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SECTION V
THEORY OF OPERATION

5.1 SYSTEM OPERATION

The operation of the KFC 200 Flight Control System can best be described by a detailed look at the contribution of each system component as the system is engaged in each of the following modes:

Attitude Reference
Flight Director Mode
Flight Director with Autopilot and Yaw Damper Mode
Altitude Hold Mode
Heading Mode
Navigational or Approach Modes
Glideslope Mode
Go Around Mode

Full system configuration as described in Section 1.2 is assumed.

5.1.1 ATTITUDE REFERENCE MODE

The Attitude Reference Mode consists of only attitude information displayed on the KI 255/KI 256/KG 258. There are no modes annunciated on the KA 285 and the KI 255 command bars rest at center display. The FD flag on the KI 255 is in view. In the KI 256, the command bar will be out of view.

5.1.2 FLIGHT DIRECTOR MODE

Engagement of the Flight Director Mode is accomplished by depressing the FD button on the KC 290 or CWS switch on pilot's control wheel. The system enters pitch attitude hold and wings level. Existing pitch attitude signals from the KI 255/KI 256 are locked in the KC 295. Subsequent deviation from this pitch attitude produces movement of the KI 255/KI 256 pitch command bar in a direction to return the airplane to the pitch attitude being flown at the time of Flight Director Engagement.

Roll attitude from the KI 255/KI 256 is sent to the KC 295 where a command is generated for display on the KI 255/KI 256 roll command bar that will keep the aircraft wings level if the bar is centered.

In the Flight Director Mode, the pilot should continually attempt to align the KI 255 Command Bars with the symbolic aircraft. The aircraft should be directed to fly into the command bars. The command bars move up or down to command a climb or descent. Right or left deflection commands a right or left roll. In the single cue KI 256, the aircraft should be directed to fly into the command bar. The Flight Director Mode (FD) is selected by depressing the FD button on the KC 290 or CWS switch and is annunciated on the KA 285.

Once in the Flight Director Mode, a new pitch attitude may be established by the trim switch on the KC 290. Depression of the top of the button produces a pitch down command. Upon release of the trim button the KC 295 automatically locks on the newly established pitch attitude. Figure 5-1 illustrates the Flight Director Mode.

5.1.3 FLIGHT DIRECTOR WITH AUTOPILOT AND YAW DAMPER MODE

The Flight Director with Autopilot and Yaw Damper Mode is the basic control mode in the KFC 200 Flight Control System. Attitude signals from the KI 255/KI 256 are processed in the KC 295 and pitch and roll commands are sent to the KI 255/KI 256 following engagement of the flight director. Commands are also processed in the KC 295 and sent to the servos upon autopilot engagement.

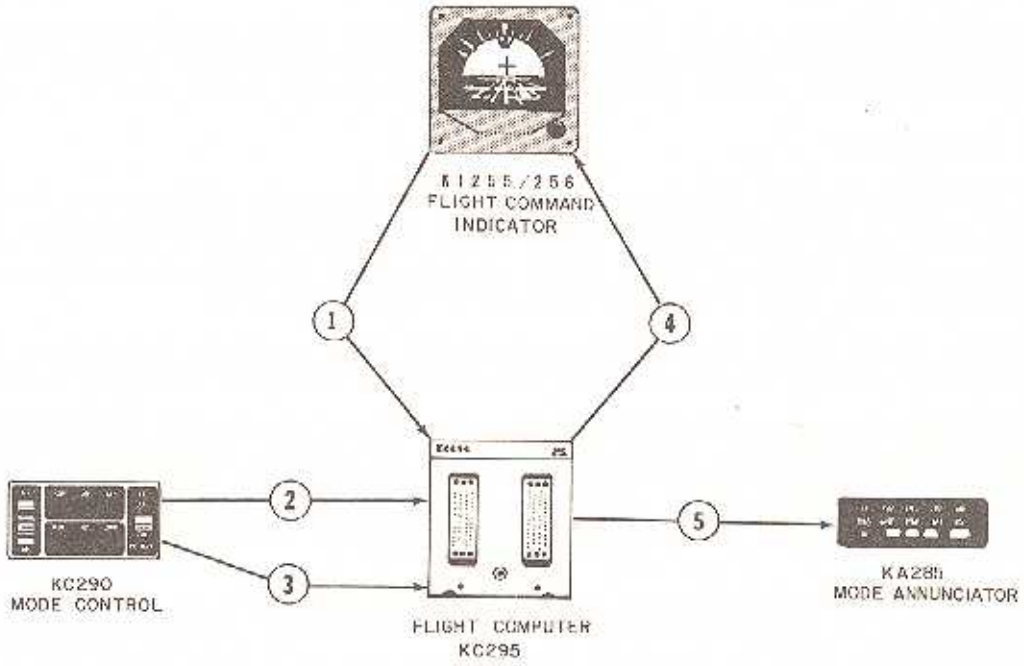
The Autopilot Mode is engaged by raising the AP lever on the KC 290. Processed pitch commands are sent to the KS 270 Servo Actuator for control surface motion. Roll commands are sent to the KS 271 Servo. Autopilot engaged is displayed on the KA 285. When the mode is disengaged, autopilot annunciator will flash at least 6 times before going off.

The pitch servo can sense an out of trim condition and after a time delay determined in the KC 295, the KS 272 Autotrim Servo is driven to relieve the out of trim condition.

If the aircraft is equipped with a Yaw Damper System, the Yaw Damper is automatically engaged when AP switch is activated. The KC 296 will receive the YD engage command either from the KC 290 or KC 291 and YD engaged is annunciated on the KC 291. Yaw rate from the KG 257 on KRG 331 and roll crossfeed from the KC 295 are processed and commands generated for the KS 271 Yaw Servo.

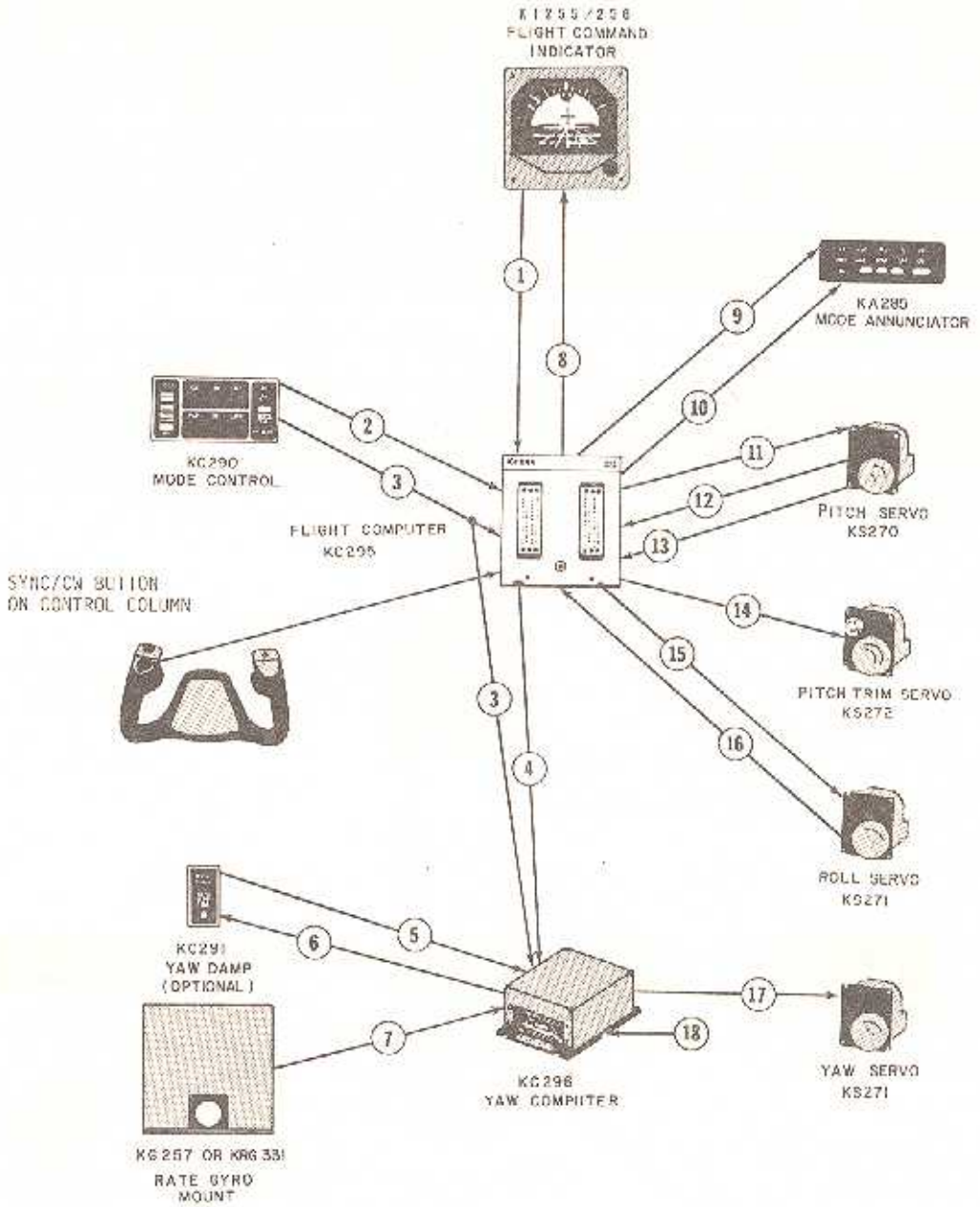
Tachometers are located in the KS 270 and KS 271 to provide rate feedback to close each control loop. In systems with KRG 331, the Yaw Servo uses pseudo Tach feedback rather than a tachometer to reduce rudder standoff effect. The Control Wheel Steering Mode (CWS) enables a pilot to take control of the airplane while in an autopilot mode, establish a new attitude or heading and return to the autopilot mode by the release of the SYNC/CWS button on the control column. Engagement of the autopilot is through a three second fader assuring smooth engagement at all times. There is no fader in the Yaw Computer.

