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E-GS-20-0008 Rev IR

Instructions for Continued Airworthiness

Flap/Slat Actuator Heater System
Gulfstream G150

Registration No.:_____

Serial No.:_____

STC No. TBD

REVISION STATUS

Rev.	Description	Approval	Date
IR	Initial Release	D. Rankin	10/9/2020

Airworthiness Limitations

The Airworthiness Limitations section is FAA approved and specifies maintenance required under 14 CFR §§43.16 and 91.403 of the Federal Aviation Regulations, unless an alternative program has been FAA approved.

There are no new (or additional) airworthiness limitations associated with this equipment and/or installation.

AIRWORTHINESS LIMITATIONS APPROVAL		
Revision	Date	Approved
IR	11/2/2020	Kreg R. Voorhies, ODA administrator Cert Works ODA ODA(AIR)-833887-NM

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1. INTRODUCTION

1.1. Purpose

This document describes the maintenance procedures related to the supplemental Flap/Slat Actuator Heating System (FSAHS) equipment installed as part of this Supplemental Type Certificate (STC). This document includes specific maintenance considerations for the affected changes to the Gulfstream G150 airplane as required for compliance with 14 Code of Federal Regulations (CFR) § 21.50(b). This document identifies specific maintenance considerations that are not already addressed by the current aircraft maintenance manual (AMM).

Modification of an aircraft with the implementation of this STC obligates the operator to include the maintenance items identified within this document into their existing maintenance program to maintain the aircraft in an airworthy condition as specified by 14 CFR §43.16, *Airworthiness Limitations*.

It is therefore the responsibility of the owner / operator to ensure the latest revisions of all documents specified are utilized during operation and maintenance of the airplane.

1.2. Distribution

A copy of this document is distributed with each original STC package. This document should be filed with a Federal Aviation Administration (FAA) Form 337, *Major Repair & Alteration (Airframe, Powerplant, Propeller, or Appliance)*, completed by the installer so that it remains as part of the permanent aircraft record.

The latest revision of this document is indicated by the highest revision letter listed in the revision history. Changes from the previous revision are specified in the description field of the revision block. This document will be completely replaced at each revision. All superseded documents should be discarded.

These Instructions for Continued Airworthiness (ICA) may be requested from Peregrine or the current STC owner on file with the FAA. Notification of any changes to the ICA will be undertaken by e-mailing the affected purchasers of the STC at those addresses registered and filed when the installation is completed.

Changes to this ICA will be made available to owners upon release to the FAA for review except for changes to airworthiness limitations and certification maintenance requirements. Any changes to airworthiness limitations and certification maintenance requirements are to be FAA-approved prior to distribution.

1.3. Definitions and Acronyms

AMM	Aircraft Maintenance Manual
APU	Auxiliary Power Unit
BIT	Built in Test
CB	Circuit Breaker
CBIT	Continuous BIT
CFR	Code of Federal Regulations
DC	Direct Current
F	Fahrenheit
FS	Fuselage Station
F/S	Flap/Slat
FAA	Federal Aviation Administration
FSAHS	Flap/Slat Actuator Heating System
Gen	Generator
ICA	Instructions of Continued Airworthiness
LBS	Pounds
LED	Light Emitting Diode
LH	Left Hand
PBIT	Power on BIT
PDU	Power Drive Unit
PTT	Push to Test
STC	Supplemental Type Certificate
Vdc	Voltage, Direct Current

2. SYSTEM DESCRIPTION

2.1. Existing G150 Flap/Slat System

The G150 flap and slat drive system is comprised of a Power Drive Unit (PDU), flexible drive shafts, and twelve linear ball screw actuators (3 per wing, 2 systems). Reference Figure 1 for the relative location of the actuators for each wing.

This STC does not modify the G150 Flap/Slat drive system including controls, indications, safety mechanisms or recommended lubrication maintenance procedures. The existing Flap/Slat actuators are modified by the installation of external supplemental heaters only.

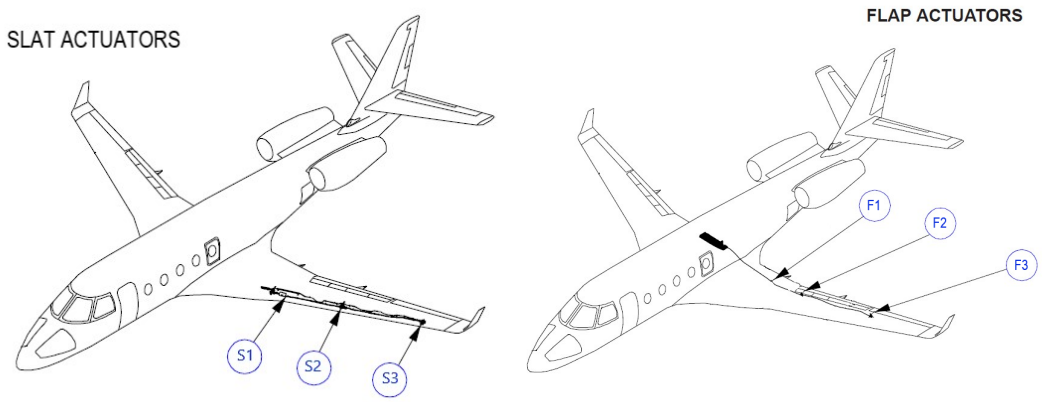


Figure 1: Flap/Slat Mechanical Components (Left Wing Shown)

2.2. Reference Documents

Source	Document No.	Revision*	Title
Applied Avionics	12-2001-04	B	VIVISUN LED The Complete Switch
Peregrine	PA-200124-805	IR	Heater Control Box Source Control Drawing
Peregrine	PA-200124-807	IR	Clamp Heater Source Control Drawing
Peregrine	PA-200124-817	IR	Clamp Heater Source Control Drawing
Peregrine	PA-200124-827	IR	Clamp Heater Source Control Drawing

*Or later approved revision

2.3. Supplemental Heater System

The Cox and Company, FSAHS consists of a Flap/Slat (F/S) Heat Controller, six flap and six slat actuator heaters (12 total), and an ON/OFF switch. The heat controller automatically cycles power to the Flap and Slat heaters if the actuator temperature drops below 40° Fahrenheit (F). A thermistor on each actuator is used to activate the system.

The installation includes an automatic load shed feature, that will remove power from the system in the event of a loss of an engine generator.

