1. GENERAL.

The aircraft is fully equipped for all–weather operation.

The ice and rain protection system is divided into:

- Wing and stabilizer (boot) de–icing.
- Engine anti–icing.
- Propeller de–icing.
- Windshield heating.
- Windshield wipers.
- Pitot tubes, Outside Air Temperature probe (OAT) and angle of attack sensor heating.

Air bleed and electrical power, mainly from the 115VAC wild frequency system, is used

for ice and rain protection. Bleed air is used for the wing and stabilizer inflatable boots, the engine split lip and inlet guide vanes. Electrical power is used for the remainder of the ice and rain protection systems.

All ice and rain protection systems are controlled from the overhead panel except for the main pitot tubes, temperature probe and angle of attack sensors which are powered automatically as soon as one AC generator is on line.

There are also caution lights advising flight crew of any system fault. When any caution light is illuminated, the ICE PROT MASTER CAUTION light is activated.

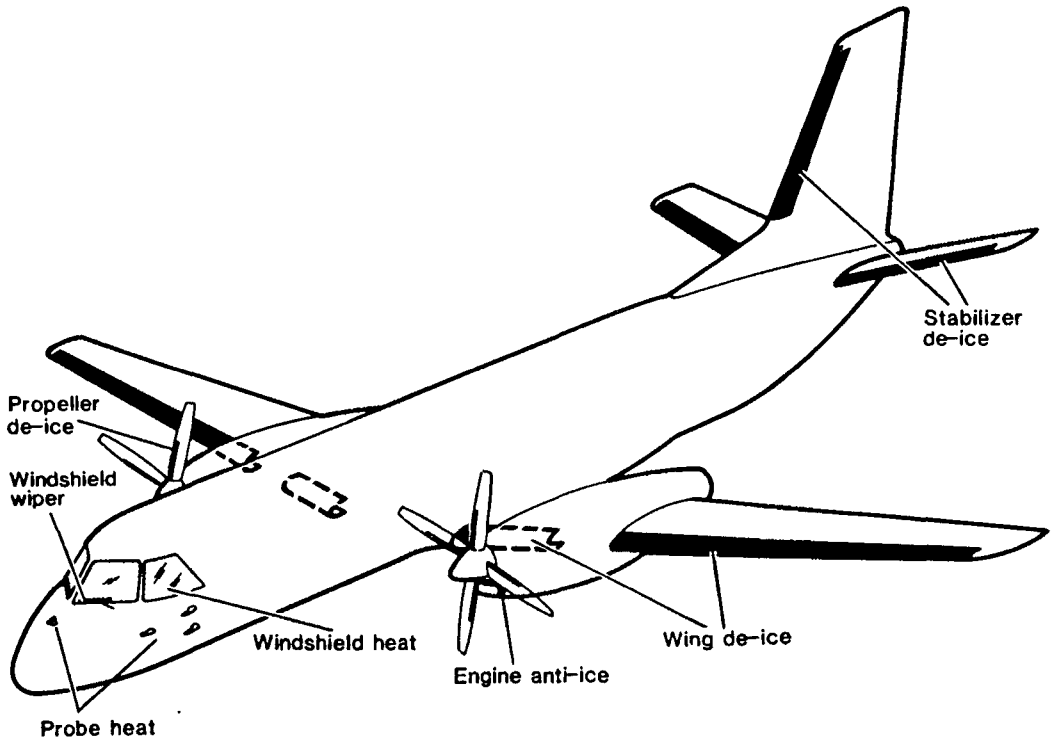


FIG. 1. Ice and rain protection system

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Wing and stabilizer (boot) de–ice.

Wing and stabilizer de–icing is provided by conventional inflatable boots located on the wing and leading edges.

Normal color of the boots are black but as an option silver colored boots are available. On the silver colored boots there are black stripes to improve ice detection.

Pre–cooled and regulated engine bleed air from both engines, supplied via the pneumatic system, is used for de–icing. With Mod No 2310 installed HP bleed valve will automatically be opened when associated PL are below 64° PLA (min takeoff position) and the CYCLING switch is placed in either ONE CYCLE or CONT position provided the HP Bleed Switch is in AUTO. Once activated the HP BLD VALVES will be opened for 30 sec. to cover a complete boot de–ice cycle. The bleed air flows via a normally open shut–off valve, controlled by the AIR SUPPLY ON/OFF switch, to a pressure regulator in each nacelle. The regulator reduces the pressure to 18 psi and contains an integral relief valve preventing the pressure from exceeding 25 psi if the regulator should become stuck open. An overheat sensor is installed downstream of each regulator. The sensor will cause a DE–ICE OV TEMP light to come on whenever the temperature reaches 150°C (300°F).

The regulated pressure is directed to a distribution duct supplying all boots through three distribution valves. The distribution valves are solenoid operated and located one in each nacelle for inboard and outboard wing de–ice and one in the fin for stabilizer deice. Integral with each distribution valve is an air ejector which passes a small flow of regulated air overboard to create enough suction to prevent the boots from inflating due to aerodynamic lift when not pressurized. When a solenoid in a distribution valve is energized, manually or by timer, it will shift from suction to pressure and a rapid inflation of the boot will occur, cracking accumulated ice. Upon completion of the automatically controlled 6 seconds timing cycle, the solenoid is de–energized and suction restored. In conditions of low temperature, –30°C and below, the rubber in the boots becomes stiff which results in the deflation sequence being prolonged.

The sequence of boot inflation is maintained by a timer control unit. Upon selection of either ONE CYCLE or CONT a timer will cause each boot zone to inflate in the following order: stabilizer, outboard wing, inboard wing, and finally re–inflation of stabilizer.

When CONT is selected this inflation cycle will be repeated every third minute.

A Push button for each boot zone permits manual override of the timer.

To monitor the boot de–ice system a TIMER light comes on should either of the following faults be detected:

- No pressure is sensed downstream the valve sequenced for opening within 4 seconds.
- The activated timer gives no inflation signal.
- The boots are not cycling.
- Pressure remains on in the stabilizer boot zones (AUTO CYCLING switch in CONT).
- Pressure remains on in the stabilizer boot zones when next cycle is activated (AUTO CYCLING switch in ONE CYCLE).
- Pressure remains on in Left and Right inboard wing or Left and Right outboard wing boot zones after more than 8 seconds.

With Mod No 2083 installed the following additional faults triggers the TIMER light.

- Pressure remains on in any boot zone (AUTO CYCLING switch in ONE CYCLE or CONT).
- Control power to timer is lost. If the W OUTB push button is depressed the TIMER light will go out, when the button is released the light will come on again.
- Depressing any of the Manual push buttons while in CONT or during a one CYCLE sequence will result in the TIMER light coming on momentarily.

In CONT, ONE CYCLE or by manually overriding the timer the inflation sequences can be monitored by following the illumination of the green indication lights which will come on whenever the respective boot zone is pressurized if BOOT IND switch is in ON position. In OFF position no illumination will occur.

2. 2. Engine anti-ice system. (Fig. 3.)

2. 2. 1. General.

An engine anti-ice system prevents ice formation on certain areas of the engine where ice buildup otherwise could be expected. These areas are the inlet lip, intake ducts including Inlet Protection Device (IPD) with exhaust nozzle which are electrically heated, and the splitter lip and inlet guide vanes, which are heated with bleed air.

Both the electrical and the bleed air parts of the system are controlled by the same L/R ENGINE anti-ice switches.

In order to increase the engine stall margin at low power operation, bleed air is bled from the 5th compressor stage and via the HMU operated sleeve valve ported to the Splitter Lip, the inlet guide vanes and the Inlet Particle Separator Ejector Duct. When power is increased the bleed air reduces and at 90% Ng corrected (temperature related) the sleeve valve is fully closed. With engine anti-icing switched ON at low power settings some air is routed from the Sleeve Valve via the Electronic Solenoid Valve to the Splitter Lip and inlet guide vanes while the rest is routed direct from the Sleeve Valve. When power is increased relatively more air is routed via the Solenoid Valve and at high power settings all bleed air for anti-icing is routed from the Sleeve Valve via the Solenoid Valve.

The electrical inlet duct heating uses 115VAC, wild frequency, supplied directly from each engine's own AC generator only. Therefore, there can be no cross-feed from the other AC generator in case of malfunction.

2. 2. 2. Upper and Lower duct
(Applicable for A/C with LUCAS intakes
(without mod. no. 2095)

In the lower leading edge section the duct is provided with a temperature control sensor, an under-temperature sensor and an over-temperature sensor. These sensors are connected to an inlet duct heater controller located in the engine nacelle equipment compartment.

The normal temperature control sensor has preset control levels for inlet heat controller to "cut in" at 60°C (140°F) and to "cut out" at 80°C (175°F). A failure in the inlet ice protection system is indicated by L or R INTAKE light coming on.

The light comes on if:

- The over-temperature sensor senses a temperature exceeding 125°C (257°F) in which case the inlet heat controller will "cut out" power to the heaters. (If the L/R ENGINE switch is left ON the light will go out when power is "cut in" at 40°C followed by a new overheat.)
- The under-temperature sensor senses a temperature below 10°C (50°F). (Inhibited for 25 sec when switching on the system to avoid nuisance warnings).
- Loss of power in one or more phases in the three-phase power supply system.

2. 2. 3. Upper and Lower Duct
(Applicable for A/C with COX intakes
(with mod no. 2095 installed)

The upper duct and the lower duct, including the particle separator and exhaust nozzle, are each provided with four thin film resistor type temperature sensors whereof two in each group are used as primary sensors and two as back-up temp sensors. The sensors are connected to the Anti-ice Control Unit (ACU) which in turn is divided into two identical and independent microprocessor control channels for heating power regulations, both in normal and back-up mode.

The ACU further includes fault monitoring and system test functions, it also contains a Control Unit Display (CUD) for degradation indications and two test/reset buttons. The CUD and buttons are located in the nacelle and is provided for maintenance trouble shooting purpose, however, when any indication light in the CUD is activated, the respective side INTAKE L/R Maintenance Light in the TEST 3 panel is activated, provided the aircraft is on ground and is controlled by the WoW switches.

It shall be observed that shutting down an engine or setting one AC generator switch to OFF while the ENGINE ANTI-ICE is ON will result in the L or R INTAKE maintenance light to come ON. The only way to reset the light is by the reset buttons in the nacelle.

- With Mod. No. 2250 the INTAKE L/R Maintenance Light in the TEST 3 panel is disconnected.
- With Mod. No. 2255 the INTAKE L/R Maintenance Light in the TEST 3 panel is removed.

On basis of the temperature information from the primary temp sensors, the two microprocessor control channels in the ACU supply time proportional modulated AC power to the thermo-wire heaters in the upper and lower duct.

A failure in the inlet ice protection system is indicated by L or R INTAKE light in the ENGINE anti-ice panel coming on. The light comes on regardless of, if the ENGINE ANTI-ICE is switched ON or not.

The light comes on if:

- Loss of more than:
  - one primary sensor
    or
    one back-up sensor
    or
    one primary and one back-up sensor

  in one duct section (upper or lower)
- Loss of DC power.
- Loss of AC power, total or partial
- An over-temperature is sensed resulting in disconnection of the primary microprocessor. Heat control will be maintained by the back-up processor.
- An under-temperature is sensed resulting in disconnection of the primary microprocessor. Heat control will be maintained by the back-up processor.
- Failure of one or more heater elements.
- loss of primary or one back-up or one primary and one back-up temp sensor in one duct section (upper or lower). Anti-icing is still controlled by the primary micro processor.

2. 2. 4. Split Lip

The split lip and inlet guide vanes are heated by bleed air ported from the 5th compressor stage via an engine anti-ice valve. A failure in the system is indicated by L or R AIR light coming on.

The light comes on if:

- The Electronic Solenoid Valve does not close when ENGINE anti-ice is switched OFF.
- The Electronic Solenoid Valve does not open when ENGINE anti-ice is switched ON.

Using engine anti-ice also illuminates L/R ENG ANTI-ICE (blue) lights located on the flight status panel. These lights come on whenever respectively L or R ENGINE anti-ice switch is turned on. The lights indicate that the system has been switched on but give no indication of correct operation of the system.

