© Lufthansa Technical Training

Reference to Figure 55 Wing A/I System Presentation

ATA 30 ICE & RAIN PROTECTION

30–11 WING ICE PROTECTION

WING ICE PROTECTION SYSTEM DESCRIPTION

General

The wing ice protection system prevents ice on the leading edge of the slats 3, 4 and 5. The system, which is the same in the LH and the RH wing, uses hot air from the pneumatic system. It is available in all flight conditions.

The two engines usually supply the pneumatic system with bleed air. If there is a failure, the cross–bleed valve opens and one engine can supply the two wings.

The system is only used during flight, but can be tested on the ground. To prevent heat damage to the slats, the ground test stops automatically after 30 seconds.

Pneumatic Circuit

The wing ice protection system is supplied with hot air from the pneumatic system, downstream of the pre–cooler. The anti–ice control valve (in the wing, outboard of the engine pylon) isolates these two systems. A restrictor downstream of the anti–ice control valve controls the air flow.

Air Distribution in the Slats

The piccolo ducts release the air into the slats through holes along their forward length. The air flows around the forward area of the slat then goes through acceleration slots into the rear section. It is then released overboard through the holes in the bottom surface of the slat.

Interfaces

These components interface with, or are in, the wing ice protection system:

the anti–ice valve control–switch (3DL),

the System Data Acquisition Concentrator/Electronic Centralized Aircraft Monitoring (SDAC/ECAM),

the Environmental Control System Zone Control and Bleed Status Computer (ECS computer: Zone Controller or Air Conditioning System Controller),

the Centralized Fault Display System (CFDS),

the landing–gear oleo proximity–switches.

Wing Anti–Ice Control Valve

Two wing anti–ice control–valves are installed on the aircraft, one in each wing leading–edge outboard of the engine pylons. A single ON/OFF switch on the cockpit overhead panel (25VU) operates the two valves.

The wing anti–ice control–valve:

- isolates the anti–ice ducts from the pneumatic system bleed–air supply when anti–icing is not required,
- controls the pressure of the wing anti–ice bleed–air, supplied by the pneumatic system.

The valves are selected electrically and actuated pneumatically. If an electrical failure occurs, the valves will automatically go back to the closed position. The valves can be locked in the closed position to let the aircraft operate in non–icing conditions.

Operation/ Control & Indicating

The wing ice protection system starts when the ANTI ICE P/BSW (**P**ush/**B**utton **SW**itch) is operated. The switch is on the overhead control panel 25VU, in the cockpit.

The pneumatic system usually takes its supply of air from the engine intermediate pressure (IP) bleed. If the engine operates at low RPM, or the bleed air temperature is too low, the supply changes to the engine high pressure (HP) bleed. The pneumatic system makes this change–over automatically and supplies air to the wing ice protection system at the correct temperature. The wing anti–ice control valve keeps the air at the correct pressure.

The wing ice protection system is energized by the P/BSW on the cockpit overhead panel 25VU. The P/BSW has two illuminated conditions:

FAULT: amber

ON: blue.

The procedure to operate the anti–ice system on the ground is the same as in flight. But on the ground the relay 4DL (ground test) supplies the ground to the relay 5DL. For safety, the relay 4DL also limits the system operation time to 30 seconds.

The FAULT light comes on (amber) if:

- the left valve air outlet pressure is low
- the right valve air outlet pressure is low
- the left and/or the right valve fails to close
- the left and/or the right valve fails to open
- the control relay (5DL) does not operate
- the change–over relay (6DL) does not operate
- the fault relay (7DL) does not operate

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

LGCIU
LH SHOCK ABSORB EXTENDED
1 2

NOTE:
LGCIU 2 FROM
RH SHOCK ABSORB EXTENDED

ANTI-ICE PANEL (25VU)

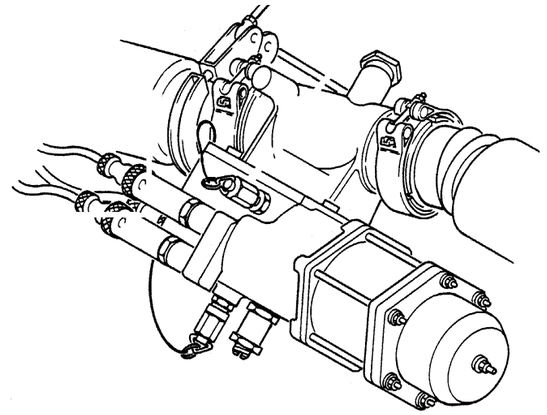
WING
FAULT
ON

28V DC

FLIGHT
GND
30 SEC.

