpoint: 4710 +/- 35 RPM).

OIL TEMPERATURE SENSING

There are two oil temperature sensors in the IDG:

- One on the IDG oil inlet port
- One on the IDG oil outlet port.

Both sensors are thermistors.

The GCU uses the voltage signal to determine oil inlet, oil outlet and rise temperature for IDG protection. The temperature information is also sent to the ECAM.

If the oil outlet temperature is above 185 celsius degrees, the FAULT legend comes on amber on the IDG pushbutton.

PRESSURE DIFFERENTIAL SWITCH

The switch is located accross the scavenge filter in the IDG. It signals a clogged filter condition to the GCU.

If the pressure increases above 70 +/- 8 PSI, the switch closes and sends a signal to the GCU. The GCU sends a message to the ECAM and CMS.

Note: if this message is displayed, a visual check of the pop-out is required.

If the pop-out shows the out position, a maintenance procedure must be performed.

OIL LEVEL SENSOR

The Remote Oil Level Sense (ROLS) function is used to detect a low IDG oil level.

Four minutes after engine shutdown on ground, the GCU will supply the sensor for 30 seconds. If the oil level is low (sensor not covered with oil), a different voltage signal is detected by the GCU. The GCU sends a BITE message to the ECAM and CMS. A visual check of the oil level sight glass is required.

If the oil level is in the red area, oil servicing must be performed.

OIL PRESSURE SWITCH

A low oil pressure (LOP) switch located in the IDG charge oil circuit provides a signal to the GCU when IDG charge oil pressure is less than 140 PSI.

In low oil pressure condition, not caused by underspeed, the IDG pushbutton FAULT legend comes on amber and an ECAM warning is triggered.

IDG DISCONNECTION

The FAULT legend comes on if the IDG oil pressure is less than 140 PSI or if the IDG oil outlet temperature is above 185 degrees.

In both conditions, the IDG must immediately be disconnected !

IDG disconnection is achieved by a solenoid activated clutch. It must be performed, via the IDG switch if the IDG pusbutton FAULT legend is on.

When the IDG pushbutton is pressed in and no underspeed is detected, the solenoid control relay is energized and connects the 28 VDC to the disconnection solenoid which will open the clutch. An internal disconnection status switch provides the effective IDG disconnected signal to the GCU. The IDG pushbutton OFF legend comes on and the FAULT legend goes off. The OFF legend remains on until the reset of the clutch is performed.

In case of low oil pressure due to underspeed, the FAULT legend remains off.

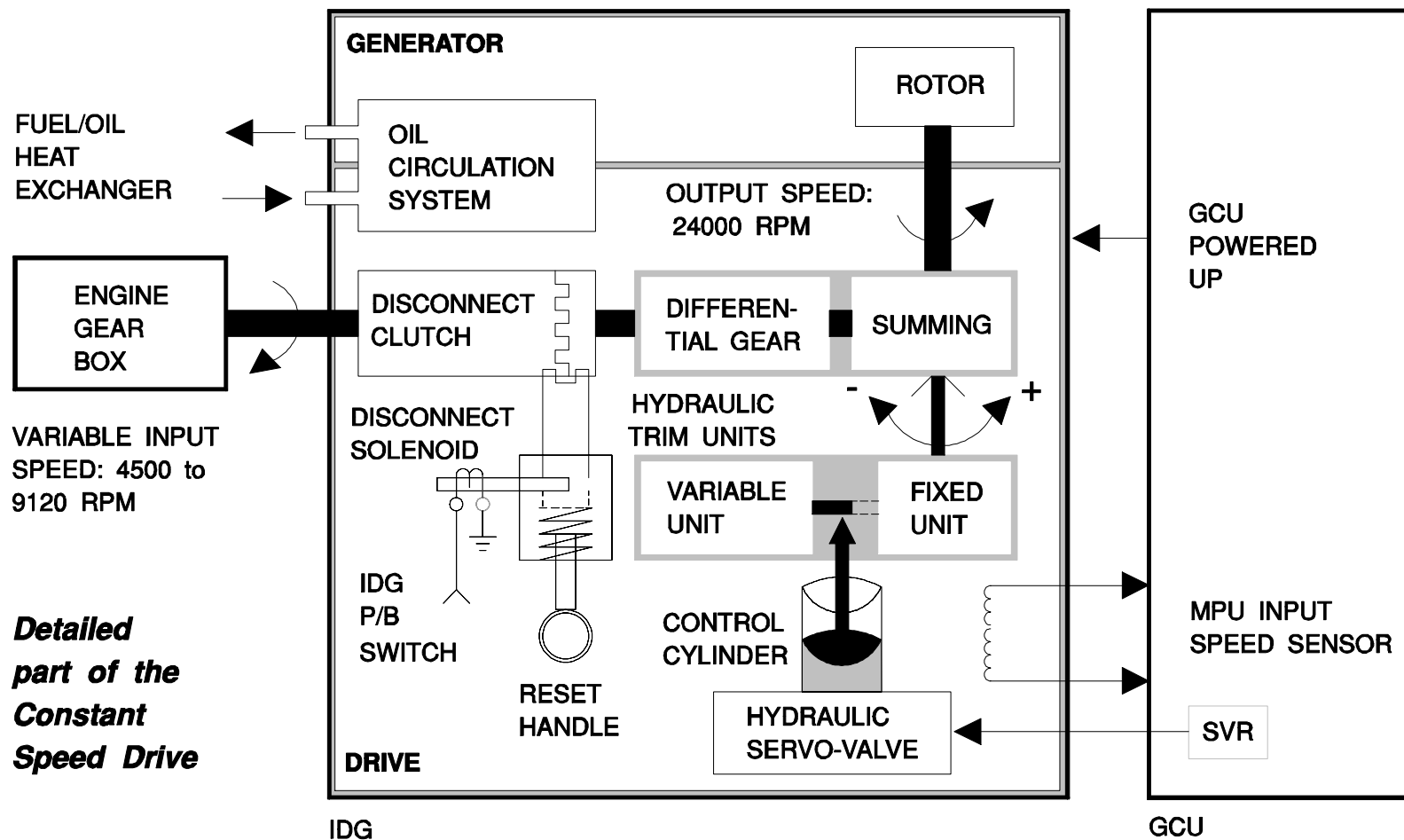
In underspeed condition, when the engine has just been shutdown, it is not possible to disconnect the IDG.

Note that detected underspeed inhibits the speed related protection circuits (underfrequency and undervoltage).

IDG reset can only be performed on ground with engine shutdown, by pulling the reset handle mounted on the IDG casing.

FIRE SWITCH

In case of engine fire, if the related fire switch is pressed in, a 28 VDC signal is sent to the corresponding GCU which shuts down its IDG.



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STUDENT NOTES:

IDG GENERATOR PART D/O

GENERATOR PORTION:

General

PMG

Generator Exciter Stage

Main Generator

Current Transformer

Generator Control Switch

IDG Pushbutton

Point Of Regulation

GENERAL

The AC generator portion of the IDG is a three-phase, brushless, spray oil cooled, rotating rectifier unit.

The generator rotor consists of an exciter rotor, a diode rectifier assembly, and a two-pole main field rotor.

The exciter rotor and main field rotor are mounted on a common shaft supported by a roller bearing set at the drive end and a ball bearing set at the opposite end.

The Permanent Magnet Generator (PMG) rotor is mounted on the output ring gear of the differential assembly.

The main generator stator, exciter stator, PMG stator and generator Current Transformer (CT) are mounted in the IDG housing.

PERMANENT MAGNET GENERATOR (PMG)

The PMG consists of a 16 pole permanent magnet rotor and a three winding stator. As the engine is running, the PMG rotor induces an AC voltage in the windings of the PMG stator. At normal operation speed, the output from the PMG is:

- 3 phases
- 1573 Hz
- 100 VAC L-L.

The output of the PMG is supplied to the GCU which uses it for the following functions:

- The GCU transforms and rectifies the voltage via a TR to 28 VDC for the internal power supply.
- The GCU sends the PMG voltage via the Generator Contactor Relay (GCR) to the voltage and frequency regulation circuit where it is rectified and applied to the exciter field for voltage regulation.

The PMG frequency is also used to monitor the generator frequency.

GENERATOR EXCITER STAGE

The exciter stage of the generator consists of a three-phase winding rotor which is located on the main generator rotor.

The stator windings and a full wave bridge rectifier (rotating diode rectifier) are also located on the rotor.

As it rotates within the stator, the exciter stage converts a DC field voltage supplied by the GCU to the exciter stator, to an AC voltage in the windings of the rotor. The induced AC voltage is rectified by the rotating diode rectifier and supplied to the windings of the main generator rotor.

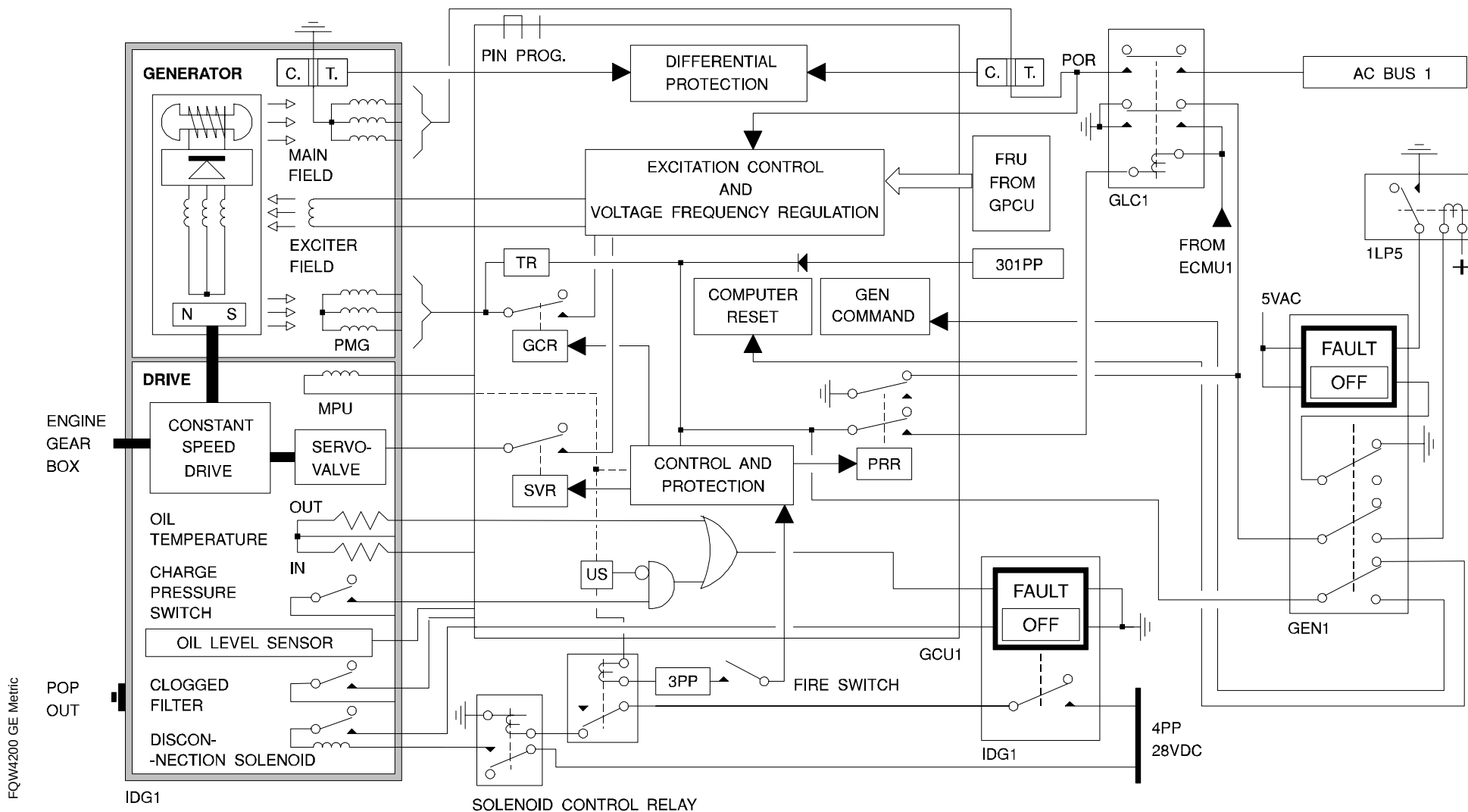
MAIN GENERATOR

The main generator consists of a two-pole rotor and a three-phase winding stator. As the rotor rotates, the DC field induces an AC voltage in the stator windings.

CURRENT TRANSFORMER

The ground connection for the three stator windings are sent through internal Current Transformers (CTs), which are used as current sensors for the GCU internal DIFFERENTIAL, OVERLOAD and OVERCURRENT protection.

Note: The Current Transformer has a 1000 to 1 ratio.



GENERATOR CONTROL SWITCH

When the switch is closed and the generator is not connected, the internal FAULT legend is on. The generator command circuit is supplied and enables closure of the Generator Control Relay (GCR) to excite the generator. Then, if the speed and all parameters are correct, the Power Ready Relay (PRR) closes and connects power to the Generator Line Contactor (GLC). To close the GLC, ECMU1 provides the ground depending on the priority rules and NBPT conditions.

When the generator control switch is open (OFF legend on), the GCR opens to de-energize the generator and the computer reset circuit is supplied.

IDG PUSHBUTTON

The springloaded pushbutton is used to disconnect the IDG from the engine gearbox. If the internal FAULT legend comes on, the IDG must immediately be disconnected.

POINT OF REGULATION

The Point Of Regulation (POR) for the generating channel is between the 6 hole CT and the GLC. It takes in account the generator feeder impedance (voltage drop of 1 to 2 VAC).

The GCU monitors the three generator phase voltages at the POR for:

- Voltage regulation control
- Over and undervoltage protection
- Incorrect Phase Sequence (IPS) protection.

STUDENT NOTES:

STUDENT NOTES

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IDG COOLING D/O

- General
- IDG Cooling Principle
- Oil Cooling
- Components

GENERAL

The IDG oil is used for IDG cooling and lubrication at the same time.

The oil enters the IDG at the opposite side of the drive end and is ported to:

- the generator stator and rotor,
- the differential gear,
- the charge pump,
- the input seal.

IDG COOLING PRINCIPLE

The input housing has rectangular grooves cut around the main generator stator core in which oil flows to cool the stator and maintain a lower IDG surface temperature.

The oil entering the rotor is distributed for cooling of:

- the exciter and main generator rotors,
- the exciter and main generator windings,
- the diodes.

The oil, supplied to the differential gear, is also used to spray cool the PMG stator and lube the disconnect spline.

The charge pump draws in the oil flow at its suction port and intensifies its pressure.

The charge oil is then used :

- as a motive flow in the hydraulic and control system,
- for cooling and lubrication of the hydraulic parts.

This used oil is then either directly ported to the deaerator or leaked to the IDG sump where it is scavenge and pumped to the deaerator. There it runs through the filter into the external system lines for cooling.

OIL COOLING

An Air Oil Heat Exchanger (AOHE) cools the IDG oil during low engine power operating conditions (ground idle, taxi, idle descent).

The air shut-off valve is a normally open valve which requires an electrical signal from the Engine Control Unit (ECU) as well as the adequate muscle pressure (above 50 PSI) to be closed.

Note: At low engine power, the air shut-off valve cannot be closed.

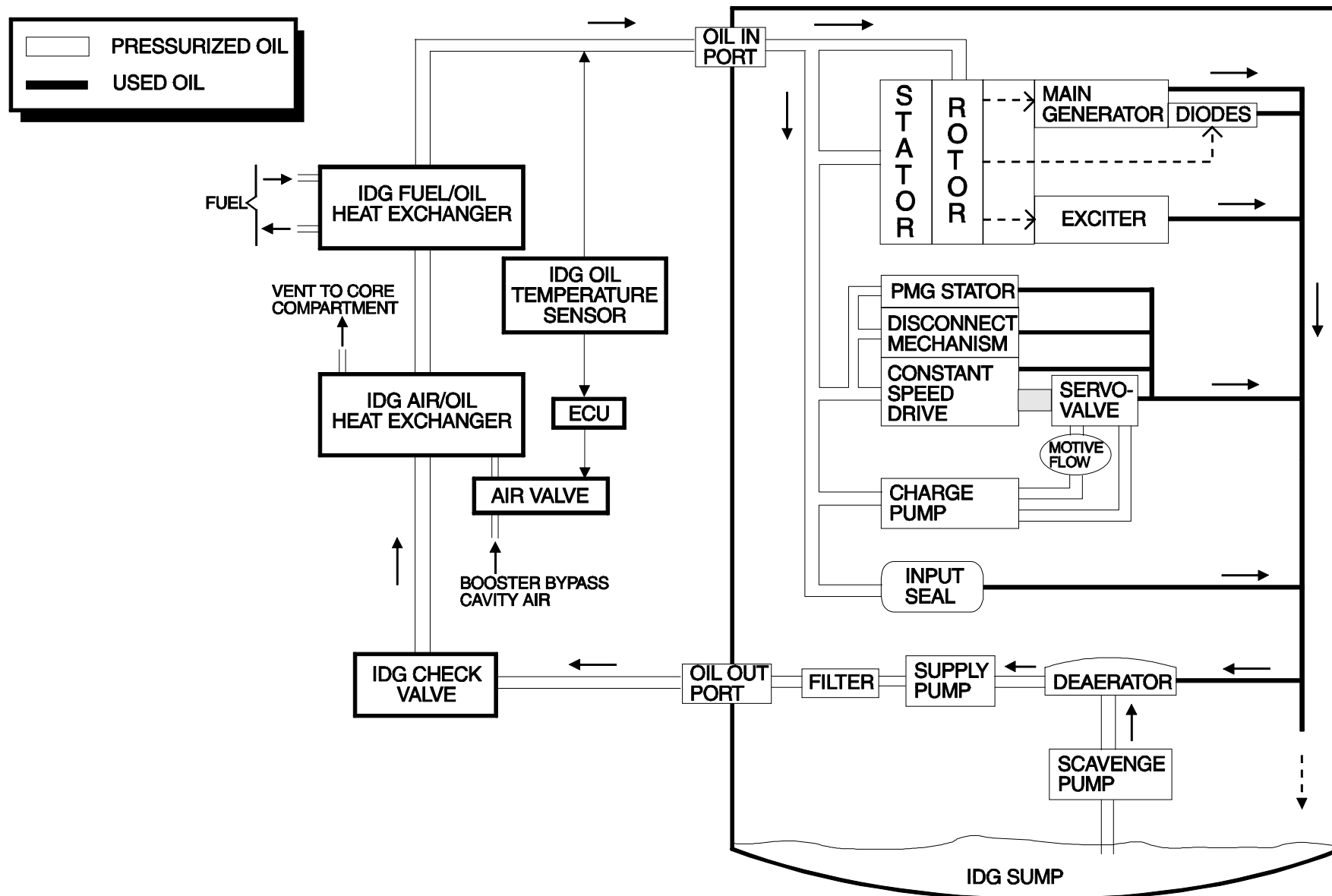
The ECU commands the valve open if the IDG oil-inlet temperature is above 127°C.

The ECU commands the valve closed when the IDG oil-inlet temperature falls below 104.4°C.

During high engine power operating conditions (take-off, climb, cruise), the IDG oil is cooled by a Fuel/Oil Heat Exchanger (FOHE).

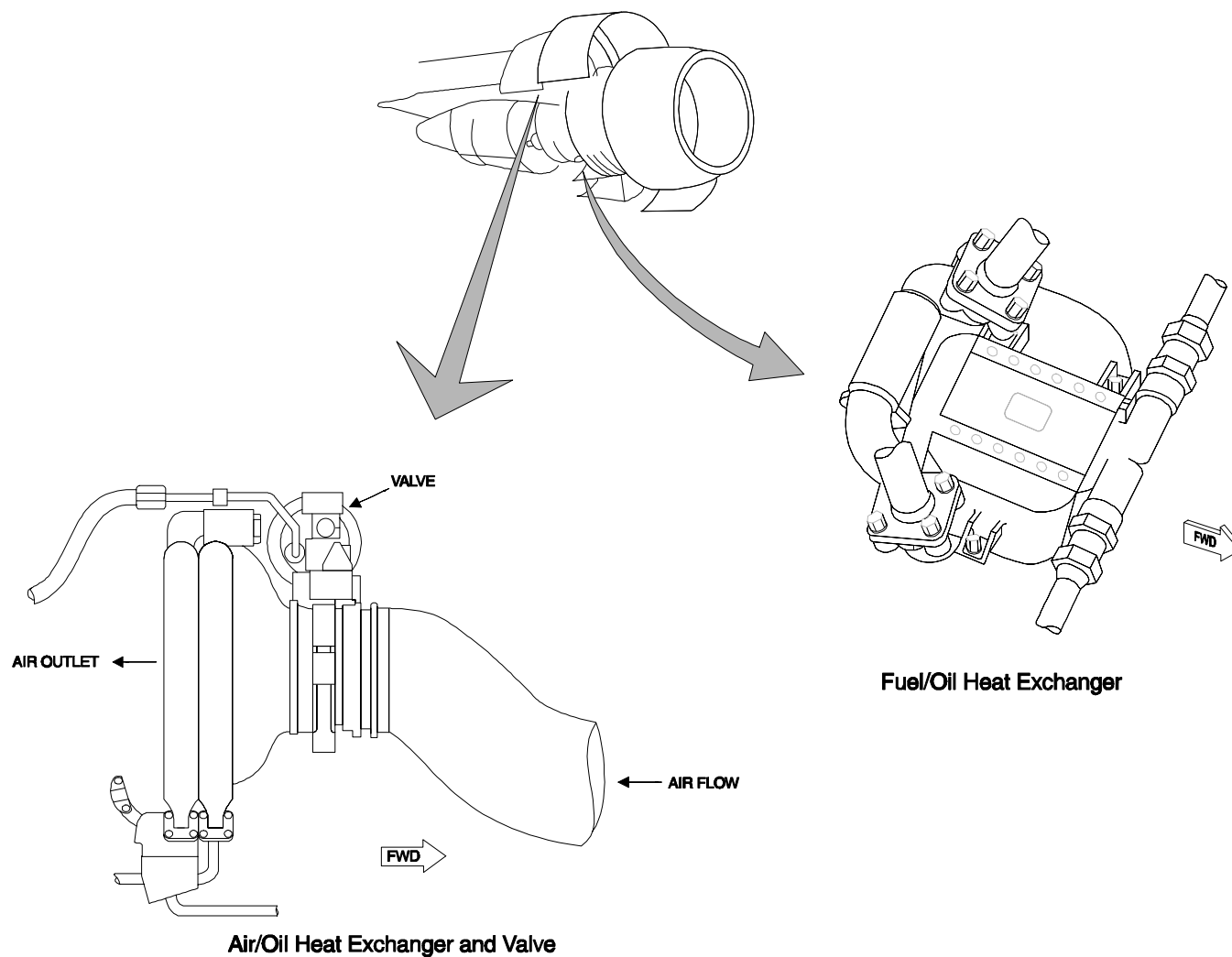
The FOHE limits the IDG oil-inlet temperature to 127°C. Engine fuel and IDG oil go through the FOHE but do not mix.

Note: the normal IDG oil-inlet temperature is between 70°C and 105°C.



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COMPONENTS



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INTEGRATED DRIVE GENERATOR MONITORING

- Oil Temperature Monitoring
- Oil Pressure Monitoring
- Oil Level Monitoring
- Oil Filter Monitoring
- Temperature and Pressure Indication

OIL TEMPERATURE MONITORING

IDG oil temperature sensors monitor the temperature of the input and output oil.

If a high difference between the input and output temperature is detected, a status message is sent to the ECAM. This difference is called a rise.

When the Oil Outlet Temperature reaches 152°C in flight only, the ELEC ECAM page is automatically displayed (advisory mode).

If the Oil Outlet Temperature exceeds 185°C the warnings are triggered.

OIL PRESSURE MONITORING

A pressure switch operates in case of oil low pressure (lower than 140 PSI) not caused by underspeed.

The normal IDG input speed range is between 4500 and 9120 RPM.

OIL LEVEL MONITORING

In case of oil low level detection on ground 4 minutes after engine shutdown, the GCU sends a status message to the ECAM.

The oil level can also be checked on ground by the oil level sight glass.

OIL FILTER MONITORING

The clogged filter sensor sends a ground signal to the GCU when the filter is clogged, which will in turn, sends a STATUS message to the ECAM.

The clogged filter indication is also given by a local visual pop-out indicator.
CAUTION :

When the pop-out indicator is out (red indication), the IDG has to be removed.

The Differential Pressure Indicator (DPI) is inhibited during cold oil conditions by a bimetal element which locks the pop-out button.

This avoids spurious indication due to high oil viscosity.

TEMP. AND PRESS. INDICATION

The oil outlet temperature is displayed on the AC ELEC page of the ECAM System Display.

In case of high Oil Outlet Temperature or oil low pressure, the following warnings are triggered :

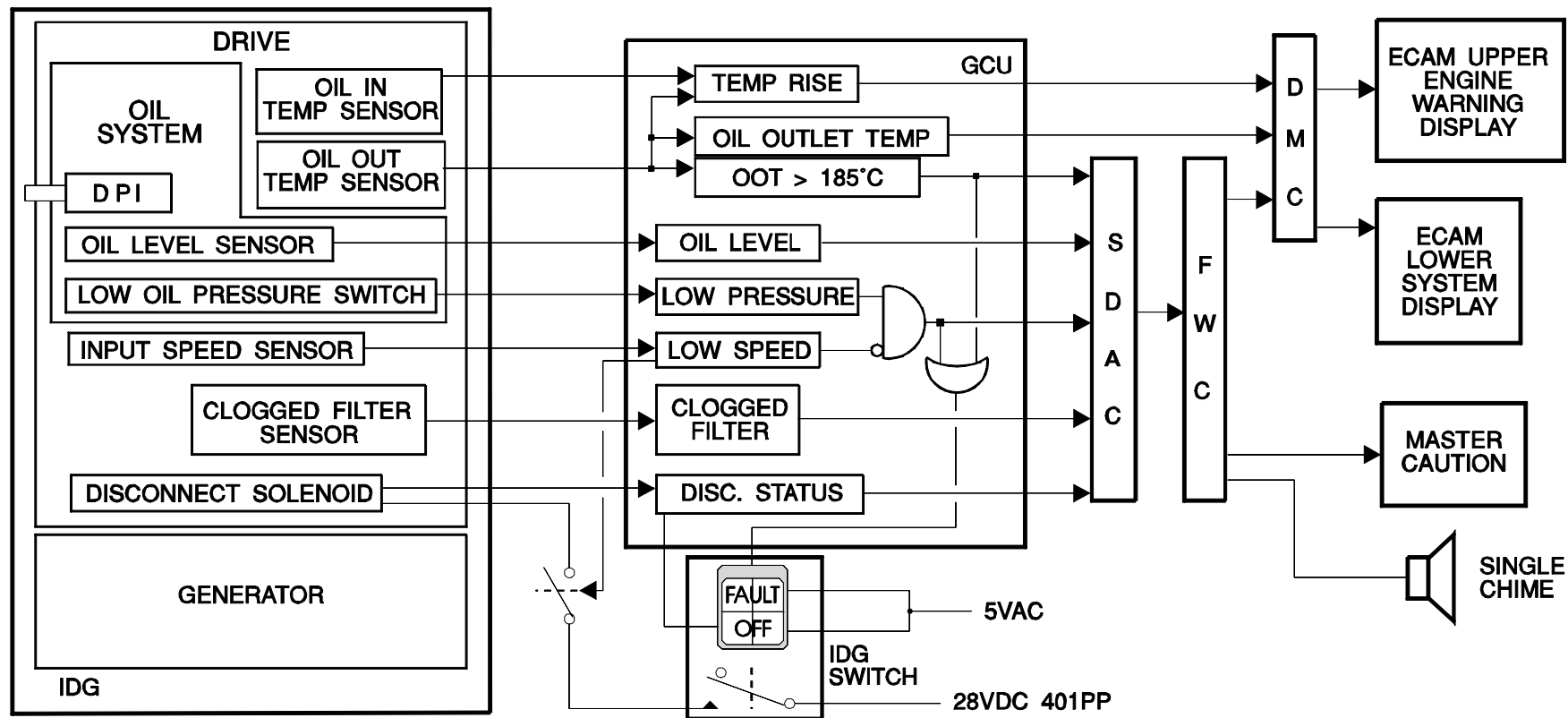
- MASTER CAUTION light
- single chime
- the message "ELEC IDG x OIL OVHT" is displayed on the upper ECAM
- the oil outlet temperature appears amber on the lower ECAM
- the FAULT legend of the related IDG pushbutton switch comes on amber.

The IDG must be disconnected immediately by :

- opening the safety guard
- pushing the IDG pushbutton switch.

Note : disconnection is only possible if the corresponding engine is running.

The disconnection (clutch open) of the IDG is confirmed by the illumination of the OFF legend of the IDG pushbutton. This light remains on until a reset is performed.



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STUDENT NOTES:

FQW4200 GE Metric

GENERATOR CONTROL UNIT D/O

- General
- Functions
- Voltage Regulation
- Frequency Regulation
- Control And Protection
- Underspeed
- Overvoltage
- Overfrequency
- Differential Protection
- Overload / Overcurrent
- Protection Function Summary

GENERAL

The 3 Generator Control Units (GCUs)(GCU 1,2 and APU GCU) are identical and interchangeable.

A special pin programming provides the GCU with the following information:

- the aircraft type
- the GCU position (IDG or APU generator)
- the current limit for voltage regulation
- the load (115 KVA for IDG and APU generator).

FUNCTIONS

The GCU fulfills several functions.

The main functions of the GCU are:

- regulation of the generator voltage
- regulation of the generator frequency (IDG only)
- No Break Power Transfer (NBPT)
- control and protection
- interface with SDACs (ECAM) and Electronic Control Box (ECB)(APU GEN only).
- interface with CMS via the GPCU.

VOLTAGE REGULATION

The voltage regulation is achieved by regulating the current through the exciter field. The voltage is kept at a nominal value at the Point Of Regulation (POR).

The POR is located at the end of the generator feeder upstream of the Generator Line Contactor (GLC). The output from the Permanent Magnetic Generator (PMG)(3 phases,1573.3Hz, 100 VAC approximately) is connected via the Generator Control Relay (GCR) to the excitation and regulation control module, where it is converted to DC voltage.

The current is applied to the exciter field. The return path of this current is controlled through a switching transistor in its voltage regulation output stage. The DC current flow through the exciter field is controlled by adjusting the switching time of the transistor, thus controlling the amount of voltage applied to the main generator windings through the rotating rectifier assembly.

FREQUENCY REGULATION

The IDG frequency regulation is performed by a servo-valve in the IDG and the servo-valve control circuitry in the GCU (via the Servo-Valve Relay (SVR)).

The PMG frequency is compared with a GCU internal reference frequency. The difference generates a control current to drive the servo-valve to produce the right output frequency.

During NBPT, the GCU will switch from its own internal frequency reference to one generated by the Frequency Reference Unit (FRU) within the GPCU.

CONTROL AND PROTECTION

The GCU control and protection functions are mainly performed by 3 internal relays:

- the Generator Control Relay (GCR) controls the generator excitation.
- the Power Ready Relay (PRR) controls the GLC and the NBPT.
- the Servo-Valve Relay (SVR) controls the IDG speed.

If a protection function is triggered, the GCR, the PRR and, in some cases, the SVR are de-energized.

UNDER SPEED

A Magnetic Pick Up (MPU) located in the IDG is used to sense the IDG input speed from the engine. When engine speed falls below the underspeed threshold (4320 RPM), the PRR trips and the excitation is biased off due to underfrequency (<355 Hz).

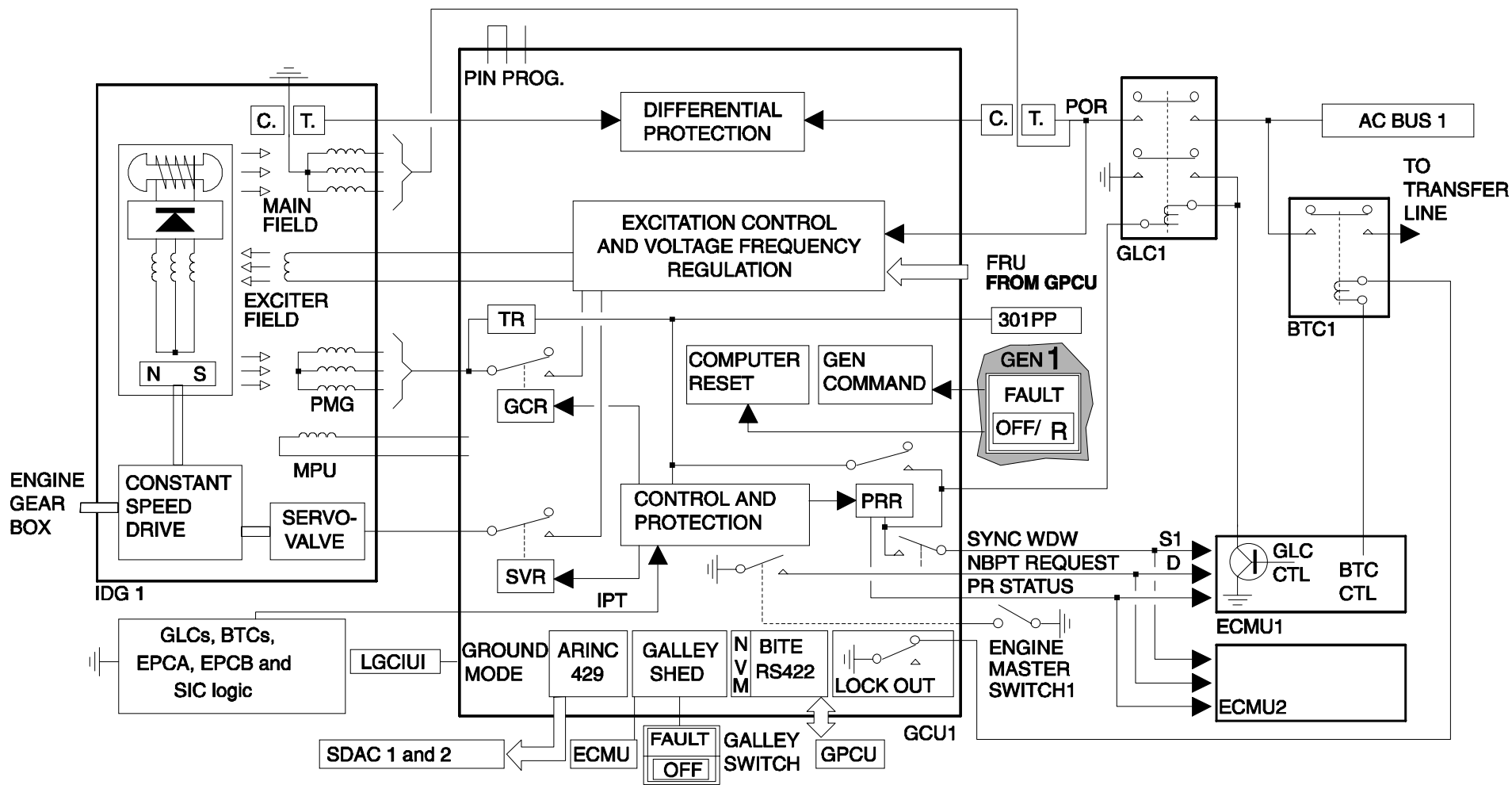
NOTE: In case of detected underspeed, no reset action via the GEN pushbutton switch is required.

OVERVOLTAGE

The GCU performs an overvoltage protection function.

If the highest individual phase at POR reaches 130 +/- 1.5 volts, the PRR and the GCR are tripped.

NOTE: The higher the overvoltage, the faster the relays are tripped.



OVERFREQUENCY

The GCU performs an overfrequency protection function.

If the PMG frequency is above 433 Hz, for at least 4 seconds, the GCU trips the PRR and the GCR.

If the PMG frequency is above 450 Hz, for at least 160 milliseconds, the GCU trips the PRR, the GCR and also the SVR.

DIFFERENTIAL PROTECTION

The differential protection (DP) is based on the comparison of each phase of the 6 hole Current Transformer (CT) and the 3 Current Transformers in the IDG.

If a differential current flow is above 45 +/- 5 A for at least 60 milliseconds, the PRR and GCR are tripped.

NOTE: the DP circuit reset is done via the GEN pushbutton switch, but it is limited to twice. After, a cold reset must be performed. This reset also includes trips for open and shorted CTs.

OVERLOAD / OVERCURRENT

The IDG Current Transformers (CTs) provide current sensing information to the GCU.

This information is used to determine generator load for overload, overcurrent, phase imbalance (delta) and also Differential Current Protection (DCP).

In case of overload, if the fault is still present 10 seconds after initialization, the GCU sends a signal to the ECMU to shed the corresponding galley supply line.

If the shedding is performed, no warning is triggered. If the shedding can not be performed, the amber FAULT legend on the GALLEY switch comes on. If the fault remains, the GCR and the PRR are tripped. If the fault still remains, the BTC is locked out after an inversed time delay.

PROTECTION FUNCTION SUMMARY

All protections marked with a star are only resettable twice using the generator control switch.

After 2 reset attempts the GCU must be powered-down (cold start) to reset the protection latch-in software.

Make sure that the related engine is shutdown to avoid power supply from the PMG.

- 1) The PRR is tripped alone in case of : Underspeed (speed is below 4320 RPM).
- 2) The GCR is tripped alone in case of :- Phase Sequence not correct
- GLC failure : current flow > $25 \pm 5A$ and the PRR is already open.
The BTC is also locked out.

3)The GCR and the PRR are tripped together in case of :

TRIGGERED FUNCTIONS	TRIGGER CONDITIONS	REMARKS
Overvoltage	One phase > 130 ± 1.5 volts	*
Undervoltage	One phase < 103 ± 1.5 volts for 4.5 seconds	
	One phase < 70 ± 1.5 volts for 160 ms	SVR tripped
Overfrequency	Frequency > 433 Hz for 4 seconds	
	Frequency > 450 Hz for 160 ms	*
Underfrequency	Frequency < 363 Hz for 4 seconds	
	Frequency < 345 Hz for 160 ms	SVR tripped
Differential Protection	Differential current flow > $45 \pm 5A$ for 60 ms	*
Overload/Overcurrent	Nominal current + 15A after BTC lock out	*
Open cable	If LCT sensed current is below 10A on a cable and above 30 A on the other one for 3 seconds	
GLC control failure	Discrepancy between PRR and GCR status for 160 ms	* 250 ms in case of NBPT
OPEN/SHORT CIRCUIT for CTs	Differential fault between line and generator currents for 60 ms	

STUDENT NOTES

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APU ELECTRICAL POWER

APU Generator
APU GCU
Control and Indication
Distribution
APU GENerator Oil Temperature Sensor

APU GENERATOR

The Auxiliary Power Unit (APU) generator is not interchangeable with Integrated Drive Generators (IDGs).

It is driven at a constant speed by the APU and can be connected to the electrical network in case of any generator failure.

It has the ability to supply the whole electrical network.

Power	115 KVA
Voltage	115 V
Frequency	400 Hz
Speed	24000 RPM
Phases	3

CONTROL AND INDICATION

The APU generator is controlled by a pushbutton switch located on the overhead ELEC panel and has two positions with two lights : white OFF and amber FAULT.

DISTRIBUTION

The APU GEN supplies the bus bars via the Auxiliary Generator Line Contactor, the Bus Tie Contactors (BTCs) and the System Isolation Contactor (SIC).

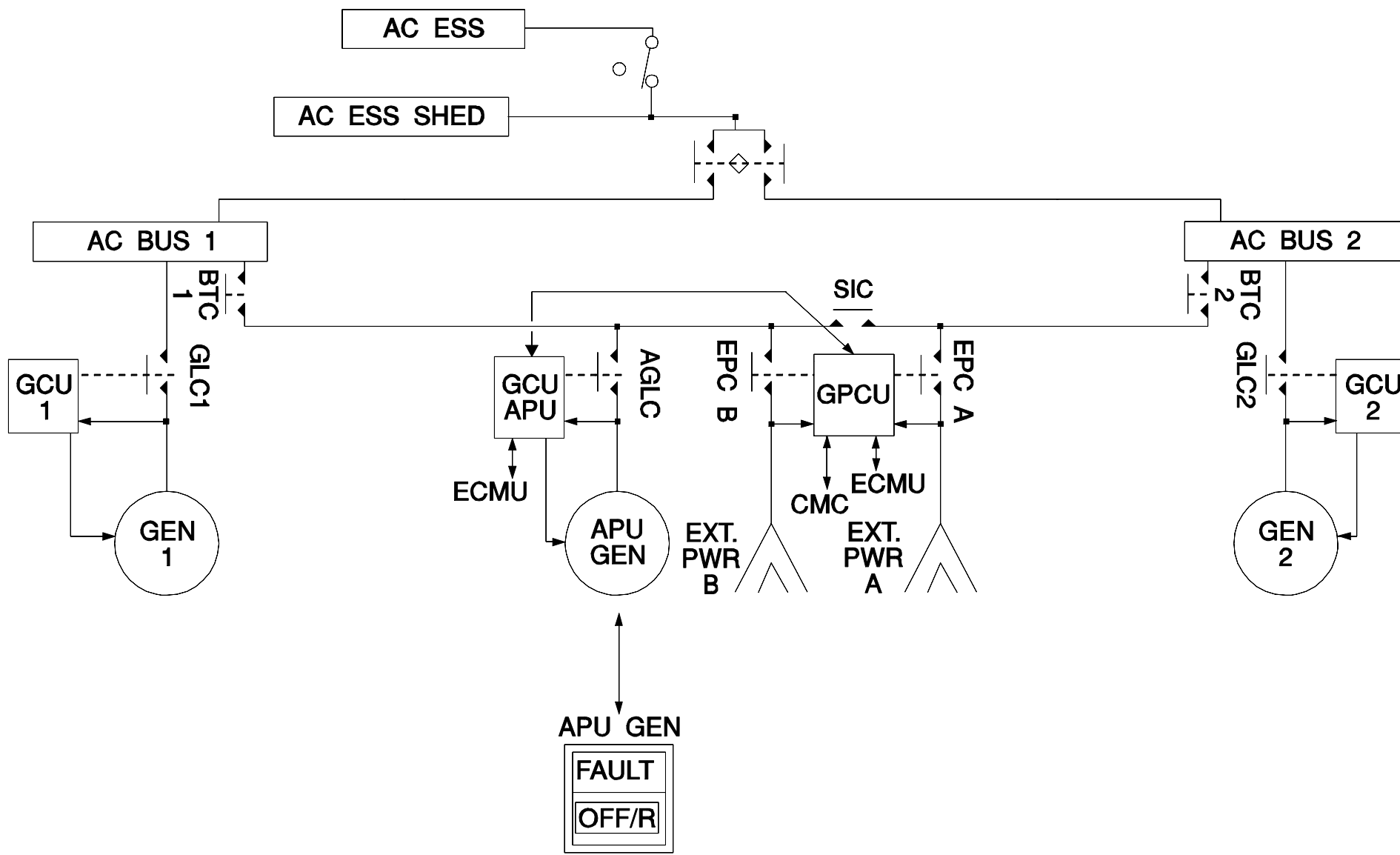
APU GCU

The APU Generator Control Unit (GCU) is identical and interchangeable with the two main GCUs.

The main functions of the APU GCU are :

- voltage and frequency regulation
- Auxiliary Generator Line Contactor (AGLC) control in accordance with ECMU
- control and protection
- No Break Power Transfer (NBPT)
- interface with the SDACs
- BITE function.

The BITE signals are connected via the Ground Power Control Unit (GPCU) to the Central Maintenance Computers (CMCs).

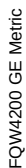


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APU GENERATOR OIL TEMPERATURE SENSOR

A temperature sensor is located on the APU generator oil outlet.

A high oil temperature leads to an immediate automatic shut down of the APU.



STUDENT NOTES:

FQW4200 GE Metric

AC AUXILIARY GENERATION D/O

APU Generator
Generator Control Unit
APU Generator Control Switch
APU GLC Control and Monitoring
Transfer Circuit
ECMU
Feeder Line
Operation

APU GENERATOR

The APU generator can supply all or parts of the normal network, depending on the priority logic. The APU generator is a two pole high speed (24000 RPM) brushless spray oil cooled generator.

Speed regulation is made by the APU (there is no Constant Speed Drive part); therefore, it is not interchangeable with the IDGs. But the structure of the generator is identical to that of the IDG.

The APU generator is cooled and lubricated by the APU oil. An oil temperature bulb is installed on the APU generator oil outlet part. The bulb is directly connected to the APU Electronic Control Box (ECB). In case of oil temperature above 185 °C, the ECB commands an immediate shutdown of the APU.

GENERATOR CONTROL UNIT

The APU Generator Control Unit (APU GCU) is identical and interchangeable with IDG GCUs due to pin-programming.

The APU GCU main functions are:

- control of the field excitation through the Generator Control Relay (GCR)
- voltage regulation.
- control of the APU GLC through the Power Ready Relay (PRR) in conjunction with ECMU1
- control and protection of the APU generator and the network.

The APU GCU has an interface with the ECAM via the SDAC and CMS via the GPCU.

Note: speed regulation is made by the APU ECB. At 95 % RPM, the ECB provides an APU ready signal to the GCU.

APU GEN CONTROL SWITCH

The APU generator switch is used to connect or disconnect the APU generator and to reset the APU GCU.

- The FAULT legend only comes on if the switch is pressed in, the APU is running (> 95 %), and one parameter is not correct.

- The OFF legend comes on when the switch is released out.

After a fault detection (tripping of the generator), the GCU must be reset by setting the switch to OFF and back to ON.

APU GLC CONTROL AND MONITORING

The APU GLC is under control of the GCU and ECMU1. If all generator parameters are correct, the GLC connects the generator to the transfer line. The connection to the busbars (BTCs and GLCs) depends on the priority logic and the No Break Power Transfer (NBPT).

TRANSFER CIRCUIT

The transfer circuit consists of the transfer line, the two BTCs and the SIC. This circuit enables the seven power sources (GEN 1, 2, APU GEN, External A and B) to supply all or half of the network according to the priority logic and the NBPT rules.

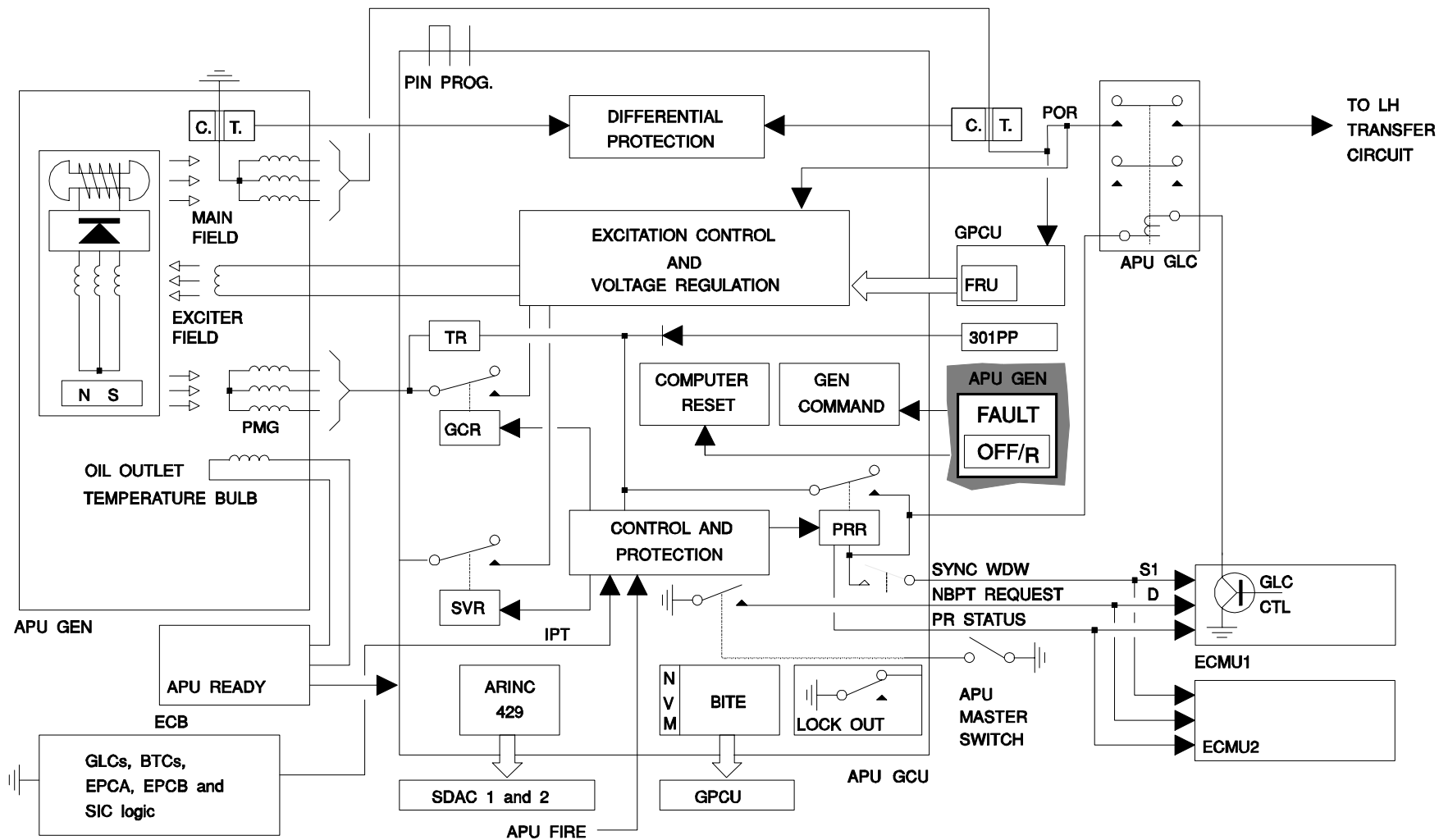
ECMU

The main task of the ECMU1 in the AC auxiliary generation is to control and monitor the APU GLC on ground, in NBPT condition.

The NBPT allows two AC power sources to be connected in parallel during the transfer phase.

After transfer completion, a special protection in the ECMU and GCU avoids an Inadvertent Parallel Trip (IPT) condition.

Due to NBPT, the APU generator has priority over External Power B. Once the APU generator is connected, phase A is sent to the Frequency Reference Unit (FRU), in the GPCU. The Frequency Reference Unit signal is sent to the other GCUs and serves as a reference for further NBPT.



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FEEDER LINE

The feeder line is also split into two cables per phase. They are routed through the cargo compartment ceiling to rack 700 VU in the avionics compartment, where they are sent through a six hole Current Transformer (CT) before connection to the APU GLC.

The feeder line and the APU generator are protected by the differential and open cable protection

OPERATION

With the APU MASTER and APU generator switch set to ON and APU running above 95% , the Generator Control Relay (GCR) is closed and the generator is excited.

If all parameters are correct, the Power Ready Relay is closed. The GCU sends the S1 signal required for a NBTP (on ground only) to the ECMUs. ECMU1 closes the APU GLC to establish an NBTP with the APU generator and the power source actually supplying the network.

STUDENT NOTES:

STUDENT NOTES

AC EMERGENCY GENERATION

Constant Speed Motor/Generator
Constant Speed Motor/Generator GCU
Control
Distribution

CONSTANT SPEED MOTOR/GENERATOR

The Constant Speed Motor/Generator (CSM/G) is driven by the green hydraulic system pressurized by engine 1 and 2 hydraulic pumps or by a Ram Air Turbine (RAT) pump in case of unavailability of the green hydraulic pumps.