2. 3. Propeller de-icing. (Fig. 3.)

The propeller blades are equipped with boots which are electrically heated from the 115 V AC wild frequency buses. The system is controlled by a switch for each propeller with positions OFF-NORM-MAX. Incorporated in the system are indications and caution lights as follows:

- The L/R PROP DE-ICE lights (blue) on the flight status panel which will come on when the system is working and will go out in case of system failure.
- One ICE PROT light (amber) on the CWP which will come on flashing together with MASTER CAUTION in case of failure.
- Two L/R PROP lights (amber) on the overhead panel will come on in case of failure.

During normal operation each propeller de-icer boot is powered by it's associated AC generator. In the event of an engine or AC generator failure the propelled de-icer boots are automatically powered from the opposite side.

When the L/R PROP de-ice switch is in NORM/MAX position 28 VDC will be applied to the timer/switching/monitor unit. The timer unit alternately turns on power to two opposite pair of blades.

In NORM position power is on for 11 seconds and off for 79 seconds. In MAX position power is on for 90 seconds and off for 90 seconds.

It is very important to observe the temperature switching point for use of NORM resp MAX modes. If using MAX mode at temperatures warmer than –12° and NORM mode at temperatures warmer than –5° , there is a risk for the ice to melt and "run back" and re–freeze behind the boots. Run back will cause a drastic reduction in Propeller thrust, up to about 30%. However, MAX mode may be used in the temperature range –10° to –12° SAT if unacceptable propeller vibrations are experienced. If unacceptable vibrations occur at warmer temperatures than –10° SAT use MAX mode for a short period until the vibrations disappear. Bear in mind the risk for run back.

A timer fault monitoring unit will automatically disconnect the power and activate L or R PROP caution light in the ICE PROTECTION panel together with ICE PROT CWP light whenever one or more of the following faults arise:

– AC or DC power failure.
– Timer not cycling or remaining permanently on.
– Over–/Undercurrent to propeller boots.
– Cycling interval periods are off by more than ± 0.5%.

2.4. Windshield heating. (Fig. 4.)

The front windshields and the forward part of the side windshields are electrically heated from the 115 VAC, wild frequency buses for anti–icing. L AC BUS supplies heating power for L front and side windshields and R AC BUS supplies heating power for R front and side windshields. In addition, air from the air conditioning system is directed to the inside of the windshields to prevent fogging as soon as the air conditioning system is working.

The power used for heating is regulated by two controllers. The left controller powers the left front and right side windshields while the right controller powers the right front and left side windshields.

Once the windshields have reached their working temperature, the controllers will modulate the power output to keep this temperature. If an open or short circuit occurs in the normal temperature sensor, the over–temperature sensor will take over and modulate the temperature together with the controller.

Each controller also provides overheat and fault protection. If a controller detects an overheat sensor circuit failure or a complete controller fault, it shuts off power to the affected windshield and illuminates the respective windshield L/R SIDE or L/R FRONT light. If, however, only the normal temperature circuit fails and the over–temperature sensor circuit takes over, the caution light will illuminate but the windshield is still heated. Positioning the switch for the affected windshield to OFF will extinguish the caution light and resets the controller channel for this windshield.

The front windshields heating can only be selected ON or OFF. When set to ON, power is applied gradually by the controller to reduce thermal stresses in the windshields. If the windshields are cold, it may take up to 6 minutes before full power is applied.

A/C 160–299:

The side windshields have no low power warm-up period. Instead, there are two power settings available, NORM and HIGH. NORM is used for defogging while HIGH is used for de–icing. When heating is applied to a side windshield NORM setting must be used for at least 7 minutes before HIGH may be selected in order to reduce the thermal stresses. As an additional precaution when HIGH is selected, NORM power will be applied whenever the aircraft is on ground (WOW, weight on wheels switches sensing ground mode).

A/C 300–UP:

The side windshields heating can be selected ON or OFF. When set to ON, power is applied gradually by the controller to reduce thermal stresses in the windshields.

2.5. Windshield wipers. (Fig. 5.)

Each front windshield is provided with a windshield wiper. The wipers can be operated both at HIGH and LOW speed. Also, each wiper rotary switch has a PARK position where the wiper is returned to stowed position.

The wiper motors have a thermal overheat protection with auto–reset when the temperature has decreased.

2.6. Pitot tubes, Outside Air Temperature probe (OAT) and angle of attack sensor heating. (Fig. 5.)

The pitot tubes, temperature probe (OAT) and angle of attack sensors are electrically heated. All except the standby pitot tube are supplied with 115 VAC, wild frequency. The standby pitot tube is supplied with 28 VDC.
There is a main pitot tube and an angle of attack sensor on each side of the airplane in the cockpit area. These tubes and sensors are heated whenever the 115 VAC wild frequency buses are powered.

The temperature probe located forward of the pilots windshields is also powered directly from the 115 VAC wild frequency system but via the WOW switch, powering the probe only in the air. A heated probe without any air flow would give an incorrect temperature reading.
The standby pitot tube, powered by 28 VDC, is controlled by a STBY PITOT switch which must be in ON position for the pitot tube to be heated. The pitot tube must be powered for 5 minutes to be provide with full anti–ice protection.

2.7. Ice detector (Optional Mod No. 1933)

The ice detector consists of an ultrasonic axially vibrating tube as sensing element. The logic is controlled by a micro–processor built into the ice detector housing. Upon sensing ice as evident by a change in frequency, at a preset level, the micro–processor will activate the L and R ENG ANTI–ICE blue status lights which will start flashing. When switching ENG A/I ON the blue light will change to steady.

The ice detector has a heating element which will de–ice the detector in a cyclic manner. When the frequency of vibration is sensed to be at a "no ice" level the heating is switched off and a new ice detection cycle is started. If the ENG ANTI–ICE has been switched ON previously, and remains ON, the blue status lights will remain steady, i.e. the flashing is suppressed.

The INVERTER must be in INV 1 position for the ice detector to work, unless Mod No. 2546 is installed, when the Ice detector is powered from R AC GEN BUS and will then work regardless of inverter selection.

CAUTION: IT IS VERY IMPORTANT TO UNDERSTAND THAT THE ICE DETECTOR ALERT SHALL NOT BE USED AS THE CUE FOR SWITCHING ON ENG ANTI–ICE. THE ICE DETECTOR FUNCTION SHALL BE CONSIDERED AN ALERT SHOULD ICING CONDITIONS BE ENTERED UNNOTICED FOR ANY REASON.

2.8. Ice detector (Optional Mod No. 3168)

The ice detector consists of an ultrasonic axially vibrating tube as sensing element. The logic is controlled by a micro–processor built into the ice detector housing. Upon sensing ice as evident by a change in frequency, at a preset level, the micro–processor will activate the L and R ENG ANTI–ICE blue status lights which will start flashing and the ICE COND indication light will illuminate in white. When switching ENG A/I ON the blue light will change to steady.

The ice detector has a heating element which will de–ice the detector in a cyclic manner. When the frequency of vibration is sensed to be at a "no ice" level the heating is switched off, the ICE COND indication light is extinguished and a new ice detection cycle is started. If the ENG ANTI–ICE has been switched ON previously, and remains ON, the blue status lights will remain steady, i.e. the flashing is suppressed.

The ice detector is powered from R AC GEN BUS.

CAUTION: IT IS VERY IMPORTANT TO UNDERSTAND THAT THE ICE DETECTOR ALERT SHALL NOT BE USED AS THE CUE FOR SWITCHING ON ENG ANTI–ICE. THE ICE DETECTOR FUNCTION SHALL BE CONSIDERED AN ALERT SHOULD ICING CONDITIONS BE ENTERED UNNOTICED FOR ANY REASON.

2.9. Ice Speed system, Mod No. 2650, SB 27–075.

The ICE SPD pushbutton will, when activated, change the trip levels (lowered angle of attack) for stick shaker and stick pusher; shaker and pusher will come on at higher speeds.

At takeoff, the change in trip levels is inhibited for 6 minutes after weight off wheels, e.g. if selected ON before take–off, it will activate 6 minutes after lift–off.

When selected ON, the ICE SPD pushbutton will illuminate as an indication of the selected mode.

3. CONTROLS AND INDICATORS.

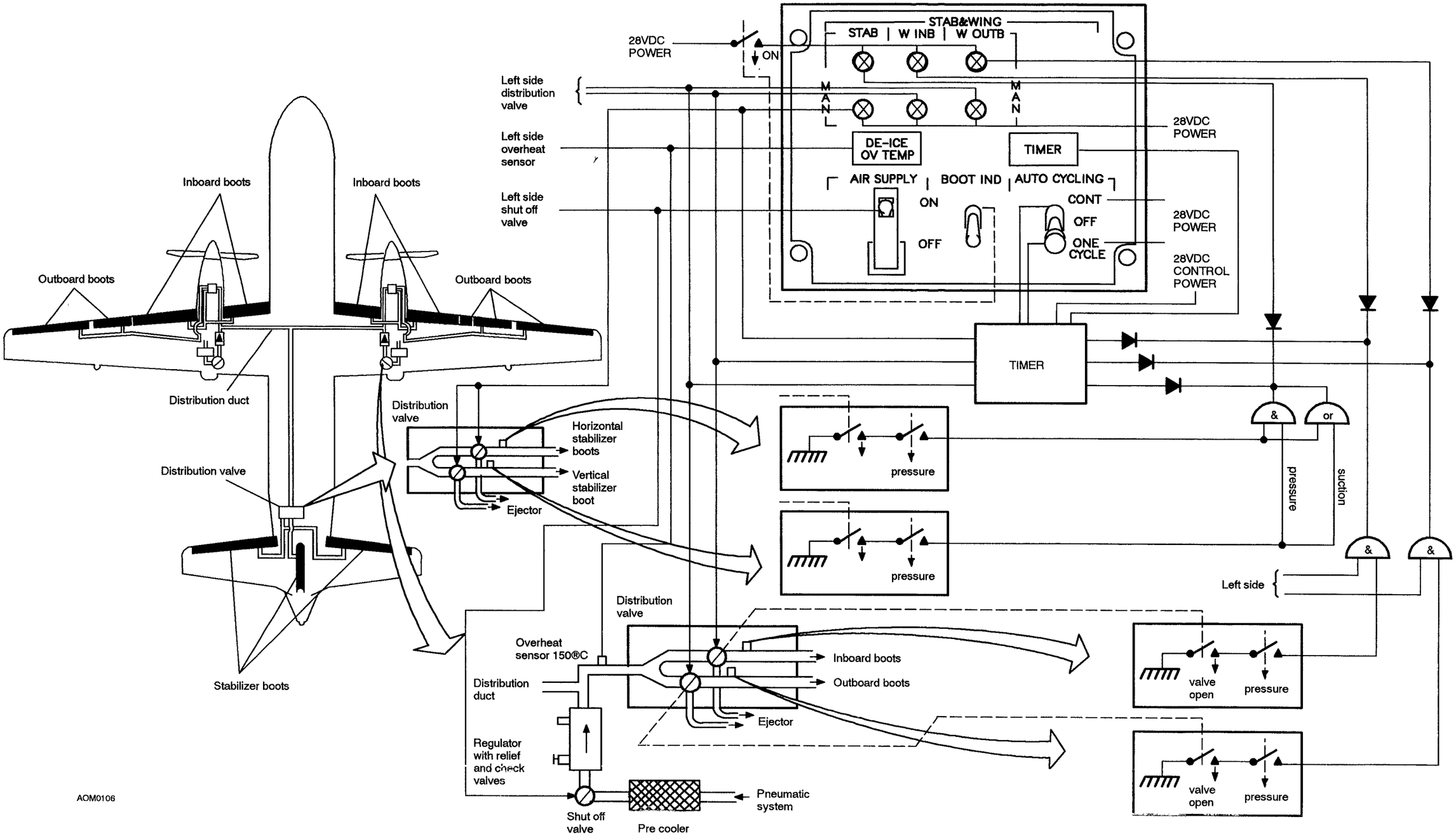


FIG 2 Wing and stabilizer de-ice system – schematic.