WING ANTI-ICE
PROTECTION SYSTEM
RELAYS

NOTE:
ONE WING ANTI-ICE
CONTROL VALVE SHOWN
OTHER SIMILAR.



SYSTEM ON
LH VALVE CLOSED
LH LO PRESS
LH HI PRESS
RH VALVE CLOSED
RH LO PRESS
RH HI PRESS

AIR CONDITIONING SYSTEM CONTROLLER (ACSC)
(ENHANCED)

ZONE CONTROLLER (ZC)
(CLASSIC)

1 2

P/B SW ON
SYSTEM ON
LH VALVE CLOSED
LH LO PRESS
LH HI PRESS
RH VALVE CLOSED
RH LO PRESS
RH HI PRESS

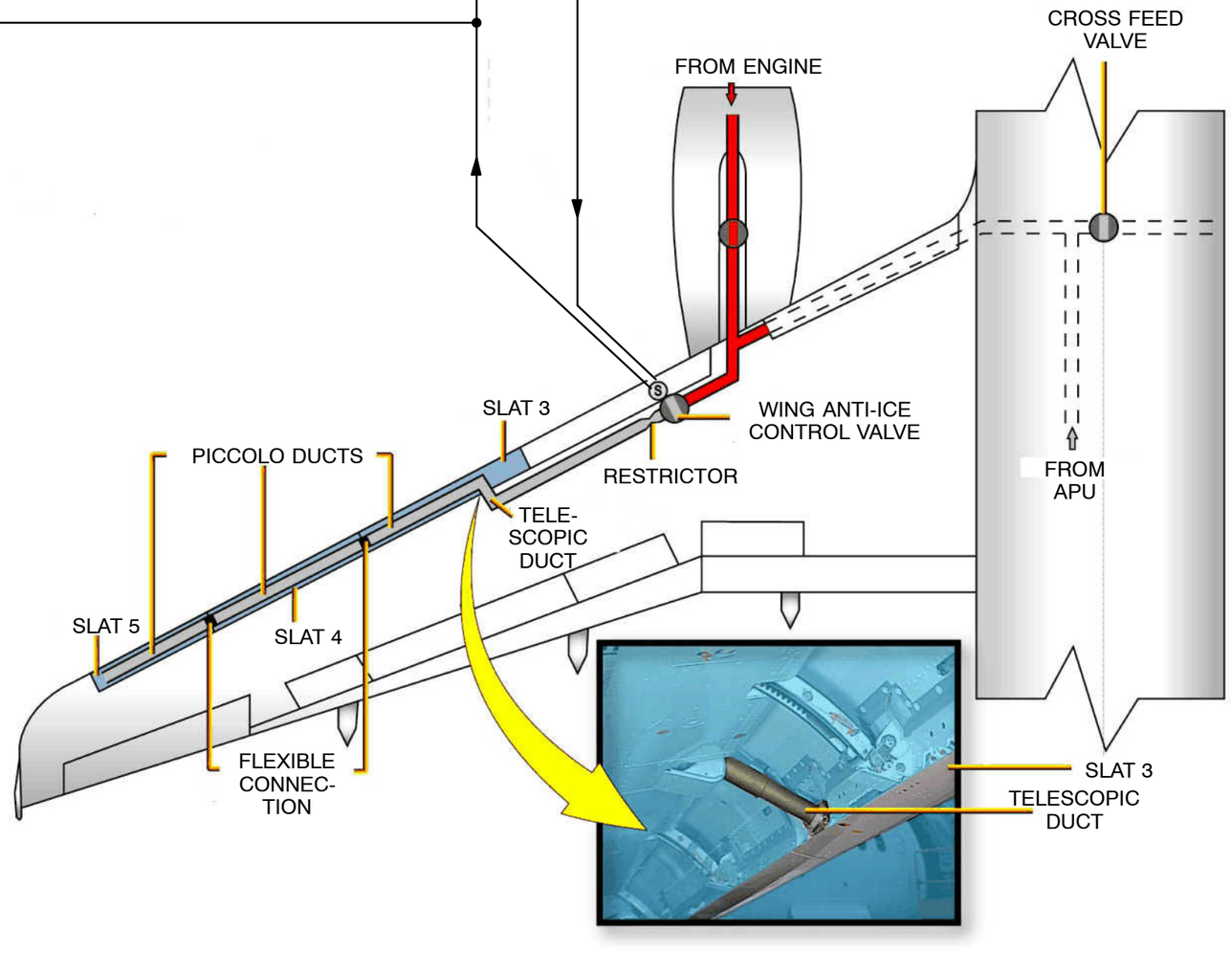
SDAC

1 2

P/B SW ON

EIU

1 2



LEGEND:

EIU:	ENGINE INTERFACE UNIT
SDAC:	SYSTEM DATA ACQUISITION UNIT
ACSC:	AIR CONDITIONING SYSTEM CONTROLLER
LGCIU:	LANDING GEAR CONTROL AND INTERFACE UNIT

Figure 55 Wing A/I System Presentation

© Lufthansa Technical Training

Reference to Figure 56 ENG A/I System

30–21 ENGINE AIR INTAKE ICE PROTECTION

SYSTEM DESCRIPTION

General

The ice protection system of the engine air intakes is normally selected only in icing conditions.

Ice protection heats the intake cowls with air bled from the engine compressor.

The function of the ice protection of the engine air intakes is to supply bleed air to heat the inlet lip during icing encounters. This maintains the inlet duct of the engine free of harmful accumulation of ice.

The installation consists of ducting, coupling, seals, a shutoff valve, mechanical supports and a piccolo tube.

The air bled from the seventh stage of the high compressor is the heat source.

A solenoid–operated shutoff valve (which is designed to be spring–loaded in the closed position in case of failure) provides the on–off control. The piccolo tube distributes the air within the leading edge of the intake cowl. The spent air exhausts via a flush duct in the aft cavity of the intake cowl.

System Interfaces

The Engine Air Intake Ice Protection System has interfaces to:

- the EIU (**E**ngine **I**nterface **U**nit),
- the Zone Controller (Classic) or
- the Air Conditioning System Controller (enhanced),
- the SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrator).

Control & Indicating

The control and indicating components are located on the overhead panel, on the ANTI ICE section of panel 25VU. Two pushbutton switches designated ENG 1 and ENG 2 are available, each associated with one engine.

Each pushbutton switch includes two luminous legends:

ON: blue,

FAULT: amber.

When you release the pushbutton switch, the ON legend is off and the system is not selected on.

When you push the pushbutton switch, the ON legend is on and the system is selected on.

Illumination of the FAULT legend indicates:

- With the ON legend off, the following failure:
  - the anti ice valve is not fully closed.

    It is necessary to push the ENG 1(2) pushbutton switch to extinguish the FAULT legend: the ON legend comes on.
- If the ON legend is on, the following failure:
  - the anti ice valve is not fully open.

    It is necessary to release the ENG 1(2) pushbutton switch to extinguish the FAULT legend: the ON legend goes off.

    If failure of the anti ice valve is detected on the ground, it is possible to lock the valve butterfly in either the open or closed position for the next flight.

The ENG ANTI ICE ON indication is displayed in green on the MEMO page on the lower part of the upper ECAM display unit if at least one of the two ice protection systems of the engine air intakes is selected on.

Warnings

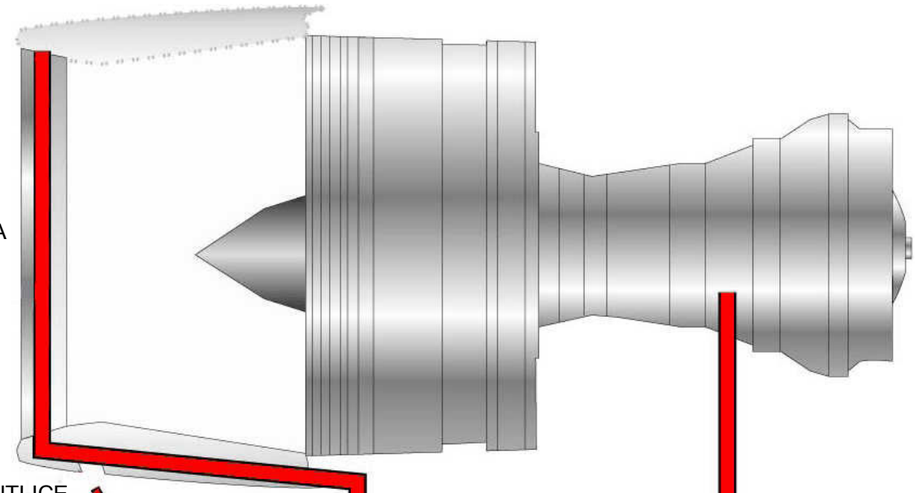
Illumination of the FAULT legend of the ENG 1(2) pushbutton switch is accompanied by activation of the ECAM system:

- activation of the single chime,
- flashing of the amber MASTER CAUT light,
- warning display on the lower part of the upper ECAM display unit.