Power	8 KVA
Voltage	115 V
Frequency	400 Hz
Speed	12000 RPM
Phases	3

Note : With the green hydraulic system only powered by the RAT pump, the CSM/G power is reduced to 3.5 KVA.

CONSTANT SPEED MOTOR/GENERATOR GCU

The emergency Generator Control Unit regulates the CSM/G speed and its output voltage. It controls and protects the system.

The CSM/G GCU detects faults and sends them to the Central Maintenance Computers (CMCs). It also incorporates a BITE function.

CONTROL

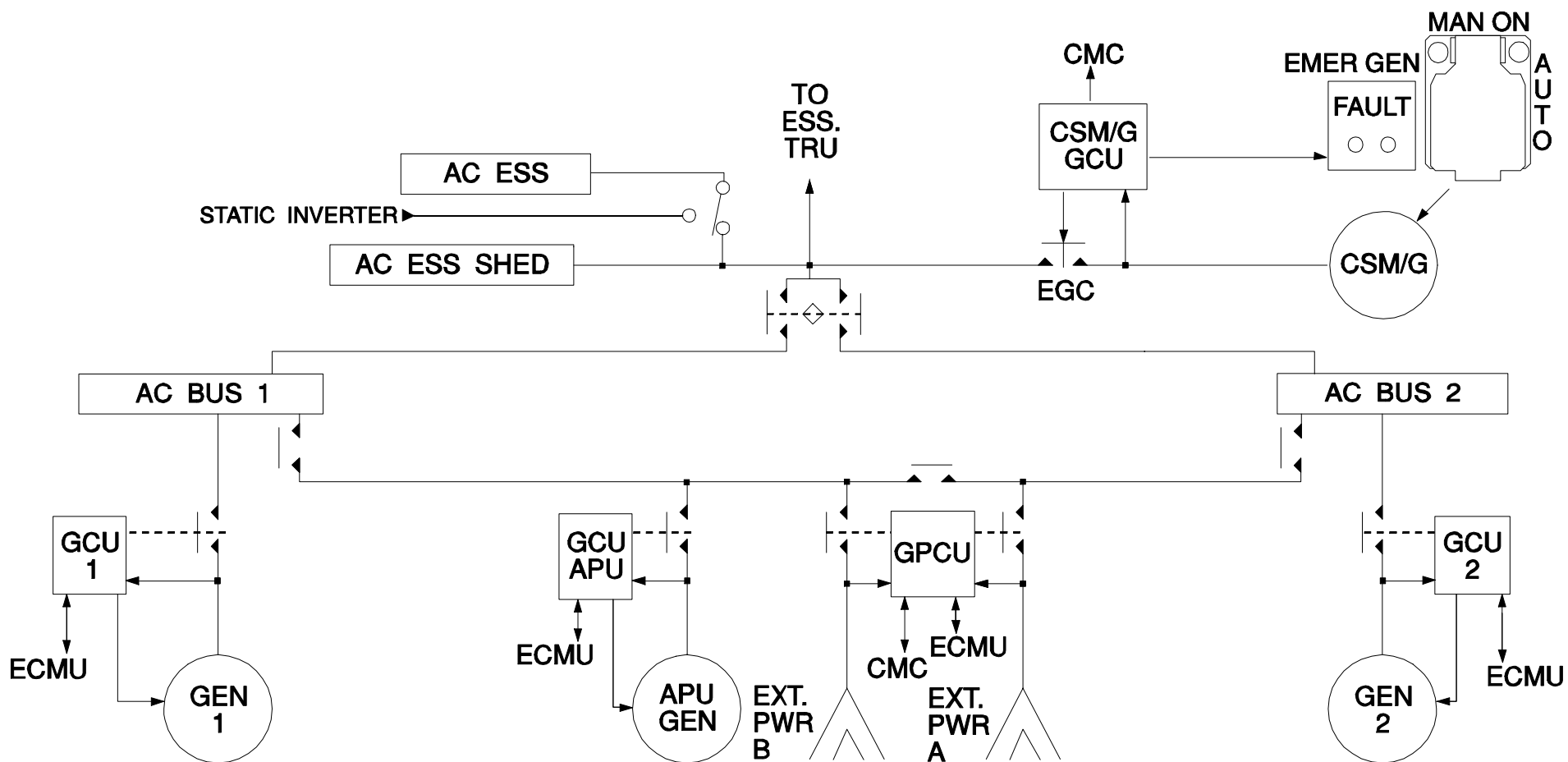
When the AC main buses are lost, the CSM/G automatically starts.

If the automatic start fails, the CSM/G must be manually started using the MAN ON pushbutton switch located on the overhead panel.

Note : In case of CSM/G shutdown due to a failure, the EMER GEN FAULT legend comes on red.

DISTRIBUTION

The CSM/G supplies the AC ESS BUS, the AC ESS SHED BUS and the ESS TRU through the Emergency Generator Contactor (EGC).



STUDENT NOTES:

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AC EMERGENCY GENERATION D/O

Purpose
CSM/G
CSM/G GCU
Emergency Generator Contactor
Automatic Control
Supply Logic
Manual Control

PURPOSE

The AC Emergency Generation system is used to restore the power supply to the essential networks in case of loss of AC main buses (emergency configuration).

CSM/G

The Constant Speed Motor/Generator (CSM/G) consists of a hydraulic motor which drives an AC generator.

The CSM/G is powered by the Green Hydraulic System which is normally pressurized by the engine pumps OR by the Ram Air Turbine (RAT).

CSM/G GCU

The CSM/G is controlled and monitored by the CSM/G Generator Control Unit (GCU) and provides the AC power to the ESSENTIAL networks.

EMERGENCY GENERATOR CONTACTOR

The EMERGENCY Generator Contactor (EGC) is under control of the GCU and supplies to the ESSENTIAL networks.

AUTOMATIC CONTROL

The CSM/G is automatically controlled when AC buses 1 and 2 are lost.

As soon as AC main busbars are lost (contactor 3XC de-energized), the start up sequence is initiated by the generation of a DC signal from the CSM/G control logic to the GCU.

Then, the CSM/G is connected to the hydraulic system and begins to run.

When the nominal CSM/G voltage and frequency are reached, the CSM/G GCU authorizes the connection to the network.

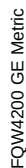
SUPPLY LOGIC

This topic presents you the different configurations according to CSM/G supply and flight conditions.

- When the CSM/G is powered by the hydraulic engine pumps, it remains on line until the end of the flight.
- When the CSM/G is powered by the RAT hydraulic pump, the electrical load is automatically reduced to approximately 3.5KVA. The AC BUS 401XP and the DC ESS BUS SHED are no longer supplied. The CSM/G stops when the slats are extended. The two main batteries supply the DC ESS BUS and, via the static inverter, the AC ESS BUS until the end of the flight.

MANUAL CONTROL

If the automatic control fails, the CSM/G can be manually controlled by the MAN ON pushbutton switch located on the EMER ELEC panel.



STUDENT NOTES:

CONSTANT SPEED MOTOR/GENERATOR D/O

Constant Speed Motor
AC Generator

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CONSTANT SPEED MOTOR

The Constant Speed Motor (CSM) is a hydraulic motor which drives a generator.

The CSM is controlled by a solenoid control valve and a servo-valve.

The CSM is equipped with a solenoid control valve which is used to allow the hydraulic power to run the CSM.

The solenoid control valve is also used to isolate the hydraulic power from the CSM when not used and to stop the CSM/G in the event of failure detected by the GCU protection module.

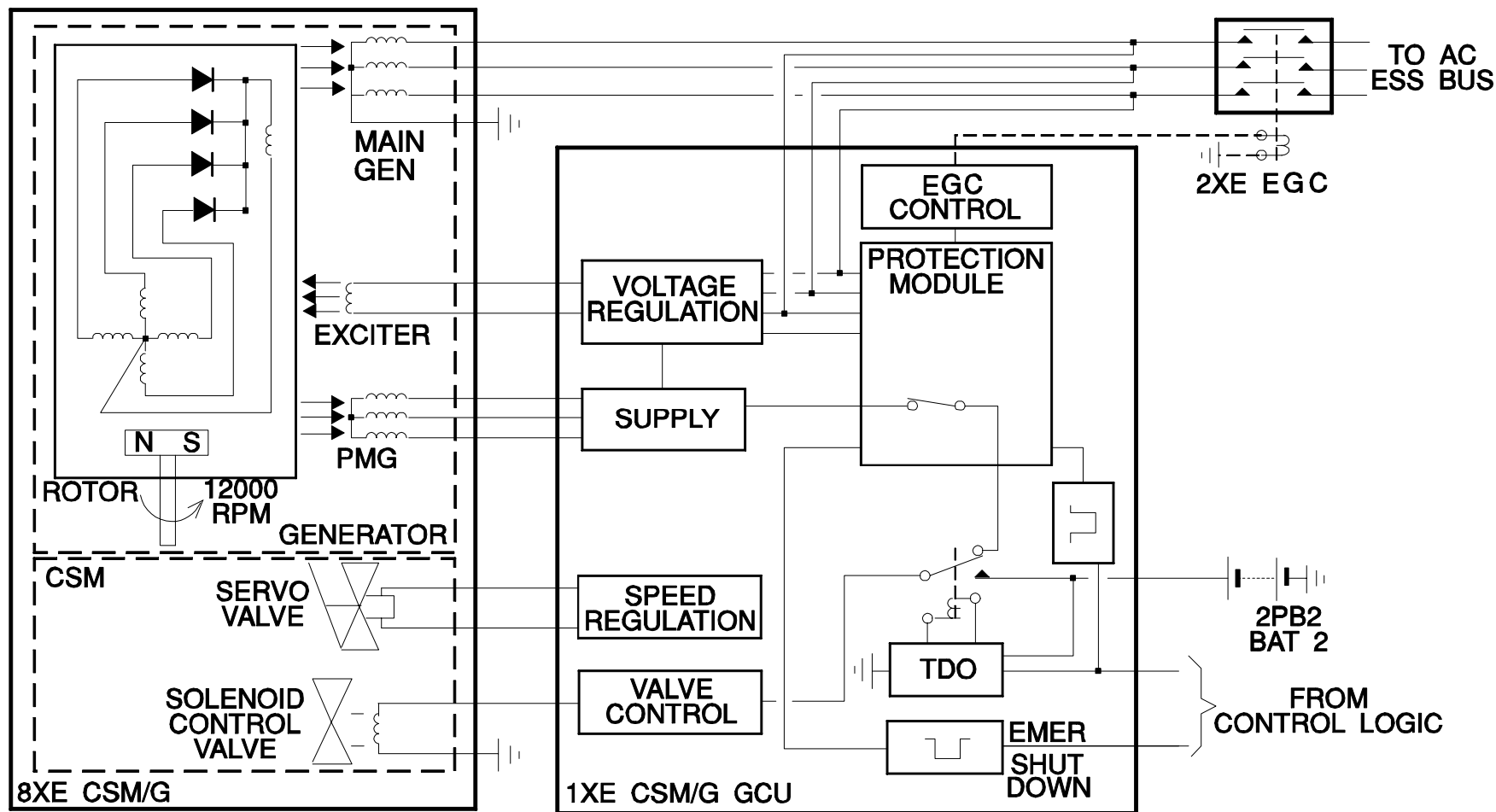
The servo-valve is controlled by the GCU speed regulation circuit and regulates the flow of the Green hydraulic fluid to maintain a constant speed for the generator.

AC GENERATOR

The generator consists of three stages :

- a main generator,
- an exciter and
- a Permanent Magnet Generator (PMG).

The generator basic operation is identical to that of the main or auxiliary generation.



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STUDENT NOTES:

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CSM/G CONTROL LOGIC

- Automatic Start
- Manual Start
- RAT Extension
- Automatic Shutdown in Flight
- Automatic Shutdown on Ground
- Interface and Warnings
- Test

AUTOMATIC START

The CSM/G control is active when the aircraft is in flight (landing gear retracted), the HOT BATTERY BUS 701PP is supplied and AC BUSES 1 and 2 are lost.

Loss of AC main buses (relays 12XE and 9XE de-energized) sends a signal to the CSM/G control circuit of the CSM/G GCU.

MANUAL START

If the automatic start fails, the CSM/G must be started manually by pressing the MAN ON pushbutton switch located on the overhead emergency power control panel.

Note : If the MAN ON switch is pressed in normal configuration, the CSM/G starts and takes over the supply to the ESSential network up to the shutdown of engines 1 and 2.

RAT EXTENSION

During CSM/G operation, if the speed of engines 1 and 2 falls below 50%, the Ram Air Turbine (RAT) is automatically extended.

When the speed of engines 1 and 2 falls below 50%, relay 2PH is energized and opens the circuit to the Hydraulic System Monitoring Unit (HSMU). The HSMU provides the RAT extension and runs the RAT hydraulic motor which in turn pressurizes the green system to keep the CSM/G operative.

AUTOMATIC SHUTDOWN IN FLIGHT

If the CSM/G is driven by the green hydraulic system and engines 1 or 2 running above 50%, the CSM/G supplies the ESSential network up to engine shutdown.

The RAT is extended (engines 1 and 2 below 50%).

In this condition, if the slats are extended, the Slats and Flaps Control Computer (SFCC) provides a signal via closed relay 2PH to energize relay 7XE which in turn activates the CSM/G shutdown circuit and opens the CSM/G control line.

AUTOMATIC SHUTDOWN ON GROUND

After landing with the CSM/G operative but not supplied by the RAT, the CSM/G is switched off as soon as engines 1 and 2 are shutdown.

INTERFACE AND WARNINGS

The shutdown signal is also sent via the Battery Charge Limiters (BCLs) to the SDACs and to the EMERgency GENeration FAULT light on the overhead panel.

Relay 26XE provides an electrical power emergency configuration signal to:

- the cargo compartment ventilating and heating system,
- the emergency lighting system,
- the navigation system.

TEST

To test the emergency generator on ground (daily check), the green hydraulic system must be pressurized by the electric pump.

Then the EMERgency GENerator TEST pushbutton must be pressed in.

This closes relay 13XE which simulates flight configuration.

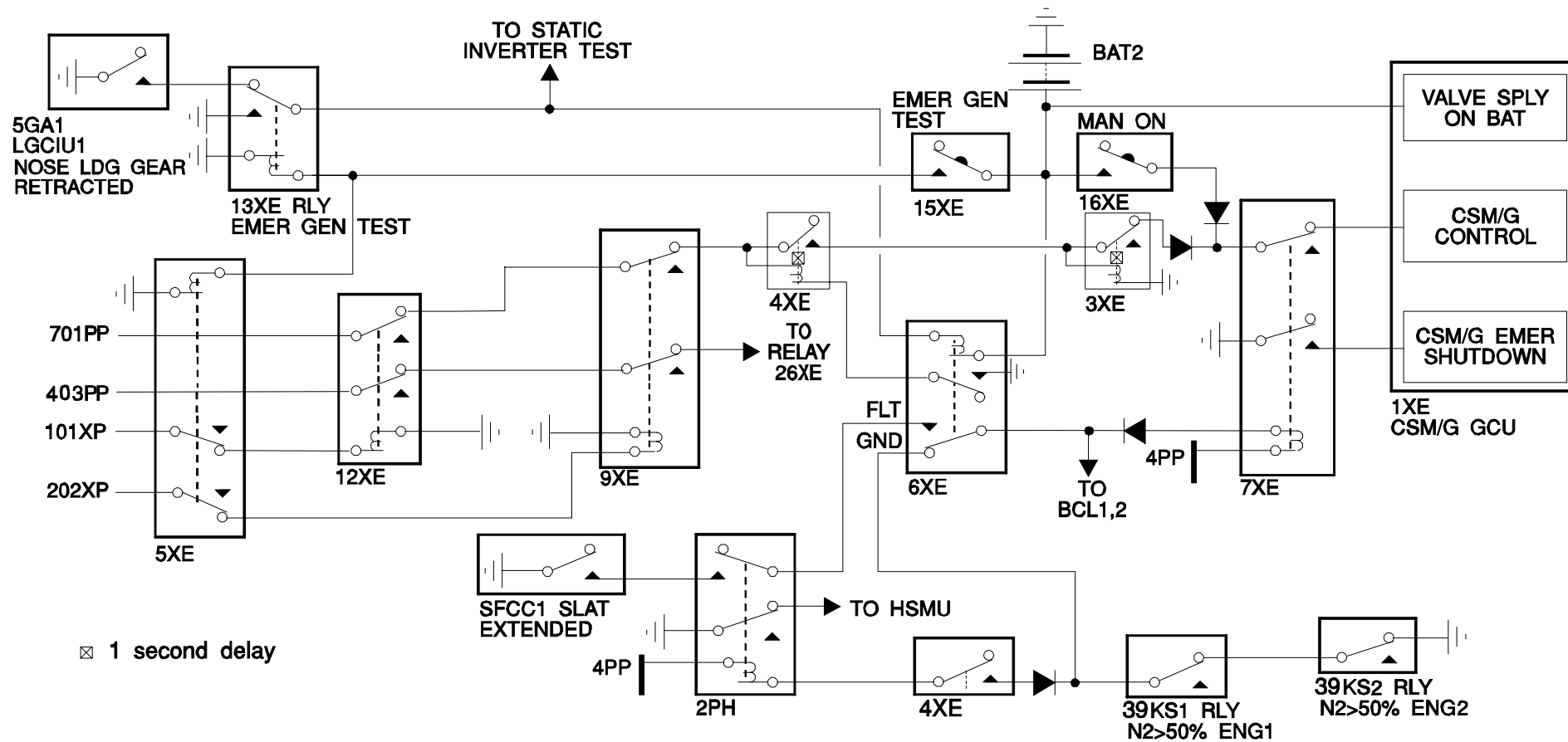
Relay 5XE is energized to simulate loss of AC BUSES 1 and 2.

Relay 6XE is energized (flight configuration).

Note : the slats must be retracted.

The CSM/G control circuit is then activated and the emergency generator takes over as long as the EMER GEN TEST pushbutton is pressed in.

During the test , the RAT extension signal is inhibited by the HSMU.



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STUDENT NOTES:

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STATIC INVERTER PRESENTATION

Static Inverter
System Description

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STATIC INVERTER

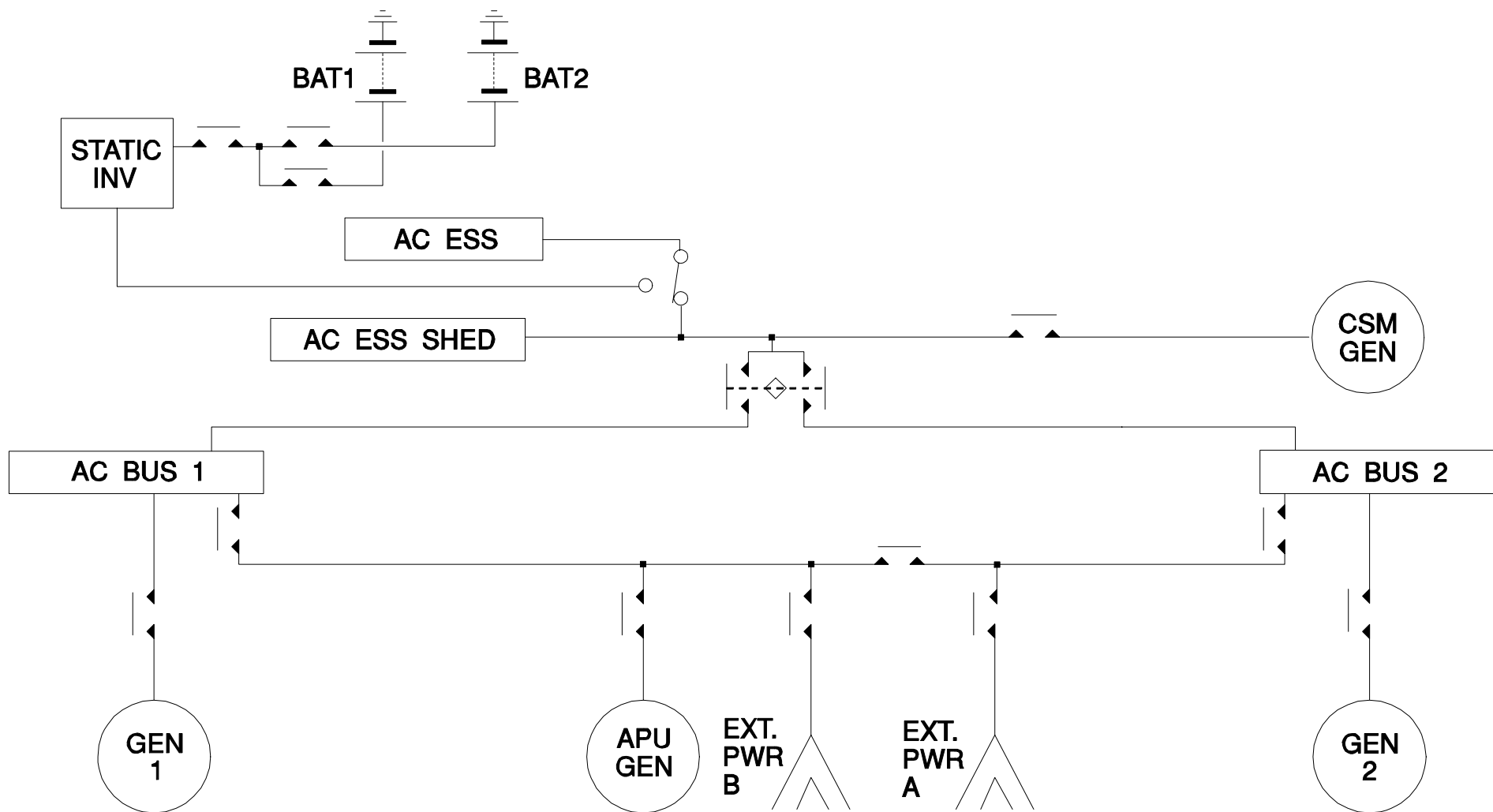
If no AC source is available the static inverter, supplied by the batteries, provides AC power to the AC ESSential BUS.
The AC ESSential SHED BUS is no longer supplied.

During operation, the static inverter voltage and frequency can be displayed on the ELEC AC ECAM page.

Power	2.5 KVA
Voltage	115 V
Frequency	400 Hz
Phase	1

SYSTEM DESCRIPTION

Normally AC ESSential and AC ESSential SHED buses are powered from AC BUS 1.
The static inverter is not powered.



STUDENT NOTES:

FQW4200 GE Metric

STATIC INVERTER D/O

Normal Configuration
Emergency Configuration
Monitoring
Test

NORMAL CONFIGURATION

The static inverter converts the direct current from the batteries into a single phase alternating current.

The static inverter is not operational as long as the essential network is supplied.

Note : The static inverter supplies only the AC ESS BUS.

Power	2.5 KVA
Frequency	400 Hz
Voltage	115 v
Phase	1

The static inverter only operates :

- On ground : when the batteries are the only power supply source with the BAT1 and BAT2 pushbutton switches pressed in,
- In flight : when no Alternating Current AC source is available.

EMERGENCY CONFIGURATION

The static inverter is used in flight in emergency configuration when the two AC main buses and the Constant Speed Motor/Generator (CSM/G) are not available.

The static inverter operates automatically in the following cases :

- when the CSM/G is not available (at slat extension with Ram Air Turbine (RAT) extended) and the aircraft speed above 50 Kts,
- at landing with aircraft speed lower than 50 Kts and both BAT1 and BAT2 pushbutton switches pressed in.

MONITORING

The parameters of the static inverter are displayed on the ECAM ELEC AC page.

The following parameters of the static inverter are monitored :

- Fan failure,
- Overheat : temperature higher than 110°C,
- Output Over Voltage : voltage higher than or equal to 130V±1.5V,
- Output Under Voltage : voltage lower than or equal to 100V ±4V.

In case of failure (for example output overvoltage), the static inverter generates a signal for the SDACs.

Note : In case of output overvoltage or 28 VDC input not present, the static inverter is switched off.

TEST

To perform the static inverter test, the EMERgency GENerator TEST pushbutton (15XE) must be pressed in. This simulates "aircraft in flight".

The following conditions must be fulfilled before pressing the pushbutton :

- all main AC buses not supplied
- BAT pushbutton switches in off position
- no pressure in the green hydraulic system (emergency generator not connected).

Under these conditions, contactors 2PC and 3PC are closed and batteries 1 and 2 are directly connected in parallel to the static inverter and also to the DC ESS BUS.

The static inverter parameters have to be checked on the ECAM system.

STUDENT NOTES:

AC ESSENTIAL GENERATION SWITCHING D/O

Normal Supply
Abnormal Automatic Supply
Abnormal Manual Supply
Interfaces

NORMAL SUPPLY

Contactors 3XC-A and 3XC-B are energized under several conditions :

- AC BUS 1 is supplied
- 3XC-B is in de-energized position (EMER GEN not operative)
- Relay 23XE and contactor 2XE not energized (EMER GEN not operative)
- AC ESS FEED pushbutton switch in normal position (pressed in).

Note: contactor 3XC is 115 VAC operated.

ABNORMAL AUTOMATIC SUPPLY

Automatic switching is performed in flight and on ground provided the AC ESSential FEED pushbutton switch is pressed in (normal position).

As soon as AC BUS 1 is no longer supplied, the following events occur :

- 1 - contactor 3XC-A opens and the relay 9XN opens.

Then, provided AC BUS 2 is supplied :

- 2 - relay 15XN is supplied
- 3 - relay 11XC is energized
- 4 - relay 3XC-B is energized.

ESSential network is recovered from AC BUS 2.

In flight, relay 6XE is energized. Relay 11XC is self-grounded through contactor 15XN. When AC BUS 1 is recovered, the supply to ESSential network remains on AC BUS 2.

On ground, relay 6XE is de-energized. When AC BUS 1 is recovered, it automatically takes over the supply to the ESSential network.

ABNORMAL MANUAL SUPPLY

In case of automatic switching failure, the FAULT legend on the AC ESSential FEED pushbutton remains on.

The switch has to be released out to perform manual switching.

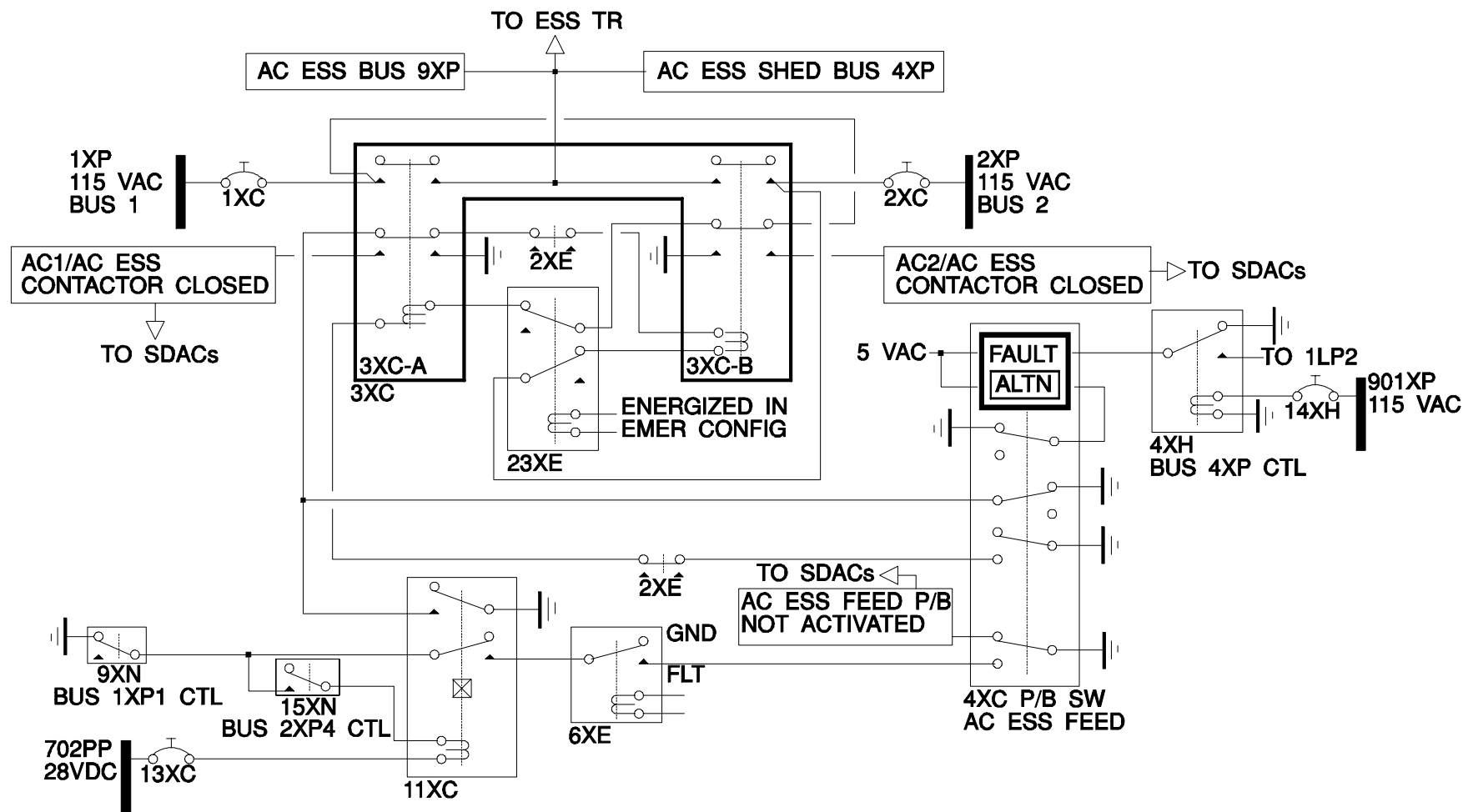
- 1 - ALTN legend comes on white
- 2 - ground is connected to 3XC-B to close it
- 3 - as soon as 3XC-B is closed, the ESSential network is recovered from AC BUS 2.

Then the FAULT legend goes off.

INTERFACES

Relay 23XE is energized as soon as the Constant Speed Motor Generator (CSM/G) Generator Control Unit (GCU) provides a closing signal for contactor 2XE.

This switching gives emergency generator priority to supply the ESSential network. The status of contactors 3XC-A and 3XC-B and the position of the AC ESS FEED pushbutton switch are sent to the SDACs to display these messages on the ECAM.



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STUDENT NOTES

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ELECTRICAL CONTACTOR MANAGEMENT SYSTEM PRESENTATION

Electrical Contactor Management Unit
ECMU Functions

ELECTRICAL CONTACTOR MANAGEMENT UNIT

The system consists of two Electrical Contactor Management Units (ECMUs).

ECMU 1 monitors the network and manages left hand contactors, Auxiliary Generator Contactor (AGC), External Power Contactor B (EPC B) and the System Isolation Contactor (SIC).

ECMU 2 monitors the network and manages right hand contactors and External Power Contactor A (EPC A).

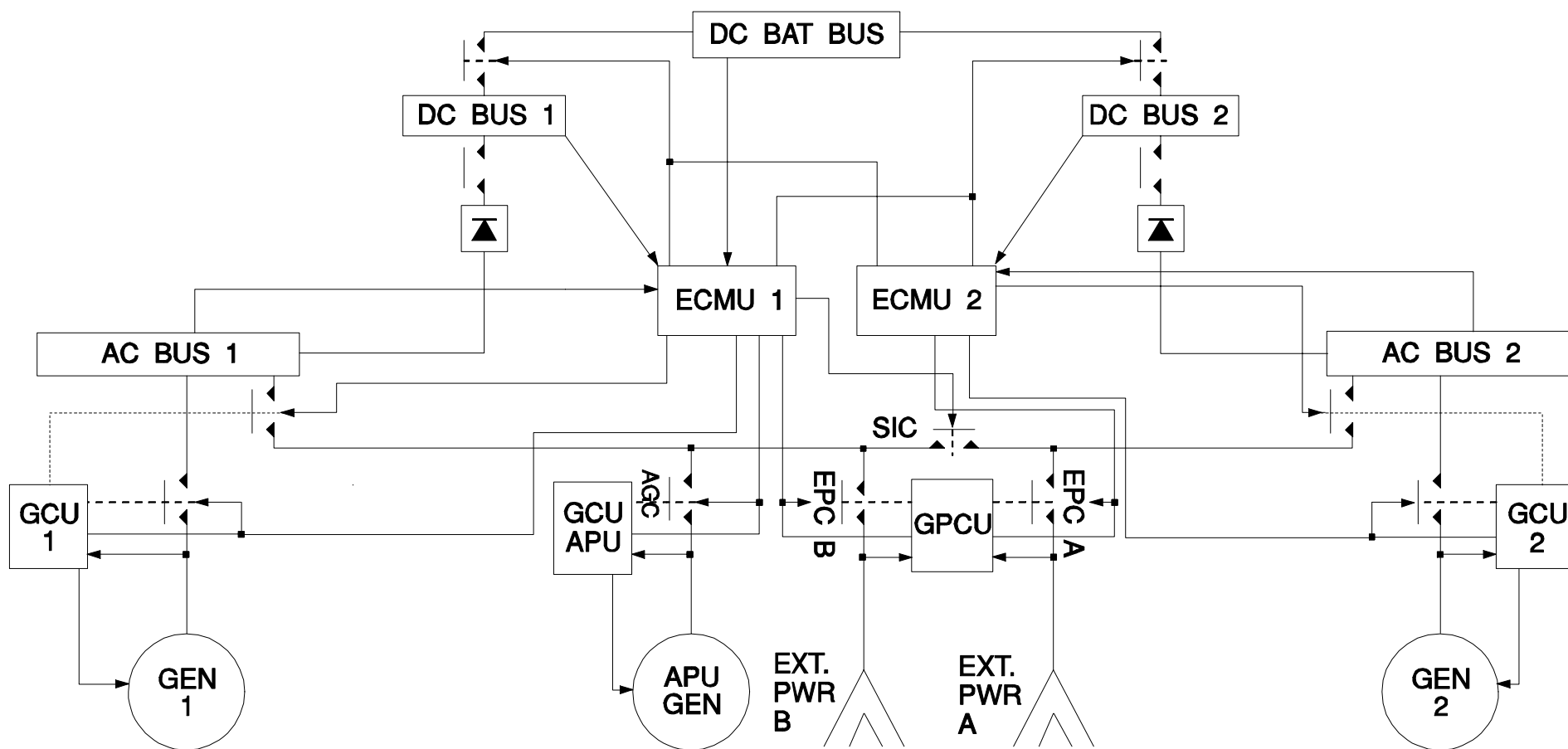
ECMU FUNCTIONS

The main ECMU functions are :

- monitoring of the aircraft network
- No Break Power Transfer (NBPT) function (only available on ground)
- controlling the AC/DC contactors.

The DC contactors are controlled by both ECMUs.

NBPT is done by paralleling AC power sources (generators 1, 2, APU generator or external power A, B) during the transfer period.



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STUDENT NOTES:

ECMU SYSTEM D/O

- General
- Power Supply
- AC Contactors Control
- NBPT Links
- DC Contactors Control
- Galley/Commercial Load Control
- Service Bus Control
- BITE Function

GENERAL

Two identical and interchangeable ECMUs are installed to monitor and control several systems.

The ECMUs control and monitor the following sub-systems :

- contactors responsible for AC main generation and distribution
- No Break Power Transfer (NBPT)
- contactors responsible for DC main generation and distribution
- galley and commercial load
- service bus
- BITE interface.

The ECMUs pin programming identifies :

- equipment installed on side 1 and on side 2
- installation of options
- type of aircraft.

The ECMU is a type 2 computer. It operates as soon as its power is supplied.

POWER SUPPLY

Each ECMU is supplied by four independent 28 VDC power sources depending on the aircraft configuration.

Normal configuration without external power :

- ECMU 1 is supplied from 301PP and 401PP
- ECMU 2 is supplied from 303PP and 403PP.

External power connected :

- ECMU 1 is supplied from External Power B (EPB)
- ECMU 2 is supplied from External Power A (EPA).

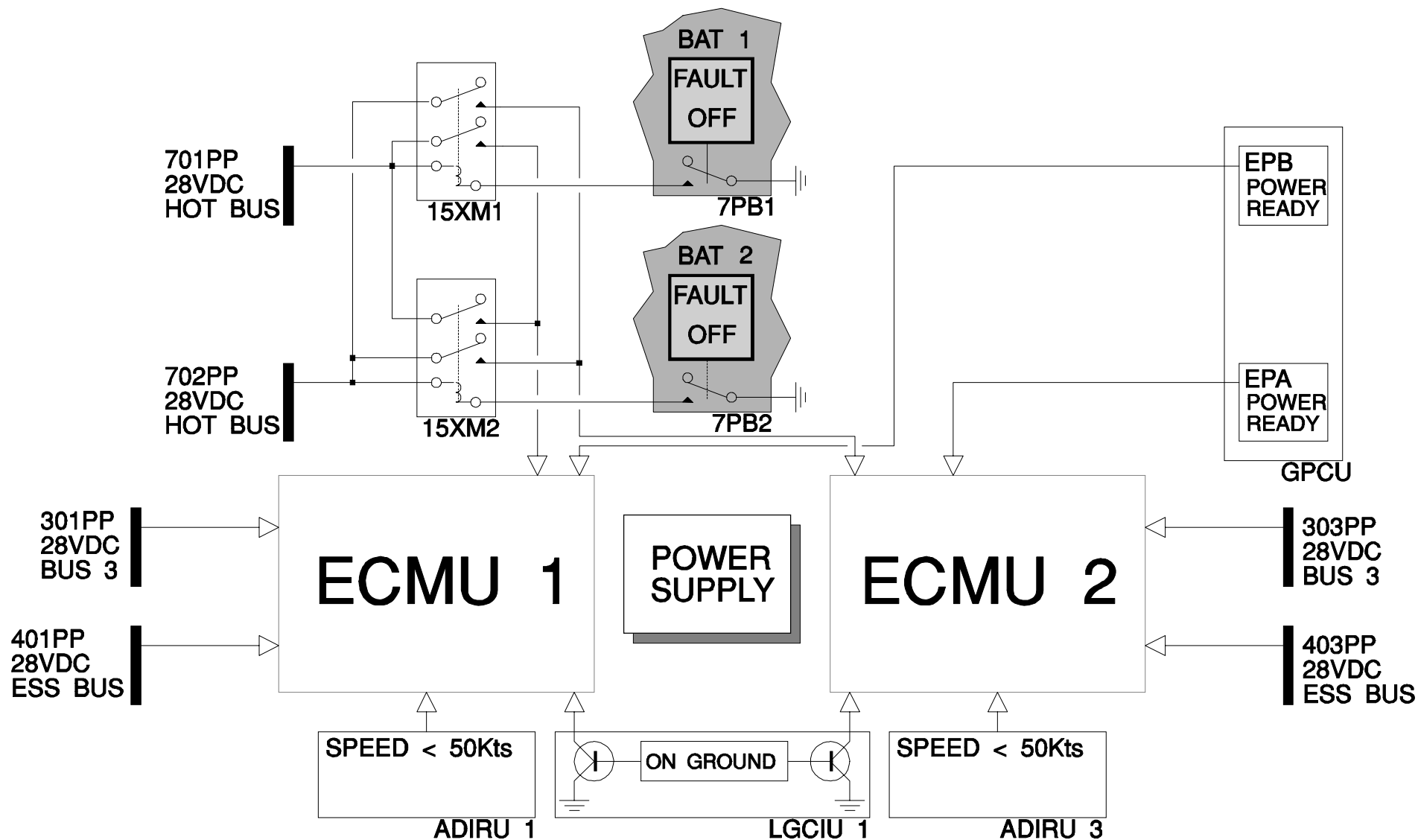
This internal supply has priority over the HOT BUS supply. HOT BUS supply is only possible if the battery switches are in AUTO position.

In electrical emergency configuration, the ECMUs are in stand by mode supplied by the HOT BUSES, because they are not operative in this mode. But in case of successful engine or APU start they become automatically operative to permit the normal network supply by the available generator.

ADIRU : Air Data Inertial Reference Unit

LGCIU : Landing Gear Control and Interface Unit

The ECMUs are interfaced with ADIRU 1 and 3, and the LGCIU 1. LGCIU 1 provides the ground/flight information to both ECMUs. ADIRU 1 provides the speed signal "less than 50 Kts" to ECMU 1. ADIRU 3 provides the speed signal "less than 50 Kts" to ECMU 2.



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AC CONTACTORS CONTROL

ECMU 1 manages only side 1 contactors and ECMU 2 side 2 contactors.

Each ECMU receives the following information :

- voltage from AC BUS 1 for ECMU 1
- voltage from AC BUS 2 for ECMU 2
- from all GCUs (PR status, S1 and D signal)
- all AC contactors and BUS TIE switch status.

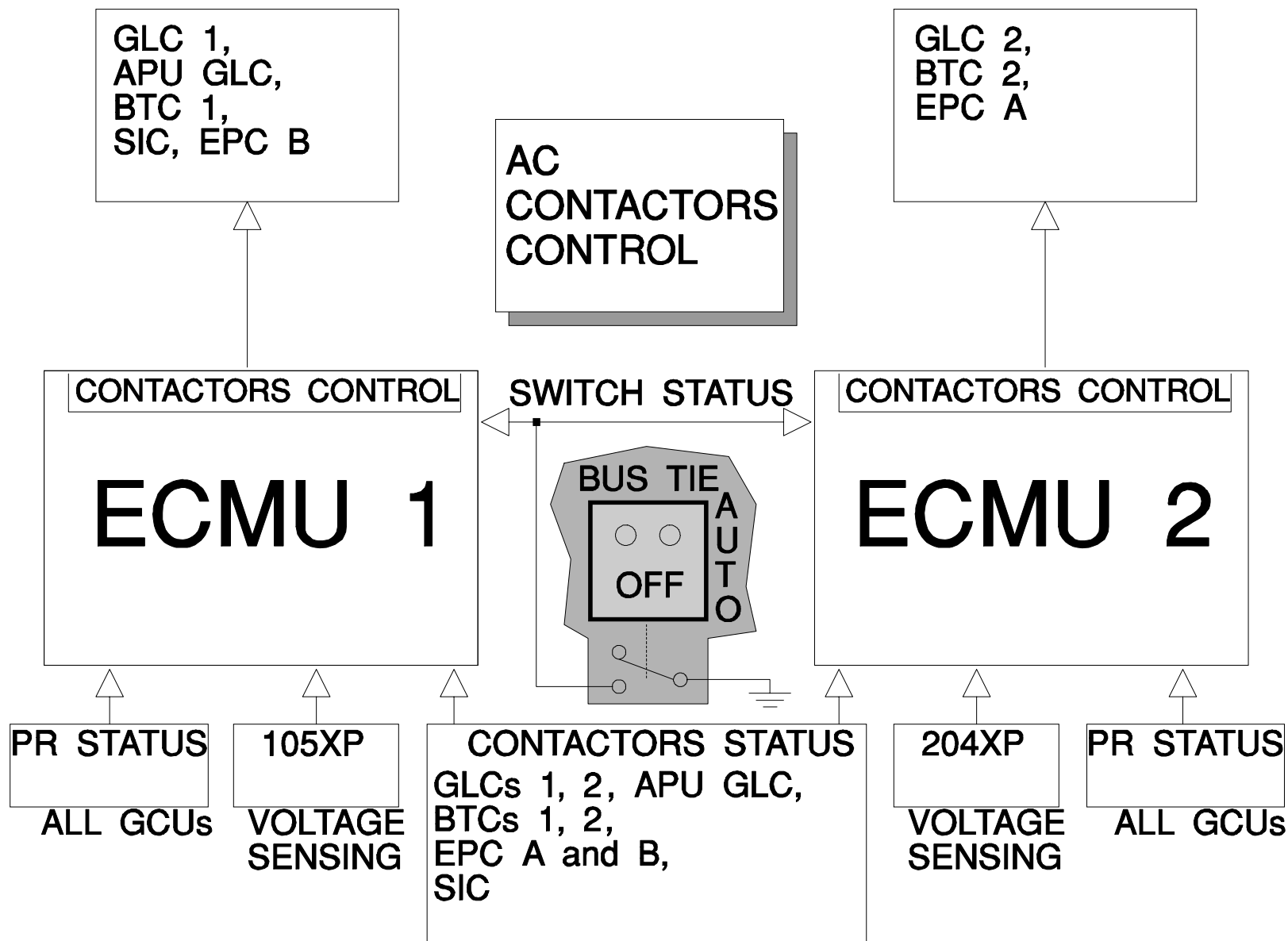
The ECMUs determine the aircraft electrical configuration according to this input status data.

On the basis of this configuration, each ECMU controls the following contactors :

- GLC 1, APU GLC, BTC 1, SIC, EPC B from ECMU 1
- GLC 2, BTC 2, EPC A from ECMU 2.

These contactors are responsible for the connection and the transfer of the AC power sources with respect to the priority rules, the NBPT and the IPT.

Note : With the BUS TIE switch in the OFF position, the 2 BTCs and the SIC are permanently open.



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NBPT LINKS

The NBPT function (only available on ground) serves to perform a power supply transfer between two power sources (such as IDGs, APU generator, external power A and B) without busbar supply cutoffs.

On the basis of the data provided by the 3 GCUs, the GPCU and the contactor status, the ECMUs manage the following contactors :

- ECMU 1 : GLC 1, APU GLC, BTC 1, SIC, EPC B
- ECMU 2 : GLC 2, BTC 2, EPC A.

This managing enables the paralleling of two synchronized AC power sources during the transfer phase.

The signals involved in the NPBT function are :

from GCU :

- D - request signal
- S1 - established synchronization signal
- Power Ready Relay status.

from ECMU : S2 - NBPT end

from GPCU : Frequency Reference Unit (FRU)

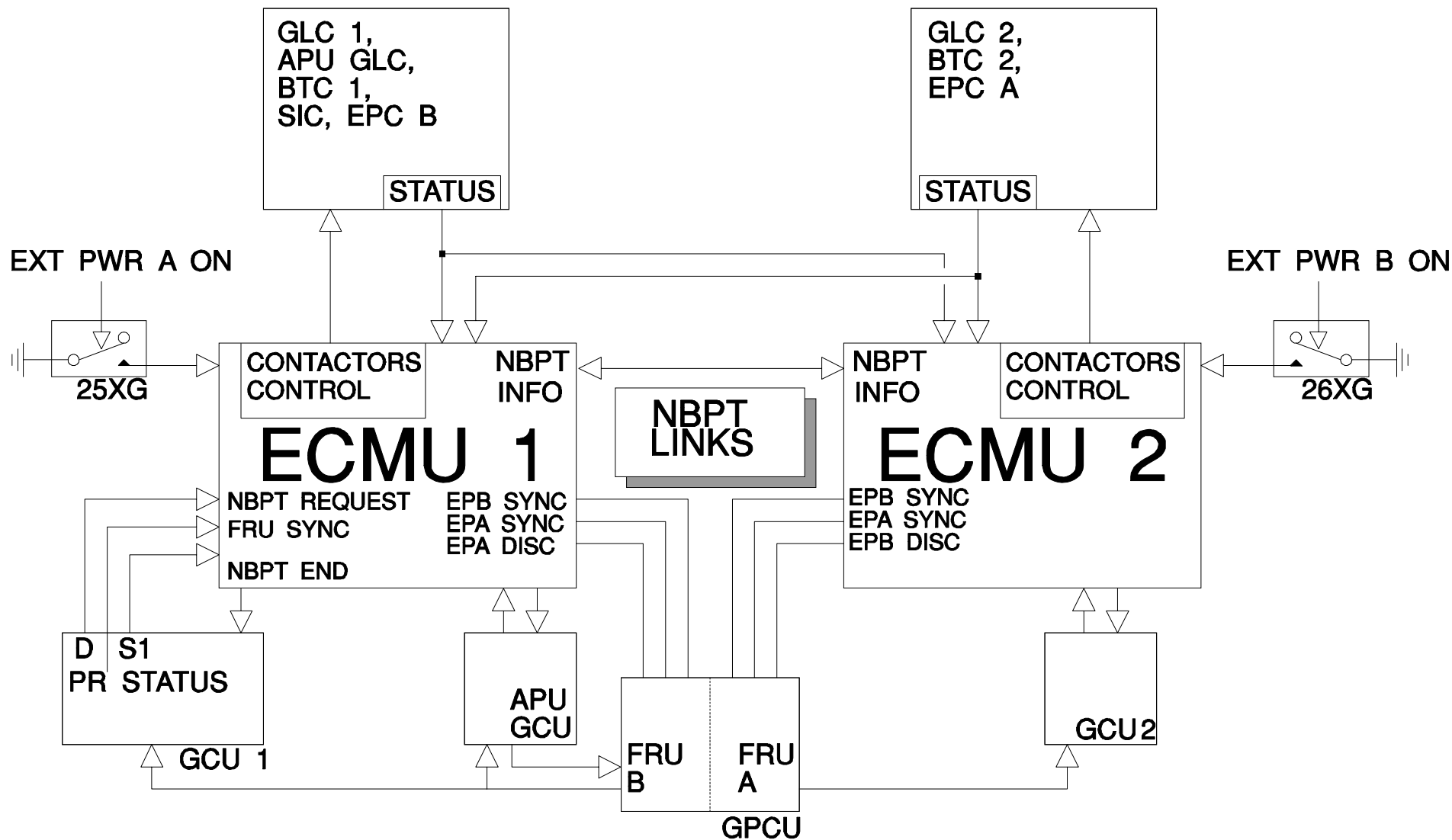
from APU GCU : S4 - FRU change signal.

If the ECMUs detect a persisting paralleling between two power sources, they activate the appropriate protections by opening the related contactors.

ECMU 1 lost GLC 1*, BTC 1, APU GLC, EPC B, SIC

ECMU 2 lost GLC 2*, BTC 2, EPC B.

(*) : Remain closed due to self-holding function.



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DC CONTACTORS CONTROL

Each ECMU controls contactors 1PC1 and 1PC2 according to the following status data in order to manage the main DC buses supply.

Both ECMUs receive the contactor status data of 5PU1, 5PU2, 1PC1, 1PC2, and 4PC.

