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# Airbus
# A318/A319/A320/A321

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## Ice and Rain Protection

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EASA Part-66

B1/B2

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# ATA 30 ICE AND RAIN PROTECTION

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## ICE AND RAIN PROTECTION SYSTEMS GENERAL DESCRIPTION

The ice and rain protection system lets the aircraft operate normally in ice conditions or heavy rain.

For anti–icing, hot air or electrical heating protects critical areas of the aircraft.

**The different subsystems of the ice and rain protection system are:**

- wing ice protection,
- engine air intake ice protection,
- probe ice protection,
- windshield ice and rain protection,
- drain mast ice protection,
- ice detection system (optional),
- water and waste system ice protection (some are optional).

Ice protection is given by the use of hot air, or electrical power, to make the necessary areas of the aircraft hot.

**The areas that hot air supplies are:**

- the leading edge of the slats 3, 4 and 5 on each wing,
- the engine air intakes.

The engine bleed air system (Ref. 36–11–00) supplies the hot air to the anti–ice system.

**The items with electrical heaters are:**

- the cockpit windshield and side windows,
- the TAT (**T**otal **A**ir **T**emperature) probes,
- the Angle of Attack (alpha) probes,
- the Pitot and Static probes of the ADS (**A**ir **D**ata **S**ystem),
- the waste–water drain–masts.

Rain is removed from the windshield with windshield wipers.

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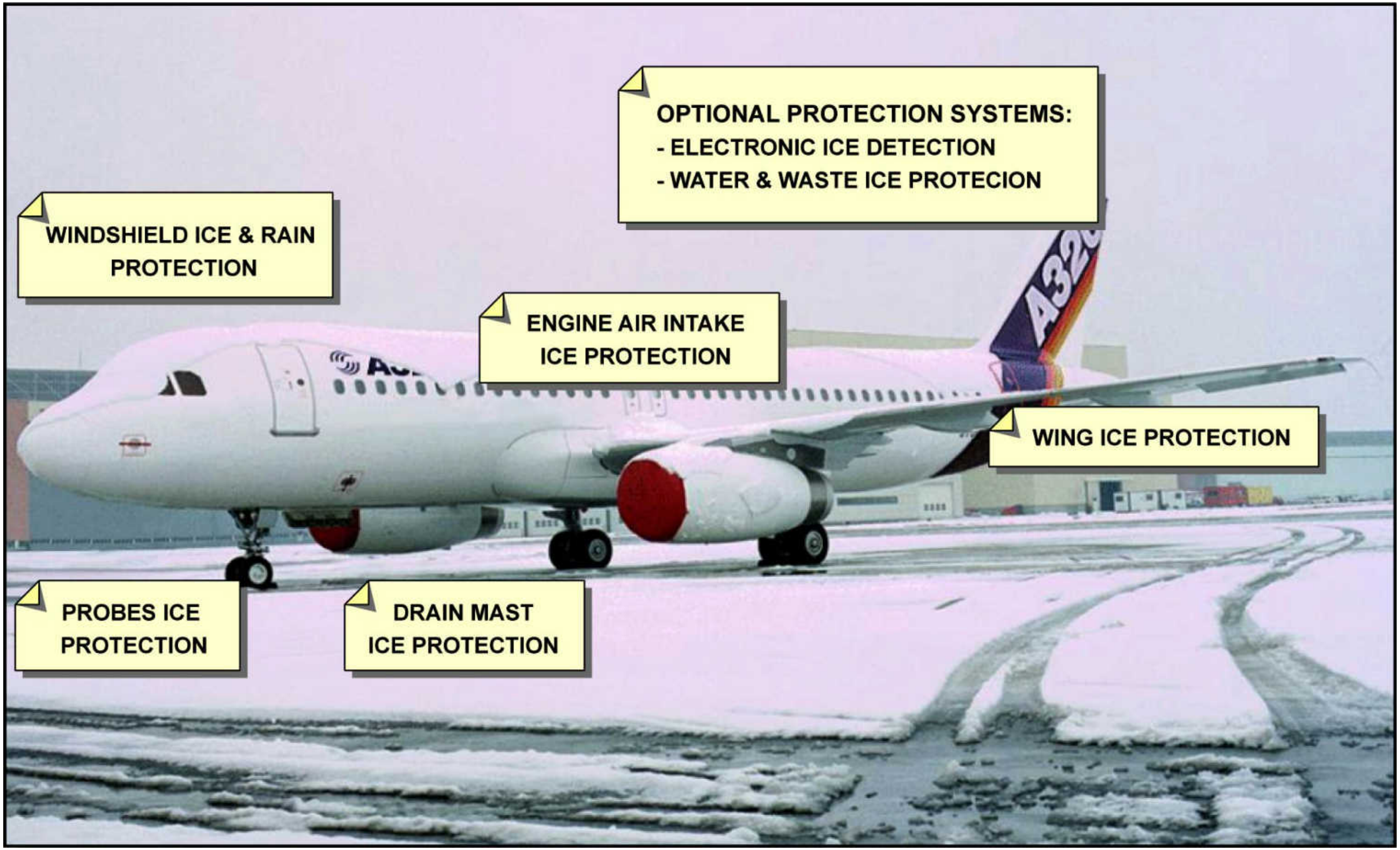


**Figure 1 System Introduction**

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# 31−31 PROBE ICE PROTECTION

## PROBE ICE PROTECTION SYSTEM INTRODUCTION

Ice protection of the Angle Of Attack (AOA) sensors, pitot probes, static ports, and Total Air Temperature (TAT) probes is achieved by electrical heating.

In order to give reliable information to the air data systems, the air data probes are heated automatically when at least one engine is running. The probes are arranged in three channels related to the three air data systems:

- CAPT, F/O and STBY (Air Data/Inertial Reference Unit (ADIRU) 1, 2, 3).

The heating system for each channel is controlled by a Probe Heat Computer (PHC) 1, 2, 3.

In the cockpit a PROBE/WINDOW HEAT P/BSW (normally in the AUTO position) may be used to select the probe heating ON with the engines shut down.

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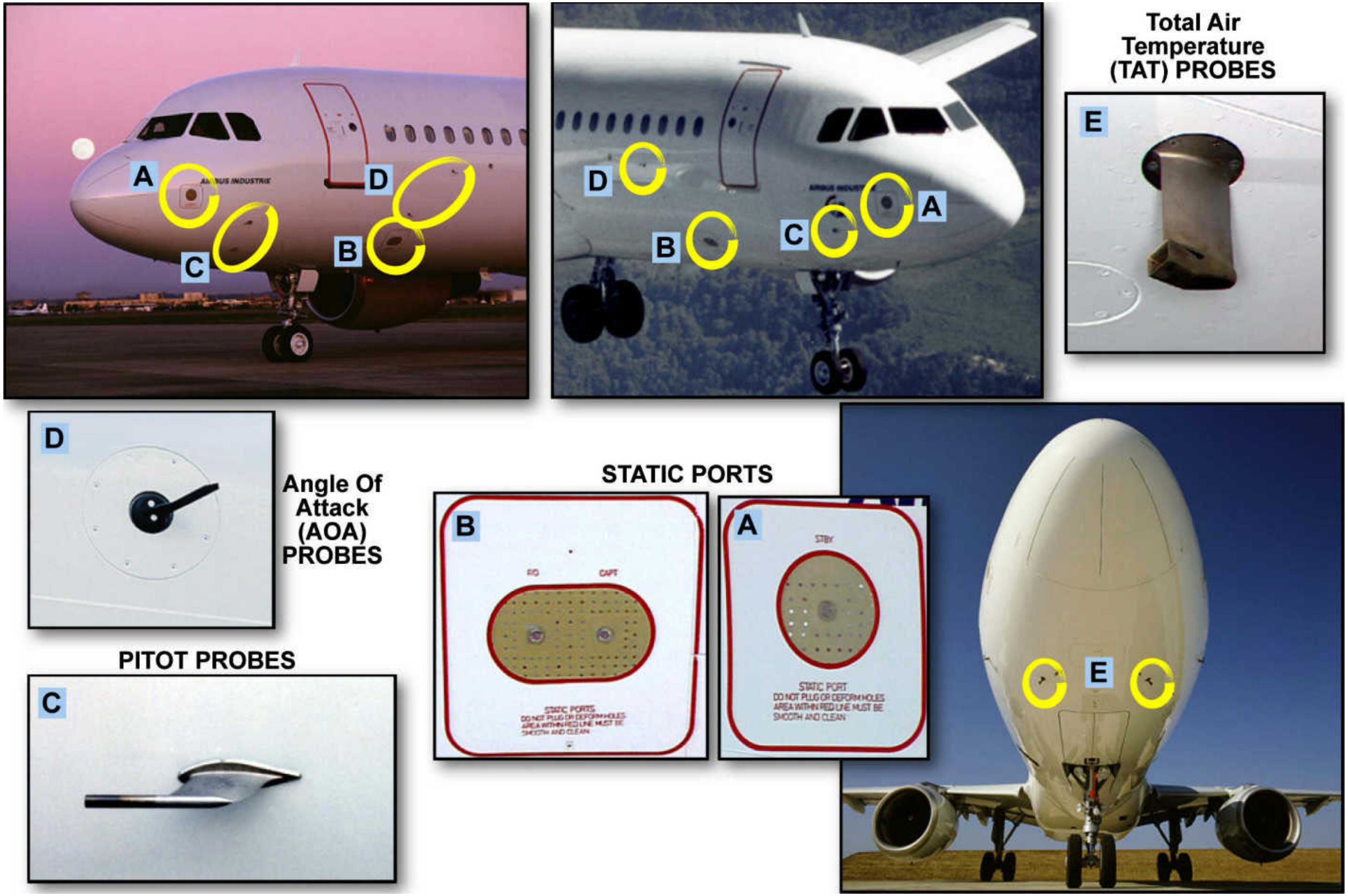


**Figure 2 Probe Ice Protection Introduction**

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## PROBE ICE PROTECTION DESCRIPTION

### GENERAL

The static ports, Angle−Of−Attack (AOA), pitot and Total Air Temperature (TAT) probes are electrically heated to prevent ice formation.

The CAPT, F/O and STBY systems are independent. Each one includes a Probe Heat Computer (PHC), which controls probe and static ports heating.

As there are only 2 TAT probes, the first one is linked to CAPTS and the second one on to the F/Os systems. PHC 3 is not linked to a TAT probe.

### Control

The probes and static ports heating come on automatically when at least one engine is running. It can also be manually activated by the PROBE/WINDOW HEAT P/B.

On ground, pitot heating is reduced and TAT heating is cut off, the Landing Gear Control and Interface Units (LGCIUs) control both.

The Probe Heating System is also switched ON automatically when the LGCIU sends a FLIGHT signal.

### Probe Heat Computer (PHC)

Heating monitoring and fault indication is given by the related PHC.

A probe or a sensor heating failure is sent to the ECAM via an Air Data/Inertial Reference Unit (ADIRU) and the Flight Warning Computers (FWC).

The PHC also transmits fault messages to the Centralized Fault Display Interface Unit (CFDIU).

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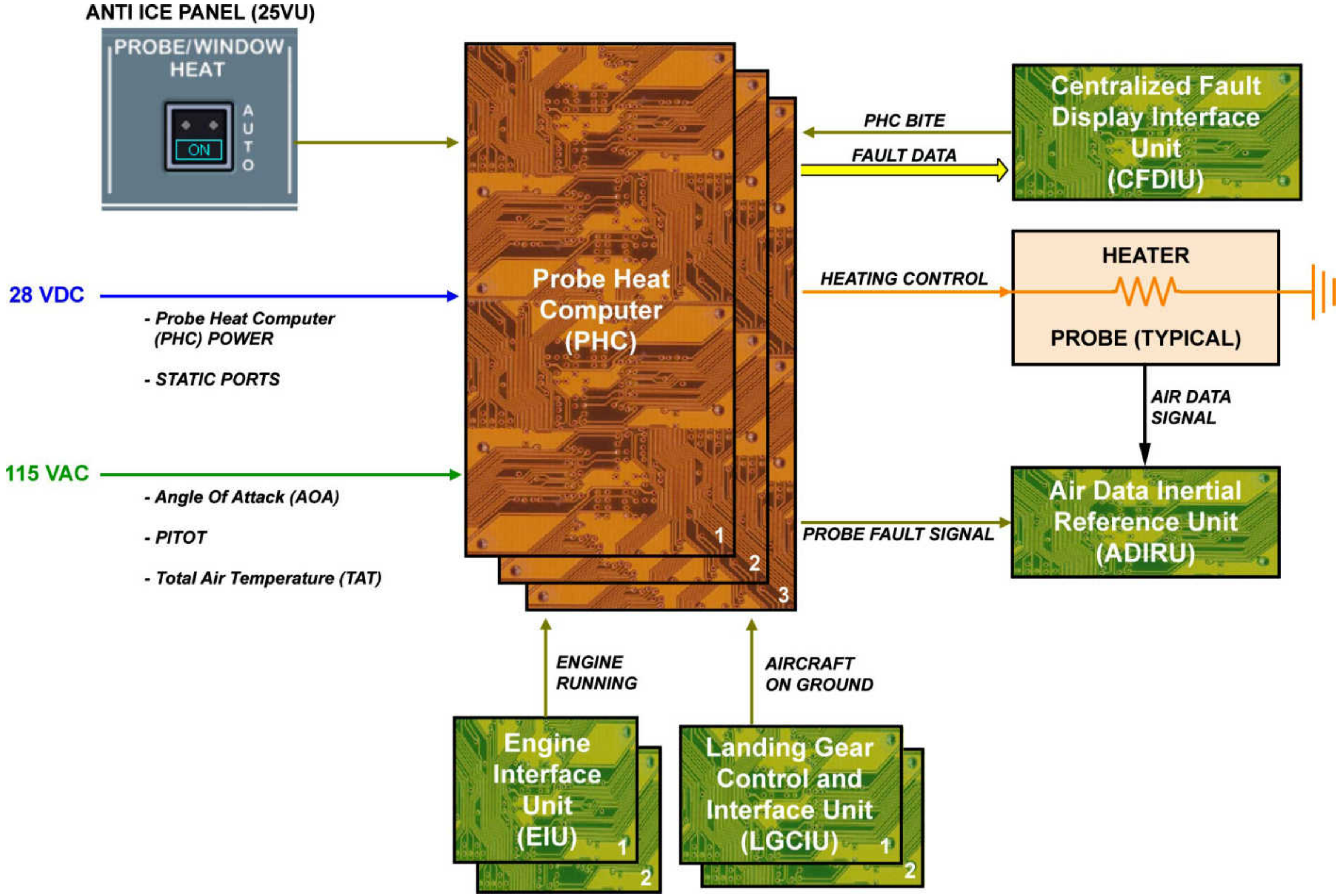


**Figure 3 Probe Ice Protection System**

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## PROBE ICE PROTECTION ARCHITECTURE

**Probe Ice Protection**

Electrical heating of the probes prevents ice accretion on the probes of the air data system:

- pitot probes,
- static probes,
- angle of attack sensors,
- TAT sensors.

The TAT sensors are not heated on the ground.

The ice protection system of the probes is arranged in three independent channels (1, 2 and 3).

**PHC (Probe Heat Computer)**

The PHC controls and monitors heating of the probes given below:

- one pitot probe,
- one AOA sensor,
- two static probes,
- one TAT sensor.

There are three PHCs, one per probe channel:

- PHC 1,
- PHC 2,
- PHC 3 (channel 3 does not include the TAT sensor).

**Interface**

The ice protection system of the probes is associated with:

- the EIU (**E**ngine **I**nterface **U**nit) (Functional Interfaces),
- the shock absorbers of the landing gear,
- the CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit)

to control and select the heating mode of the probes.

**WARNING:** IF YOU PULL THE PHC POWER SUPPLY C/B, THE RELATED PROBES AND STATIC PORTS WILL BE HEATED (FLIGHT POSITION).

OIL LOW PRESSURE AND GROUND RELAYS ARE ENERGIZED BY THE ENGINE INTERFACE UNIT(EIU) WHEN THE RELATED ENGINE IS NOT RUNNING. IF YOU PULL THE EIU POWER SUPPLY C/B, THE RELATED ENGINE OIL LOW PRESSURE AND GROUND RELAYS ARE DEENERGIZED, THIS WILL CAUSE RELATED PROBES AND STATIC PROBES TO BE HEATED.