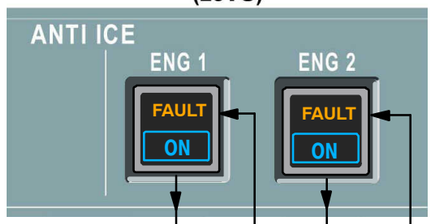
FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

ANTI-ICED AREA



(25VU)



AIR CONDITIONING SYSTEM CONTROLLER (ACSC) *(ENHANCED)*

ZONE CONTROLLER (ZC) *(CLASSIC)*

1
2

FULL AUTHORITY DIGITAL ENGINE CONTROL (FADEC)

OPEN SIGNAL
VALVE NOT OPEN
VALVE NOT CLOSED

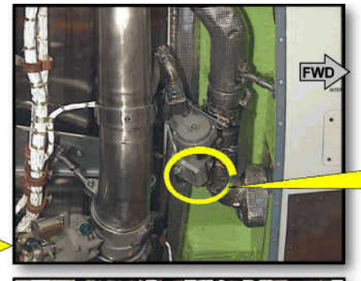
SYSTEM DATA ACQUISITION CONCENTRATOR (SDAC)

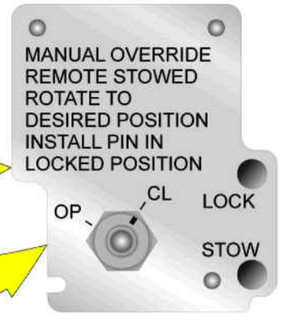
1
2

ENGINE 1/2
ANTI ICE P/B ON

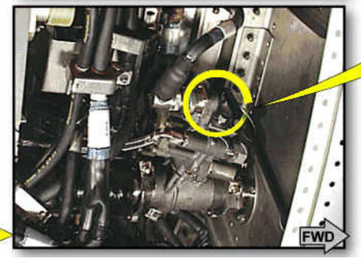
ENGINE 1/2
VALVE FAULT

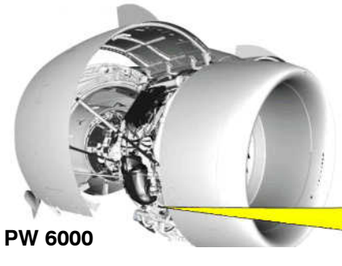
IAE V2500



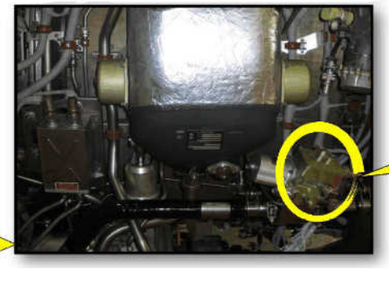


CFM 56





PW 6000



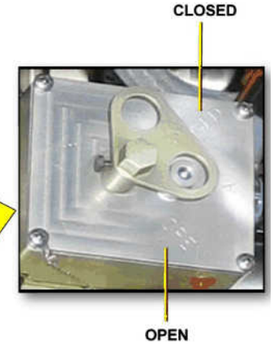


Figure 56 ENG A/I System

© Lufthansa Technical Training

Reference to Figure 57 Probe Heating System Schematic

30–31 PROBE ICE PROTECTION

SYSTEM DESCRIPTION

General

The air data system includes several probes and sensors (pitot and static probes, angle of attack and TAT (**T**otal **A**ir **T**emperature) sensors located on the fuselage in zones particularly exposed to ice.

An electrical heating system integral with each probe operates permanently to maintain probe efficiency. Permanent monitoring of the probes is ensured by PHC (**P**robe **H**eat **C**omputers).

Warning is provided to indicate heating malfunction of each probe.

The air data system comprises three independent detection channels:

- 1 (Captain),
- 2 (First Officer),
- 3 (Standby).

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 (only PHC 1 & 2).