ECMU 1 receives :

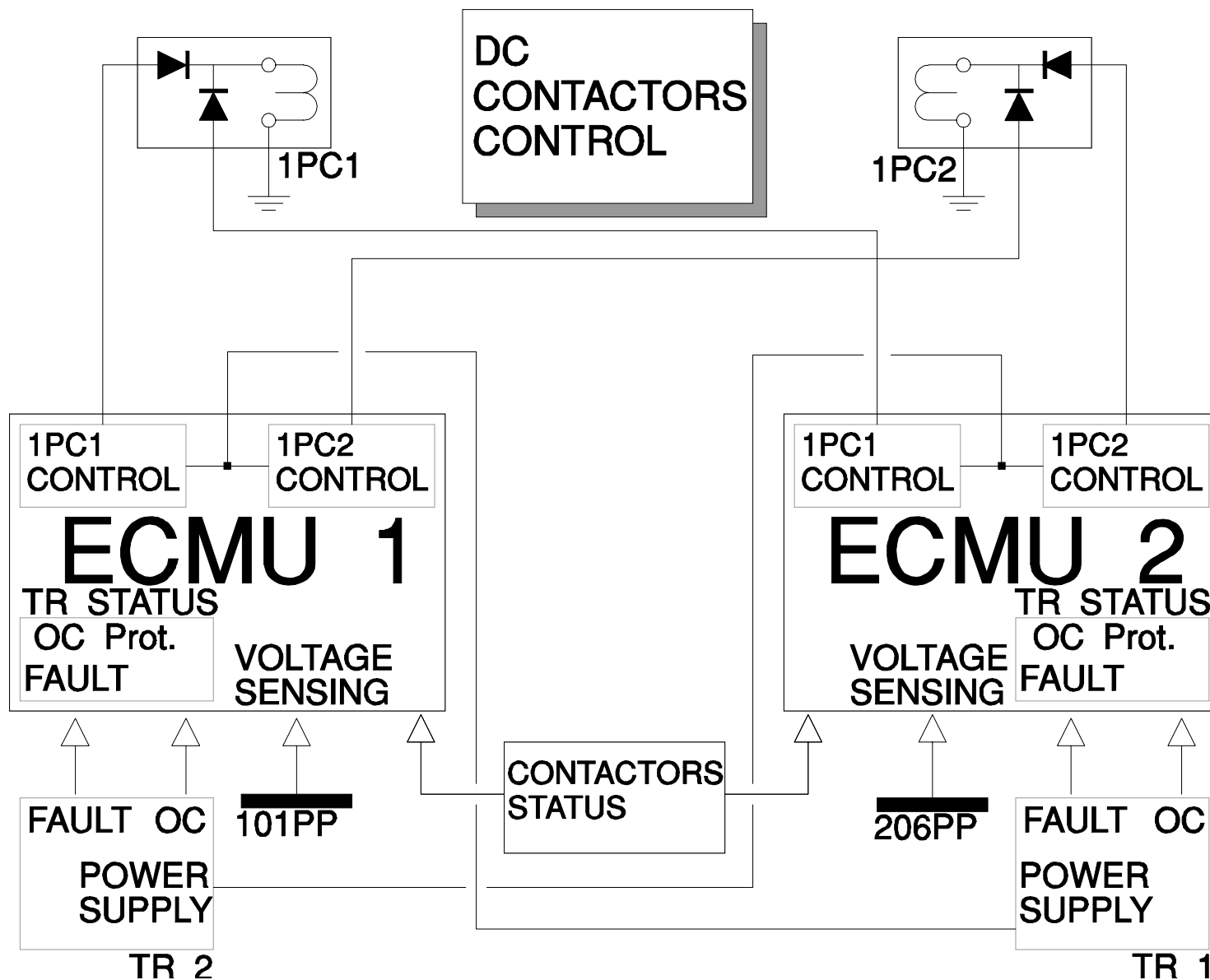
- status of TR 2 (FAULT, OverCurrent)
- 28 VDC from TR 1 to supply 1PC1 and 1PC2 control logic
- voltage from busbar 101PP.

ECMU 2 receives :

- status of TR 1 (FAULT, OverCurrent)
- 28 VDC from TR 2 to supply 1PC1 and 1PC2 control logic
- voltage from busbar 206PP.

Note : the OverCurrent signal is used by the ECMU to inhibit the automatic transfer in case of detected overcurrent on one side.

Loss of one ECMU does not affect the main DC buses supply.



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GALLEY/COMMERCIAL LOAD CONTROL

The galley/commercial load control consists in controlling the galley Remote Control Circuit Breakers (RCCBs) which serve to shed the galley supply according to the electrical sources available and overloads, and the Galley and Commercial control switches position.

Each ECMU determines the electrical configuration of the aircraft on the basis of the status data from the three GCUs, the GPCU (overload) and the two control switches.

The two main relays, 2XA1 and 2XA2, are supplied from busbar 601PP via the two control switches in series and from the corresponding ECMU. These two main relays control the power to the corresponding RCCBs.

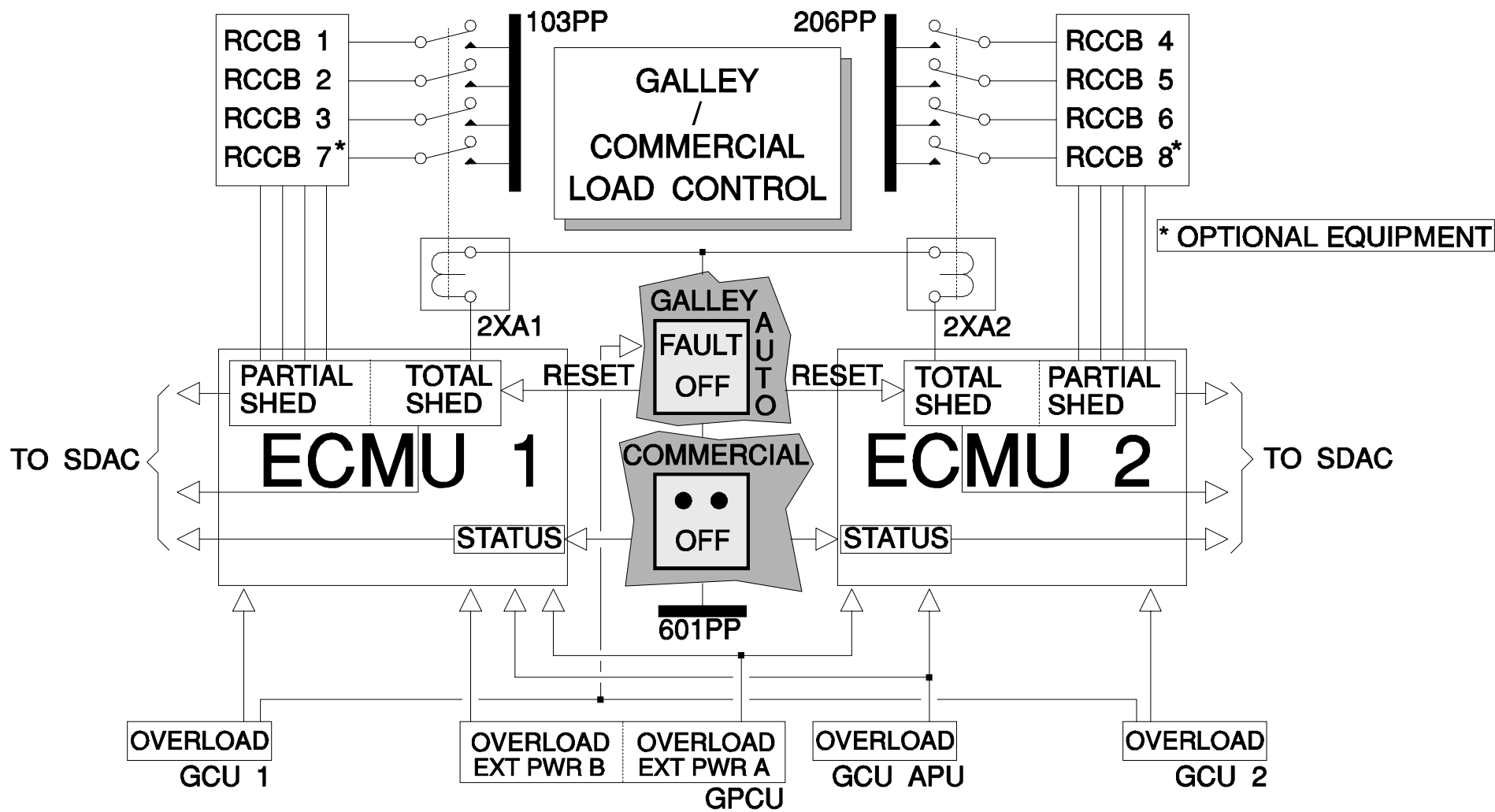
Individual opening or closing of the RCCBs is controlled from the PARTIAL SHED logic of each ECMU. If one RCCB is open due to generator overload, the message : "GALLEY PART SHED" is displayed on ECAM.

If the GALLEY control switch is in the off position :

- the OFF legend comes on
- both main relays are de-energized
- all galleys are off
- the ECAM message "GALLEY SHED" is displayed
- the control logic is reset.

If the COMMERCIAL control switch is in the off position :

- the OFF legend comes on
- all galleys are off
- all service buses are off
- the ECAM message "COMMERCIAL OFF" is displayed.



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SERVICE BUS CONTROL

The ECMUs control the RCCBs which serve to supply the SERVICE BUSES. The opening or closure of the RCCBs depends on the aircraft supply configuration sensed by the ECMUs.

ECMU 1 monitors and controls RCCBs 6XN1 and 7XN1.

ECMU 2 monitors :

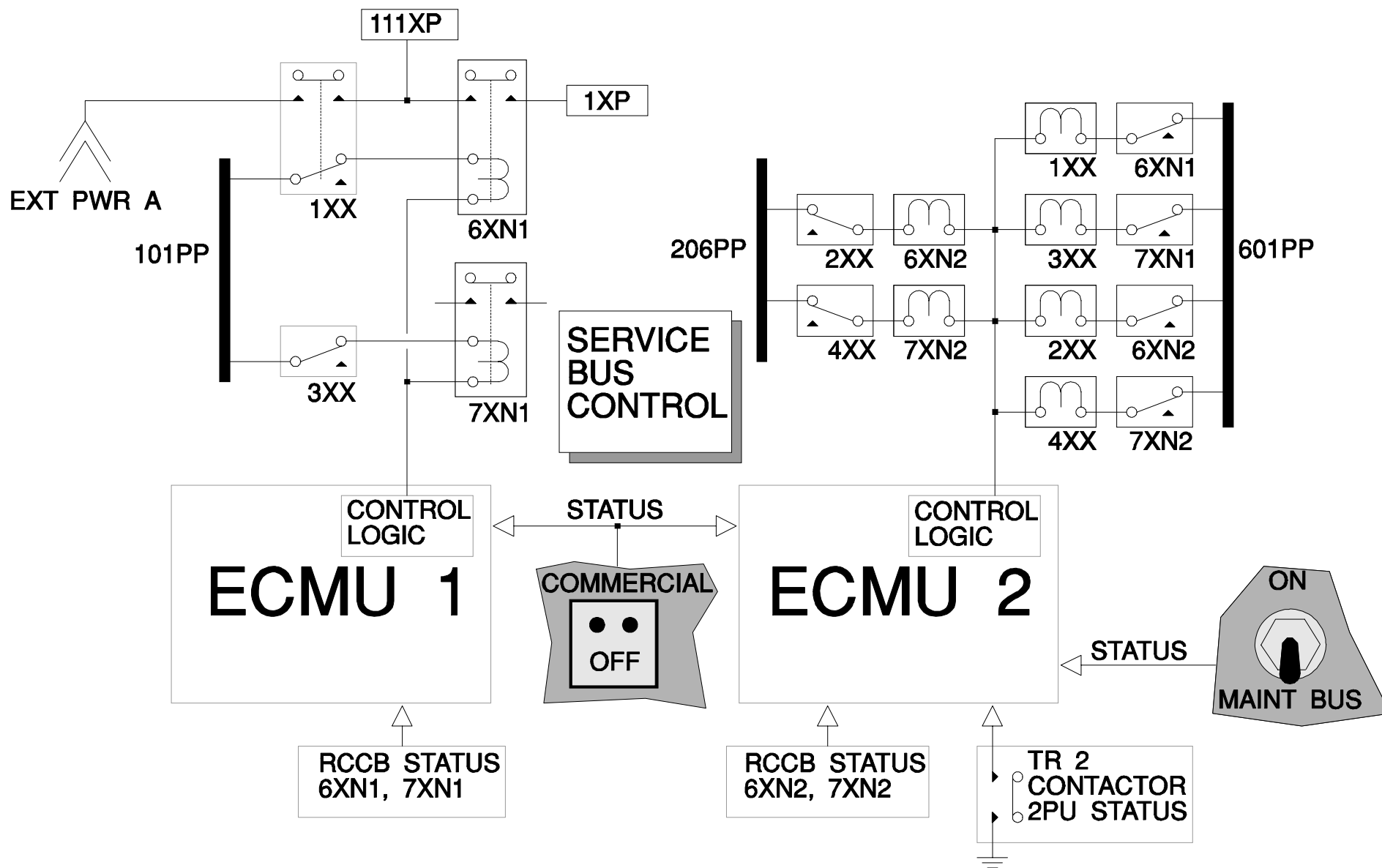
- RCCBs 6XN2 and 7XN2
- TR2 supply contactor 2PU (TR supply from AC BUS 2)
- position of the MAINT BUS switch.

ECMU 2 controls RCCBs 6XN2, 7XN2, 1XX, 2XX, 3XX and 4XX.

If the COMMERCIAL switch is in the off position :

- the ECAM message "COMMERCIAL OFF" is displayed
- the OFF legend comes on
- all RCCBs open, the SERVICE BUS is no longer supplied.

Note : Also the galleys are no longer supplied.



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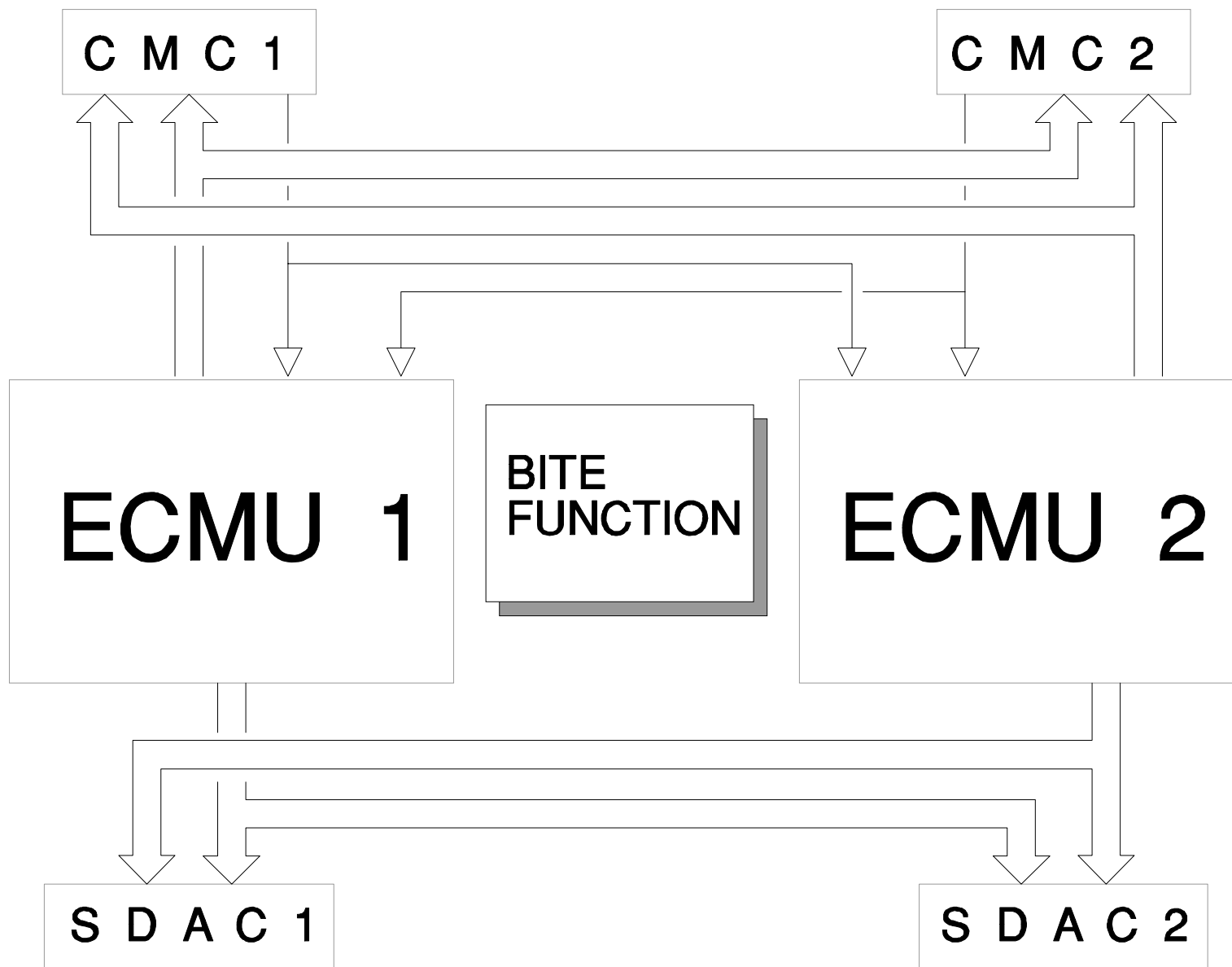
BITE FUNCTION

ARINC 429 buses serve to transmit BITE data to both CMCs and configuration data to both SDACs.

Each ECMU continually monitors its inputs, outputs and internal functions to determine if a failure condition exists. Failure information will be stored in the internal NVM and also sent to the CMCs.

A self-test of the ECMU is automatically performed at power-up, or manually by requesting a test through the CMS.

Based on the analysis of the ECMU functions, each ECMU provides data to both SDACs to display on ECAM the condition of the power supply and the messages "GALLEY SHED", "GALLEY PART SHED" or "COMMERCIAL OFF".



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STUDENT NOTES

FQW4200 GE Metric

AC WARNING AND OPERATING LIMITATIONS

- GEN Fault
- GEN Overload
- IDG Oil LO PR/OVHT
- AC Bus Fault
- AC ESS Fault
- EMER Config
- ECMU Fault
- Operating Limitations

GEN FAULT

This warning appears in case of generator disconnection.

GEN OVERLOAD

This warning is triggered if the load of one generator is above 100 % of rated output.

IDG OIL LO PR/OVHT

These warnings are triggered if :

- OIL LO PR : a low oil pressure is detected.
- OIL OVHT : an outlet oil temp. is detected above normal max. temperature (above 185°C).

These failures will lead to an IDG disconnection.

AC BUS FAULT

This warning is triggered if the busbar is no longer supplied.

AC ESS FAULT

The E/WD is lost in this case. The failure title will be shown on the lower ECAM, the system page will be shown on request.

This warning is triggered if the busbar is no longer supplied.

EMER CONFIG

This warning is triggered in case of loss of both main generators.

ECMU FAULT

This warning is triggered if the Electrical Contactor Management Unit (ECMU) is found faulty. ECMU 1 controls Generator Line Contactor (GLC) 1 and ECMU 2 controls GLC 2.

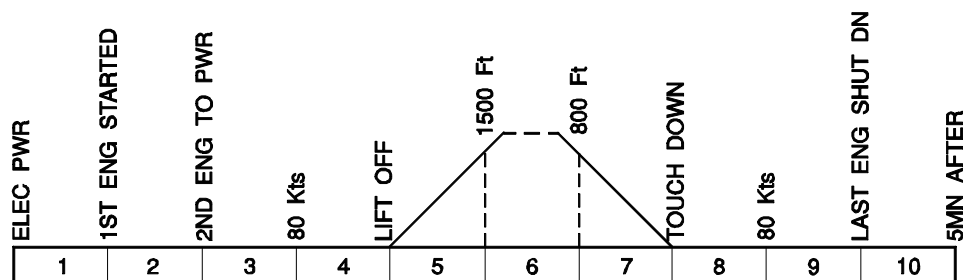
In case of ECMU failure, do not reset the corresponding generator.

OPERATING LIMITATIONS

- Maximum rated output of an engine driven generator : approx 115KVA
- Maximum rated output of the APU generator : approx 115KVA

General MMEL :

The aircraft can be dispatched with one engine generator failed or with the APU generator failed.
A failed ECMU is a "NO GO" item.



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
GEN 1(2) FAULT - protection trip initiated by associated GCU or opening of line contactor with GEN pb sw at ON GEN 1(2) OFF GEN 1(2) pb sw at OFF with no FAULT APU GEN FAULT - protection trip initiated by associated CGU - or opening of line contactor with APU GEN pb sw at ON	SINGLE CHIME	MASTER CAUT	ELEC AC	GEN 1(2) FAULT It	1, 3, 4, 5, 7, 8, 10
				NIL	
				APU GEN FAULT It	3, 4, 5, 7, 8,
GEN 1(2) or APU GEN OVERLOAD load of one generator is above 100% of rated output EXT PWR A OVERLOAD load of external power is above 100% of rated output	SINGLE CHIME	MASTER CAUT	ELEC AC	GALLEY FAULT It	3, 4, 5, 7, 8,
					3 to 8
IDG 1(2) OIL LO PR IDGF oil pressure low IDG 1(2) OIL OVHT IDG outlet oil temp. above 185°C	SINGLE CHIME	MASTER CAUT	ELEC AC	IDG 1(2) FAULT It	1, 4, 5, 7, 8, 10
AC BUS 1 FAULT AC BUS 2 FAULT Busbar(s) is (are) no longer supplied	SINGLE CHIME	MASTER CAUT	ELEC AC	NIL	4, 8
AC ESS BUS FAULT Busbar no longer supplied AC ESS BUS SHED Busbar no longer supplied	SINGLE CHIME	MASTER CAUT	ELEC AC	AC ESS FEED FAULT It	4, 8
				NIL	4, 8
EMER CONFIG loss of main generators EMER GEN FAULT	CRC	MASTER WARN	ELEC AC	EMER GEN FAULT It	4, 8
	SINGLE CHIME	MASTER CAUT		EMER GEN FAULT It	3, 4, 5, 7, 8, 10
ECMU 1(2) FAULT	SINGLE CHIME	MASTER CAUT	ELEC AC	NIL	3, 4, 5, 7, 8

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STUDENT NOTES

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AC GENERATION COMPONENTS (2)

IDG1 (2)
APU Generator
GCU (IDG/APU)
ECMU
CSM/G
CSM/G GCU
Static Inverter

IDG1 (2)

FIN/ZONE

FIN: 4000XU

Zone : 400

COMPONENT DESCRIPTION

The Integrated Drive Generator (IDG) is installed on the engine gear box.

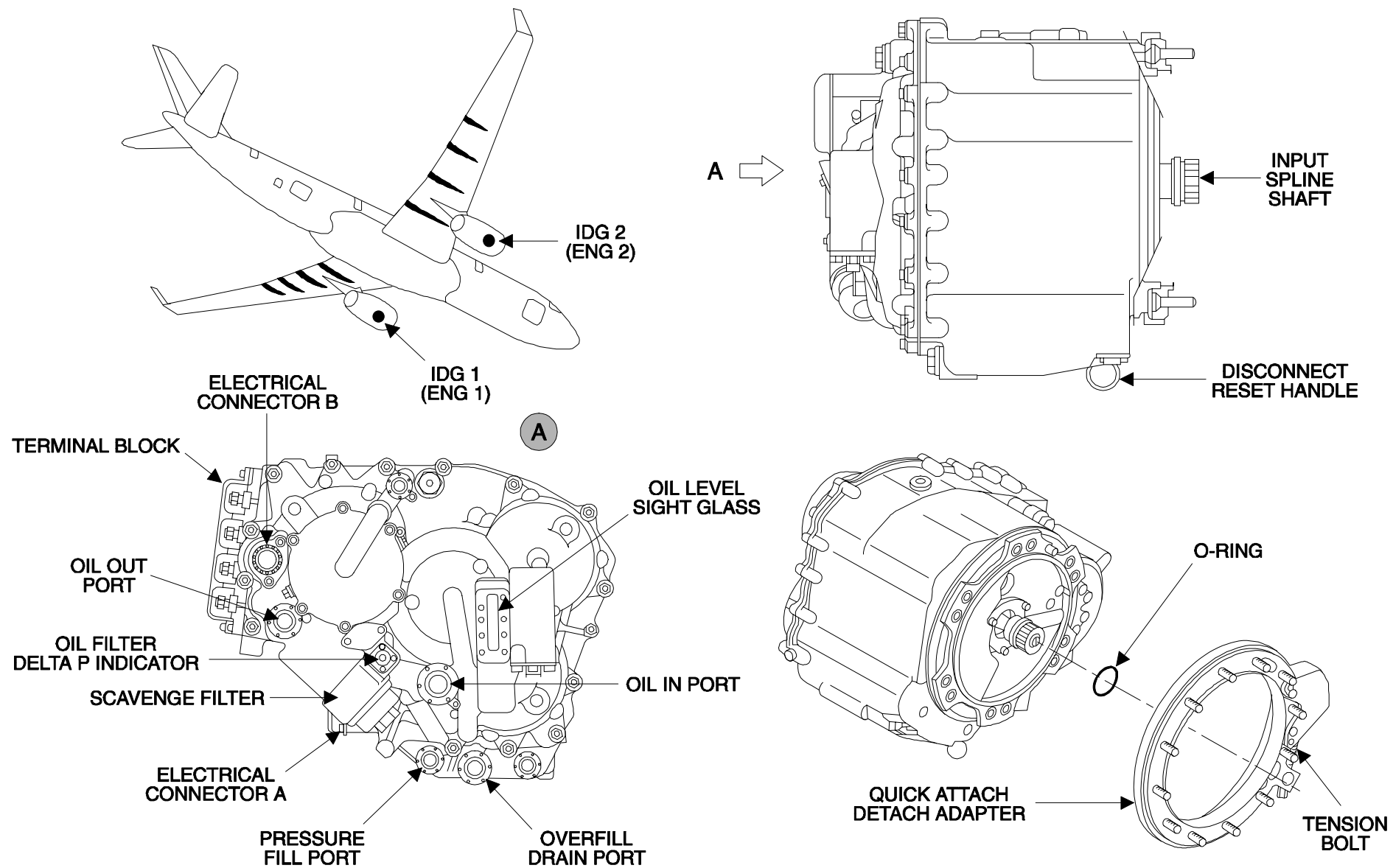
The IDG features:

- three differently sized electrical connectors,
- a terminal block (for the phases),
- two oil level sight glasses,
- two oil ports (in/out)
- one oil filter delta P indicator (POP OUT).

SAFETY PRECAUTIONS

WARNING:

BE CAREFUL WHEN YOU WORK ON THE ENGINE COMPONENTS IMMEDIATELY AFTER THE ENGINE IS SHUT DOWN. THE ENGINE COMPONENTS CAN STAY HOT FOR UP TO ONE HOUR.



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APU GENERATOR

FIN/ZONE

FIN: 8XS

Zone: 315/316

COMPONENT DESCRIPTION

The APU generator is brushless, spray oil cooled and comprises:

- the Permanent Magnet Generator (PMG),
- the exciter,
- the rotating rectifier assembly,
- the main generator.

SAFETY PRECAUTIONS

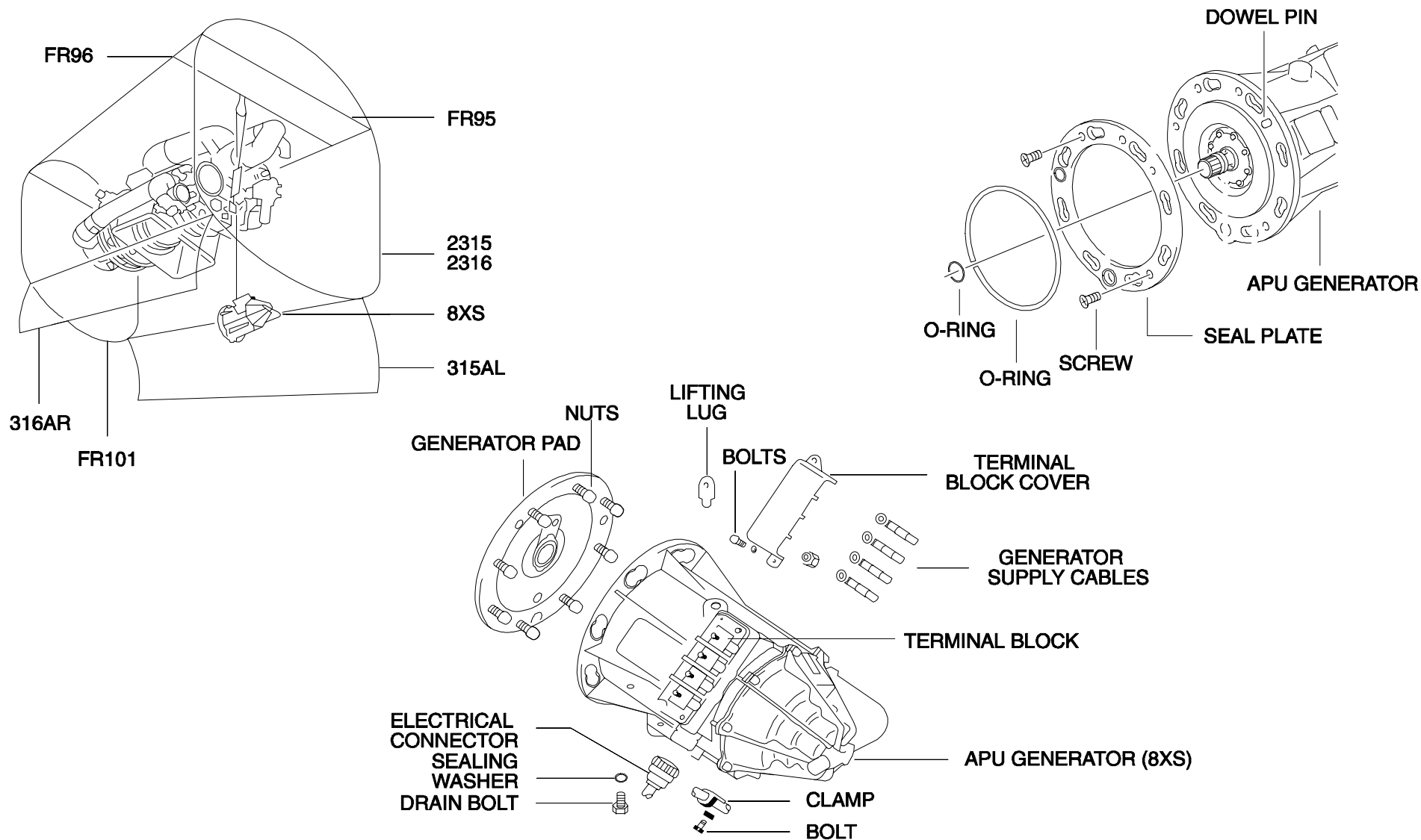
Put the warning notice in position on panel 215VU to tell persons not to start the APU.

WARNING:

DO NOT TOUCH THE APU UNTIL IT IS SUFFICIENTLY COOL TO PREVENT BURNS WHEN YOU DO THE MAINTENANCE TASK(S).

WARNING:

DO A CHECK OF THE OIL TEMPERATURE AND, IF NECESSARY, LET THE OIL GET COOL. HOT OIL CAN BURN YOUR EYES AND SKIN.



FQW4200 GE Metric

GCU (IDG/APU)

FIN/ZONE

FIN: 1XU1 (2) for IDG GCU

1XS for APU GCU

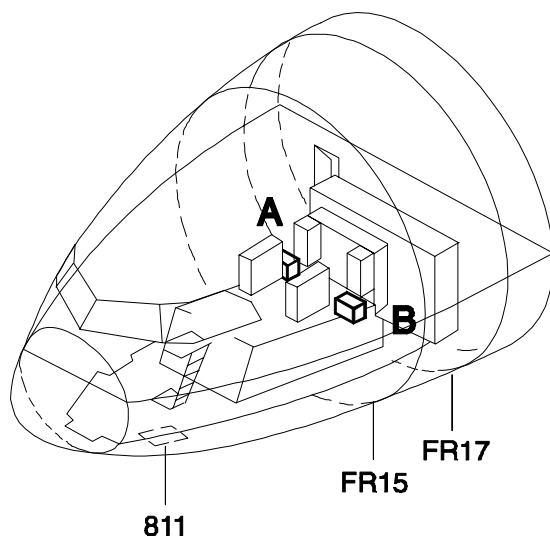
Zone: 120

COMPONENT DESCRIPTION

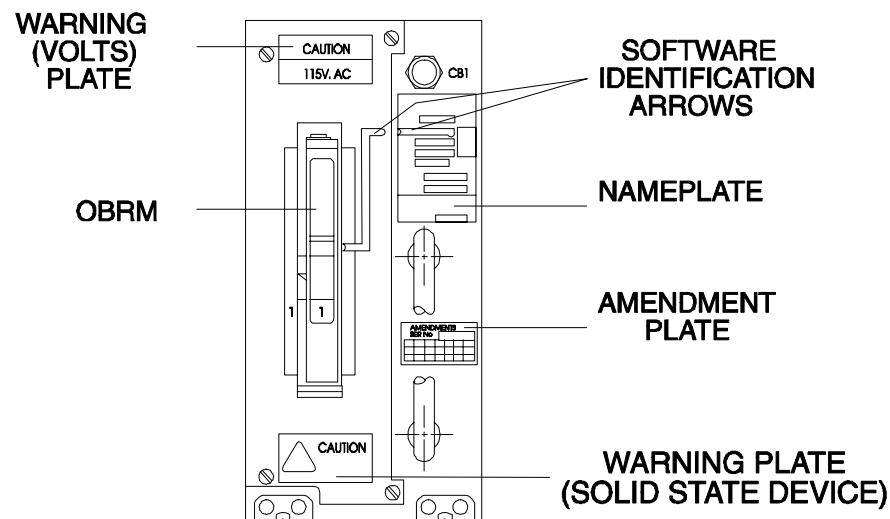
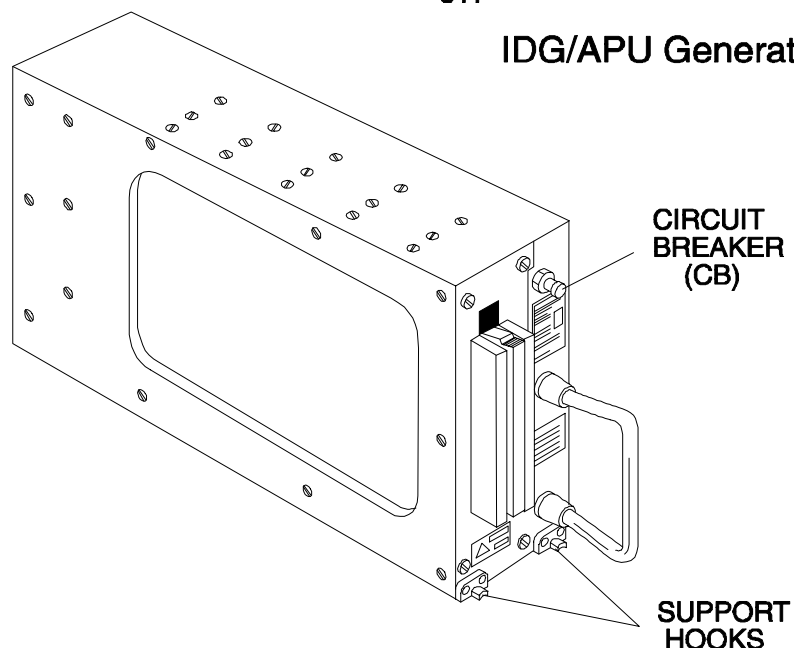
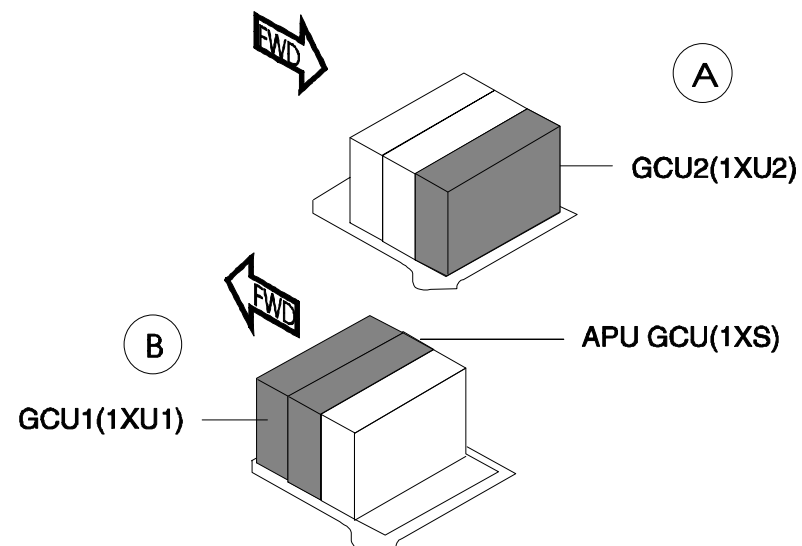
The IDG GCUs and APU GCU are identical and interchangeable.

The GCU front face features:

- Electrostatic Discharge Sensitive (ESDS) and high voltage warning labels,
- name and modification plates,
- a 2,5 ampere circuit breaker (not for GCU reset) and an OBRM for GCU software.



IDG/APU Generator Control Unit (GCU)



FQW4200 GE Metric

ECMU

FIN/ZONE

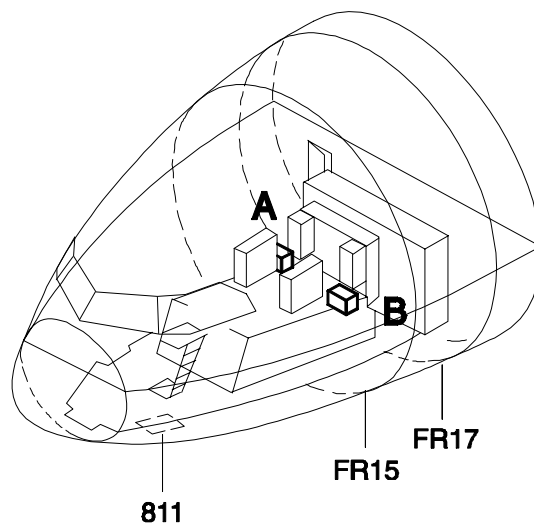
FIN: 1XM1 (2)

Zone : 120

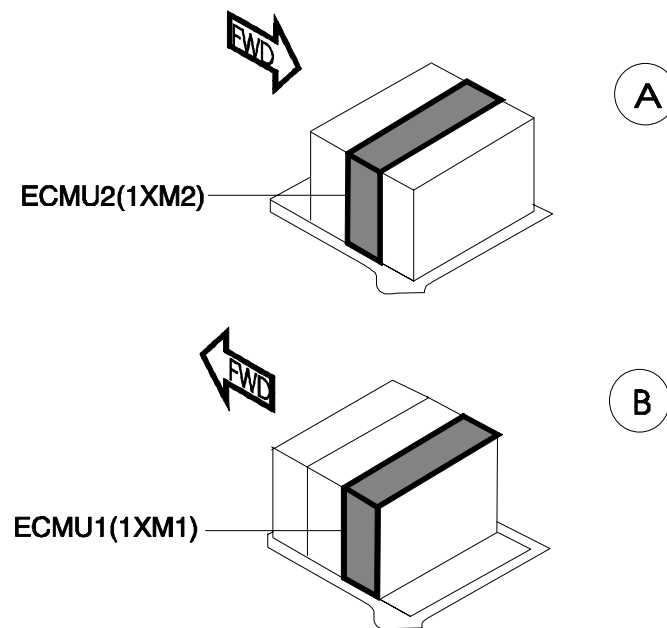
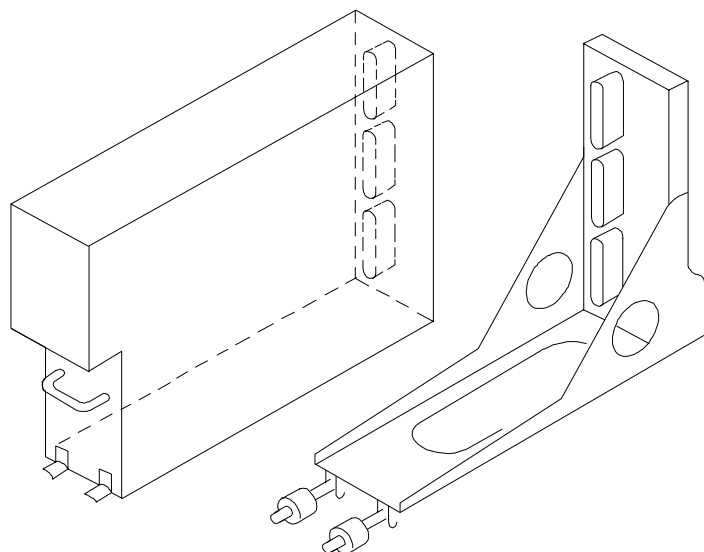
COMPONENT DESCRIPTION

The two ECMUs are identical and interchangeable.

The front face of the ECMU features a RESET pushbutton.



Electrical Control Management Unit (1XM1, 1XM2)



FQW4200 GE Metric

CSM/G

FIN/ZONE

FIN: 8XE

Zone: 148

REMOVAL/INSTAL

At removal be careful and correctly hold the CSM/G.

At installation, you must do the electrical bonding.

The operational test of the emergency generation system must be performed to complete the CSM/G installation.

SAFETY PRECAUTIONS

Make sure that the Green hydraulic system is depressurized.

Open, safety and tag the circuit breakers listed in the AMM.

WARNING:

ISOLATE THE ELECTRICAL CIRCUITS FROM THE RELATED EQUIPMENT AND THE ENVIRONMENT TO PREVENT INJURY TO PERSONS AND/OR DAMAGE.

WARNING:

OBEY THE HYDRAULIC SAFETY PROCEDURES.

WORK ON THE HYDRAULIC SYSTEMS CAN BE DANGEROUS.

WARNING:

MAKE SURE THAT THE TRAVEL RANGES OF THE FLIGHT CONTROL SURFACES ARE CLEAR BEFORE YOUR PRESSURIZE/DEPRESSURIZE A HYDRAULIC SYSTEM. MOVEMENT OF THE FLIGHT CONTROL SURFACES CAN BE DANGEROUS AND/OR CAUSE DAMAGE.

WARNING:

PROTECT YOUR HANDS AND FACE FROM THE GAS WHICH COMES OUT WHEN YOU OPEN THE MANUAL DEPRESSURIZATION VALVE OF THE RESERVOIRS.

THERE COULD BE A RISK OF:

- BURNS FROM HOT GAS,
- CONTAMINATION FROM HYDRAULIC FLUID CONTAINED IN THE GAS.

WARNING:

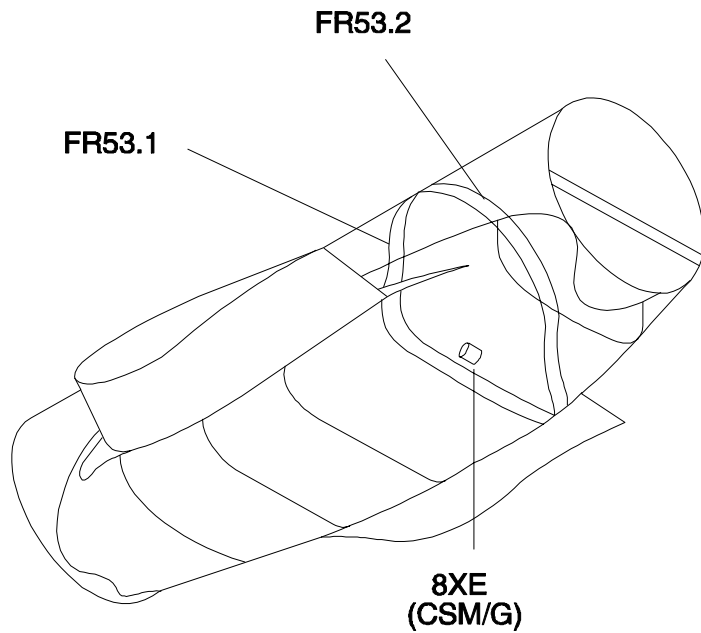
MAKE SURE THAT THE GROUND SAFETY-LOCKS ARE CORRECTLY INSTALLED ON THE LANDING GEAR.

THIS PREVENTS UNWANTED MOVEMENT OF THE LANDING GEAR.

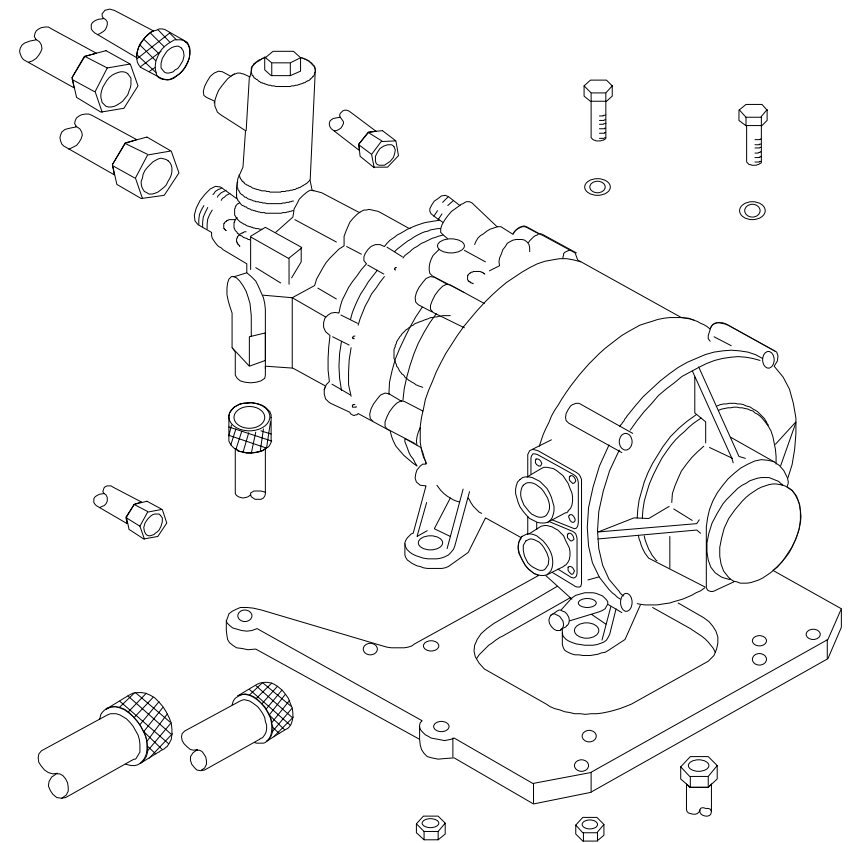
WARNING:

DO NOT WALK ON A CLOSED LANDING GEAR DOOR.

THIS PREVENTS INJURY IF THE DOOR OPENS SUDDENLY.



Constant Speed Motor/Generator (8XE)



CSM/G GCU

FIN/ZONE

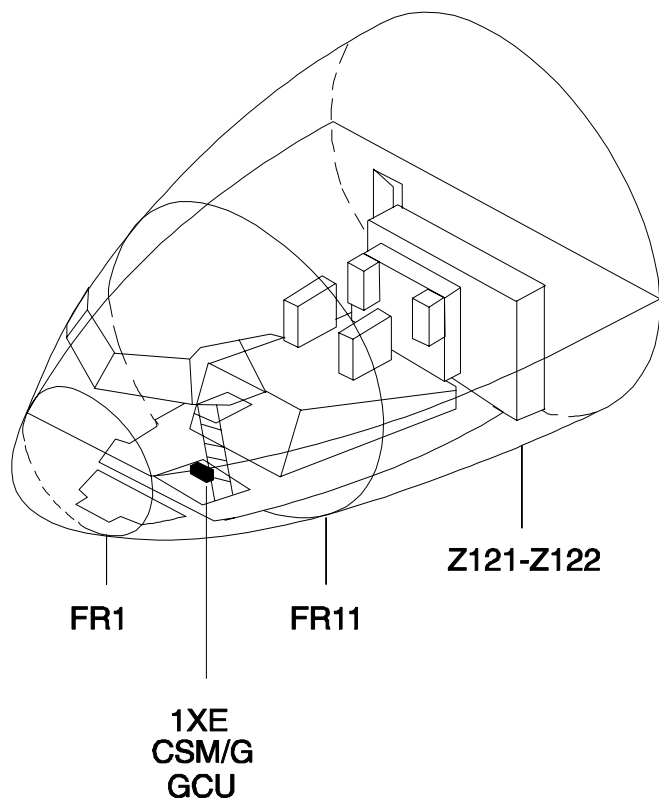
FIN: 1XE

Zone: 121

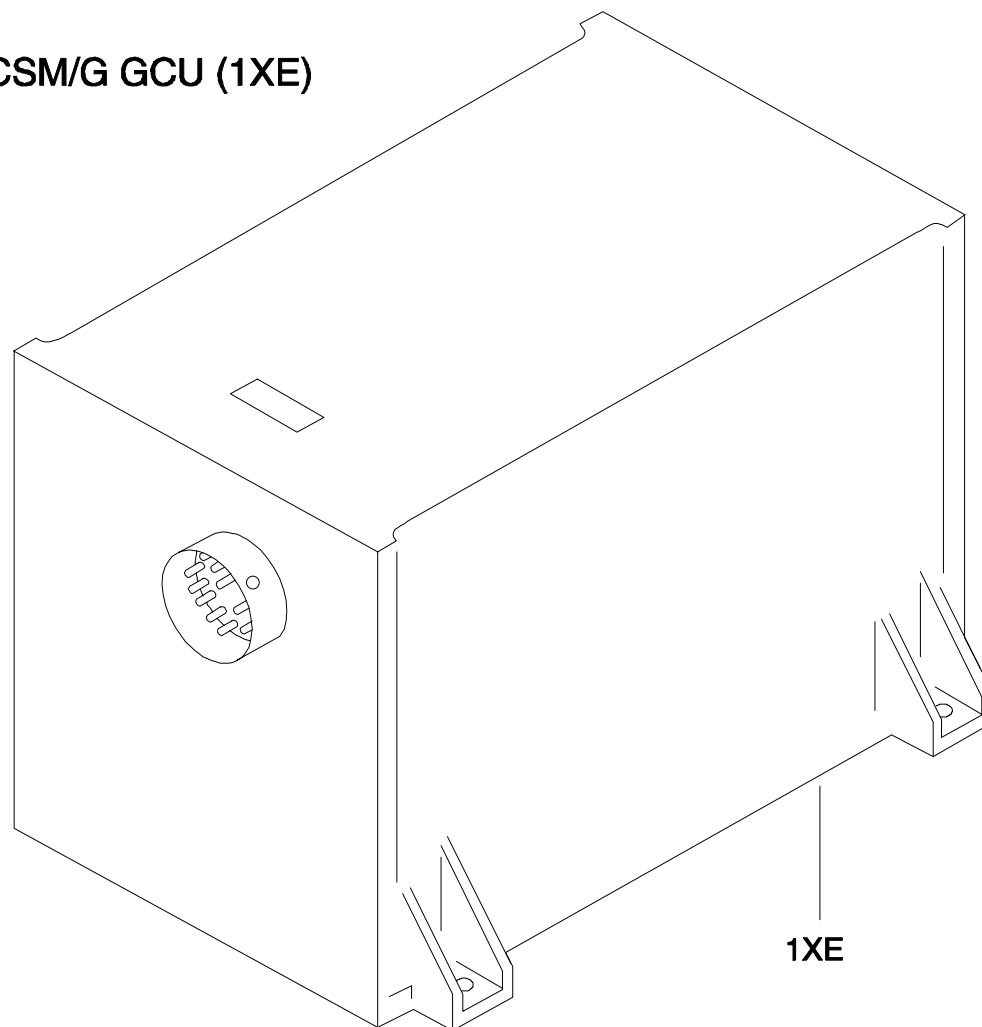
COMPONENT DESCRIPTION

The CSM/G GCU housing features:

- two labels,
- one electrical connector,
- a red LED.