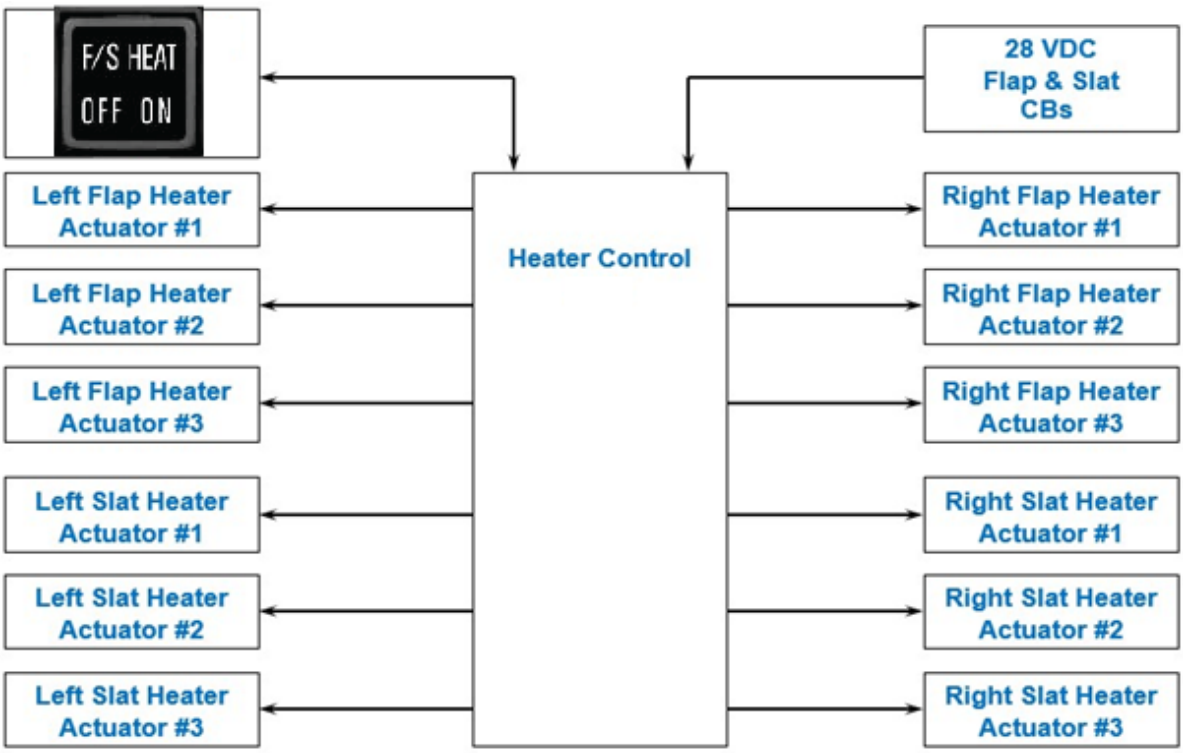


Figure 2: FSAHS Block Diagram

2.4. System Components

This STC installs the components identified in Table 1.

Table 1: Flap/Slat Actuator Heating System Components

Component	Source	Part Number	Location
Flap Actuator Heaters	Peregrine	PA-200124-807	Flap 1 (F1)
		PA-200124-817	Flap 3 (F3)
		PA-200124-827	Flap 2 (F2)
Slat Actuator Heaters		PA-200124-806	Slat 3 (S3)
		PA-200124-817	Slat 1 (S1), Slat 2 (S2)
FSHCU		PA-200124-805	LH Belly Fairing
ON/OFF Switch	Applied Avionics	LED-41-14-EA3-E2N2P	Flight Deck, Center Pedestal
Circuit Breakers	ETA	4210-IAI-15	OVHD CB Panel
Heater Enable Relay	TE Connectivity	FC-325-8	RH Cabin Sidewall
Relay Mounting Bracket	Peregrine	PA-200124-303	RH Cabin Sidewall
Blocking Diode	Amphenol	TJSE20705	OVHD CB Panel
Control Box Mounting Brackets	Peregrine	PA-200124-303	LH Belly Fairing

2.4.1. Flap/Slat Heat Control Unit (FSHCU)

The F/S Heat Control Unit (P/N PA-200124-805) is mounted adjacent to the cabin power inverter located near fuselage station (FS) 287. The installation utilizes metal brackets to secure the controller to structure. Light Emitting Diodes (LED) on the control box indicate the status of the heater system. A Press-To-Test (PTT) switch is located on the exterior of the controller to initiate a self-test of the system when the airplane is on the ground. The controller also performs a self-test at power up and at predetermined intervals during normal operation. System faults are identified as a red illuminated LED.

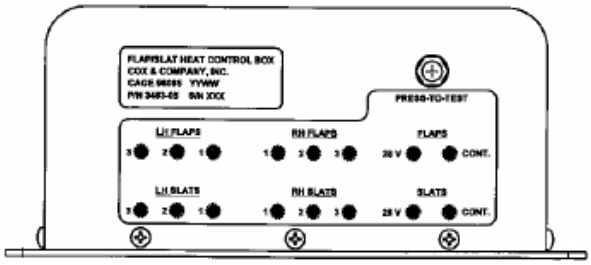


Figure 3: F/S Heat Controller

2.4.2. Heaters

Cox has designed four heater part numbers for the Flap/Slat actuators on the G150. All are of the wrap-around, cuff-style, design and are mounted on the exterior of the actuators and secured with stainless-steel band clamp(s). Thermistor installed on each heater provides temperature feedback data to the FSHCU to allow automatic cycling of the actuator heaters and ensures the upper limit of 130° F is not reached.

- PA-200124-827

Heater PA-200124-827 is a dual element heater that is installed on flap actuator #2 on both wings (2 total).

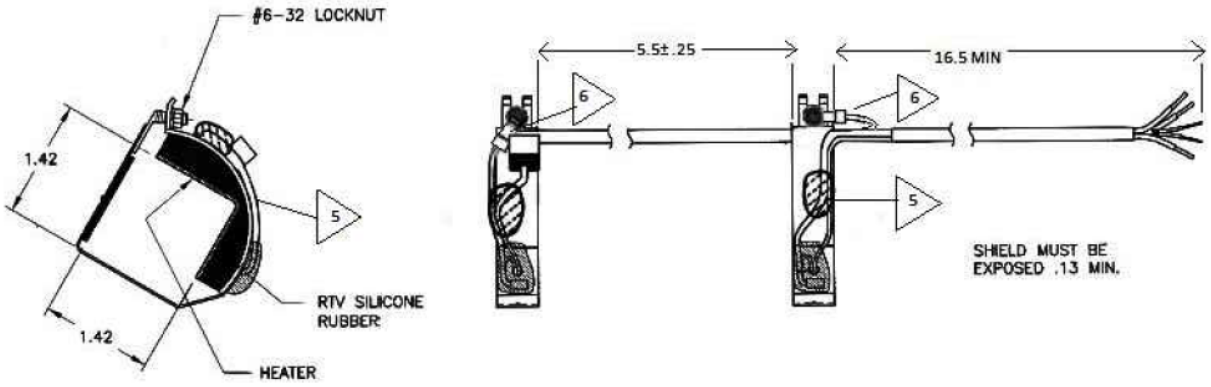


Figure 4: Actuator Heater PA-200124-827 (F2)

- PA-200124-817

Heater PA-200124-817 is a dual element heater that is installed on flap actuator #3 and slat actuators #1 and #2 on both wings (6 total).

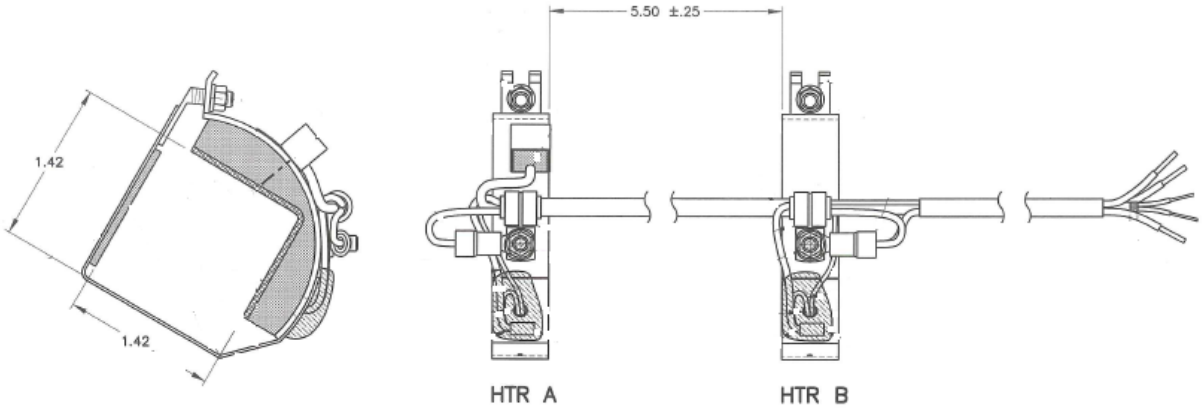


Figure 5: Actuator Heater PA-200124-817 (F3), (S1), (S2)

- PA-200124-807

Heater PA-200124-807 is a dual element heater that is installed on Flap Actuator #1 on both wings (2 total).