The TAT sensors are not heated on the ground.

Probe Heat Computer (PHC)

Three PHCs (one per channel) control and monitor heating of the probes given below:

- one pitot probe,
- one AOA sensor,
- two static probes,
- one TAT sensor (not PHC 3).

Interfaces

The ice protection system of the probes is associated with:

- the EIU (**E**ngine **I**nterface **U**nit)
- 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.

Operation

The probe ice protection system is active when:

- one engine is running, or
- the aircraft is in flight condition, or
- the PROBE/WINDOW HEAT pushbutton switch is in ON configuration.

The probes are then heated with the following conditions:

- Static Probe and AOA Sensor with the same power on ground and in flight.
- TAT sensor only in flight.
- pitot probe:
  - on the ground: half–wave heating,
  - in flight: full–wave heating.

Indication

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) to activate an ECAM caution message.

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
  - power outputs for CFDS test only.
- External circuits:
  - integrity of probe heaters (CFDS test only).

Memory deletion (Last Leg Report) is ensured by the ground/flight transition.

WARNING: OPEN THE HEATING POWER CIRCUIT–BREAKERS FIRST BEFORE YOU OPEN THE PHC COMPUTER POWER CIRCUIT BREAKERS!
IF YOU DO NOT OBEY THIS SEQUENCE:

- THE PROBES WILL BECOME TOO HOT!
- THIS CAN CAUSE DAMAGE TO EQUIPMENT AND INJURY TO MAINTENANCE PERSONNEL.!

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

HEATING POWER

COMPUTER POWER

PROBE / WINDOW HEAT
ON
AUTO

P/B NOT SELECTED

EIU 1

ENG.1 NOT RUNNING AND A/C ON GND

EIU 2

ENG.2 NOT RUNNING AND A/C ON GND

PHC 1
< LAST LEG REPORT
< TEST
< CLASS 3 FAULTS
< RETURN

BITE TYPE 2 MENU OF PHC 1 (2)

CFDIU

TEST

B I T E

PROBES HEAT COMPUTER 1 (PHC 1)

GND LOW

FLT NORM

FLT

CURRENT MONITORING

CURRENT MONITORING

CURRENT MONITORING

CURRENT MONITORING

CURRENT MONITORING

LGCIU 1 2

CAPTAIN'S PROBES

PITOT

TAT

STAT L

STAT R

AOA

PHC 2 TO ADIRU 2 FOR F/O PROBES

PITOT

TAT

STAT L

STAT R

AOA

PHC 3 TO ADIRU 3 FOR STANDBY PROBES

PITOT

STAT L

STAT R

AOA

FAULT OUTPUT DISCRETES

LH STAT

RH STAT

AOA

PITOT

TAT

ADIRU 1

FWC 1 2

LEGEND:

ADIRU:	AIR DATA/INERTIAL REFERENCE UNIT
AOA:	ANGLE-OF-ATTACK
CFDIU:	CENTRALIZED FAULT DISPLAY INTERFACE UNIT
EIU:	ENGINE INERFACE UNIT
FWC:	FLIGHT WARNING COMPUTER
LGCIU:	LANDING GEAR CONTROL AND INTERFACE UNIT
STAT:	STATIC

Figure 57 Probe Heating System Schematic

© Lufthansa Technical Training

Reference to Figure 58 Probe Heating System Operation Schematic

PROBE HEATING SYSTEM OPERATION

PROBES

Pitot Probes

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 V AC nominal.

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

Static Probes

Power is applied to the periphery of the orifice. Power is supplied with 28V DC nominal.

Angel Of Attack Sensor (AOA)

The AOA sensor is of the vane type. Power is applied to the internal solid–state heaters of the vane. Power is supplied with 115V AC nominal.

TAT Sensor

Power is applied to the leading edge of the air inlet. Power is supplied with 115V AC nominal. Heating is cut off on the ground. The PHC automatically controls this changeover.

PROBE HEAT COMPUTERS (PHC)

Inputs

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

- from the LGCIU (**L**anding **G**ear **C**ontrol and **I**nterface **U**nit), ground/flight information and from the LGCIU validity,
- from the Oil PRESS & GND relays 12KS1 & 12KS2,
- for the ON control,
- from the CFDS for the maintenance test,
- for the reset function

Outputs

The PHC generates discrete standard outputs:

- to the FWC (**F**light **W**arning **C**omputer) via the ADIRU (**A**ir **D**ata/**I**nertial **R**eference **U**nit):
  - for the indication of TAT sensor heating or not,
  - for the indication of the pitot probe heating fault,
  - for the indication of the L static probe heating fault,
  - for the indication of the R static probe heating fault,
  - 1 for the indication of the AOA sensor heating fault,

And one ARINC 429 low–speed data bus for fault message to the CFDS.