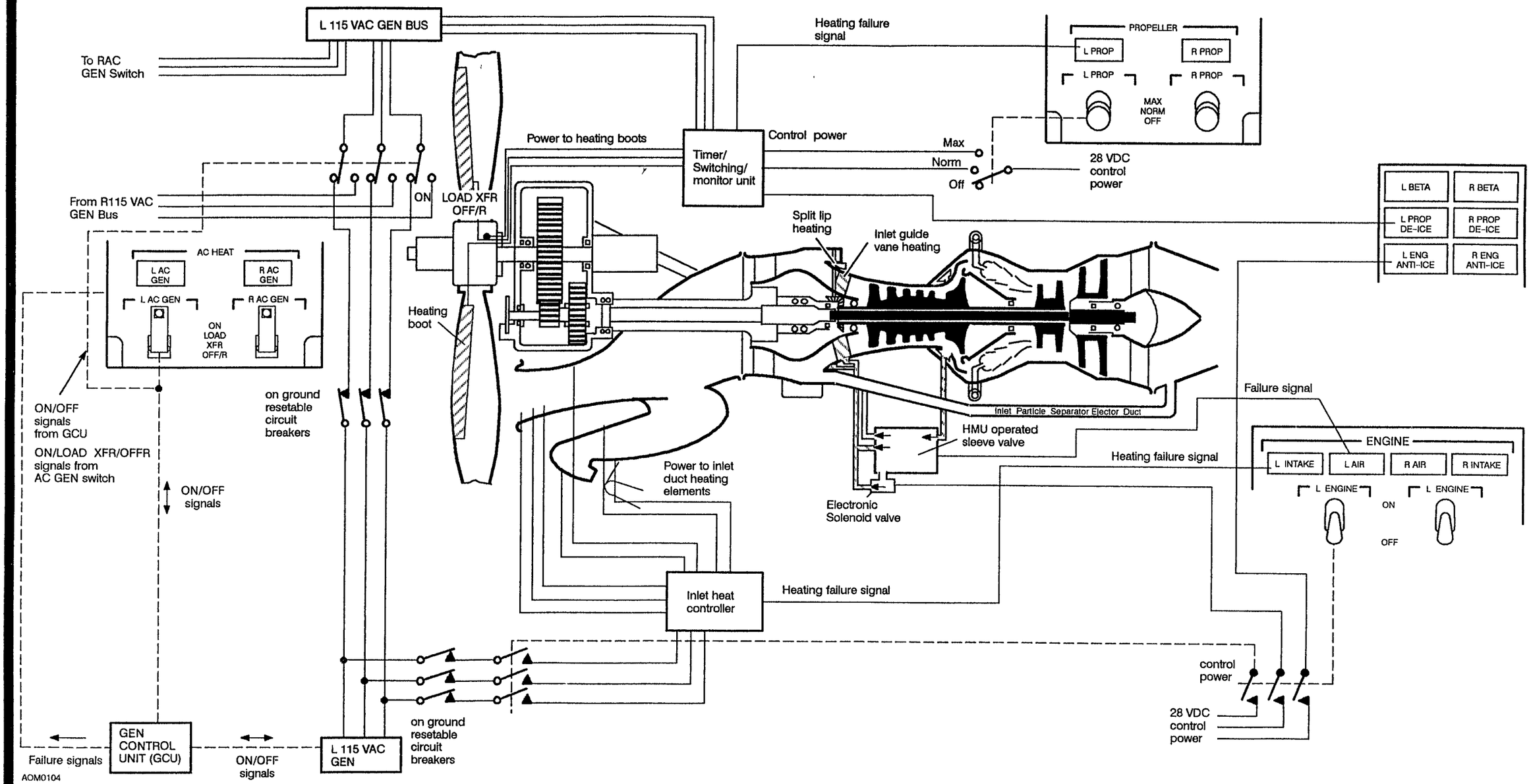


FIG 3 Engine anti-ice propeller de-ice system – schematic

THIS PAGE IS APPLICABLE TO AIRCRAFT WITH LUCAS INTAKE.
Without Mod No 2095

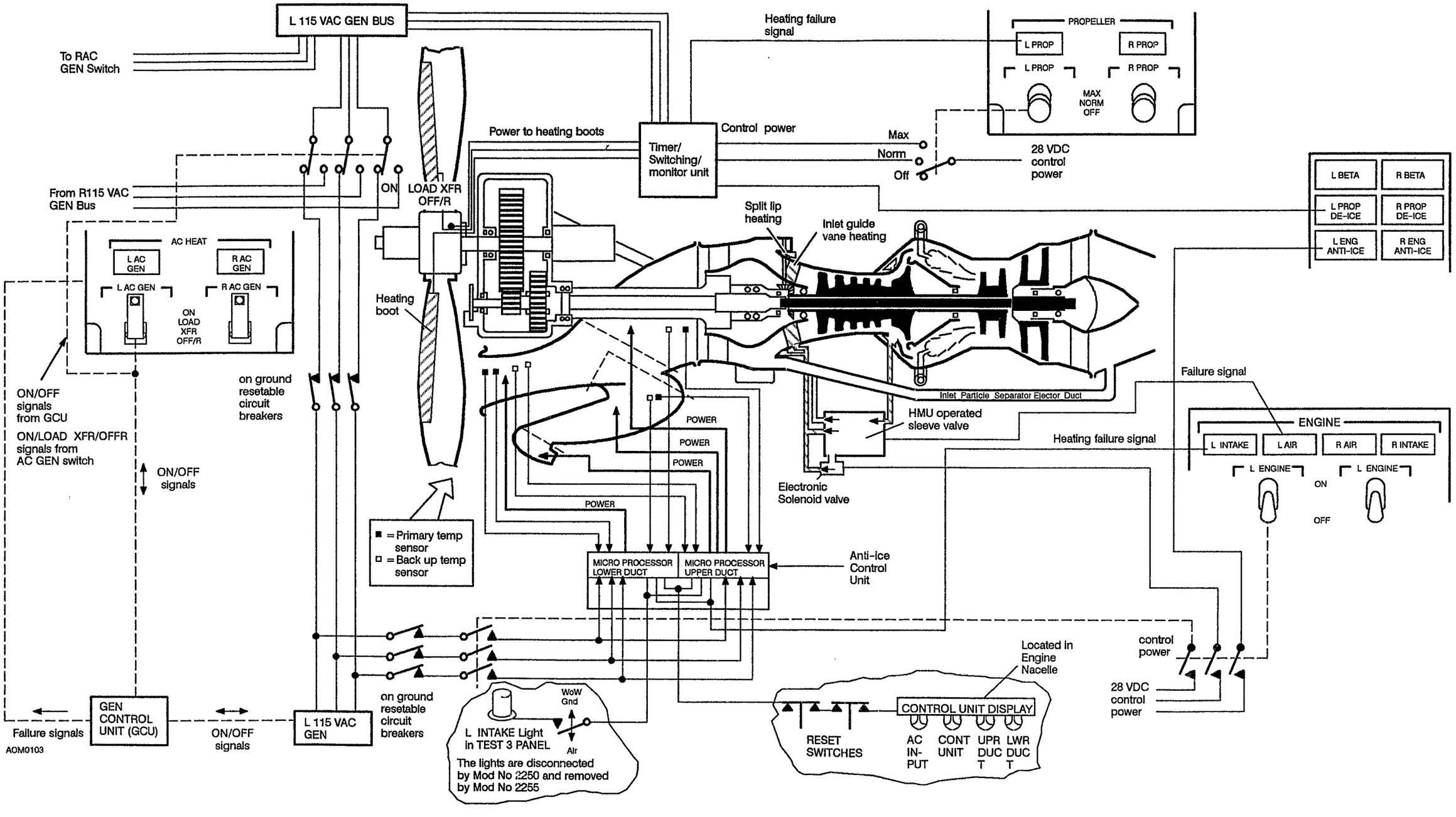


FIG 3 Engine anti-ice and propeller de-ice system - schematic

THIS PAGE IS APPLICABLE TO AIRCRAFT WITH COX INTAKE. With Mod no 2095

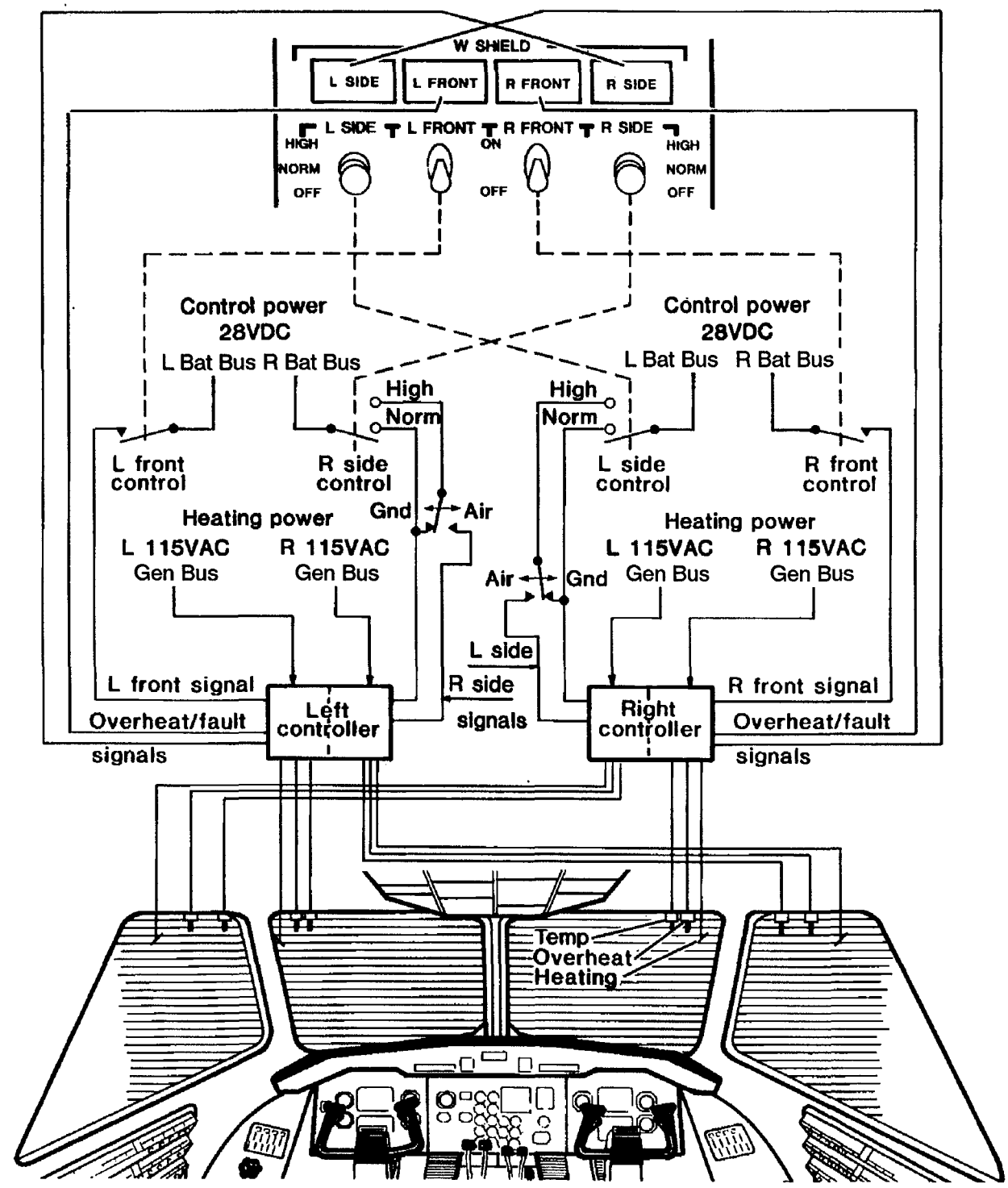


Fig. 4. Window heat – schematic.