Figure 5-2 depicts a KFC 200 Flight Director with autopilot and Yaw Damper Mode.



1. PITCH AND ROLL ATT SIGNAL
2. FD ENGAGE
3. PITCH TRIM
4. PITCH AND ROLL COMMAND
5. FD ANNUNCIATE

FIGURE 5-1 FLIGHT DIRECTOR MODE



1. PITCH AND ROLL ATT SIGNAL
2. FD ENGAGE
3. AP ENGAGE
4. ROLL CROSSFEED
5. YD ENGAGE
6. YD ANNUNCIATE
7. YAW RATE
8. PITCH AND ROLL COMMAND
9. FD ANNUNCIATE
10. AP ANNUNCIATE
11. PITCH SERVO DRIVE
12. AUTO TRIM SENSE
13. TACH FEEDBACK
14. TRIM SERVO DRIVE
15. ROLL SERVO DRIVE
16. TACH FEEDBACK
17. YAW SERVO DRIVE
18. TACH FEEDBACK

FIGURE 5-2 FLIGHT DIRECTOR WITH AUTOPILOT AND YAW DAMPER MODE

5.1.4 ALTITUDE HOLD

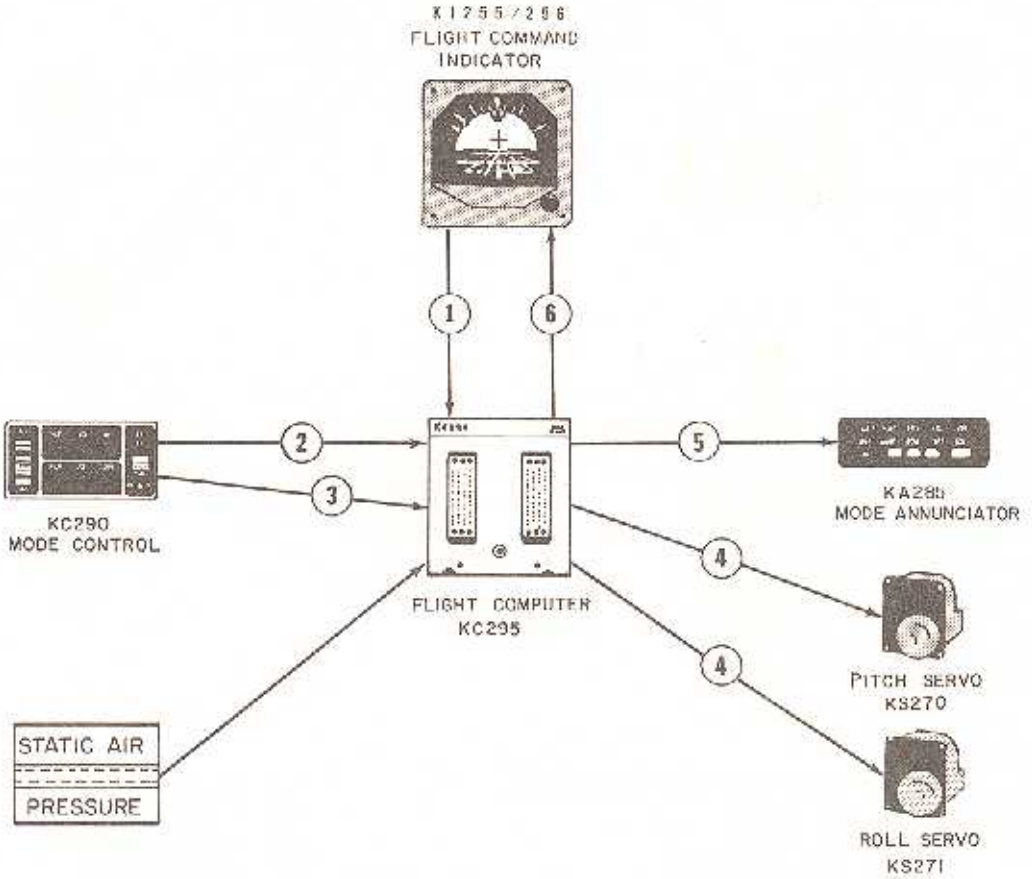
The Altitude Hold Mode is engaged by depressing the ALT Button on the KC 290 Mode Controller. The system then locks onto the existing altitude and deviations above or below it produce commands to realign the aircraft with the correct altitude. Static pressure changes are sensed in the KC 295 and amplified. Output lines send commands to the KI 255/KI 256 for visual monitoring and flight control operation. Commands are sent to the servos in the Autopilot Mode. The KA 285 annunciates the ALT Mode.

The trim button on the KC 290 enables the pilot to command a control change in altitude at a rate of approximately 600 feet/minute. Upon release of the trim button, the system returns to Altitude Hold Mode, locked onto the newly established altitude.

The SYN/CWS (Control Wheel Steering) Mode will allow the pilot to synchronize the Altitude Hold Mode to his present altitude or to change altitude by manually flying to a new altitude and then upon releasing the SYN/CWS switch to hold the altitude present when switch is released.

5.1.4.1 Altitude Preselect Mode

Prior to engaging ALT Arm, an altitude must be selected on the KAS 297. The ALT Arm Mode is then engaged by pressing the arm switch on the KAS 297. The KAS 297 will compare the selected altitude against the actual barometric altitude and compute a capture point based on closure rate. When this capture point is reached, a series of trim pulses controlled by the KAS 297 will command a pitch attitude change to round out towards the selected altitude. At the zero crossing the KAS 297 will automatically engage the ALT Hold Mode. Figure 5-3 shows the Altitude Hold configuration.



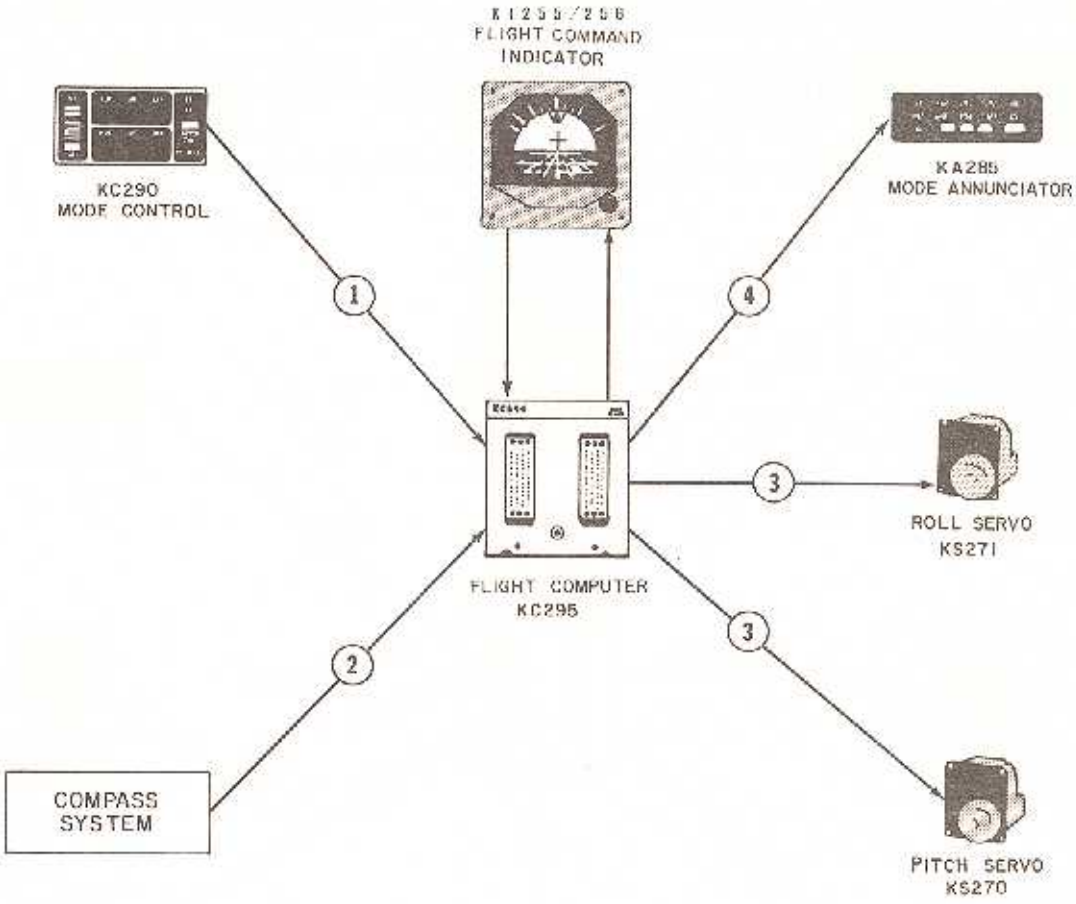
1. PITCH AND ROLL ATT SIGNAL
2. ALTITUDE ENGAGE
3. TRIM COMMAND
4. PITCH AND ROLL SERVO DRIVE
5. ALTITUDE HOLD ANNUNCIATION
6. PITCH AND ROLL COMMANDS

FIGURE 5-3 ALTITUDE HOLD MODE

5.1.5 HEADING MODE

The Heading Mode may be selected by depressing the HDG button on the KC 290. Both prior to and after selection of the mode, the Heading Bug can be rotated to select a desired heading. The error between the actual aircraft heading displayed under the lubber line and the heading selected causes a right or left bank to return the aircraft to the selected heading. Actual heading to the left of the selected heading causes a right bank. The error is processed in the KC 295 and sent to the KI 255/KI 256 for display and to the servos for autopilot control. HDG mode is annunciated in the KA 285.