CONTROL & INDICATING

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.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

NOTE:
EXTERNAL PWR ON
ENG. 1&2 OFF

(49VU)

28V DC PHC POWER SUPPLY

PROBE/WINDOW HEAT

AUTO

PROBE/WINDOW HEAT P/B
(25VU)

(49VU)

(121VU)

EIU 1

EIU 2

PRESS

LOW PRESS

ENG 1 OIL LOW PRESS & GND RELAY

ENG 2 OIL LOW PRESS & GND RELAY

(121VU)

LGCIU 1

(121VU)

LGCIU 2

LGCIU 2 OPERATIVE

(122VU)

28V DC STATICS SUPPLY

(49VU)

115V AC AOA POWER SUPPLY

115V AC PITOT POWER SUPPLY

(122VU)

115V AC TAT POWER SUPPLY

PROBES HEAT COMPUTER 1 (PHC)

AND

SYSTEM OFF

SYSTEM ON

FAULT OUTPUT DISCRETES

LH STAT

RH STAT

AOA

PITOT

TAT

ADIRU 1

ARINC 429 OUTPUT

CFDIU TEST INPUT

TEST

CFDIU

AND

FLIGHT

GROUND

CURRENT MEASUREMENT

LH STATIC

CURRENT MEASUREMENT

RH STATIC

CURRENT MEASUREMENT

AOA

CURRENT MEASUREMENT

PITOT

STSTEM OFF

FLT = 1

CURRENT MEASUREMENT

TAT

STSTEM OFF OR GND

Lufthansa Technical Training

Figure 58 Probe Heating System Operation Schematic

© Lufthansa Technical Training

Reference to Figure 59 Window Heating System Schematic

30–42 WINDSHIELD ANTI–ICING AND DEFOGGING

SYSTEM DESCRIPTION

General

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 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.

Interfaces

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

- the Engine OIL LOW PRESS & GROUND relays 10KS1 & 10KS2 controlled by the EIU (**E**ngine **I**nterface **U**nits) 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 Interface **U**nit),
- the SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrator).

Operation

The probe ice protection system is active when:

- one engine is running, or
- the aircraft is in flight condition, or
- the PROBE/WINDOW HEAT pushbutton switch is in ON configuration.

The windows are then heated with the following conditions:

- the sliding & fixed windows with the same power on ground and in flight,
- the windshield with a three times higher power in flight as on ground.

WIndows

The heating element is a film.

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

For the fixed & sliding windows two temperature sensors are installed inside each windshield (one sensor active, the other spare).

Window Heat Computers (WHC)

The WHC provides the functions given below:

temperature regulation,

monitoring,

safety.

There are two WHCs Installed.

The temperature sensor cuts off heating when the temperature exceeds or undershoots a certain temperature.

ATTENTION: On very hot days, when the aircraft is standing in the sun the window temperature could exceed this limit and a FAULT message is shown on the ECAM, although the system is operative.