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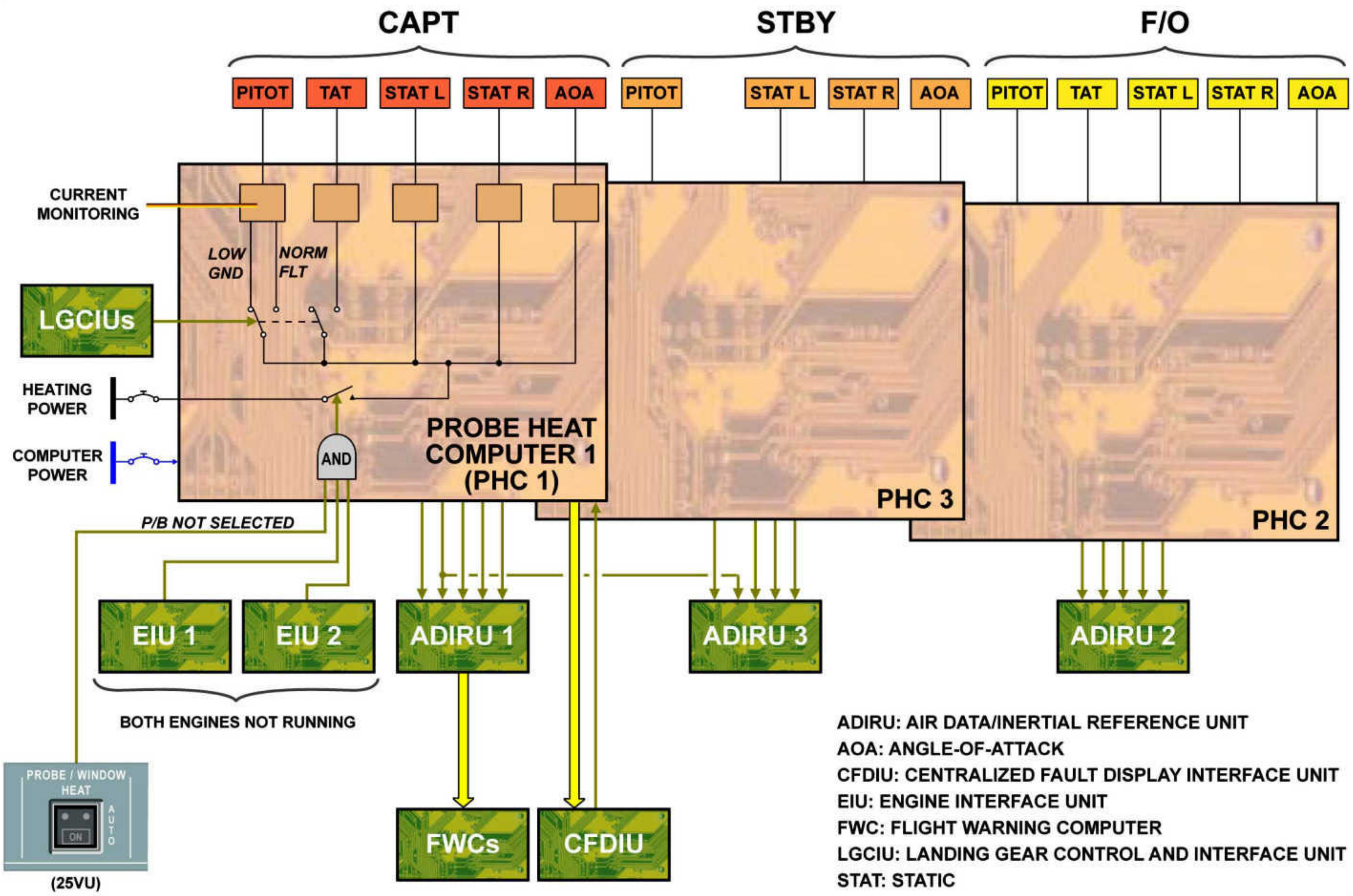


**Figure 4 Probe Heat Computer**

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## SYSTEM DESCRIPTION

**PHC (Probe Heat Computer)**

The PHCs are installed in the avionics compartment.

The PHC controls and monitors heating of the probes given below:

- one pitot probe,
- two static probes,
- one AOA sensor,
- one TAT sensor.

The PHC identifies and memorizes the failures.

There are three PHCs, one per probe channel:

- PHC 1,
- PHC 2,
- PHC 3 (Channel 3 does not include the TAT sensor).

The PHC is supplied with 28VDC. Three ports enable the PHC position to be selected.

The PHC controls the heating of the probes and sensors according to acquisition of discrete aircraft information. This function is achieved by a hardware logic device independent of the software.

**Inputs**

The PHC acquires 10 discrete inputs of standard type (ground/open):

- 4 from the LGCIU (**L**anding **G**ear **C**ontrol and **I**nterface **U**nit), 2 ground/flight information, and 2 from the LGCIU validity,
- 2 from the EIUs, engine running or not,
- 1 for the ON control,
- 1 from the CFDS for the maintenance test,

**Outputs**

The PHC generates 5 discrete outputs to the FWC (**F**light **W**arning **C**omputer) via the ADIRU (**A**ir **D**ata/**I**nertial **R**eference **U**nit):

- 1 for the indication of TAT sensor heating or not,
- 1 for the indication of the pitot probe heating fault,
- 1 for the indication of the L static probe heating fault,
- 1 for the indication of the R static probe heating fault,
- 1 for the indication of the AOA sensor heating fault,

The PHC transmits one ARINC 429 low−speed data bus for fault message to the CFDS.

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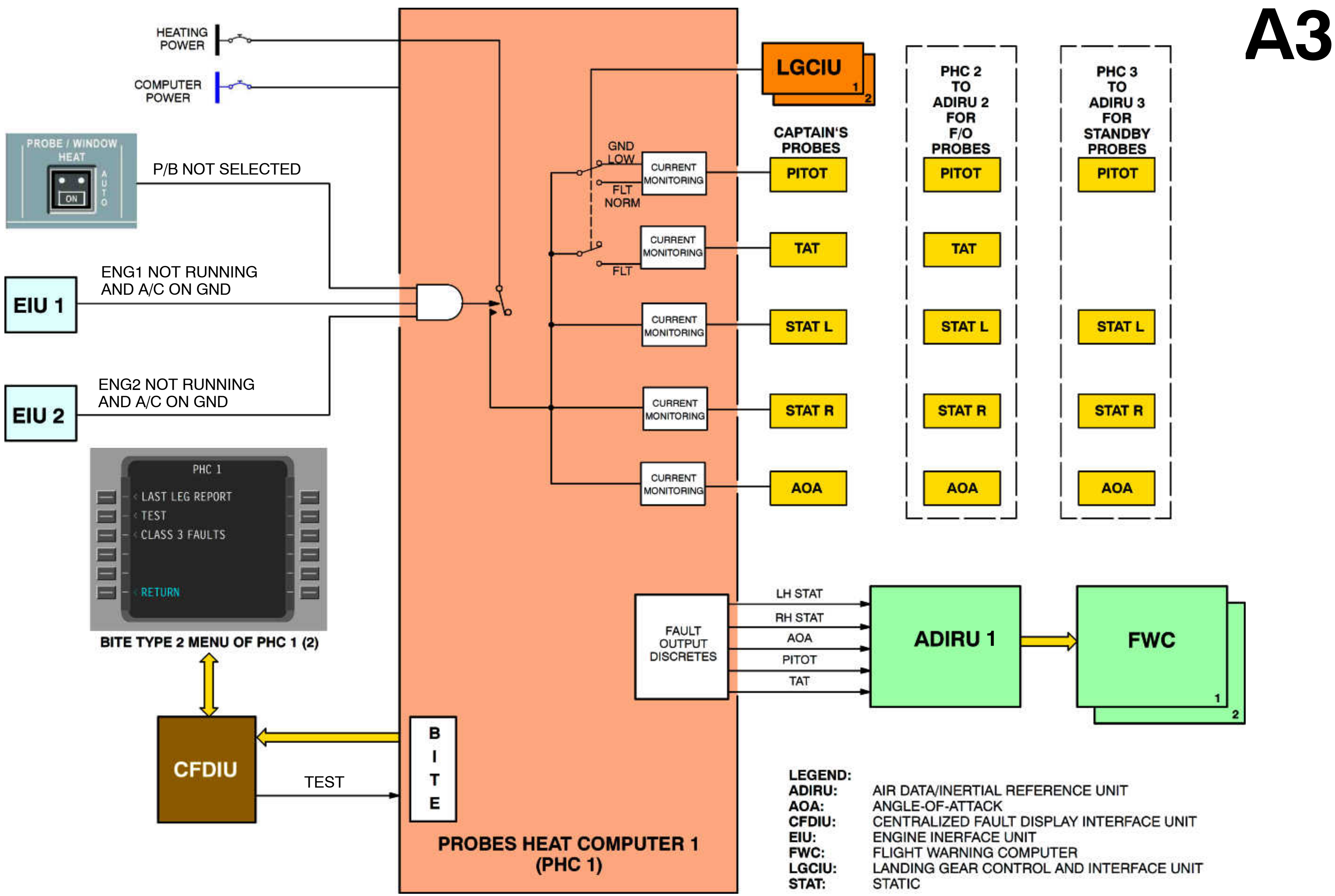


Figure 5 PHC - System Description

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## COMPONENT DESCRIPTION

### Pitot Probe

Power is applied to:

- the main portion of the detection tube of total pressure,
- the inner surface of the cavity located in the mast.

Power is supplied with 115 VAC nominal.

**NOTE:** Heating of the pitot tube is reduced on the ground.
The PHC automatically controls the changeover of the probe heating level.

### Static Probe

Power is applied to the periphery of the orifice.

Power is supplied with 28VDC nominal.

### AOA Sensor

The AOA sensor is of the vane type.

Power is applied to the internal solid−state heaters of the vane.

Power is supplied with 115VAC nominal.

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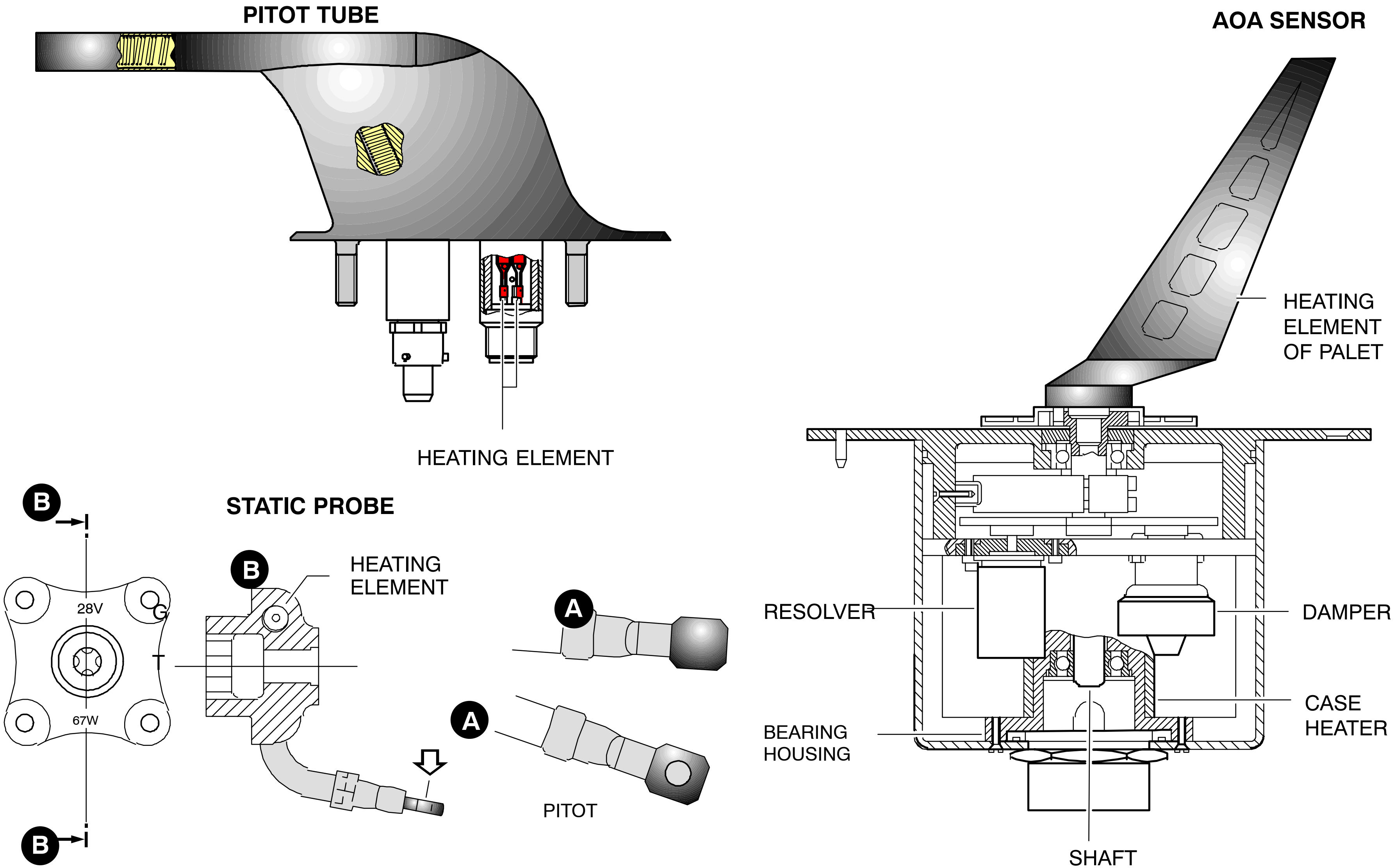


**Figure 6 Pitot Tube, Static Probe and AOA Sensor**

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**TAT Sensor**

Power is applied to the leading edge of the air inlet.

Power is supplied with 115VAC nominal.

Heating is cut off on the ground. The PHC automatically controls this changeover.

**NOTE:** Heating is cut off on the ground.
The PHC automatically controls this changeover.

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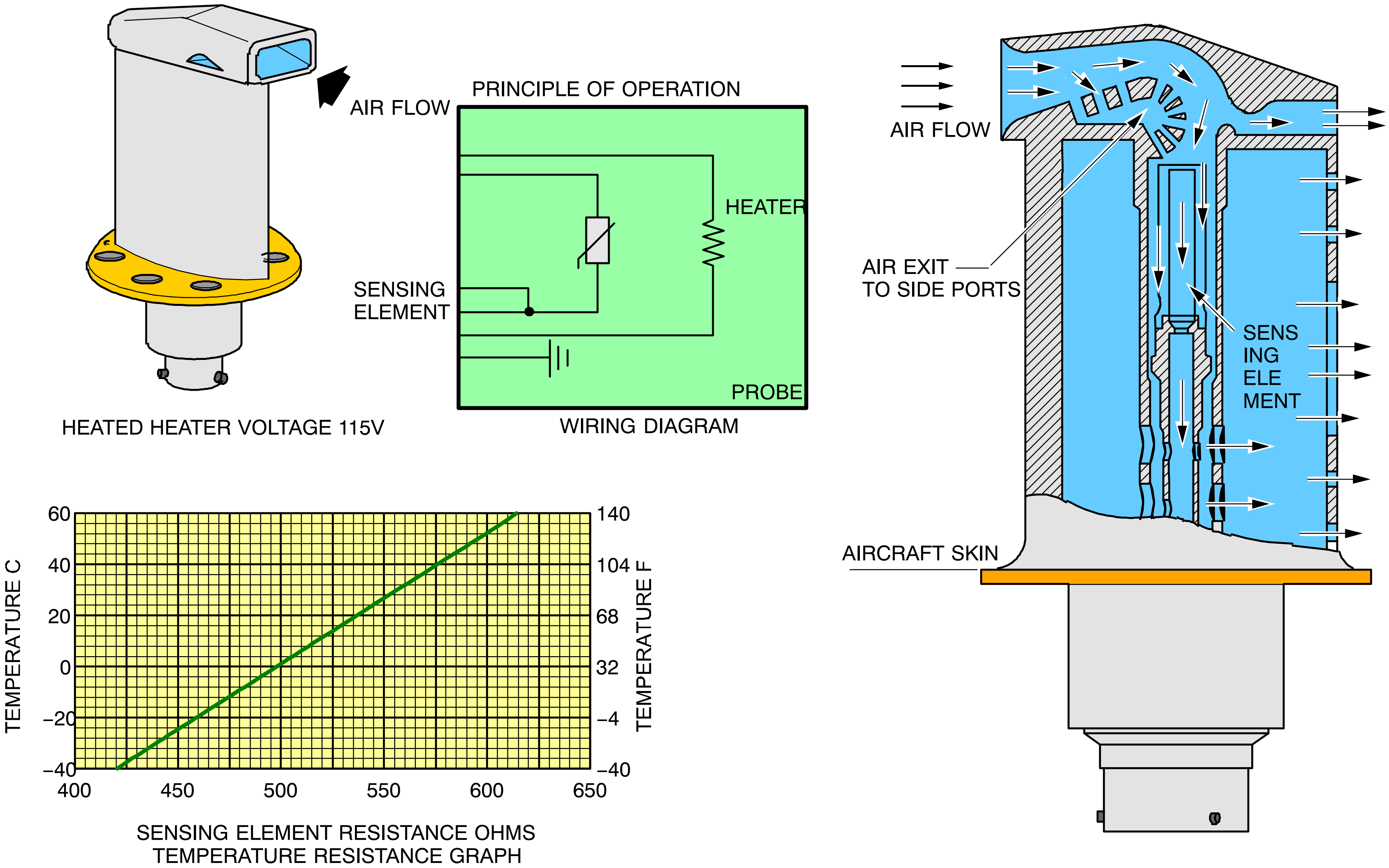


**Figure 7 TAT Sensor**

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## CONTROLS-FUNCTIONAL OPERATION

### Operation

The conditions:

- ENG 1 RUNNING,
- or ENG 2 RUNNING,
- or PROBE/WINDOW HEAT pushbutton switch in ON configuration.

Cause heating of the probes given below:

- static probe,
- AOA sensor,
- pitot probe.
  There are two heating levels for the pitot probe:
  - on the ground: half−wave heating,
  - in flight: full−wave heating,
- TAT sensor in flight.

### Monitoring

The PHC monitors heating of the static probes, AOA sensor, pitot probes and TAT sensor.

Current detection with a preset threshold is provided for monitoring purposes.