Figure 5-4 depicts the KFC 200 components utilized in the Heading Mode.



1. HEADING ENGAGE
2. HEADING DATUM
3. PITCH AND ROLL SERVO DRIVE
4. HEADING ANNUNCIATE

FIGURE 5-4 HEADING MODE

5.1.6 NAVIGATIONAL OR APPROACH MODES

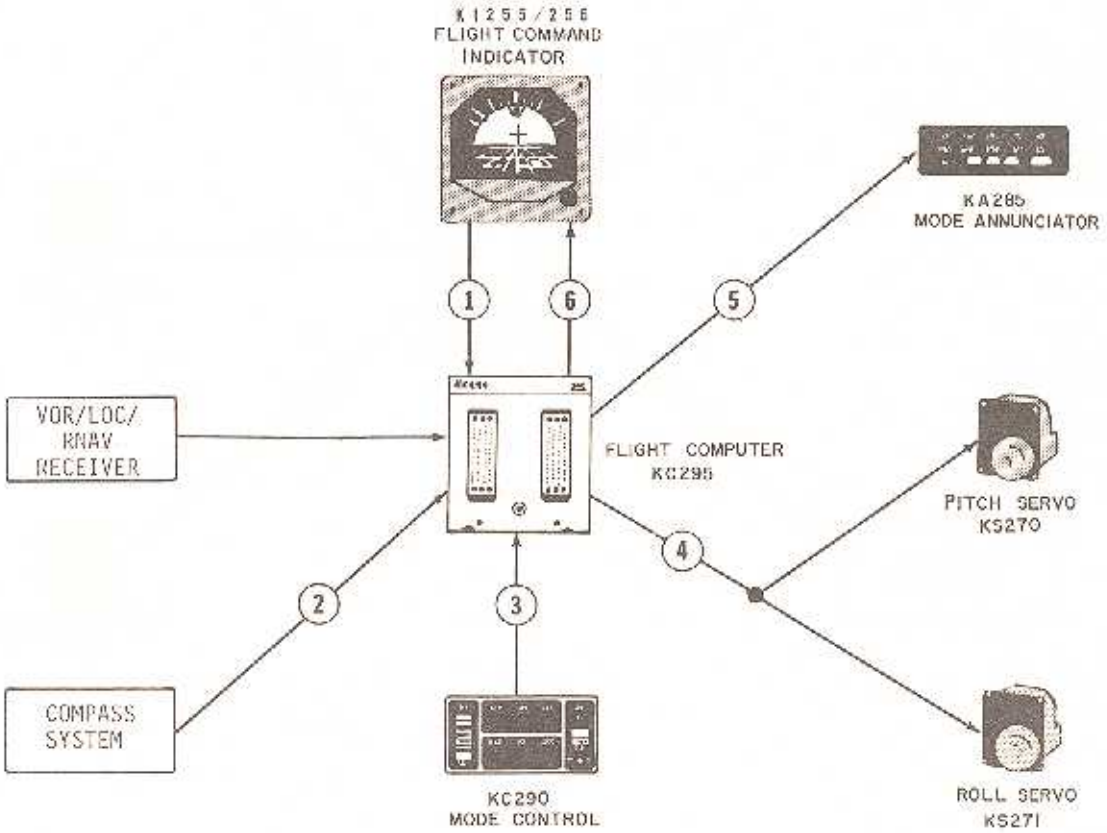
The Navigational (NAV) Mode is used when flying VOR or RNAV enroute coupled. The deviation signal from the NAV receiver is sent to the KC 295 for processing into roll commands. The same signal is displayed on the appropriate course deviation indicator.

Depression of the NAV button on the KC 290 places the system in a NAV ARM condition unless the system is within track limits. Then it will go straight to NAV CPLD and bypass NAV ARM, as indicated by the NAV and CPLD lights being illuminated. If the system is not within track limits it will be in a state of NAV ARM as indicated on the KA 285 by the NAV and ARM lights being illuminated. Using beam deviation and beam rate the KC 295 computes beam capture point, at which time the airplane is commanded to turn on to the beam. The KA 285 annunciates this transition by switching from NAV and ARM to NAV and CPLD.

The Approach Mode is used when making any type of radio guided approach to landing, VOR, RNAV, or ILS. The Approach Mode is selected by depressing the APPR button on the KC 290. The functional operation of the Approach Mode is similar to that described for the NAV Mode. The KA 285 annunicates APPR and ARM and APPR and CPLD. For flight stability the localizer gain is reduced on passage of the Middle Marker.

For Back Course ILS operation the Back Course (BC) button on the KC 290 is depressed. The electronics reverses the polarity of beam deviation and course for proper steering onto the beam. BC is annunciated on the KA 285 (APPR Mode must be selected to enable BC Mode).

Figure 5-5 describes the KFC 200 System Components used in the NAV or Approach Modes.



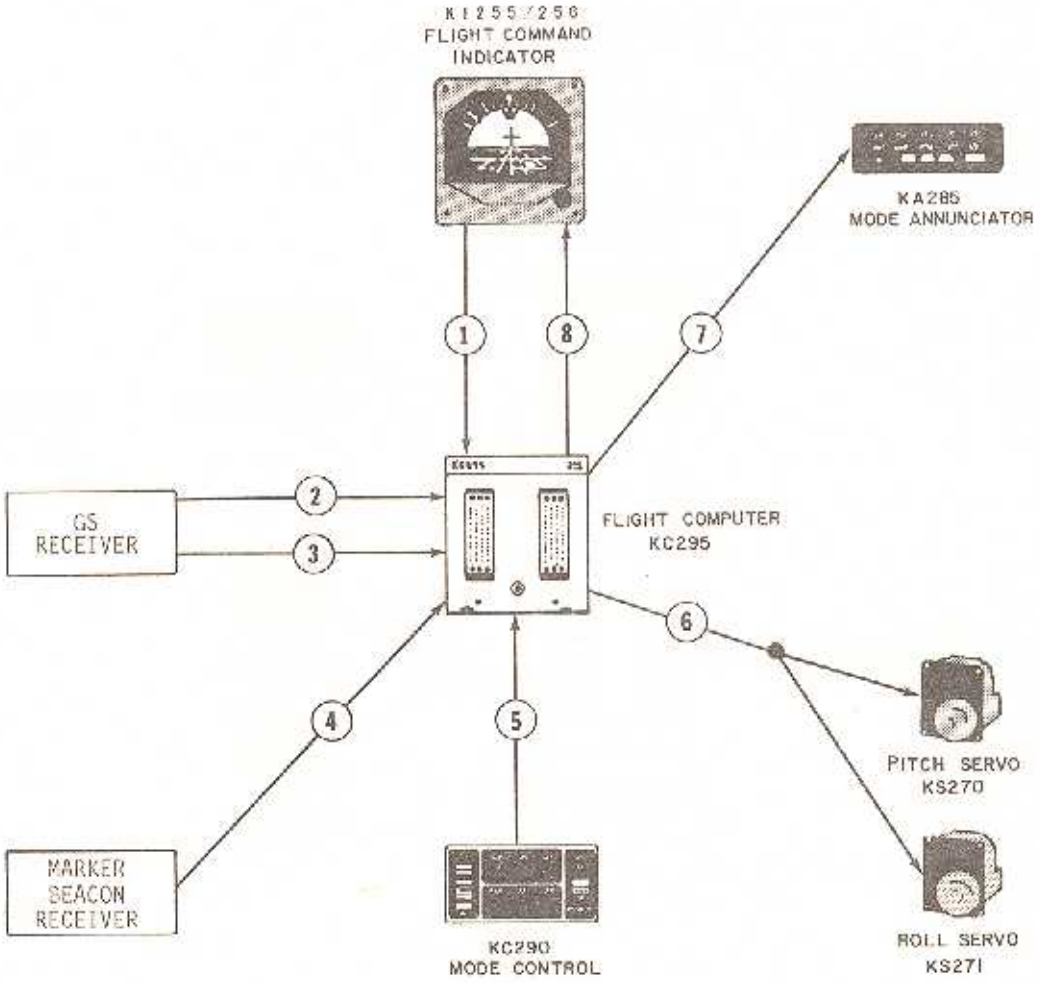
1. PITCH AND ROLL ATT SIGNAL
2. COURSE DATUM
3. NAV, APPR, BC ENGAGE
4. PITCH AND ROLL SERVO DRIVE
5. NAV, ARM, APPR, CPLD, BC ANN
6. PITCH AND ROLL COMMAND

FIGURE 5-5 NAV OR APPROACH MODES

5.1.7 GLIDESLOPE MODE

The Glideslope Mode can only be used when Approach Coupled to a localizer and with the Glideslope receiver valid. The Glideslope valid flag must be pulled from view. When the aircraft passes through the beam center, transfer from the existing pitch mode (Altitude or Pitch Attitude Hold) is initiated. The steering commands are then based upon glideslope beam deviation. Glideslope coupled (GS) is annunciated on the KA 285. If the Glideslope signal is lost, GS flashes 6 or more times and disengages. If the signal returns, GS re-engages. For flight stability, the Glideslope deviation gain is reduced on passage of the Middle Marker. This reduced gain is locked into the KC 295 until APPR Mode is recycled. Back Course inhibits Glideslope Coupled.