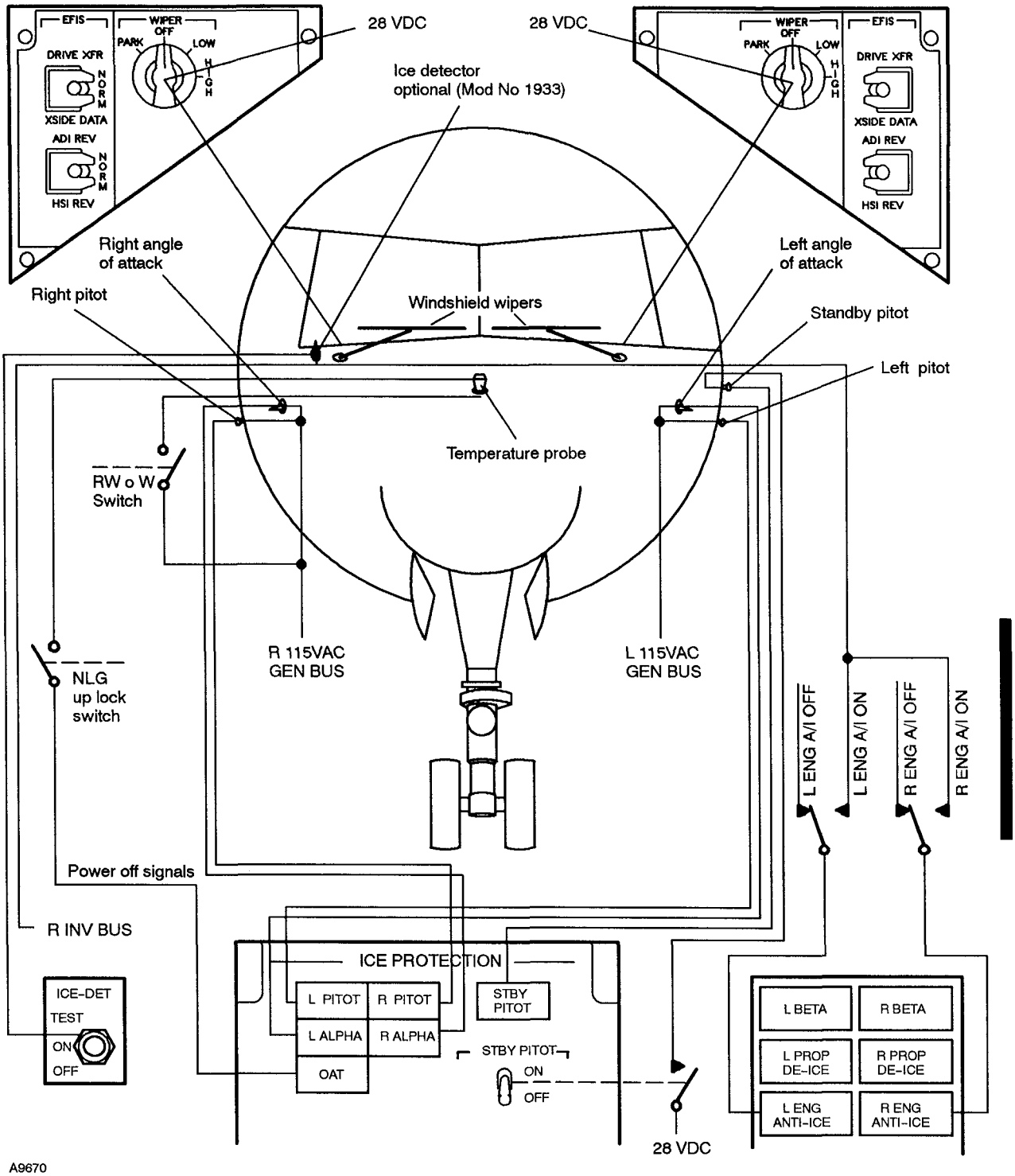


Fig. 5. Windshield wiper and probe heat – schematic.

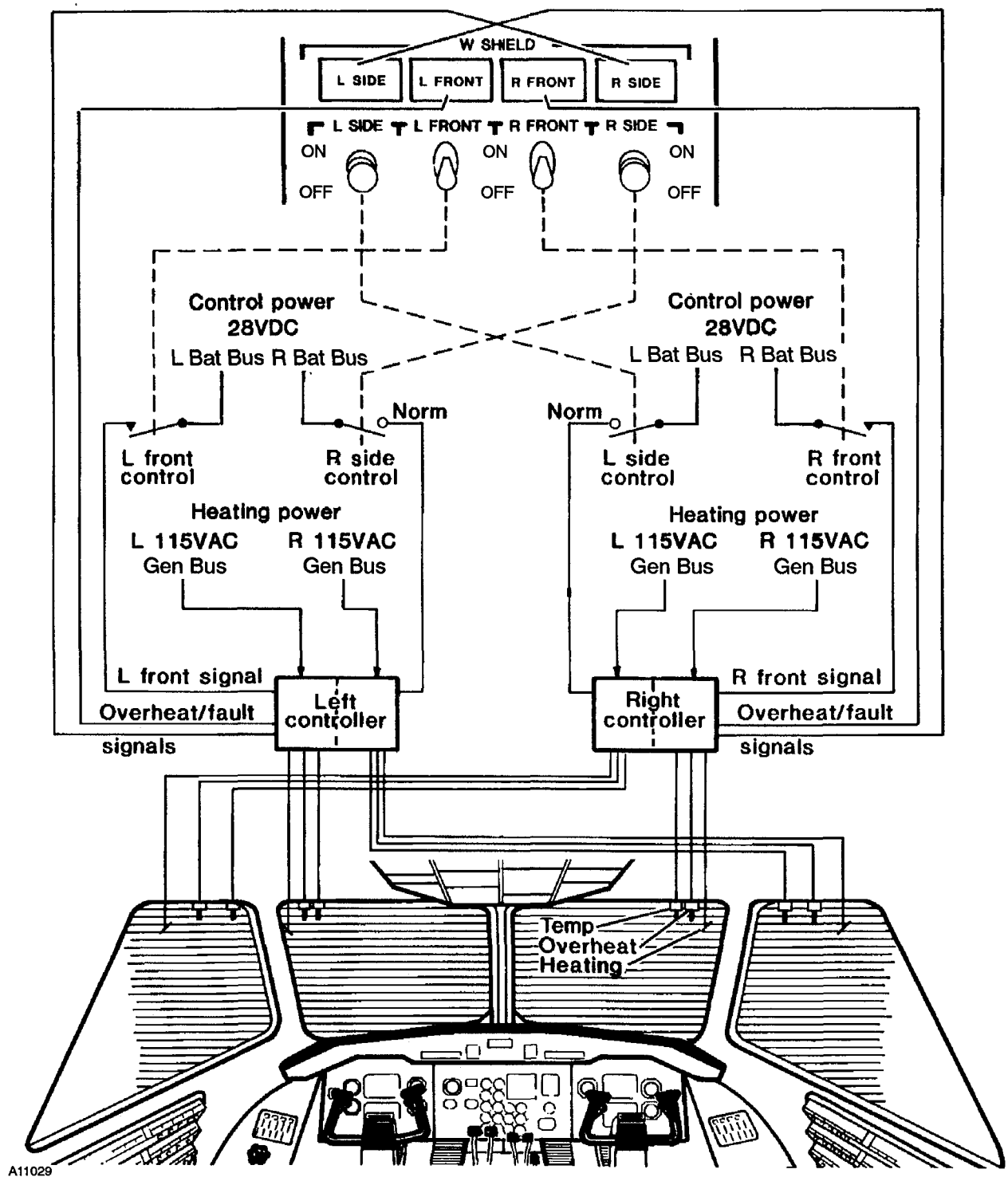


Fig. 4. Window heat – schematic.

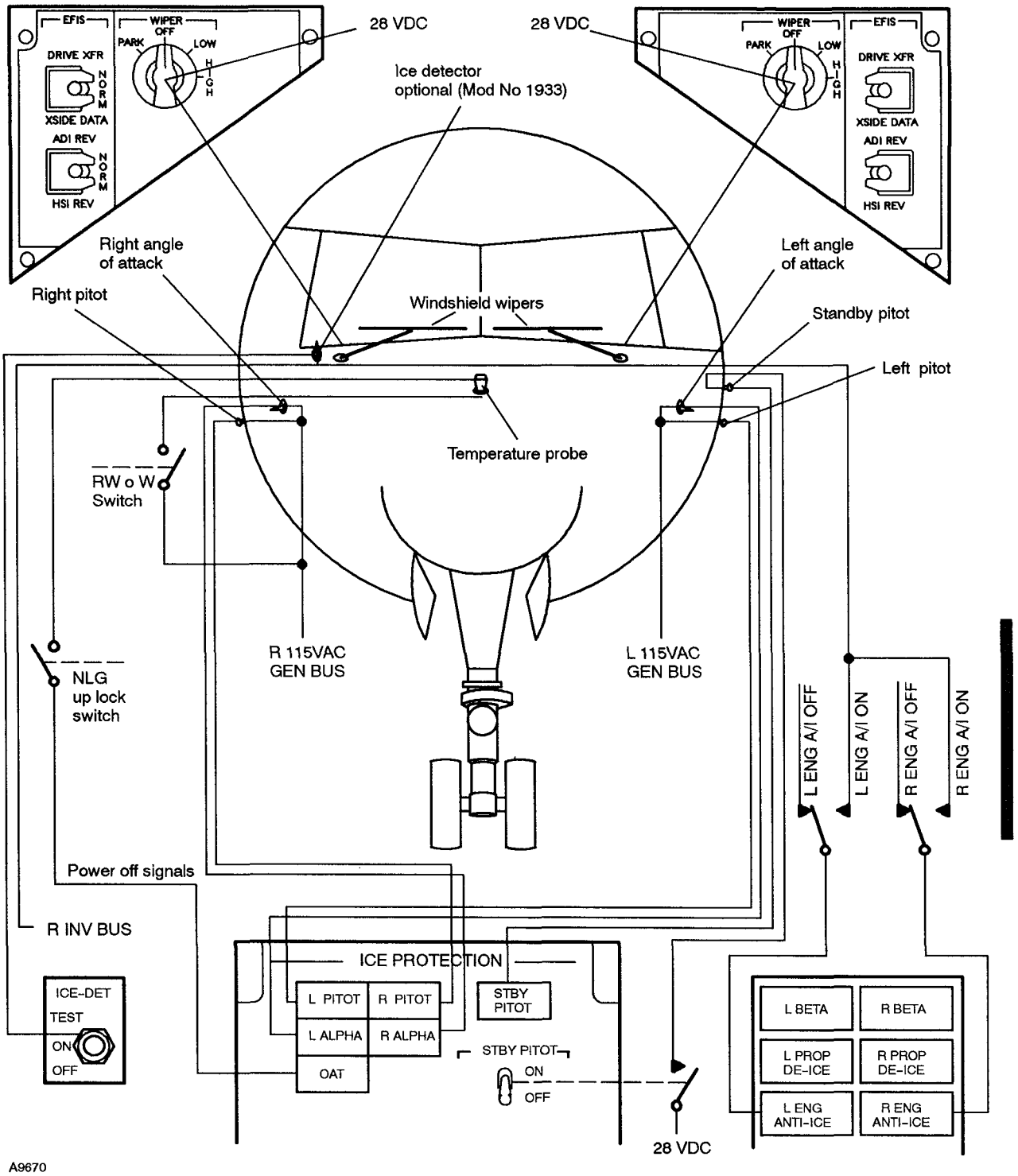
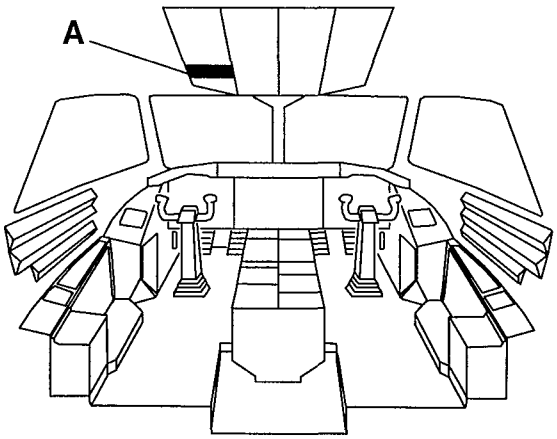


Fig. 5. Windshield wiper and probe heat – schematic.