Low heating or overcurrent or heating loss or discrepancy between the ground and flight information sent by the LGCIUs triggers a warning.

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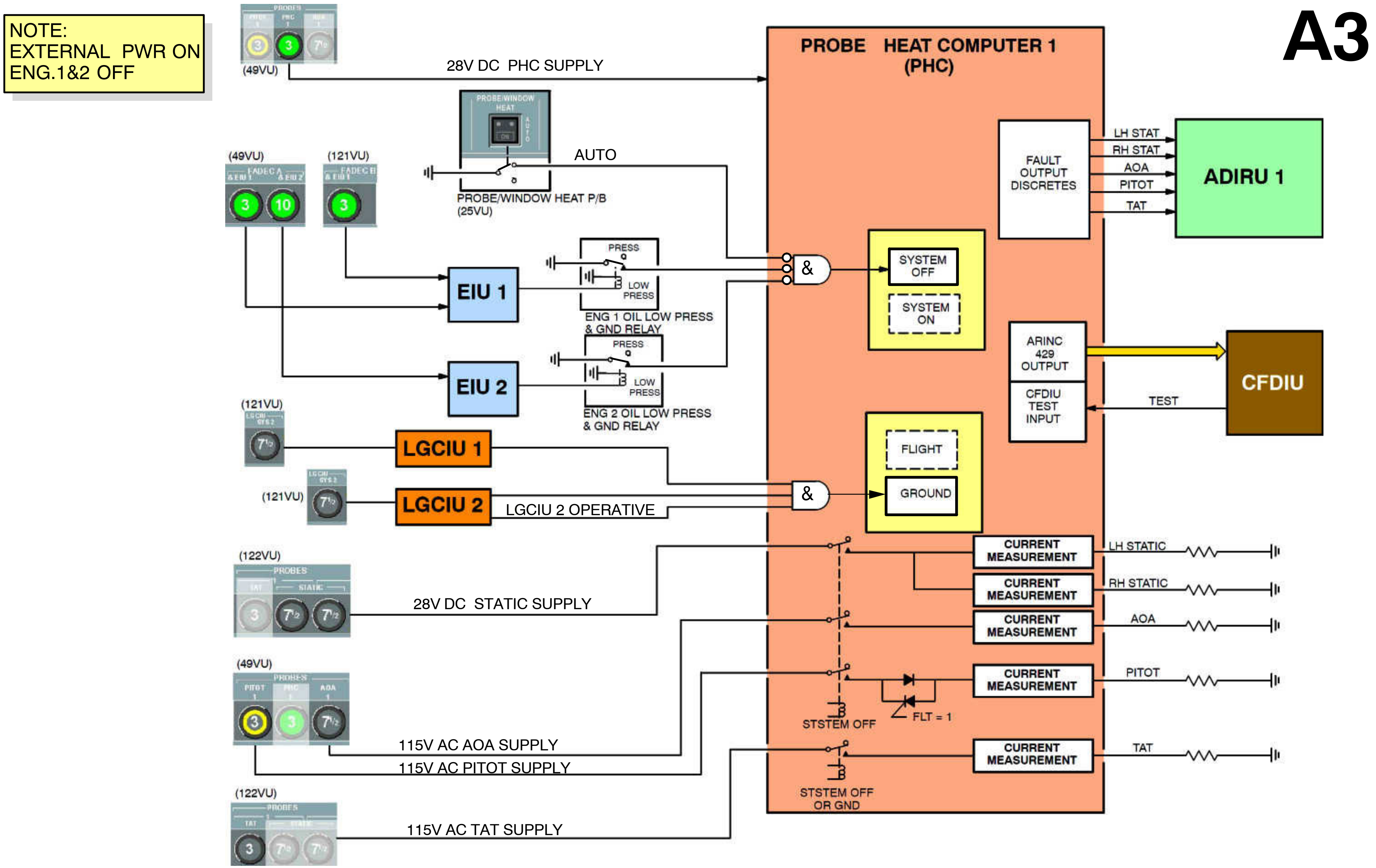


Figure 8 Operation/Control and Indicating

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## SYSTEM OPERATION

### Operation

The conditions:

- ENG 1 RUNNING,
- or ENG 2 RUNNING,
- or PROBE/WINDOW HEAT pushbutton switch in ON configuration.

Cause heating of the probes given below:

- static probe,
- AOA sensor,
- pitot probe.

  There are two heating levels for the pitot probe:
  - on the ground: half−wave heating,
  - in flight: full−wave heating,
- TAT sensor in flight.

### Monitoring

The PHC monitors heating of the static probes, AOA sensor, pitot probes and TAT sensor.

Current detection with a preset threshold is provided for monitoring purposes.

Low heating or overcurrent or heating loss or discrepancy between the ground and flight information sent by the LGCIUs triggers a warning.

Monitoring of the TAT sensors is inhibited on the ground.

A monitoring system activates a warning when heating is incorrect. Warning is triggered as follows:

- For pitot probe,
  - in flight when the current I is lower than 0.9 A or greater than 6 A,
  - on ground when the current I is lower than 0.4 A or greater than 4 A.
- For TAT sensor,
  - When the current I is lower than 0.8 A or greater than 4 A.
- For AOA sensor,
  - When the current I is lower than 0.12 A or greater than 5 A.
- For L and R static probes,
  - when the current is lower than 1.3 A or greater than 4 A.

The PHC serves to:

- identify the faulty element(s),
- memorize the faulty element.

### Indication

The PHC continuously emits signals via the ARINC 429 bus (low speed).

A discrete output (one per probe) informs the ADIRU of associated probe channel of the heating fault.

Then, the ADIRU informs the FWC (**F**light **W**arning **C**omputer).

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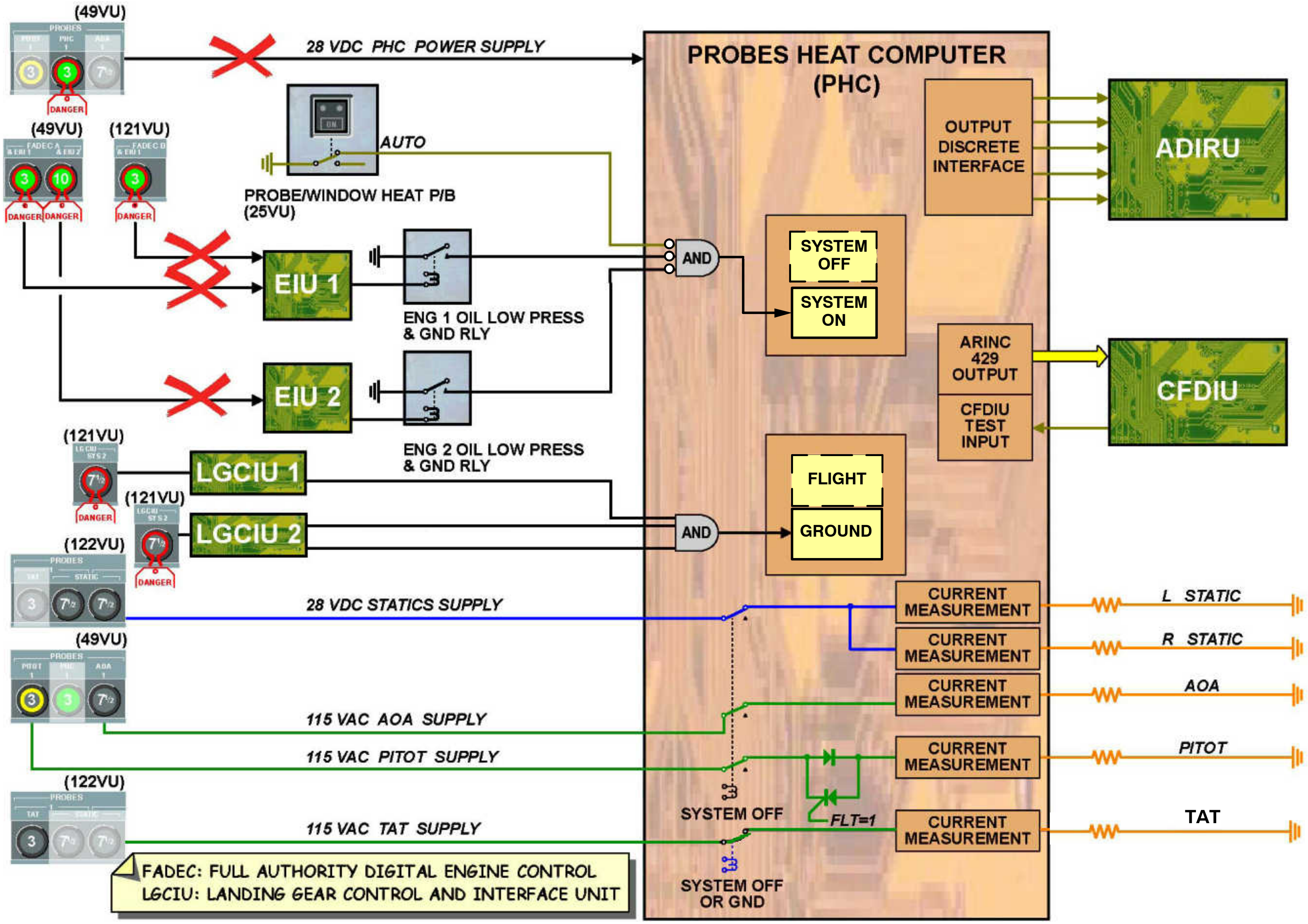


**Figure 9 Operation/Control and Indicating**

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## SYSTEM WARNINGS OPERATION

### SINGLE PROBE FAILURE

If a static port or a probe heating is faulty, an aural warning sounds and the MASTER CAUTION messages come on. The failure is shown amber on the EWD. The same warnings are triggered in case of fault of the following probes and static ports:

- CAPT: L(R) STATic, AOA (**A**ngle−**O**f−**A**ttack) and TAT (**T**otal **A**ir **T**emperature),
- F/O: PITOT, L(R) STAT, AOA and TAT,
- STBY: PITOT, L (R) STAT, AOA.

**NOTE:** The related PHC (**P**robe **H**eat **C**omputer) triggers warnings through its associated ADIRU (**A**ir **D**ata/**I**nertial **R**eference **U**nit).

### PROBE HEAT COMPUTER FAILURE

If a PHC is faulty, an aural warning sounds and the MASTER CAUTION messages come on. The failure is shown amber on the EWD. The same warnings are triggered in case of failure of:

- PHC 2: F/O PROBES,
- PHC 3: STBY PROBES.

### DOUBLE PITOT PROBE FAILURE

If two Pitot probes heating are faulty, an aural warning sounds and the MASTER CAUTION messages come on. The failure is shown amber on the EWD. The same warnings are triggered in case of fault of the following Pitot probes:

- CAPT + F/O PITOT,
- CAPT + STBY PITOT,
- F/O + STBY PITOT.

### ALL PITOT PROBES FAILURE

If all the Pitot probes heating is faulty, an aural warning sounds and the MASTER CAUTION messages come on. The failure is shown amber on the EWD.

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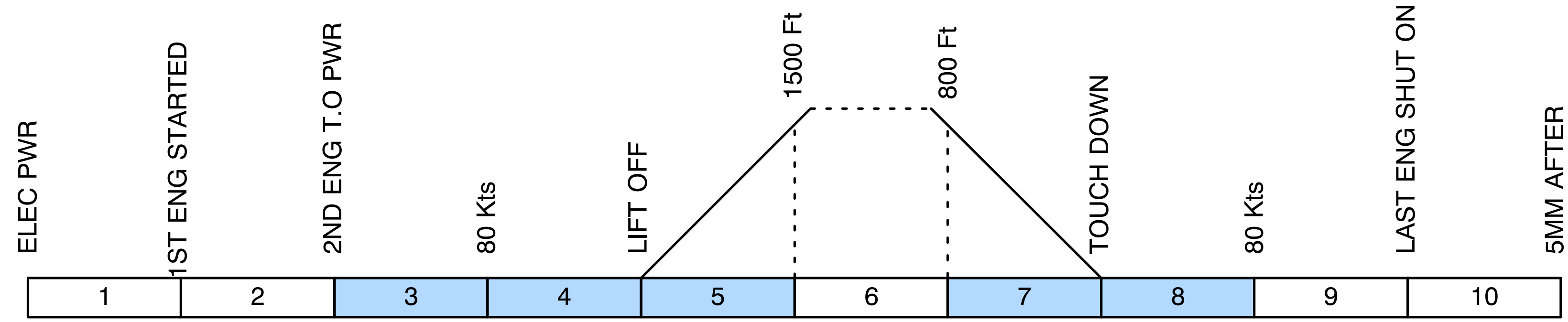


| E/WD FAILURE MESAGE | AURAL WARNING | MASTER LIGHT | SD PAGE CALLED | LOCAL WARNINGS | FLIGHT PHASE INHIBIT |
|---|---|---|---|---|---|
| ANTI ICE CAPT (F/O) PITOT<br>ANTI ICE CAPT (F/O) L (R) STAT<br>ANTI ICE CAPT (F/O) AOA<br>ANTI ICE CAPT (F/O) TAT<br>FAILURE OF THE CORRESPONDING PROBE HEATING | | | | | 3, 4, 5, 7, 8 |
| ANTI ICE STBY PITOT<br>ANTI ICE STBY L (R) STAT<br>ANTI ICE STBY AOA<br>FAILURE OF THE CORRESPONDING PROBE HEATING | | | | | |
| ANTI ICE CAPT (F/O) (STBY) PROBES<br>FAILURE OF PROBE HEAT CHANNEL / COMPUTER | SC | MASTER CAUT | NIL | NIL | |
| ANTI ICE CAPT + F/O PITOT<br>ANTI ICE CAPT + STBY PITOT<br>ANTI ICE F/O + STBY PITOT<br>FAILURE OF THE CORRESPONDING PITOT PROBE HEATING | | | | | 4, 5, 8 |
| ANTI ICE ALL PITOT<br>FAILURE OF CAPT, F/O AND STBY PITOT PROBE HEATING | | | | | |

**Figure 10 Probe Heating ECAM Messages**

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# 30–42 WINDSHIELD ANTI-ICING AND DEFOGGING

## GENERAL DESCRIPTION

The anti–icing and defogging system of the windshield keeps a clear visibility through the windshield and windows in icing or foggy conditions.

This objective is achieved by electrical heating of the windshield and windows.

The system is automatically started at engine start–up.

A pushbutton switch also controls operation of the system (pushbutton switch in ON configuration), when the aircraft is on ground with engines off.

The system is made up of two independent sub–systems, left and right.

Each sub–system controls heating of the windshield and windows located on the same side with respect to the aircraft centerline.

Each sub–system includes:

- one windshield
- two windows:
  - one sliding and one fixed (aft)
- one WHC (**W**indow **H**eat **C**omputer)

In each sub–system, the windshield temperature regulation and the window temperature regulation are independent.


**Figure 11 Cockpit Windows**

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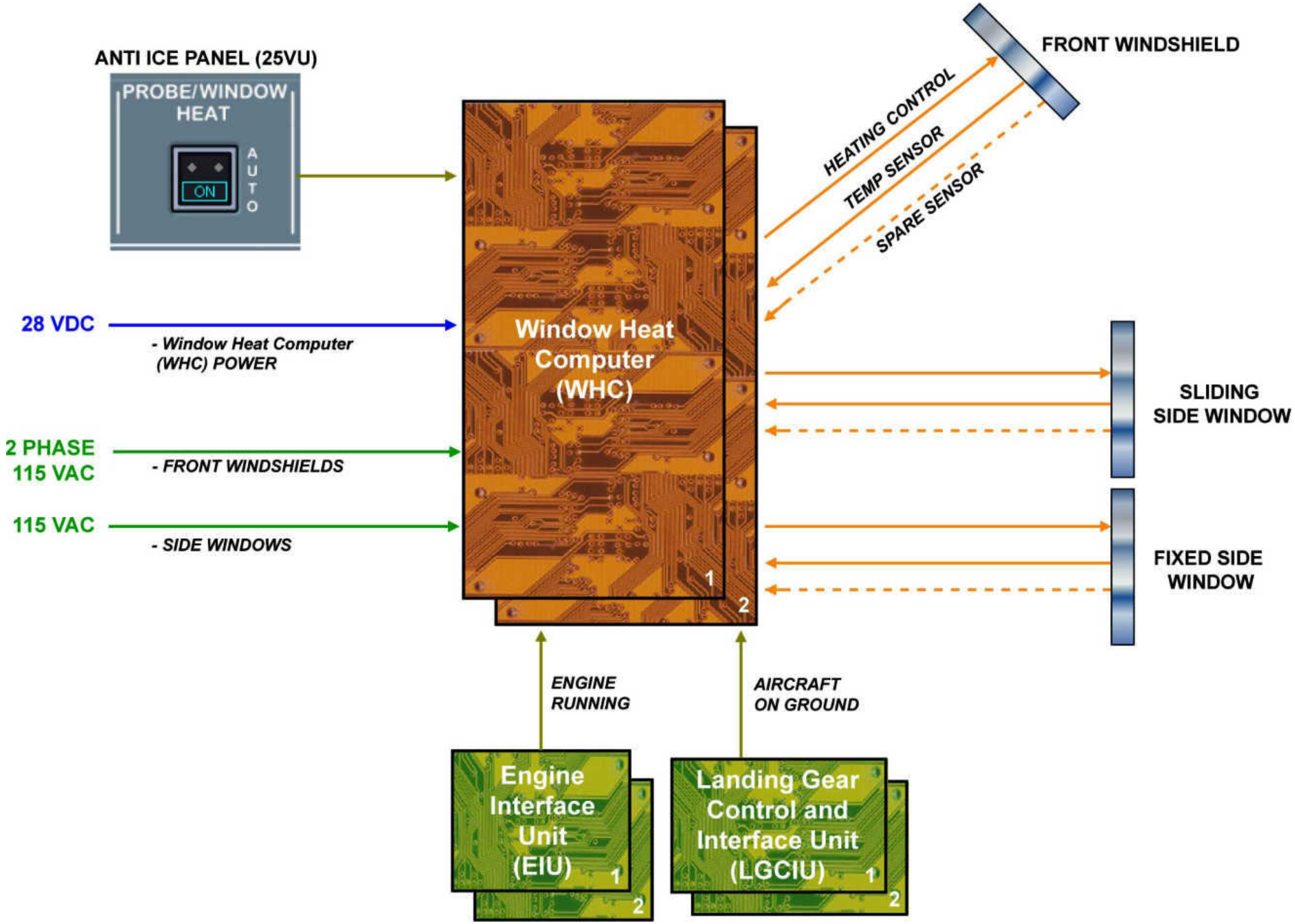


Figure 12 Window Anti-Icing and Defogging Introduction

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## CONTROL AND INDICATION

### Monitoring

The faults of the heating system of each window are shown on the upper ECAM (**E**lectronic **C**entralized **A**ircraft **M**onitoring) display unit.

