

# ECLIPSE 500



## Flight Controls

Do Not Use For Flight

### 3. Flight Controls

#### 3.1 General

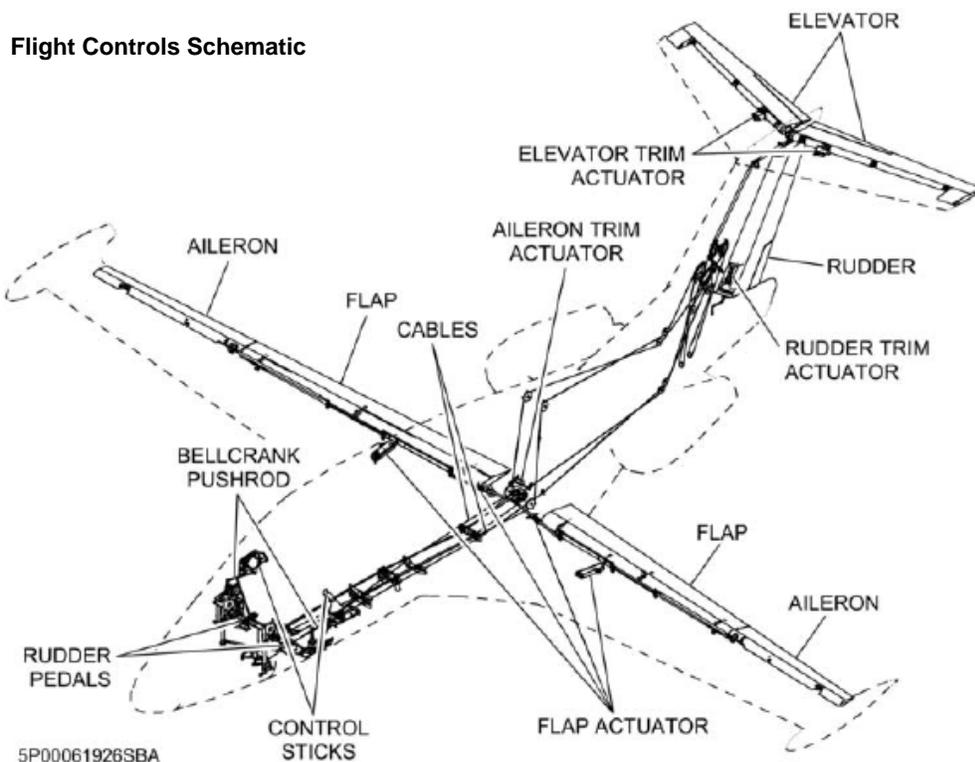
The flight control system consists of primary flight controls (ailerons, rudder, and elevator) and secondary flight controls (wing flaps and trim).

The primary flight controls are operated with a sidestick and rudder pedals at each pilot station. The primary flight control system is a mechanical system which uses bellcranks, pushrods, cables, and pulleys to actuate the control surfaces. Rudder pedals are individually adjustable. Static wicks are attached to the elevator (two per elevator) and wing tip tanks (one per tip tank) to discharge static electricity.

Trim for the three primary flight controls is electrically powered. Elevator and aileron trim is controlled by a four-position switch on the top of each sidestick. Rudder trim is controlled by a rotary switch mounted on the aft portion of the center pedestal. Trim position for all three axes is displayed on the MFD. If a normal trim control fails, all three trim systems can be controlled using the flight controls synoptic page on the MFD. All trim motors can be inhibited in the event of a trim runaway.

To protect against high wind conditions, a gust lock is placed over the left sidestick to secure the ailerons and elevator in place, while the rudder is locked by mechanical resistance from the nose wheel steering system.

The wing flaps are electrically powered fowler flaps, controlled by a three-position flap selector lever located on the throttle quadrant. Flap position is displayed on the upper portion of the MFD.