Figure 5-6 shows the KFC 200 System components used in the Glideslope Mode.



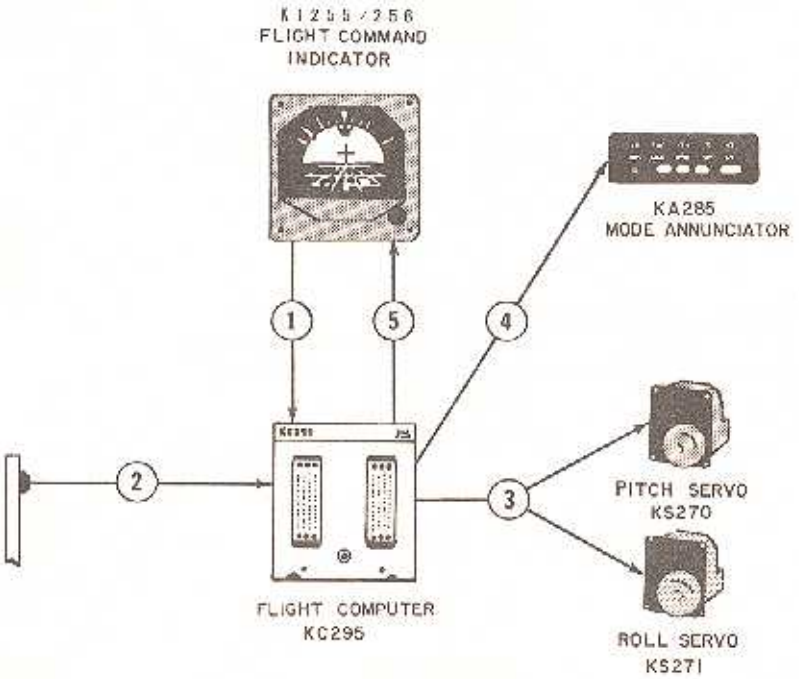
1. PITCH AND ROLL ATT SIGNAL
2. GS DEV & VALID
3. ILS ENGERIZED
   (REQUIRED FOR GLIDESLOPE CPLD)
4. MIDDLE MARKER
5. APPR, BC ENGAGE
6. PITCH AND ROLL SERVO DRIVE
7. GS COUPLED ANNUNCIATE
8. PITCH AND ROLL COMMAND

FIGURE 5-6 GLIDESLOPE MODE

5.1.8 GO AROUND MODE

A preset pitch up angle usually set for the best rate of climb for single engine aircraft and the best single engine rate of climb for twin engine aircraft can be selected by depressing the Go Around (GA) switch usually located on or near the throttles. This mode can be used at any time, usually at missed approach. On most aircraft it is necessary to automatically disengage the autopilot when Go Around is selected to prevent a sudden pitch up which could cause a stall. After the appropriate power setting has been established for the commanded pitch up attitude, the Autopilot if disengaged may be re-engaged. Go Around (GA) is displayed on the KA 285.

Figure 5-7 shows the KFC 200 System components used with the Go Around Mode.



1. PITCH AND ROLL ATTITUDE SIGNAL
2. GO AROUND SWITCH
3. PITCH AND ROLL SERVO DRIVE
4. GO AROUND ANNUNCIATE
5. PITCH AND ROLL COMMAND

FIGURE 5-7 GO AROUND MODE

5.2 UNIT TECHNICAL DESCRIPTIONS

5.2.1 KA 285

The following description of the KA 285 should be used in conjunction with Figure 5-8:

The controls/indicators on the KA 285 are as follows:

A.	Mode Annunciators	Illuminate when in particular mode or preflight test mode.
B.	Trim Fail Annunciator	Illuminates when a trim failure or preflight test is sensed.
C.	Marker Beacon Receiver Annunciators	Provides a 3 light marker beacon display.
D.	Photo-resistor	Senses ambient light for light dimmer circuitry.

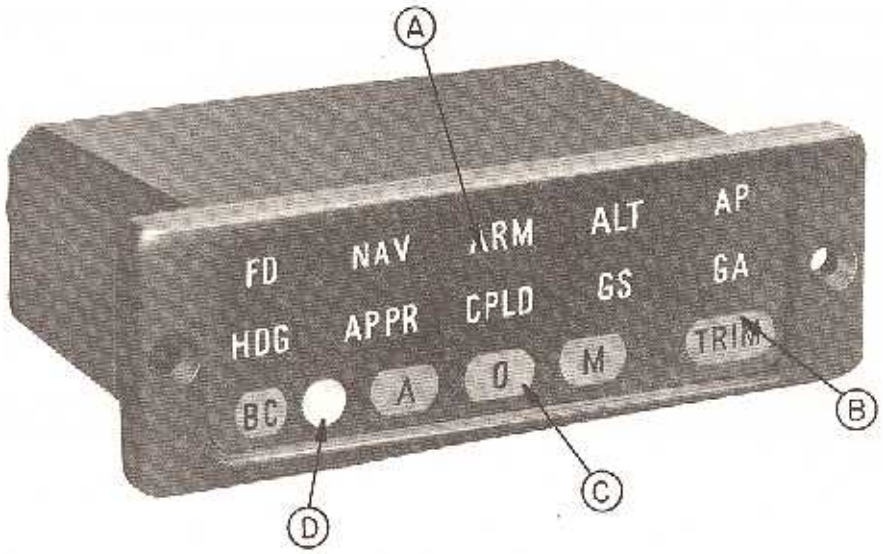


FIGURE 5-8 KA 285

5.2.2 KC 290/292

The following description of the KC 290/292 should be used in conjunction with Figure 5-9.

A. Pitch Trim Control

Used to trim the pitch axis in Altitude Hold or Pitch Attitude Hold. Depressing the top part of the switch causes a pitch down command.

B. Heading Button

Pushbutton switch which activates the Heading Mode. Steering commands are dependent upon the position of the heading select indicator on the KI 525/A. A second depression of the button disengages the mode.

C. Flight Director Button

Pushbutton switch which activates the Flight Director Mode. A second depression of the button disengages the mode.

D. Servo Effort Meter

In KC 292, this button is replaced by an elevator servo effort meter.

E. Altitude Button

Pushbutton switch which activates the Altitude Hold Mode. Steering commands are originated by the altitude hold board of the KC 295. A second depression of the button disengages the mode.

F. Autopilot Engage Switch

In -00 units a lever type switch is used to engage the autopilot mode. Raising the lever up engages the autopilot mode. The lever is lowered to disengage the mode. While engaged, the switch is held by a solenoid in the AP/ON position.

In -01 units a lever type switch is used to engage the autopilot mode. Raising the lever up engages the autopilot mode. The lever is lowered to disengage the mode. This causes a 1.5 to 2.5 second aural alert, while engaged, the switch is held by a solenoid in the AP/ON position.

G. Press to Test Switch

Pushbutton switch that energizes the preflight test function of the KFC 200 system.

H. Approach Button

Pushbutton switch which activates the approach mode. Steering commands are originated from radio beam deviations from the navigational approach avionics. A second depression of the button disengages the mode.

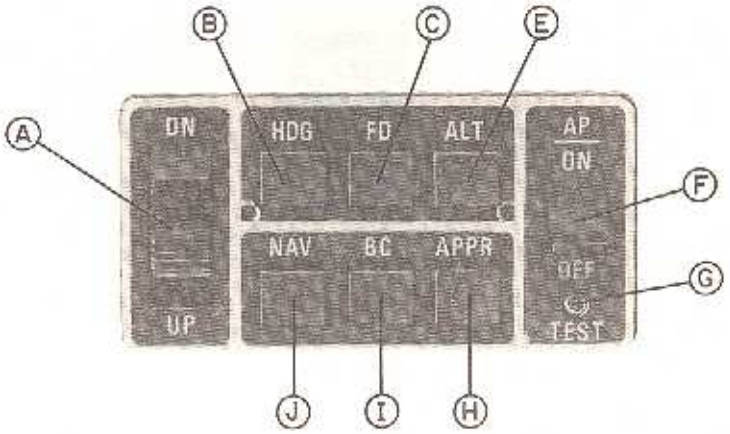
I. Back Course Button

Pushbutton switch which inverts course datum and radio beam deviation when flying on the back course portion of the ILS. A second depression of the button cancels back course.

J. NAV Button

Pushbutton switch which activates the NAV mode. Steering commands are originated from radio beam deviations from the navigational avionics. A second depression of the button disengages the mode.