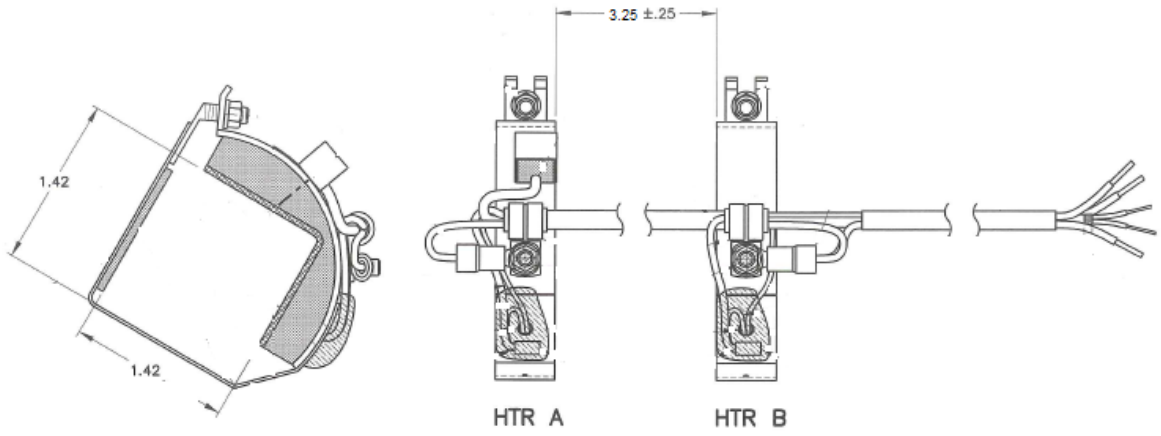


Figure 6: Actuator Heater PA-200124-807 (F1)

- PA-200124-806

Heater PA-200124-806 is a single element heater that is installed on Slat Actuator #3 on both wings (2 total).

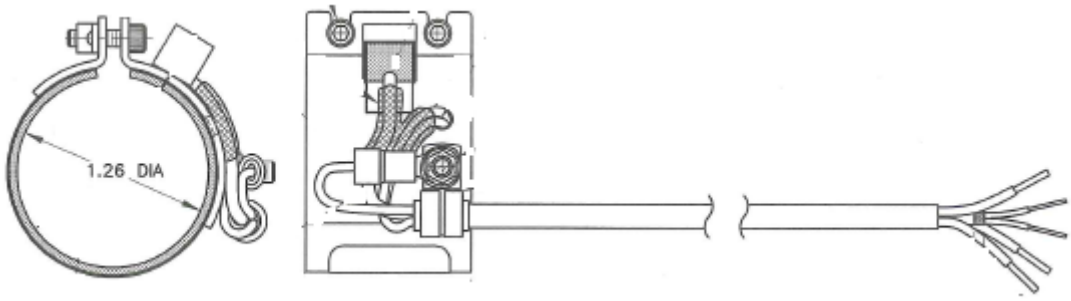


Figure 7: Actuator Heater PA-200124-806 (S3)

For ease of maintenance, the heaters are attached by mechanical means rather than by adhesion.

2.4.3. Heater Enable Switch/Annunciator

The system is enabled by an ON/OFF Switch installed on the aft end of the center pedestal of the flight deck, within the reach of either pilot.

Figure 8: Cockpit Annunciator Switch

2.5. Component Locations

2.5.1. Controller

The F/S heat controller is mounted on the right side of the lower fuselage under the belly fairing. It is accessed by opening the emergency brake access panel (141AB) (reference Figure 9.

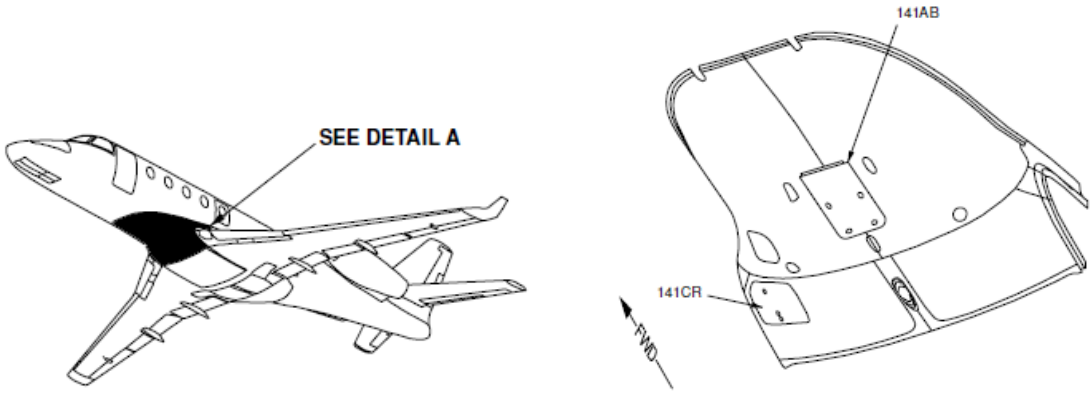


Figure 9: Control Box Location

2.5.2. Flap Actuator Heaters

Actuator #1 (F1) requires the PA-200124-807 heater, actuator #2 (F2) requires the PA-200124-827 heater, and actuator #3 (F3) requires PA-200124-817. Each heater consists of two heating elements and a thermistor. The heaters are secured to the square portion of the flap actuators as shown in Figure 10.

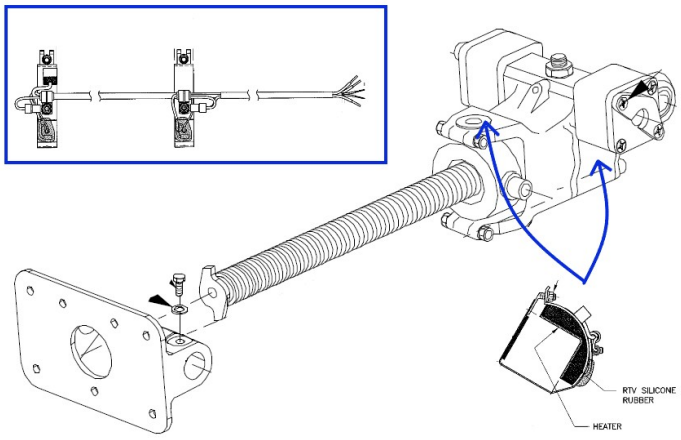


Figure 10: Flap Actuator Heater Location (ALL)

The heaters may be inspected with the flap extended. Orientation of the heaters on the actuator are depicted in Figure 11. ***Note proper orientation to ensure that heaters do not interfere with airframe structure!***