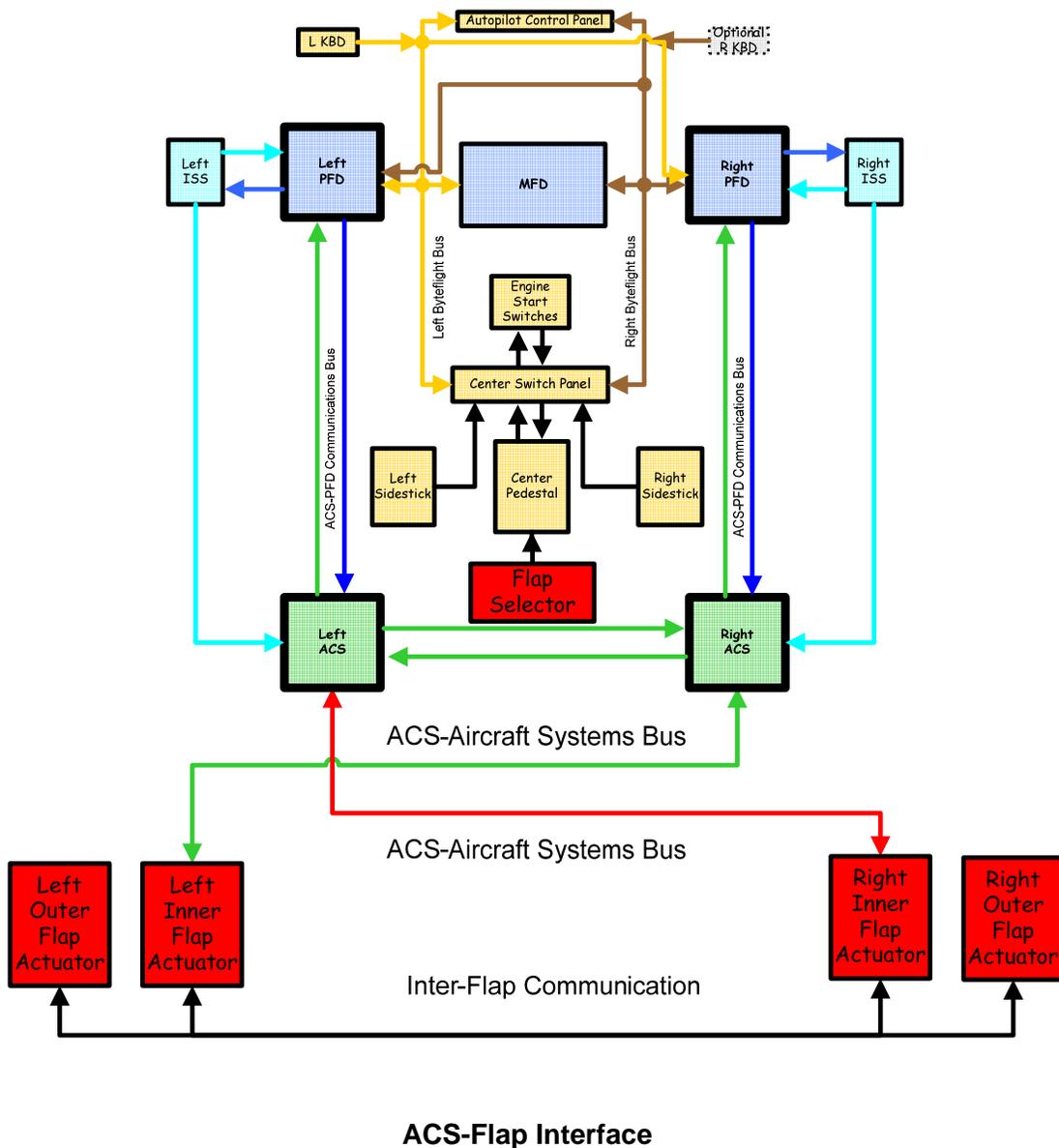
## 3.2 Aircraft Computer System (ACS) Interfaces

### 3.2.1 Flaps

There are four electromechanical flap actuators on the Eclipse 500, two per flap. The ACS is responsible for commanding the flaps to the position selected by the pilot using the flap selector switch on the throttle quadrant. The ACS also monitors each actuator for actual position versus the pilot selected position, as well as monitoring the status of each actuator for failure.