In case of a window heat failure the WHC automatically stops heating of the affected window.

The WHC serves to:

- identify the faulty component(s)
- store the fault(s) in a memory which is not erased after supply cut−off

### Indicating

Two discrete outputs (one for the windshield, one for the two windows) inform the SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrator) of a heating fault.

The SDAC transmits this information to the FWC (**F**light **W**arning **C**omputer).

### Maintenance Test

The WHC continuously emits failure status via the ARINC 429 bus.

A signal from the CFDIU permits to check the correct operation of the system and of the related safety features.

The ground/flight transition deletes the memory.

The WHC has a Type 2 BITE system.

### Leading Particulars

- A loss of 28 Volt supply is indicated as a failure.
- The WHC includes electromagnetic power contactors.
- The WHC also incorporates protections against overvoltages due to lightning strike and to static electricity on the windows.
- The power outputs are protected against short circuits.
- The test function is inhibited in flight.

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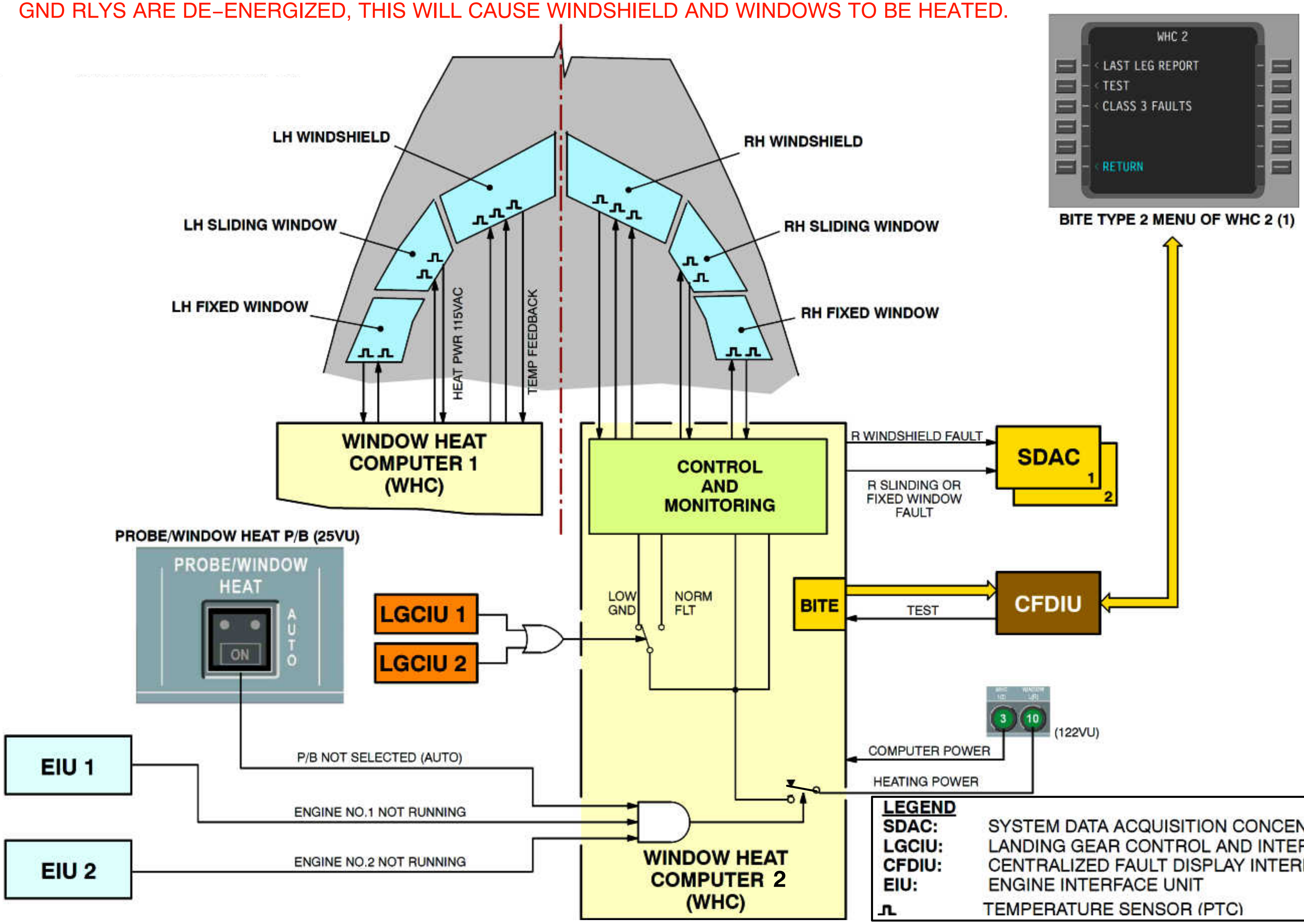
**CAUTION:** IF YOU HAVE TO PULL THE EIU POWER SUPPLY C/BS, THE RELATED ENGINE OIL LOW PRESS AND GND RLYS ARE DE–ENERGIZED, THIS WILL CAUSE WINDSHIELD AND WINDOWS TO BE HEATED.

A3




| LEGEND | |
|---|---|
| SDAC: | SYSTEM DATA ACQUISITION CONCENTRATOR |
| LGCIU: | LANDING GEAR CONTROL AND INTERFACE UNIT |
| CFDIU: | CENTRALIZED FAULT DISPLAY INTERFACE UNIT |
| EIU: | ENGINE INTERFACE UNIT |
| ⎍ | TEMPERATURE SENSOR (PTC) |

**Figure 13 Controls and Indication**

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## WINDSHIELD FUNCTIONAL OPERATION

### General

Two temperature sensors (or optionally three depending on the windshield part number) are installed inside each windshield (one sensor active, the other(s) spare).

Two temperature sensors (one is in spare, which can be used permanently if the first one fails) are installed in each of the fixed and sliding side windows.

The regulation threshold of the WHC is between 35 and 42 deg.C

The temperature is monitored by the in–service sensor.

### Windshield

Two heating power levels are available for the windshield:

- 23 W/dm2 on the ground,
- 70 W/dm2 in flight only (not allowed on the ground).

A 200 VAC/400 Hz line delivers these power outputs on the ground and in flight.

### Sliding-/Fixed Window

One heating power level only is available for the windows: 15 W/dm2 on the ground as well as in flight.

A 115 VAC/400 Hz line delivers this power output.

### Extreme Temperature Detection

Detection of window extreme temperatures or failure of associated temperature sensor causes:

- activation of a warning in the cockpit,
- automatic cut off of the heating of the defective window.

These extreme temperatures are given below:

- +60 deg.C (140 deg.F): corresponds to an overheat or to the sensor in open circuit
- –60 deg.C (–76 deg.F): corresponds to the sensor in short circuit.

**NOTE:** A (lighted) icing indicator is installed on the outer face of the windshield post to indicate the presence of ice.

### Interface

The windshield anti–icing and defogging system is related to the systems given below:

- the EIU (**E**ngine **I**nterface **U**nit) to ensure the heating control,
- the landing gear shock–absorbers to ensure the selection of the heating mode (for the windshield,
- the CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit),
- the SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrator).

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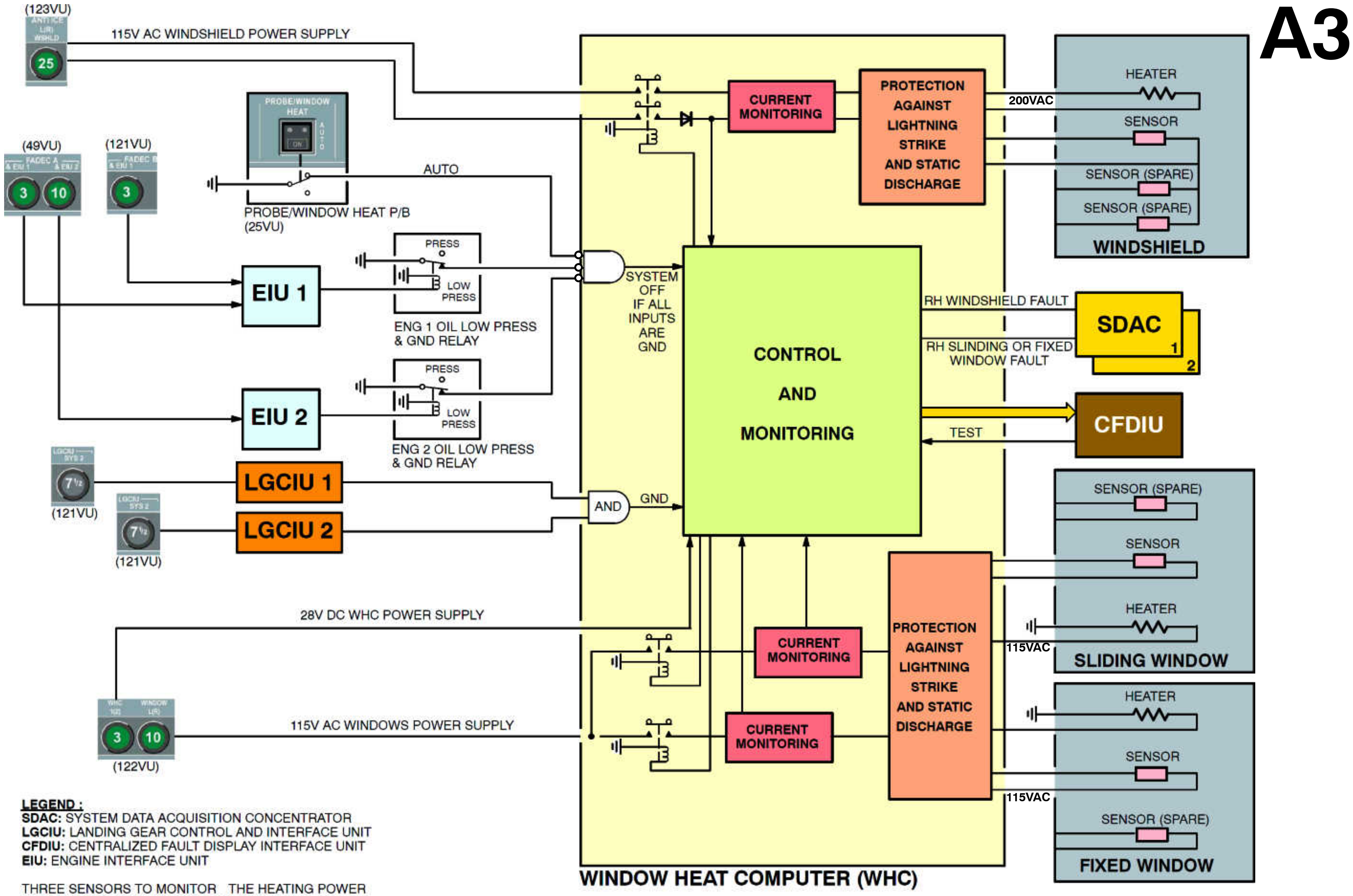


**LEGEND :**
**SDAC:** SYSTEM DATA ACQUISITION CONCENTRATOR
**LGCIU:** LANDING GEAR CONTROL AND INTERFACE UNIT
**CFDIU:** CENTRALIZED FAULT DISPLAY INTERFACE UNIT
**EIU:** ENGINE INTERFACE UNIT

THREE SENSORS TO MONITOR THE HEATING POWER
IS ONLY AN OPTION AND NOT STANDART.

**Figure 14 WHC Detailed System Schematic**

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**WINDOW HEAT COMPUTER (WHC)**

The WHC provides the functions given below:

- temperature regulation,
- monitoring,
- safety.

There are two WHCs:

- one for the right side identified WHC2,
- one for the left side identified WHC1.

The regulation nominal is to between 35 and 42 deg.C (95 and 107.60 deg.F) for each window.

The regulation minimum range which includes tolerances is to between 30 and 38 deg.C (86 and 100.40 deg.F).

The temperature sensor cuts off heating when the temperature is plus or minus 60 deg.C (140 deg.F).

The WHC provides two heating levels for the windshield:

- high level in flight,
- low level on the ground.

Low/high level ratio is 1/3.

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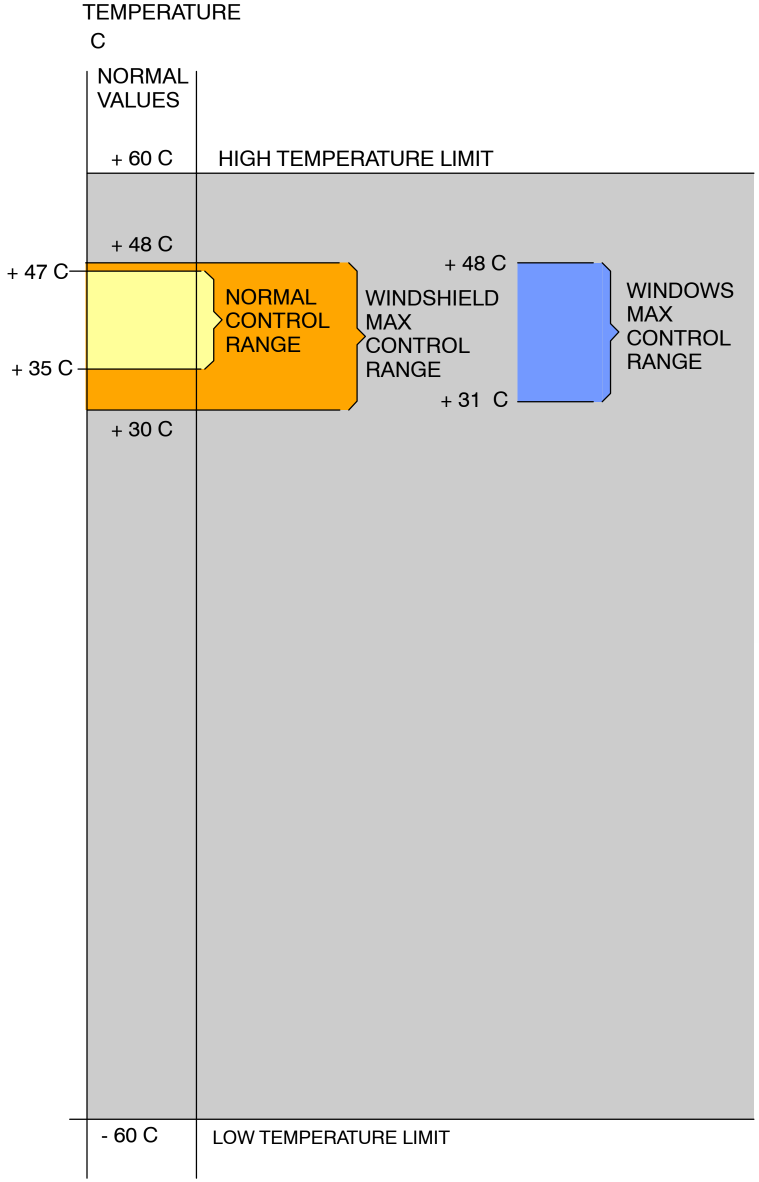


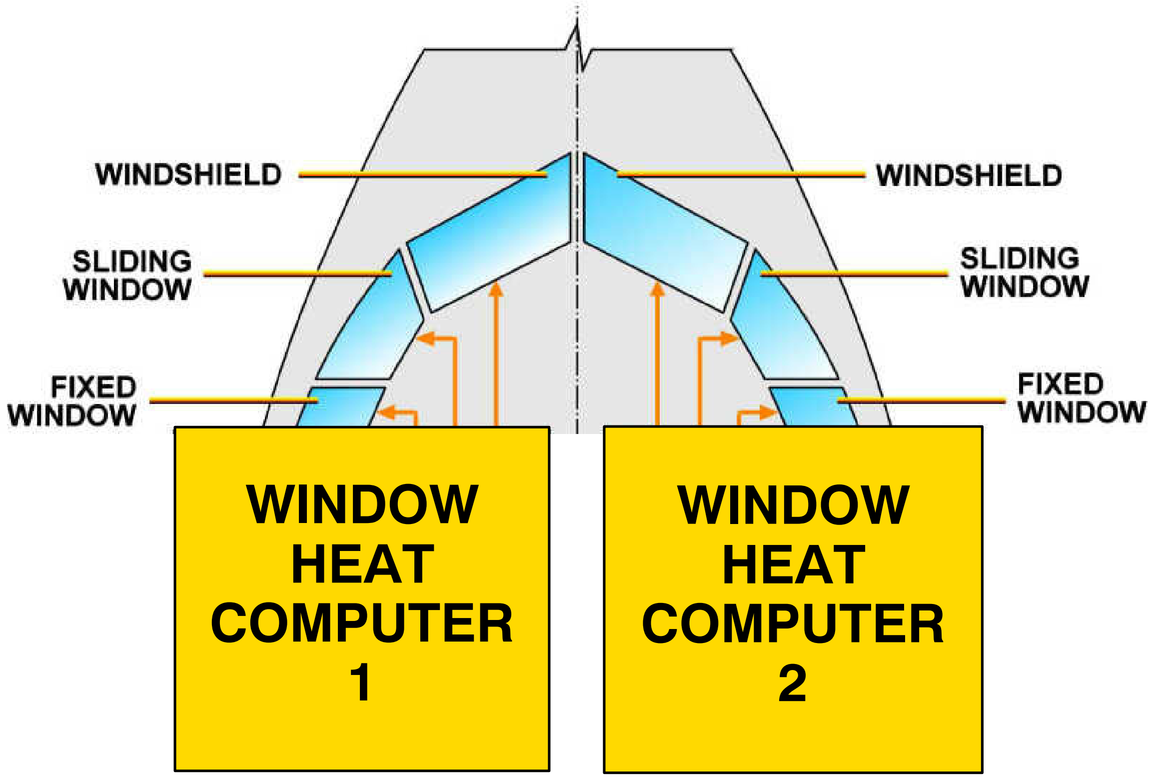


**Figure 15** Window Heat Computer

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## WINDSHIELD/WINDOWS HEATING TROUBLESHOOTING

**L+R WINDSHIELD**

If both windshield heatings are faulty, an aural warning sound, the MASTER CAUTion comes on. The failure is shown amber on the EWD.