CSM/G GCU (1XE)

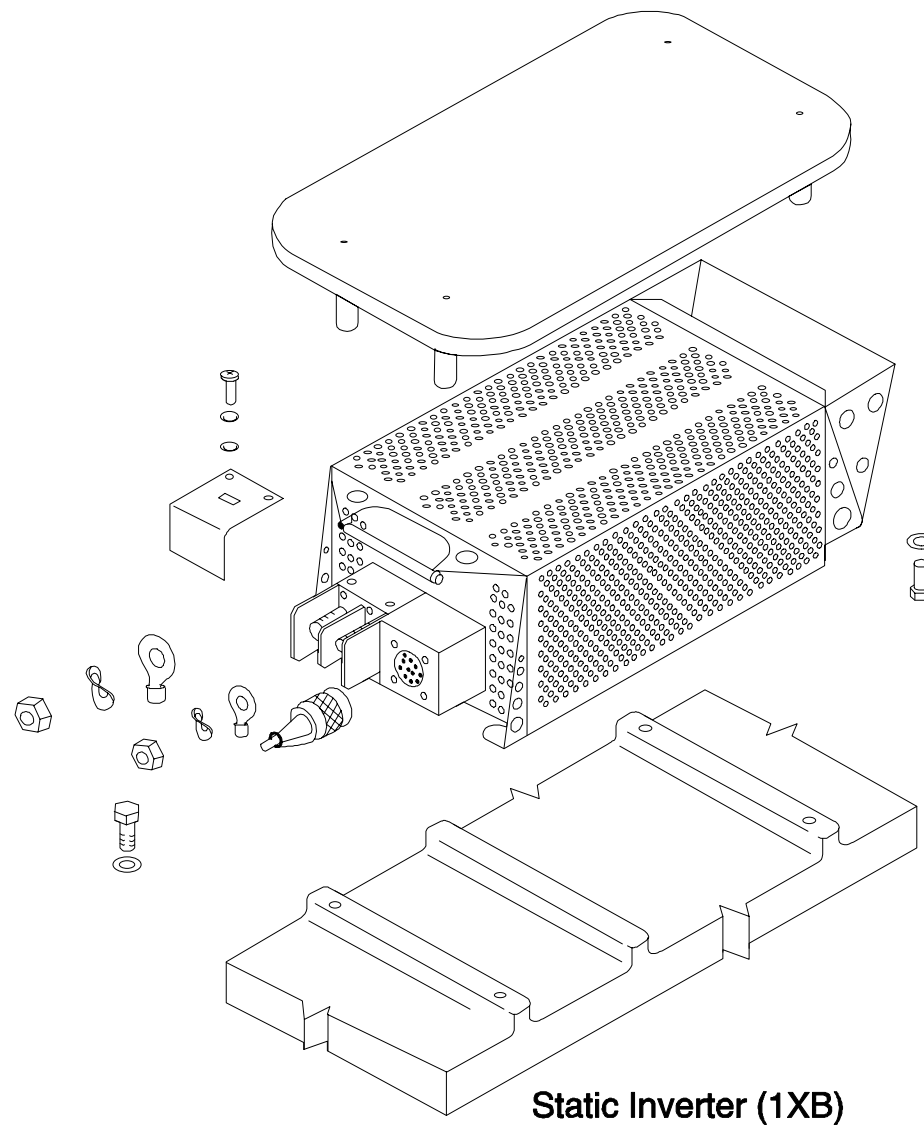
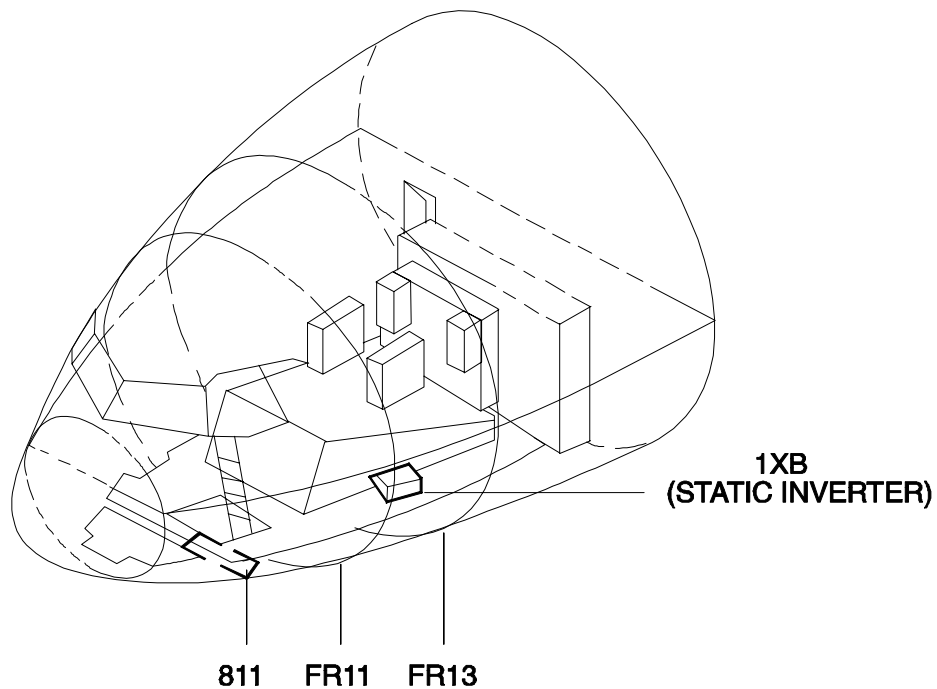


STATIC INVERTER

FIN/ZONE

FIN: 1XB

Zone: 121



STUDENT NOTES

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AC GENERATION COMPONENTS (3)

Safety Precautions
GLC/BTC
SIC
EMERGENCY GLC
AC ESS BUS Switching Contactor

SAFETY PRECAUTIONS

Comply with the safety precautions, warnings and cautions.

- (1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released:
 - BAT 1, BAT 2, APU BAT,
 - GEN 1 (2), APU GEN,
 - EXT A (B).
- (2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel:
 - 211VU (EMER ELEC PWR),
 - 235VU (ELEC).
- (3) Make sure that the external power is not connected to the aircraft receptacle.
- (4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.

WARNING:

MAKE SURE THAT NO AC OR DC POWER SOURCE IS CONNECTED TO THE AIRCRAFT ELECTRICAL CIRCUITS.

STUDENT NOTES

FQW4200 GE Metric

GENERATOR LINE CONTACTOR/BUS TIE CONTACTOR (GLC/BTC)

FIN/ZONE

FIN : 9XU1(2) for GLC
3 XS or APU GLC
11XU1(2) for BTC
Zone : 120

COMPONENT DESCRIPTION

The 3 Power Contactors are three pole contactors.

Each power contactor comprises two parts: the Base and the Removable part.

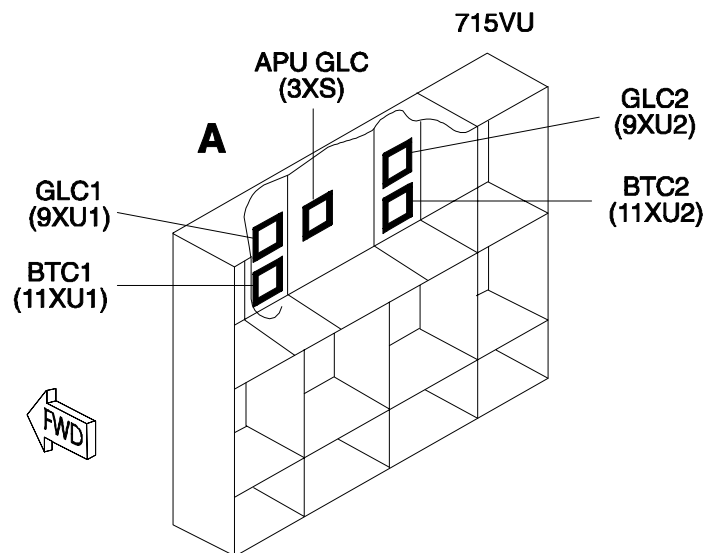
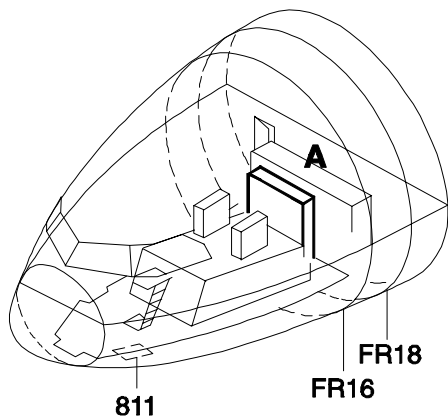
The Base features:

- a power terminal,
- shunts,
- fastener devices for the removable contacts,
- installation fixtures.

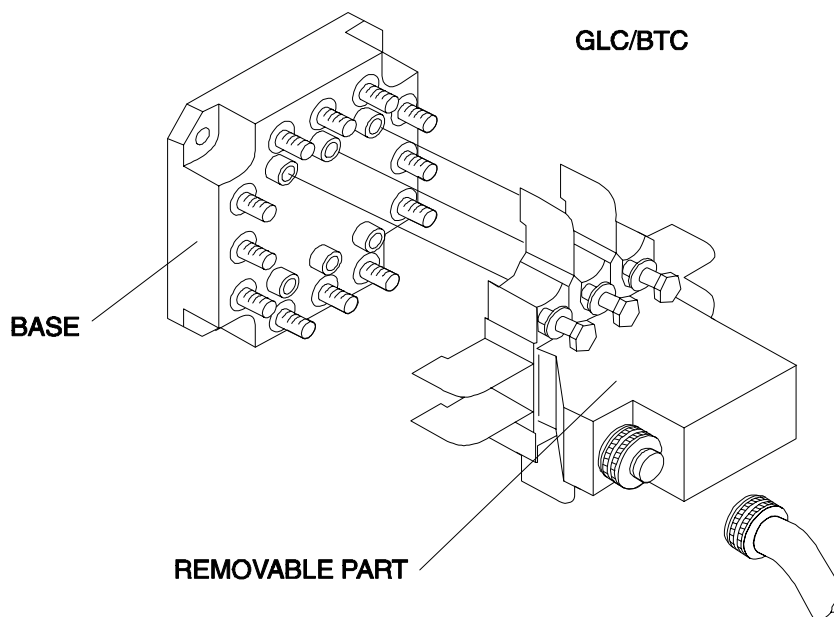
The Removable features:

- a power commutation unit,
- an electromagnetic control,
- auxiliary contacts,
- a connector.

NOTE: The GLCs, APU GLC and BTCs are identical and interchangeable.



FQW4200 GE Metric



SYSTEM ISOLATION CONTACTOR (SIC)

FIN/ZONE

FIN : 12XU

Zone : 120

COMPONENT DESCRIPTION

The Power Contactors are three pole contactors.

Each power contactor comprises two parts: the Base and the Removable part.

The Base features:

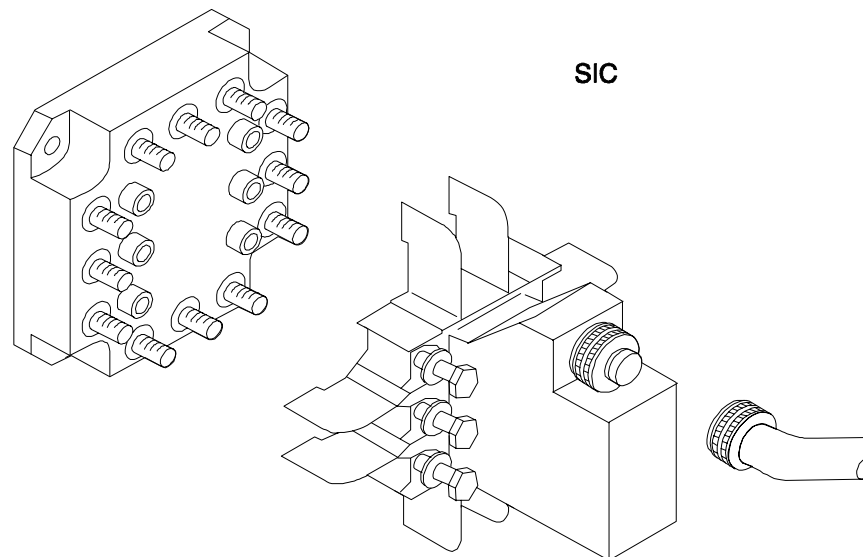
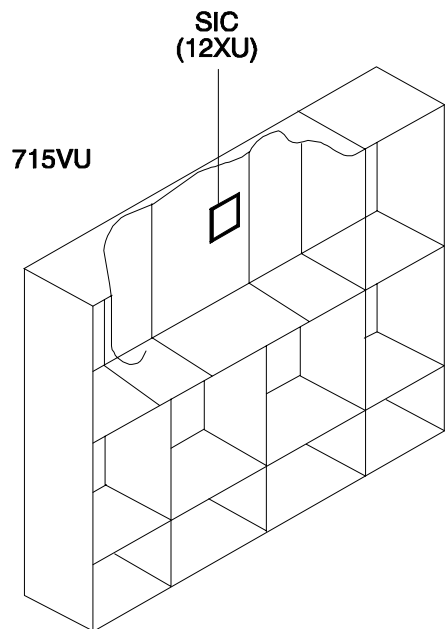
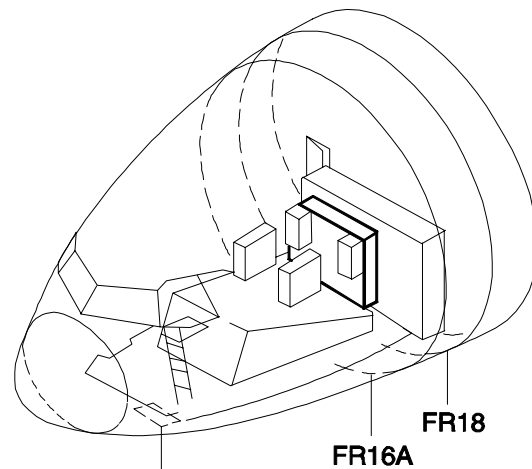
- a power terminal,
- shunts,
- fastener devices for the removable contacts,
- installation fixtures.

The Removable features:

- a power commutation unit,
- an electromagnetic control,
- auxiliary contacts,
- a connector.

IN SITU TEST

Do the operational test of side 1 and side 2 isolation
(Ref. TASK 24-22-00-710-801).



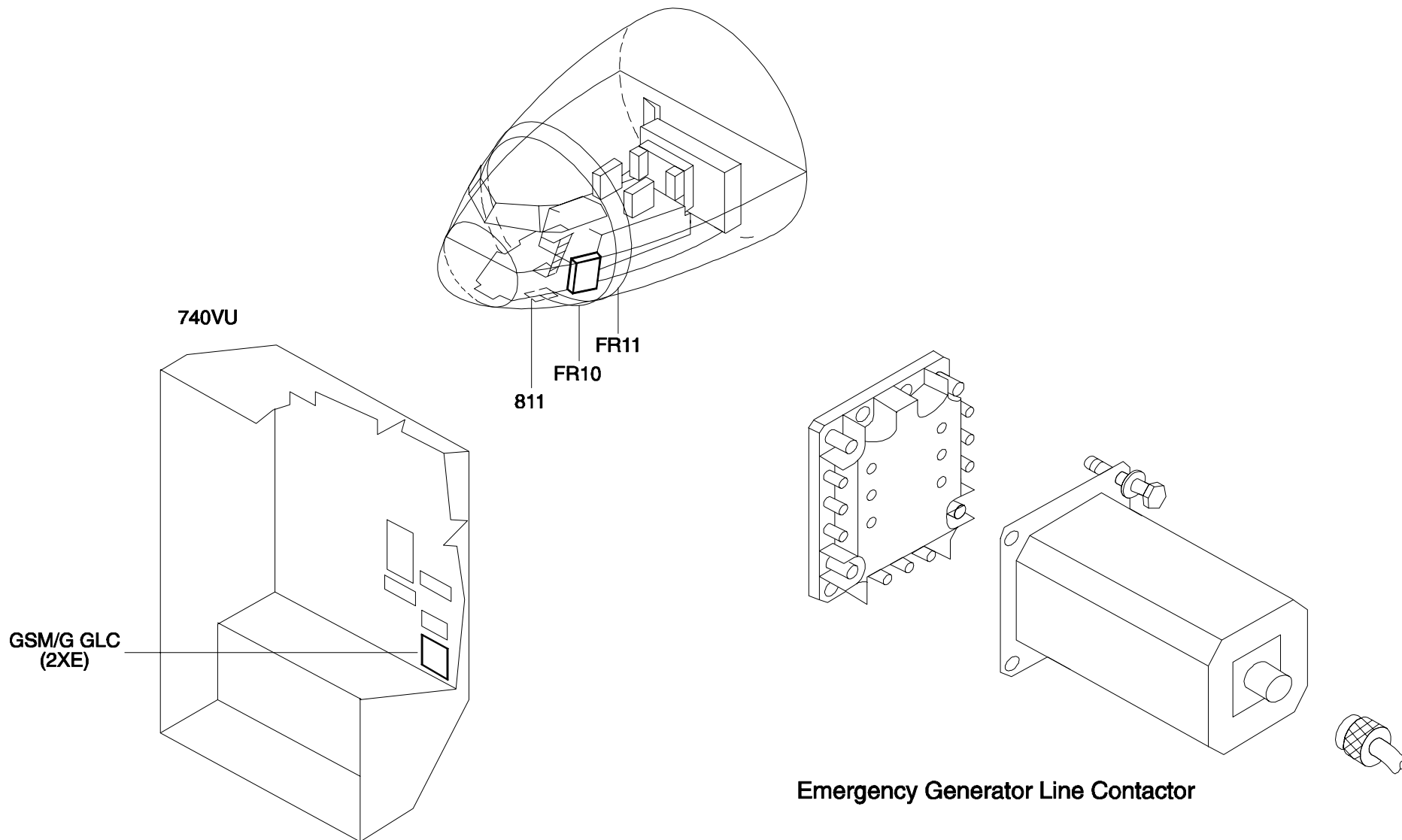
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EMERGENCY GLC

FIN/ZONE

FIN : 2XE

Zone : 120



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AC ESS BUS SWITCHING CONTACTOR

FIN/ZONE

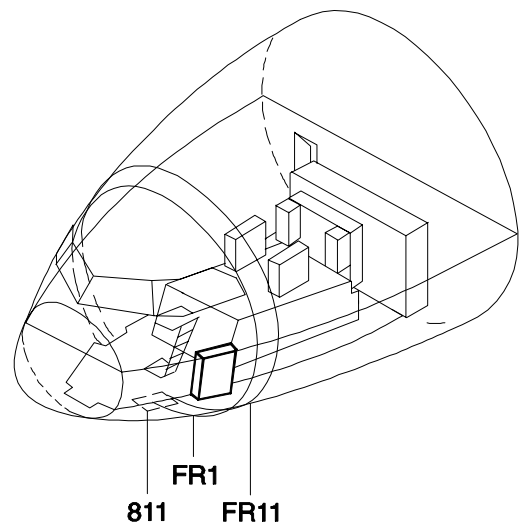
FIN : 3XC

Zone : 121

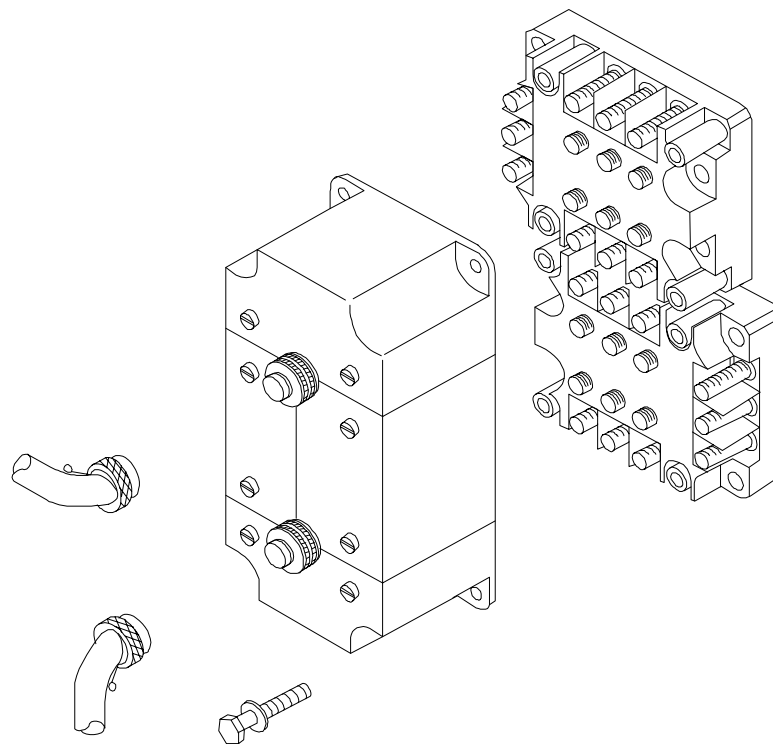
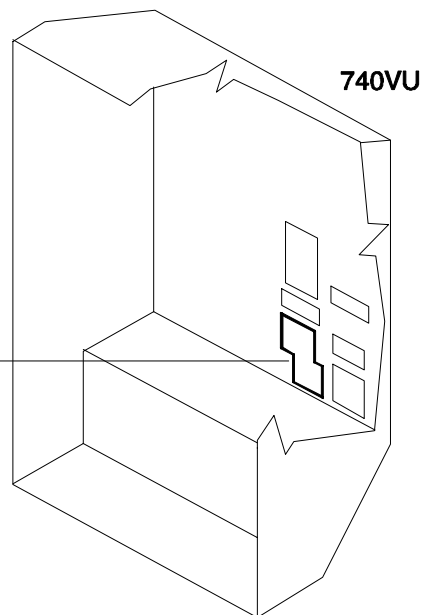
COMPONENT DESCRIPTION

This is a double solenoid contactor (3XCA and 3XCB).

NOTE : The 3XC CONTACTOR solenoids are supplied with
115VAC.



AC ESS BUS
SWITCHING
CONTACTOR
(3XC)



AC ESS BUS switching contactor

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STUDENT NOTES

EXTERNAL POWER SUPPLY

- General
- Ground Power Control Unit
- Normal Supply
- Service Bus Supply
- Remote Control Circuit Breakers

GENERAL

The aircraft network can be supplied by two Ground Power Units (GPUs).

Ground Power Unit requirements :

- 115 V three-phase
- 400 Hz
- 90 KVA.

Both GPUs are controlled and monitored by one Ground Power Control Unit (GPCU).

GROUND POWER CONTROL UNIT

The Ground Power Control Unit (GPCU) will not allow faulty ground power to be applied to the aircraft network to protect the aircraft systems.

The GPCU monitors the following parameters :

- over/under voltage,
- over/under frequency,
- phase sequence,
- overcurrent,
- open cable or short circuit,

NORMAL SUPPLY

When all parameters are correct and the EXTERNAL A switch is pressed in, the associated external power contactor closes and the entire network is supplied via the transfer circuit.

The System Isolation Contactor (SIC) closes when only one external power is connected. It is opened when both external power A and B are connected.

SERVICE BUS SUPPLY

The AC service buses can be supplied from the aircraft network or by the external power A only.

For ground service purposes, provided all parameters are correct, it is possible to supply the AC and DC service buses only.

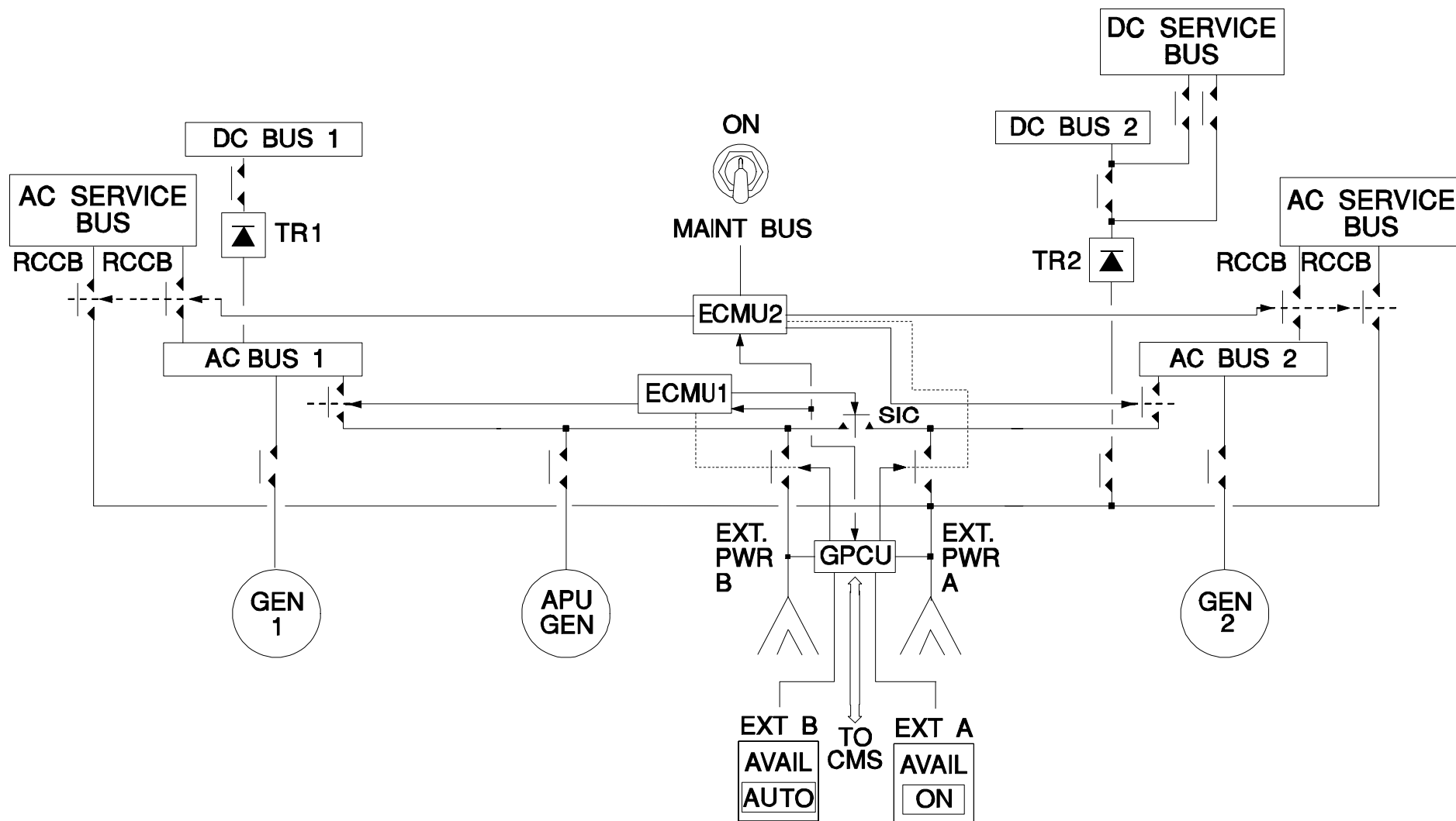
The MAINT BUS switch has to be in the ON position.

This switch is on the circuit breaker panel located in the forward cabin ceiling.

REMOTE CONTROL CIRCUIT BREAKERS

Power is delivered to the AC service buses through the Remote Control Circuit Breakers (RCCBs) which are used to control the supply.

Note : These RCCBs are controlled by ECMU2.



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STUDENT NOTES:

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EXTERNAL POWER SUPPLY D/O

General
Monitoring and Control
Operation

GENERAL

Two external power receptacles A and B located after the nose landing gear well enable power supply of the entire aircraft network up to 90 KVA each.

The Ground Power Units (GPUs) supply the Transfer Circuit through External Power Contactors (EPC) A and B.

Note: External Power B is connected to the left hand side of the network and External Power A to the right hand side.

A Ground Power Control Unit (GPCU) containing separate channels for external power A and B, controls and protects the connection and disconnection of the GPUs to the network.

The management of External Power A is the same as External Power B.

Note: the diagram shows the connection of External Power B.

MONITORING AND CONTROL

The 115 VAC, 400 Hz, 3 phase output of the Ground Power Unit is connected to the aircraft network through EPC B.

The monitoring and control of the connection is made by two internal relays:

- the Interlock Monitoring Relay (IMR),
- the Power Ready Relay (PRR).

The IMR is energized when:

- the GPU DC control power sensed on the interlock circuit is less than 42 VDC,
- if the voltage sensed on the interlock circuit is less than 13 VAC,
- all external power parameters checked by the internal control and protection circuit are correct.

The Power Ready Relay is energized when:

- the external power interlock is valid,
- and all parameters are correct.

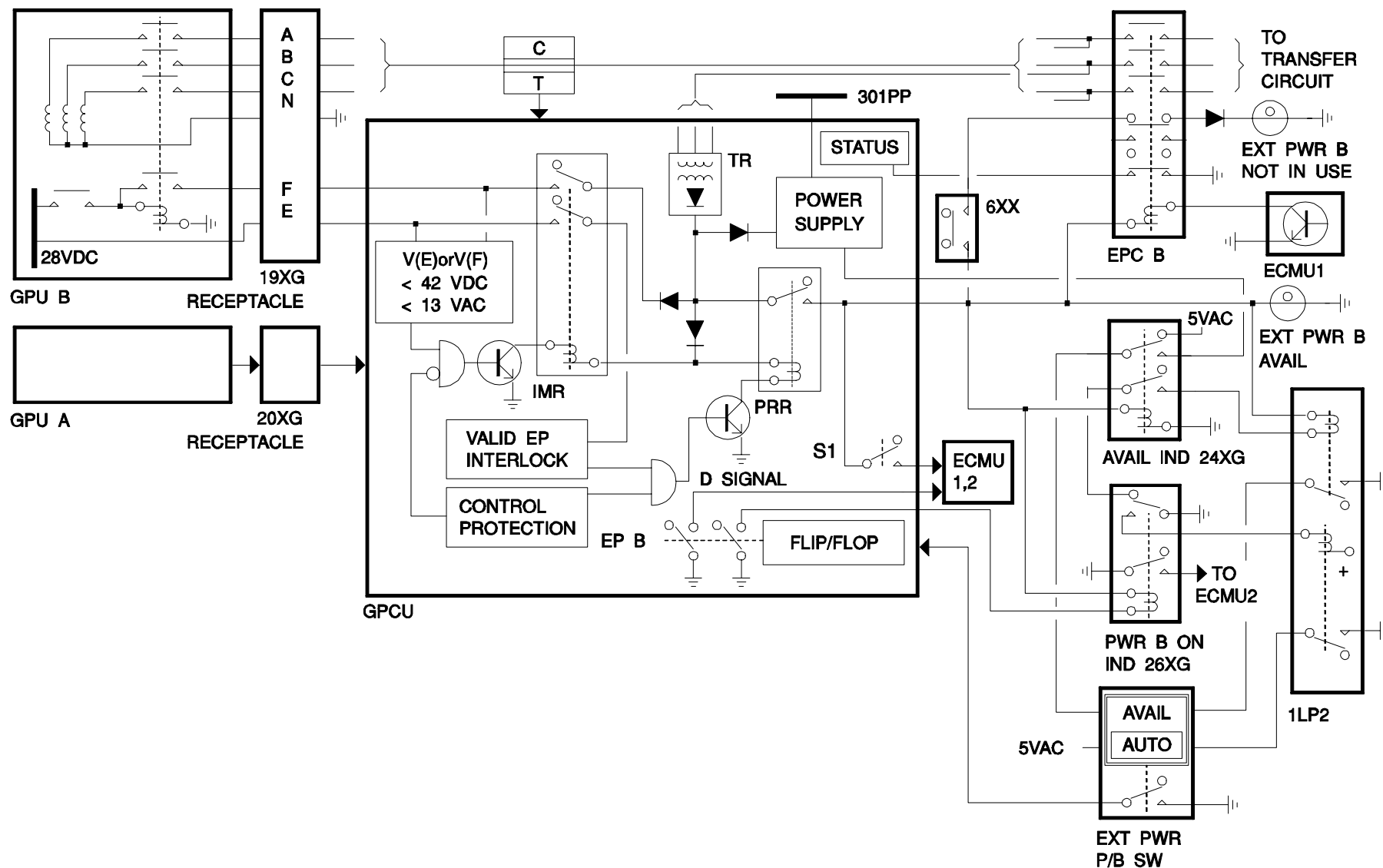
The annunciators NOT IN USE and AVAILABLE located on the ground power receptacle panel are on.

The closed PRR connects power from the Transformer Rectifier (TR) to the following items:

- to the solenoid of EPC B,
- to the EXT PWR B NOT IN USE light (white) via contactor 6XX (maintenance bus switch off) and EPC B,
- directly to the EXT PWR B AVAIL light (amber),
- to the solenoids of relays 24XG and 26XG.

The closed relay 24XG controls:

- illumination of the AVAIL legend on the external power pushbutton switch via 1LP2,
- 5 VAC supply for the AVAIL legend from the internal power supply module.



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OPERATION

When the external power pushbutton switch is pressed, the flip flop provides the D signal to both ECMUs for NBPT function, and a ground signal to the solenoid of relay 26XG.

The closed relay 26XG provides the following:

- cuts the supply for the AVAIL legend and lights the AUTO (ON) legend via 1LP2,
- connects the signal Power B ON to ECMU2.

Then ECMU1 provides a ground signal to close the EPC, provided the S1 signal for NBPT function is valid.

The GPU output is now connected to the transfer circuit.

The External Power NOT IN USE light goes off.

Note: The connection of the ground power to the busbars depends on the supply and transfer logic.

GROUND POWER CONTROL UNIT D/O

- General
- Power Supply
- Monitoring
- Interlock
- External Power Contactor (EPC) Control
- Frequency Reference Unit (FRU)
- Protection
- Interface

GENERAL

The Ground Power control Unit (GPCU) performs the following functions for external power A and B control and Built In Test Equipment (BITE) communication:

- monitoring,
- interlock function,
- External Power Contactor (EPC) control,
- protection,
- Frequency Reference Unit (FRU) function for No Break Power Transfer (NBPT),
- protection,
- BITE function.

The diagram shows the connection for External Power B.

POWER SUPPLY

The Ground Power Control Unit internal power supply module is supplied from Transformer Rectifier (TR) A and B and, as a back up, from the battery bus 301PP.

In addition, each TR supplies its own channel.

MONITORING

The primary function of the GPCU, while the aircraft is on ground, is to monitor the external power supplied to the aircraft and control its application to the transfer line.

INTERLOCK

When a Ground Power Unit is applied, the TR is supplied and connects 28 VDC to the Interlock Monitoring Relay (IMR), Power Ready Relay (PRR) and the supply module.

When the 28 VDC control voltage from the GPU connected via pin F and E to the GPCU is within accepted limits (<42 VDC and <13 VAC) and when the delivered 115 VAC sensed at Point Of Reference (POR) is accepted by the control and protection module, then the IMR closes.

The closed IMR connects 28 VDC from the TR via pin F to the GCU. This interlock voltage acts as a holding source for the GPU output contactor.

The second contact of the IMR connects the control voltage (pin E) to the valid External Power (EP) interlock module. This module provides a signal to close the PRR.

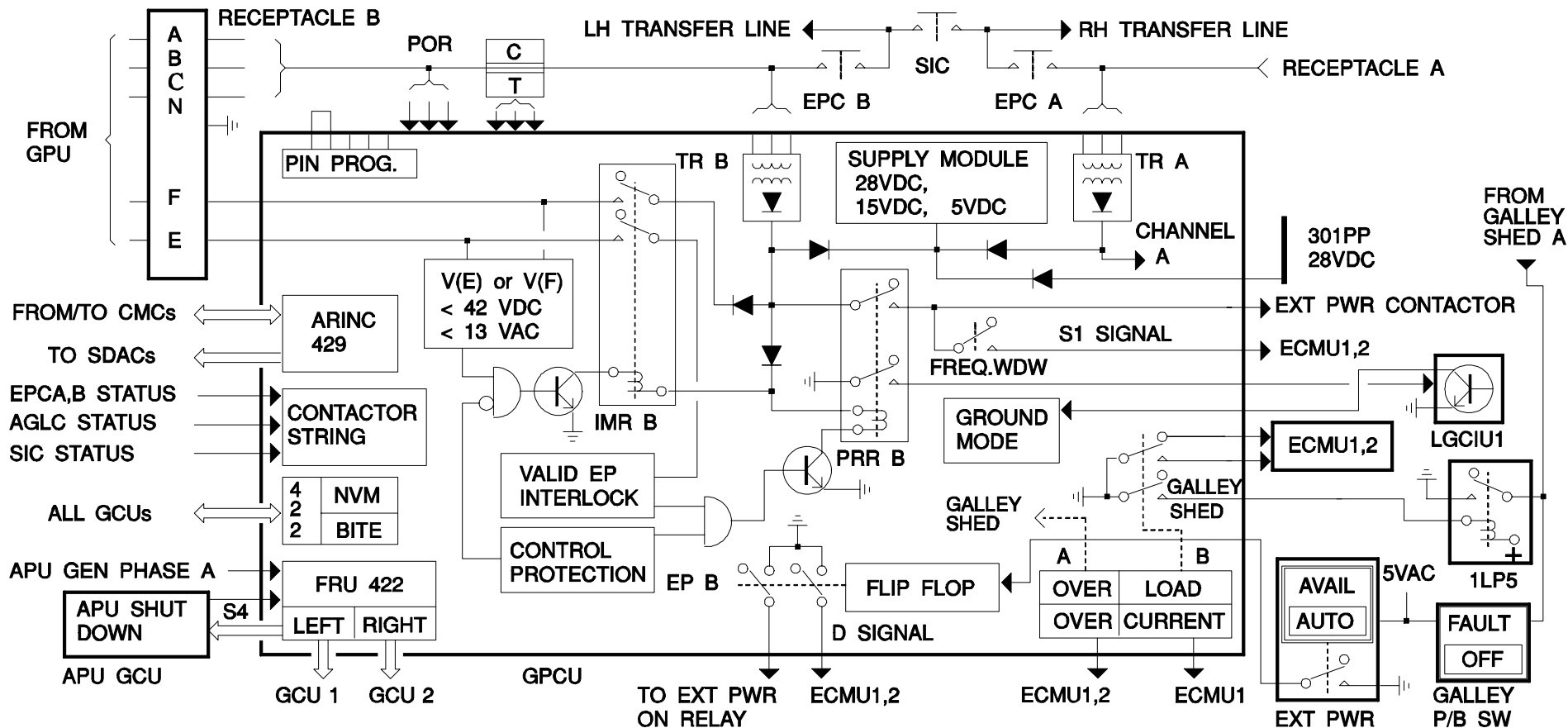
EXTERNAL POWER CONTACTOR (EPC) CONTROL

The closed PRR provides 28 VDC to the solenoid of the EPC.

As soon as the external power pushbutton switch is pressed, the D signal is sent to both ECMUs to inform them that an external power is ready to be involved in an NBPT.

The corresponding ECMU provides the ground to the EPC when S1 signal is valid.

Note: for external power B, the blue auto legend comes on.



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FREQUENCY REFERENCE UNIT (FRU)

The Frequency Reference Unit (FRU) is active on ground only when LGCIU1 provides a ground mode signal.

The FRU sends frequency reference signals, based on external power quality, to each GCU to perform the NBPT.

The FRU is divided into a Left Hand (LH) and a Right Hand (RH) part.

- LH part: GCU 1. APU GCU
- RH part: GCU 2.

For better NBPT operation, the APU generator has priority to supply the left hand side of the transfer line.

Therefore, as soon as the APU generator is connected, phase A is connected to the FRU because the quality of the APU generator is more stable than the GPU supply.

Then, the FRU sends the APU generator frequency reference signal to GCU 1 and also to GCU 2 if external power A is disconnected.

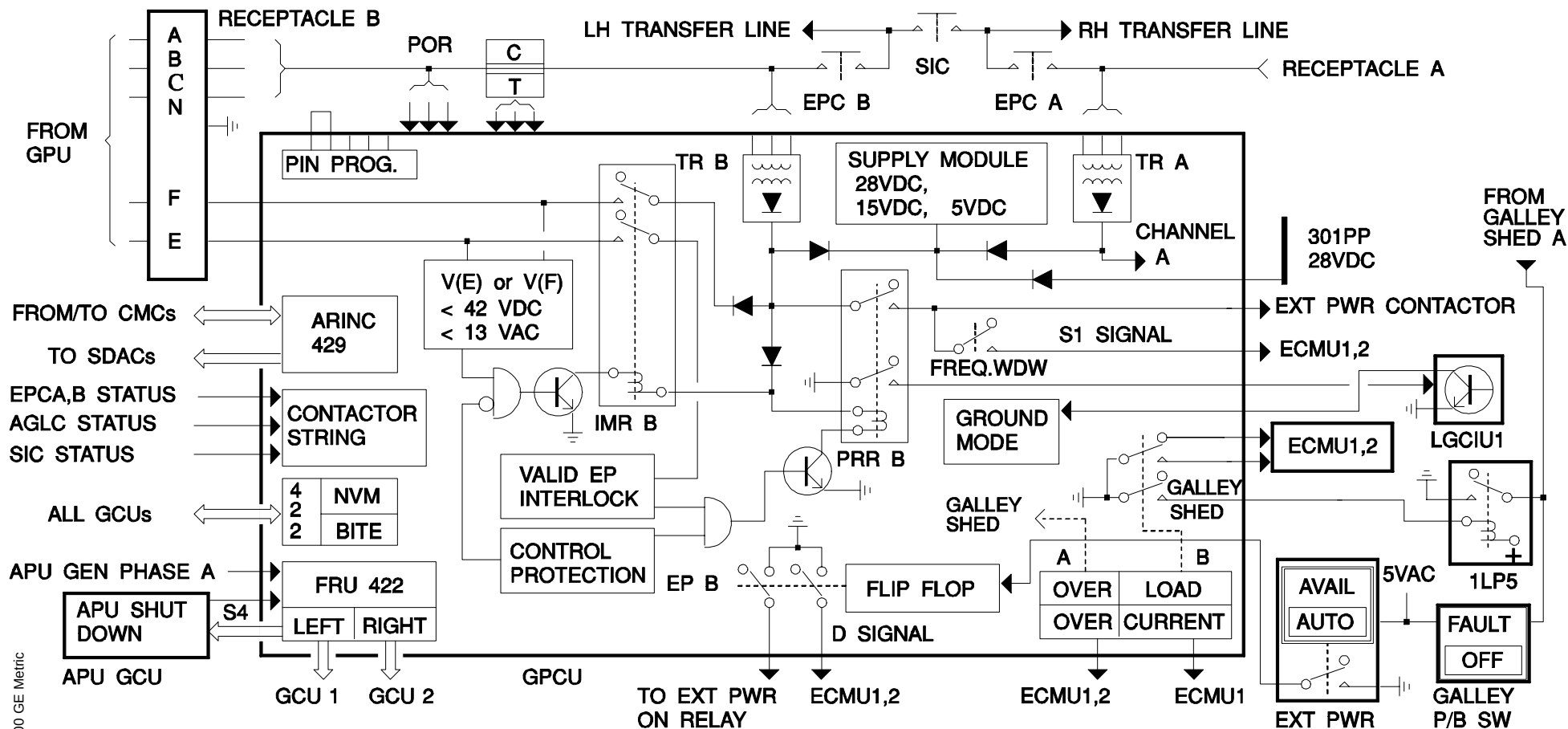
Note: Before engine 2 start, switch off the external power pushbutton switch that closes the System Isolation Contactor (SIC).

The APU generator takes over the supply. That ensures an NBPT of IDG 2 with APU generator phase A reference.

It minimizes a power break transfer risk.

At APU shut down, the GCU sends an S4 signal to the Frequency Reference Unit to switch back to the external power reference.

The GPCU receives 4 contactor string signals to determine what power source signal should be present on the left and right FRU



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PROTECTION

The GPCU performs the following protection functions for both external power channel:

- overvoltage,
- undervoltage,
- overfrequency,
- underfrequency,
- overcurrent,
- overload,
- external power interlock,
- Incorrect Phase Sequence (IPS),
- open cable or open or short circuit,
- EPC failure.

* Overvoltage:

Overvoltage (OV) protection is accomplished by monitoring the 3 phases at POR.

An OV condition exists when the highest phase voltage exceeds 130+/-1,5 VAC.

After an inverse time delay, the IMR and PRR are tripped.

* Undervoltage:

The Undervoltage (UV) is sensed in the same way as overvoltage.

An undervoltage condition exists when the lowest phase voltage is less than 103+/-1,5 VAC.

After a 4.5 second time delay max, the PRR and the IMR are tripped.

* Overload:

The overload is sensed by the current transformer.

An OverLoad condition exists when overcurrent on any phase has persisted for 10 seconds.

The galley shed relay is energized and sends a ground signal to the ECMUs and to the galley pushbutton switch.

The ECMUs reply by shedding galley loads depending on the supply configuration.

If the overload condition persists for an additional 2 seconds after the load shedding action by the ECMUs (galley switch FAULT legend ON), the ECAM warnings are triggered and the message EXT PWR B OVERLOAD appears on the Engine Warning Display.

All galley loads must be shed by setting the galley pushbutton switch to OFF. The message GALLEY OFF appears.

If after galley shedding an overload is still detected, the overcurrent protection will be triggered after an inverse time delay:

- the IMR and PRR are tripped,
- the overcurrent signal is sent to one or both ECMUs depending on the channel, to open the Bus Tie Contactors (BTCs) and the SIC.

* Overcurrent:

The overcurrent is sensed by the current transformer.

An overcurrent condition exists when the current on any one phase exceeds the nominal current rating of 260 A by more than 17 A.

In the overcurrent (OC) protection circuit, there are two OC status relays:

- OC channel A relay sends a signal to both ECMUs.
The ECMUs reply by opening the System Isolator Contactor (SIC), BTC1 and 2.
- OC channel B relay sends a signal only to ECMU1.
ECMU1 replies by opening BTC1,2 and the SIC.

The IMR and the PRR are tripped together in case of :

TRIGGERED FUNCTIONS	TRIGGER CONDITIONS	SENSOR
Overvoltage	One phase > 130+/-1.5 volts	P.O.R.
Undervoltage	One phase < 103+/-1.5 volts for 4.5 s	P.O.R.
Overfrequency	Phase A > 433+/-1 Hz for 4 s	P.O.R.
Underfrequency	Phase A < 363+/-1 Hz for 4 s	P.O.R.
	Phase A < 325+/-1 Hz for 160 ms	P.O.R.
IPS	Incorrect phase sequence A-B-C-N for 80 ms	P.O.R.
Overcurrent	One phase > 260 A (nominal current) +17 A	C.T.
Overload *	One phase > 277 A for 10 s	C.T.
Open cable or open/short circuit	One phase < 10 A Two other phases > 30 A } for 3 s	C.T.
External power interlock	AC voltage > 13 Volts DC voltage > 42 Volts	pin E,F
EPC failure	External power > 25+/-5 A for 140 ms	EP current

* Only galley shed relays trip

INTERFACE

The ground Power Control Unit is interfaced with the Ground Control Units (GCUs), the Centralized Maintenance Computers (CMCs), the Electronic Centralized Aircraft Monitoring (ECAM) and the Landing Gear Control Interface Unit (LGCIU) 1.

* The GPCU interfaces with each of the 3 GCUs via RS422 links.

The GPCU always initiates the transfer of information from the GCUs, and communicates during 2 transmission modes: normal and interactive mode.

- In normal transmission mode, the GPCU interrogates periodically each GCU for: channel status, fault status, GCU LRU identification and PIN programming information.

- In interactive transmission mode (only on ground when requested from CMCs), the normal mode may be interrupted by a self test command. The GPCU will request a self test of each of the GCUs and will perform its own self test routine.

* The GPCU interfaces with the two CMCs which are type one computers, via two ARINC 429 links.

During normal mode of transmission, the GPCU will continually send its own and the 3 GCU fault data to the CMCs.

* The GPCU interfaces with two System Data Acquisition Concentrators (SDACs) via an ARINC 429 link.

During all operation modes, the GPCU will continually transmit data to the SDACs. The SDACs will use these data to provide information and warnings to the ECAM.

* The GPCU receives an air/ground mode signal from Landing Gear Control and Interface Unit 1 (LGCIU1) which is used for the NBPT and to enable the interactive mode of communication between the GPCU and the CMCs.

The GPCU also provides a ground signal to LGCIU1 when the PRR is energized to maintain ground mode when the aircraft is jacked up.

NO BREAK POWER TRANSFER D/O

APU Master Switch to ON
Engine 1 Master Switch to ON
APU Master Switch to OFF

APU MASTER SWITCH TO ON

The LH side is supplied by EXTERNAL Power B alone. After pressing the APU START pushbutton, the APU start sequence begins.

At 95 % rated speed, the Electronic Control Box (ECB) provides the APU READY signal to the APU GCU. The Generator Control Unit (GCU) monitors all output parameters and when they are within accepted limits, the GCU issues the D signal to both ECMUs.

The Frequency Reference Unit (FRU) in the GPCU sends the frequency information of EXTERNAL Power B to the APU GCU. If the frequency is within the limits of 390 to 410 Hz, the APU GCU sends the APU RAMP signal to the ECB. The RAMP signal is an ARINC 429 signal which will cause the ECB to adjust the APU speed.

The speed adjustment rate and direction depends on the difference between the frequency of external power B and the APU generator frequency. When the APU generator frequency and phase angle match the GPCU frequency reference signal, the APU GCU issues the S1 signal to both ECMUs. The S1 signal indicates that the APU generator is ready to be momentarily placed in parallel with EXTERNAL Power B.

ECMU 1 closes the APU Generator Line Contactor (APU GLC) to place external power B in parallel with the APU generator on the transfer line. After a short time delay ECMU 1 opens the external power B line contactor and the APU generator powers AC BUS 1. The NBPT is completed.

When the External Power Contactor B (EPC B) opens, the EXTERNAL power B synchronization signal (S1), the APU generator ramp drive signal and the APU generator synchronization signal (S1) are all removed.

When the APU generator ramp drive signal is removed, the APU ECB will stop adjusting the APU speed, and will regulate the APU speed (and thus the APU generator frequency) to 400 Hz.

The GPCU frequency reference signal, for the left side of the aircraft, changes from external power B frequency to the APU generator frequency.

ENGINE 1 MASTER SWITCH TO ON

The LH side is supplied by the APU GENERATOR. The engine start sequence begins.

If the speed is correct, GCU 1 monitors all output parameters. When they are within the accepted limits, GCU 1 issues the D signal to the ECMUs and closes the internal Power Ready Relay (PRR).

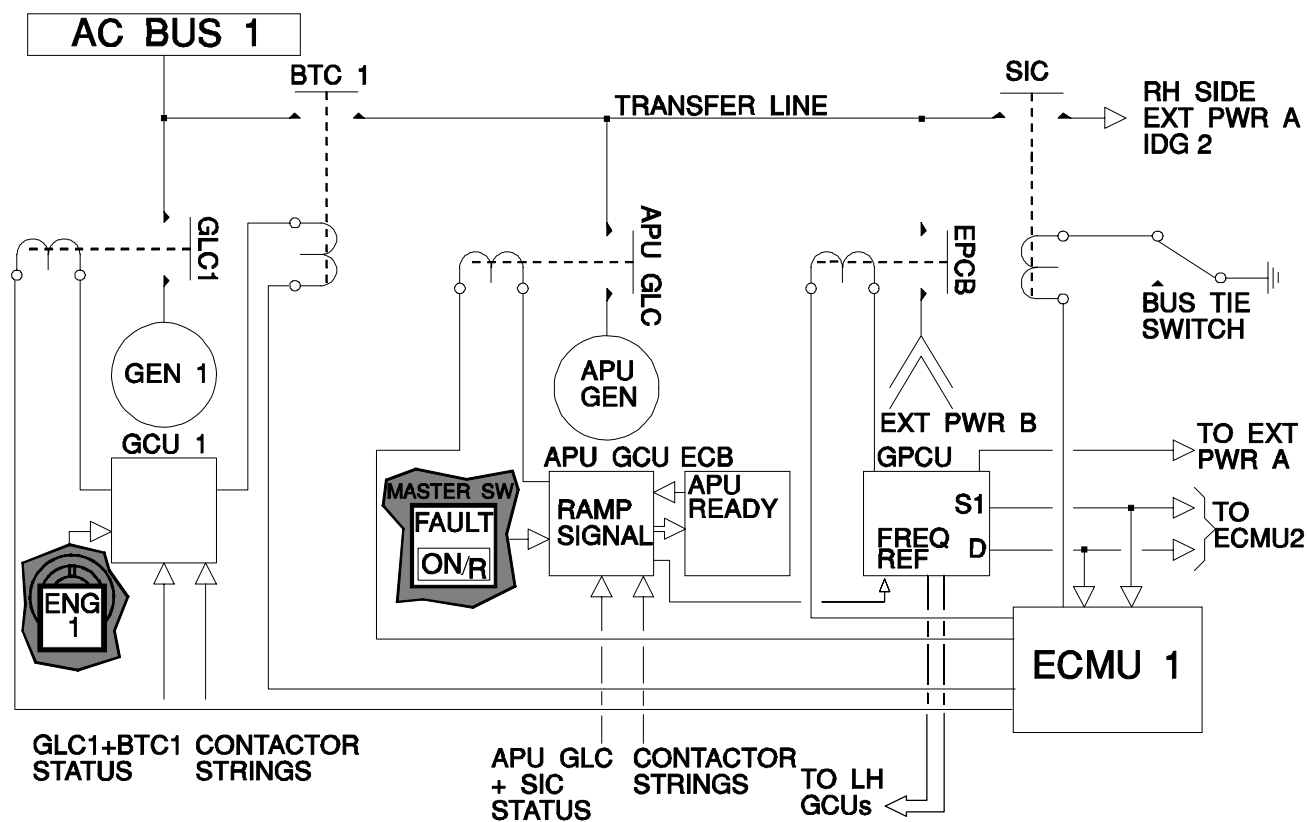
The GPCU FRU sends the frequency information of the APU generator phase A to GCU 1.