The left flap actuators receive their commands and report their status to the right ACS, while the right flap actuators receive their commands and report their status to the left ACS.

All actuators communicate with each other to assure flap position agreement

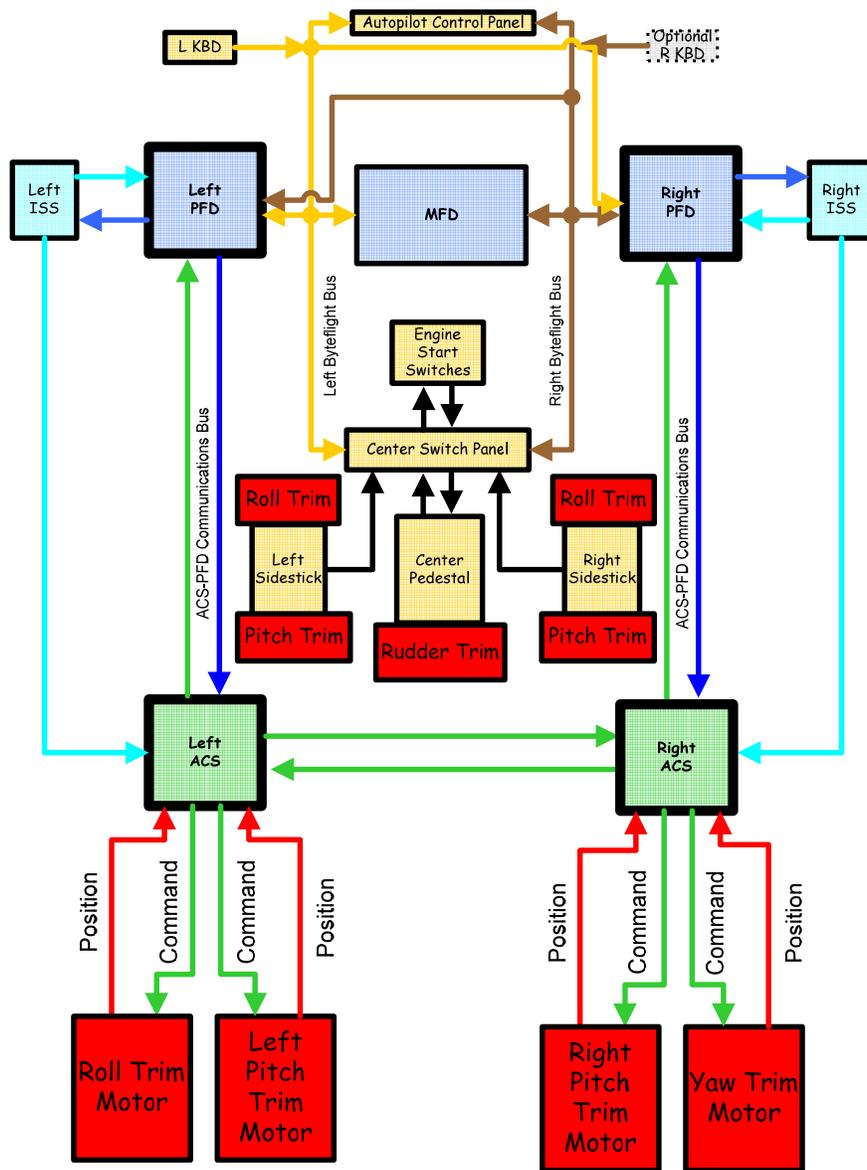


### 3.2.2 Trim

The Eclipse 500 has four trim motors; two are used for pitch trim, one for roll (aileron) trim and one for yaw (rudder trim). Pilot control for pitch and roll trim is through the trim switch on each sidestick, while rudder trim inputs are made through the rudder trim switch on the throttle quadrant.