KC 290



KC 292

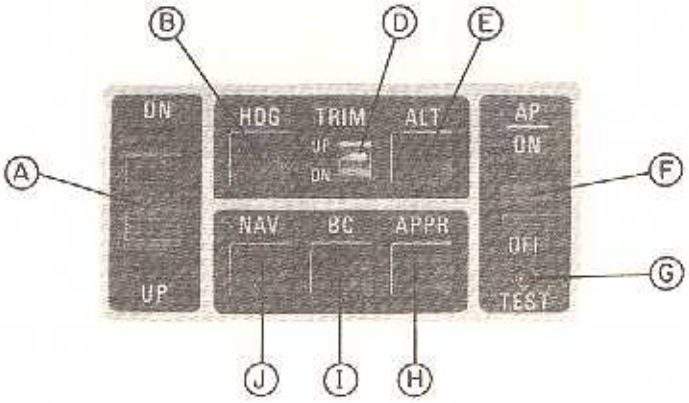


FIGURE 5-9 KC 290/KC 292

5.2.3 KC 291

The following description of the KC 291 should be used in conjunction with Figure 5-10.

A. Mode Button	Pushbutton switch which activates the Yaw Damp Mode. A second depression of the button disengages the mode.
B. "ON" Annunciator	When the Yaw Damp Mode is engaged "ON" is annunciated.
C. Photocell	Photocell used to automatically dim the "ON" annunciator is subdued ambient light.

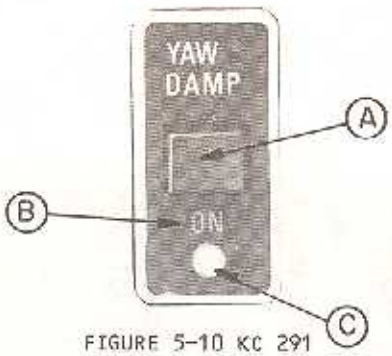


FIGURE 5-10 KC 291

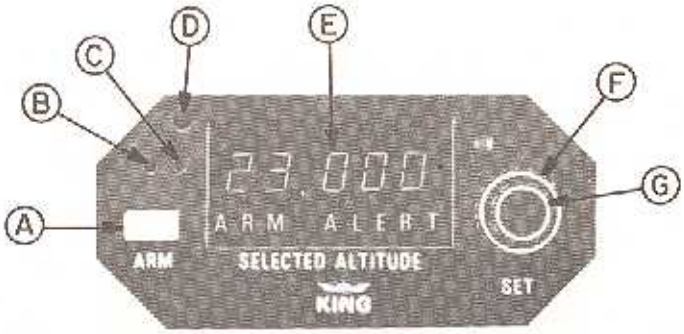


FIGURE 5-11 KAS 297

5.2.3.1 KAS 297

The following description of the KAS 297 should be used in conjunction with Figure 5-11.

a. Altitude ARM Switch

Momentary push switch used to engage Altitude ARM Mode (display will annunciate ARM). Flight Director or Autopilot is required for operation.

b. Altitude LO Calibration Pot

Front panel accessible screwdriver adjusted control for calibrating the KAS 297 for use with a particular altimeter (low altitude adjustment).

c. Altitude HI Calibration Pot

Front panel accessible screwdriver adjusted control for calibrating the KAS 297 for use with a particular altimeter (high altitude adjustment).

d. Photocell

Used to automatically control display brightness.

e. Display

High-voltage gas discharge display which indicates selected altitude in feet, Altitude ALERT Annunciator, and Altitude ARM Annunciator.

f. Selected Altitude Control

Control used to set the one thousand foot digit in the selected altitude display. Clockwise rotation selects increasing altitude. Mechanism has no stops. Range: 0 to 49,000 feet.

Controls used to set the one hundred foot digit in the selected altitude display. Clockwise rotation selects increasing altitude. Mechanism has no stops. Ranges: 0 to 900 feet.

5.2.4 KC 295

5.2.4.1 Physical Description

The following description of the KC 295 should be used in conjunction with Figure 5-12. The basic assemblies of the KC 295 are as follows:

a.	Input Connector (J1)	Female connector and RFI filter.
b.	Input Connector (J2)	Male connector and RFI filter.
c.	Static Air Fitting	Static Air Pressure for altitude hold information.
d.	Mother Board	Printed circuit board to which other circuit board connectors are attached.
e.	Logic Board (A3)	Plug in printed circuit board containing pitch and roll logic electronics. -300 series components are located on this board.
f.	Pitch Board (A2)	Plug in printed circuit board containing pitch analog electronics. -200 series components are located on this board.
g.	Altitude Hold Board (A6)	Plug in printed circuit board containing altitude hold electronics and altitude pressure transducer. -600 series components are located on this board.
h.	Adapter Board (A4)	Plug in printed circuit board containing attitude gyro signal demodulation, nulling, gain adjustment and AC excitation. Adjustment of loop gains dependent upon aircraft type is accomplished on this board. Autotrim detection and drive is located here. -400 series components are located on this board.
j.	Adapter Board Nameplate	Identifies adapter board as to compatability for certain aircraft type.
k.	Lateral Board (A1)	Plug in printed circuit board containing lateral or roll axis analog electronics. -100 series components are located on this board.
l.	Power Supply Board (A5)	Printed circuit board containing power supply electronics. -500 series components are located on this board.
m.	Part Number Tag	Indicates part number which varies according to particular aircraft installation.

5.2.4.2 KC 295 Functional Description

A functional description of the KC 295 follows. Figures 6-3 and 6-4 should be used in this discussion.

All lines from connectors J2951 and J2952 receive RFI filtering by passing through inductive beads and a feedthru capacitor plate located between the connectors and the mother board. Power input lines are routed to the A5 power supply board. The DC input (14 or 28VDC) is chopped into an AC signal by I502. It is then routed through T501, then rectified for input to the +15VDC linear regulators, I503 and I504. +10V power is derived from the +15V supply by Q507. Failure monitoring is provided by I501.

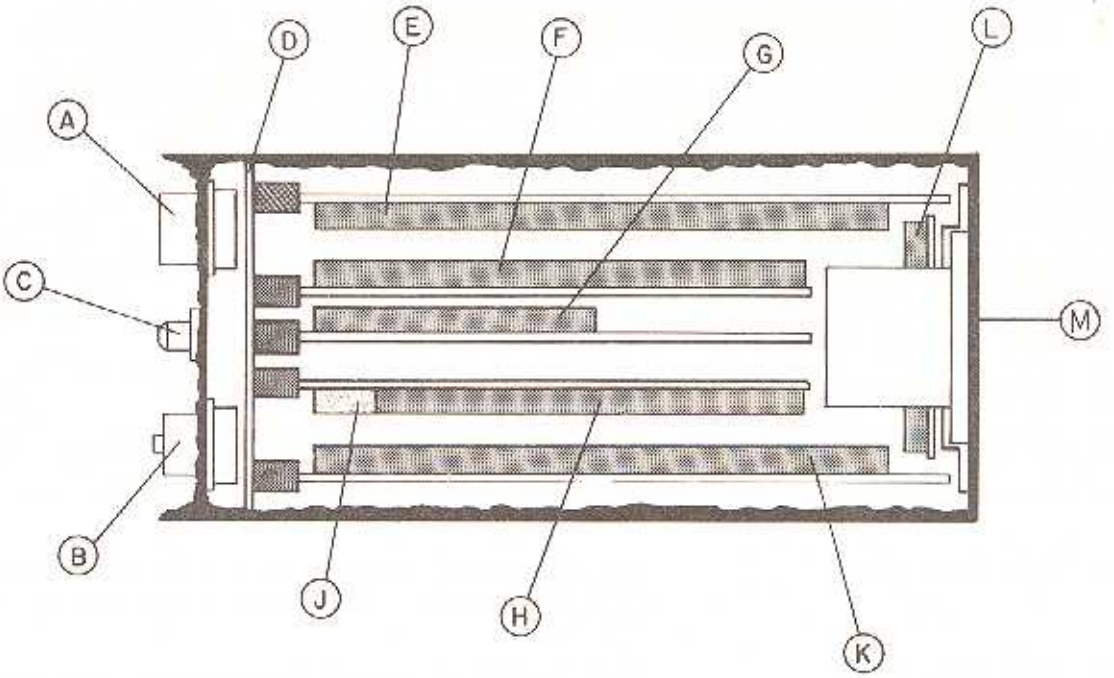


FIGURE 5-12 KC 295

a. Flight Director Mode

Upon engagement of the Flight Director Mode, the KFC 200 system enters pitch attitude hold and wings level. Pitch attitude signals are sent through demod I408C where they are scaled and converted to DC. I203B provides additional scaling and its output provides the DC pitch attitude used throughout the pitch axis. J2952-P is a test output for the DC pitch attitude. A pitch synchronizer composed of I211A, I211B, and I203A locks on to the pitch attitude at the time of engagement, and, upon subsequent movement from this attitude, produces error commands through analog switch I204A and I202B. I202D provides the pitch command to the KI 255 pitch command bar or the KI 256 command bar.

Roll attitude for holding wings level in Flight Director Mode and as attitude feedback in other lateral modes is sent to I408D for demodulation and scaling. I108C provides further scaling. J2952-X is a test output for DC roll attitude. The attitude signal then goes through summing amplifier I104A. I105A and I104D process the signal for visual display on the KI 255 roll command bar or the KI 256 command bar.

b. Altitude Hold Mode

The Altitude Hold board contains a sensitive frequency-to-voltage converter that converts the output of an air pressure controlled resonator into an error signal.

A trim function is added to allow the pilot to trim the plane's altitude up or down at about 600 feet/minute in the Hold mode by incrementing or deincrementing the stored altitude data.