**L(R) WINDSHIELD**

If either windshield heating is faulty, an aural warning sounds, the MASTER CAUT comes on. The failure is shown amber on the EWD.

The detection of extreme temperature or failure of the associated sensor causes:

- warning activation,
- automatic cut−off of the windshield heating.

**L(R) WINDOW**

If either the sliding window or the fixed window heating is faulty, the failure is shown amber on the EWD. The detection of extreme temperature or failure of the associated sensor causes:

- warning activation,
- automatic cut−off of the related window heating.

**1(2) WHC**

If there is a lost of one WHC, the failure is not shown on the EWD. In case of an WHC 1 fault the indication is ANTI ICE L WINDSHIELD &
ANTI ICE L WINDOW

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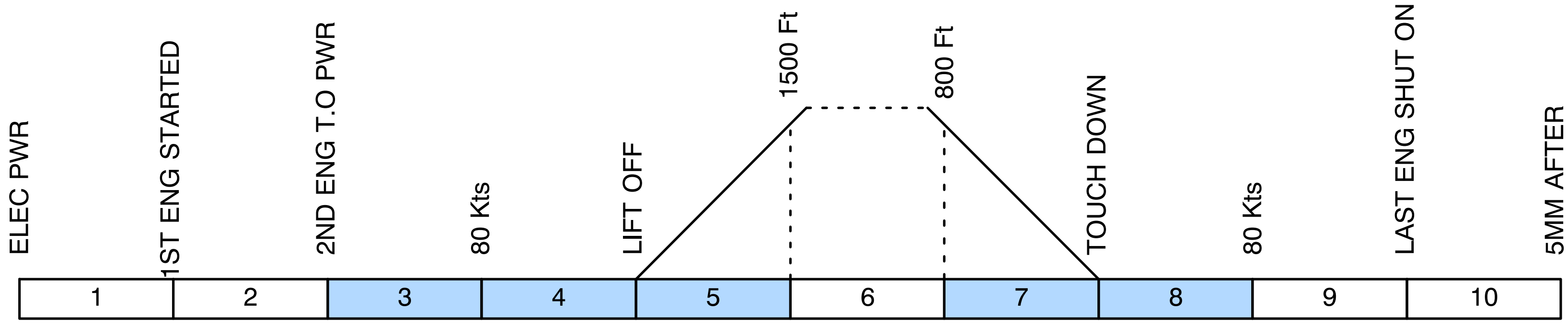


<table>
<tr><th>E/WD FAILURE MESAGE</th><th>AURAL WARNING</th><th>MASTER LIGHT</th><th>SD PAGE CALLED</th><th>LOCAL WARNINGS</th><th>FLIGHT PHASE INHIBIT</th></tr>
<tr><td><u>ANTI ICE</u> L (R) WINDSHIELD<br>FAILURE OF LEFT OR RIGHT WINDSHIELD HEATING</td><td rowspan="2">SC</td><td rowspan="2">MASTER CAUT</td><td rowspan="3">NIL</td><td rowspan="3">NIL</td><td rowspan="3">3, 4, 5, 7, 8</td></tr>
<tr><td><u>ANTI ICE</u> L + R WINDSHIELD<br>FAILURE OF BOTH WINDSHIELD HEATING</td></tr>
<tr><td><u>ANTI ICE</u> L (R) WINDOW<br>FAILURE OF LEFT OR RIGHT SLIDE OR FIXED WINDOW HEATING</td><td>NIL</td><td>NIL</td></tr>
</table>

**NOTE:** THERE IS NO DEDICATED MESSAGE IN CASE OF A WHC FAULT!

**Figure 16 Window Heating ECAM Messages**

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## COMPONENT LOCATION

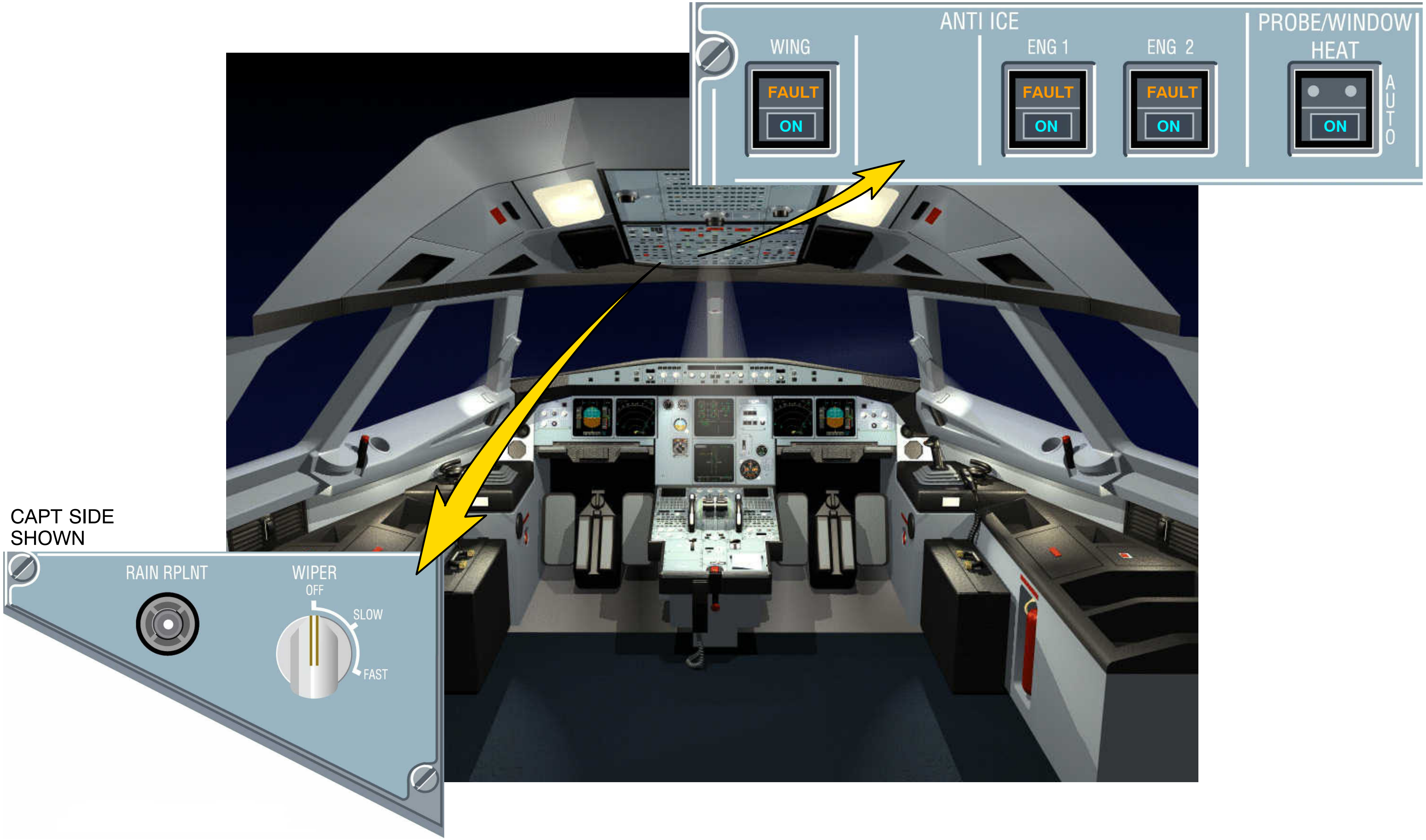


Figure 17 Ice & Rain Protection System Controls

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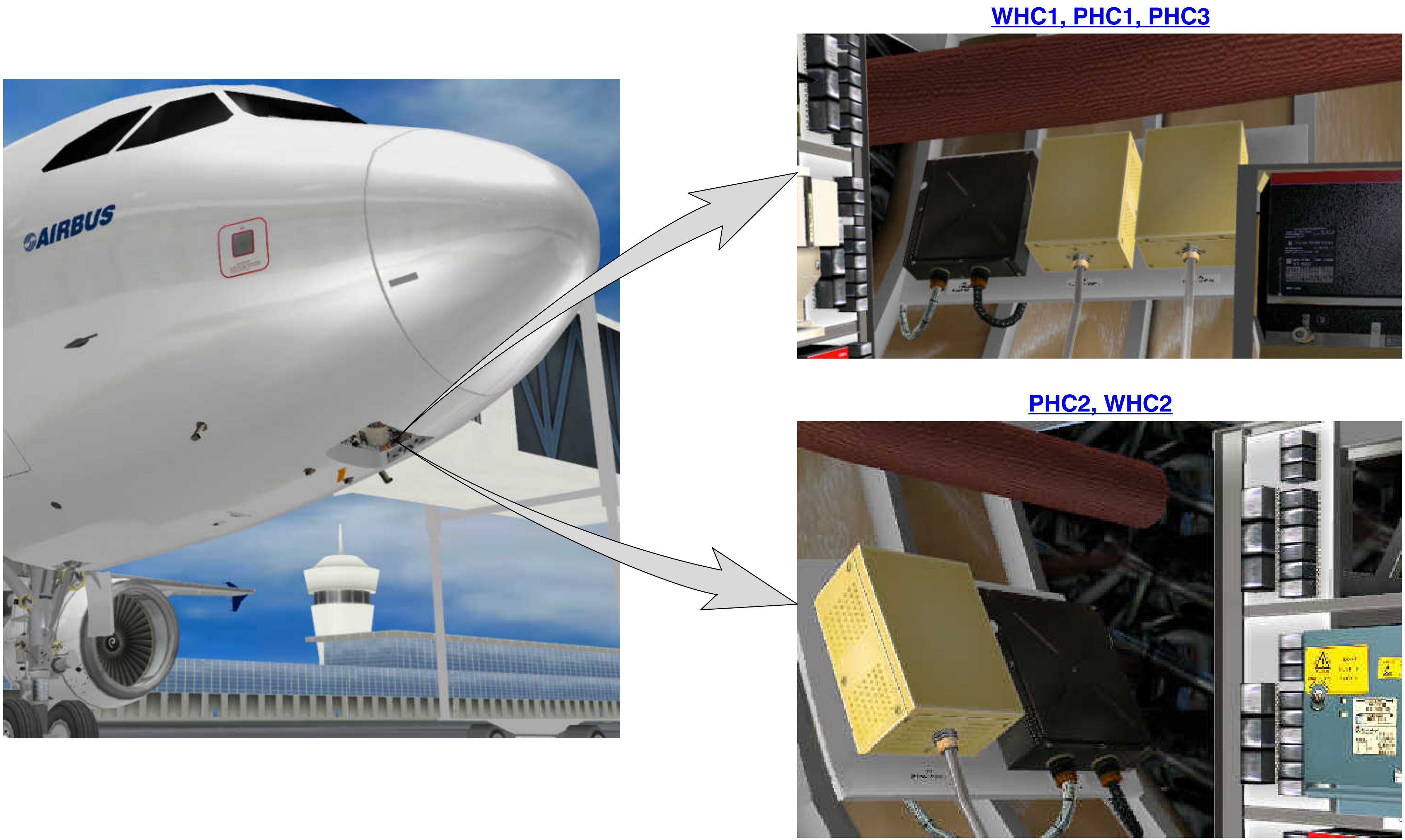


**Figure 18 WHC & PHC Location**

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# 30−45 WINDSHIELD RAIN PROTECTION

## INTRODUCTION

### WIPER SYSTEM PRESENTATION

Rain removal from the windshield is ensured by two independent wipers powered by DC motors. The wiper system is designed to work efficiently up to 200 knots.

Each wiper is controlled by a rotary selector located on the overhead panel. ”SLOW” or ”FAST” speed can be selected. The selector switch can be optionally equipped with an ”INTerMiTtent” position. During intermittent operation, the DC motor is assisted by a timer.

When the selector is set to ”OFF”, the wiper stops in the parking position and is lifted off the aircraft structure, at the bottom part of the windshield.

**Do not operate the wipers on a dry windshield.**

### RAIN REMOVAL

Rain removal from the windshield is done by two independent wipers and by a rain repellent system in heavy rain. The wipers operate independently. The rain repellent is discharged onto the left or right windshield from a pressurized canister installed at the rear of the cockpit.

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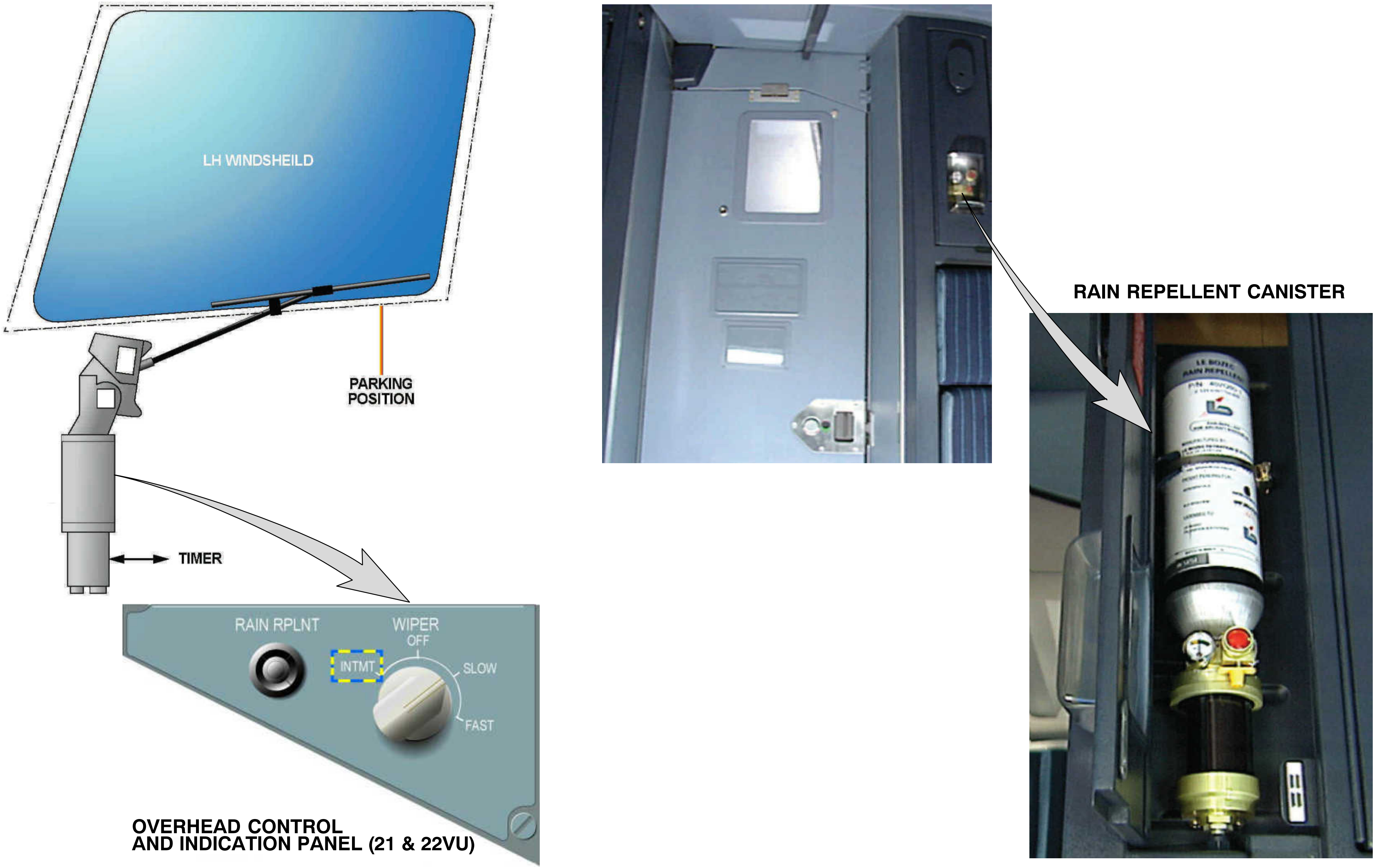


**Figure 19 Wiper and Rain Repellent System**

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## WIPER SYSTEM DESCRIPTION

Two totally independent sub−systems are provided:

- CAPT sub−system (left windshield),
- F/O sub−system (right windshield).

a two−speed electric motor serves to operate each arm/blade assembly.