The ACS commands the actuators based on these pilot inputs. The left ACS is responsible for commanding and monitoring the left pitch trim and roll trim motors, while the right ACS is responsible for commanding and monitoring the right pitch trim and yaw trim motors.

In addition to commanding the trim motors the ACS also receives position information from each actuator and monitors for unexpected movement, actuator position errors, as well as pitch trim disagreement.



ACS-Trim Interface

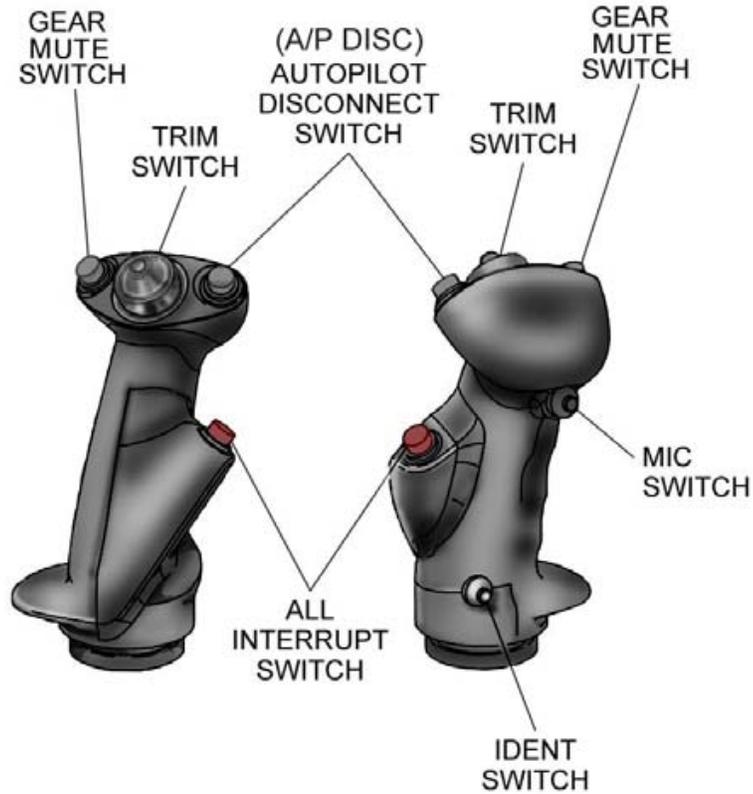
3.3 Limitations and Specifications

**3.3.1 Wing Flaps**

|   |               |
|---|---------------|
| Maximum altitude for flap extension ..... | 20,000 ft MSL |
| VFE:                                      |               |
| T/O .....                                 | 200 KEAS      |
| LDG .....                                 | 120 KEAS      |