Timer light (amber).

Will come on if:

– no pressure is sensed downstream the valve sequenced for opening within 4 seconds.

– the activated timer gives no inflation signal.

– the boots are not cycling.

– pressure remains on in the stabilizer boot zones (AUTO CYCLING switch in CONT).

– pressure remains on in the stabilizer boot zones when next cycle is activated. (AUTO CYCLING switch in ONE CYCLE.)

– pressure remains on in Left and Right inboard wing or Left and Right outboard wing boot zone after more than 8 seconds.

With Mod No 2083 installed the following additional faults triggers the TIMER light.

– pressure remains on in any boot zone (AUTO CYCLING switch in ONE CYCLE or CONT).

– control power to timer is lost. If the W OUTB push button is depressed the TIMER light will go out, when the button is released the light will come on again.

– drepressing any of the Manual push buttons while in CONT or during a one CYCLE sequence will result in the TIMER light coming on momentarily.

Boot indication lights (green).

Will come on whenever the respective boot system is pressurized and BOOT IND switch is ON.

Manual de–ice buttons.

Overrides timer function and keeps respective de–ice valve open as long as button is depressed.

DE–ICE OV TEMP light (amber).

Will come on together with associated master caution whenever either of the two overheat sensors detects an overtemperature.

AIR SUPPLY switch.

ON shutoff valves open.

OFF shutoff valves closed.

BOOT IND switch.

When in OFF the boot indication light system is deactivated.

AUTO CYCLING

Activates timer to give a four–times six second cycle of boot inflation in the following order:

° Stabilizer
° Outboard wing
° Inboard wing
° Stabilizer

ONE CYCLE (Spring loaded to OFF position): One complete cycle.

CONT: One complete cycle every third minute.

A STABILIZER AND WING DE–ICE PANEL

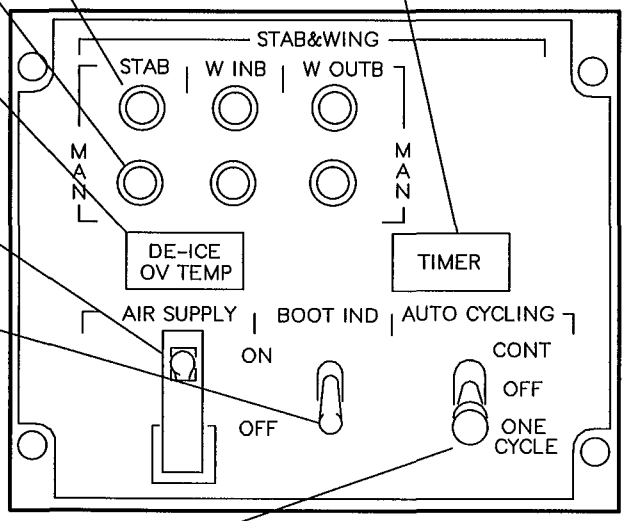


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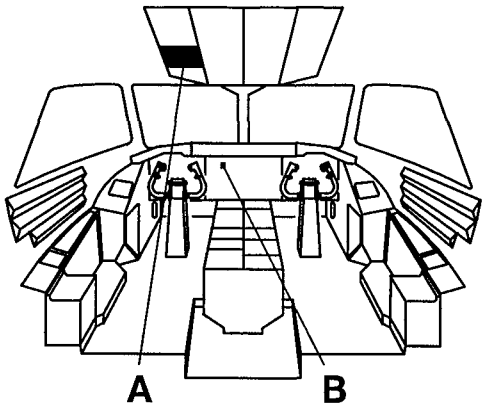
FIG 6. Stabilizer and wing de–ice system – controls and indicators



L/R INTAKE light (amber).
Will come on for a failure in the engine duct electrical anti–icing systems.

L/R AIR light (amber).
Will come on under the following conditions.
– If the Electronic Solenoid Valve does not open when respective ENGINE anti–ice switch is turned ON.
– If the Electronic Solenoid Valve does not close when respective ENGINE anti–ice switch is turned OFF.

L/R ENGINE anti–ice switch.
Controls both electrical and bleed air sections of the engine anti–ice system and illuminates the ENG ANTI–ICE light in the Flight Status Panel.

L/R AC GEN light (amber).
Will come on if the generator fails.

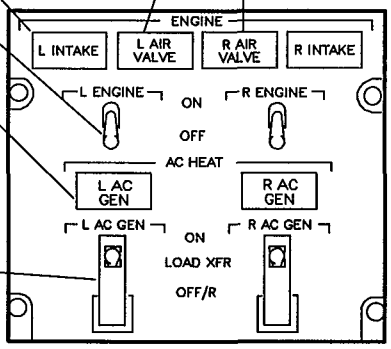
L/R AC GEN switch.
Controls AC generator power supply.

ON:	– AC generator on line.
	– Automatic power transfer from other side in case of generator failure (except for intake heating).
	– No power transfer in case of generator control failure.
	– No power transfer in case of failure in power feeder line to 115 VAC GEN BUS.
LOAD XFR	– Power transfer from other side.
	– Intake heat supplied by own generator
OFF/R	– Off reset position.
	– Power transfer from other side.
	– No intake heat.

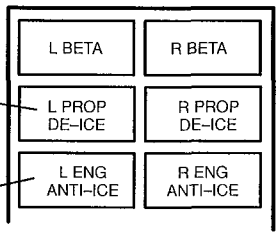
L/R PROP DE–ICE light (blue).
Will come on when the system is working and will go out in case of system failure.

L/R ENG ANTI–ICE light (blue).
Will come on whenever the engine anti–ice switch is turned on. With the optional ice detector system (Mod No 1933) installed the lights come on flashing when ice is detected. With the Eng anti–ice switched on the lights change to steady indication.

A ENGINE ANTI–ICE PANEL

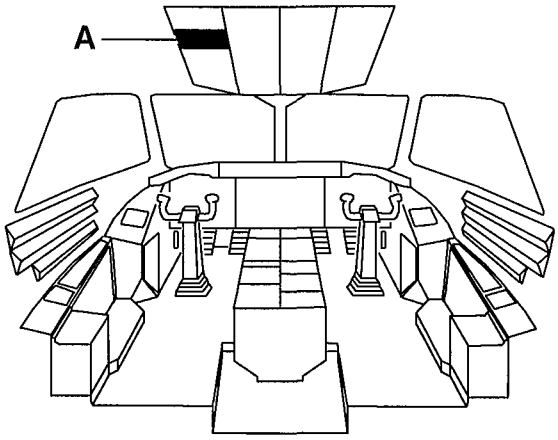


B FLIGHT STATUS PANEL

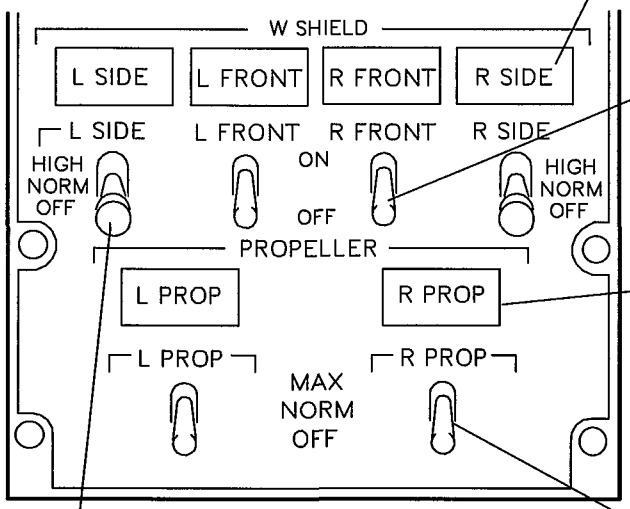


A9669

FIG 7. Engine anti–ice system – controls and indicators.



A PROPELLER AND WINDSHIELD DE–ICE PANEL



L/R SIDE/FRONT light (amber).

Will come on when an overheat or controller fault occurs.

L/R FRONT windshield heating switch.

Regulated power is applied to front windshield when set to ON.

L/R PROP light (ambers).

Will come on when a fault is detected in an activated system.

L/R SIDE windshield heating switch.

NORM Used for defogging.
HIGH Used for de–icing.
OFF Resets controller if tripped.

NORM must be used for 7 minutes before HIGH is selected. When HIGH is selected on ground NORM power will be applied until WoW switch senses airborn.

L/R PROP de–ice switch.

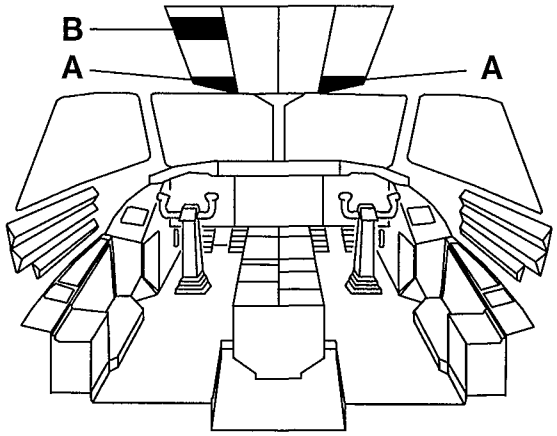
When set to ON a timer/monitor initiates heating cycles as below for each pair of symmetrical propeller blades and illuminates the PROP DE–ICE light.

Heating cycles:

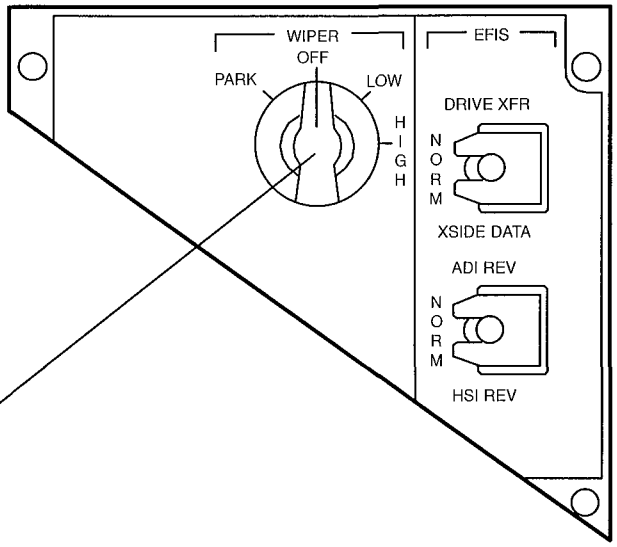
– NORM	Power on 11 sec, power off 79 sec.
– MAX	Power on 90 sec, power off 90 sec.

A9923

FIG 8. Propeller and windshield de–ice systems – controls and indicators



A WINDSHIELD WIPER PANEL



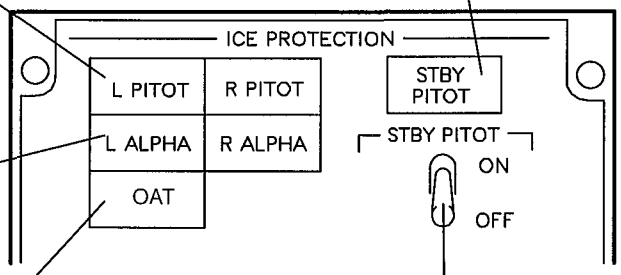
Wiper rotary switch

PARK	Wiper is returned to stowed position.
OFF	Wiper stops in present positon.
LOW	Wiper operates at low speed.
HIGH	Wiper operates at high speed.

STBY PITOT light (amber).
Will come on when power is lost to the standby pitot tube.

L/R PITOT light (amber).
Will come on when power is lost to the respective main pitot tube.