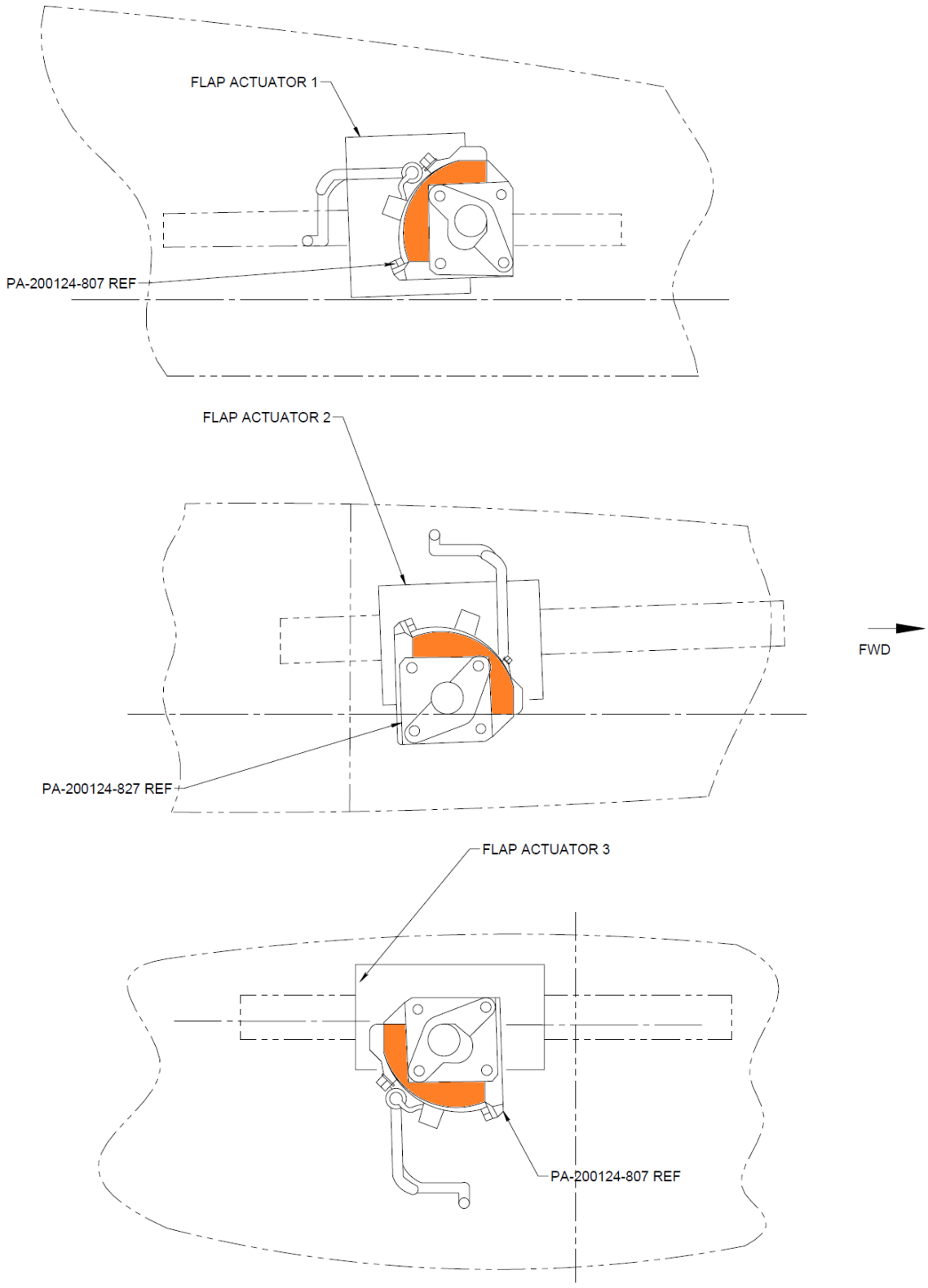


Figure 11: Heater Orientation on Flap Actuators

2.5.3. Slat Actuator Heaters

Actuators #1 (S1) and #2 (S2) require the PA-200124-817 heaters and actuator #3 (S3) requires the PA-200124-806 heater. The PA-200124-817 heater consists of two heating elements and a thermistor, while the PA-200124-806 contains a single heating element and thermistor. The PA-200124-817 heaters are secured to the square portion of the slat actuators as shown in Figure 12. The PA-200124-806 heater is a circular design to fit securely around actuator 3 as shown in Figure 13. The heaters maybe inspected with the slats extended. The heater orientation on the actuator may be adjusted for best fit during installation.