BITE

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

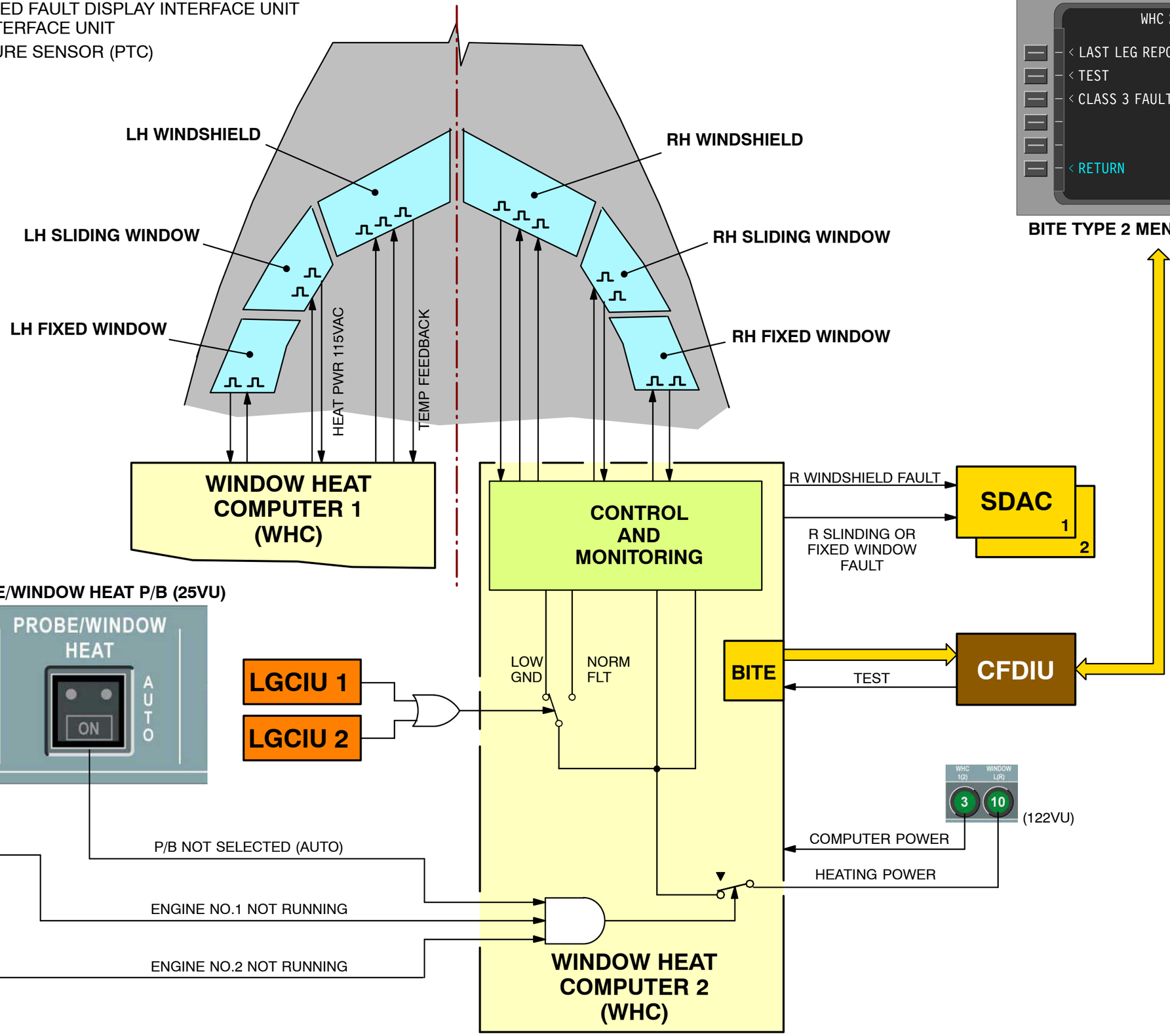
The ground/flight transition deletes the Last Leg Report memory.

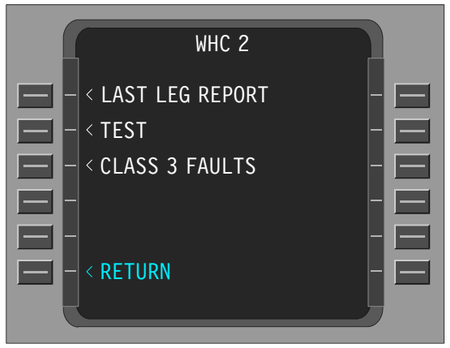
FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

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)





BITE TYPE 2 MENU OF WHC 2 (1)

Figure 59 Window Heating System Schematic

© Lufthansa Technical Training

Reference to Figure 60 Window Heating System Operation

WINDSHIELD ANTI–ICING AND DEFOGGING SYSTEM OPERATION

System Design

Two or three temperature sensors may be installed in the windows.

The regulation threshold of the WHC is between 35°C and 42°C. The temperature is monitored by the in–service sensor.

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 V AC/400 Hz line delivers these power outputs on the ground and in flight.

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

A 115 V AC/400 Hz line delivers this power output.

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

activation of a warning in the cockpit via the Central Warning System,

automatic cut off of the heating of the defective window.

These extreme temperatures are given below:

- +60°C which corresponds to an overheat or to the sensor in open circuit,
- -60°C which corresponds to the sensor in short circuit.
- In case of a temperature sensor fault (resistance not between 370 to 715 ohms), the spare sensor can be connected at the electrical connector of the related window.