B PROBE HEAT PANEL



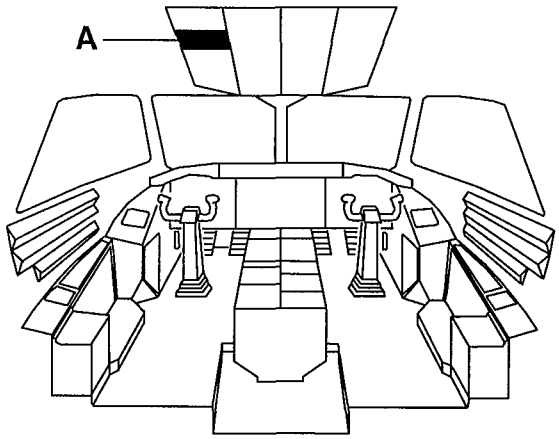
L/R ALPHA light (amber).
Will come on when power loss is lost to the respective angle of attack sensor.

OAT light (amber).
Will come on when power is lost to the temperature probe when NLG is locked in retracted position.

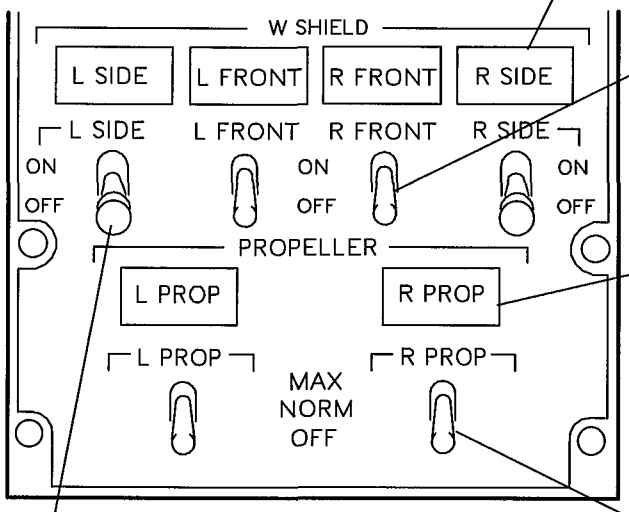
STBY PITOT switch.
When selected ON, standby pitot tube is powered.

A9924

FIG 9. Windshield wiper and probe heat system – controls and indicators.



A PROPELLER AND WINDSHIELD DE–ICE PANEL



L/R SIDE/FRONT light (amber).
Will come on when an overheat or controller fault occurs.

L/R FRONT windshield heating switch.
Regulated power is applied to front windshield when set to ON.

L/R PROP light (ambers).
Will come on when a fault is detected in an activated system.

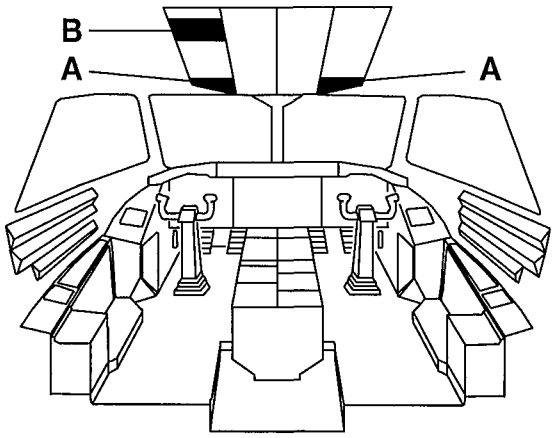
L/R PROP de–ice switch.
When set to ON a timer/monitor initiates heating cycles as below for each pair of symmetrical propeller blades and illuminates the PROP DE–ICE light.

Heating cycles:

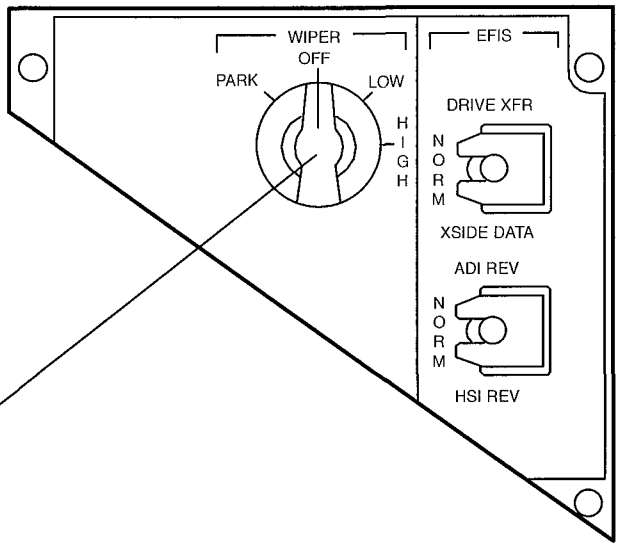
– NORM	Power on 11 sec, power off 79 sec.
– MAX	Power on 90 sec, power off 90 sec.

A11028

FIG 8. Propeller and windshield de–ice systems – controls and indicators.



A WINDSHIELD WIPER PANEL



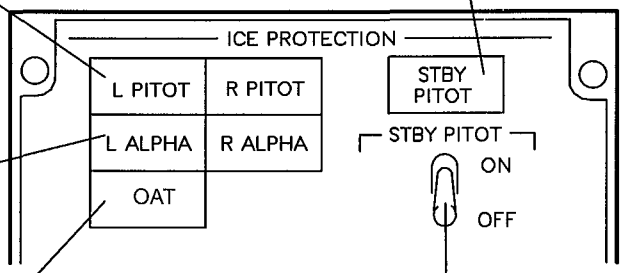
Wiper rotary switch

PARK	Wiper is returned to stowed position.
OFF	Wiper stops in present positon.
LOW	Wiper operates at low speed.
HIGH	Wiper operates at high speed.

STBY PITOT light (amber).
Will come on when power is lost to the standby pitot tube.

L/R PITOT light (amber).
Will come on when power is lost to the respective main pitot tube.

B PROBE HEAT PANEL



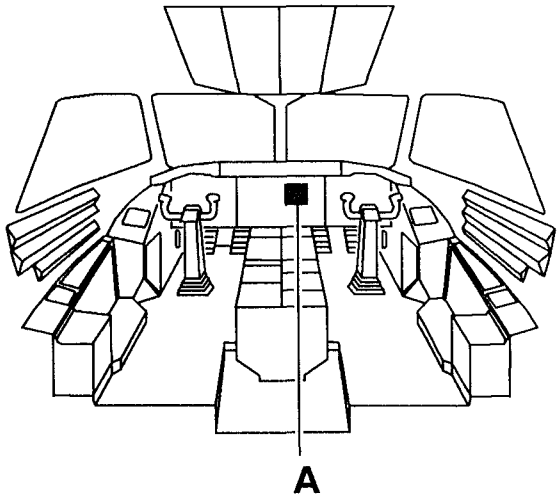
L/R ALPHA light (amber).
Will come on when power loss is lost to the respective angle of attack sensor.

OAT light (amber).
Will come on when power is lost to the temperature probe when NLG is locked in retracted position.

STBY PITOT switch.
When selected ON, standby pitot tube is powered.

A9924

FIG 9. Windshield wiper and probe heat system – controls and indicators.



A CENTRAL WARNING PANEL

ICE PROT light (amber)

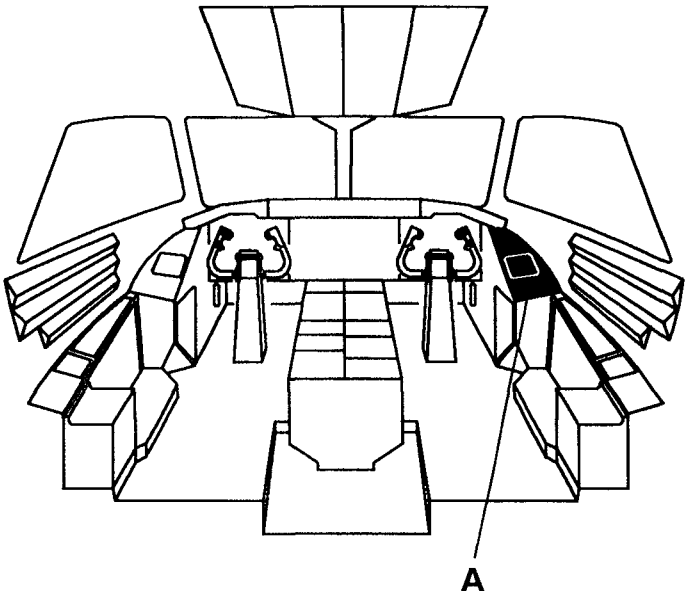
The ICE PROT light will come on flashing whenever a caution light associated with the ice protectin system comes on.

L FIRE DET FAIL	FUEL ↑	ELEC ↑	R FIRE DET FAIL
ICE PROT ↑	ENGINE ↑	FLAPS	AIR COND ↑
PARK BRK ON	HYDR ↓	EMER LTS UNARMED	OXYGEN
A-SKID INOP ↓	AVIONICS	AVIONICS VENT	DOORS ↑
L STALL FAIL	GUST LOCK	PUSHER SYSTEM	R STALL FAIL

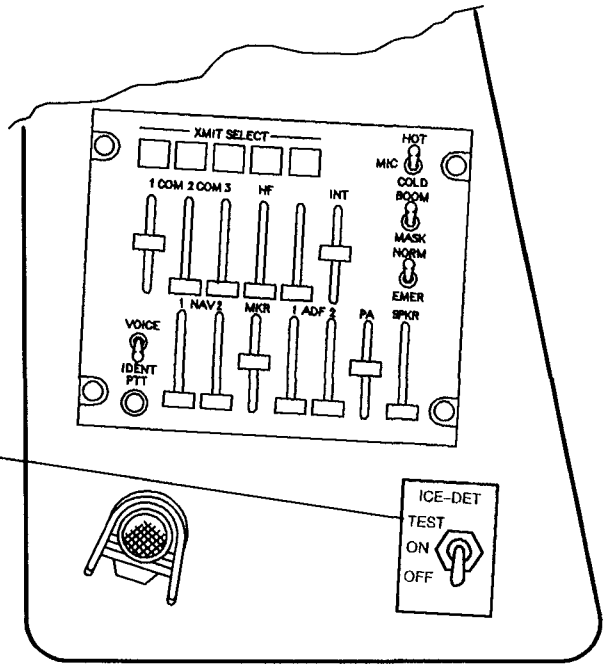
A9920

FIG 10. Ice and rain protection master caution – controls and indicators

3. CONTROLS AND INDICATORS.



A SIDE PANEL



ICE DETECTOR switch
Optional Mod No 1933

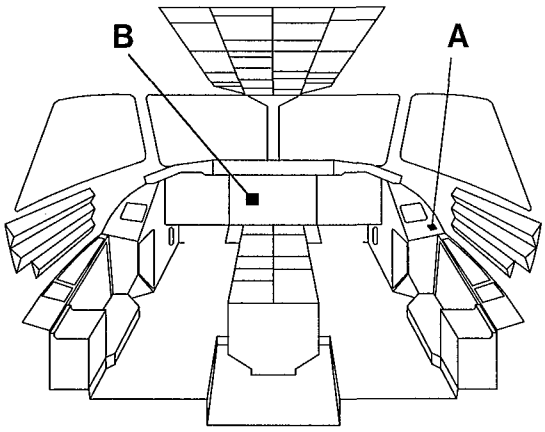
TEST– Self test of the ice detector micro-processor. Flashing of the L and R ENG ANTI-ICE blue status light within 5 seconds while the switch is hold in TEST position is a confirmation of a successful selftest.

ON – The ice detection system is ON.