### 3.4 Controls and Indicators

#### 3.4.1 Sidestick



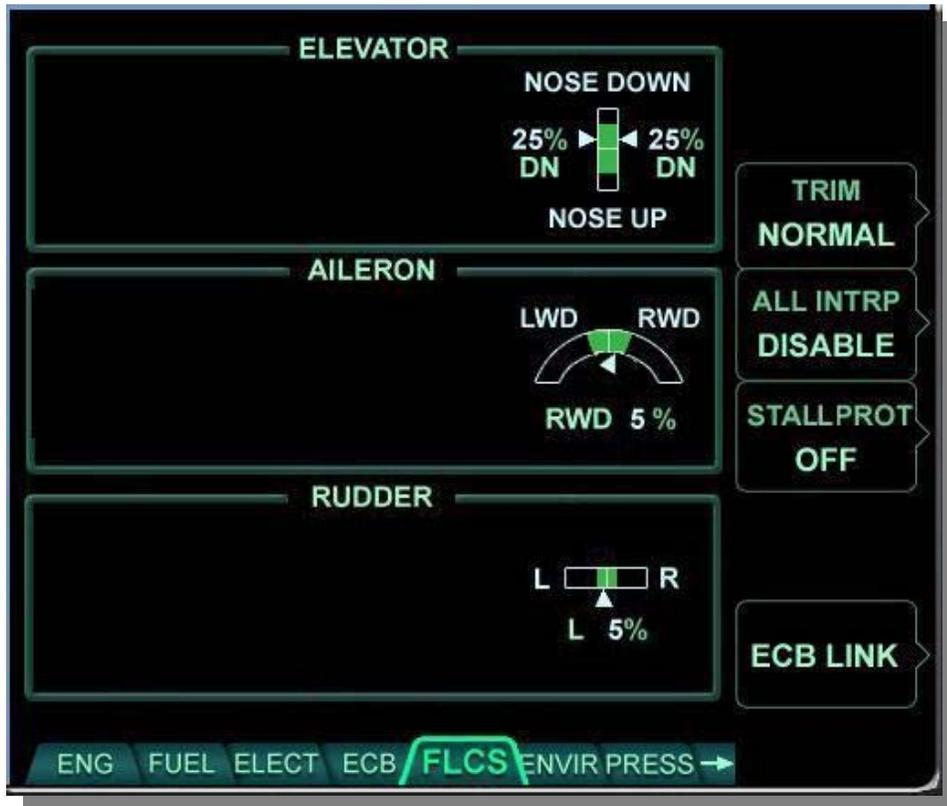
- A/P DISC ..... Disconnects the autopilot.
- ALL INTERRUPT ..... Disconnects the autopilot, autothrottle, flight director, yaw damper, over/underspeed protection, and inhibits the stick pusher and all trim while the ALL INTERRUPT switch is pressed. Holding this switch down for two seconds will prompt the Flight Controls(FLCS) synoptic to appear on the MFD.
- MIC..... Keys the headset or oxygen mask microphone.
- GEAR MUTE..... Silences the landing gear warning horn for conditions when the warning horn is mutable.
- IDENT ..... Activates transponder IDENT function.
- TRIM SWITCH ..... Activates Aileron and Elevator trim.

### 3.4.2 Throttle Quadrant



**Throttle Quadrant**

### 3.4.3 Flight Controls Synoptic



The flight control synoptic (FLCS) provides a display of position, alternate trim control inputs, and control over the stall protection system.

Trim position is shown graphically, and as a percentage of control surface movement, with a white trim pointer indicating its exact position.

Elevator ..... % NOSE UP or NOSE DOWN  
 Ailerons ..... % Left Wing Down (LWD) or Right Wing Down (RWD)  
 Rudder ..... % Left or Right

Each trim position display has a green band which is the trim position range for takeoff. Should trim indications become unavailable, a TRIM POSITION FAULT advisory message appears and the trim pointer is removed.

Four line select keys provide additional control of the flight control system.

#### TRIM

All trim switches (aileron, elevator, and rudder) can be disabled by the line select key labeled TRIM. The two selections are:

- NORMAL
- ALTERNATE

In NORMAL, all trim inputs are controlled through the sidestick and rudder trim switches. In the event of an emergency or if the pilot chooses to use the MFD as the primary means of trim control, selecting ALTERNATE will allow the pilot to use the

concentric knobs on the lower portion of the MFD to control trim in each individual axis. Rotating the outer knob moves a cursor box to the desired axis, while rotating the inner knob changes the trim setting.