HI passed pitch attitude from I202A is summed with the altitude error at I202B.

c. Heading Mode

The heading datum information comes from the KI 525A Pictorial Navigation Indicator and enters the KC 295 through scaling amplifier I115B. The signal then enters the bank angle limiter I104C through analog switch I105B. It is then summed with roll attitude for limiting.

d. Navigation Mode

The output from the NAV receiver is amplified and filtered by I115A and I115D. A capture point, designed to give smooth turn onto the beam is computed by I107C, I107D, I108A, I110C and I117. Beam deviation and beam rate are the inputs for this computation. Once the capture has occurred, the deviation signal from I115D is sent through I110B, I108D, I108B and I104B where shaping and limiting of the signal takes place. The signal is then coupled into the bank angle limiter I104C.

DC course datum enters I115C where it is scaled and then shaped and limited in I107A and I107B. It is coupled to the bank angle limiter through analog switch I105D.

e. Approach Mode (Localizer)

The localizer receiver output is amplified and filtered by I115A and I115D. The approach loop consisting of I113B, I113C, I113D and I113A provides shaping and limiting of the error command. The localizer command is summed into the bank angle limiter through I105C. Course datum is also summed in this mode.

f. Back Course

If back course is selected the localizer error and course datum error is reversed to provide proper polarity steering while on the ILS Back Course. This reversal is accomplished by changing gains in inverting amplifiers in the approach and course datum loops.

g. Approach Mode (Glideslope)

The glideslope receiver output is amplified by I205D. Gain scheduling is provided by analog switch I204D which lowers the glideslope gain upon passage of the middle marker. The glidslope capture is computed such that capture occurs upon crossing the center of the beam. Sensing of this is performed in I205A and I205B.

Hi passed pitch attitude is summed with the glideslope error in I202B as is the case in Altitude Hold Mode.

h. Go Around Mode

Energizing Go Around places a pitch up command through I201C into I202B where it is summed with pitch attitude also coming through I201C. R404 on the adapter board adjusts the amount of pitch attitude commanded during Go Around.

i. Up Elevator Compensation

Up elevator compensation, designed to provide lift when making roll maneuvers, is generated from the roll attitude signal. The up elevator signal is continuously coupled to the pitch command amplifier I202B.

j. Autopilot Mode

When the autopilot is engaged the servos are engaged and drive signals are generated for them as follows:

1. Pitch

I201A receives inputs from the flight director I202B and pitch rate (HI passed pitch attitude) from I210B.

When the autopilot mode is engaged, I210C turns the command signal on slowly to provide smooth flight during mode engagement. I208C sums the command signal with the elevator servo tach signal through I208A and I208D to provide smooth servo operation. Servo drive is obtained from I208C and inverter I208B. Autopilot operation after I202B is independent of which mode is engaged.

2. Autotrim

When a requirement for elevator trim has been sensed, a signal goes to the autotrim delay circuit of I401A and I401D for trim up. After a predetermined delay time, the trim up drive line is activated, driving the pitch trim servo. When trim down has been sensed the command drives through I401B, I401C. I402, I403, I404 perform the trim fail monitor function.

3. Manual Electric Trim

When the manual electric trim is activated by the trim switch on the control wheel, the autotrim and autopilot is disengaged if engaged and the pitch trim of the aircraft is controlled manually.

4. Roll

I101A receives inputs from the Flight Director I104A and roll rate (HI passed roll attitude) from I101B. When the autopilot mode is engaged, I101D turns the command signal on slowly to provide smooth flight during mode engagement. I103A sums the command signal with the aileron servo tach signal through I103B and I103D to provide smooth servo operation. Servo drive is obtained from I103A and inverter I103C.

5.2.5 KC 296

5.2.5.1 Physical Description

The following description of the KC 296 should be used in conjunction with Figure 5-13.

a.	A1 Board	Printed Circuit Board containing analog control logic circuitry.
b.	A2 Board	Printed Circuit Board containing engage logic and power supply.
c.	Transistor, Regulator Mounting	Q201, Q209, I202, I203 are sandwiched between the mounting plate and A2 card for heatsinking.
d.	Flextape	Flextape circuit interconnecting the A1 and A2 boards.
e.	Mounting Plate	Unit mounting plate.
f.	Cover	Unit Cover.
g.	Connectors	Printed Circuit Board card edge connectors.

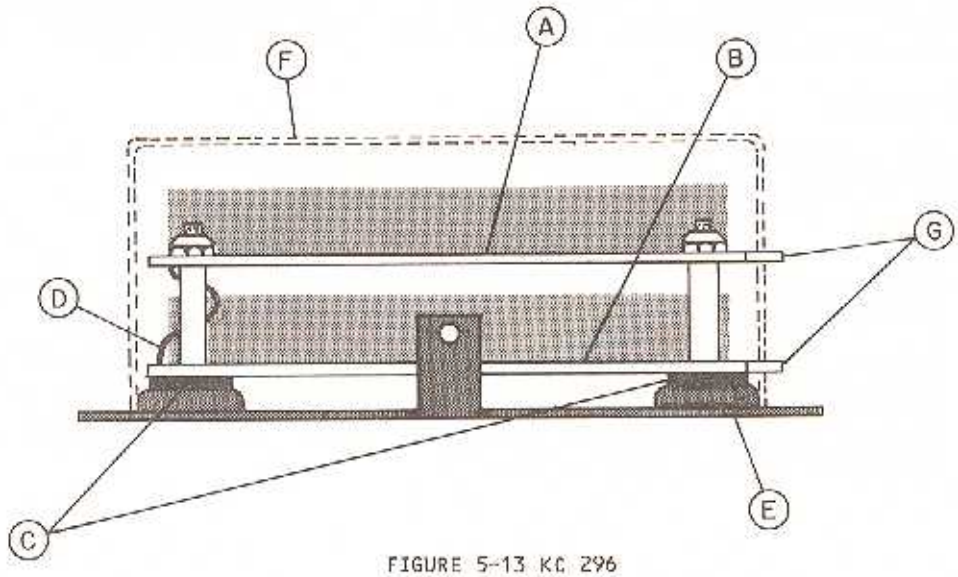


FIGURE 5-13 KC 296

5.2.5.2 Functional Description

A functional description of the KC 296 follows. Figure 6-5 should be used in this discussion.

The unit consists of two printed circuit board assemblies. The top board (A1) contains the analog yaw axis control circuitry while the bottom board (A2) contains the engage logic and power supply circuitry.

Yaw rate from the KG 257 or KRG 331 enters J2961-2 and J2961-C into I101C for differential amplification and scaling. After further scaling in I101A, it is hipassed into I103D for acceleration control. I103C sums hipassed Yaw rate and hipassed roll attitude. The sum is scaled and switched by Q101 upon Yaw damp or autopilot engagement into I103A. I103A sums the control signal with Yaw Servo tach feedback from I102B and I102A for smooth Yaw Servo operation. Servo drive is obtained from the outputs of I103A and inverter I103B.

Roll crossfeed from the KC 295 enters J2961-F and J2961-H into I101B for differential amplification. It is then hipassed into I103C for roll rate control and limiting. It is then summed with hipassed yaw rate as described above.

28VDC unit power enters through pass transistor Q201 where it is preregulated down to 14VDC. Q201 is bypassed for 14VDC operation.

I201 and Q202, Q203, Q204, Q205 provide an AC signal which is rectified and regulated by I202 for +15V and I203 for -15V. +10V is supplied by a zener diode regulator derived from the +15V supply.

5.2.6 KI 255

The following discussion of the KI 255 should be used in conjunction with Figure 5-14.

A.	Pitch Attitude Indicator	Displays actual pitch attitude. Markings indicate attitude from 20° down to 15° up. Maximum pitch up or down movement can be ±85°.
B.	Bank Angle Indicator	Displays actual bank angle. Markings indicate 10, 20, 30, 60, 90°, right or left bank. The bank angle indicator is operational through 360°. Right indicator implies a left bank.
C.	Symbolic Airplane Adjustment	Adjusts the symbolic airplane up and down. (Screw slot or knob adjust available.
D.	Symbolic Airplane	Reference for attitude and command information.
E.	Pitch Command Bar	Displays computed pitch command from KC 295.
F.	Roll Command Bar	Displays computed roll command from KC 295.
G.	Flight Director Flag	Indicates when Flight Director Mode is engaged. The flag is out of view when the mode is engaged.