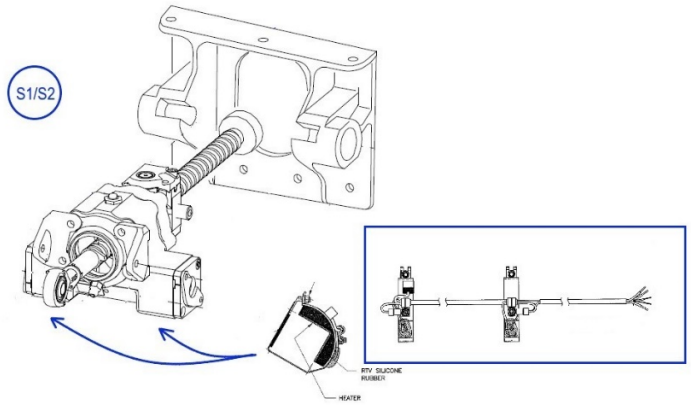


Figure 12: #1 Slat (Inboard) and #2 Slat (Mid) Actuator Heater Installation

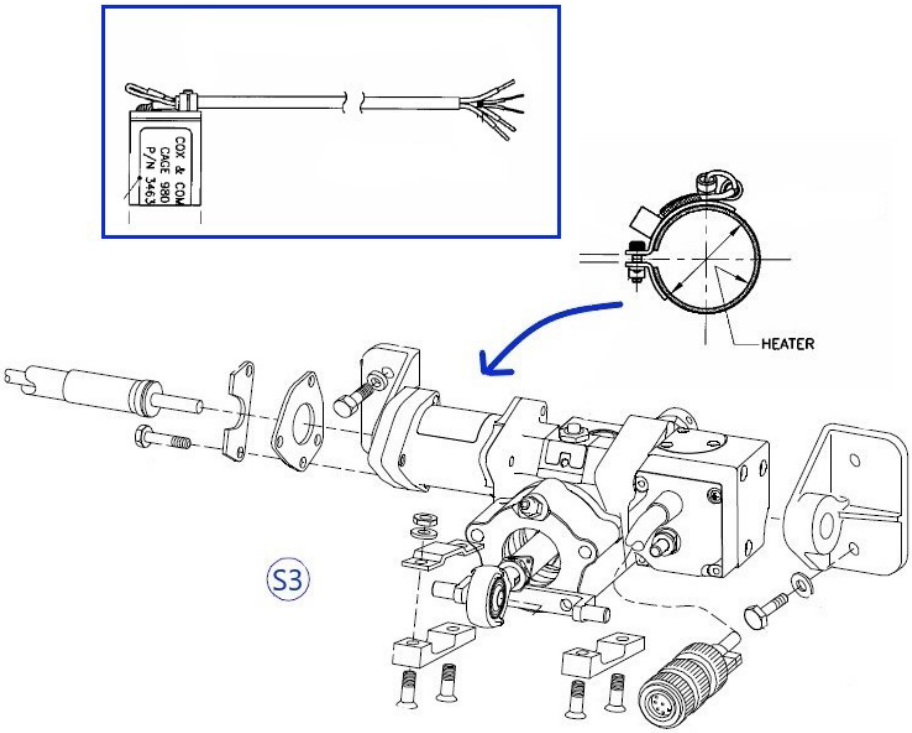


Figure 13: #3 Slat (Outboard) Heater Installation

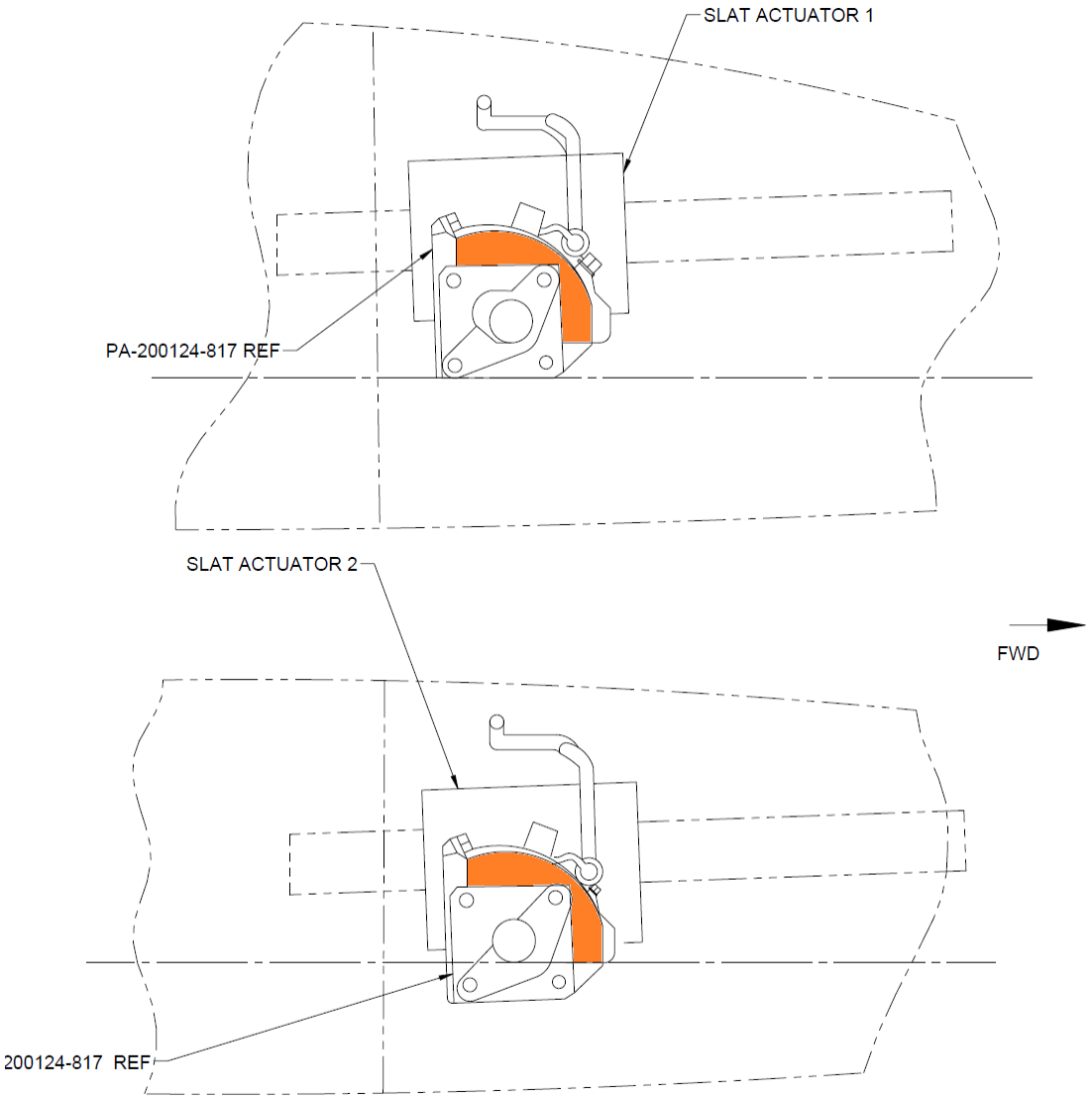


Figure 14: Heater Configuration, Slat Actuators

2.6. System Power Source

28 Volt direct current (Vdc) power is supplied to the controller via two 15 Ampere (A), Circuit Breakers (CBs) located on the cockpit overhead panel. One CB powers the flap heater channel and the other powers the slat heater channel.

An enable relay is installed in the right sidewall (FS 233.62) to supply power at the controller. The relay requires 28 Vdc and a ground to operate. The ground signal is provided by the ON/OFF switch located the cockpit. 28 Vdc is provided by two independent sources.

1) With both engine generators on-line, relay power is supplied by the closed contacts of the R & L Generator (GEN) Fail Relays. In the event either generator fails, the respective relay opens, and heater power is removed.
2) For testing the system on the ground, the enable relay may be powered by selecting the Battery Master Switch to the “OVRD LOAD REDUCT” position. This selection allows the relay to be powered with no engines running.

Reference PA-200124-901, *Flap/Slat Actuator Heater System Wiring Diagram*, for additional details on the heater power circuit.

2.7. Wiring Diagrams

The wiring diagram is included in Appendix A.

2.8. Wire Routing

Figure 15 and Figure 16 depict the routing of the installed wires. The wires are routed adjacent to the existing airplane wire bundles to the maximum extent possible. Wiring in the cabin is accessed by removing the sidewall, ceiling, or center pedestal access panels. Wiring external to the aircraft is accessed by removing the necessary access panels as detailed in Section 7.