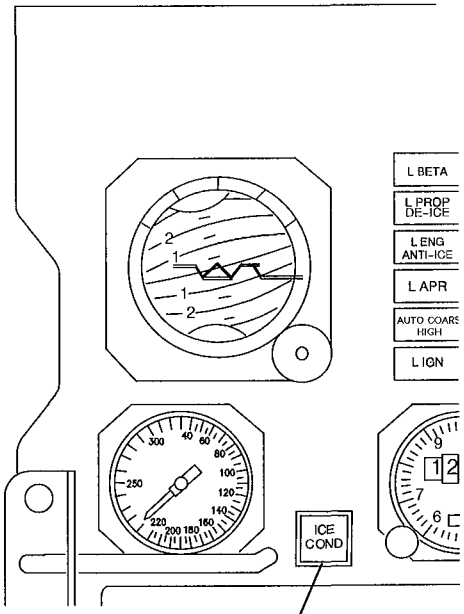
OFF – OFF position

A9667

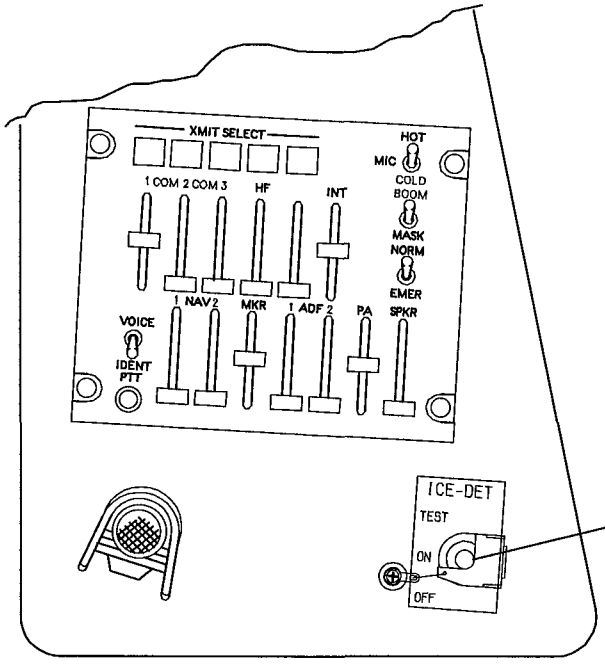
FIG 11. Ice Detection System (Option Mod No 1933)



B CENTER INSTRUMENT PANEL



A SIDE PANEL



ICE COND indication light (white)
Optional Mod No 3168

The ice detection indication light comes on if the ice detector senses ice.

ICE DETECTOR switch
Optional Mod No 3168

TEST– Self test of the ice detector micro–processor. Illumination of the white ICE COND indication light and flashing of the L and R ENG ANTI–ICE blue status light within 5 seconds while the switch is hold in TEST position is a confirmation of a successful selftest.

ON – Normal position. The ice detection system is ON.

OFF – Guarded OFF position. Should only be used if the system is faulty.

A28796

FIG 12. Ice Detection System (Option Mod No 3168)

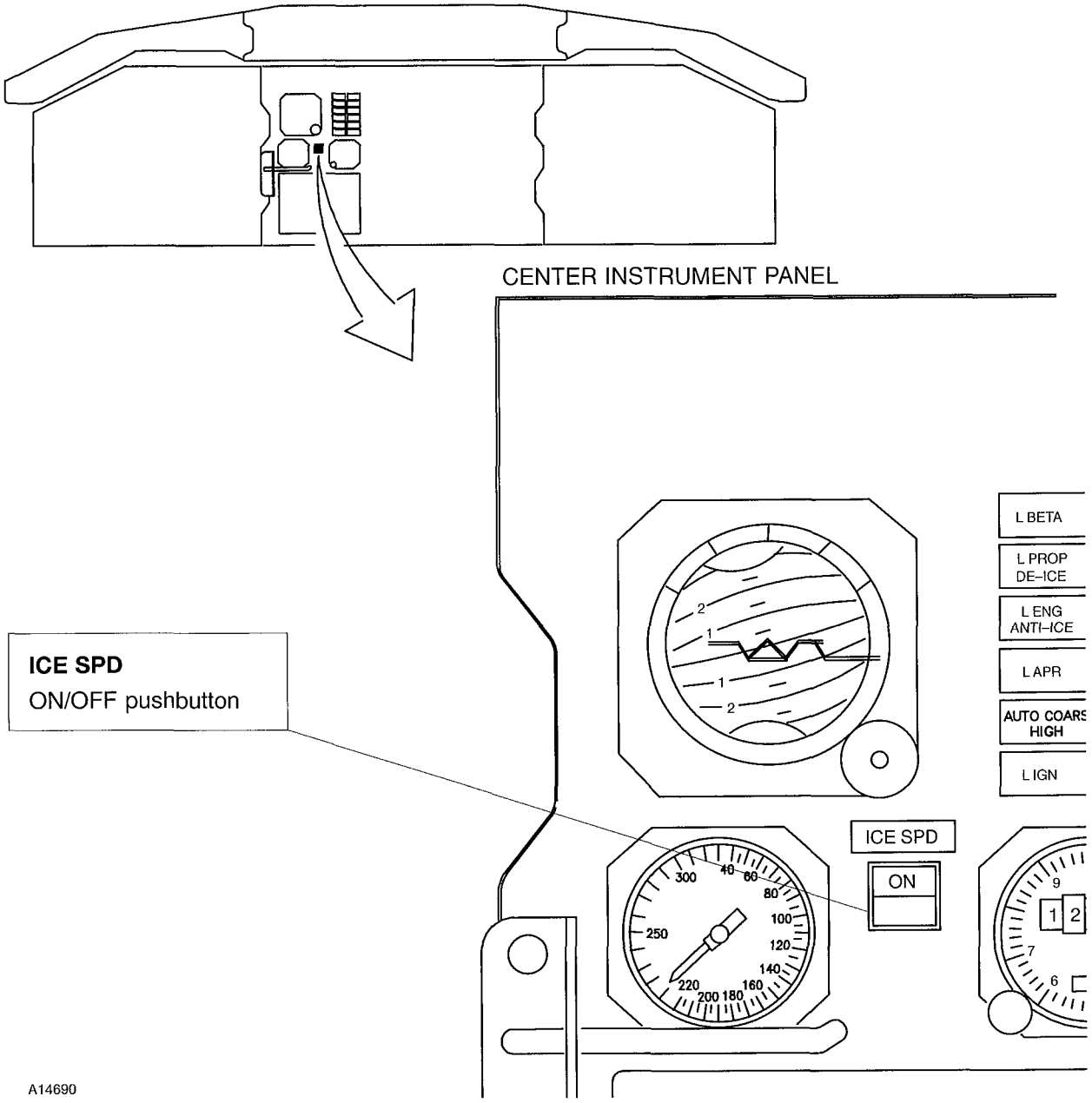


FIG 13. ICE SPD button (Option Mod No 2650).

4. ELECTRICAL POWER SUPPLY.

Wing and stabilizer de–ice.

Timer control	L BAT BUS	K–21	STAB & WING AUTO CTL
Shutoff valves	R BAT BUS	S–21	STAB & WING AIR SUP CONTROL
Manual control	R BAT BUS	S–22	STAB & WING MAN CTL & IND
Indications	R BAT BUS	S–22	STAB & WING MAN CTL & IND

Engine anti–ice.

Control L and R	L BAT BUS	H–27	L/R ENG ANTI–ICE CONTROL
Electrical control L	L BAT BUS	H–26	L INTAKE
Air control L	L MAIN BUS	H–25	L AIR VALVE
Electric control R	R BAT BUS	R–27	R INTAKE
Air control R	R MAIN BUS	R–28	R AIR VALVE

Left intake.

PWR Ø A ..... L 115 VAC GEN BUS
PWR Ø B ..... L 115 VAC GEN BUS
PWR Ø C ..... L 115 VAC GEN BUS

Right intake.

PWR Ø A ..... R 115 VAC GEN BUS
PWR Ø B ..... R 115 VAC GEN BUS
PWR Ø C ..... R 115 VAC GEN BUS

Propeller de–ice.

Left propeller.

PWR Ø A	L 115 VAC GEN BUS	H–24	PWR Ø A
PWR Ø B	L 115 VAC GEN BUS	H–23	PWR Ø B
PWR Ø C	L 115 VAC GEN BUS	H–22	PWR Ø C
Control	L BAT BUS	H–21	CONTROL

Right propeller.

PWR Ø A	R 115 VAC GEN BUS	P–21	PWR Ø A
PWR Ø B	R 115 VAC GEN BUS	P–22	PWR Ø B
PWR Ø C	R 115 VAC GEN BUS	P–23	PWR Ø C
Control	R BAT BUS	P–24	CONTROL

Windshield heat

L front

PWR Ø A	L 115 VAC GEN BUS	J–23	PWR Ø A
PWR Ø B	L 115 VAC GEN BUS	J–22	PWR Ø B
Control	L BAT BUS	J–21	CONTROL

L side

PWR Ø C	L 115 VAC GEN BUS	J–26	PWR Ø C
PWR Ø A	L 115 VAC GEN BUS	J–25	PWR Ø A
Control	L BAT BUS	J–24	CONTROL

R front

PWR Ø A	R 115 VAC GEN BUS	R–21	PWR Ø A
PWR Ø B	R 115 VAC GEN BUS	R–22	PWR Ø B
Control	R BAT BUS	R–23	CONTROL

R side

PWR Ø A	R 115 VAC GEN BUS	R–24	PWR Ø A
PWR Ø B	R 115 VAC GEN BUS	R–25	PWR Ø B
Control	R BAT BUS	R–26	CONTROL

Windshield wipers

Wiper L	L BAT BUS	H–28	L WIPER
Wiper R	R MAIN BUS	P–28	R WIPER

Probe heat

Pitot L	L 115 VAC GEN BUS	J–27	L PITOT Ø C
Pitot R	R 115 VAC GEN BUS	S–25	R PITOT Ø A
Angle of attack L	L 115 VAC GEN BUS	J–28	L ALPHA Ø C
Angle of attack R	R 115 VAC GEN BUS	S–24	R ALPHA Ø A
Temperature probe	R 115 VAC GEN BUS	S–23	OAT Ø A
Standby pitot power	R ESS BUS	S–26	STBY PITOT PWR
Standby pitot control	R ESS BUS	S–27	STBY PITOT CONTROL
Ice detector (optional Mod No 1933)	R INV BUS (INV 1)		
Ice detector with Mod No 1933 and 2546	R 115 VAC GEN BUS		
Ice detector with Mod No 3168	R 115 VAC GEN BUS	Not in cockpit	

4. ELECTRICAL POWER SUPPLY.

Wing and stabilizer de–ice.

Timer control	L BAT BUS	K–21	STAB & WING AUTO CTL
Shutoff valves	R BAT BUS	S–21	STAB & WING AIR SUP CONTROL
Manual control	R BAT BUS	S–22	STAB & WING MAN CTL & IND
Indications	R BAT BUS	S–22	STAB & WING MAN CTL & IND

Engine anti–ice.

Control L and R	L BAT BUS	H–27	L/R ENG ANTI–ICE CONTROL
Electrical control L	L BAT BUS	H–26	L INTAKE
Air control L	L MAIN BUS	H–25	L AIR VALVE
Electric control R	R BAT BUS	R–27	R INTAKE
Air control R	R MAIN BUS	R–28	R AIR VALVE

Left intake.

PWR Ø A	L 115 VAC GEN BUS
PWR Ø B	L 115 VAC GEN BUS
PWR Ø C	L 115 VAC GEN BUS

Right intake.

PWR Ø A	R 115 VAC GEN BUS
PWR Ø B	R 115 VAC GEN BUS
PWR Ø C	R 115 VAC GEN BUS

Propeller de–ice.

Left propeller.

PWR Ø A	L 115 VAC GEN BUS	H–24	PWR Ø A
PWR Ø B	L 115 VAC GEN BUS	H–23	PWR Ø B
PWR Ø C	L 115 VAC GEN BUS	H–22	PWR Ø C
Control	L BAT BUS	H–21	CONTROL

Right propeller.