When Integrated Drive Generator (IDG) 1 frequency and phase angle match the GPCU frequency reference signal, GCU 1 issues the S1 signal to both ECMUs. The S1 signal indicates that IDG 1 is ready to be momentarily placed in parallel with the APU generator.

ECMU 1 closes GLC 1 to place the IDG 1 power in parallel with the APU generator on AC BUS 1.

After a short time delay, ECMU 1 opens Bus Transfer Contactor (BTC) 1. IDG 1 powers the AC BUS 1. The NBPT is completed.

Note : Before engine 2 starting, the EXTERNAL Power A must be disconnected to avoid NBPT between IDG 2 and EXTERNAL Power A.



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APU MASTER SWITCH TO OFF

The LH side is supplied by the APU GENerator.

CAUTION : If the APU BLEED switch is in ON position, it must be set to off. Then the APU MASTER switch can be set to off after a 2 minutes delay, to avoid NBPT function inhibition.

The APU shutdown sequence begins after 15 seconds. The APU GCU receives a discrete shutdown signal from the APU MASTER switch.

The APU GCU causes the following :

- removing of the D signal to the ECMUs indicating that the APU generator is being shutdown and requesting an NBPT.
- issuing of the frequency change request signal S4 to the GPCU (the FRU switches to EXternal Power B reference and provides this signal to the LH GCUs).
- when the APU GCU receives the frequency reference signal (EXternal power B) from the GPCU, it generates the RAMP signal to the ECB. If the frequency reference signal from the GPCU is within the limits of 390 to 410 Hz, the ECB adjusts the APU speed. The speed adjustment rate and direction depends on the difference between the frequency of EXternal Power B and APU generator.

When the APU generator frequency and phase angle match the GPCU frequency reference signal, the S1 signal is issued to the ECMUs indicating that the APU generator is ready to be momentarily placed in parallel with the EXternal Power B source.

After a short time delay, ECMU 1 opens the APU GLC and EXternal Power B supplies the LH side. If no other power source (EXternal Power A or IDGs) are connected to the RH side, the ECMU 1 closes the System Isolation Contactor (SIC) and EXternal Power B supplies the entire network.

Note : if synchronization between APU GEN and EXternal Power cannot be achieved within 15 seconds a break power transfer is achieved.

INADVERTENT PARALLELING TRIP PROTECTION D/O

Inadvertent Paralleling Trip Protection

INADVERTENT PARALLELING TRIP PROTECTION

The ECMUs control the operation of the system contactors to allow the AC electrical system to operate as a split bus system and to prevent parallel operation. If a failure occurs such that a parallel condition exists (ECMU fault or failed contactor), the GCU takes over the protection.

Each GCU permanently monitors the status of its channel GLC and BTC. Each GCU also monitors the three discrete contactors string inputs to determine if an inadvertent paralleling condition still exists after the ECMU controlled switching.

The APU generator supplies the LH network and EXTERNAL Power A the RH side. The SIC is open. Engine Master switch 1 is set to ON. No Break Power Transfer occurs between the APU generator and IDG 1.

Normally, 80 milliseconds after closing of GLC 1, ECMU 1 removes the plus supply for BTC 1 to open it.

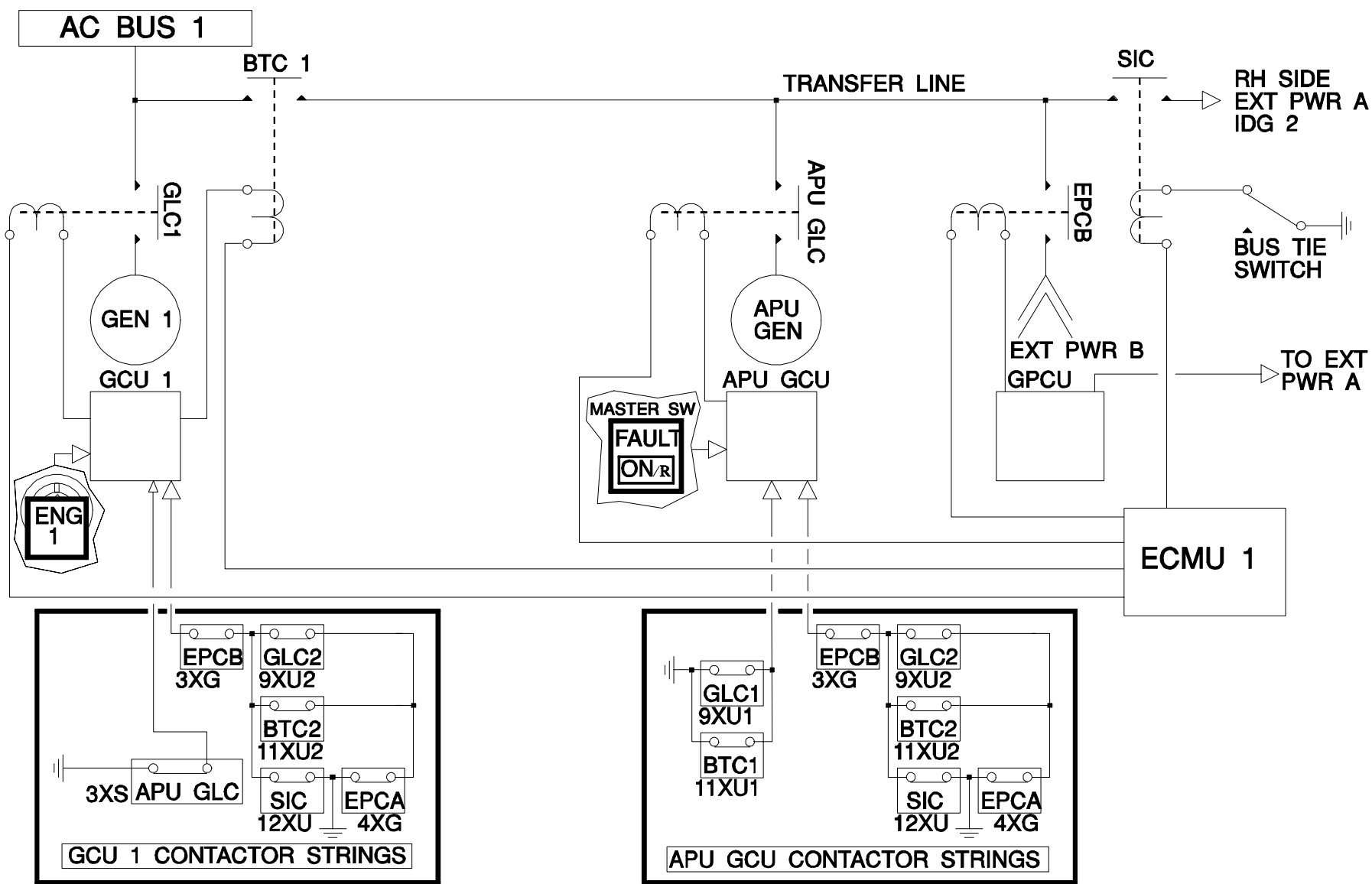
If BTC 1 stays closed after 130 ms, ECMU 1 removes the ground supply for the APU GLC to open it. If it also stays closed, GCU 1 takes over.

If the GLC and BTC status signals indicate that these contactors are closed (IDG is on the transfer line) and one of the discrete contactor string signals indicates that there is another power source (for example APU GEN) on the transfer line, the GCU determines that an inadvertent parallel condition exists. If this condition persists for at least 160 ms, the GCU will lock out the BTC by removing its ground signal.

If opening of the BTC does not occur and the parallel condition persists after 60 ms, the GCU will open the PRR and the Generator Control Relay (GCR) to disable the generating channel.

The channel can be reset up to twice by cycling the generator control switch. After two reset attempts, a cold reset is required.

Note : Reset of the BTC lock-out relay can only be accomplished by cold start of the GCU.



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STUDENT NOTES

AC AND DC GROUND SERVICE BUS CONTROL

General
AC Service Network
DC Service Network
Control and Protection

GENERAL

The AC and DC service bus networks are normally supplied from the aircraft network. The DC supply is provided by TR2.

The AC and DC service bus networks can be supplied directly from external power receptacle A without powering the entire aircraft network.

AC SERVICE NETWORK

The AC service network comprises 6 sub-busbars.

35XN is closed if the FORWARD/MID galley is on (111MC closed) and 101PP is supplied.

The AC sub-busbars can be directly supplied under these conditions :

- Ground Power Source connected to receptacle A only
- EXTERNAL Power AVAIL light ON
- MAINTenance bus switch set to ON.

6XX is closed if 2PU is open.

19XN is closed if 601PP is supplied and RCCB 1XX is closed.

DC SERVICE NETWORK

The DC service network comprises one main bus (6PP) and 3 sub-busbars 601PP, 602PP and 603PP.

The DC service network is supplied from TR 2.

In normal supply mode, TR2 is supplied via contactor 2PU.

In direct supply mode, TR 2 is supplied via contactor 6XX.

CONTROL AND PROTECTION

The solenoid held MAINTenance BUS switch controls and protects the service network when it is supplied directly from external power A. The switch is held in the ON position if all parameters of external power A, checked by the GPCU, are correct.

ECMU 2 is informed and commands all RCCBs and contactors to supply the service network from external power A.

When at least one parameter is not accepted by the GPCU, the switch is automatically unlatched and the service network is no longer supplied.

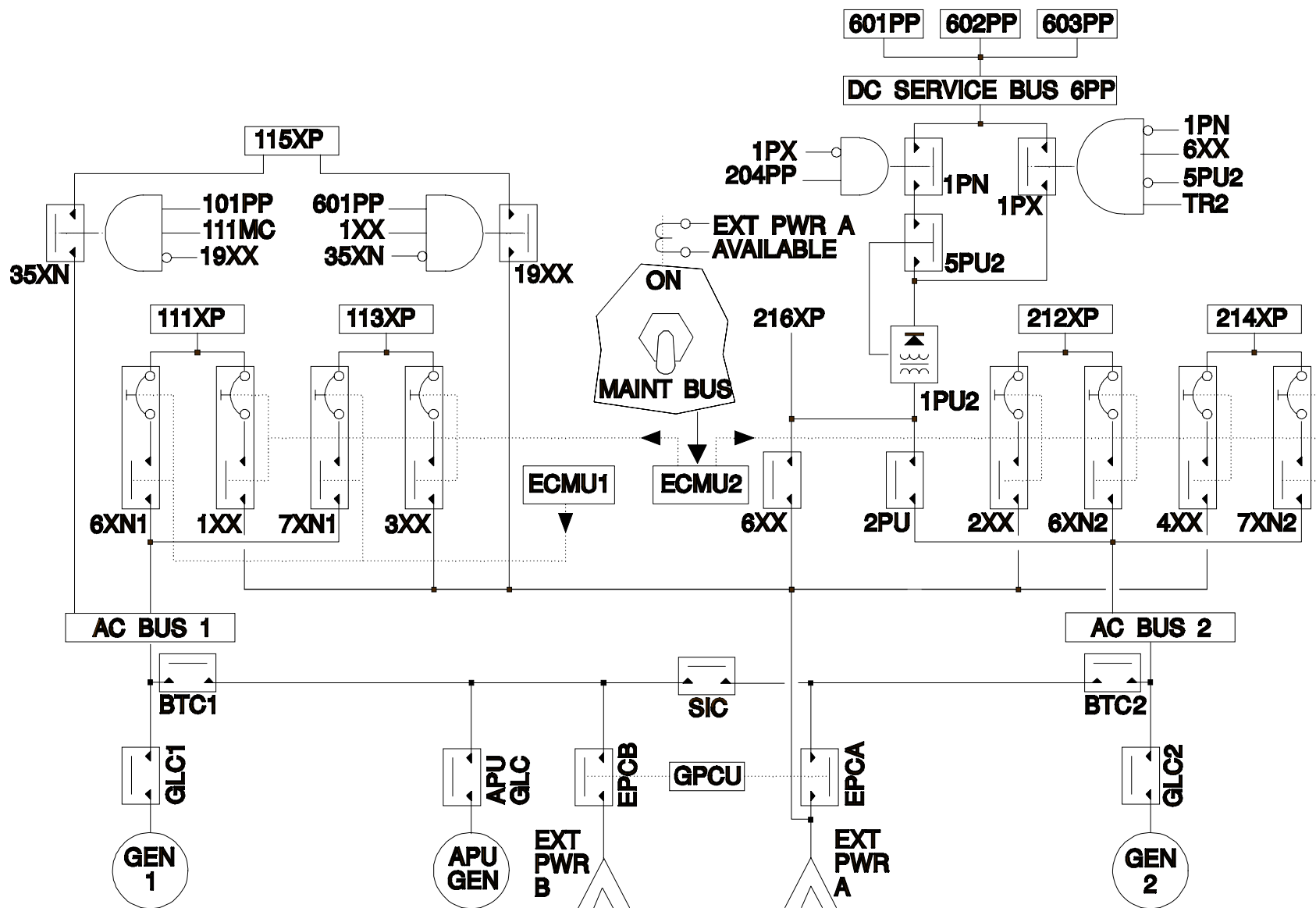
Note : The GPCU switches off the GPU.

When TR 2, supplied via 2PU (normal supply), fails, contactor 5PU2 opens and the following events occur.

If TR2 is off but not due to overcurrent, contactor 1PN remains in the closed position because DC BUS 2 is then automatically supplied from DC BUS 1 (204PP remains supplied).

If TR2 is off due to overcurrent, the DC service buses are no longer supplied (DC BUS 2 and sub-busbar 204PP off), contactor 1PN opens.

When TR 2, supplied via 6 XX (direct supply), fails contactor 1 PX opens and the DC network is no longer supplied.



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STUDENT NOTES

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EXTERNAL POWER COMPONENTS (2)

Safety Precautions
GPCU
External Power Receptacle

SAFETY PRECAUTIONS

Comply with the safety precautions, warnings and cautions.

WARNING:

MAKE SURE THAT NO EXTERNAL POWER IS CONNECTED.
THERE IS A RISK OF ELECTROCUTION IF THE EXTERNAL POWER
STAYS CONNECTED.

GPCU

FIN/ZONE

FIN : 1XG

Zone : 122

COMPONENT DESCRIPTION

The GPCU front face features:

- Electrostatic Discharge Sensitive (ESDS) and High Voltage warning Labels,
- name and modification plates,
- four C/Bs (not for reset),
- an On-Board Replaceable Memory module (OBRM).

IN SITU TEST

The operational test of the GPCU must be performed through the MCDU to complete the GPCU installation.

SAFETY PRECAUTIONS

(1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released:

- BAT 1, BAT 2, APU BAT (the OFF legend is on),
- GEN 1(2) APU GEN (the OFF legend is on),
- EXT A(B) (the AVAIL legend is on).

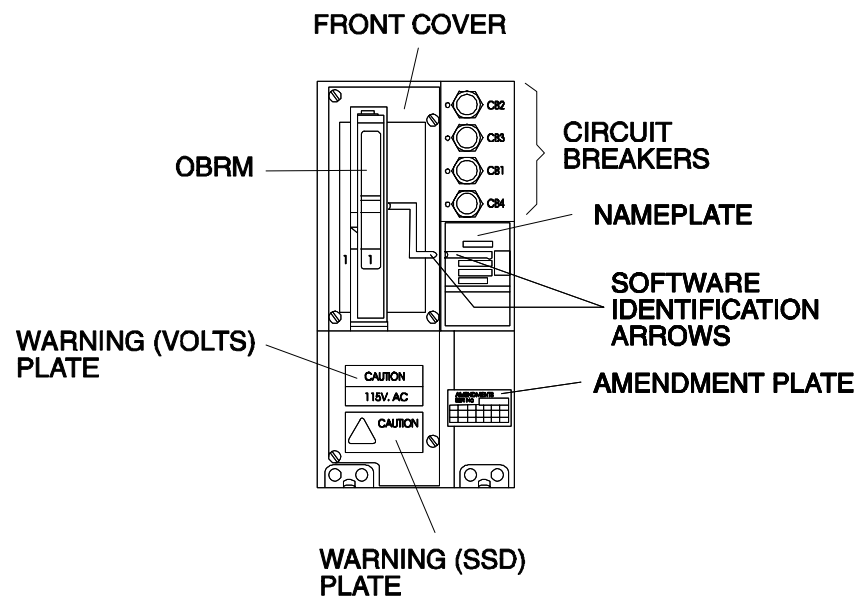
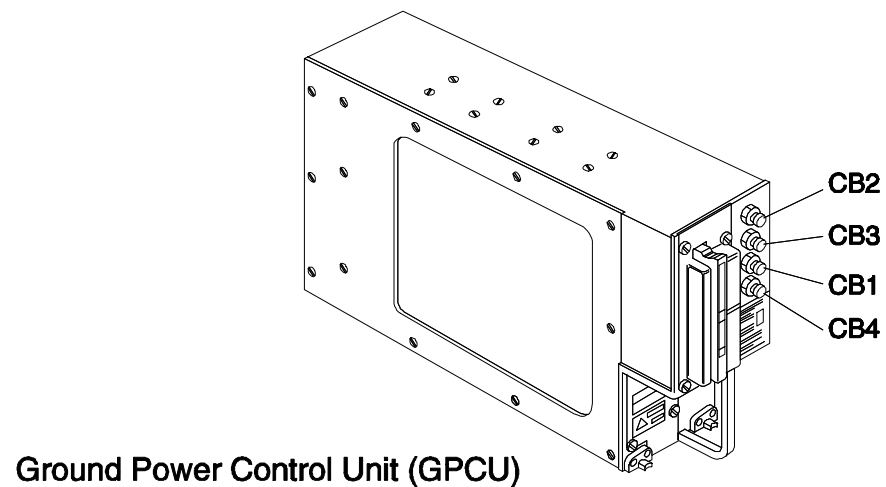
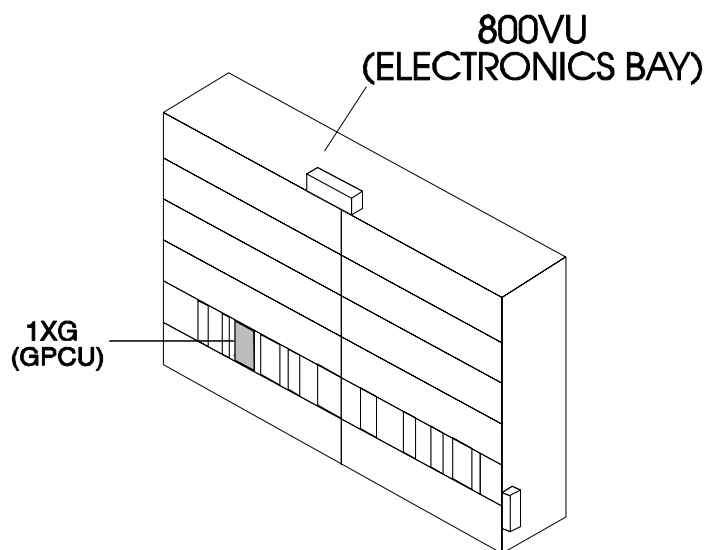
NOTE: The purpose of (1) is to check that the above mentioned pushbutton switches are released. This is possible only if the External Power is connected.

(2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel:

- 211VU (EMER ELEC PWR),
- 235VU (ELEC).

(3) Make sure that no external power is connected to the aircraft receptacle(s) EXT PWR A(B).

(4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.



EXTERNAL POWER RECEPTACLE

FIN/ZONE

FIN : 19XG, 20XG

Zone : 120

IN SITU TEST

The aircraft electrical circuits have to be energized in order to test the installation of the receptacle (TASK 24-41-00-861-801).

SAFETY PRECUATIONS

(1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released:

- BAT 1, BAT 2, APU BAT (the OFF legend is on),
- GEN 1(2) APU GEN (the OFF legen is on),
- EXT A(B) (the AVAIL legend is on).

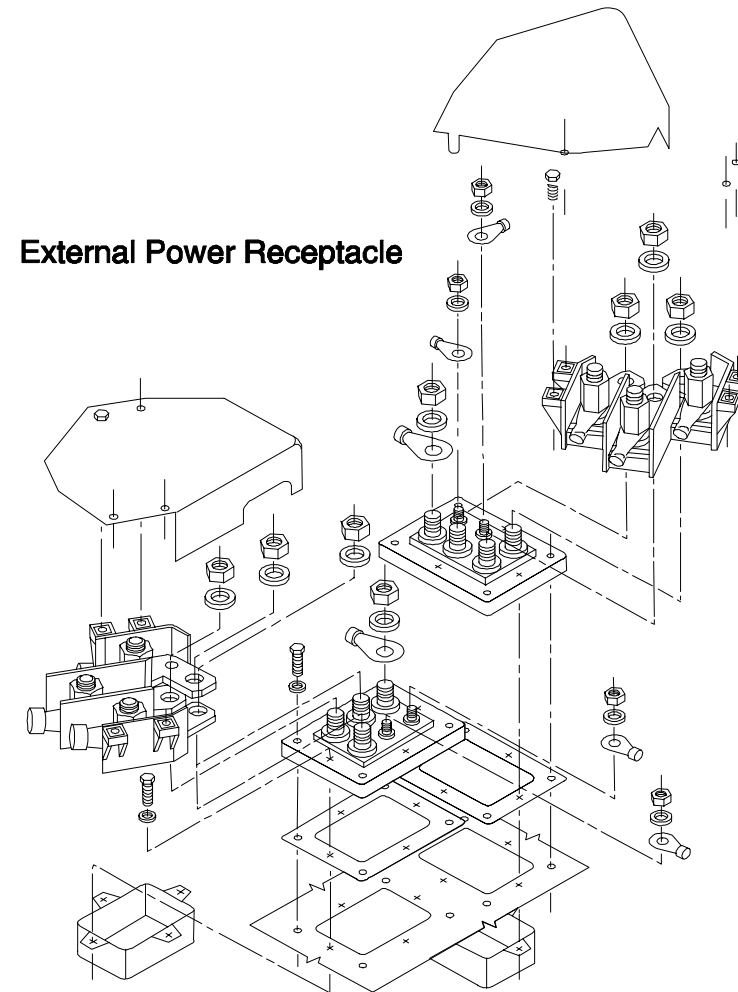
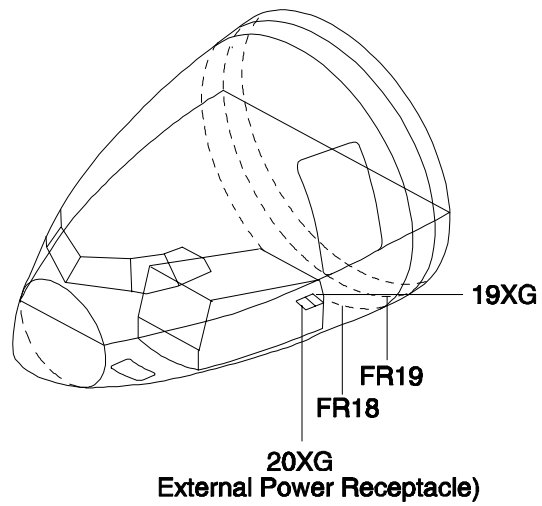
NOTE: The purpose of (1) is to check that the above mentioned pushbutton switches are released. This is possible only if the External Power is connected.

(2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel:

- 211VU (EMER ELEC PWR),
- 235VU (ELEC).

(3) Make sure that no external power is connected to the aircraft receptacle(s) EXT PWR A(B).

(4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.



EXTERNAL POWER COMPONENTS (3)

Safety Precautions
EPC
RCCB

SAFETY PRECAUTIONS

Comply with the safety precautions, warnings and cautions.

WARNING:

MAKE SURE THAT NO EXTERNAL POWER IS CONNECTED.

EXTERNAL POWER CONTACTOR (EPC)

FIN/ZONE

FIN : 3XG, 4XG
Zone : 120

(3) Make sure that no external power is connected to the aircraft receptacle(s) EXT PWR A(B).

(4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.

COMPONENT DESCRIPTION

The power contactor comprises two parts: The base and the removable part.

The base features:

- a power terminal,
- shunts,
- fastener devices for the removable contacts,
- installation fixtures.

The removable part features:

- a power commutation unit,
- an electromagnetic control,
- auxiliary contacts,
- a connector.

IN SITU TEST

Make sure that the procedure to energize the aircraft electrical circuits with the external power supply is correct (ref. TASK 24-41-00-861-801).

SAFETY PRECAUTIONS

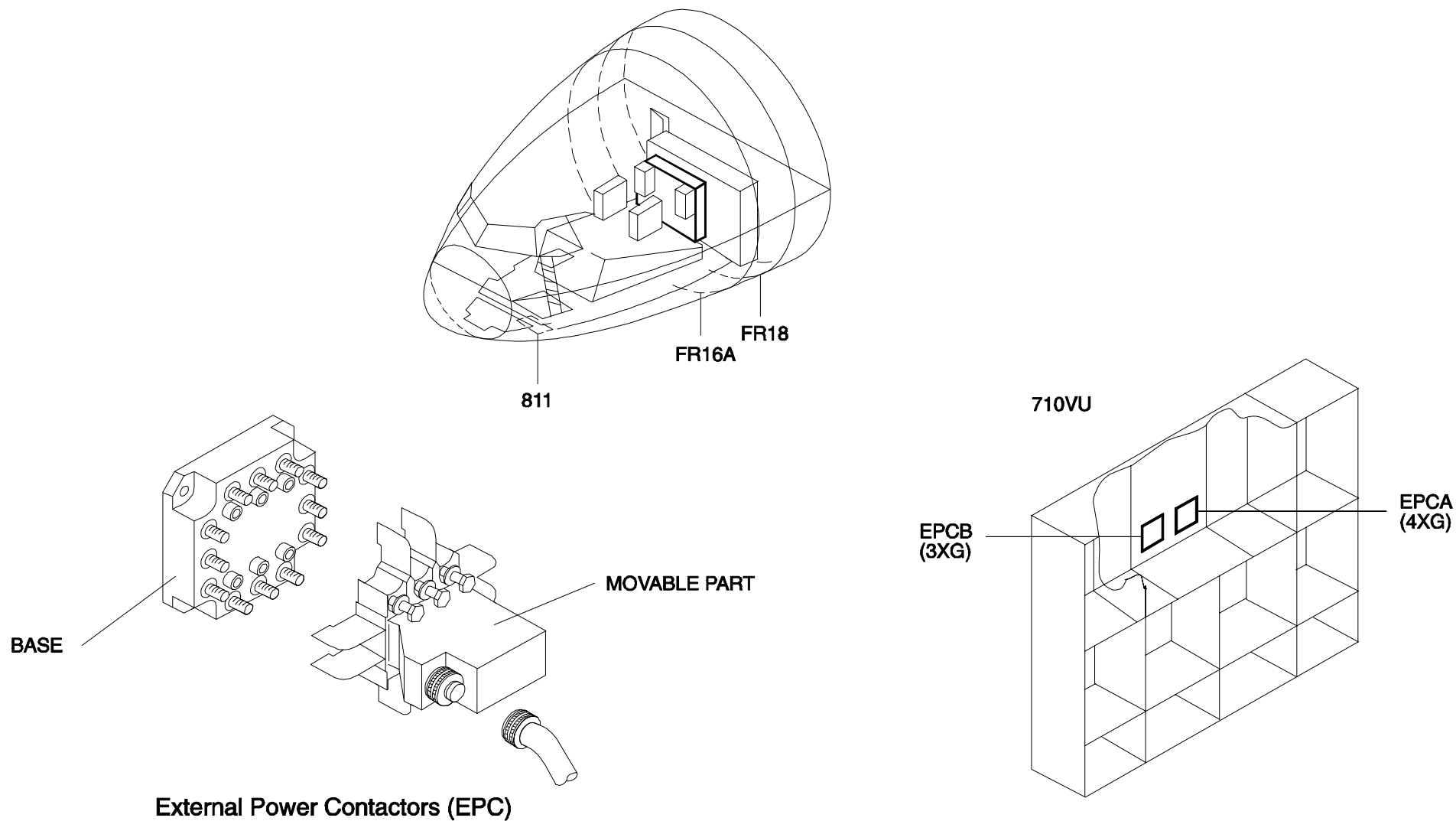
(1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released:

- GEN 1(2) APU GEN (the OFF legend is on),
- EXT A(B) (the AVAIL legend is on).

NOTE: The purpose of (1) is to check that the above mentioned pushbutton switches are released. This is possible only if the External Power is connected.

(2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel:

- 211VU (EMER ELEC PWR),
- 235VU (ELEC).



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REMOTE CONTROL CIRCUIT BREAKER (RCCB)

FIN/ZONE

FIN : 1XX, 2XX, 3XX, 4XX

Zone : 120

COMPONENT DESCRIPTION

The RCCB is a three-pole contactor and a thermal circuit breaker.

The front face features:

- a supply side (A1, B1, C1),
 - a load side (A2, B2, C2),
 - a rating identification label,
 - a visual state indication: OPEN or CLOSED main contacts status message,
 - a RESET button:
- when pressed in: RCCB re-operation is possible in case of tripping,
when released (out position), RCCB re-operation is not possible, in
case of main circuit overload.

NOTE: All RCCBs are interchangeable.

SAFETY PRECAUTIONS

(1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released:

- BAT 1, BAT 2, APU BAT,
- GEN 1(2) APU GEN (the OFF legend is on),
- EXT A(B) (the AVAIL legend is on).

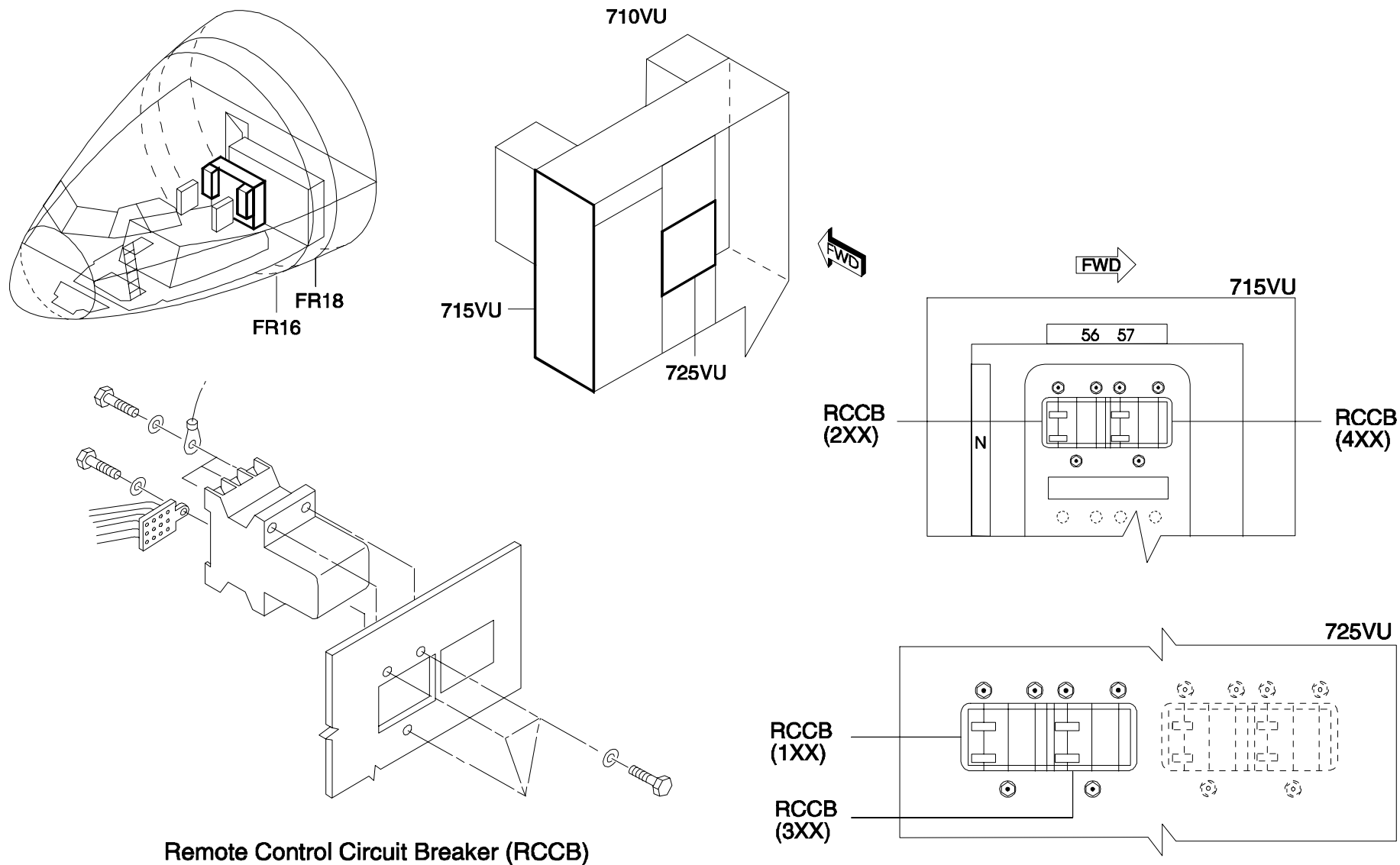
NOTE: The purpose of (1) is to check that the above mentioned pushbutton switches are released. This is possible only if the External Power is connected.

(2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel:

- 211VU (EMER ELEC PWR),
- 235VU (ELEC).

3) Make sure that no external power is connected to the aircraft receptacle(s) EXT PWR A(B).

(4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.



FQW4200 GE Metric

DC GENERATION

Transformer Rectifiers
Batteries
Distribution
TR Operation
Battery Operation
BCL Function

TRANSFORMER RECTIFIERS

There are four identical Transformer Rectifiers (TR1, TR2, APU TR and ESS TR).

Each TR converts the three phase alternating current into 28 V Direct Current.

BATTERIES

There are three identical nickel-cadmium Batteries (BAT1, BAT2 and APU BAT).

DISTRIBUTION

TR1, powered from AC bus 1, supplies DC BUS 1 and the DC BAT BUS.

TR2, powered from AC bus 2, supplies DC BUS 2 and the DC Service bus. TR2, when powered from EXT power A, supplies the DC SERVICE bus only.

The ESS TR, powered from AC BUS 1 or AC BUS 2 or CSM/G, supplies the DC ESS BUS and the DC ESS SHED BUS.

The APU TR, powered from AC BUS 2, is only used to supply the APU starter and to charge the APU battery.

The two main batteries (BAT 1 and BAT 2) are connected to the DC BAT BUS. They also supply the static inverter and, under certain configurations, the DC ESS BUS.

Note : the HOT BUSES are always supplied.

The APU battery is only used for starting the APU.

TR OPERATION

The four TRs start to operate as soon as they are supplied by the associated AC busbars.

In the event of TR1 loss, DC BUS 1 and DC BAT BUS are restored from TR2 through the ECMU controlled contactors.

If TR2 is lost, DC BUS 2 is restored from TR1 through the same contactors.

If the ESS TR is lost, the DC ESS BUS and the DC ESS SHED BUS are recovered from the DC BAT BUS.

BATTERY OPERATION

BAT 1 and BAT 2 are connected to the DC BAT BUS through contactors.

These contactors are controlled by the Battery Charge Limiters (BCL).

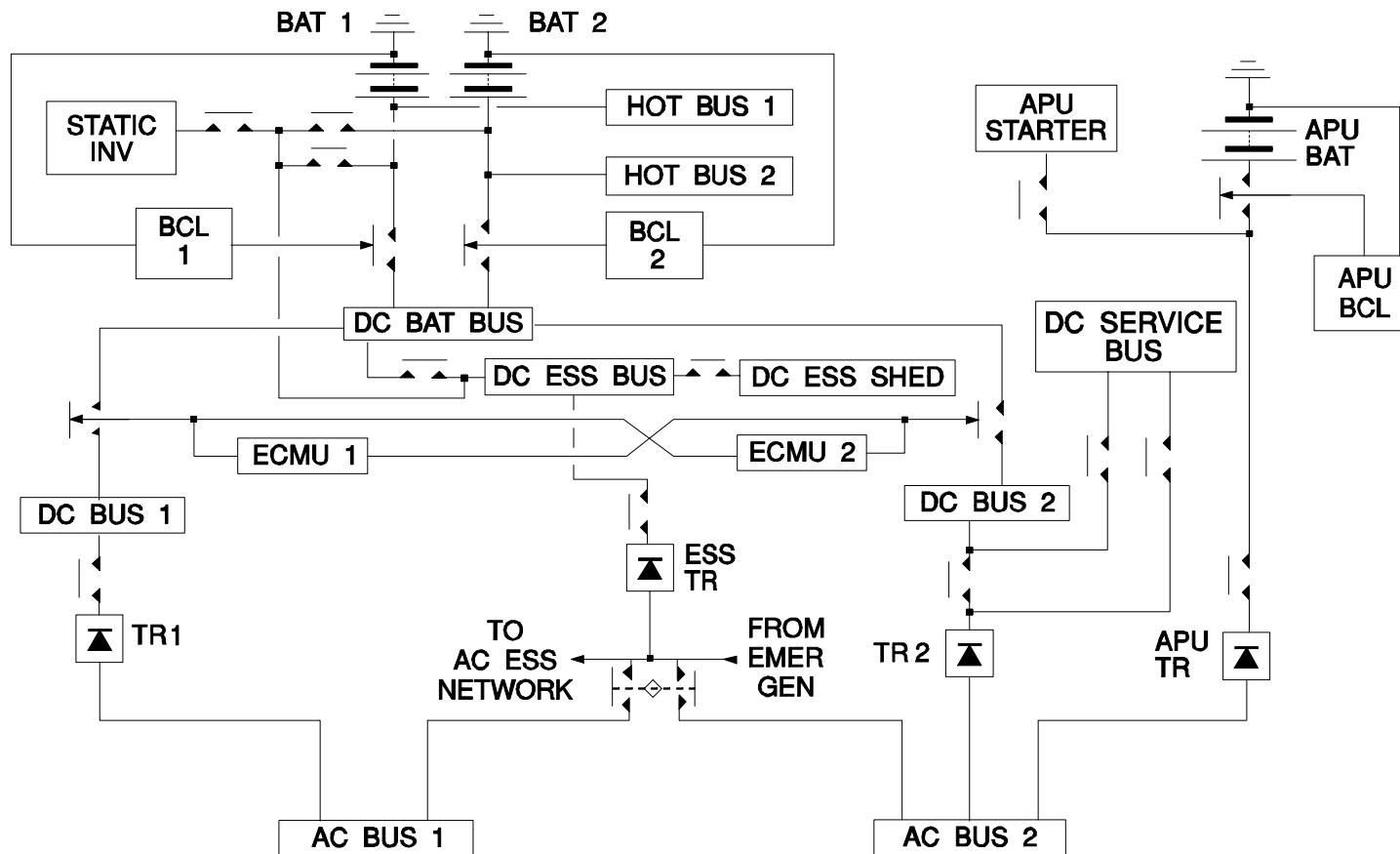
The APU battery is connected to the APU STARTER through a contactor and controlled by the APU BCL.

BCL FUNCTION

The three Battery Charge Limiters (BCLs) are identical and interchangeable.

The BCLs :

- ensure automatic battery connection for charging or discharging,
- protect the battery against thermal runaway, short circuit or complete discharge.



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STUDENT NOTES:

FQW4200 GE Metric

DC MAIN GENERATION D/O

General
TR1
TR2
APU TR
Monitoring card
Interface
Operation

GENERAL

The DC main and essential generation consists of four identical and interchangeable Transformer Rectifiers (TRs) and their related contactors.

The DC main generation system is composed of TR1 and TR2 which supply DC BUS 1 and DC BUS 2.

The APU TR is used to charge the APU battery and to start the APU.

Each TR contains:

- a transformer part
- a rectifier part
- a monitoring card.

TR1

TR1 converts the 115 VAC power from AC BUS 1 into 28 VDC.

The monitoring card is supplied by the internal 28 VDC and from bus 401PP as a back-up supply.

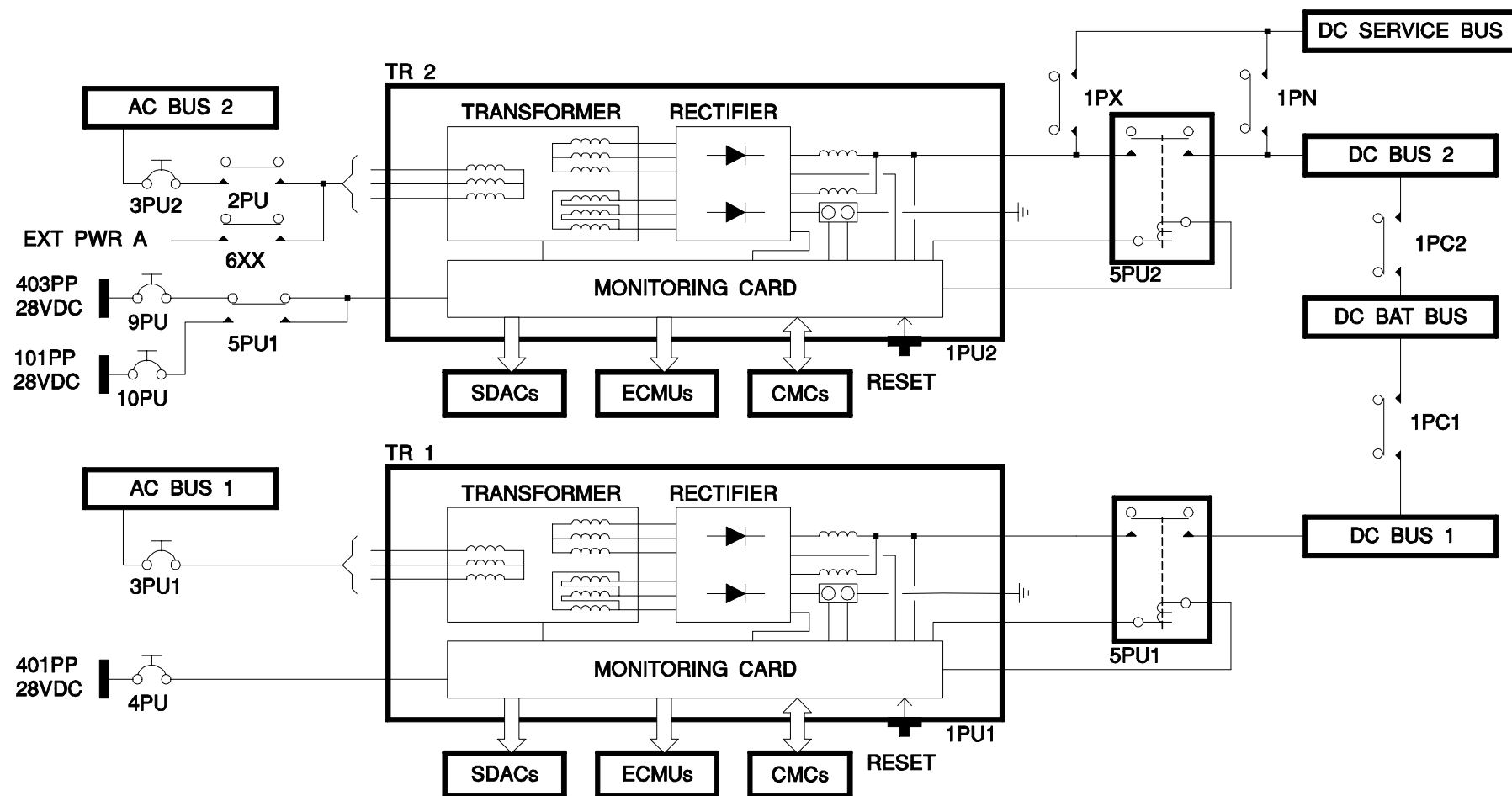
The 28 VDC output is connected to DC BUS 1 via contactor 5PU1.

TR2

TR2 converts the 115 VAC power into 28 VDC from AC BUS 2 via contactor 2PU, or on ground with only external power A connected and the maintenance bus switch in ON position via contactor 6XX.

The monitoring card is supplied by the internal 28 VDC and from bus 101PP. If TR1 is not operating (5PU1 open), the monitoring card of TR2 is supplied from bus 403PP.

The 28 VDC output is connected to DC BUS 2 via contactor 5PU2 and via contactor 1PN to DC SERVICE BUS 6PP. The 28 VDC output can also be connected to the DC SERVICE BUS via contactor 1PX, only on ground with external power A connected and the maintenance bus switch in ON position.



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APU TR

The APU TR converts the 115 VAC power from AC BUS 2 into 28 VDC. The monitoring card is only supplied by the internal 28 VDC. The 28 VDC output is directly connected to busbar 909PP and, via contactor 7PU, to busbar 309PP, to the APU starter, the APU battery for charging (5PB closed) and to busbar 709PP.

MONITORING CARD

The monitoring card contains the power supply module, the control and protection circuits.

The TR is protected against:

- overhear (Transformer and Rectifier)
- overcurrent
- open or short circuited diode (Rectifier).

Whenever a protection circuit is triggered, the DC output contactor (PU) opens and remains open until a reset is performed.

The reset can be performed:

- from the MCDU via the Centralized Maintenance Computers (CMCs)
- from the reset button on the TR housing.

INTERFACE

The TRs interface with several systems.

TR1 and TR2 interface with:

- SDACs for ECAM warning and indication
- ECMUs for control of contactors 1PC1 and 1PC2 (for automatic transfer and short circuit protection)
- CMCs for TR reset.

APU TR interface with:

- SDACs for ECAM warning and indication
- CMCs for TR reset.

OPERATION

Each TR is operative if the corresponding busbar is supplied. Provided all parameters are correct, the DC contactor (PU) closes and connects the power to the corresponding DC busbar.

Normal operation:

- TR1 and TR2 are active
- 1PC1 is closed and 1PC2 is open.

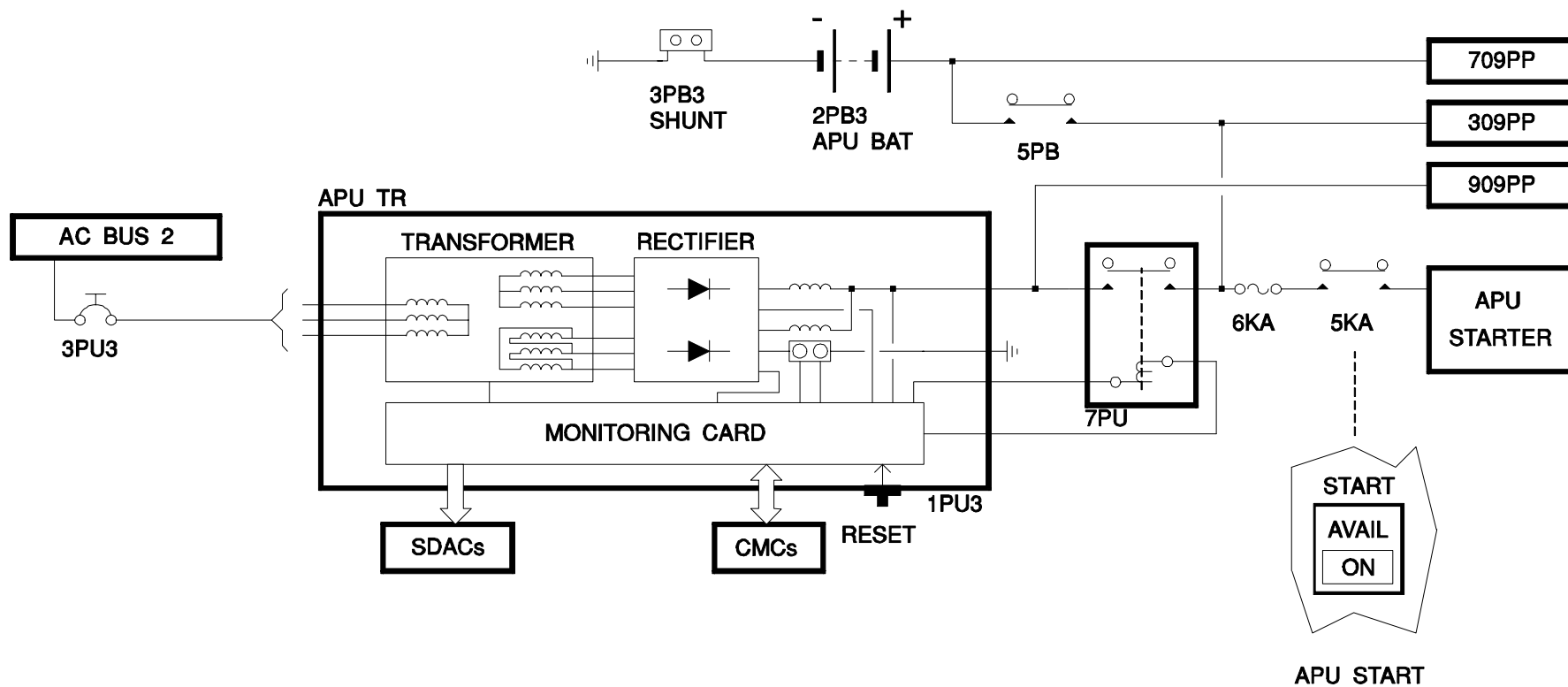
Abnormal operation:

- TR1 or TR2 are off but not due to overcurrent
- 1PC1 and 1PC2 are closed.

On the APU TR, the closed contactor 7PU connects the DC power to contactor 5KA and 5PB.

5KA is closed if the APU START pushbutton is pressed.

5PB is closed if the APU battery needs charging.



STUDENT NOTES:

DC ESSENTIAL GENERATION D/O

General
Power Supply
Monitoring Card
Interface
Operation

GENERAL

The DC Essential generator system is composed of the ESSential Transformer Rectifier (ESSential TR) and its associated contactor.

The 28 VDC output is connected to the DC ESSential BUS via the contactor 3 PE.

POWER SUPPLY

The ESSential TR can be supplied with 115 VAC / 400 Hz 3 phases from:

- AC BUS 1 in normal configuration
- AC BUS 2 automatically in case of loss of AC BUS 1 (abnormal configuration)
- Emergency Generator (CSM/G) automatically in case of loss of AC BUS 1 and AC BUS 2 (Emergency configuration).

MONITORING CARD

The monitoring card contains the power supply module and the control and protection circuits.

It is supplied by the internal 28 VDC and, as back-up supply, from DC BUS 101 PP.

The ESSential TR is protected against :

- overcurrent
- overheat (Transformer and Rectifier)
- open or short circuited diode (Rectifier).