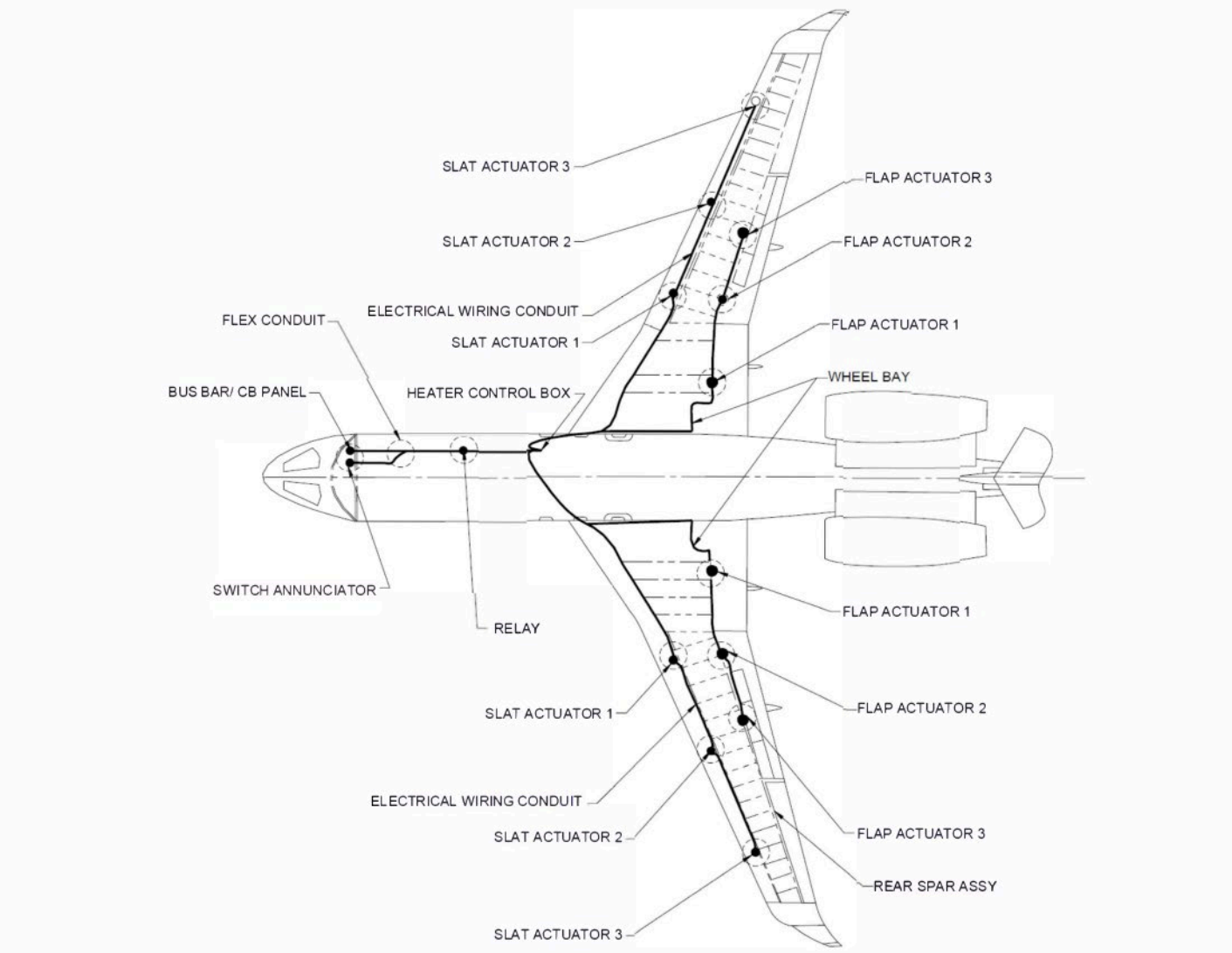


Figure 15: System Wire Routing and Component Location

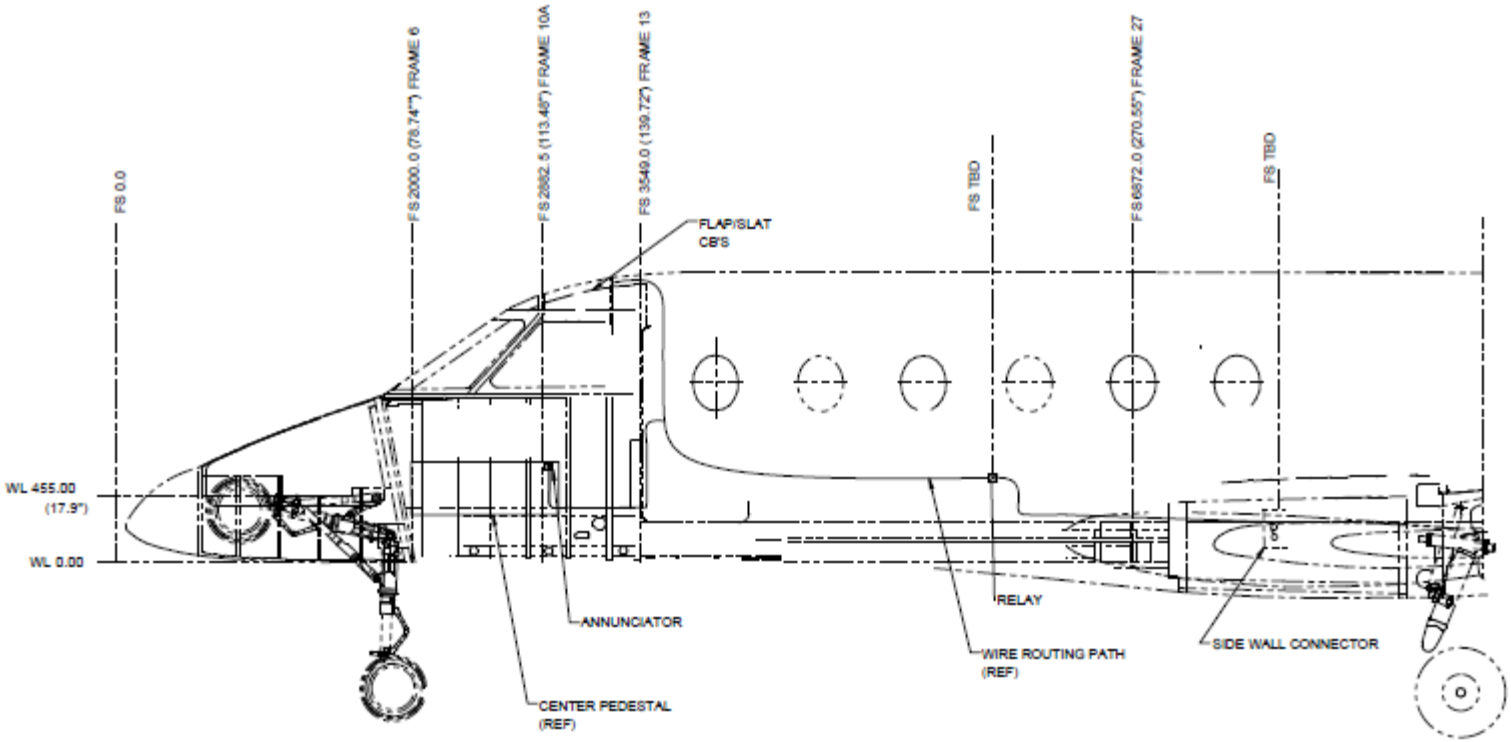


Figure 16: System Wire Routing, Cabin

3. SYSTEM OPERATION AND CONTROL

3.1. Control Logic

The FSHCU is comprised of two separate sections (channels). One channel controls the six flap actuator heaters and the other controls the six slat actuator heaters. The controller activates all heaters on a channel when any of the thermistors on that channel sense a temperature below 40ºF and turn off all heaters when all sensors readings are above 60º F. To prevent a thermal overheat, if any sensor temperature exceeds 130º F, the system will de-power all heaters on that channel. The system will reactivate once the actuator has cooled below 110º F.

3.2. Built in Test Function

The control unit contains Built-In-Test Equipment (BITE) that checks the integrity of the system. The test is performed at Power-on and periodically during normal operation.

A Press-To-Test switch on the face of the control box initiates the BITE when pressed and held for approximately 2 seconds. This allows for the system to be tested while the airplane is on the ground. System status/faults are confirmed by observing the color of the device LED. The system receives power from the 28 Vdc distribution buses when both generators are operating. To test the system on the ground, with the engines not running, the system can be powered by the auxiliary power unit (APU) or an external power cart.

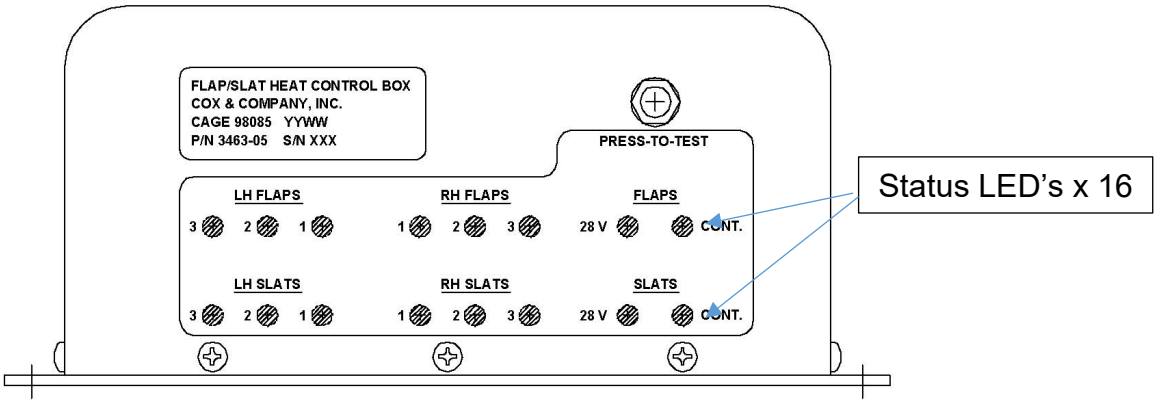


Figure 17: Control Box LED's

3.3 ON/OFF Switch-Annunciator

The Heater Cuff system is controlled by a ON/OFF Switch-Annunciator allows for pilot control of the Heater Cuff system. This switch is mounted on the aft left-hand side of the center pedestal.

If necessary, the flight crew can disable the Heater system by pressing the ON-OFF Switch.

4. SERVICING INFORMATION

4.1. Control Box

The F/S Heat Controller contains no line serviceable components. Maintenance of the Controller is “on condition” and requires no periodic checks, tests, inspections, and has no mandatory replacement intervals. However, it is recommended that approximately every six months, the system test is accomplished (see Section 3.2) to ensure the entire Actuator Heating System is functioning correctly.

Should the Controller require repair or replacement, contact:

Peregrine
7385 S Peoria St Unit C4
Englewood, CO 80112
Tel.: (303) 325-3873
Email: info@peregrine.aero https://www.peregrine.aero/

4.2. Actuator Heaters

The Actuator Heaters contains no line serviceable components. Maintenance of the Controller is “on condition” and requires no periodic checks, tests, inspections, and has no mandatory replacement intervals. However, it is recommended that approximately every six months the following maintenance actions should be performed to ensure the Actuator Heater will function correctly.

1. Visually inspect the heaters for any damage
2. Inspect the heater wires for signs of chaffing or environmental damage
3. Verify the heater is securely attached to the actuator

Should the Heater require repair or replacement, contact:

Peregrine
7385 S Peoria St Unit C4
Englewood, CO 80112
Tel.: (303) 325-3873
Email: info@peregrine.aero

4.3. System ON-Off Switch Annunciator

There is no specific requirement for scheduled maintenance to be carried out on ON-OFF Annunciation switch.