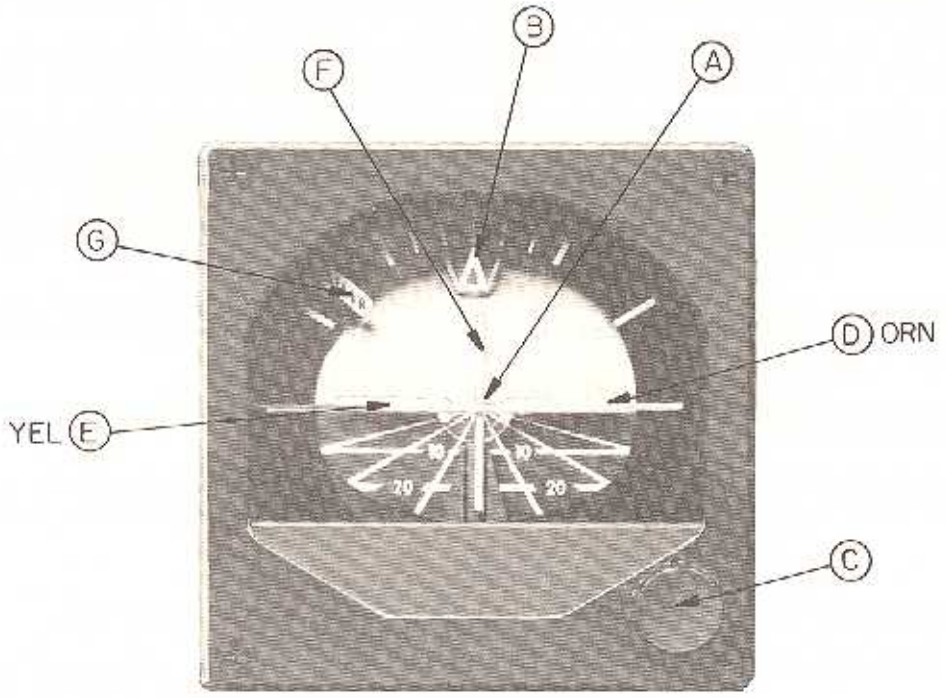
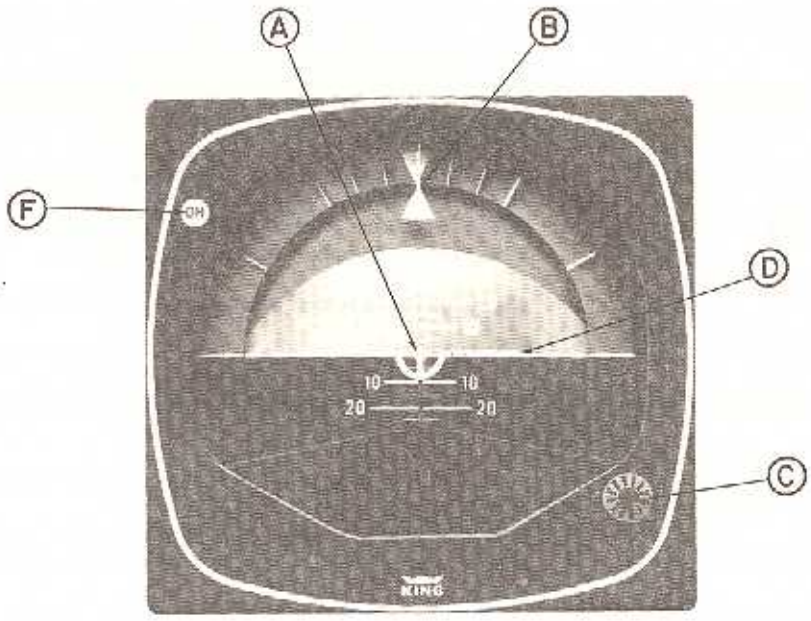


FIGURE 5-14 KI 255

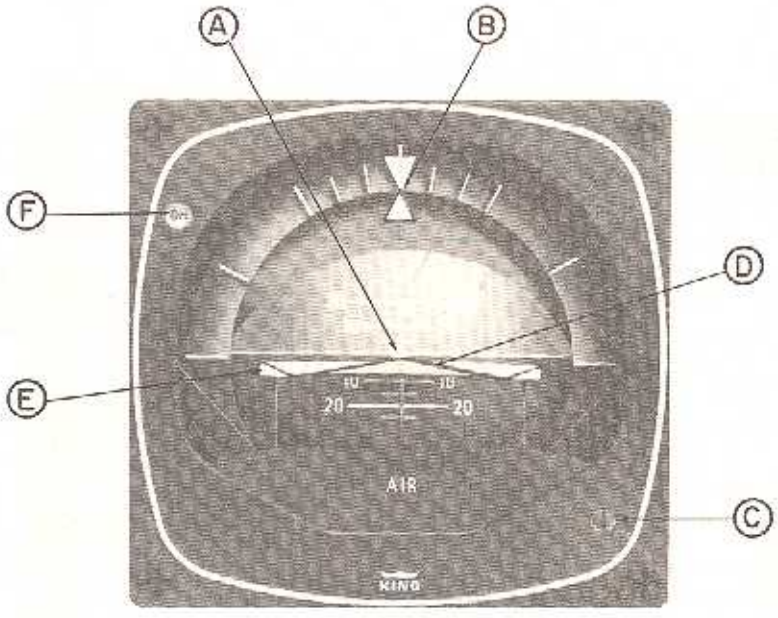
5.2.7 KI 256/KG 258

The following discussion of the KI 256 and the KG 258 should be used in conjunction with Figure 5-15.

A.	Pitch Attitude Indicator	Displays actual pitch attitude. Markings indicate attitude from 25° down to 25° up. Maximum unprecessed pitch up or down movement is 80°. Controlled precessed is employed to achieve a 360° movement.
B.	Bank Angle Indicator	Displays actual bank angle. Markings indicate 10, 20, 30, 60, 90°, right or left bank. The bank angle indicator is operational through 360°.
C.	Symbolic Airplane Adjustment	A screw slot adjusts the symbolic airplane up and down.
D.	Symbolic Airplane	Reference for attitude and command information.
E.	Command Bar (KI 256 ONLY)	Single cue, displays computer pitch and roll commands from KC 295 Flight Computer. The command bar is in view only when Flight Director Mode is engaged.
F.	DH Annunciator	Provides an DH annunciator controlled externally by a radio altimeter.



KG 258 HORIZON GYRO



KI 256 FLIGHT COMMAND INDICATOR

FIGURE 5-15 KI 256/KG 258

5.2.8 KS 270, KS 271, KS 272, KS 273

The following description of the KS 270, KS 271, KS 272, KS 273 servos should be used in conjunction with Figure 5-16.

A.	Tach Motor (KS 270/271 ONLY)	Motor driven by drive motor to provide velocity feedback for smooth servo operation.
B.	Drive Motor	Main drive motor which provides torque to the output shaft.
C.	Engage Solenoid	Solenoid which, when energized, holds the servo drive gear in mesh with the servo mount slip clutch.
D.	Output Shaft	Shaft which meshes with servo mount slip clutch.
E.	Locating Pin	Pin which locates servo properly on servo mount.
F.	Electronics Assembly	Plate which holds the power drive transistors. (Not applicable in KS 273).
G.	Interconnect Pigtail	Cable which provides interconnect to airplane wiring harness.
H.	Trim Switch (KS 270 Pitch Servo ONLY)	Switches which sense servo effort and call for autotrim drive after prescribed delay determined in KC 295.
I.	Autotrim Transfer Relay (KS 272 ONLY)	Relay used to transfer trim motor control from manual trim to autopilot controlled autotrim.

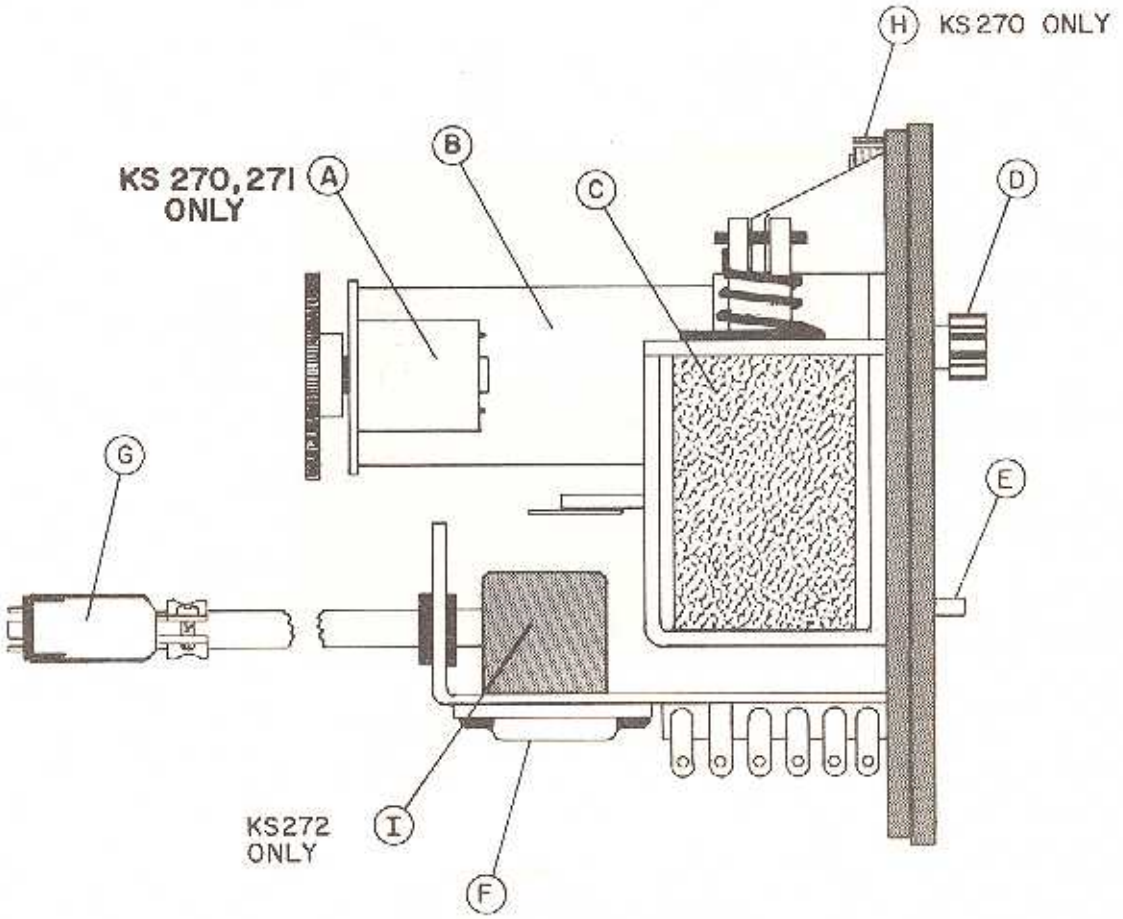


FIGURE 5-16 KS 270, KS 271, KS 272, KS 273

5.2.9 KA 118

5.2.9.1 Physical Description

The following description of the KA 118 should be used in conjunction with Figure 5-17.