Whenever a protection circuit is triggered, the DC output contactor 3 PE opens and remains open until a reset is performed.

A reset can be performed :

- from the MCDU via the CMS
- from the reset button on the TR housing.

INTERFACE

The ESSential TR interfaces with :

- SDACs for ECAM warnings and indication
- CMS for TR reset.

OPERATION

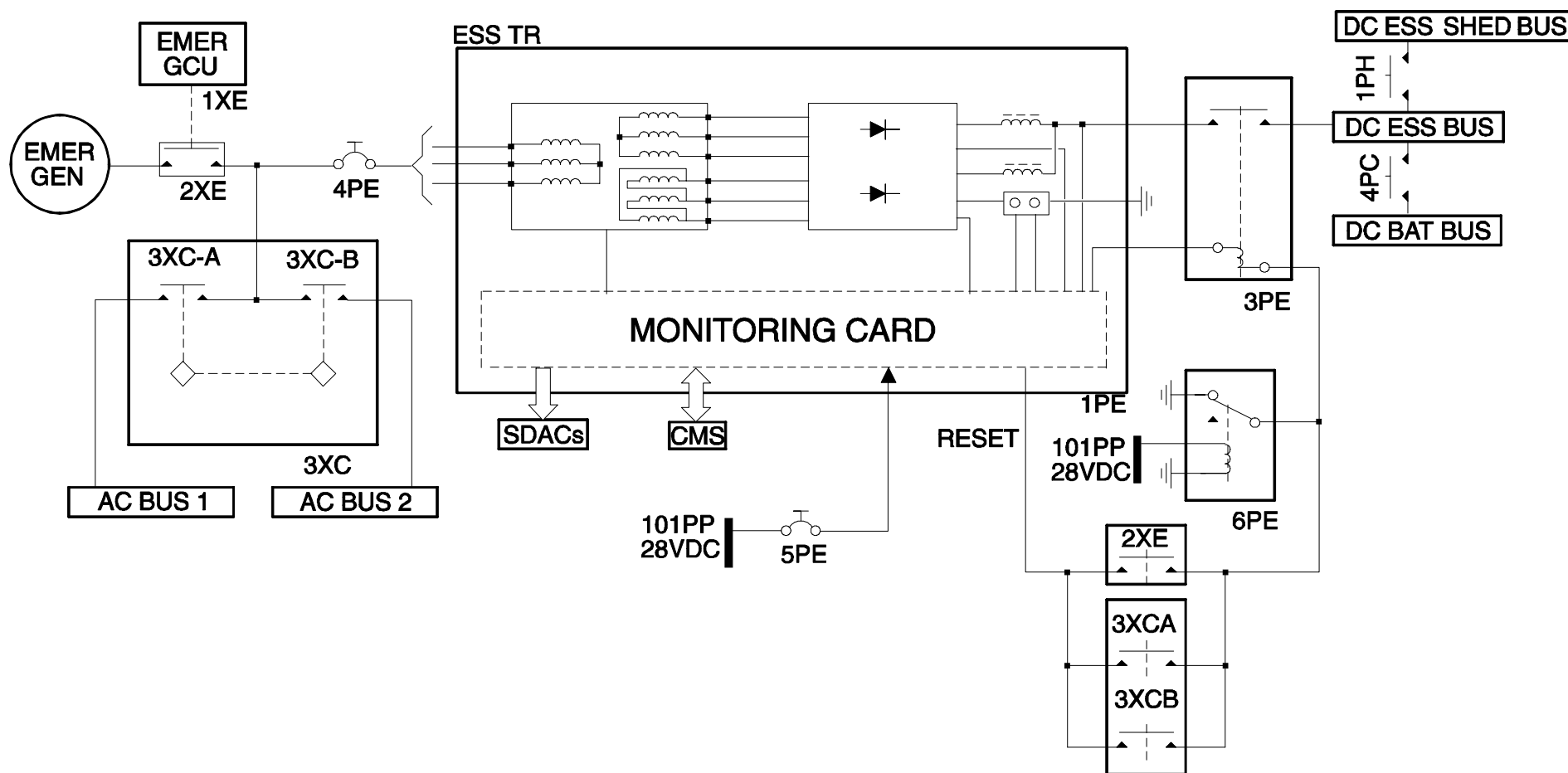
The ESSential TR is operative if the corresponding busbar is supplied.

Provided all parameters are correct, the DC contactor closes and connects the power to the DC ESSential network.

The DC ESSential SHEDdable BUS is lost in case of :

- CSM/G supplied by the RAT
- on battery only (Emergency configuration).

To avoid contactor 3PE opening, due to an AC power input transfer, the contactor 6PE opens if busbar 101PP is no longer supplied ; this connects a ground to 3 PE to keep it energized.



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STUDENT NOTES.

BATTERY SYSTEM D/O

Batteries 1/2
APU Battery
Battery Description
Battery Control
Indication Monitoring

BATTERIES 1/2

The two main batteries are used as a backup supply, if no other power source is connected.

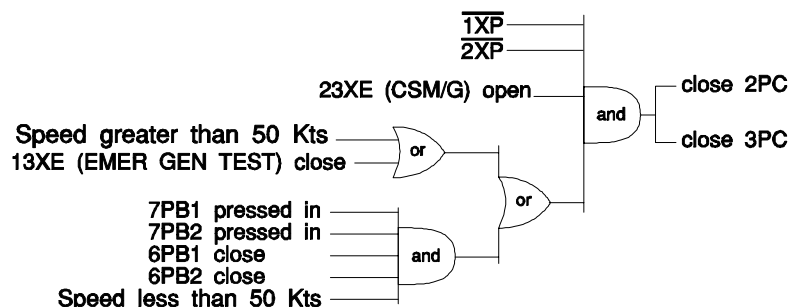
The two main batteries are used to supply the DC ESSential busbar and the static inverter via contactors 2PC and 3PC.

Note : the related HOT BUS is always supplied.

Each battery is associated to one Battery Charge Limiter (BCL). The BCL ensures the battery charge/discharge and protection by controlling the battery contactor.

If the BAT pushbutton switch is pressed in, the battery contactor is closed and connects the battery to the battery busbar for charging or discharging. Once normal supply is established, contactor 1PC1 is closed and the DC BAT BUS is supplied from DC BUS 1 for battery charging.

Contactors 2PC and 3PC control logic



BATTERY DESCRIPTION

The three batteries are identical and interchangeable. Each battery is ventilated by two ducts. The differential pressure between the cabin and the outside is used to provide battery ventilation.

Each battery has 20 nickel cadmium cells in a titanium case. Each cell can be removed separately. The battery nominal voltage is 24VDC, nominal capacity is 37AH.

BATTERY CONTROL

Each BCL is controlled by means of a pushbutton switch located on the overhead ELEC panel.

OFF position :

The pushbutton is released out. The BCL is not operating and the battery can not be connected to the BAT busbar. The OFF legend comes on white. The message "BAT OFF" is displayed on the ECAM.

ON position :

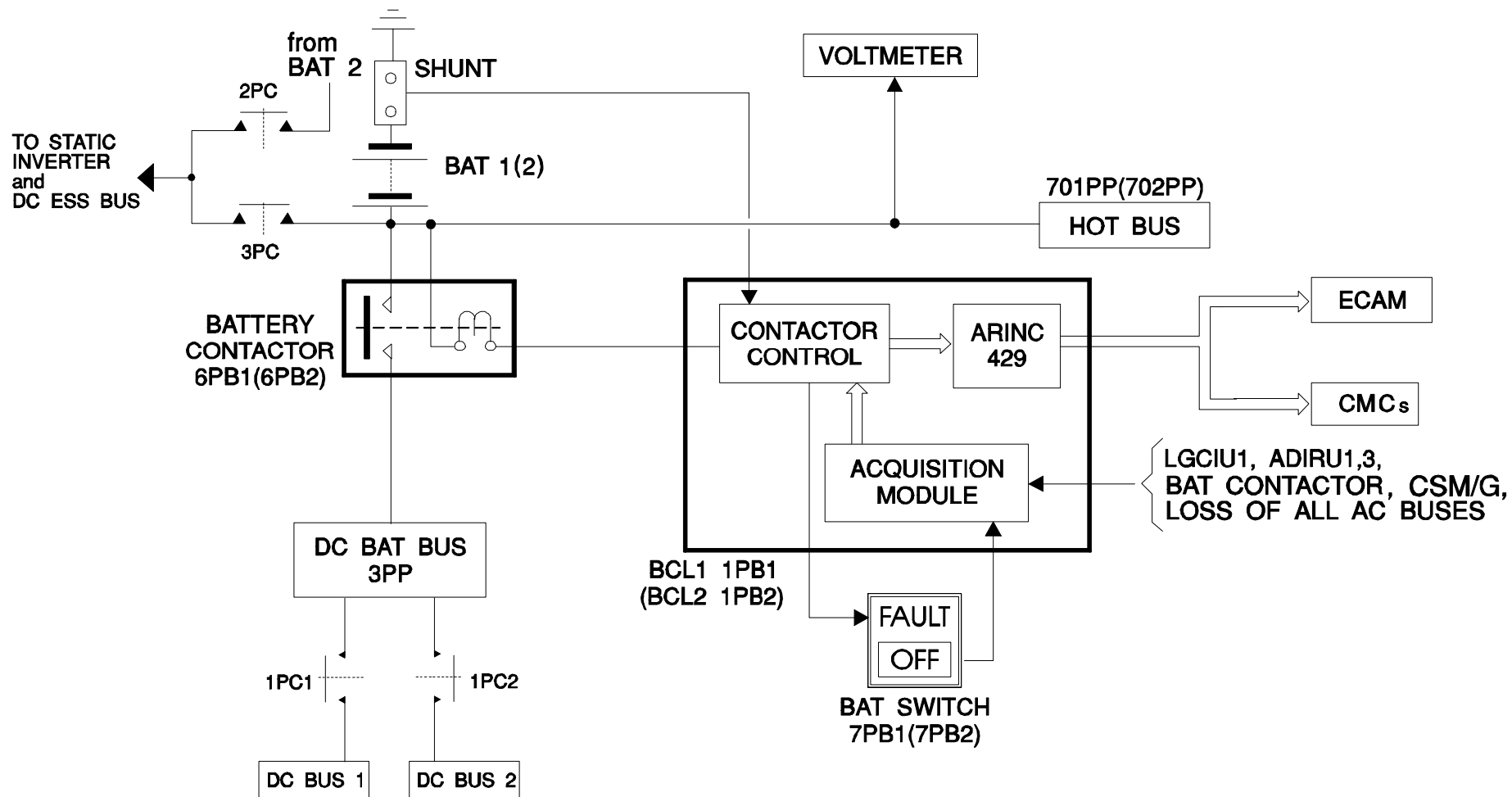
The pushbutton switch is pressed in. The BCL is operating and automatically controls the coupling or uncoupling of the battery. If a battery thermal runaway or short circuit is detected, the battery contactor automatically opens and the FAULT amber legend comes on with the ECAM warnings.

If the FAULT legend is on, the switch must be released out (OFF position).

INDICATION/MONITORING

Battery parameters are displayed on the ECAM and on the voltmeter which is located on the overhead ELEC power panel.

System failures and BITE data are sent to the Centralized Maintenance Computers.



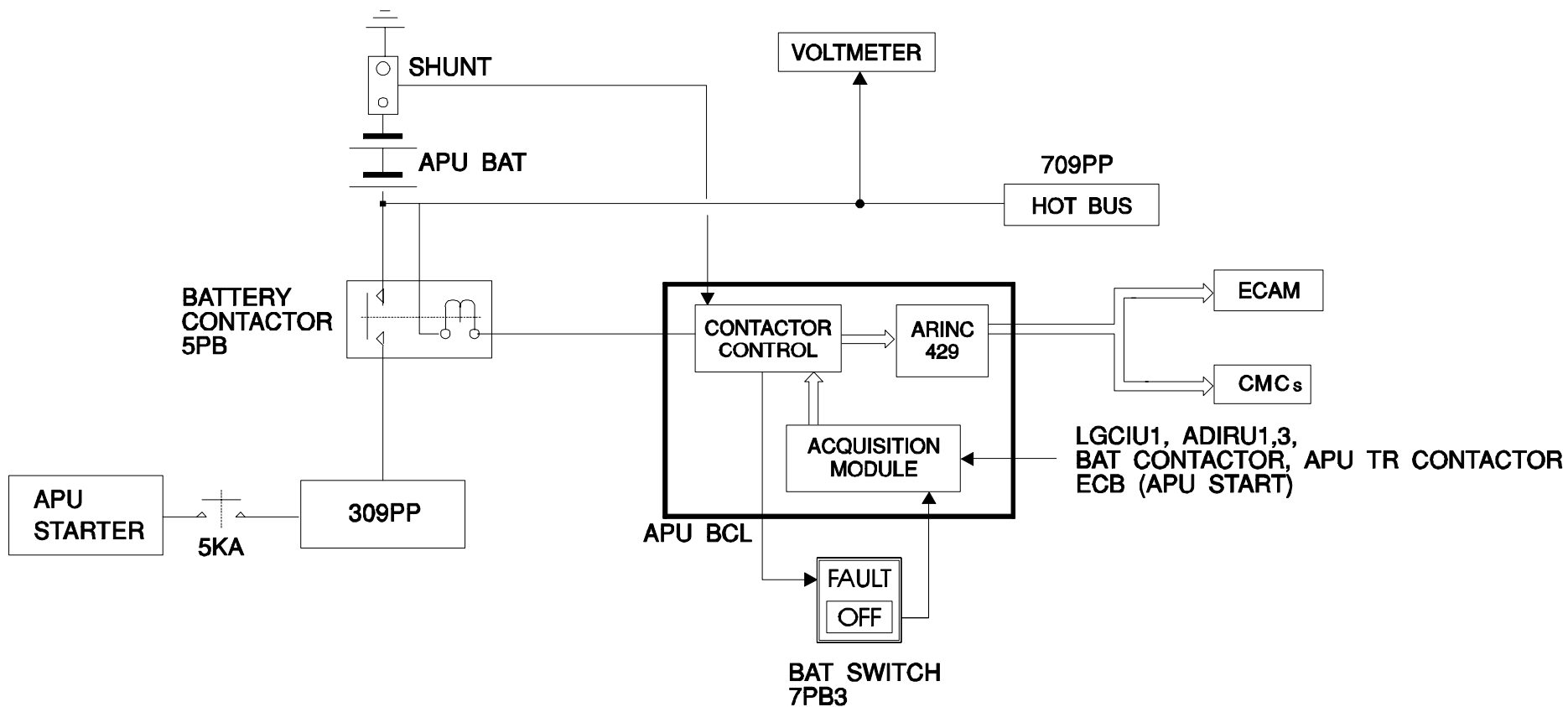
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APU BATTERY

The APU battery is only used to start the APU.

The APU BCL ensures battery charge/discharge and protection in the same way as for the main batteries.

Note : the three BCLs are identical and interchangeable due to pin-programming.



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STUDENT NOTES:

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BATTERY CHARGE LIMITER (BCL) D/O

Description
Purpose
BCL Power Supply
Battery Charge
Thermal Runaway, Short Circuit Protection
Complete Discharge Protection
Hot Bus Protection
Backup Supply
APU Starting
EMER GEN Fault Light Control
Bat Fault Light Control

DESCRIPTION

The three Battery Charge Limiters are identical and interchangeable. PIN programming determines the position of the BCL (1, 2 or APU) and the aircraft type.

PURPOSE

The main function of the BCLs is to control the battery contactor and BATtery FAULT warning. BCL 1 and BCL 2 also control the EMERgency GENerator FAULT warning.

The battery contactor control includes the following functions :

- ensure battery charge,
- protect the battery against thermal runaway or short circuit,
- prevent complete discharge,
- maintain HOT BUS supply in case of short circuit on the BAT BUS.

NOTE : BCL 1,2 also ensure power supply when no electrical power is available.

BCL POWER SUPPLY

Each BCL is supplied by its own battery via battery bus 3PP, provided the corresponding battery switch is pressed in.

BATTERY CHARGE

When battery voltage is lower than 26.5 Volts and DC BAT BUS higher than 27 Volts, the contactor is closed for battery charging.

When the charge current is less than 4 Amps decreasing for 10 seconds on ground or 30 minutes in flight, the contactor opens. When the battery voltage reaches 26.5 volts, another charge cycle starts.

NOTE : A charge cycle of 30 minutes is initiated at the beginning of a flight if no charge cycle occurred during the last flight.

THERMAL RUNAWAY, SHORT CIRCUIT PROTECTION

If the charge current is above 10 Amps and increasing by more than 0.375 Amps per minute (thermal runaway) or the charge current is greater than 150 Amps for 90 seconds (short circuit), the contactor opens and the warnings are triggered.

After these failure configurations, the corresponding pushbutton switch must be set to off.

Setting the switch to on again resets the BCL.

COMPLETE DISCHARGE PROTECTION

On ground only, when the battery voltage is lower than 23 Volts for 16 seconds, the contactor opens automatically.

HOT BUS PROTECTION

In order to maintain the HOT BUS supply, the contactor opens under these conditions :

- discharge current greater than 150 Amps for 0.3 seconds,
- discharge current is greater than 400 Amps,
- battery voltage less than 13 Volts for 0.5 milliseconds.

BACKUP SUPPLY

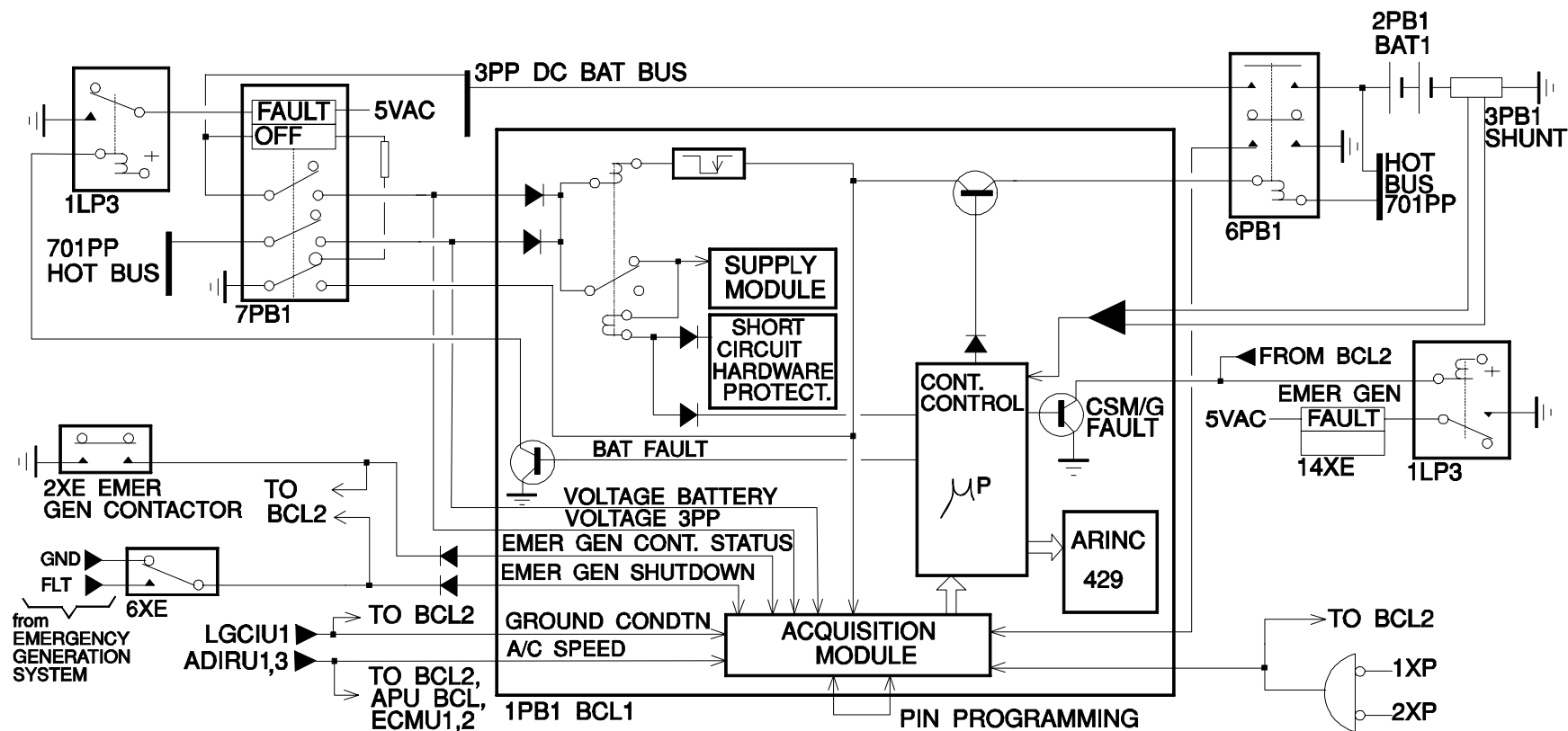
On ground with speed less than 50 Kts, when the 2 AC BUSes are not supplied, BCL 1 and 2 close contactors 6PB1 and 6PB2 to supply DC BAT BUS 3PP.

APU STARTING

When the APU starting sequence is initiated, the BCL closes contactor 5PB. This provides power to start the APU.

As soon as the APU MASTER switch is set to on, the APU Electronic Control Box (ECB) provides a signal to the APU BCL to close contactor 5PB.

Note : If the APU TR is operating, its output is connected to 309PP. If the APU TR is not operating, contactor 7PU sends a ground signal to the APU BCL to increase the current limitation. This allows APU STARTING on battery alone.



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EMER GEN FAULT LIGHT CONTROL

In EMERgency configuration, if the CSM/G is inoperative, the EMER GEN FAULT light comes on red on the EMER ELEC POWER panel. This light is controlled by BCL 1 and 2.

Note : EMER GEN shutdown signal is sent to the BCL to illuminate the red FAULT light.

BAT FAULT LIGHT CONTROL

In case of thermal runaway or short circuit, the FAULT legend of the BAT pushbutton comes on amber.

STUDENT NOTES:

FQW4200 GE Metric

STUDENT NOTES

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DC NORMAL GENERATION SWITCHING D/O

- General
- DC Normal Bus Switching
- ECMU
- Operation
- TR1 Fault (No Overcurrent)
- TR1 Fault (Overcurrent)
- TR1 and TR2 Fault

GENERAL

This circuit monitors and controls the DC normal network supply (DC BUS 1, DC BUS 2 and DC BAT BUS).

The switching enables:

- Normal supply of the busbars,
- Automatic power transfer in case of failure and
- Transfer inhibition in case of a short circuit.

DC NORMAL BUS SWITCHING

The switching circuit consists of contactors 1PC1 and 1PC2.

They are controlled in parallel by the Electronic Contactor Management Units 1 and 2 (ECMU1 and ECMU2).

ECMU

The DC supply configuration is sensed by the ECMUs.

Due to supply changes, the ECMUs provide a control logic for contactors 1PC1 and 1PC2.

In normal supply configuration, contactor 1PC1 is closed and 1PC2 is open.

OPERATION

Provided that AC BUS 1 is supplied and contactor 5PU1 is closed (TR1 operating), the ECMU1 internal control logic 1PC1 closes contactor 1PC1.

Due to the logic, only 1PC1 control in ECMU1 is active.

So, the ECMU2 internal control logic keeps contactor 1PC2 open.

TR1 FAULT (NO OVERCURRENT)

If TR1 fails, but not due to overcurrent, ECMU1 detects that 5PU1 is open, and then opens 1PC1.

ECMU2 detects that 1PC1 is open and closes 1PC2 to supply DC BAT BUS.

Then, as soon as 1PC2 is closed, ECMU2 closes 1PC1 to supply DC BUS 1 from DC BAT BUS.

TR2 now supplies the three DC buses.

TR1 FAULT (OVERCURRENT)

If TR1 fails due to overcurrent, contactor 5PU1 opens.

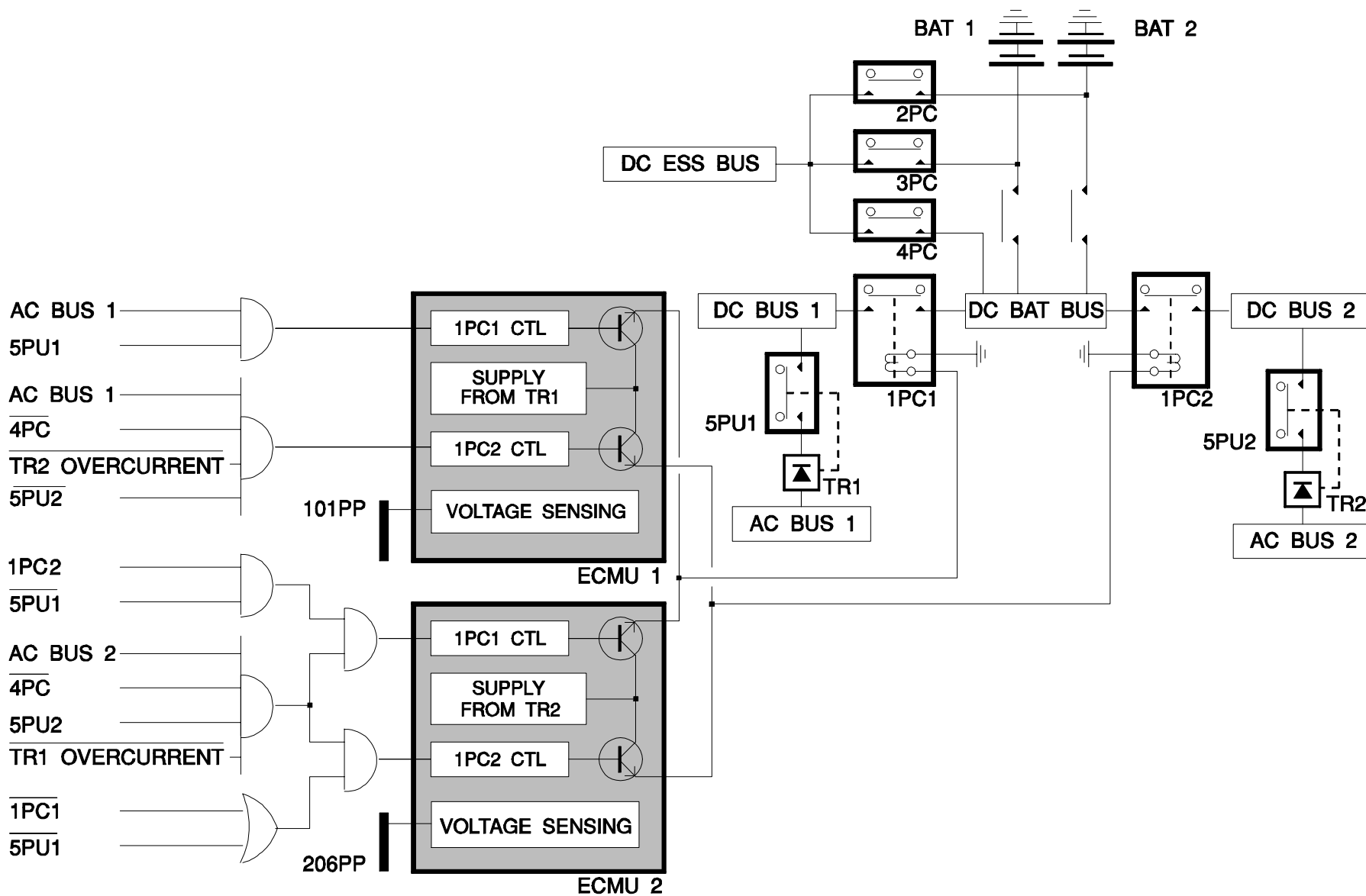
Then, ECMU1 opens 1PC1.

The TR1 overcurrent signal inhibits the closure of 1PC2 and 1PC1.

TR1 AND TR2 FAULT

Contactors 1PC1 and 2, and 5PU1 and 2 stay open.

Power is no longer supplied on DC BUS 1, DC BUS 2 and DC BAT BUS.



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STUDENT NOTES:

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DC ESSENTIAL GENERATION SWITCHING D/O

General
Operation

GENERAL

This circuit controls and monitors the supply of the DC ESSential network consisting of the DC ESSential bus 4PP and the DC ESSential SHEDdable bus 8PP.

The switching enables :

- the normal supply from the ESSential TR,
- the abnormal supply from the BAT BUS,
- the emergency supply from the batteries.

OPERATION

Here is a description of the various operation configurations :

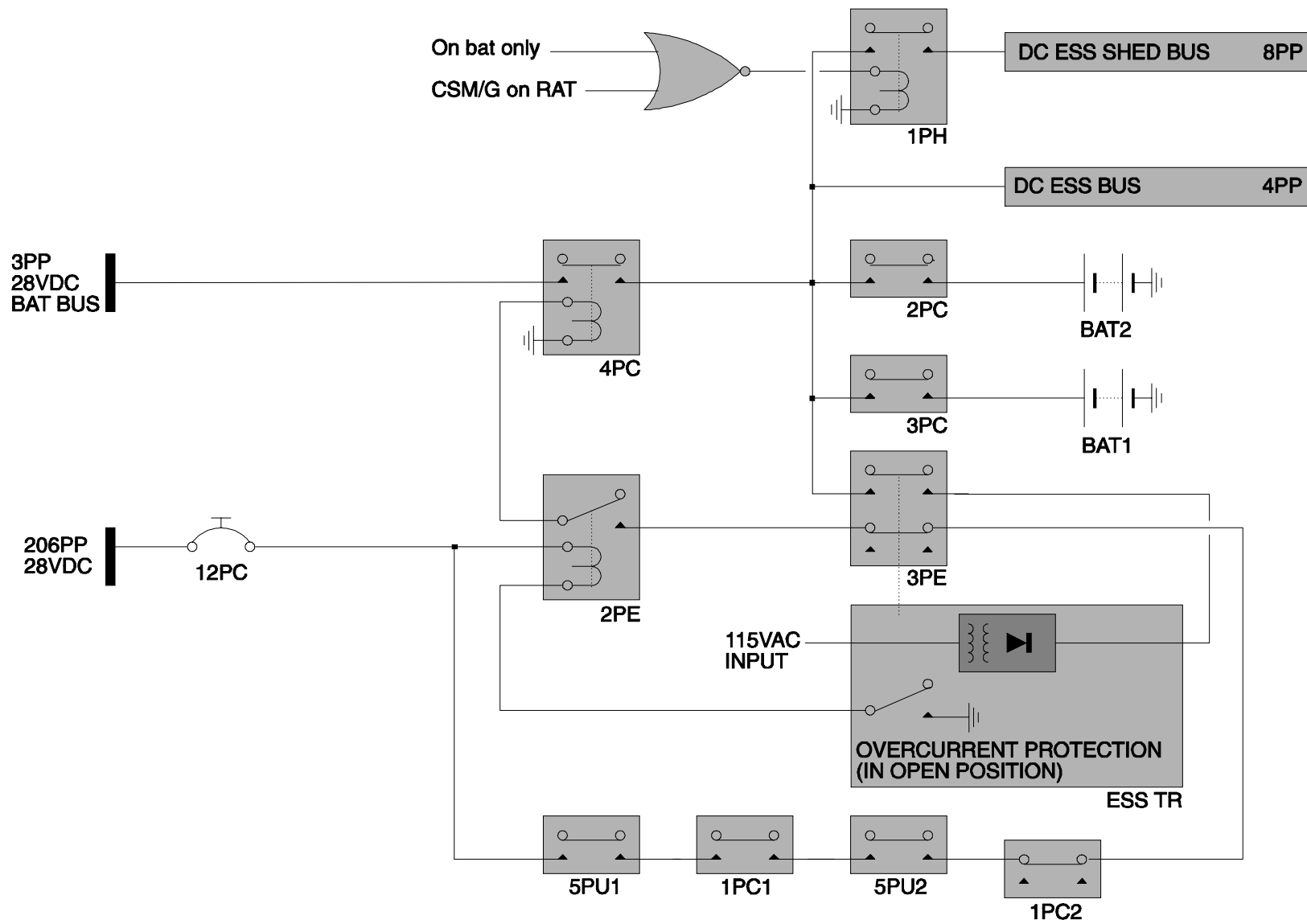
- 1 - In normal supply configuration, the ESSential TR supplies the DC ESSential bus 4PP via the contactor 3PE and the DC ESS SHED bus 8PP via the contactor 1PH.

- 2 - In case of ESS TR fault, but not due to overcurrent (3PE open, 2PE closed), provided TR1 supplies DC BUS 1 (5PU1 closed) and BAT BUS (1PC1 closed), and TR2 only supplies DC BUS 2 (5PU2 closed, 1PC2 open), the contactor 4PC closes and connects power from BAT BUS to the ESSential network.

- 3 - In case of ESS TR fault due to overcurrent, the contactor 2PE opens and trips the contactor 4PC. The essential network is then no longer supplied.

- 4 - In case of TR1 (or TR2) and ESS TR fault not due to overcurrent, 5PU1 (or 5PU2) is open and the DC ESS network is completely lost. The TR2 (or TR1) maintains the supply to the DC NORMAL network.

- 5 - On batteries only, the contactors 2PC and 3PC are closed and only the DC ESS bus is supplied (1PH remains open).



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STUDENT NOTES

DC WARNINGS

BAT Fault
DC Bus Fault
TR Fault

BAT FAULT

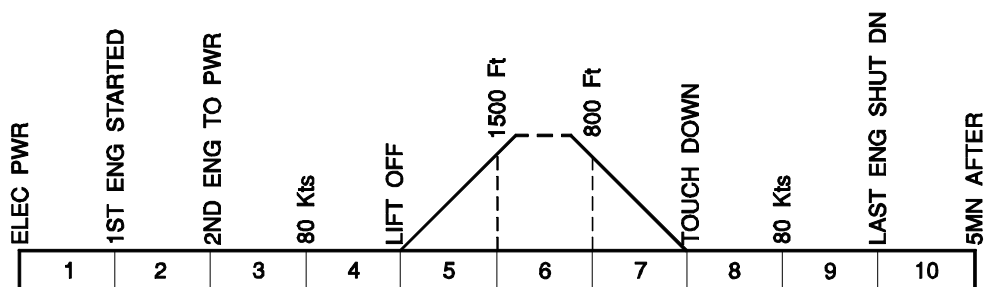
This warning appears in case of Thermal Runaway, Short Circuit or Battery Voltage less than 12 VDC.

DC BUS FAULT

This warning is triggered if the busbar is no longer supplied.

TR FAULT

This warning is triggered if the corresponding Transformer Rectifier (TR) is found faulty: in case of Overheat, Minimum Current, Overcurrent or Open or Short circuited diode detection.



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
BAT 1(2) FAULT charging current increases at an abnormal rate APU BAT FAULT charging current increases at an abnormal rate	SINGLE CHIME	MASTER CAUT	ELEC DC	BAT 1(2) FAULT It	3, 4, 5, 7, 8,
				APU BAT FAULT It	
DC BUS 1 FAULT DC BUS 2 FAULT DC BUS 1 + 2 FAULT DC ESS BUS FAULT Busbar(s) is (are) no longer supplied DC ESS BUS SHED Busbar is no longer supplied DC BAT BUS FAULT Busbar is no longer supplied	SINGLE CHIME	MASTER CAUT	ELEC DC	NIL	4, 8
					3, 4, 8, 9
TR 1 (2), APU TR or ESS TR FAULT	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8,

STUDENT NOTES

FQW4200 GE Metric

DC GENERATION COMPONENTS (3)

- Safety Precautions
- Transformer Rectifiers (TRs)
- TR Contactors
- Batteries
- Battery Charge Limiter (BCL)
- Battery Line Contactor (BLC)
- APU BLC

SAFETY PRECAUTIONS

Comply with the safety precautions, warnings and cautions.

STUDENT NOTES

TRANSFORMER RECTIFIERS

FIN/ZONE

For TR-1(-2)

FIN: 1PU1(2)

Zone : 120

For ESS-TR

FIN: 1PE

Zone: 122

For APU-TR

FIN: 1PU3

Zone: 162

COMPONENT DESCRIPTION

The four Transformer Rectifiers (TR) are identical and interchangeable.

TR-1 and TR-2 are ventilated by air extraction from the aircraft ventilation system.

The ESS-TR and APU-TR are only ventilated by natural convection.

The TR features :

- a "power supply input "connector J001,
- an "output monitoring "connector J002,
- two "power supply output" terminals,
- a LED for Fault Indication (Overheat, minimum current, overcurrent or open or short circuited diode detection),
- a RESET pushbutton to reset the LED.

IN SITU TEST

For the MAIN TR(s) (1PU1/1PU2)

The operational test of the DC main generation must be performed to complete the installation of the TR(s).

For the APU TR (1PU3)

The operational test of the DC Essential generation must be performed to complete the APU TR installation.

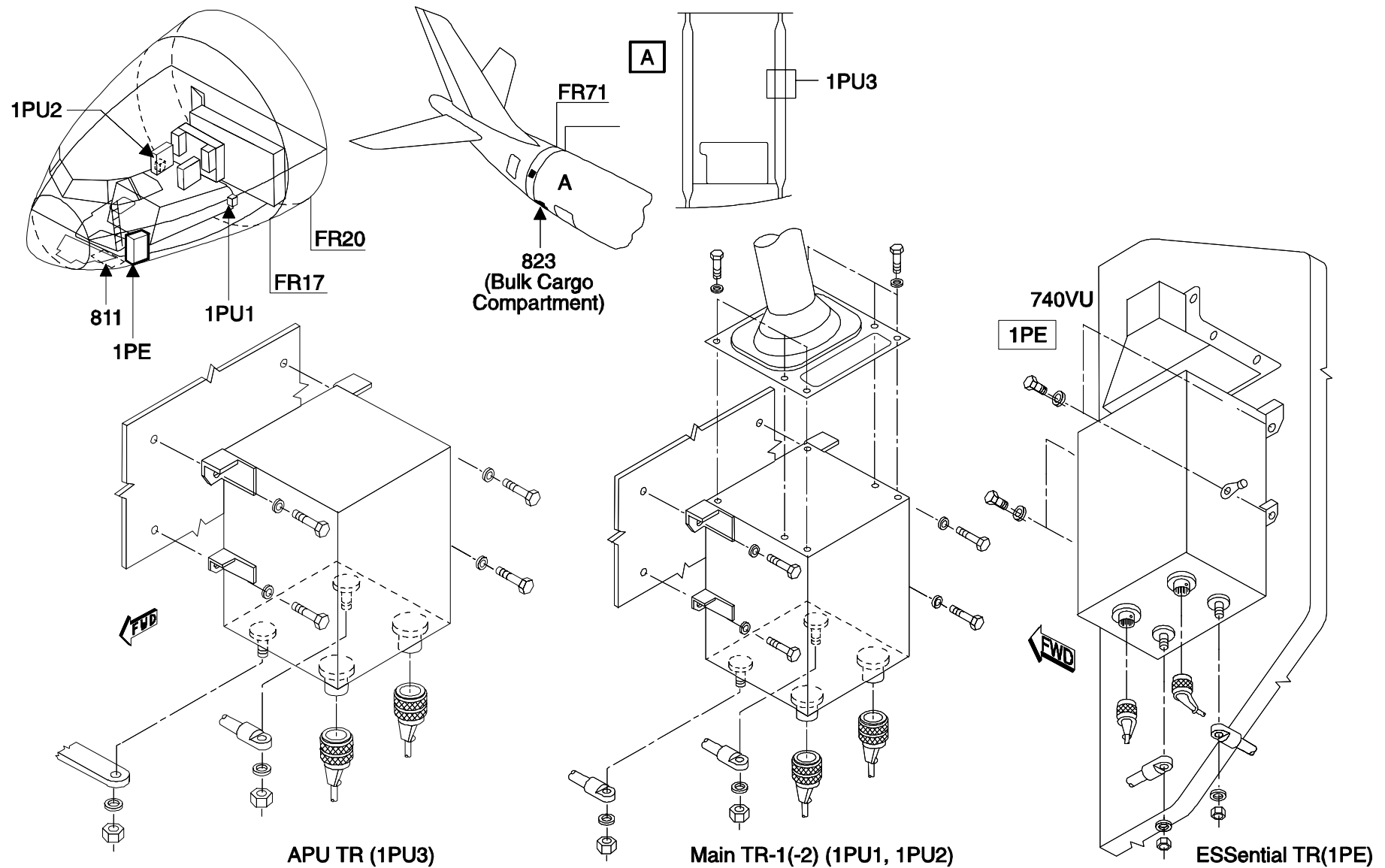
For the ESS TR (1PE)

The operational test of the DC Essential generation must be performed to complete the ESS TR installation.

REMOVAL/INSTALL

For any TR, comply with the safety precautions and warnings.

Conditions of installation : The unit must be installed in a vertical position, with the connectors down.



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TR CONTACTORS

FIN/ZONE

For TR-1(-2)

FIN: 5PU1, 5PU2

Zone: 120

For ESS TR

FIN: 3PE

Zone: 120

For APU TR

FIN: 7PU

Zone: 162

COMPONENT DESCRIPTION

The four power contactors are identical and interchangeable.

They connect the TR DC output to the corresponding bus bar.

A TR comprises two parts : The Base and the Removable part.

The Base features:

- a power terminal,
- shunts,
- fastener devices for the removable contacts,
- installation fixtures.

The Removable part features:

- a power commutation unit,
- an electromagnetic control,
- auxiliary contacts,
- a connector.

IN SITU TEST

The operational test of DC Main Generation Switching must be performed to complete the TR CONTACTOR installation(Ref. TASK 24-34-00-710-801).

SAFETY PRECAUTIONS

(1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released :

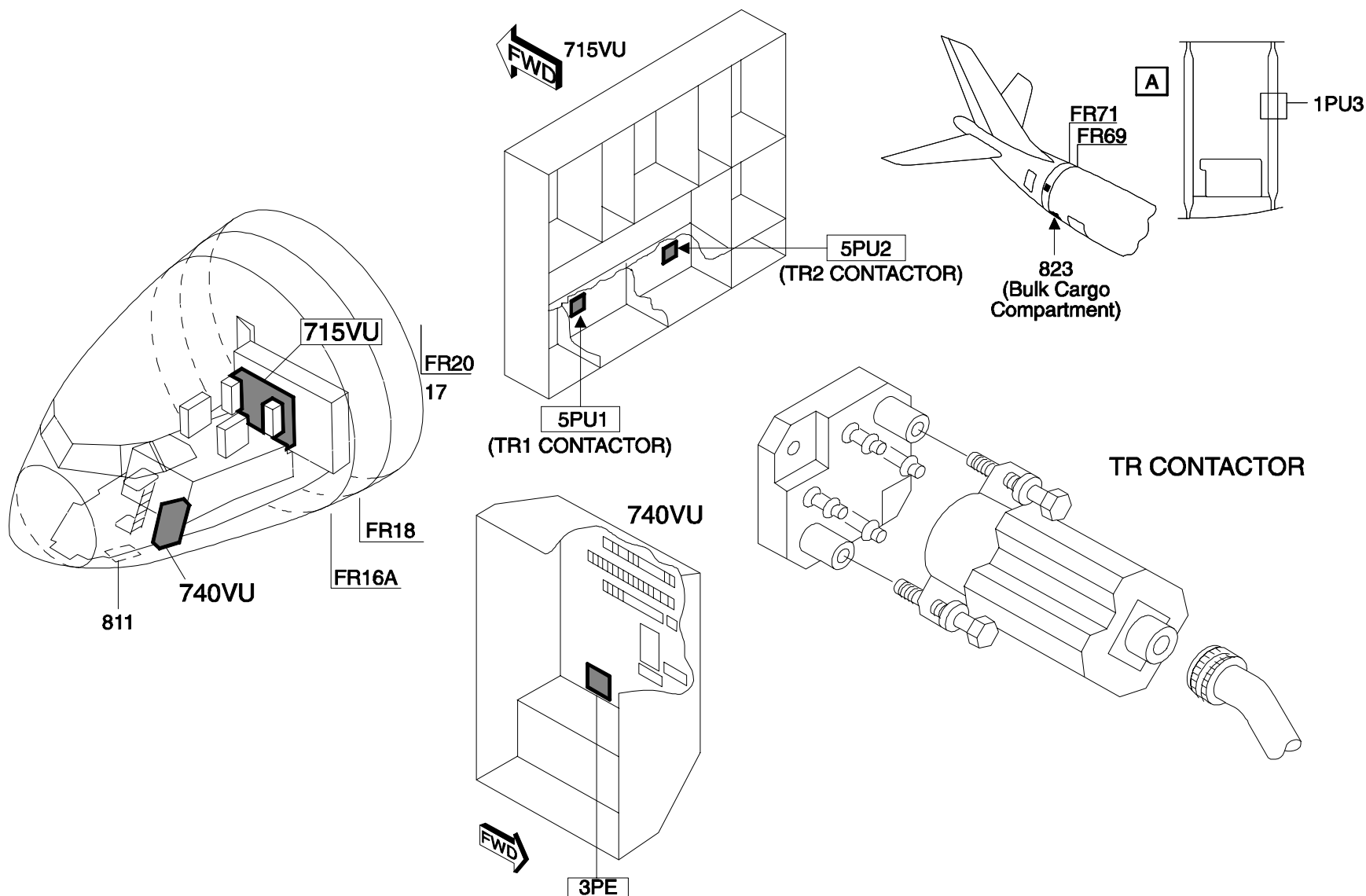
- BAT 1, BAT 2, APU BAT (the OFF legend is on),
- GEN 1 (2), APU GEN(the OFF legend is on),
- EXT A (B)(the AVAIL legend is on).

(2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel :

- 211VU (EMER ELEC PWR),
- 235VU (ELEC).

(3) Make sure that no external power is connected to the aircraft receptacle.

(4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.



BATTERIES

FIN/ZONE

FIN: 2PB1, 2PB2

Zone: 162

FIN: 2PB3 (APU BATTERY)

Zone: 120

COMPONENT DESCRIPTION

The three batteries are identical and interchangeable.

Each battery has two ventilation ducts for the evacuation of any oxygen or hydrogen emanation.

In each battery there are 20 Nickel Cadmium accumulators installed in a Titanium case.

Main features :

- nominal voltage : 24VDC,
- nominal capacity : 37AH,
- high electrolyte reserve : 60 cm³,
- high instantaneous power,
- two ventilation ducts,
- explosion proof.

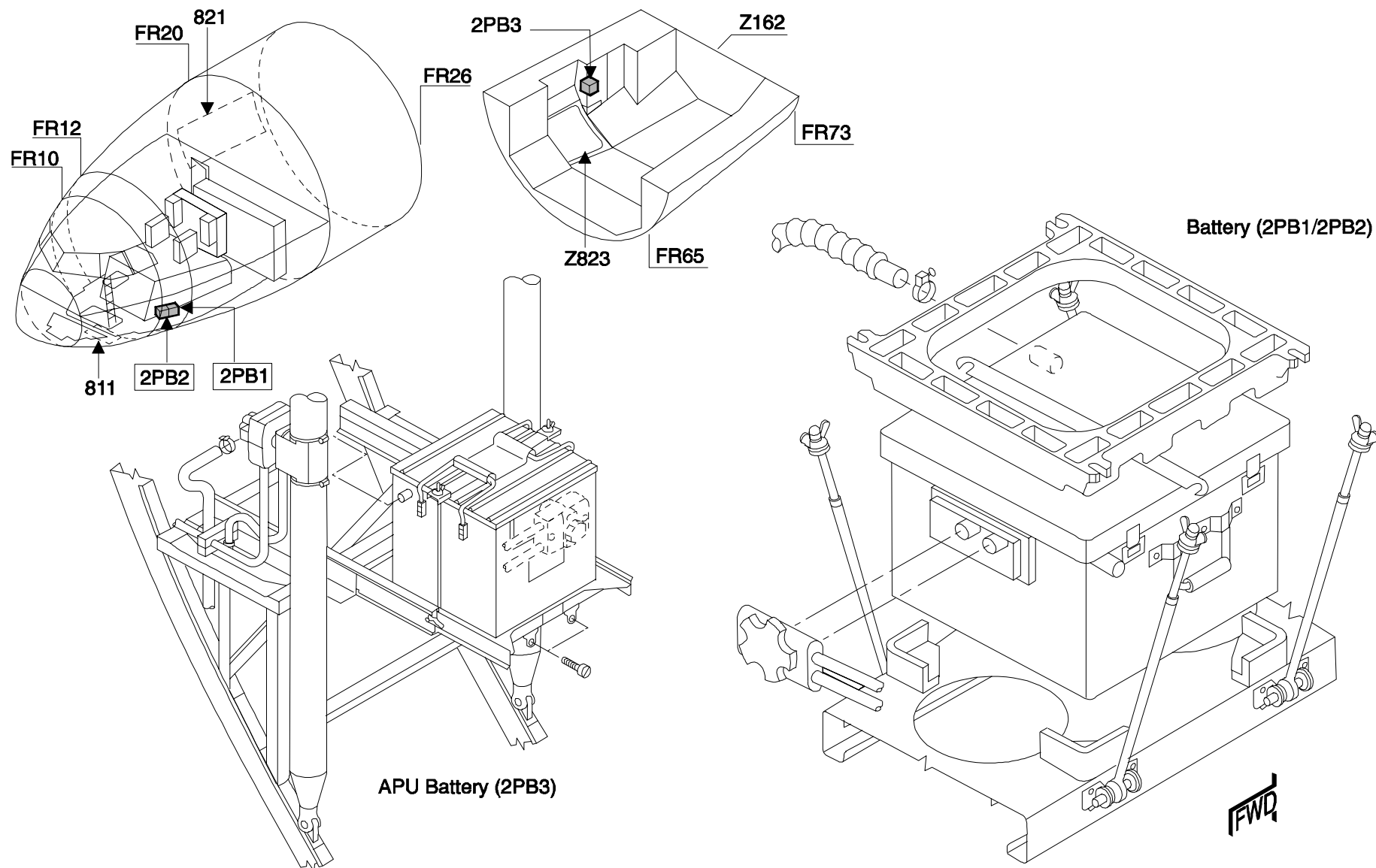
SAFETY PRECAUTIONS

For the batteries 2PB1/2:

In the cockpit, on the overhead panel 235VU, put a warning notice to tell persons not to operate the batteries.

For the APU battery :

In the cockpit, on the overhead panels 215VU and 235VU, put a warning notice to tell persons not to operate the APU and the batteries.



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BATTERY CHARGE LIMITER (BCL)

FIN/ZONE

FIN: 1PB1, 1PB2

Zone: 121

FIN: 1PB3 (APU BCL)

Zone: 162

COMPONENT DESCRIPTION

The BCL is rectangular in shape.

The rear face features :

- a permanent label (with Manufacturer information)
- a modifiable label (with Part Number, Inspection date...)
- a 41-pin connector (J201).