Each sub−system ensures that clear vision is maintained through the windshield during all rain conditions and during the following flight phases:

- taxi,
- takeoff,
- approach,
- landing.

Control switches located on the overhead panel are provided for each wiper to select the wiper speed:

- slow operation (SLOW position),
- fast operation (FAST position),
- stop (OFF position) in a parking position of the arm/blade assembly.

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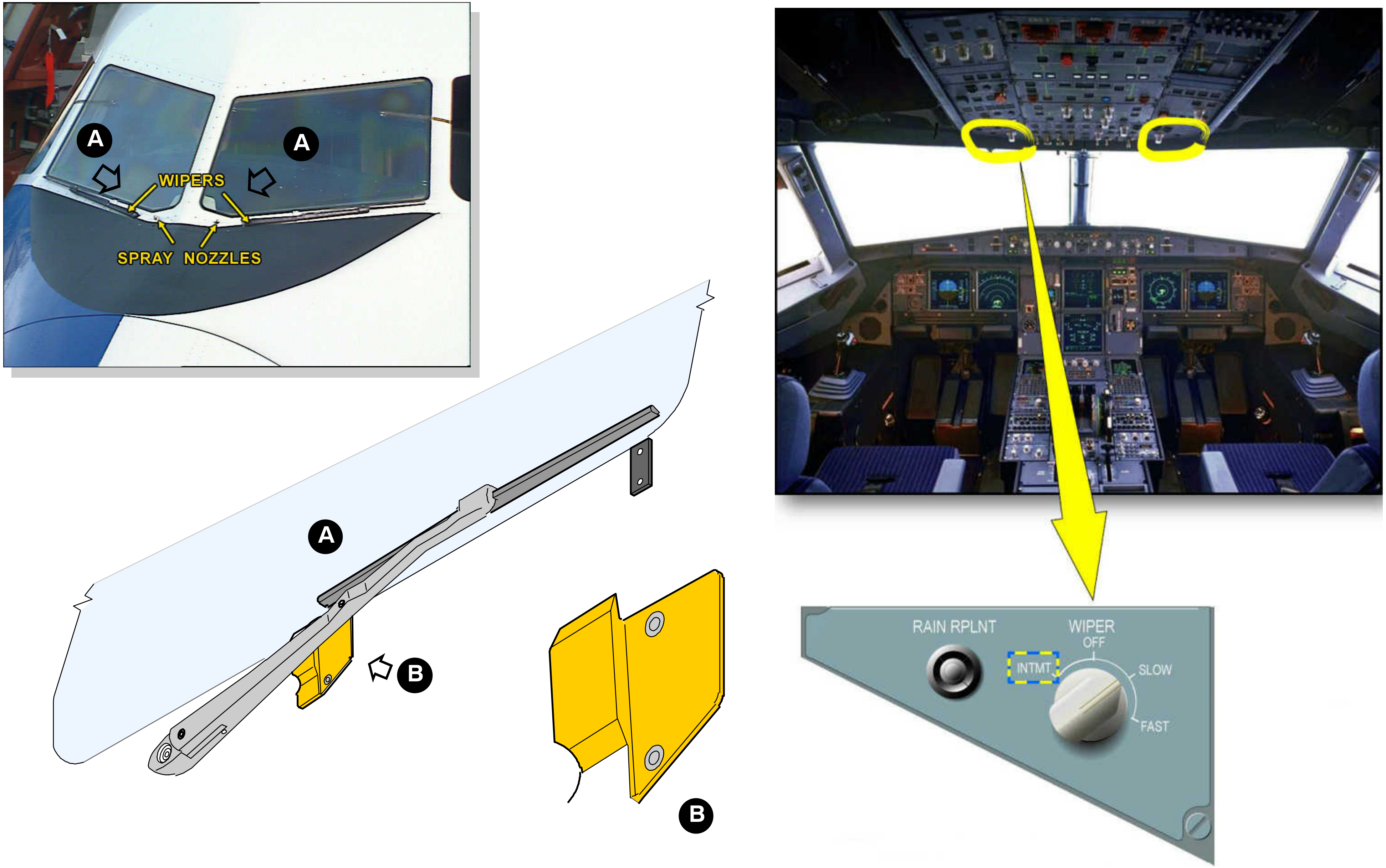


**Figure 20 Wiper System**

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## WIPER SYSTEM-COMPONENT DESCRIPTION

### Motor converter

The motor and converter form a single assembly.

The motor is provided with a thermal protection which protects the mechanical and electrical components of the system.

The motor converter assembly provides the sweeping angles defined on the referenced figure, via the wiper arm/blade assembly.

The motor converter serves to obtain the parking position of the wiper arm when the WIPER control switch is placed in the OFF position.

The converter changes the rotary motion of the motor into an oscillatory motion of the wiper arm (alternate sweeping).

The motor leading particulars are:

- direct current,
- permanent magnet,
- two rotation speeds (slow/fast) for sweeping,
- one slow speed, inverted rotation, for the parking position,

It is possible, even on aircraft, to replace the motor from the assembly without, mechanical damage to the motor/converter junction.

### Capt and F/O wiper arms

Each rigid arm serves to adjust the parking position angle (lower position) to plus or minus 1 deg. by the use of a splined bushing between the converter output shaft and the arm.

The arm/blade junction is rigid enough to maintain the blade/arm angle constant in all the utilization cases.

The pressure of the arm on the windshield is adjustable.

The arm is coated with a dull–black anti–reflective paint.

### Blade

The form of the blade is designed to ensure even sweeping of the windshield in all the utilization conditions; the tolerances of the blade pressure adjustment must be observed.

It is possible to replace the blade without removing the arm.

When the wiper system is in operation, the blade should in no case overlap onto the metal frame of the windshield.3).

### Control Switch

The WIPER control switch located on the overhead panel (panels 21VU and 22VU) incorporates a quick–break device which enables electrical switching in the following positions:

- OFF: parking and stop position,
- SLOW: slow speed,
- FAST: fast speed.

### Parking position and liftoff device

When the wiper system is selected OFF, the arm/blade assembly stops in the parking position; in this position, the arm is lifted off with respect to the aircraft structure, at the windshield lower part (parking position).

The liftoff device avoids any risk of collecting dust, sand or other abrasive particles which could cause windshield damage upon next operation of the wipers.

### Sweeping pressure

The pressure of the wiper arm–blade assembly is adjustable within the range of pressures corresponding to forces between 2 daN (4.4961 lbf) and 5.5 daN (12.3644 lbf); these are applied to the center of the blade perpendicular to the windshield plane.

Within these limits, there is no degradation of the system performance.

In all the utilization conditions (normal or abnormal operation of the wiper system), rupture of one or several parts of this system will not result in damage to the aircraft structure or the engines.

If, due to wiper system failure, the wiper arm stops away from the stop position (impossible to return the arm to the stop position), the flight can continue in all safety without any speed restriction

### Speed

The wiper system operates efficiently without adverse effect on its performance up to corrected speeds, Vc, of 200 kts.

Operation of the wiper system is even possible for speeds between 200 and 250 kts. In such a case, the wiper arm can be placed in the parking position.

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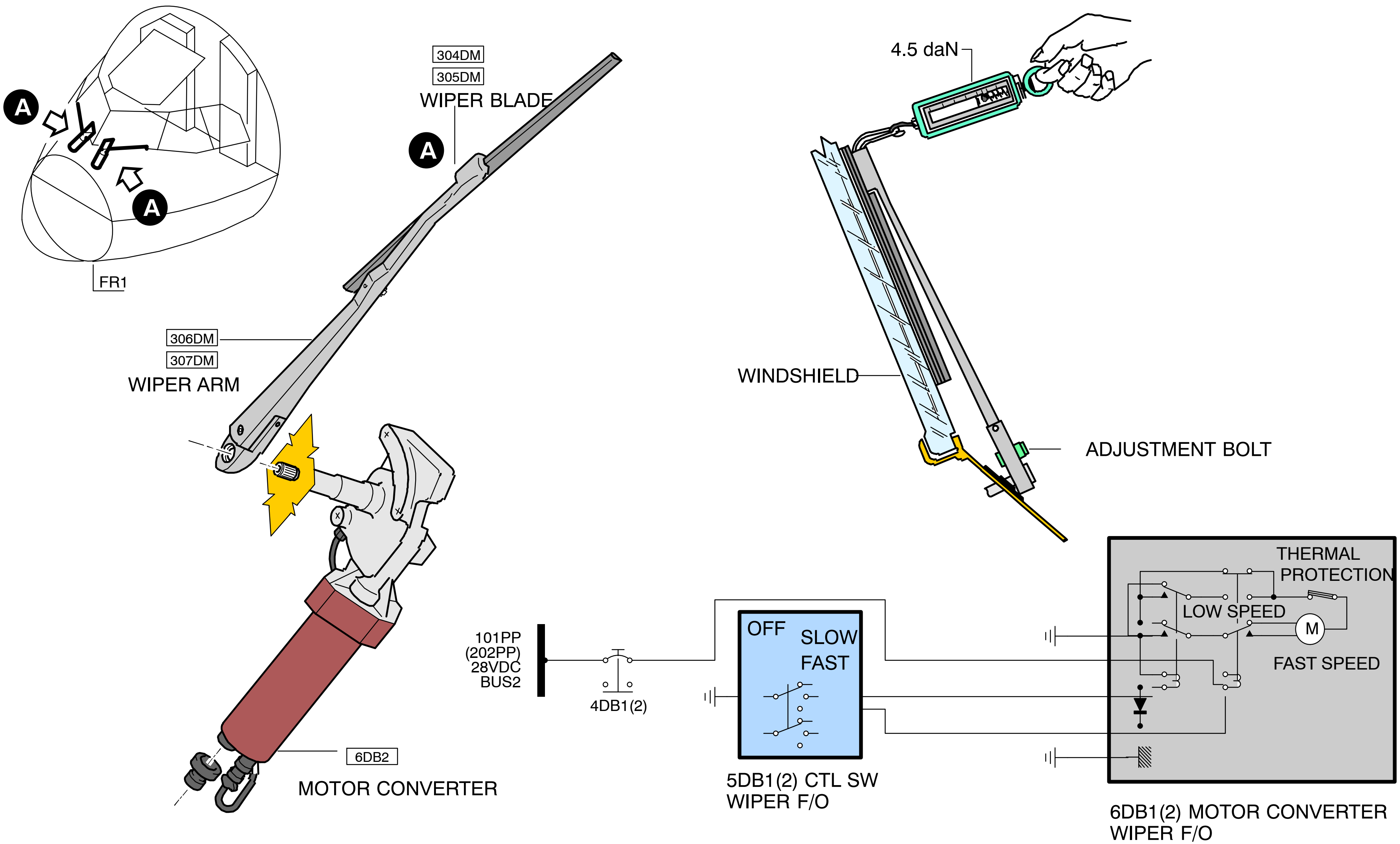


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**Figure 21 Wiper Motor Converter & Adjustment**

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## RAIN REPELLENT GENERAL DESCRIPTION

**Rain Repellent**

The rain repellent fluid used is packaged in a nitrogen pressurized can.

The nitrogen pressurizes the lines of the rain repellent system.

The can is directly fitted to the rain−repellent fluid gage, thus enabling the sealing valve of the can to open.

The components given below are located on the side of the rain−repellent fluid gage:

- a pressure gage indicating the pressure in the system and thereby the remaining fluid,
- a purge pushbutton used to purge the lines when the can is replaced.

Lines release the fluid to each of the two spray systems which operate independently.

A fluid spray system is provided for each windshield.

It incorporates the components given below:

- a solenoid valve (time controlled),
- a control pushbutton switch,
- a spray nozzle.

A CAPT(FO) RAIN RPLNT pushbutton switch, located in the cockpit, serves to control the system.

Upon actuation of the pushbutton switch, the time−controlled solenoid valve of the associated system enables fluid release to the spray nozzles for a limited period.

To initiate a new cycle, it is necessary to release then to push again the control pushbutton switch.

Each solenoid valve is installed as near as possible to its associated spray nozzle to limit:

- the response time of the system,
- loss of fluid between the valve and the nozzle,
- the risks of internal clogging due to the evaporation of the residual fluid.

Each spray nozzle protrudes from the skin panel of the aircraft and incorporates four directional orifices with calibrated diameters.

The two nozzles are arranged symmetrically and are not interchangeable; precise angular positioning is required.

The purge system is provided to eliminate the fluid remaining between the check valve and the nozzle after each application of the fluid. The hot air manifold of the air conditioning system supplies the purge air at a pressure of 4 plus or minus 1 PSID with reference to the cabin pressure.

The assembly comprising the check valves and the rain−repellent blowout reservoir:

- enables air to flow permanently to the spray nozzles when the rain−repellent system does not operate,
- shuts off the air supply lines during spraying of the rain−repellent fluid.

The system is inhibited on the ground (connection to the EIU (**E**ngine **I**nterface **U**nit).

**Ground checks**

Check reading on the pressure gage fitted to the fluid gage assembly.

If the pointer appears in the yellow band identified REPLACE, approximately ten applications of fluid are left in the can before need of can replacement.

When replacing the can, purge the system lines using the purge pushbutton located on the fluid gage assembly

Do not operate the system in dry weather conditions. In the event of inadvertent application on dry surfaces, wash at the earliest opportunity.

Avoid projections of fluid onto the mucous membranes.

**Utilization in flight**

The rain−repellent system is used in heavy rain, more precisely when the wipers are not sufficient at high aircraft speed.

One or two applications of the fluid are generally sufficient for one takeoff or approach and landing sequence; however, the number of applications is unrestricted so as to improve visibility, regardless of the fluid amount used.

**NOTE:** Never spray fluid on a dry windshield. in the event of inadvertent application, do not operate the wipers before the rain wets the windshield.

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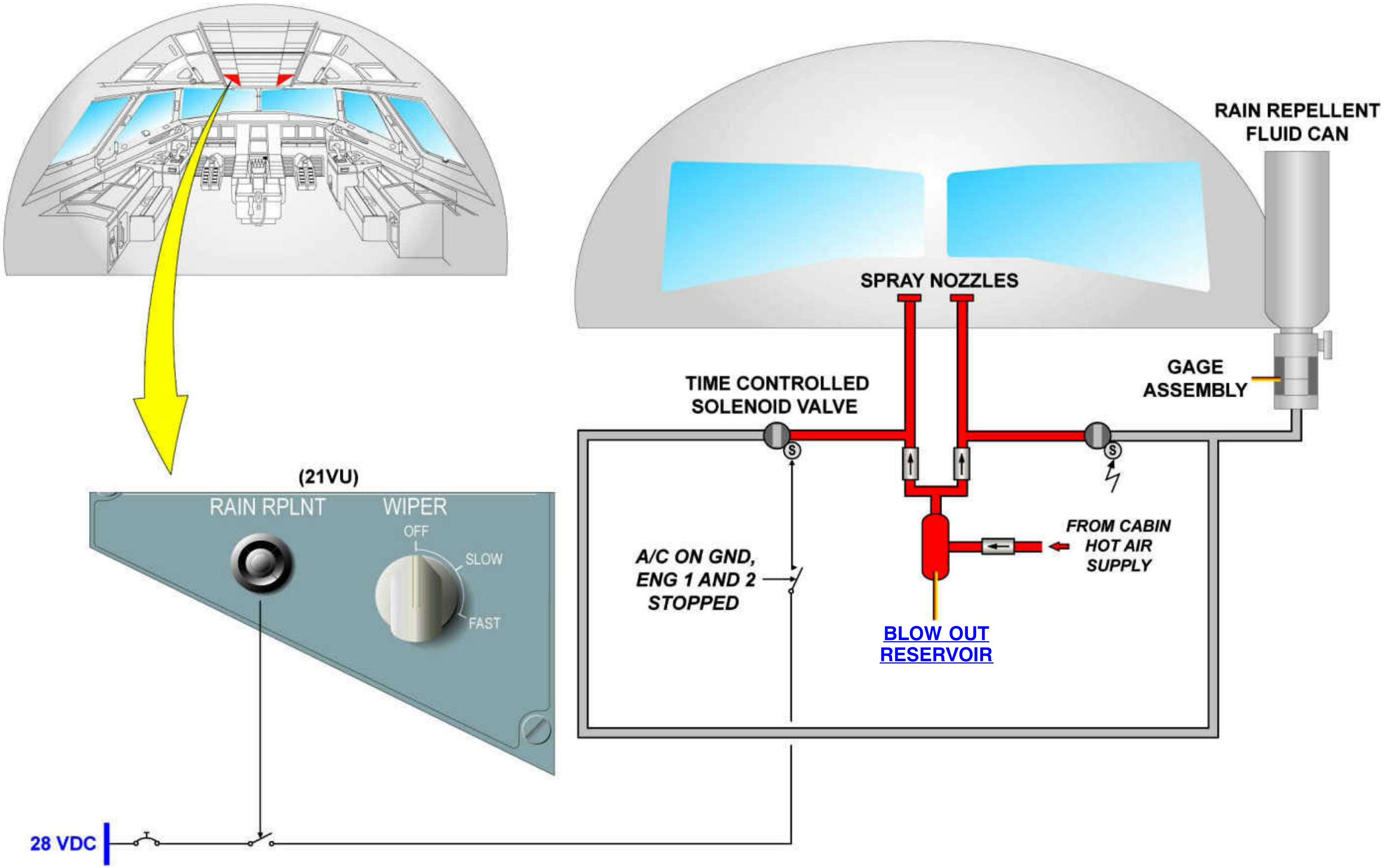


Figure 22 Rain Repellent System

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## RAIN REPELLENT SYSTEM-COMPONENT DESCRIPTION

**Rain repellent fluid can**

The pressurized can is attached to the aft−left wall of the cockpit.