**⇒NOTE:**

Pressing the ALL INTERRUPT switch on the sidestick for two seconds will cause the flight controls synoptic to appear to allow switching from NORMAL to ALTERNATE

**ALL INTRP**

The ALL INTERRUPT line select key disables all interrupt switch on both sidesticks in the event that the switch fails in the all interrupt position

The ALL INTRP line select key has two selections

- NORMAL
- DISABLE

**STALL PROT**

The stall protection line select key allows enabling and disabling of the stall protection system and has two selections

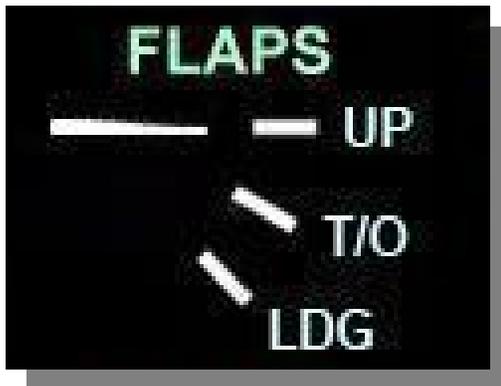
- ON
- OFF

Pressing the stall protection line select key prompts a CONFIRM and CANCEL line select key to appear. If CONFIRM is pressed, stall protection is turned OFF and a STALL PROTECTION OFF status message appears.

**ECB LINK**

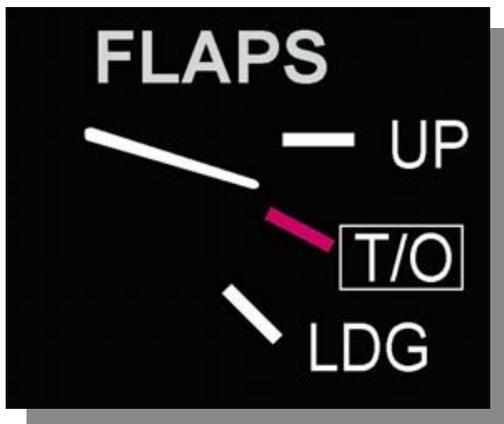
The ECB LINK line select key selects the Flight Control Electronic Circuit Breaker synoptic.

### 3.4.4 Flap Position Display

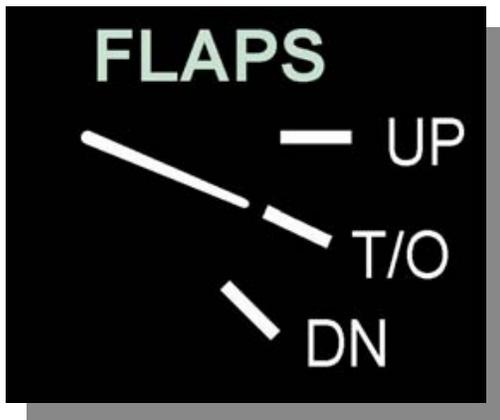


**Flap Position (Normal)**

When the flap selector is moved, a white box is displayed around the selected position. The flap position tick mark turns magenta until the flap position agrees with the flap selector position, at which point the tick turns white and the white box disappears.



**In Transit to T/O Position**



**Flap Position Display (T/O Position)**

If a flap failure occurs due to an actuator failure or asymmetry sensed by any flap actuator, all flap movement stops, the pointer remains displayed in the last position and a FLAP FAIL caution message appears.

### 3.5 System Description

#### 3.5.1 Ailerons

The ailerons are located outboard of the flaps, with deflection accomplished by lateral movement of either sidestick. Control inputs pass through a series of pushrods, cables and pulleys to the control surfaces.

#### 3.5.2 Rudder

Rudder deflection is accomplished through the left and right rudder pedals. Pedal travel is four inches fore and aft of neutral. Control inputs pass from the rudder pedals to the rudder control surface through a series of cables, pushrods and other associated components.



Rudder pedals are individually adjustable fore and aft (1.75 inch travel) by depressing a lever located above each pedal and pulling or pushing the pedals to adjust.

### 3.5.3 Elevator

The two elevators on the horizontal stabilizer are mechanically connected. Elevator deflection is accomplished by fore and aft movement of either sidestick. Control inputs pass through a series of cables, pushrods and other associated components to move the elevators.