Should the Annunciator require repair or replacement, contact:

Aerospace Optics, Inc.
3201 Sandy Lane, Fort Worth, TX 76112
Toll Free: 1 - 888 - VIVISUN
E-Mail: switches@vivisun.com

5. MAINTENANCE CONSIDERATIONS

Particular attention should be given to clamping of wire harnesses in the wing leading and trailing edge areas. The system installation allows for the heater clamps to be secured to the actuator housing in a position that is clear of the moving actuator components. When servicing wiring to the heater clamps, ensure that the wiring is securely clamped clear of moving parts prior to aircraft return to service.

6. TROUBLESHOOTING INFORMATION

The controller performs a complete system test during every power on cycle and every thirteen minutes during operation.

The system can be manually tested using the Press to Test switch.

System status is available by monitoring the LED indicators on the face of the control box (reference Figure 17). Troubleshoot the system using the procedures identified in Table 2.

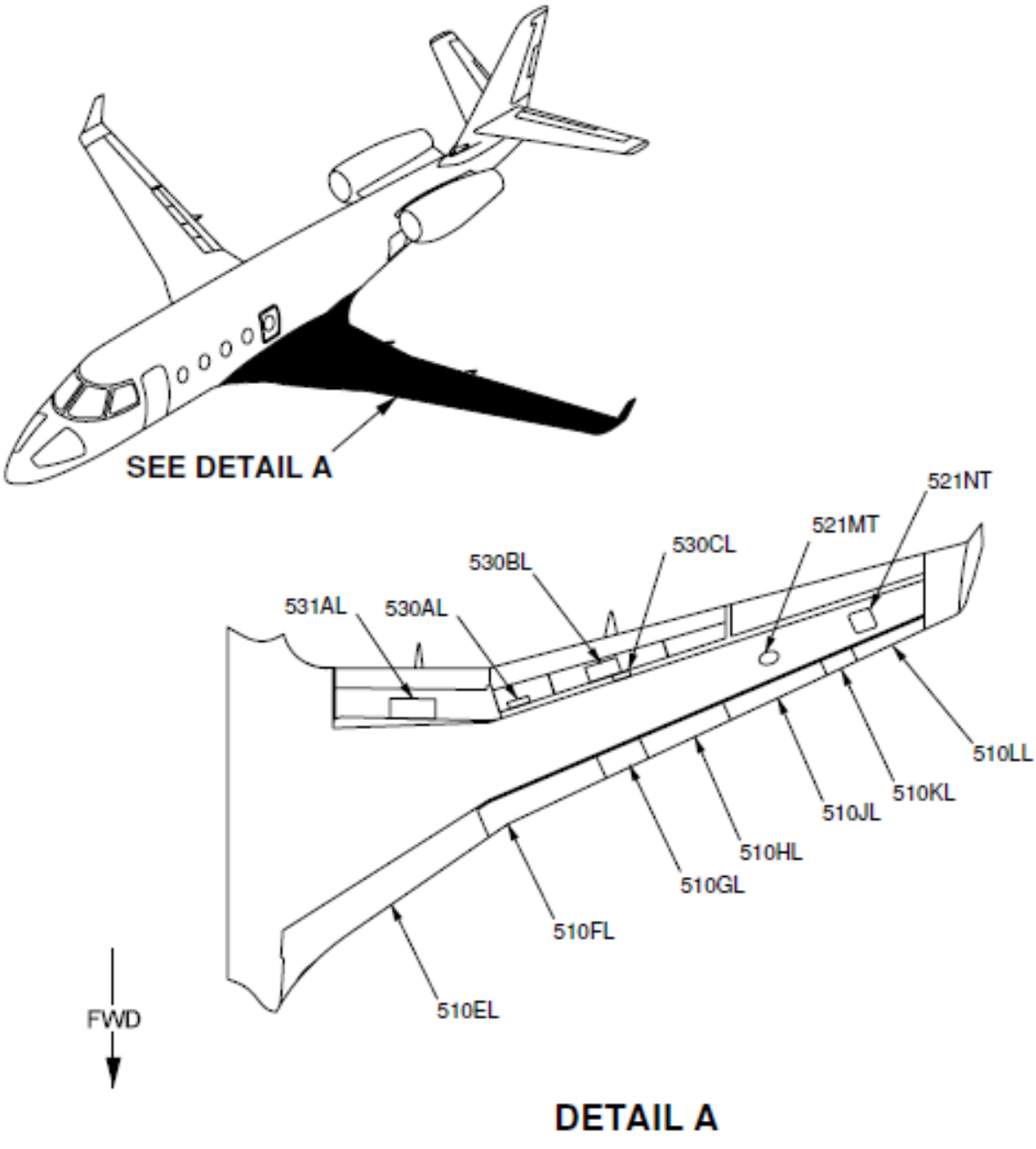
Table 2: Fault Reporting and Corrective Action

LED Description	Indication	Fault	Action Required
LH/RH Flaps/Slats	Green or off	None	None
LH/RH Flaps/Slats	Steady Red	Heater over-current, Heater low current, shorted heater or open heater	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Replace defective heater corresponding to the specific red LED.
LH/RH Flaps/Slats	Flashing Red	Open or shorted temperature sensor	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Replace defective heater corresponding to the specific red LED.*
Flaps/Slats 28v	Green	None	None
Flaps/Slats 28v	Off	Voltage is below 26vdc	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Check the DC voltage supply to the Controller
Flaps/Slats Cont.	Green	None	None
Flaps/Slats Cont.	Red	Open or shorted output device (power switch or relay)	1. Verify the integrity of wiring/contacts/connectors on the heaters and controller. 2. Replace the Controller

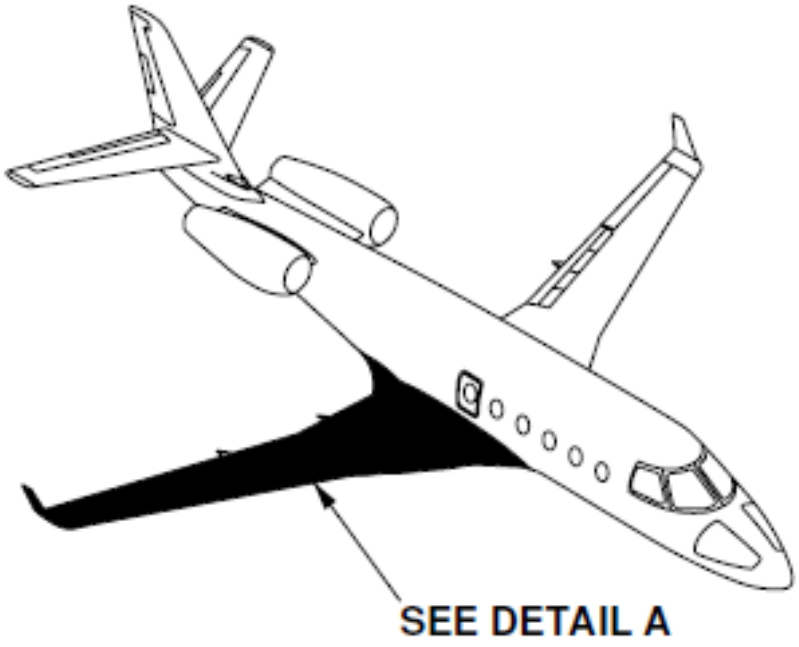
* Note: The temperature sensor is located within the heater assembly and cannot be replaced separately.