The can contains 475 cubic centimeters of usable rain−repellent fluid.

The system is pressurized with nitrogen; the nitrogen pressure in the can when full is 5.8 +0.7 −0.4 bar (84.1218 +10.1526 −5.8015 psi).

A valve held closed under the load of internal pressure seals the can. A thin pin is provided for displacement of the valve.

**Rain repellent fluid gage assembly**

The gage assembly forms the can receptacle. The can is mounted on the receptacle, valve downwards.

The receptacle includes the pin provided for unseating of the sealing valve of the can.

A pressure gage indicates the pressure in the can and thereby the quantity of fluid in the can:

- green band: the pressure is sufficient,
- yellow band: the pressure is low; the can must be replaced.

The fluid gage incorporates a 80 cubic centimeters transparent chamber from which the fluid level is visible. When the can is completely empty, the remaining nitrogen pressure and the fluid remaining in the gage are still sufficient for several flights before replacement of the can.

A purge pushbutton located on the can serves to purge the lines of the system when the can is replaced

**Solenoid valve**

Upon energization, the valve controls the flow of rain repellent fluid released to the nozzles by means of an incorporated electronic timing device.

The timing device, adjustable between 0.1 and 1.0 second, is set at 0.4 second (Lufthansa).

The solenoid valve is normally closed and is supplied with 28VDC nominal.

**Spray nozzle**

A single nozzle serves to spray the rain repellent fluid on the corresponding windshield.

The nozzle has four orifices of small diameter

**Rain repellent blowout reservoir**

During application of the fluid onto the windshield, the reservoir provides an increase in transient air pressure which serves to purge the lines of the system after each application of the fluid.

It constitutes a decantation reservoir:

- for the rain repellent fluid in the event of possible leakage of valves,
- for water which could remain in the air bled from the air conditioning system and freeze on the nozzle orifices.

The reservoir can serve as a test connector to check for absence of clogging of the nozzles, using an appropriate pressurization tool connected to the test valve of the reservoir.

**Purge check valves**

Each valve is designed to prevent fluid to flow to the rain−repellent blowout reservoir and to the air conditioning system.

**Test check valve**

Each valve is designed to prevent fluid to flow to the rain−repellent blowout reservoir and to prevent fluid to flow to the air conditioning system.

The check valve is mainly provided to isolate the system located upstream (towards the air conditioning system) when the check of the nozzles is performed using a special pressurization tool which is connected to the rain−repellent blowout reservoir.

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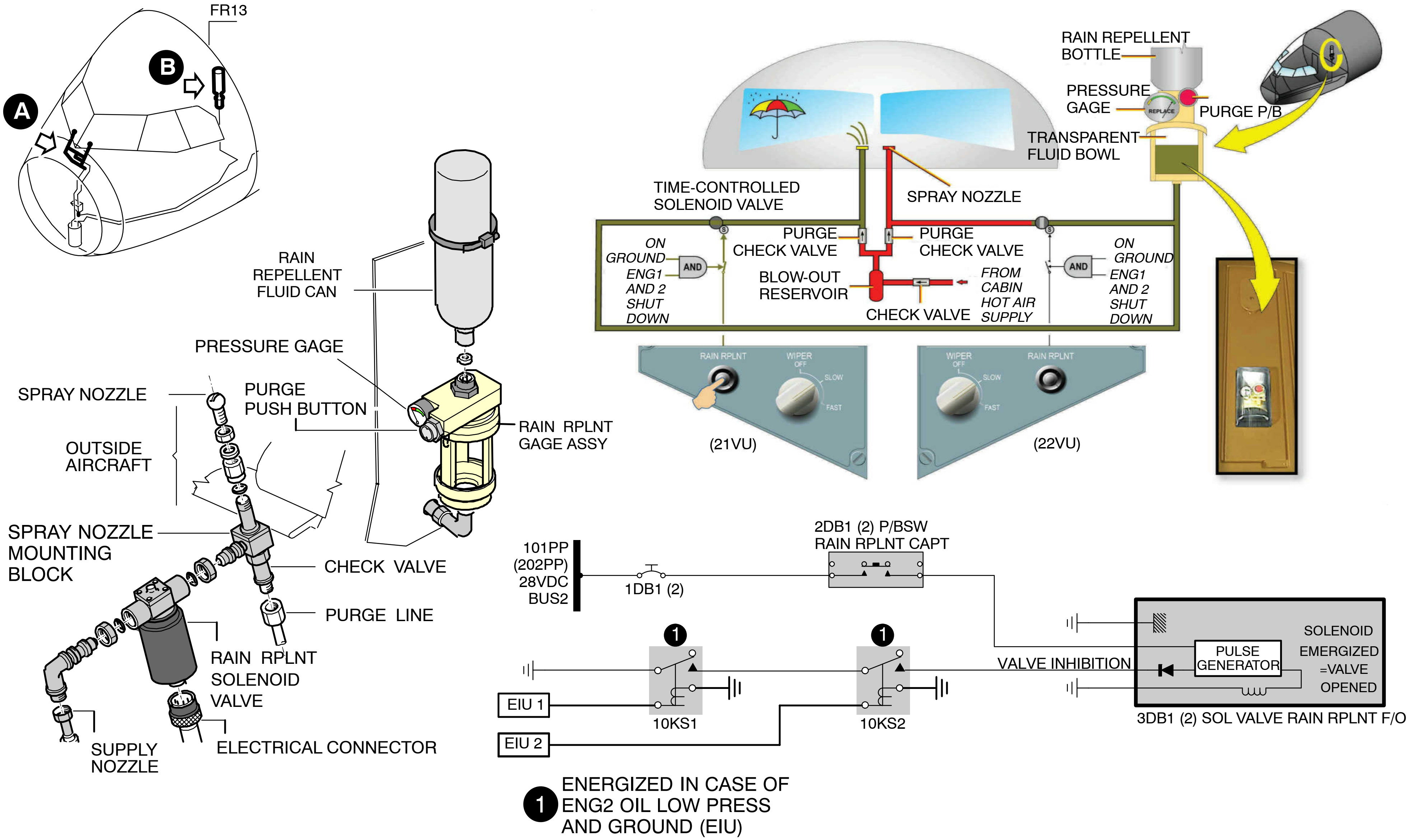


**Figure 23 Rain Repellent Components**

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# 30–81 ICE DETECTION

## GENERAL DESCRIPTION

### VISUAL ICE INDICATOR

A visual ice indicator is installed in the central retainer of the windshield.

It can be illuminated to check for icing conditions at night or in dark conditions.

The ice indicator has a titanium part with openings, a transparent cover and a LED (**L**ight **E**mitting **D**iode).

The indicator light LED is supplied with 28 VDC and controlled by the ICE INDicator & STandBY COMPASS switch.

### ELECTRONIC ICE DETECTION SYSTEM (OPTIONAL)

The ice detection system has two separate ice detector probes on the forward lower section of the fuselage.

The probes detect ice build–up. They also indicate, through the MEMO display, that icing conditions have disappeared.

The system logic generates ECAM messages according to ice detector signals and the flight crews selection of engine or wing anti–icing systems.

It also indicates the end of the icing conditions.

This system is inhibited on ground.

The ice detection system does not control the ENG or WING anti–icing systems.

The purpose of the advisory ice detection system is to enable:

- better detection of icing conditions,
- cutting off of the anti ice system when the latter is no longer necessary (fuel saving).

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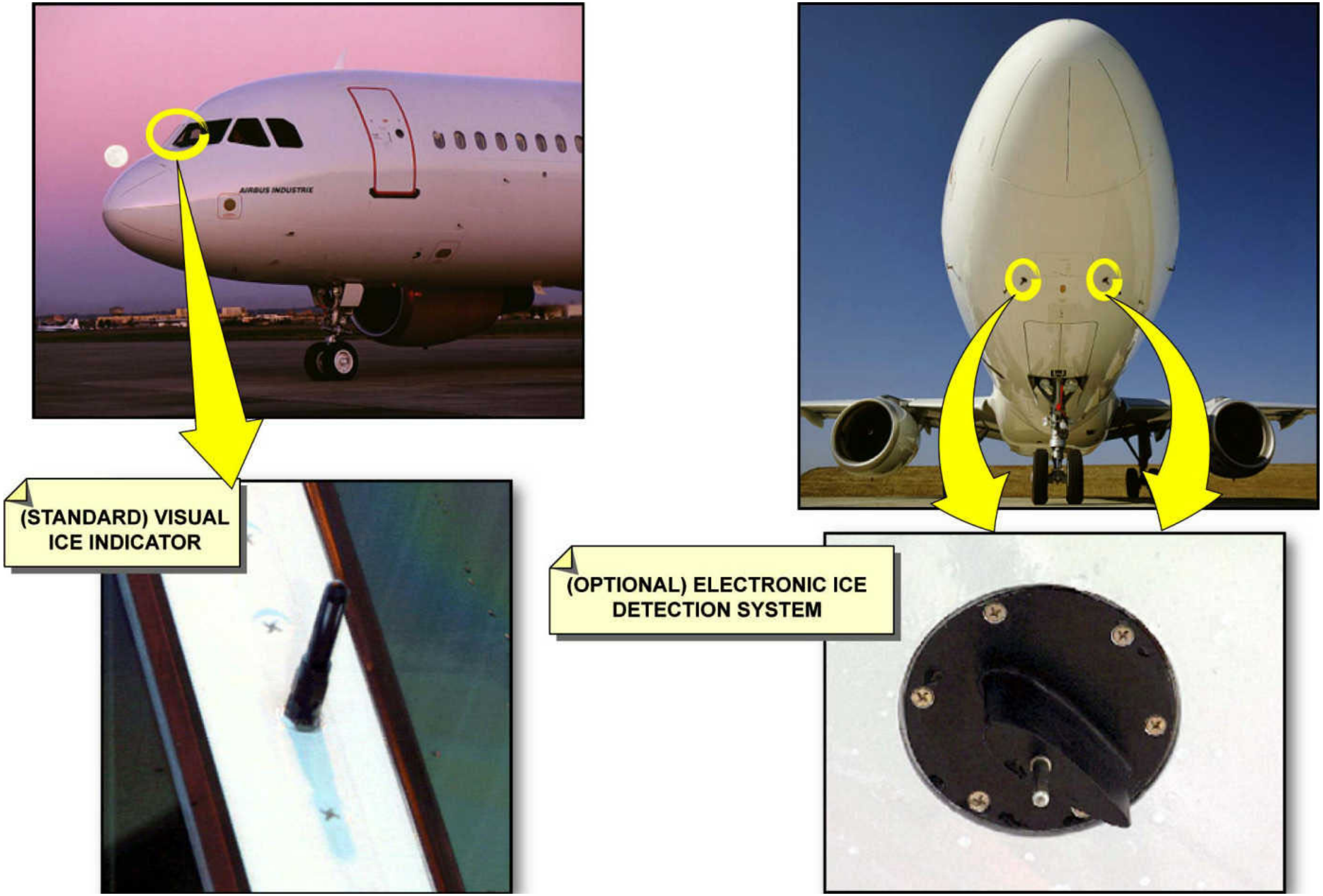


**Figure 24 Ice Detectors**

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## SYSTEM PRESENTATION

### GENERAL

#### System Description

A lighted icing indicator is installed in lieu of one windshield center panel retainer bolt. It is visible by both pilots. Its illumination is controlled by a switch (INT LT/ICE IND & STBY COMPASS) located on the panel 25VU.

The indicator body and the end of the indicator is made of titanium.

The end of the indicator is made of titanium, with openings for lighting.

The ice detection system comprises:

- one ICE IND & STBY COMPASS switch located on the INT LT section of the panel 25VU,
- a lighted icing indicator located on the center panel retainer between the two windshield panels.

The icing indicator Lighting is supplied with 28 VDC.

**NOTE:** The integration of a light source in the ice detector is optional.

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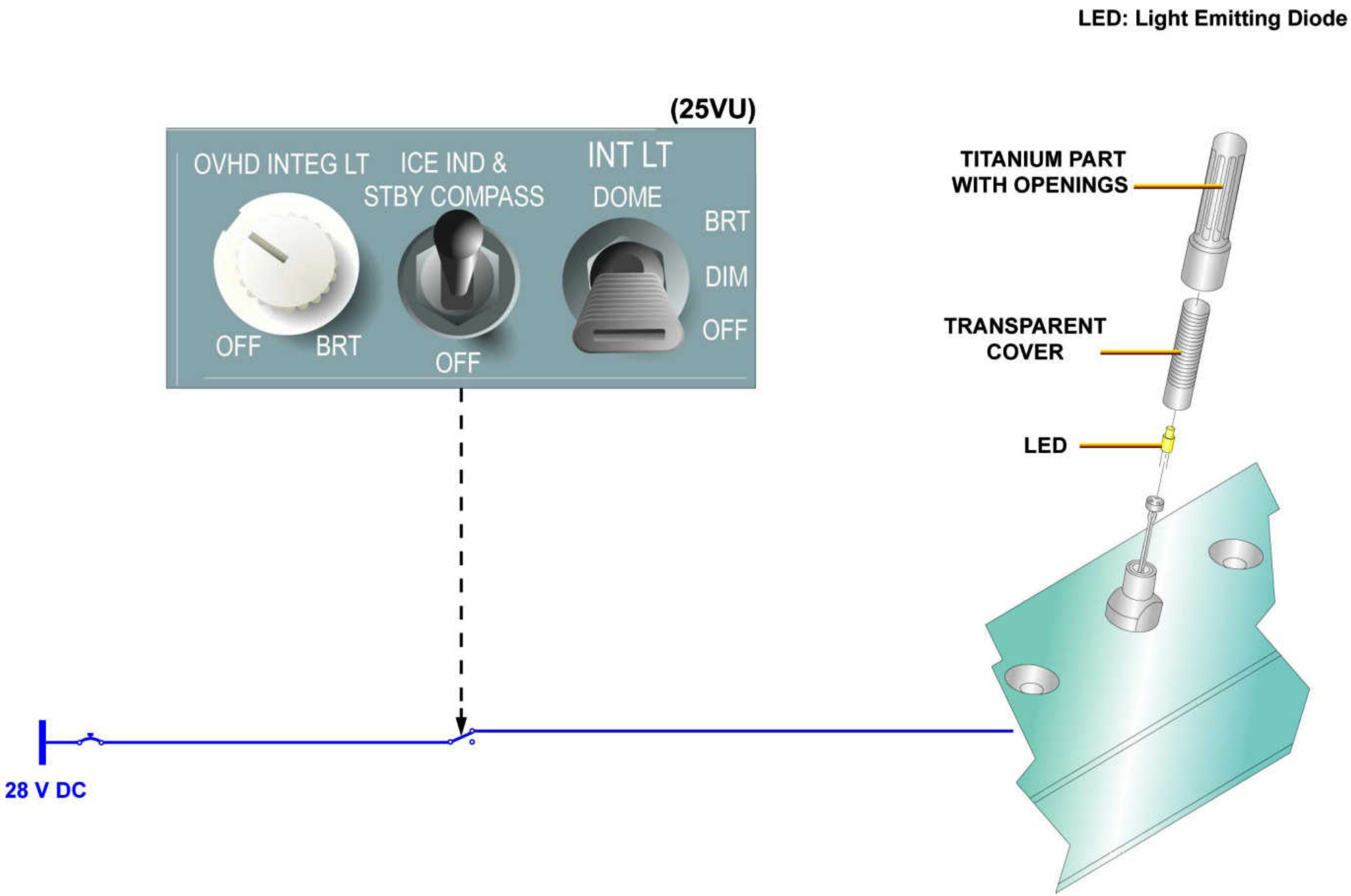


**Figure 25 Visual Ice Detector**

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## ELECTRICAL ICE DETECTOR (OPTION) SYSTEM DESCRIPTION

### FUNCTION

The purpose of the dual advisory ice detection system is to supply:

- a better detection of icing conditions,
- fuel saving by cutting off the hot air bleed for the anti-ice systems when the latter are no longer necessary.

The dual advisory ice detection system is made of two ice detectors installed on the aircraft skin and directly connected to the FWC (**F**light **W**arning **C**omputer) to send warning messages to the crew on the EWD.