### 3.5.4 Sidestick

The ailerons and elevator are controlled with one of two sidesticks located on the left and right cockpit sidewall. The sidesticks are angled inward to allow for natural wrist position. The control surfaces are unpowered and move together through a mechanical interconnect.

Aileron and elevator trim is controlled by a four position switch on the top of each sidestick. Each sidestick has the additional switches:

A/P DISC ..... Disconnects the autopilot, yaw damper still engaged.

ALL INTERRUPT ..... Disconnects the autopilot, autothrottle, flight director, yaw damper, over/underspeed protection, and interrupts the stick pusher and all trim while the ALL INTERRUPT switch is pressed. Holding this switch down for two seconds will prompt the Flight Controls(FLCS) synoptic to appear on the MFD.

MIC ..... Keys the headset or oxygen mask microphone

GEAR MUTE ..... Silences the landing gear warning horn for conditions when the warning horn may be muted.

IDENT ..... Activates the transponder IDENT feature

TRIM ..... Activates Aileron and Elevator trim

### 3.5.5 Trim

The aileron, elevator, and rudder trim are electrically operated. Aileron and elevator trim are controlled by switches on each sidestick, while rudder trim is controlled by a rotary switch on the throttle quadrant.

Inputs from the trim control switches are sent to several trim actuators. Aileron trim actuators move the aileron centering spring, resetting the neutral position of the ailerons. A rudder trim actuator moves trim tab on the rudder. Pitch trim is provided through two pitch trim actuators, one on each elevator. The trim actuators send trim position back to the ACS, where it is sent to the MFD for continuous display.

A “drum roll” aural tone is heard if manual or autopilot elevator trim movement is continued for more than two seconds. If uncommanded trim motion is sensed a TRIM UNCOMMANDED warning message appears, requiring trim to be deactivated with the ALL INTERRUPT switch on the sidestick.

Trim is also adjustable on the flight control synoptic using the concentric knobs on the lower portion of the MFD. This feature is designed to provide trim control in the event of a failure of the normal trim controls, but it is available for selection at all times.

A failure of trim in any axis will cause a PITCH TRIM FAIL, AILERON TRIM FAIL, or RUDDER TRIM FAIL caution message to appear. Trim for Aileron and Rudder will be unavailable in the event of a failure; however should a pitch trim failure occur, limited trim capability will be available through the second elevator trim actuator.

### 3.5.6 Flaps

Each wing trailing edge has a single fowler flap. The flaps are controlled through the three-position flap selector located on the throttle quadrant. Flap selector position is sent to both ACSs, which then control the flaps in parallel. The flaps can be set to three positions:

- UP
- T/O (Takeoff)
- LDG (Landing)

Flaps are moved by four electro-mechanical actuators, two on each flap, one inboard and one outboard. Flap position is sent to the ACS by the actuators, then to the MFD for continuous display.

To prevent asymmetrical deployment, flaps only operate if all four actuators are synchronized. Electronics in each flap actuator monitor its position relative to the other actuators. If any actuator senses or causes a flap position mismatch greater than two degrees, all flap motion ceases and a FLAP FAIL caution message appears.

If flap asymmetry is sensed on the ground, the ACS automatically attempts to synchronize the flaps. If flap synchronize is unsuccessful, a FLAP FAIL caution message appears, and the flaps do not operate.

In the event that a flap actuator fails to stop at the position selected by the flap selector position, that actuator will continue to run to maintain the requested setting against the airflow. This condition triggers a FLAP POSITION HOLD FAIL caution message to appear.

### 3.5.7 Gust Lock

The gust lock for the ailerons and elevator is a fabric strap which is installed over the left sidestick to hold it full right. The gust lock is held in position by adjustable straps that clip into a ring to the left of the sidestick and to the pilot seat track.

The rudder is held in position by mechanical resistance in the nose wheel steering system.

## 3.6 Normal Operations

### 3.6.1 Sidestick

#### CONTROL MOVEMENT

The sidestick is angled inboard in a "natural" wrist position. Pitch control is accomplished with forward and aft movement of the sidestick. The wrist angle must stay neutral when adjusting pitch to avoid introducing unwanted roll.