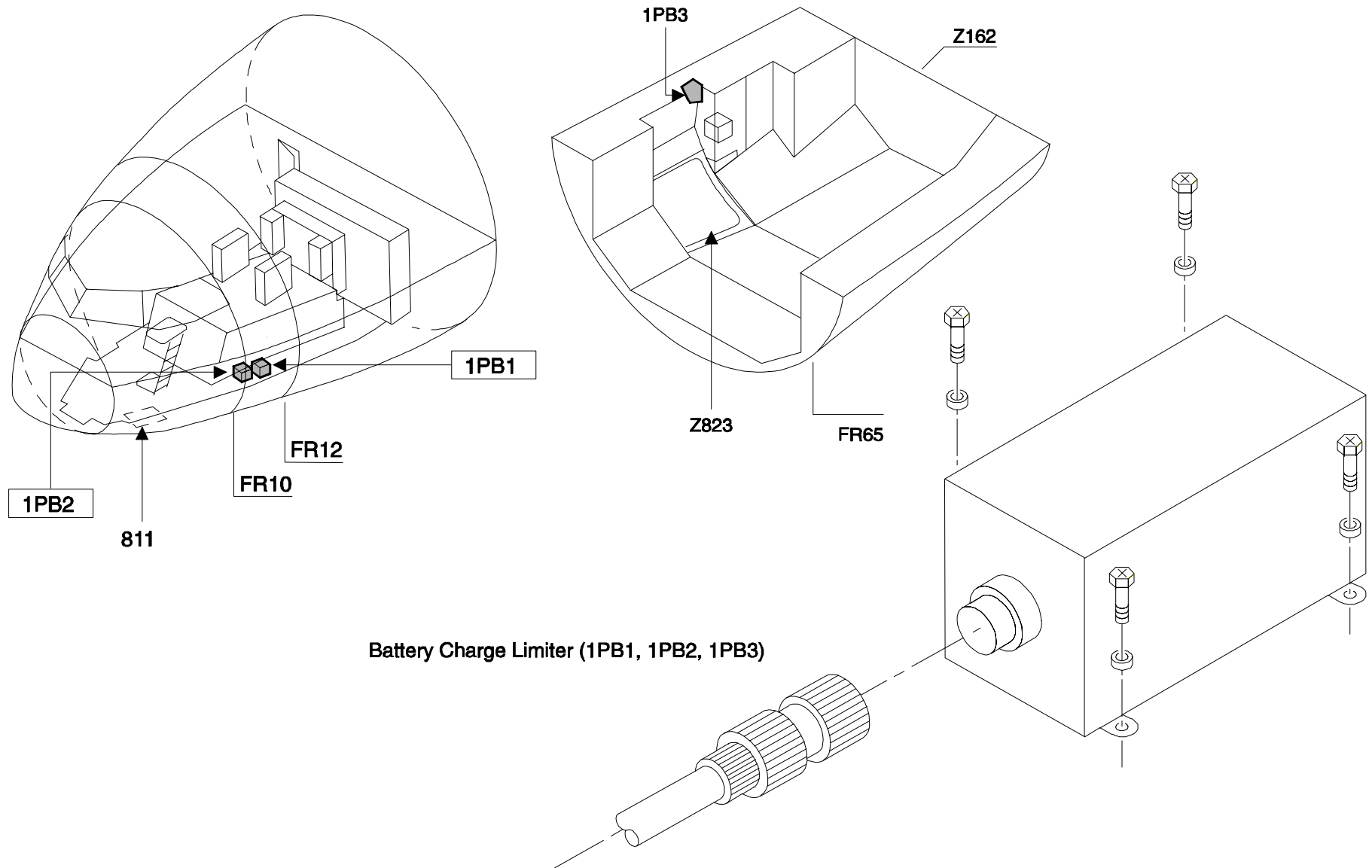
SAFETY PRECAUTIONS

For BCLs 1PB1, 1PB2 :

In the cockpit, on the overhead panel 235VU, put a warning notice to tell persons not to operate the batteries.

For BCL 1PB3 :

In the cockpit, on the overhead panels 215VU and 235VU, put a warning notice to tell persons not to operate the APU and the batteries.



BATTERY LINE CONTACTORS (BLCs)

FIN/ZONE

FIN: 6PB1, 6PB2

Zone: 121

COMPONENT DESCRIPTION

The power contactor comprises two parts :
the Base and the Removable part.

The Base features:

- a power terminal,
- shunts,
- fastener devices for the removable contacts,
- installation fixtures.

The Removable part features:

- a power commutation unit,
- an electromagnetic control,
- auxiliary contacts,
- a connector.

SAFETY PRECAUTIONS

(1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released :

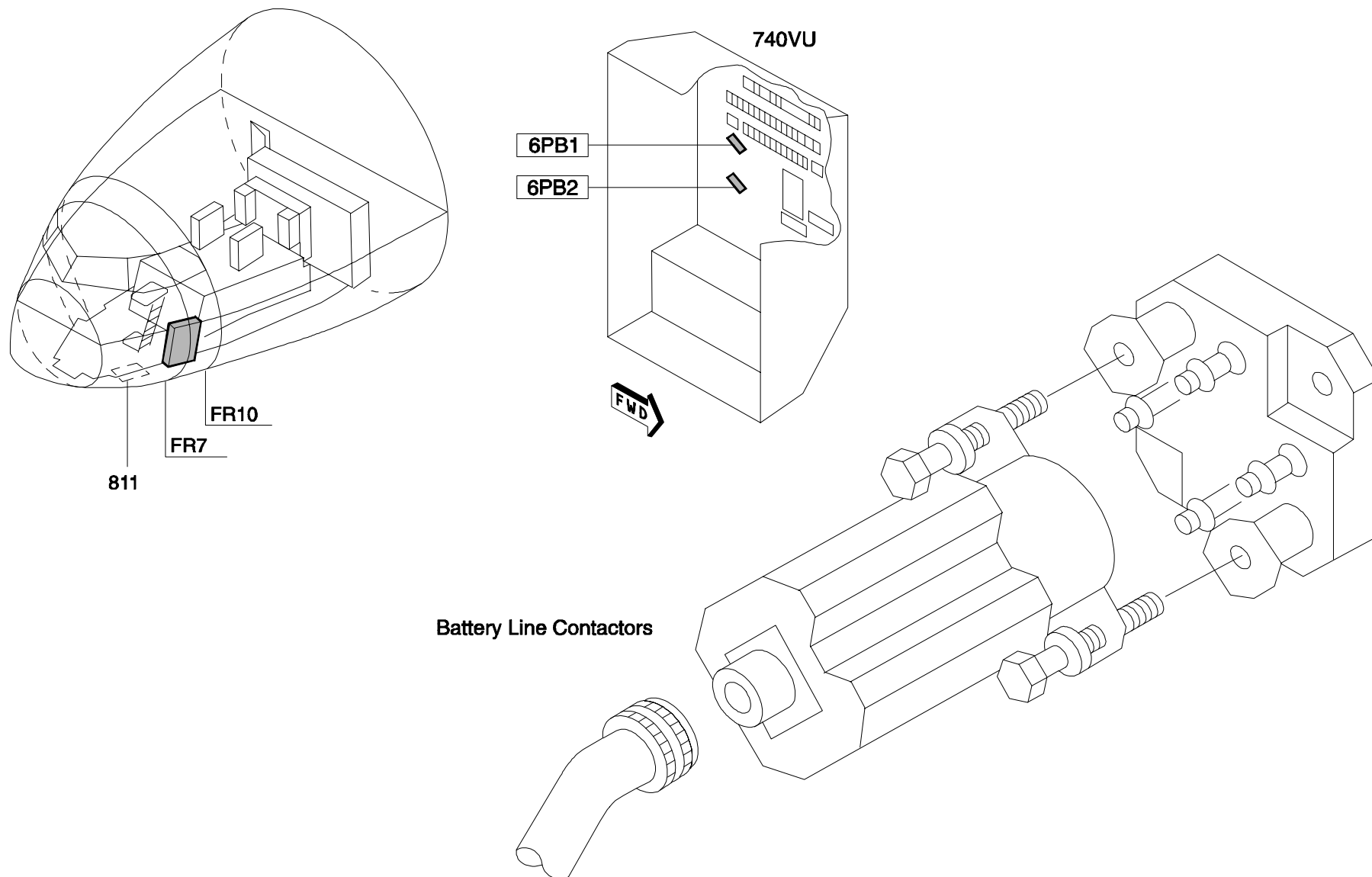
- BAT 1, BAT 2, APU BAT,
- GEN 1 (2), APU GEN,
- EXT A (B).

(2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel :

- 211VU (EMER ELEC PWR),
- 235VU (ELEC).

(3) Make sure that no external power is connected to the aircraft receptacle.

(4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.



APU BLC

FIN/ZONE

FIN: 5PB (APU BAT)

Zone: 162

COMPONENT DESCRIPTION

The power contactor comprises two parts :

The Base and the Removable part.

The Base features :

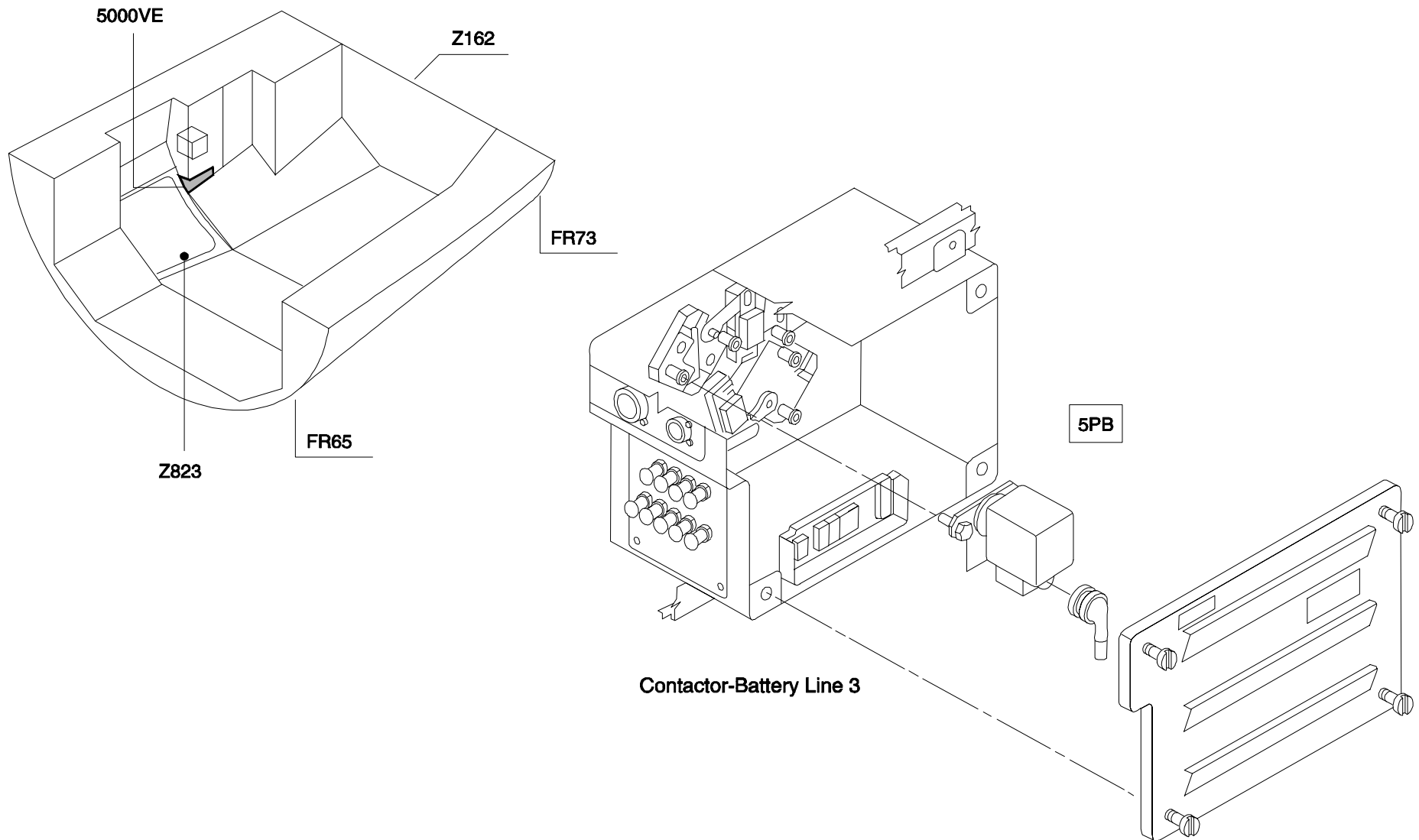
- a power terminal,
- shunts,
- fastener devices for the removable contacts,
- installation fixtures.

The Removable part features :

- a power commutation unit,
- an electromagnetic control,
- auxiliary contacts,
- a connector.

SAFETY PRECAUTIONS

In the cockpit, on the overhead panels 215VU and 235VU, put a warning notice to tell persons not to operate the APU and the batteries.



STUDENT NOTES

SYSTEM NORMAL OPERATION

Ground Configuration
APU Generator Supply Only
Normal Configuration

GROUND CONFIGURATION

The aircraft network is supplied :

- by external power A only or,
- by external power A and B or,
- by external power A and B and APU GENerator according to supply logic priority.

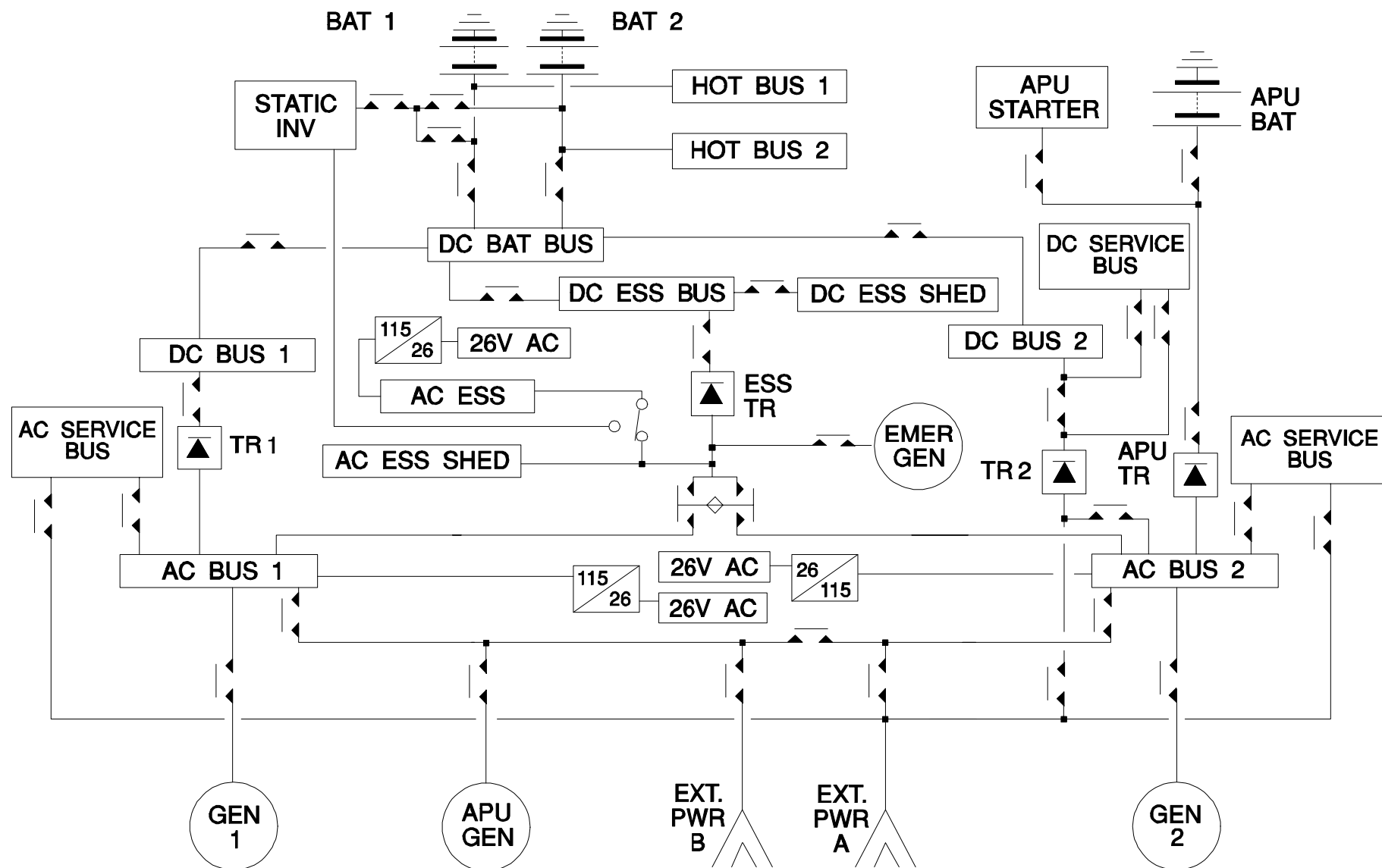
APU GENERATOR SUPPLY ONLY

The whole aircraft network is supplied by the APU generator after external power A and B disconnection.

NORMAL CONFIGURATION

In normal flight configuration, the aircraft network is supplied by two main generators.

Supply priority	AC BUS 1	GEN 1/APU GEN/EXT PWR B/EXT PWR A/GEN 2
for each main		
busbar :	AC BUS 2	GEN 2/EXT PWR A/APU GEN/EXT PWR B/GEN 1



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STUDENT NOTES

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SYSTEM ABNORMAL OPERATION

Loss of One Main GEN
Loss of ESS TR
Loss of One Main TR
Loss of AC Bus 1

LOSS OF ONE MAIN GEN

If one main generator is lost, all the aircraft network is supplied (with or without the Auxiliary Power Unit (APU) generator) through the transfer circuit.

LOSS OF ESS TR

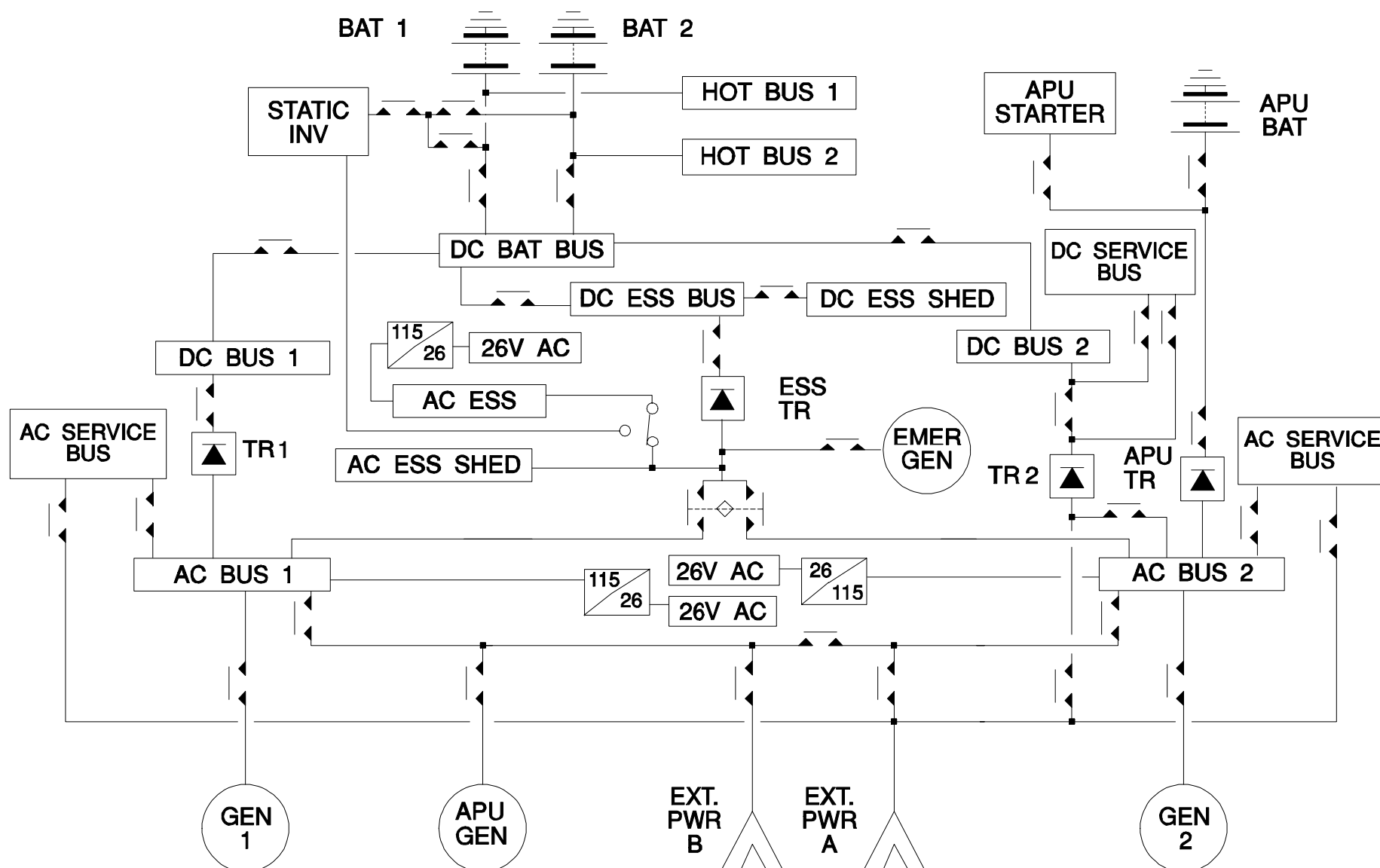
If the ESSential Transformer Rectifier (ESS TR) is lost, the DC ESS BUS and DC ESS SHED BUS are automatically recovered from the TR1 through the DC BAT BUS.

LOSS OF ONE MAIN TR

If one main Transformer Rectifier is lost the other main TR automatically restores all DC buses.

LOSS OF AC BUS 1

If AC BUS 1 is lost, the AC ESSential BUS and the ESSential TR are automatically supplied from AC BUS 2.



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STUDENT NOTES:

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SYSTEM EMERGENCY OPERATION

EMER Generator Normal Supply
EMER Generator Supply by RAT
Batteries Supply

EMER GENERATOR NORMAL SUPPLY

In emergency configuration (loss of AC BUS 1 and AC BUS 2), the AC ESS BUS, AC ESS SHED BUS and ESS TR are restored via the emergency generator using the green hydraulic system pressurized by engine driven pumps.

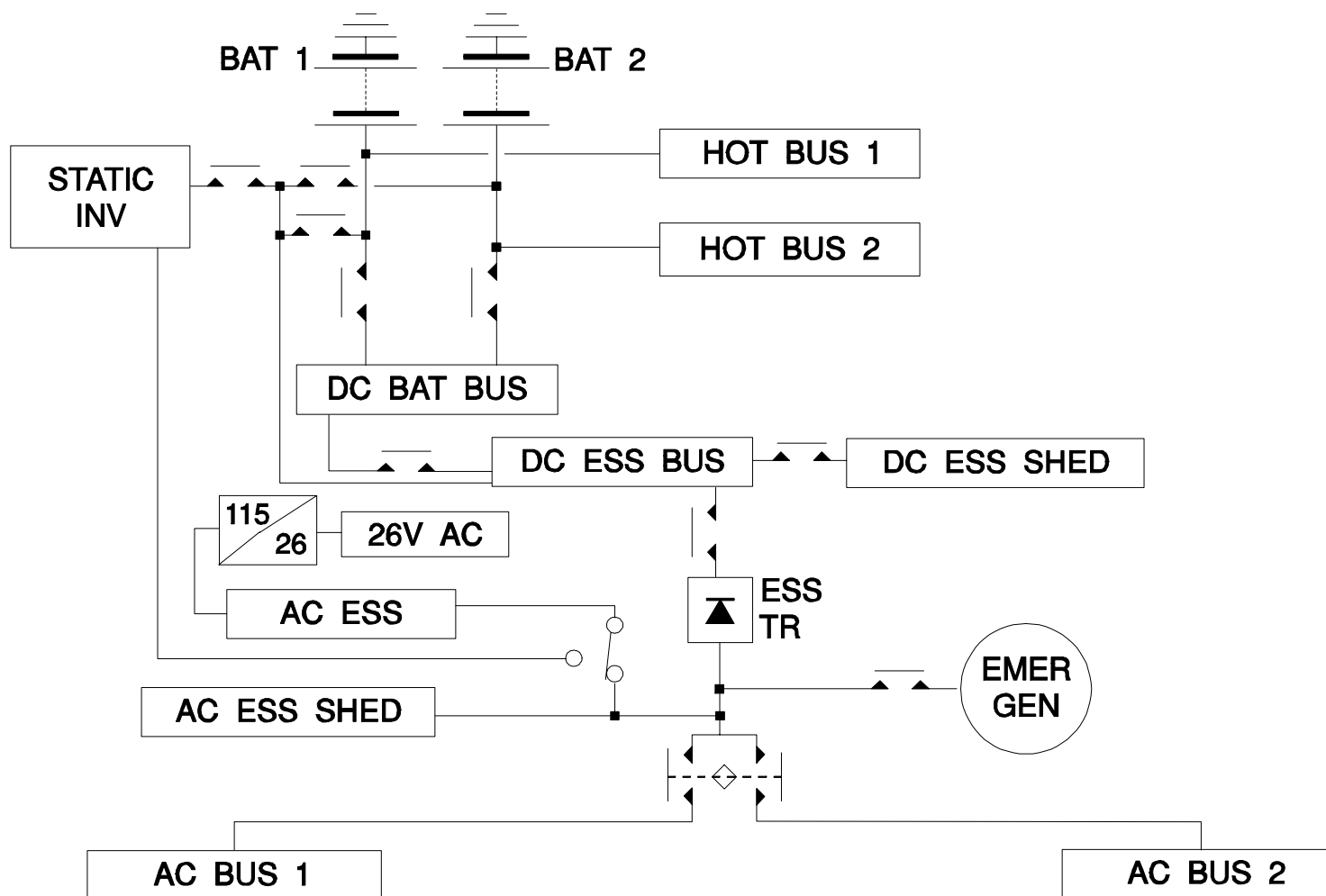
DC ESS BUS and DC ESS SHED BUS are restored through the ESS TR.

EMER GENERATOR SUPPLY BY RAM AIR TURBINE

In case of Ram Air Turbine (RAT) operation (Emergency configuration and loss of both engines), the AC and DC ESS buses are powered, the DC ESS SHED bus and some AC ESS SHED sub-busbars are automatically shed.

BATTERIES SUPPLY

When the EMERgency GENerator is unavailable in flight, the main batteries supply the DC ESS BUS, the HOT BATtery BUS and the static inverter, which, in turn, supplies the AC ESS BUS.



STUDENT NOTES:

FQW4200 GE Metric

CIRCUIT BREAKER MONITORING SYSTEM PRESENTATION

Normal Configuration
Circuit Breaker Tripped
Circuit Breaker Monitoring Unit Not Available

NORMAL CONFIGURATION

All circuit breakers are located in the avionics compartment.

The circuit breakers status is monitored individually by the Circuit Breaker Monitoring Unit (CBMU). It sends this information to the ECAM.

When no circuit breaker is open or tripped, the NORMAL message is displayed in green on the ECAM C/B page.

C/B TRIPPED

The tripped circuit breaker list is displayed on the ECAM C/B page.
The last tripped Circuit Breaker (C/B) is displayed at the top of the screen.

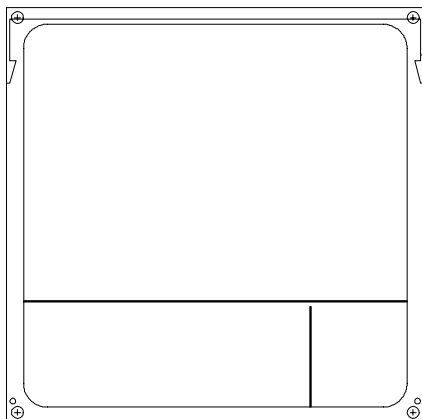
If a C/B is tripped, it is indicated by a message on the EWD. The C/B page, manually selectable only, gives the list of the tripped C/Bs.

An arrow indicates page overflow (more than 18 tripped C/Bs).

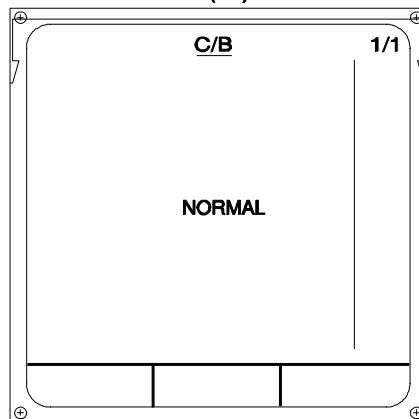
CBMU NOT AVAILABLE

NOT AVAIL message is displayed in amber when data from CBMU is not available.

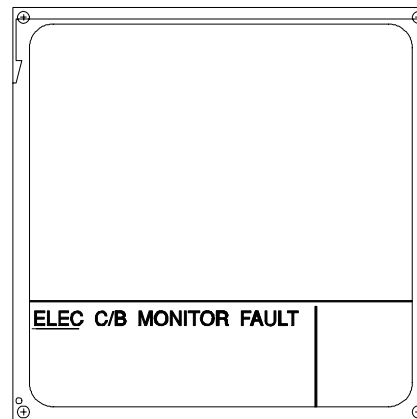
Engine/Warning Display
(EWD)



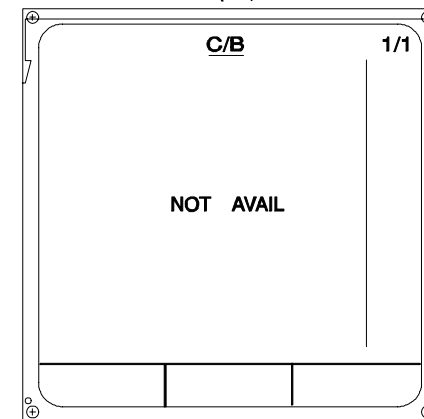
System Display
(SD)



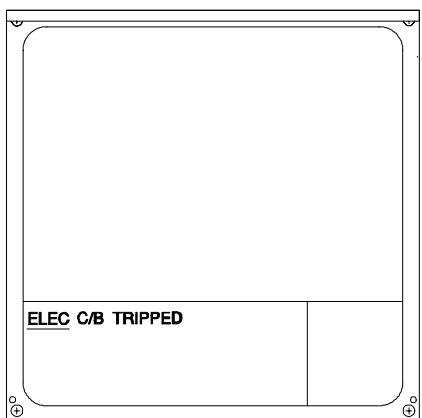
Engine/Warning Display
(EWD)



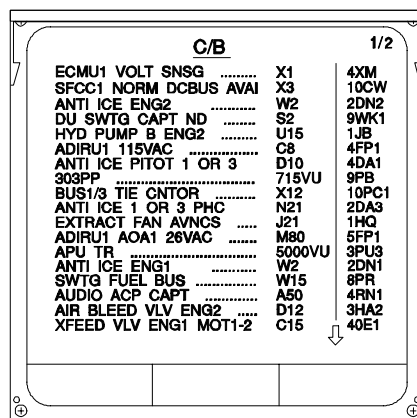
System Display
(SD)



Engine Warning Display
(EWD)



System Display
(SD)



STUDENT NOTES:

CIRCUIT BREAKER MONITORING SYSTEM D/O

- General
- CB status
- CB Identification
- System Operation
- Closed CB
- Open CB
- Remote Control Circuit Breaker (RCCB)
- Interface
- CBMU Data Base

GENERAL

The Circuit Breaker Monitoring System (CBMS) consists of one Circuit Breaker Monitoring Unit (CBMU) which monitors the status of the Circuit Breakers (CBs) and Remote Control Circuit Breakers (RCCBs).

The Circuit Breaker Monitoring System (CBMS) performs the following functions:

- CB and RCCB monitoring,
- status identification and data transmission,
- monitoring of the open CBs for optional equipment.

The CBs and RCCBs are arranged in groups of a maximum of 30.
The CBMU monitors 26 groups on side 1 and 16 groups on side 2.

CB STATUS

The CBMU performs a scanning of the CBs and RCCBs status through a wiring matrix, by sending a DRIVE signal on the auxilliary contacts.

The RETURN signal informs the CBMU of the status, according to the auxilliary contacts which are open when the main contacts of the CBs or RCCBs are closed.

The CB status can be:

- closed,
- open or
- unknown, if neither open or closed position can be confirmed in case of failure.

CB IDENTIFICATION

The CBMU contains in a Non Volatile Memory, the data about all the monitored CBs and RCCBs, according to the aircraft configuration.

The identification of open CBs is made by designation, panel position and Functional Item Number (FIN).

SYSTEM OPERATION

As soon as the CBMU is powered up, on ground or in flight, it begins the scanning of all the CBs.

The CBMU is supplied from busbar 101PP.

CLOSED CB

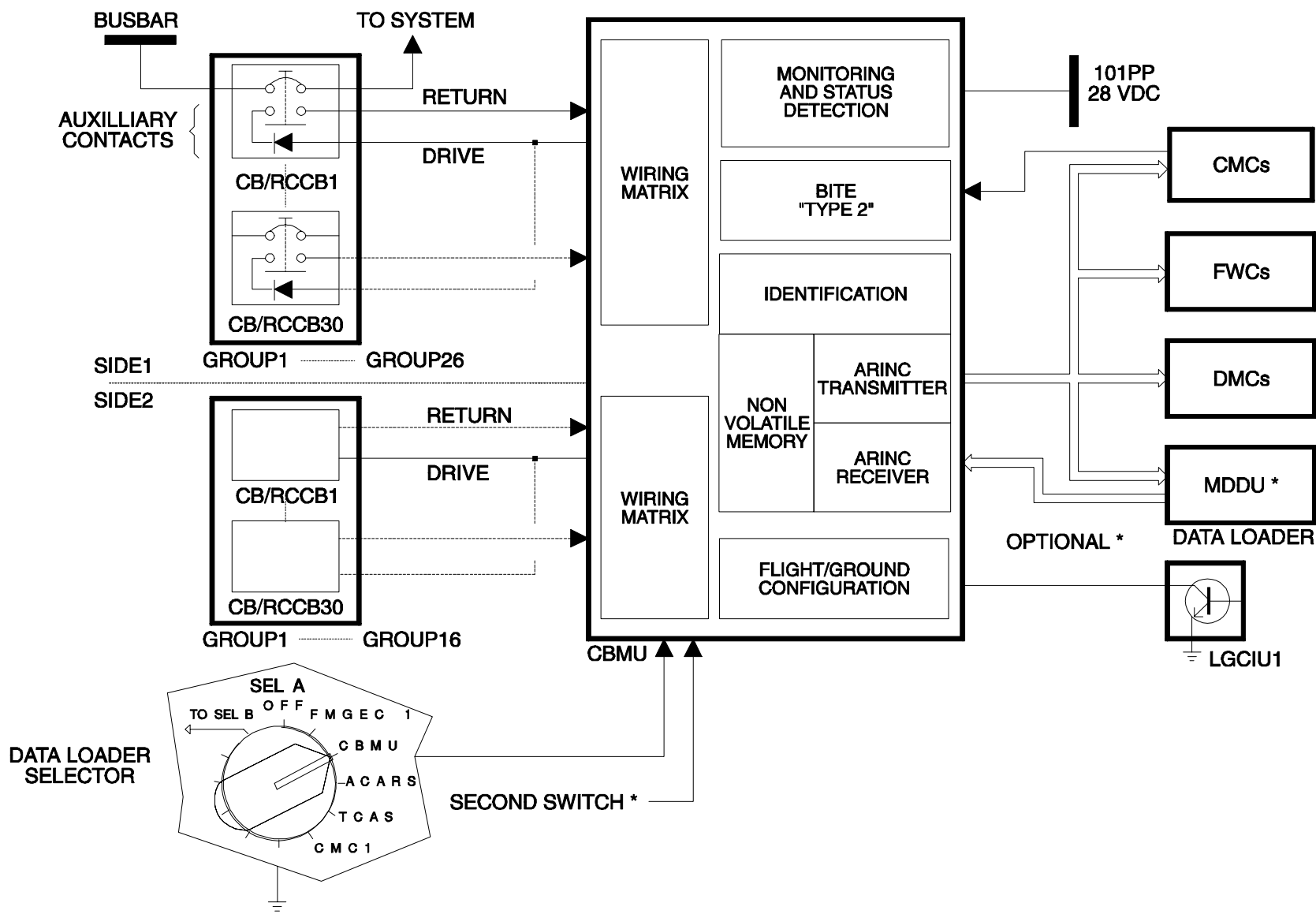
When no CB is open or tripped, the NORMAL message is displayed when calling the CB ECAM page.

OPEN CB

When the CBMU detects an open or tripped CB, its identification is transmitted to the ECAM via the Display Management Computers (DMCs) and Flight Warning Computers (FWCs) and a warning is triggered.

All data related to the open CBs are stored in a Non Volatile Memory for BITE function, and sent to the Centralized Maintenance Computers (CMCs).

The CBMU also monitors the CBs in pulled position when the corresponding equipment is not installed, in case of optional equipment.
If one of these CBs is detected not pulled, a maintenance message is sent to the CMCs.



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REMOTE CONTROL CIRCUIT BREAKER (RCCB)

The Remote Control Circuit Breaker includes a thermal circuit breaker for line protection and a remote controlled contactor for load switching.

Note that the contactor trips if the internal circuit breaker detects an overload.

The reset P/B switch on the front panel of the RCCB has two stable positions:

- When pressed in, the reset P/B switch enables electrical control. On the front of the RCCB, the CLOSE legend appears.
- The reset pushbutton switch is released out when there is an overload on the supply circuit. In this case, the visual legend changes from CLOSE to OPEN.

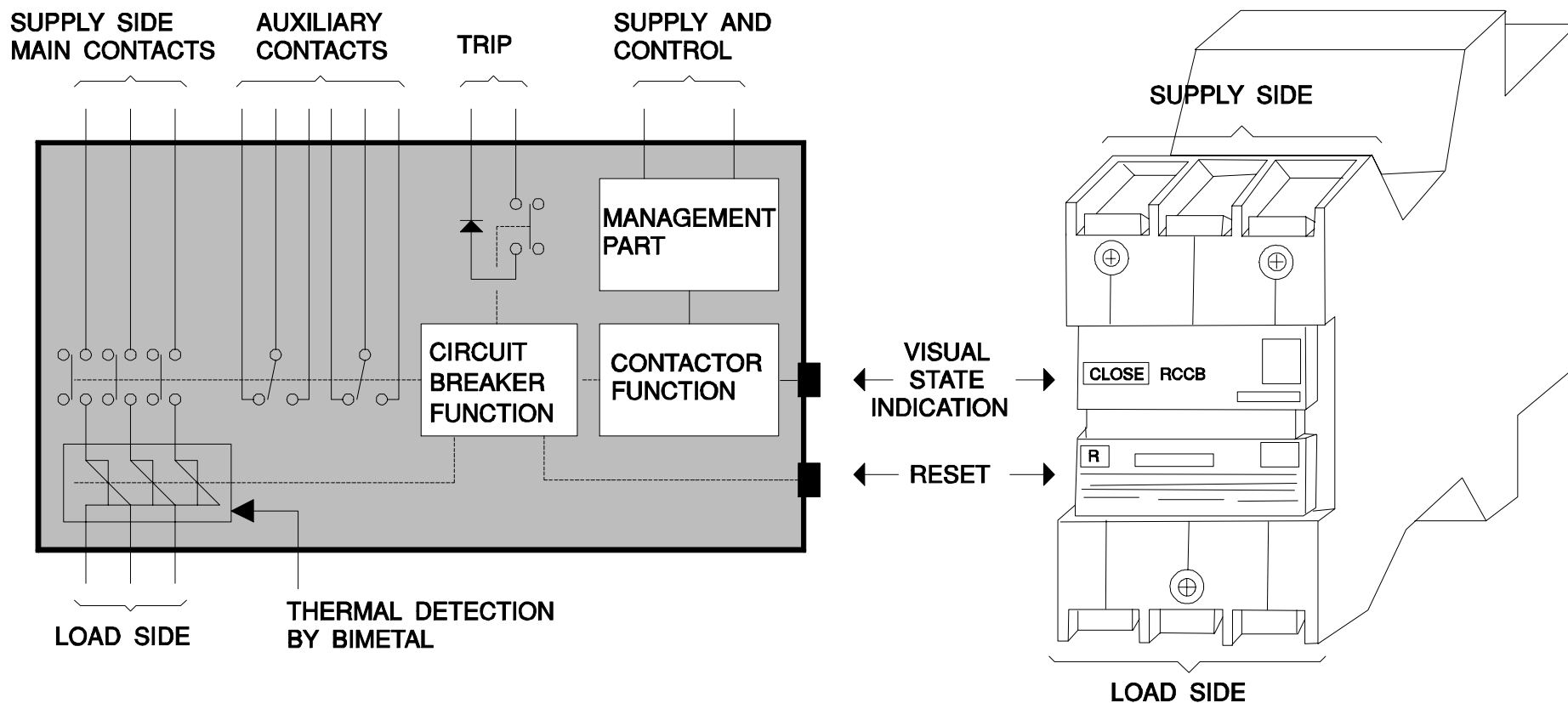
INTERFACE

The FWCs and DMCs enable the display of ECAM messages and warnings. The CMCs are used to provide BITE messages to the Centralized Maintenance Computers (CMCs).

CBMU DATA BASE

The Multipurpose Disk Drive Unit (MDDU) is an optional equipment, used on ground only to perform the up-loading of the CB data list in the CBMU by means of a diskette.

When the DATA LOADER selector switch is set to CBMU, a ground signal is sent to the CBMU and the CB data is transferred to the Non Volatile Memory.



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STUDENT NOTES:

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CB MONITORING WARNINGS

CBMU Fault
C/B Tripped

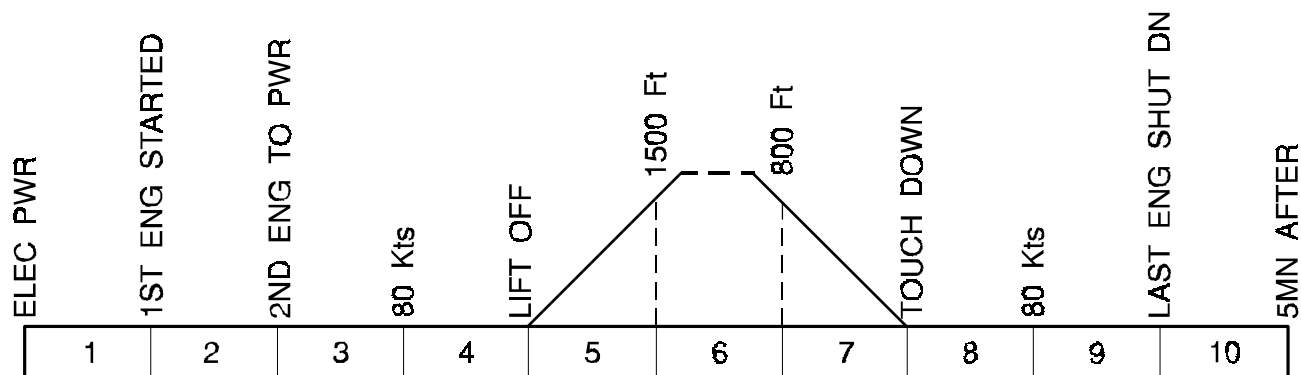
CBMU FAULT

Up to 80 Kts and above 800 ft, the crew is only warned by the automatic display of the CBMU FAULT message on the EWD ELEC page.

C/B TRIPPED

If the CBMU detects a C/B tripped, up to 80 Kts and above 800 ft, the crew is warned by a single chime and MASTER CAUTION comes on.

The C/B system page is not automatically displayed and has to be called manually.



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
C/B TRIPPED One C/B tripped	SINGLE CHIME	MASTER CAUT	NIL	NIL	3, 4, 5, 7, 8,
CBMU FAULT	NIL	NIL	NIL	NIL	3, 4, 5, 7, 8,

STUDENT NOTES

C/B MONITORING COMPONENT

Safety Precautions
CBMU

SAFETY PRECAUTIONS

Comply with the safety precautions, warnings and cautions.

STUDENT NOTES

CBMU

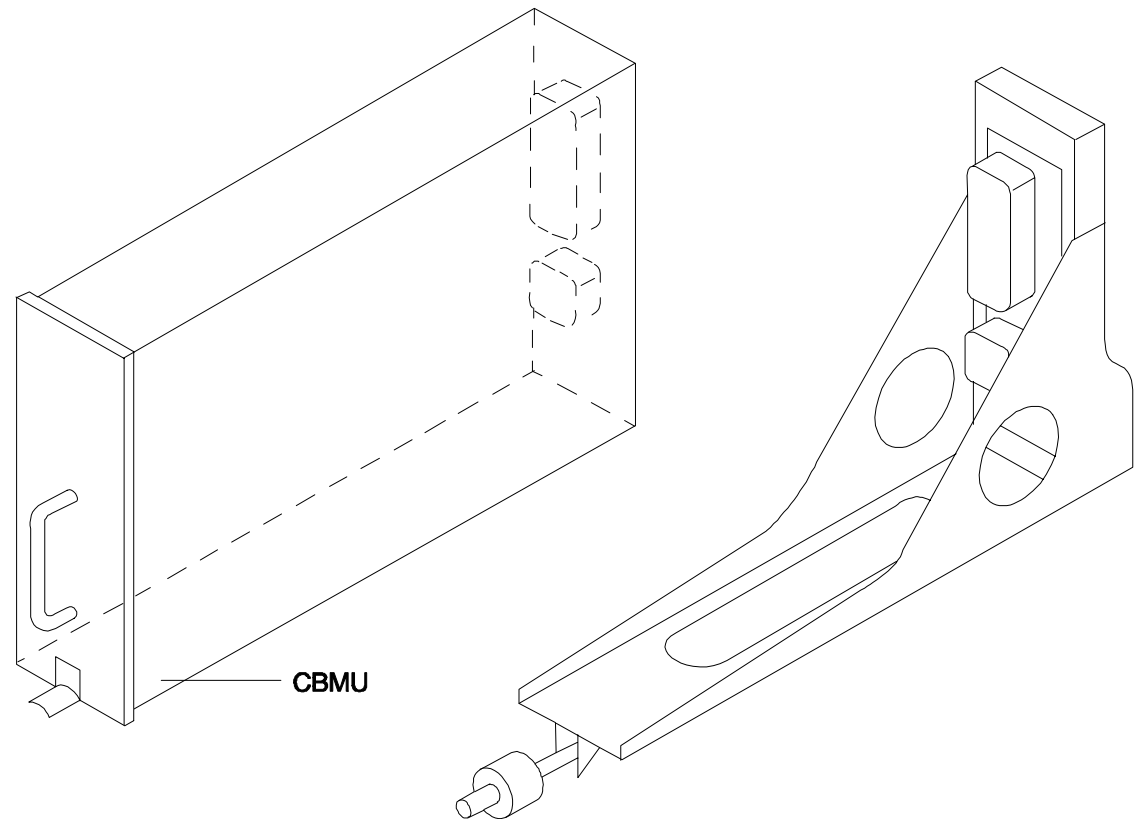
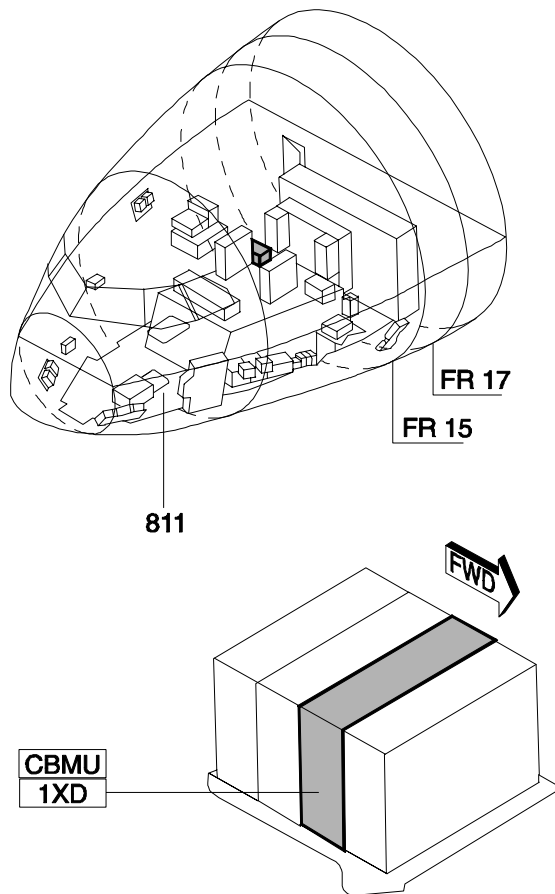
FIN/ZONE

FIN : 1XD

Zone : 120

IN SITU TEST

The BITE test of the CBMU must be performed through the MCDU to complete the CBMU installation.



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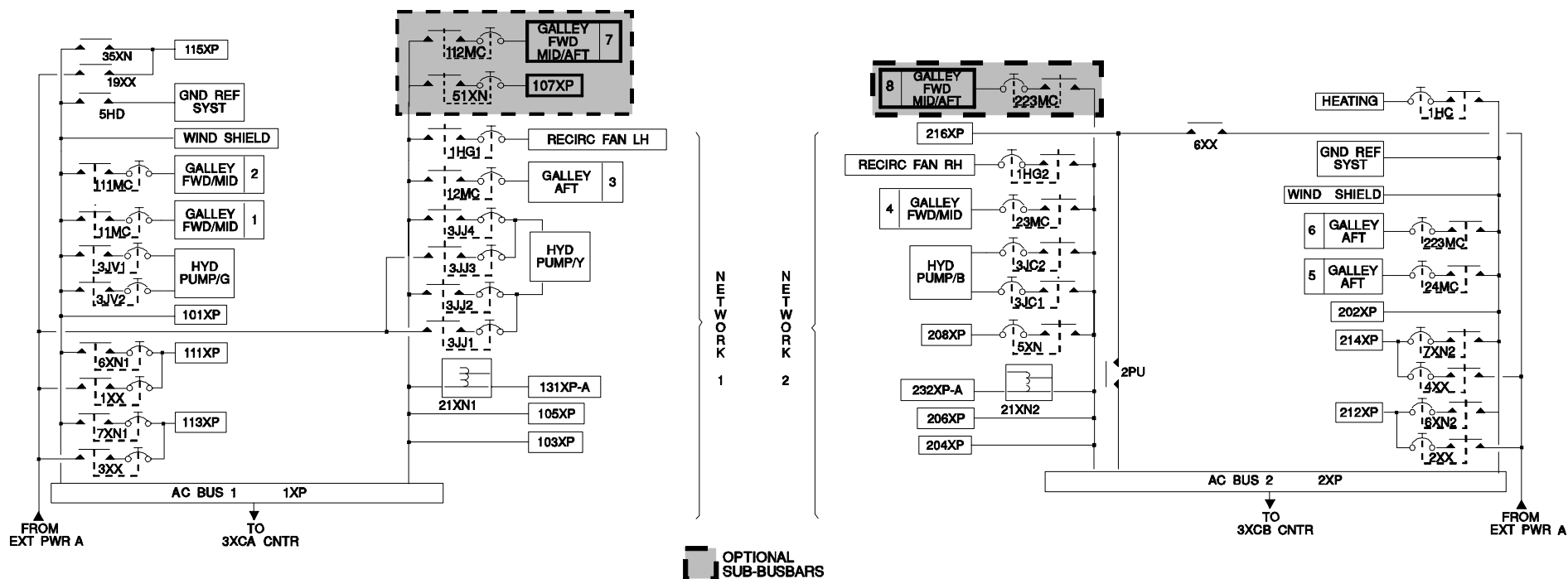
STUDENT NOTES

AC LOAD DISTRIBUTION

AC Main Distribution
AC Essential Distribution
Land Recovery
Sub-busbar Remote Control Circuit Breaker
Commercial Switch
Auto-transformer

AC MAIN DISTRIBUTION

The AC main distribution is composed of 2 independent networks and their associated sub-busbars.