### DETECTION

Two levels of detection are given:

- "ICE DETECTED" corresponding to an elementary detection,
- "SEVERE ICE DETECTED" corresponding to 7 successive elementary detections.

The ice detection system is operating at electrical power-up. It sends warning messages when the aircraft is in flight, depending on the altitude and when TAT (**T**otal **A**ir **T**emperature) is below 8C (46.4F), even with one ice detector faulty.

### MESSAGES

The ice detectors generate three different discrete signals:

- "ICE DETECTED" signal when engine air intake anti-ice is necessary,
- "SEVERE ICE DETECTED" signal when wing anti-ice is necessary,
- "ICE DETECT FAULT" signal when the two ice detectors are faulty.

### MONITORING

Each ice detector is installed with a BITE function for continuous monitoring. The "FAULT" signals are also sent to the SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrator) and to the CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit).

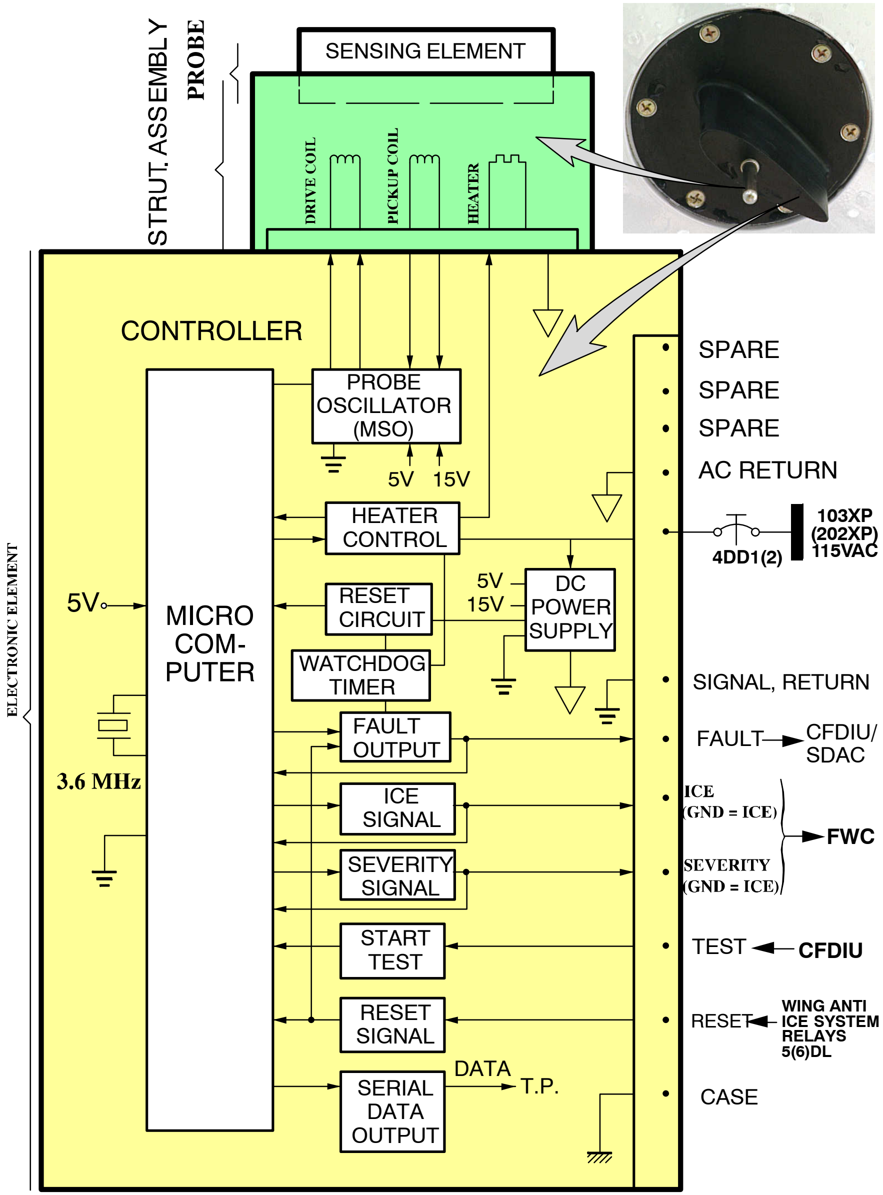


Figure 26 Electronic Ice Detector Internal Circuits

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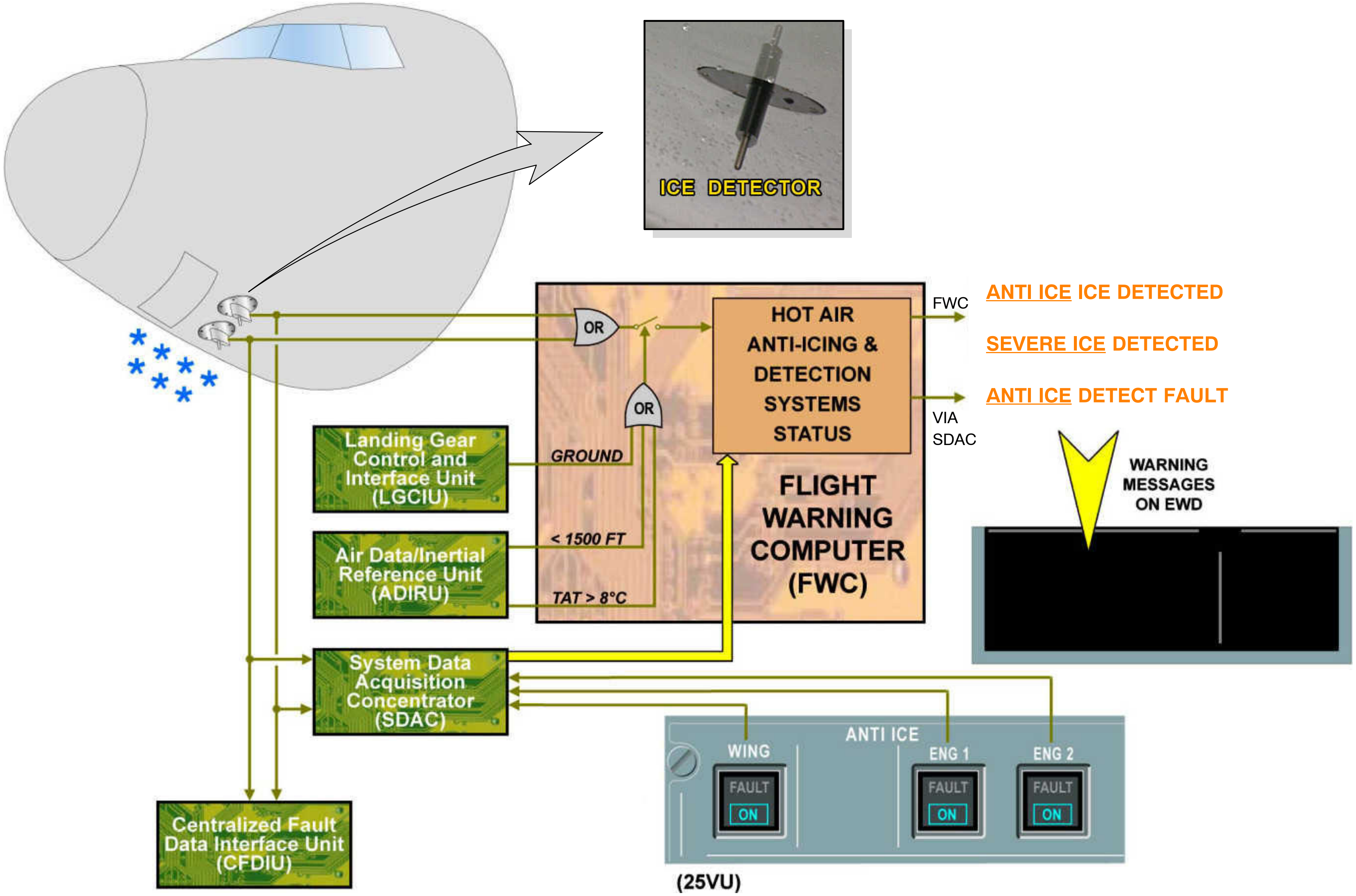


**Figure 27 Electronic Ice Detection**

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## ICE DETECTION SYSTEM CAUTION MESSAGES SYSTEM OPERATION

### ICE DETECTOR INDICATING

Each ice detector generates three signals:

- ICE DETECTED

The ice detector sends the ICE signal when a thickness of 0.5 mm of ice is accreted on its sensing element. This signal is maintained for 60 seconds. If new ice detections occur within 60 seconds, the ICE signal is maintained for 60 seconds after the last detection.

If ice is detected by at least one ice detector and the engine anti ice P/B switches are off, an aural warning sounds, the master caution light comes on and the failure is shown amber on the E/WD (**E**ngine / **W**arning **D**isplay).

### SEVERE ICE DETECTED

The ice detector generates the SEVERITY signal when a number of 7 elementary ice detections is reached.

The threshold for the SEVERITY signal corresponds to approximately 5 mm of ice accreted on the most critical protected surface of the wings (wing tips).

The SEVERITY signal is reset and its processing is inhibited as long as the ice detectors receive an input indicating that the wing anti ice is supplied from the aircraft.

If severe ice is detected by at least one ice detector and the wing anti ice P/B is off, an aural warning sounds, the master caution light comes on and the failure is shown amber on the E/WD.

### ICE DETECT FAULT

The ice detector has an internal monitoring to get an appropriate failure rate. A FAULT signal is sent when a fault is detected. In this case, the ICE and SEVERITY signals are inhibited.

If both ice detectors are faulty, an aural warning sounds, the master caution light comes on and the failure is shown amber on the E/WD.

The ENG A.ICE and/or WING A.ICE is/are pulsing on the memo part of the E/WD if no ice is detected for more than 130 seconds.

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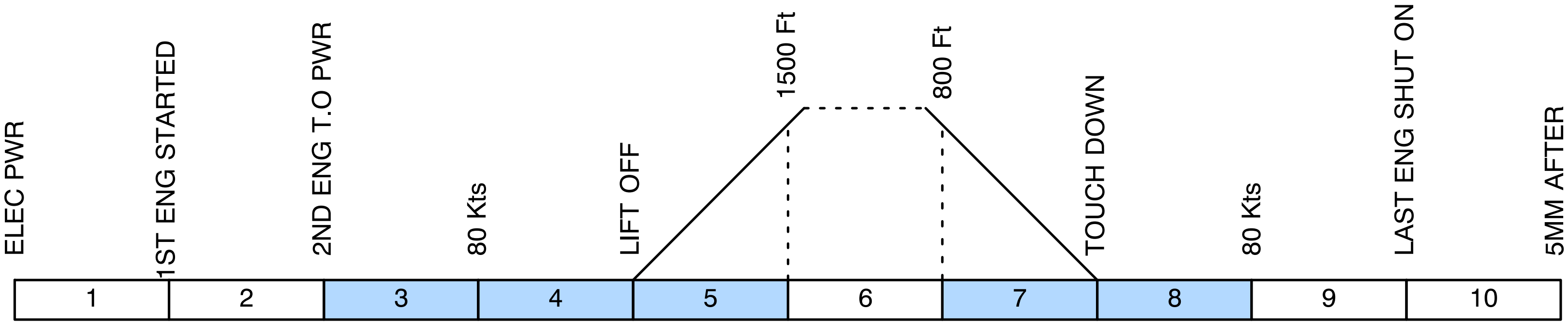


| E/WD FAILURE MESAGE | AURAL WARNING | MASTER LIGHT | SD PAGE CALLED | LOCAL WARNINGS | FLIGHT PHASE INHIBIT |
|---|---|---|---|---|---|
| **ANTI ICE ICE DETECTED**<br>IN FLIGHT > 1500FT AND TAT < 8°C, ICE DETECTED BY AT LEAST ONE DETECTOR AND ENG ANTI ICE P/BSW OFF | | | | | |
| **SEVERE ICE DETECTED**<br>IN FLIGHT > 1500FT AND TAT < 8°C, HEAVY ICE DETECTED BY AT LEAST ONE DETECTOR AND WING ANTI ICE P/BSW OFF | SC | MASTER CAUT | NIL | NIL | 3, 4, 5, 7, 8 |
| **ANTI ICE DETECT FAULT**<br>ICE DETECTOR 1 AND 2 FAULT | | | | | |

**NOTE:** THERE IS NO DEDICATED MESSAGE IN CASE OF A WHC FAULT!

**Figure 28 Ice Detetcion ECAM Messages**

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**System BITE**

All 3 PHCs, both WHCs and the ice detectors (if installed) are connected directly to the CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit).

Each system menu is available through the MCDU.

**BITE Types**

The System BITEs of the Ice Protection system are as follows:

- Type 2
  - Probe Heat Computer
  - Window Heat Computer
- Type 3
  - Electronic Ice Detector (if installed)

**PHC BITE**

The PHC performs a test initiated either by power up or by the CFDS.

The purpose of the test is to check:

- Internal circuits:
  - CPU RAM,
  - EPROM,
  - acquisition of discrete inputs,
  - discrete outputs (ADIRS must be on),
  - power outputs for CFDS test only.
- External circuits:
  - integrity of probe heaters (CFDS test only).

**WHC BITE**

A signal from the CFDIU permits to check the correct operation of the system and of the related safety features.

The ground/flight transition deletes the memory.

**Electrical Ice Detector BITE**

The ice detector incorporates a built−in test feature with remote Initiated Test capability and provides a discrete output signal for remote display of an ice detector failure. In addition to the Initiated Test, the built−in test continuously monitors the internal components and functions for failure conditions during normal operation.

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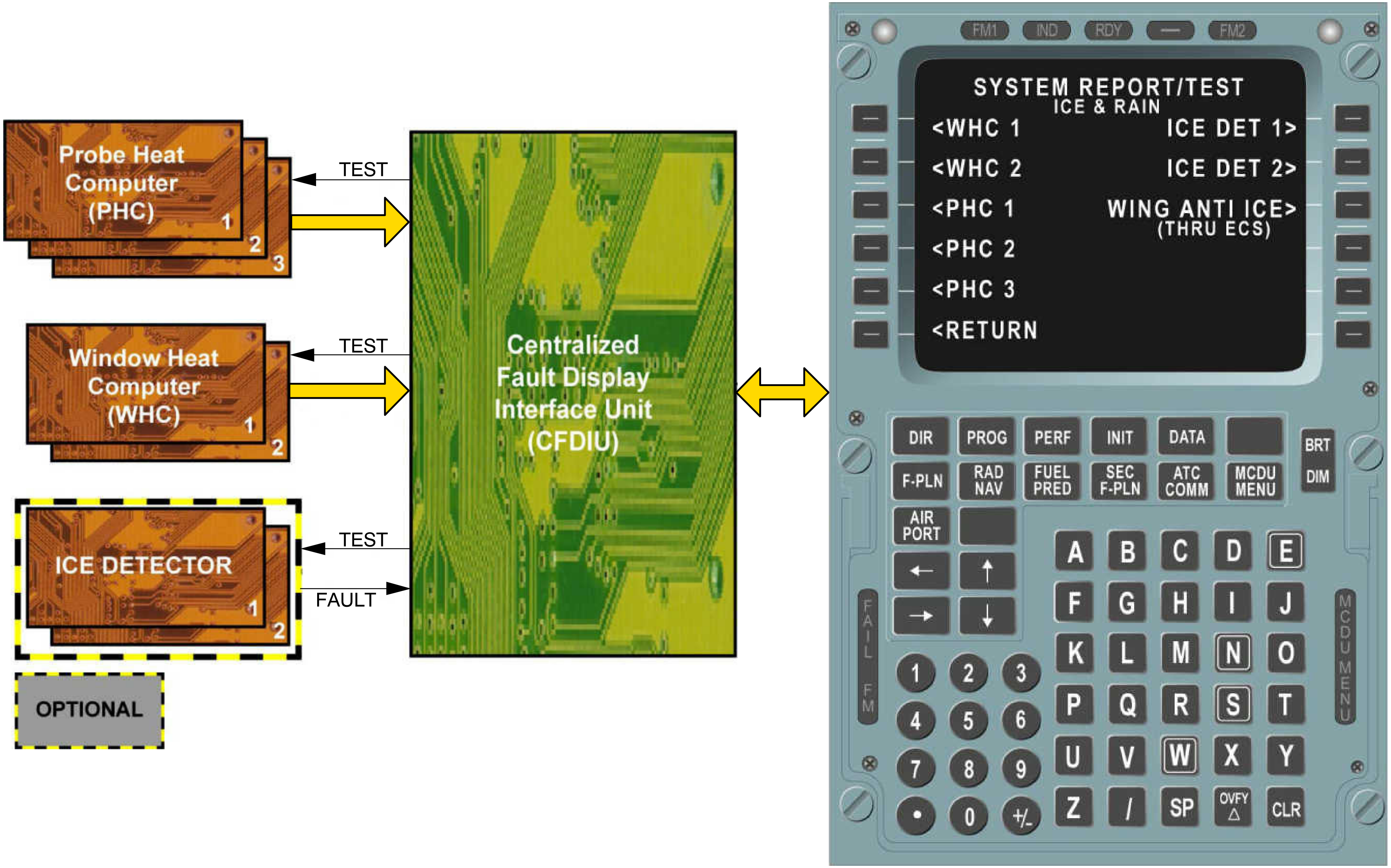


**Figure 29 Maintenance/Test Facilities**

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