PWR Ø A	R 115 VAC GEN BUS	P–21	PWR Ø A
PWR Ø B	R 115 VAC GEN BUS	P–22	PWR Ø B
PWR Ø C	R 115 VAC GEN BUS	P–23	PWR Ø C
Control	R BAT BUS	P–24	CONTROL

Windshield heat

L front

PWR Ø A	L 115 VAC GEN BUS	J–23	PWR Ø A
PWR Ø B	L 115 VAC GEN BUS	J–22	PWR Ø B
Control	L BAT BUS	J–21	CONTROL

L side

PWR Ø A	L 115 VAC GEN BUS	R–24	PWR Ø A
Control	L BAT BUS	R–26	CONTROL

R front

PWR Ø A	R 115 VAC GEN BUS	R–21	PWR Ø A
PWR Ø B	R 115 VAC GEN BUS	R–22	PWR Ø B
Control	R BAT BUS	R–23	CONTROL

R side

PWR Ø A	R 115 VAC GEN BUS	J–25	PWR Ø A
Control	R BAT BUS	J–24	CONTROL

Windshield wipers

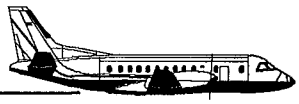
Wiper L	L BAT BUS	H–28	L WIPER
Wiper R	R MAIN BUS	P–28	R WIPER

Probe heat

Pitot L	L 115 VAC GEN BUS	J–27	L PITOT Ø C
Pitot R	R 115 VAC GEN BUS	S–25	R PITOT Ø A
Angle of attack L	L 115 VAC GEN BUS	J–28	L ALPHA Ø C
Angle of attack R	R 115 VAC GEN BUS	S–24	R ALPHA Ø A
Temperature probe	R 115 VAC GEN BUS	S–23	OAT Ø A
Standby pitot power	R ESS BUS	S–26	STBY PITOT PWR
Standby pitot control	R ESS BUS	S–27	STBY PITOT CONTROL
Ice detector (optional Mod No 1933)	R INV BUS (INV 1)		
Ice detector with Mod No 1933 and 2546	R 115 VAC GEN BUS		
Ice detector with Mod No 3168	R 115 VAC GEN BUS	Not in cockpit	

1. LIMITATIONS.

	Unit	Min	Normal	Max
1.1. SYSTEM LIMITS.				
– Windshield heating.				
° Switching side windows direct from OFF to HIGH not authorized.				
° Time in NORM before switching to HIGH.	min	7		
– Pitot tubes.				
° Time from switching STBY PITOT ON until full ice–protection is obtained.	min	5		
– Windshield wipers.				
° In LOW position.	kts			130
° In HIGH position.	kts			160



2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 1. FOD-PREVENTION.	**GENERAL.**

CAUTION

Ice must never be allowed to build-up on the engine air intake lips or intake. Once ice formation occurs, turning on anti-ice may free the ice build-up in chunks that could be sucked through the engine compressor, possibly causing Foreign Object Damage (FOD) and a power interruption.

DO NOT RELY ON AIRFRAME VISUAL ICING CUES TO TURN ENGINE ANTI-ICE ON. USE THE TEMPERATURE AND VISUAL MOISTURE CRITERIA SPECIFIED FOR ICING CONDITIONS.

Ice conditions are defined as:

Icing conditions exist when outside air temperature (OAT) on the ground and for takeoff, or static air temperature (SAT) in flight, is +5°C or below, and visible moisture in any form is present (such as clouds, fog with visibility of one mile or less, rain, snow, sleet, and ice crystals).

Icing conditions also exist when the OAT on the ground and for takeoff is +5°C or below when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush may be ingested by the engines, or freeze on engines, nacelles, propellers, or engine sensor probes.

When anticipating engine anti-ice operation turn on engine anti-ice early. Turning engine anti-ice on well in advance will preheat the surface and thereby prevent ice formation. Turn engine anti-ice on if there is any possibility that icing conditions exist.

Takeoff on RWY with standing water, slush, wet or dry snow:

When taking off in this condition there is a risk of spray ingestion into the engines. Switch on engine anti-ice when ambient temperature is +5°C and below (operation may be restricted by national rules).

Ice formation discovery during night flight:

When operationally feasible, switching on cockpit dome light will increase the possibility of discovering unexpected ice i.e. on the wipers. Using strobe-light or switching on landing light now and then will increase the possibility of identifying unexpected icing conditions. The air inlet can be inspected from cockpit by use of flashlight.

Operation in and after certain icing conditions:

During flight through heavy snow, heavy sleet or ice crystals, substantial amount of ice may be collected on parts of the bird catcher even with a fully functioning engine anti-ice system. This is no problem even with a fully functioning engine anti-ice system, as long as a positive airflow through the bird-catcher is assured. However, REVERSE POWER OPERATION BELOW 50 KTS (EVEN WITH A FULLY OPEN EXHAUST NOZZLE) AND DURING PROPELLER BRAKE OPERATION WITH A MORE THAN 30% ICED-UP (BLOCKED) NOZZLE THE AIRFLOW IS REVERSED THROUGH THE BIRDCATCHER.

(Cont' d)

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	Such conditions are potentials for ice being sucked into the engine. After encountering such conditions keep the engine anti–ice system ON for the duration of flight at temperature below +5°C if operationally feasible. Engine anti–ice ON during ground operation after landing will assure that both the air and the walls in the birdcatcher is warmed up. This will expedite melting of possible ice collected in the birdcatcher. However, if the prevailing temperature is below the freezing point, de–icing of the birdcatcher might be necessary. An inspection of the air intake/birdcatcher for possible residual ice/snow, will determine the need for de–icing of the birdcatcher. **If icing conditions have been encountered during flight:** – If operationally feasible avoid use of reverse thrust below 50 kts.
2. 2. WING AND STABILIZER DE–ICE OPERATION. (Cont'd)	**System check. (HP VALVE in AUTO)** 1. AIR SUPPLY switch ..... CHECK ON 2. BOOT IND switch ..... ON – Set BOOT IND switch to ON for boot indication lights to work during test. 3. AUTO CYCLING switch ..... ONE CYCLE – Set AUTO CYCLING switch momentarily to the ONE CYCLE position and release it to OFF. – Observe boot indication lights to come on one at a time (for approximately 6 sec.) in the following order: STAB – W OUTB – W INB – STAB. 4. Caution lights ..... CHECK – Check DE–ICE OV TEMP and TIMER caution lights to be off. **In flight, when wing and stabilizer de–icing required.** NOTE HP bleed may be required for operation of the boot de–ice system at high altitudes and/or low power settings. With Mod No 2310 installed HP Bleed will be automatically provided when PL is below 64° (min Takeoff position) and the boots are cycling provided the HP valves are in AUTO position.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	5. AUTO CYCLING switch ..... CONT / ONE CYCLE – Operate the BOOT DE–ICE system at the first sign of ice formation anywhere on the aircraft, or upon annunciation from an ice detector system, (if installed) whichever occurs first. Continue to operate the system in either CONT mode, or operate the system as needed (if ice accumulation between the cycles is estimated to be more than 5 mm (1/4 inch)) to minimize the ice accumulation on the airframe. In severe icing it might be necessary to operate the boots manually, in between the automatic cycling in CONT mode, to minimize ice accumulation. Use the BOOT DE–ICE system until the airplane is determined to be clear of ice after leaving icing conditions. – Observe boot indication lights to come on, one at a time. – Do not use CONT mode on final approach. Complete boot de–icing prior to landing (to prevent the boot from inflating during the flare). **When wing and stabilizer de–icing no longer required.** 6. AUTO CYCLING switch ..... OFF **Boots de–ice manual operation.** – Press and hold one manual push–button at a time for 6 sec. in the following sequence: STAB–W OUTB – W INB–STAB. – Observe respective BOOT IND light to come on. – Repeat as often as required (ice accumulation more than 5 mm (1/4 inch)).
2. 3. ENGINE ANTI–ICE OPERATION. (Cont'd)	**Engine anti–ice must be switched on:** – Well in advance before icing conditions are encountered in flight. In icing conditions move CL into MIN/MAX range as soon as possible after engine start and switch ON engine anti–ice. **When engine anti–ice required.** CAUTION On ground, use the officially reported temperature when deciding upon use of engine anti–ice system as temperature on EFIS is normally too high. NOTE When switching Engine Anti–ice ON or OFF check proper function by observing a decrease or increase in engine torque setting. In case of no decrease or increase, reduce power to below 88% Ng cycle switch (OFF then ON) and then increase max cruise power to restore proper function. NOTE APPLICABLE TO AIRCRAFT WITH COX INTAKE Mod No 2095 INSTALLED. In extreme cold temperatures L/R INTAKE light may come on after engine anti–ice activation bacause of the relatively long time to reach working temperature. Selecting the switch to OFF then ON will solve the problem since at this time the intake has been preheated.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	1. ENGINE anti–ice switches ..... ON (ONE AT A TIME) – Check L/R ENG ANTI–ICE light to come on. For corrections to thrust settings, see section 26 POWER SETTINGS. **When engine anti–ice no longer required.** NOTE To avoid exceeding torque setting chart limit, a reduction in torque may be required before switching OFF Engine Anti–Ice system. 2. ENGINE anti–ice switches ..... OFF – Check L/R ENG ANTI–ICE lights to go off.
2. 4. PROPELLER DE–ICING OPERATION. (Cont'd)	**Propeller de–icing shall be used:** – When ice accretion is observed on any part of the aircraft at temperatures of –5°C and colder. ° In NORM mode when the temperature is between –5°C and –12°C SAT. ° In MAX mode when temperature is –13°C SAT and colder. CAUTION On ground, use the officially reported temperature when deciding upon use of engine anti–ice system as temperature on EFIS is normally too high. NOTE Increased propeller RPM improves the ice shedding capabilities of propellers and spinners. Therefore, select max RPM if severe icing conditions ar experienced or expected. NOTE If unacceptable propeller vibrations occur in the temp. range –10°C to –12°C SAT due to propeller ice, use MAX mode. If unacceptable vibrations occur at warmer temperatures than –10°C use MAX for a short period until the vibrations disappear. Bear in mind the possibility of runback ice with subsequent performance degradation if the system is continuously operating in MAX at SAT warmer than –12°C. Switch to NORM as soon as possible. **System check.** 1. L/R PROP switches ..... NORM – Leave L/R PROP switches in NORM for more than 90 seconds. ° Check L/R PROP DE–ICE lights to come on.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	2. L/R PROP switches ..... OFF – Check L/R PROP DE–ICE lights to go out. **When propeller de–ice required.** NOTE When switching from NORMAL to MAX or MAX to NORMAL turn the switch to OFF before selecting MAX respectively NORMAL. Switching direct from NORMAL to MAX or vise versa may result in nuisance TIMER caution. 3. L/R PROP switches ..... NORMAL/MAX – Check L/R PROP DE–ICE light to come on. **When propeller de–ice no longer required.** 4. L/R PROP switches ..... OFF – Check L/R PROP DE–ICE lights to go out.
2. 5. WINDSHIELD HEATING.	**When windshield heating required.** 1. W SHIELD L/R FRONT switches ..... ON 2. W SHIELD L/R SIDE switches ..... NORM, THEN HIGH – Set windshield SIDE switches in NORM. NORM must be selected for at least 7 minutes before HIGH may be selected. NOTE If HIGH is selected on ground NORM power will be supplied while on ground. **When windshield heating no longer required.** 2. W SHIELD heat switches ..... OFF
2. 6. WINDSHIELD WIPER OPERATION	– Do not operate windshield wipers on dry windshields. – Max IAS in LOW position is 130 kts and 160 kts in HIGH position. 1. Windshield wipers ..... PARK/OFF /LOW/HIGH – Set as required.

CONDITIONS	NORMAL PROCEDURES
2. 7. PROBE HEAT.	Probe heat for the main pitots, angle of attack sensors and (only in flight) temperature probe is activated when the 115 AC GEN BUSES are powered. **Before takeoff.** 1. STBY PITOT switch ..... ON – Check that STBY PITOT light is not on. – 5 minutes heating up time is required before full ice protection is obtained. **After landing.** 2. STBY PITOT switch ..... OFF – Check that STBY PITOT light is on.
2. 8. ICE SPD. **With Mod No. 2650 installed.**	**ICE SPD pushbutton shall be activated:** – If ice accumulation is observed on the aircraft or if it is not certain there is no ice on the wings. Deactivate the system when it is certain there is no ice on the wings.
2. 9. FREEZING RAIN/ FREEZING DRIZZLE.	**Identification of freezing rain / freezing drizzle.** Substantial ice build up on the spinner, further aft than normally observed, might be an indication of freezing rain / drizzle. If observed, increase scanning of the wing. If accumulation of ice on the upper surface aft of the boots is observed, exit the area with these conditions immediately to avoid extended exposure. If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot. Keep the autopilot disengaged until the upper wing surface is free from ice. If an unusual roll response or uncommanded roll control movement is observed, decrease the angle of attack.