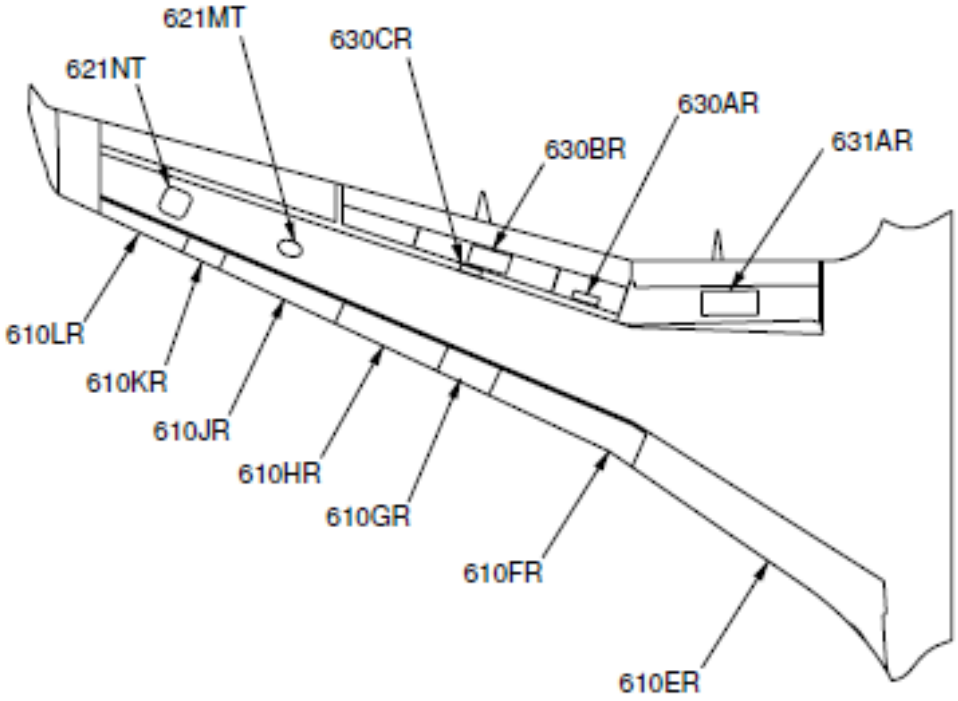
7. COMPONENT REMOVAL AND REPLACEMENT

This section identifies the maintenance procedures for replacing the FSAHS components identified in Table 1. The components are accessed by removing the appropriate panels identified on the following pages. Additional information can be found in the Gulfstream G150 Airplane Maintenance Manual (AMM).



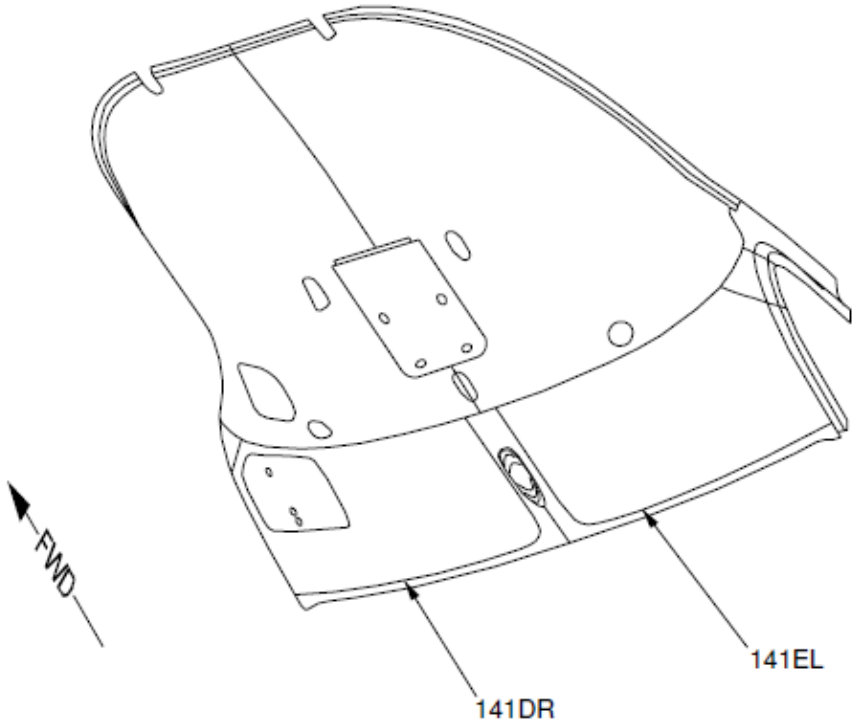
Left Wing Access Panels and Doors





DETAIL A

Right Wing Access Panels and Doors



DETAIL A

Forward Fuselage Fairing Access Panels

7.1. Heater Control Unit

Prior to removing the heater control box, all electrical power shall be turned off in order to prevent electrical shorts or electrical shock during the removal.

1. Remove the three circular connectors from the heater control box.
2. Remove the four 10-32 mounting bolts retaining the heater control box to the mounting brackets.
3. Remove the heater control box from the aircraft.

Installation of the new control box is the reverse order of the steps listed in section 7.1.

Return to service by per performing a self-test of the system as described in Section 9.

7.2. Actuator Heaters

Prior to removing the actuator heater, all electrical power shall be turned off in order to prevent electrical shorts or electrical shock during the removal of the component.

1. Disconnect the actuator heater from the aircraft wiring. The existing M81824-1-2 environmental splices will need to be removed.
2. Remove the actuator heater attachment hardware.
3. Remove the actuator heater from the aircraft.

Installation of the new Actuator Heater is the reverse order of the steps listed in section 7.2. Splice wire using M81824-1-2 environmental splices.

Return to service by per performing a self-test of the system as described in Section 9.

7.3. ON-OFF Annunciator Switch Removal and Replacement

Removal of the F/S Heat Annunciator Switch

- Master Power- Power Off.
- Carefully remove the annunciator switch lens cap by gently pulling the annunciator switch lens cap from the annunciator body.
- Carefully remove the lens cap from its hinged slide retainers.
- Loosen the two flat head screws on the annunciator body.
- Remove the slide retainer from the back of the annunciator body.
- Slide the annunciator out of the panel.
- Using tool M22885/108T8234, or similar, remove the electrical plug from the back of the annunciator body.

Installation of the F/S Heat Annunciator Switch

- Verify the annunciator switch that is to be installed in the panel is the same part number.
- Install the plug on the back of the new annunciator body.
- Slide the annunciator body back into the panel.
- Install the slide retainer onto the annunciator body.
- Tighten the two flat head screws that are on the annunciator body, ensuring they grasp the slide retainer.
- Carefully install the annunciator lens cap onto the hinged slide retainers.
- Carefully hinge the annunciator lens cap up and into the annunciator body.
- Return to service by per performing a self-test of the system as described in Section 9..

8. WEIGHT AND BALANCE

Weight and balance additions to the aircraft as a result of this STC are documented in Table 3.

Table 3: Weight and Balance

Description	Weight	Quantity
Heater Control Box	3.4 lbs	1
Flap/Slat Actuator Heater (double element)	0.2 lbs	10
Outboard Slat Actuator Heater (single element)	0.15 lbs	2
F/S Annunciator Switch	0.25 lbs	1

Notes:

1. *Aircraft Weight and Balance records shall be adjusted to account for any removed equipment upon installation of the above items. Changes shall account for the specific configuration of the installed equipment listed above.*
2. *Aircraft Weight and Balance records shall account for the exact placement of equipment on the aircraft.*
3. *Aircraft Equipment list and electrical loads shall be adjusted to account for addition of the above components, and any removed equipment.*

9. RETURN TO SERVICE INSTRUCTIONS

The system shall be tested for proper functionality after any of its included components have been replaced.

Note that the complete system test at the time of initial installation includes a test of the system, including a verification of electromagnetic compatibility.

The controller performs a complete system test during every power on cycle and every thirteen minutes during operation.

The system can be manually tested using the Press-to-Test switch (see Section 3.2).

System status is available by monitoring the LED indicators on the face of the control box (reference Figure 11).

APPENDIX A: WIRING DIAGRAM

This appendix identifies the wiring diagram required for the FSAHS system functionality. A PDF copy of the wiring diagram of the latest approved revision is attached to this document for viewing.

Drawing Number	Description
PA-200124-901	Flap/Slat Actuator Heater Wiring Diagram