Moving the sidestick toward the left commands a left bank; while moving the sidestick toward the right commands a right bank.

On the ground, the sidestick is full forward as the static position of the elevators is full down. As airspeed increases during the takeoff roll, the elevators and sidestick assume a neutral pitch position before rotation.

#### TRIM

Aileron and pitch trim are accomplished by moving the four-way trim switch on either sidestick. Rudder trim is activated by moving the rotary rudder trim switch on the pedestal.

## 3.7 Abnormal Procedures

### 3.7.1 All Interrupt

There is a red ALL INTERRUPT switch on the inboard side of each sidestick. The button has the following functions:

- Disconnects the autopilot.
- Disconnects the flight director.
- Disconnects the autothrottle.
- Disconnects the yaw damper.
- Disconnects the over/under speed protection.
- Interrupts the stick pusher as long as the switch is held down. When the switch is released, the stick pusher is restored.
- Interrupts all trim movement, as long as the switch is held down. When the switch is released, trim movement is restored.

When pressed, an ALL INTERRUPT ACTIVE status message appears. Should the ALL INTERRUPT switch fail, a L (R) ALL INTERRUPT FAULT advisory appears.

### 3.7.2 Elevator Trim Tab Split

In the event that the left and right elevator tabs differ in position, a ELEVATOR TRIM TAB SPLIT advisory message appears. Re-synchronizing the tabs is accomplished by making small trim inputs.

### 3.7.3 Alternate Trim

In the event of a failure of a normal sidestick or rudder switch trim control a L (R) SIDESTICK TRIM FAULT, or RUDDER TRIM FAULT advisory message appears and alternate trim must be selected. This is accomplished using the flight controls synoptic on the MFD and the concentric knobs located on the left lower corners of the MFD.

- Hold ALL INTERRUPT button for two seconds or Select the flight controls synoptic
- Select ALTERNATE with the TRIM line select key
- When the ALTERNATE is enabled, a white selector box appears around the elevator trim display.
- Rotating the outer knob located on the bottom of the MFD moves the selector box between the rudder trim, aileron trim, and elevator trim displays.
- Trim is accomplished using the inner knob. Each “click” of the knob provides a 0.25 second trim command. The inner knob must be continuously rotated to keep the trim moving.

### 3.8 Crew Alerting System Messages

| Message                    | Condition  | Category |
|----------------------------|--|----------|
| TRIM UNCOMMANDED           | Uncommanded trim movement detected   | Warning  |
| AILERON TRIM FAIL          | Aileron trim actuator not responding normally to input or has failed   | Caution  |
| PITCH TRIM FAIL            | One or both pitch trim actuators are not responding normally to input or has failed. Trim authority may be limited | Caution  |
| FLAP FAIL                  | Flaps have failed  | Caution  |
| FLAP POSITION HOLD FAIL    | Backdrive clutch failed; actuator motor will actively try to keep flaps in position                                | Caution  |
| RUDDER TRIM FAIL           | Rudder trim actuator not responding normally to input or has failed  | Caution  |
| L (R) ALL INTERRUPT FAULT  | Left or right all-interrupt switch has failed (ground only)  | Advisory |
| ELEVATOR TRIM TAB SPLIT    | Left and right elevator trim tabs differ in position.  | Advisory |
| RUDDER TRIM FAULT          | Rudder trim switch inoperative (ground only)   | Advisory |
| L (R) SIDESTICK TRIM FAULT | Left or Right trim switch inoperative (ground only)  | Advisory |
| TRIM POSITION FAULT        | Trim position indicators failed. Trim pointer is removed   | Advisory |
| ALL INTERRUPT ACTIVE       | ALL INTERRUPT switch active  | Status   |
| STALL PROTECTION OFF       | Stall protection selected OFF  | Status   |