Indicating

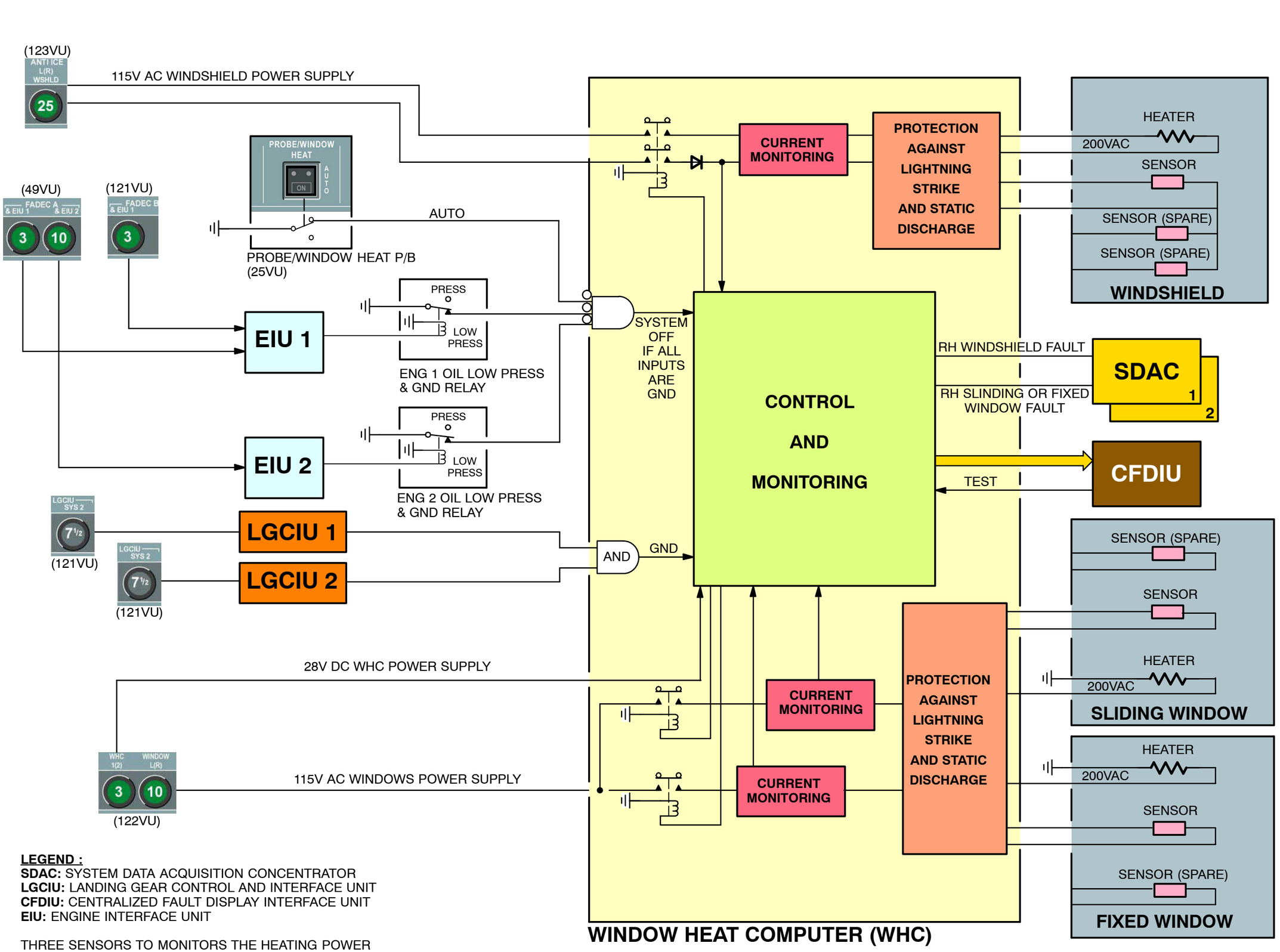
In case of failure the WHC continuously emits the BITE status via the ARINC 429 bus to the CFDIU.

Two discrete outputs (one for the windshield, one for the two windows) inform the crew of a heating fault.

The SDAC transmits this information to the FWC (Flight Warning Computer).

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



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 MONITORS THE HEATING POWER IS ONLY AN OPTION AND NOT STANDART.

Figure 60 Window Heating System Operation