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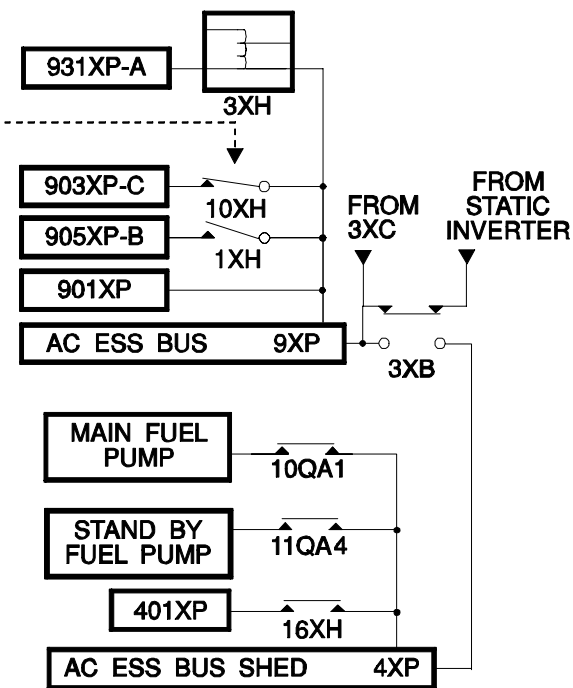
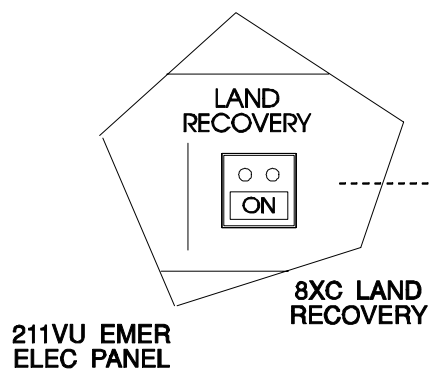
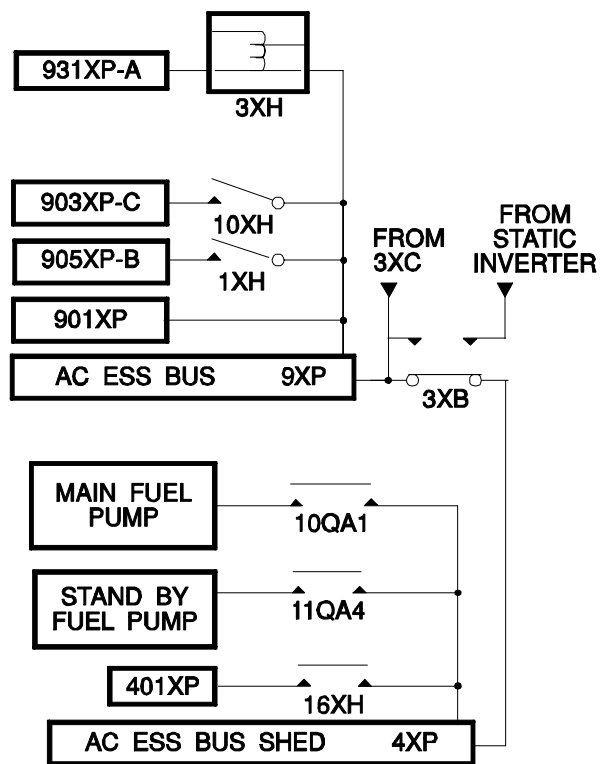
AC ESSENTIAL DISTRIBUTION

The AC essential distribution is composed of AC ESSential BUS 9XP, AC ESSential BUS SHED 4XP and their associated sub-busbars.

LAND RECOVERY

In emergency configuration (CSM/G), before the extension of the slats and landing gear, the crew must release out the LAND RECOVERY pushbutton switch.

The ON legend, on the LAND RECOVERY pushbutton switch, comes on. The sub-busbar 903XP-C is recovered through the closed contactor 10XH.



FQW4200 GE Metric

SUB-BUSBAR RCCB

The RCCBs are controlled by the commercial pushbutton switch 22XN through the ECMUs.

Certain sub-busbars are supplied through RCCBs.

Busbars	Sub-busbars	RCCBs
1XP	111XP, 113XP	6XN1, 7XN1
2XP	208XP, 212XP, 214XP	5XN, 6XN2, 7XN2

NOTE :

Sub-busbars 111XP,113XP,115XP,212XP,214XP and 216XP can be supplied directly from the external power in ground service configuration.

COMMERCIAL SWITCH

Each RCCB has an associated control logic in the ECMUs depending on the COMMERCIAL pushbutton switch position.

ON position (pushed) :

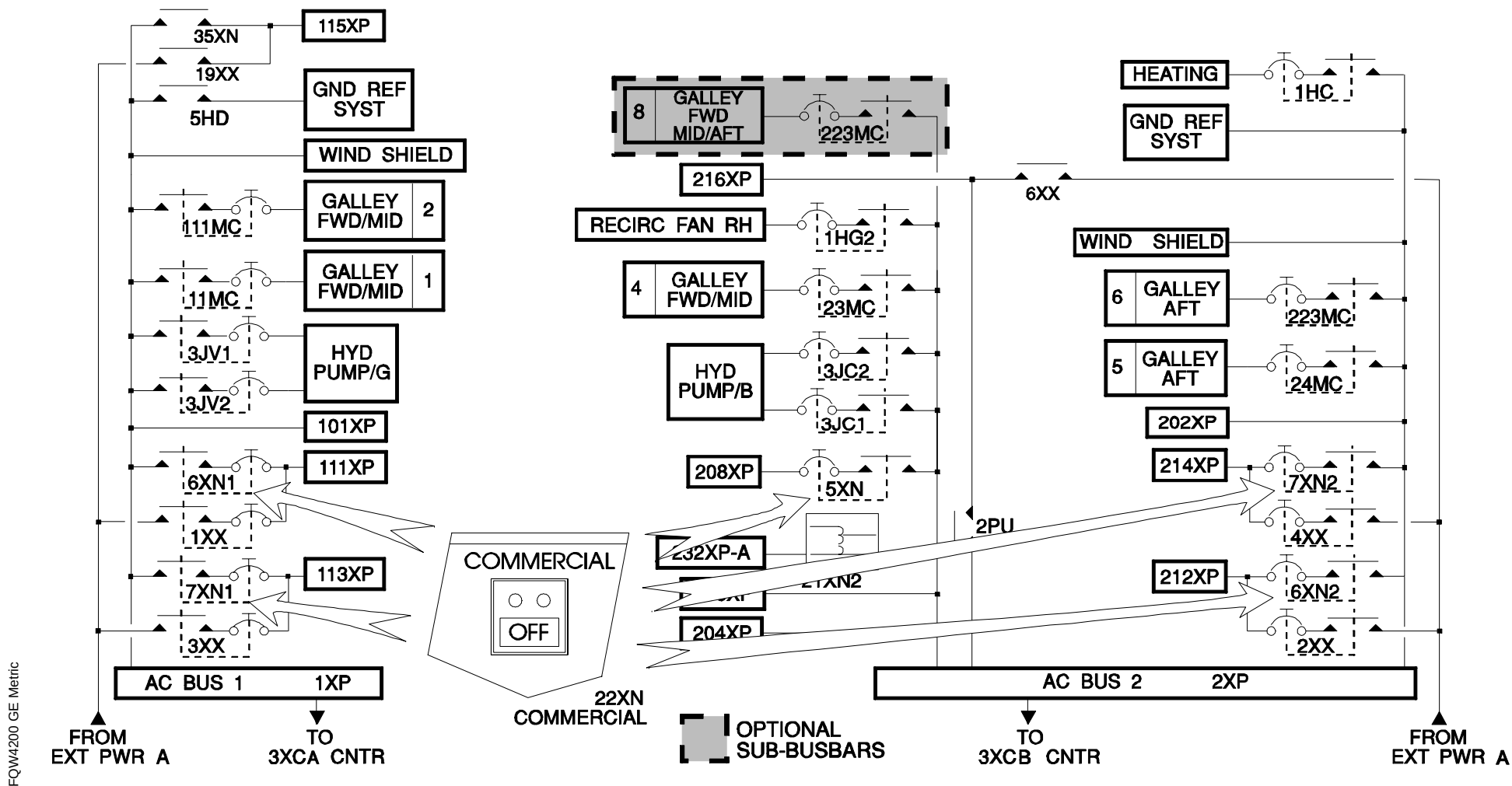
This position enables closure of RCCBs 6XN1, 7XN1, 6XN2, 7XN2, 5XN and power supply of the galleys through ECMUs 1 and 2.

OFF position (released out) :

The OFF legend comes on. Sub-busbars 111XP, 113XP, 212XP, 214XP, 208XP and all the galleys are shed.

NOTE :

The COMMERCIAL OFF message is displayed on the ELEC AC page.



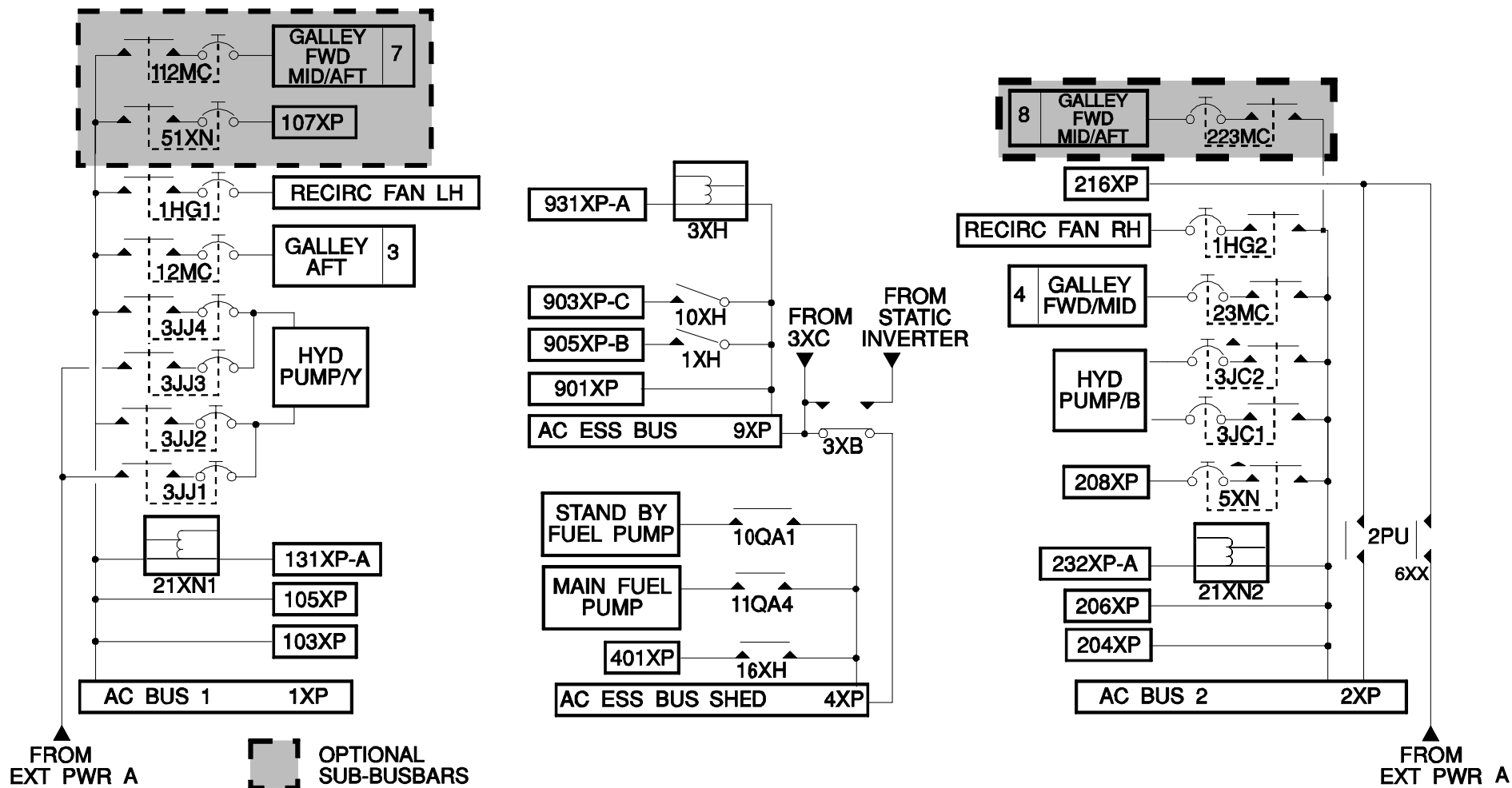
AUTO-TRANSFORMER

Three 115/26VAC transformers are used by the AC distribution.

Two of them by the main distribution and the third one by the essential distribution.

Busbars	115/26VAC transformer	Sub-busbars
1XP	21XN1	131XP-A
2XP	21XN2	232XP-A
9XP	3XH	931XP-A

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STUDENT NOTES:

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DC LOAD DISTRIBUTION

DC Main Supply Distribution
DC Service Bus Supply Distribution
Fuel Bus Supply Distribution
Essential Supply Distribution
DC Essential Bus Shed Logic
APU Start Supply Distribution

DC MAIN SUPPLY DISTRIBUTION

The DC main distribution network consists of DC BUS 1, DC BUS 2, the BAT BUS and the corresponding sub-busbars.

DC SERVICE BUS SUPPLY DISTRIBUTION

The DC Service main busbar and the associated sub-busbars are normally supplied from DC BUS 2 via contactor 1PN.

With the maintenance bus switch in ON position, it is possible to supply only the service buses from external power A only.

FUEL BUS SUPPLY DISTRIBUTION

The ESSential fuel bus and the main fuel bus can be supplied from the service bus or directly from the batteries.

The essential fuel bus can be supplied from the essential bus.

ESSENTIAL SUPPLY DISTRIBUTION

The DC Essential distribution network consists of the DC ESSential bus, the DC ESSential SHEDdable bus and the associated sub-busbars.

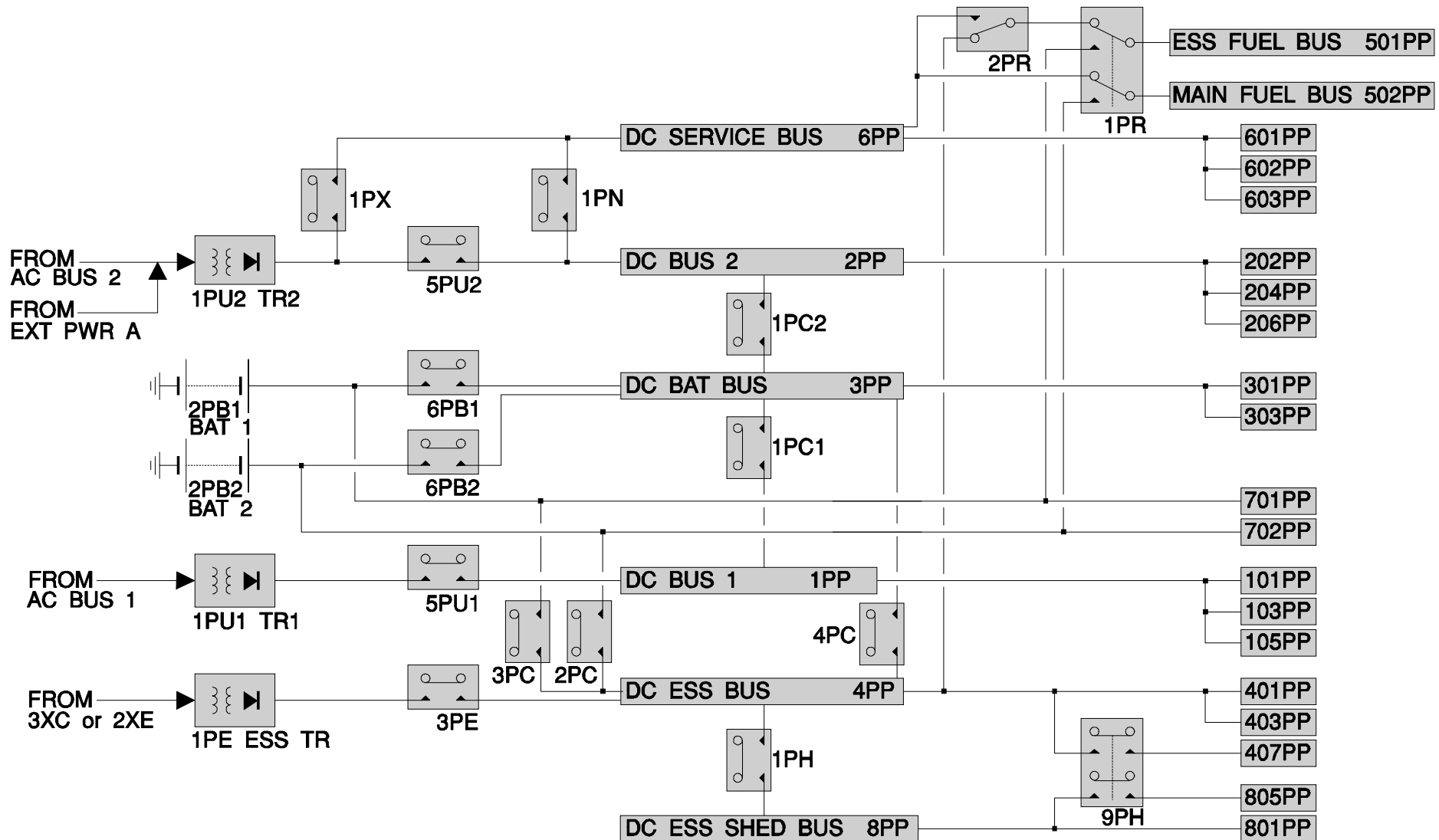
In normal configuration, these buses are supplied from the ESSential TR.

In abnormal configuration (loss of Essential TR not due to overcurrent), they are supplied from the BAT BUS (via 4PC).

In emergency configuration (Essential TR supplied from the CSM/G), sub-busbars 805PP and 407PP are automatically shedded (9PH open). They can be recovered by pressing the LAND RECOVERY switch.

If the CSM/G is supplied by the Ram Air Turbine (RAT) (in case of loss of engine 1 and 2), contactor 1PH opens and all sheddable buses are lost.

In emergency configuration, on batteries only, the DC essential network is supplied from the batteries via contactors 2PC and 3PC. The sheddable buses are lost (1PH open).



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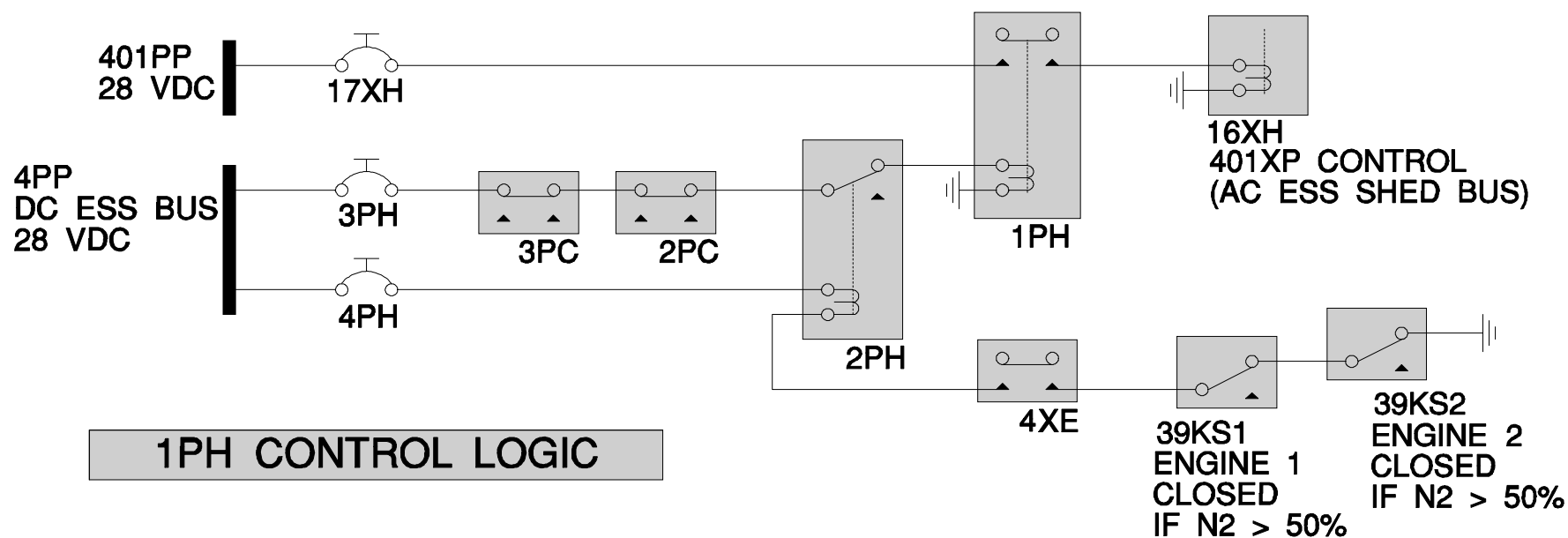
DC ESSENTIAL BUS SHED LOGIC

Contactors 2PH controls the shedding contactors 1PH (DC ESSENTIAL SHEDDABLE BUS) and 16XH (AC ESSENTIAL SHEDDABLE sub-busbars 401XP).

If 2PH is energized, the sheddable buses are no longer supplied.

2PH is energized if the CSM/G is supplied (4XE closed) by the RAT and engines 1 and 2 are below 50 % (39KS1 and 39KS2 de-energized).

On batteries only (2 PC and 3 PC energized), all sheddable buses are lost.

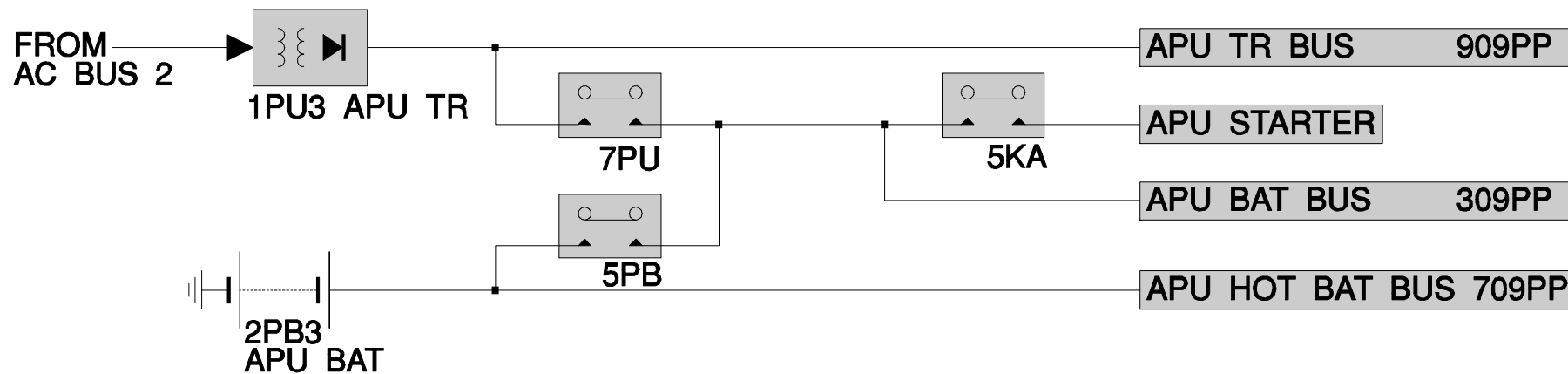


FQW4200 GE Metric

APU START SUPPLY DISTRIBUTION

The APU start system consists of the following buses :

- APU TR BUS 909PP which is directly supplied from the APU TR
- APU STARTER BUS which is supplied from the battery (via 5PB) and from the APU TR (via 7PU) provided the APU start pushbutton is pressed in (5KA closed)
- APU BAT BUS 309PP which is supplied from the battery or from the APU TR
- APU HOT BAT BUS 709 which is directly supplied from the APU BAT.



STUDENT NOTES

LAND RECOVERY D/O

General
Operation

GENERAL

In case of emergency (ESsential TR supplied from CSM/G), the essential sub-busbars are shed to save power.

These buses can be recovered by pressing the LAND RECOVERY pushbutton switch. This operation recovers items required for a safe landing in case of emergency.

OPERATION

The LAND RECOVERY switch is only active if the CSM/G is connected to the essential network.

As soon as the emergency generator is connected, a ground signal is sent, via the LAND RECOVERY switch, to close relay 7XC.

7XC de-energizes 9PH (407PP and 805PP are shed) and 10XH (903XP is shed).

Setting the LAND RECOVERY switch to ON cuts the ground to 7XC which energizes 9PH and 10XH to recover power on the shed buses.

STUDENT NOTES

FQW4200 GE Metric

REFUELING ON BATTERY

General
Normal Configuration
Ground Service Configuration
Battery Only Configuration

GENERAL

The refueling electrical network is normally supplied by the aircraft network. If the aircraft network is not supplied, the batteries can be used as a power source.

The refueling operation can be made according to 3 different configurations :

- Normal configuration,
- Ground service configuration,
- Battery only configuration.

NORMAL CONFIGURATION

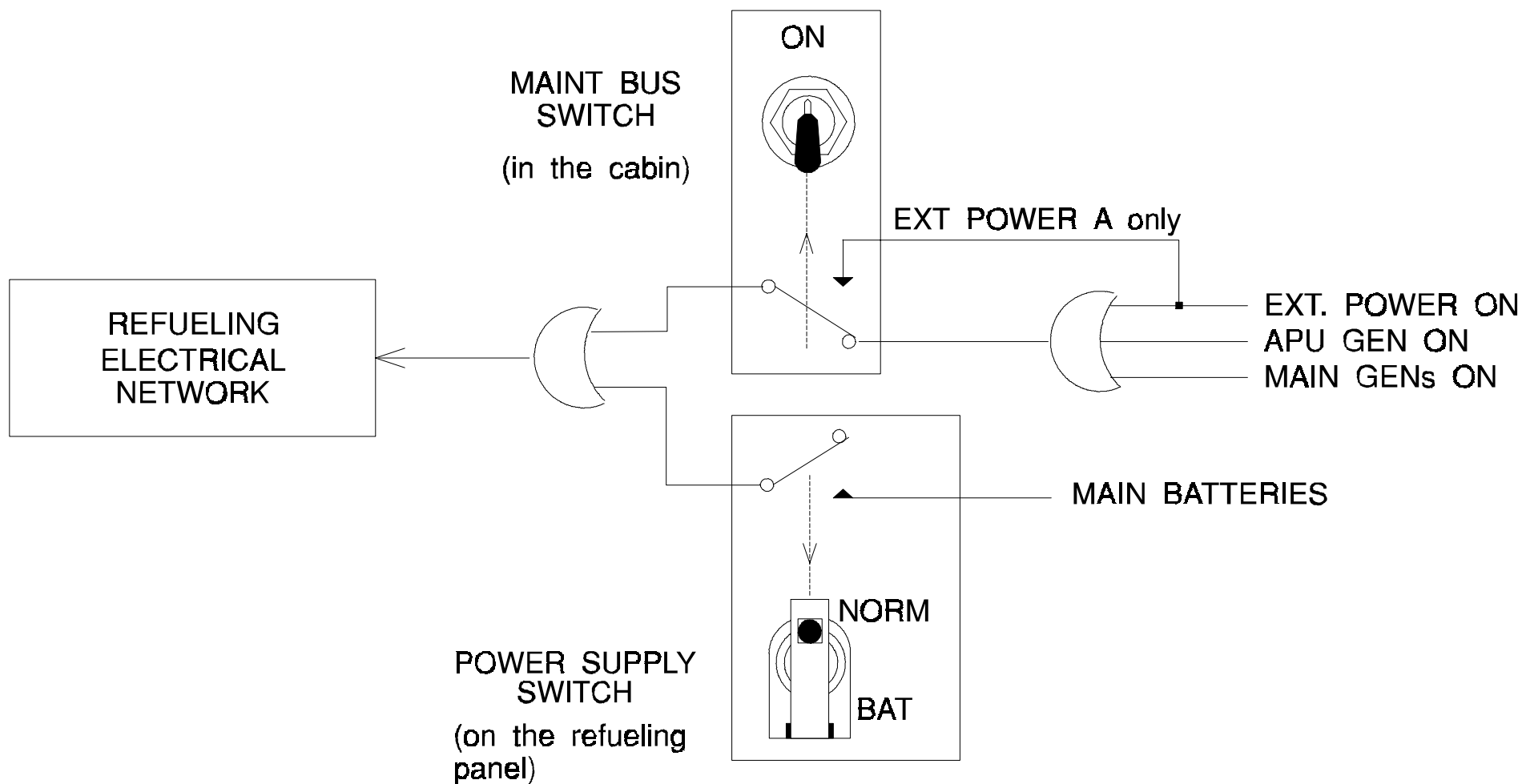
In normal configuration, the refueling electrical network is supplied either by the external power, the APU generator or the main generators.

GROUND SERVICE CONFIGURATION

In ground service configuration, the refueling electrical network is supplied by the external power A only via the MAINT BUS switch without energizing the whole aircraft network.

BATTERY ONLY CONFIGURATION

In battery only configuration, the electrical network is supplied by the main batteries.



FQW4200 GE Metric

STUDENT NOTES:

FQW4200 GE Metric

GALLEY SUPPLY

Galley pushbutton switch
AUTO Position
OFF Position
FAULT legend

GALLEY PUSHBUTTON SWITCH

The galley main power supply is controlled from the cockpit overhead panel by means of the commercial and galley pushbutton switches.

Note: both must be pushed to supply the galleys.

The galley pushbutton switch is used to shed all the galleys and to reset the galley supply.

AUTO POSITION

When the galley pushbutton switch is pressed in, all galleys are supplied, according to the supply configuration of the aircraft.

The ECMUs automatically control the shedding of the galleys in case of general overload or failure.

OFF POSITION

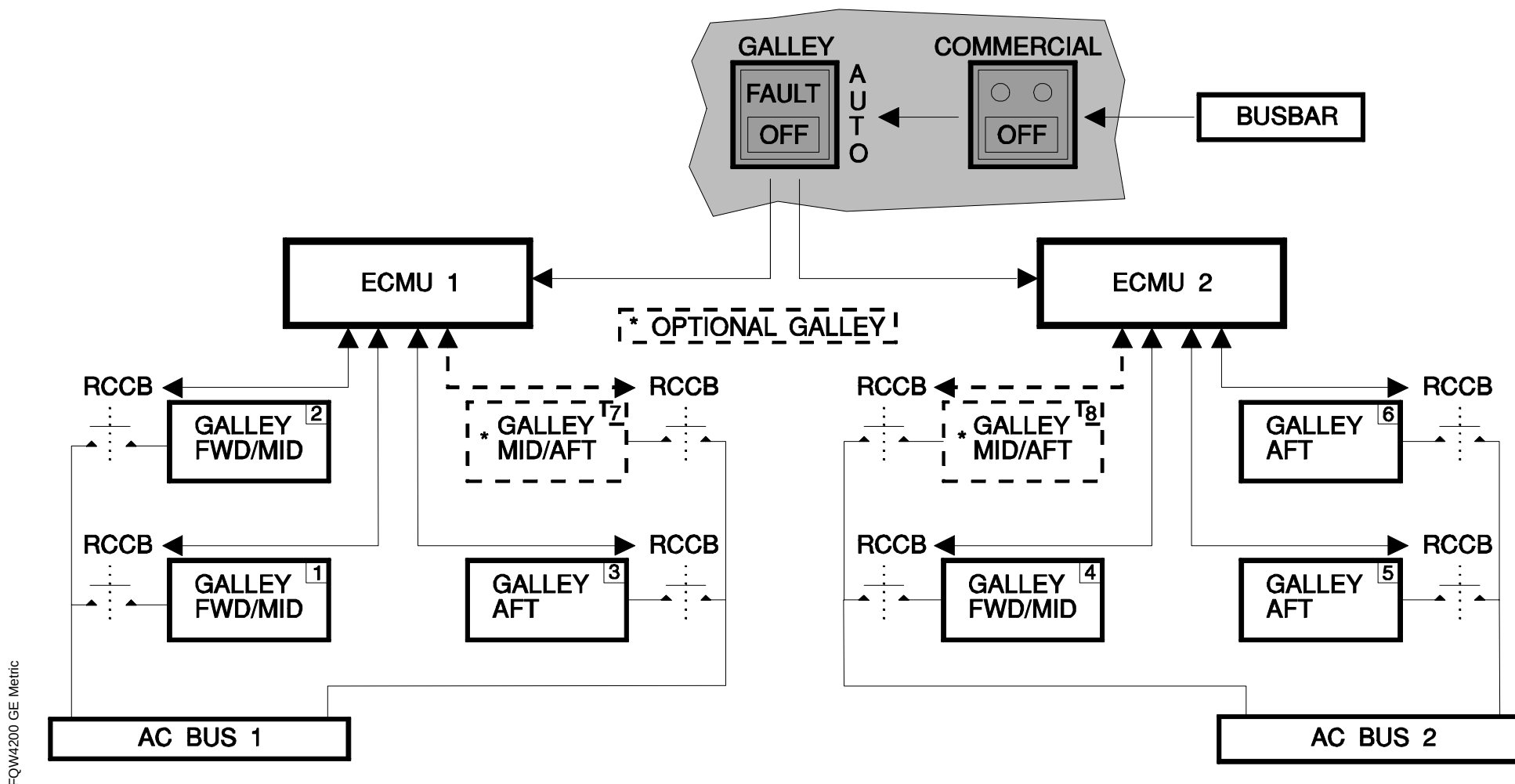
When the galley pushbutton switch is released out, all the Remote Control Circuit Breakers (RCCBs) are tripped through ECMUs and all the galleys are shed.

The white OFF legend comes on.

FAULT LEGEND

With the galley pushbutton switch in auto position and when the automatic shedding cannot be performed through the RCCBs, the FAULT legend comes on amber, associated with a single chime. An ECAM message is displayed on the Engine/Warning Display.

The galley supply must be shed manually by releasing out the galley pushbutton switch. All the galleys are shed by setting the galley pushbutton switch to OFF.



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STUDENT NOTES

GALLEY SUPPLY

- General
- Electronic Contactor Management Unit (ECMU)
- Main Relays
- Galley Switch
- Commercial Switch
- Operation
- IDG Failure (no APU GEN)
- IDG Failure (with APU GEN)
- Shedding On Ground

GENERAL

The galley power supply system provides the galley with 115 VAC, 400Hz, from the two AC normal busbars.

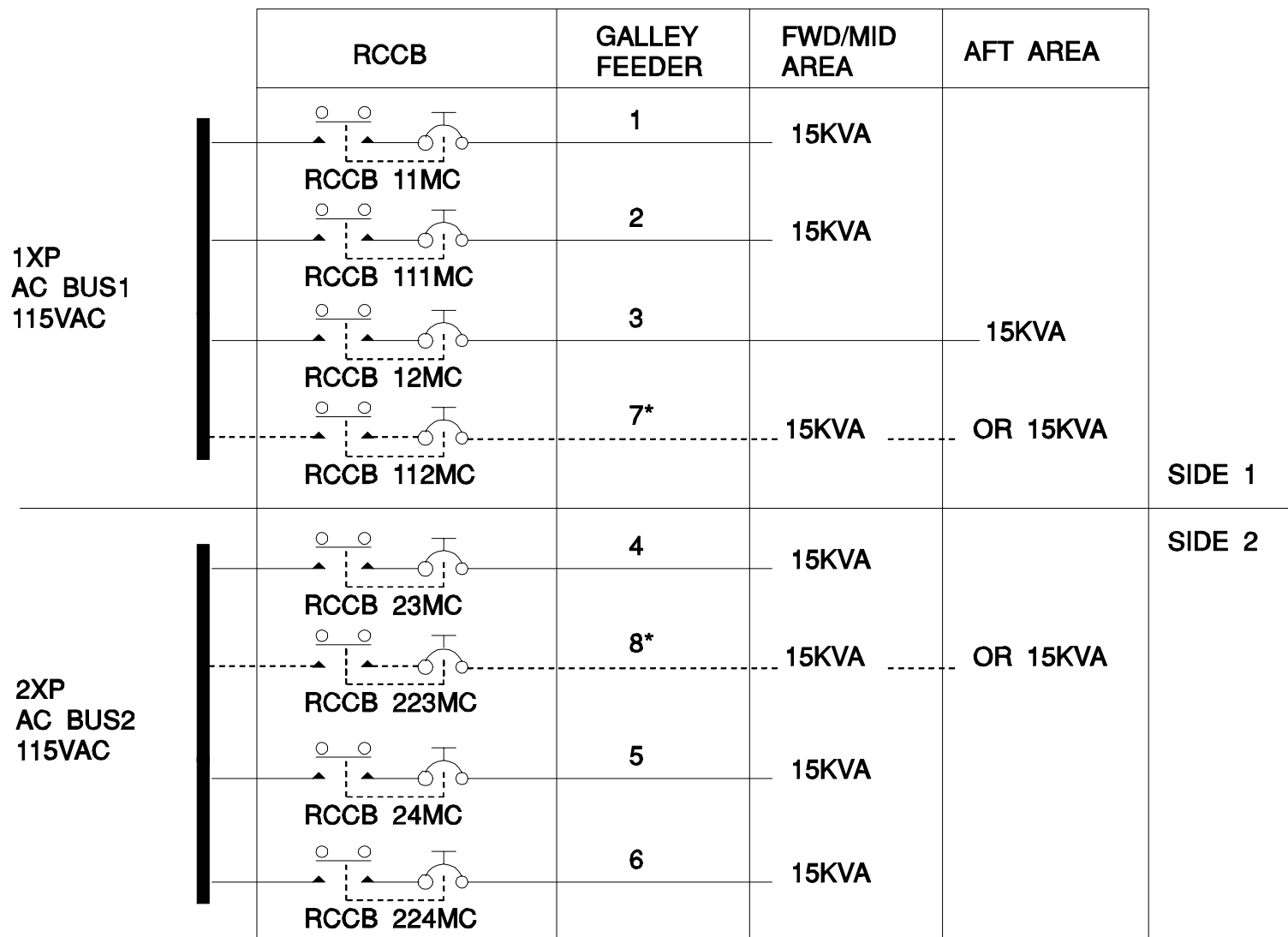
Six (plus two optional) power feeders provide the power to the terminal blocks which are installed in the forward (FWD), middle (MID), and aft (AFT) areas near the galleys.

The maximum load for each feeder is 15KVA, the maximum available load for all galleys is 90KVA (120KVA with optional feeders).

The Remote Control Circuit Breakers (RCCBs) control and protect the power supply to the feeders.

The Electrical Contactor Management Units (ECMUs) and the galley main relays control the RCCBs.

The supply system is controlled from the overhead panel COMMERCIAL and GALLEY pushbutton switches connected in series.



* OPTIONAL 120 KVA

FQW4200 GE Metric

ECMU

Each ECMU determines the configuration of the aircraft on the basis of the IDG overload and failure status data.

They are given by the three Generator Control Units (GCUs), the Ground Power Control Unit (GPCU), the Generator Line Contactors (GLC1,2 and APU), External Power Contactors (EPCs) A and B and the two control pushbutton switches (GALLEY and COMMERCIAL).

Each ECMU manages on one side its own RCCBs.

- ECMU1 manages:
main relay 2XA2,
RCCB 11MC (Feeder1),
RCCB 111MC (Feeder2),
RCCB 12MC (Feeder3),
RCCB 112MC (Feeder7*).
- ECMU2 manages:
main relay 2XA1,
RCCB 23MC (Feeder4),
RCCB 24MC (Feeder5),
RCCB 223MC (Feeder6),
RCCB 224MC (Feeder8*).

* optional 120 KVA.

MAIN RELAYS

According to the electrical power sources available, overloads if any and the position of the GALLEY and COMMERCIAL pushbutton switches, the ECMUs control the two main relays 2XA1 and 2XA2 for total galley shedding and the RCCBs for partial galley shedding.

The two main relays are supplied from busbar 601PP via the two control switches in series and from the corresponding ECMU TOTAL SHED logic.

These two relays also control the power for the corresponding RCCBs. Individual closing or opening of the RCCB is then controlled from the ECMU PARTIAL SHED logic.

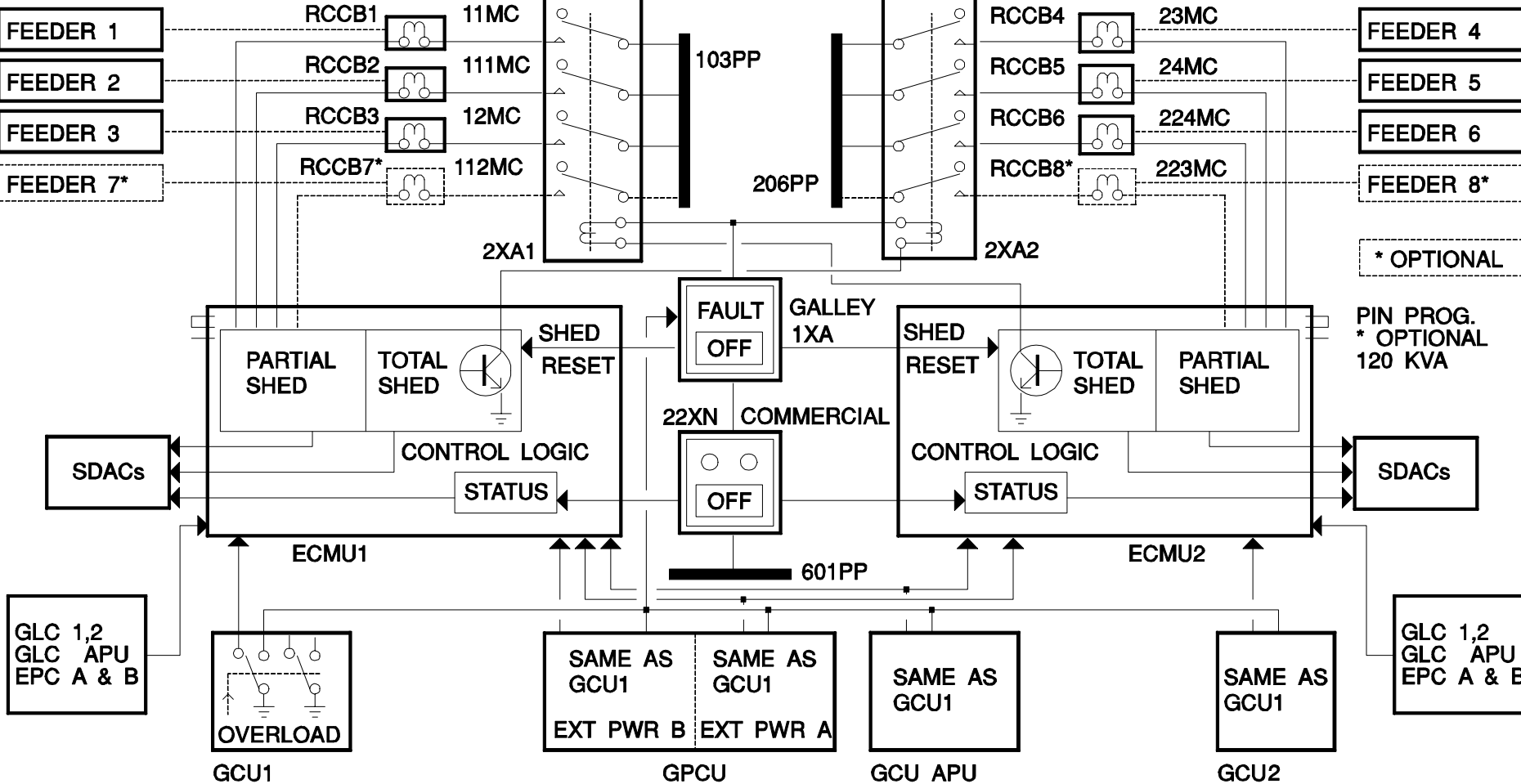
GALLEY SWITCH

In ON position, and when the COMMERCIAL pushbutton switch is ON, the main relays and the RCCBs are controlled from the ECMUs according to the electrical sources available.

If at least one RCCB is open due to IDG overload (the automatic shedding has been performed), the GALLEY PARTIALLY SHED message appears on the AC ELEC page.

The FAULT legend comes on amber if an overload is detected and the appropriate shedding is not performed.

In OFF position, the OFF legend comes on. Both main relays are de-energized and then, all galleys are off. The GALLEY SHED message appears on the AC ELEC page and the control logics of the ECMUs are reset.



COMMERCIAL SWITCH

In ON position, the COMMERCIAL pushbutton switch connects power from 601PP to the GALLEY pushbutton switch, and sends a status to both ECMUs.

In OFF position, the OFF legend comes on.

All galleys and all service buses are off.

The COMMERCIAL OFF message appears on the ECAM.

OPERATION

If an overload is detected, the GCU or the GPCU provides a signal to the related ECMU which sheds the galley according to the automatic shedding logic.

If the shedding is effective, no warning is triggered.

If the shedding is not performed, the related RCCB stays closed and the following warnings are triggered:

- The amber FAULT legend on the GALLEY control pushbutton switch comes on.
- The message: GEN2 (1,APU GEN,EXT PWR) OVERLOAD appears on the Engine/Warning Display.

The crew has to switch off the GALLEY pushbutton switch.

All galleys are shed and the white OFF legend appears.

This action results in opening the two main relays which open all RCCBs.

- The GALLEY SHED message appears on the ELEC AC page of the System Display.

The control logic is also reset.

Note: setting the GALLEY P/B switch back to ON, the GALLEY will be recovered only if there is no longer an overload condition.

IDG FAILURE (NO APU GEN)

Here are the various feeders supplied according to the supply configuration

Note: optional feeder 7 or 8 is shed as soon as one IDG has failed on its side.

If one IDG has failed, two feeders are shed on its side.

If the last feeder is overloaded, it is also shed. If both IDGs fail, no galley is supplied.

IDG FAILURE (WITH APU GEN)

Here are the various feeders supplied according to the supply configuration.

In case of failure of one IDG, all feeders are still supplied.

If both IDGs have failed, no galley is supplied.

SHEDDING ON GROUND

When the power is supplied by one Ground Power Unit (GPU) or by the APU GEN, all the feeders are supplied.

If an overload is detected, all the feeders are shed.

When the power is supplied by the External Power A and B, or External Power A and APU GEN, all the feeders are supplied.

In case of overload, the feeders supplied by the overloaded power source are shed.

NO APU GEN CONNECTED

IDG CONFIGURATION	SIDE	GALLEY FEEDER SHED	
		IDG OFF	IDG OVERLOAD
1 IDG FAILURE	1	1,3	2
	2	5,6	4

WITH APU GEN CONNECTED

IDG CONFIGURATION	IDGs OFF	GALLEY FEEDER SHED	
			APU GEN OVERLOAD
1 IDG FAILURE	1		2,3
	2		4,6
2 IDG FAILURES		1,2,3,4,5,6	

STUDENT NOTES

FQW4200 GE Metric

AC & DC LOAD DISTRIBUTION COMPONENT

Safety Precautions
NORMAL/ESSENTIAL AUTOTRANSFORMER
(NORM/ESS. A/XFMR)

SAFETY PRECAUTIONS

Comply with the safety precautions, warnings and cautions.

- (1) In the cockpit, on the overhead panel 235VU, make sure that these pushbutton switches are released:
 - BAT 1, BAT 2, APU BAT,
 - GEN 1 (2), APU GEN,
 - EXT A (B).
- (2) In the cockpit, put a warning notice to tell persons not to operate the pushbutton switches on these panels of the overhead panel:
 - 211VU (EMER ELEC PWR),
 - 235VU (ELEC).
- (3) Make sure that the external power is not connected to the aircraft receptacle.
- (4) Put a warning notice on the access door 121EL to tell persons not to connect the external power.

WARNING:

MAKE SURE THAT NO AC OR DC POWER SOURCE IS CONNECTED TO THE AIRCRAFT ELECTRICAL CIRCUITS.

NORMAL/ESSENTIAL AUTOTRANSFORMER (NORM./ESS. A/XFMR)

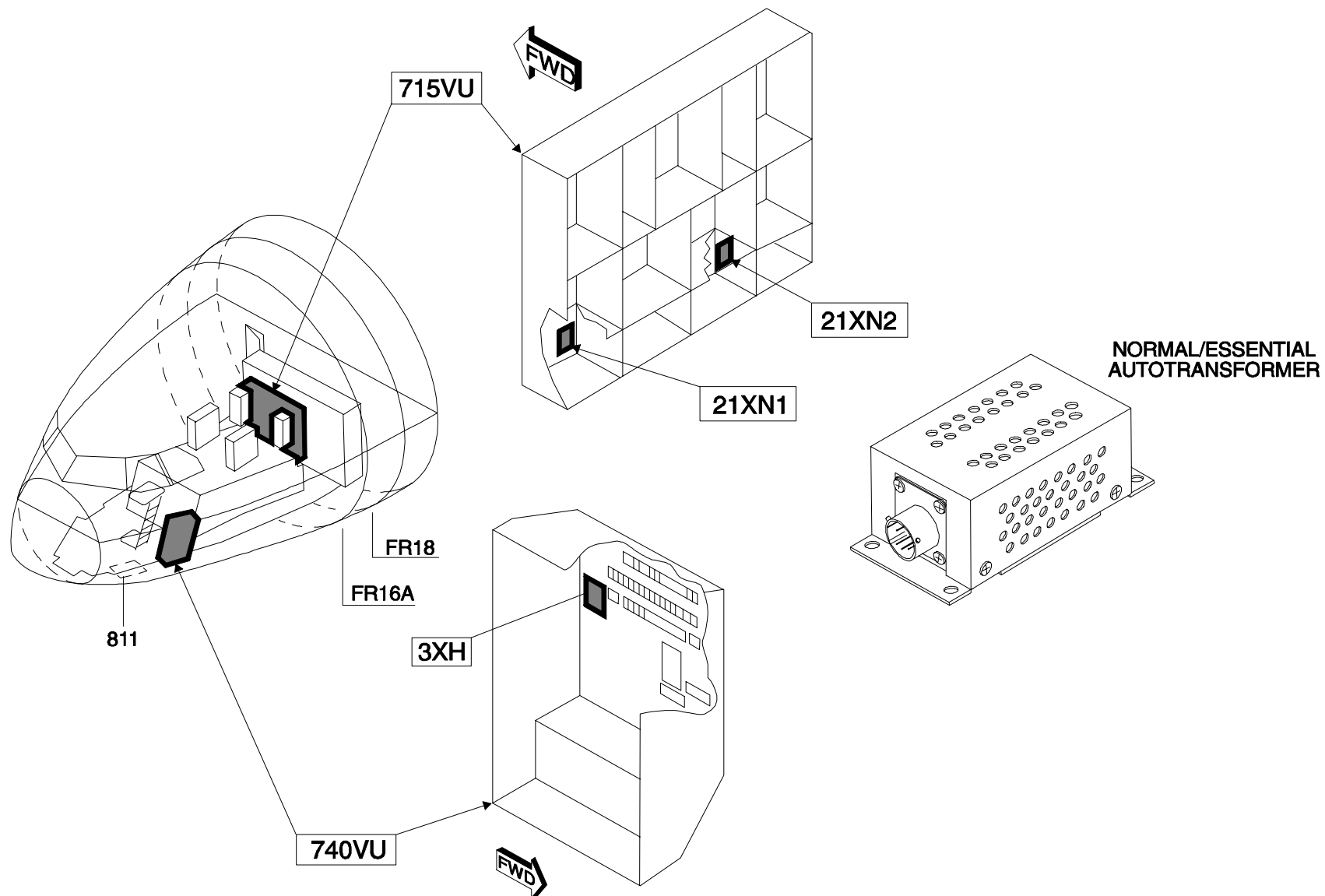
FIN/ZONE

FIN : 21XN1, 21XN2 (for NORM. A/XFMR)
3XH (for ESS. A/XFMR)
Zone : 120

COMPONENT DESCRIPTION

The A/XFMR features:

- a rectangular cover assembly with holes for ventilation,
 - a bed plate assembly on which the autotransformer is fastened,
 - a 6 pin electrical connector,
- and various screws, nuts and washers.



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STUDENT NOTES

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