a. Printed Circuit Board containing demodulator circuitry.

b. Q101, power transistor for input power requirements, is located here for proper heat sinking.

c. Mounting Plate

d. Unit Cover

e. Card Edge Connectors

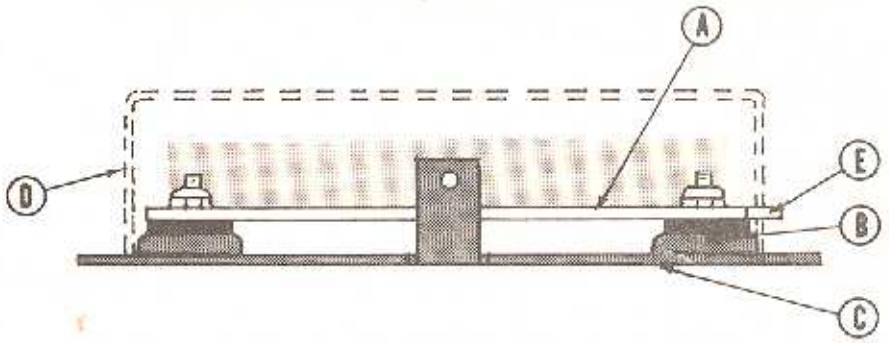


FIGURE 5-17 KA 118

5.2.9.2 Functional Description

The KA 118 converts AC heading select and course datum signals into DC commands for use in the KC 295 Flight Computer. On -00 units, an internal oscillator generates the 10.5V peak 400Hz excitation that excites the course datum synchro and synchronizes the demodulation circuitry. On -01 units, the oscillator circuitry is omitted and the reference excitation is supplied by the aircraft.

5.2.10 KA 117

5.2.10.1 Physcial Description

The following description of the KA 117 should be used in conjunction with Figure 5-18.

a. Upper Board - Printed Circuit Board which contains analog processing signals for the KA 117.

b. Lower Board - Printed Circuit Board which contains drive signals for the KA 117.

c. Transistors - Q102, Q103, Q104, Q105 Power Drive Transistors are located here for proper heat sinking.

d. Flex Tape - Flextape circuit interconnecting the upper and lower boards.

e. Unit Mount Plate

f. Unit Cover

g. Printed Circuit Board card edge connectors

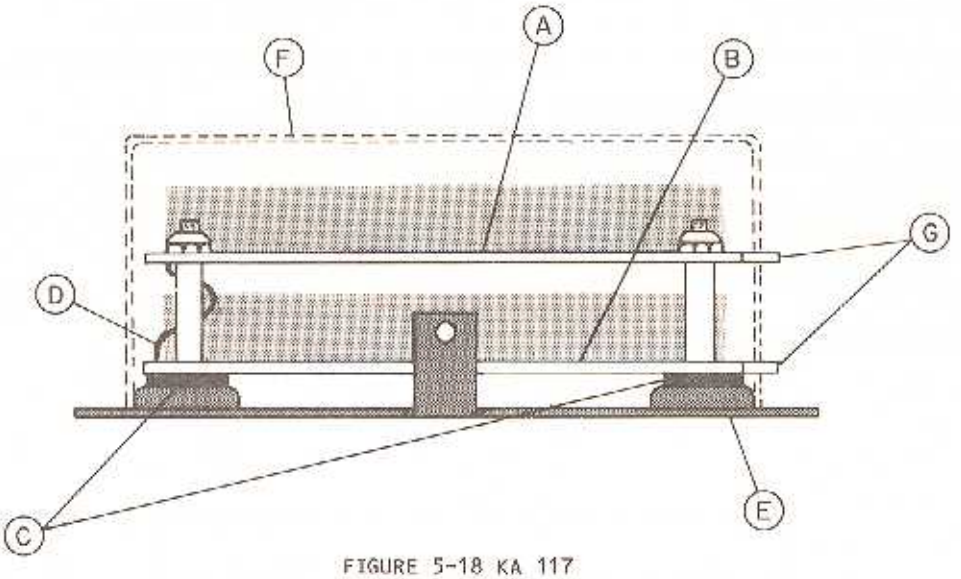


FIGURE 5-18 KA 117

5.2.10.2 Functional Description

The KA 117 interfaces the KC 295 computer with pitch trim systems in those installations which require proportional drive.

Trim drive power is provided by a four transistor power bridge which causes the trim motor to operate in a pulsing mode. The pulse duty cycle is established by command conditioning circuitry which adjusts the trim rate to a proportional value of the autopilot's pitch command.

Also included are monitor command logic, time delay logic and steering diodes for proper routing of commands.

5.2.11 KRG 331

For information concerning the KRG 331, refer to installation manual 006-0515-00.

5.2.12 KA 141

For information concerning the KA 141, refer to installation and maintenance manual 006-0519-00.

5.2.13 KA 142

5.2.13.1 Functional Description

The KA 142 interfaces the KC 295 Autopilot Computer with the pitch trim servo in those installations which require two different trim speeds. The KA 142 is capable of operating on +14 or +28 volts by using an external jumper between pins K and 6 when the unit is to be operated on +14 volts.

When a flaps in motion signal is received by the KA 142, the time delay circuit quickly commands the trim speed switch driver to drive the trim speed switch to fast trim. When the flaps come to a stop, the time delay circuit will keep the KA 142 in fast trim speed for a certain period of time. That period of time is determined by a pot in the time delay circuit.

The autotrim direction drive sensor monitors the flaps in motion switches both UP and DOWN. If the autopilot system tries to trim both UP and DOWN at the same time, the autotrim direction drive sensor will pull one of the trim drive lines to ground. This will prevent the trim servo from trying to drive both directions at the same time which could result in damage to the trim servo. Both flaps in motion UP and flaps in motion DOWN follow the same theory of operation.

5.2.14 KAS 297

5.2.14.1 Functional Description

The KAS 297 select utilizes one microprocessor for most of the work in the unit. One function the computer performs is to supply new display data at 2msec intervals for the display decoders. The microprocessor also supplies a monitor of all control switches every 2msec for pilot commands such as increment or decrement of altitude or ARM enable. The action of the increment/decrement switch is unique in that storage of the number is in data memory in the microprocessor and the switch merely tells the microprocessor program to step the number in increments of ±1. The ARM enable signal from the mode logic circuit is buffered from 10V to 5V. The microprocessor is also used to load the non-volatile memory at any time the altitude is changed by the pilot. Barometric pressure is processed by the A/D converter to a digital form which is sent to the microprocessor to be processed.

5.2.15 KA 132

5.2.15.1 Functional Description

The KA 132 is an Acceleration Switch which monitors positive and negative vertical G-forces on the aircraft. If the aircraft experiences a ±1 G-force the KA 132 disengages the autopilot. This force can be caused by two things; turbulance, or a runaway pitch or roll servo.

5.3 SYSTEM MODE LOGIC SWITCHING

This section contains a comprehensive study of the Enables and Inhibits found in the Mode Logic of the KFC 200 System. Engagement of modes is accomplished through the KC 290 Mode Controller. Controls on the throttle (Go Around) and Control Column (Sync/Control Wheel Steering) are described from a functional view.

In most cases, the Mode Enables and Inhibits are performed in the KC 295 Flight Computer Logic Section.

5.3.1 MODE SELECTOR/FLIGHT CONTROLLER (KC 290)

Except as noted, all switches SPDT momentary, alternate-action type.

All pushbuttons are lighted to identify mode controlled. Lighting is either 14VDC or 28VDC controlled through pilot's dimmer circuit.

5.3.2 KC 295 MODE OPERATION

Mode logic operation of the KC 295 Autopilot Computer is described as follows:

A. Flight Director (FD):

Engaged By:

1. Toggling it on.
2. Toggling on any other mode.
3. Activating CWS switch.
4. Steps 1, 2, 3, not active in an autopilot only system.
5. "Autopilot only" system engages FD mode when AP switch engages. FD is not annunciated in AP only systems.

Disengage By:

1. Toggling it off.
2. Power Failure of +15, -15, +10, A/C.
3. Autotrim disconnect switch.
4. Loss of compass valid when on HS, NAV, APPR, ARM or CPLD modes.
5. "Autopilot Only" system AP switch disengagement forces all modes off.
6. In some systems, the trim interupt disconnects all FD modes (covered by particular STC).

NOTE

IF AP IS ENGAGED, FD IS INHIBITED FROM TOGGLILNG OFF. FD MODE ALONE (EXCEPT "AP ONLY") WILL RESULT IN PITCH ATTITUDE HOLD AND WINGS LEVEL HOLD.

B. Heading Select (HDG):

Engaged By:
1. Toggling it on (When compass valid).

Disengaged By:
1. Engaging GA
2. Compass invalid
3. APPR or NAV CPLD
4. Toggling it off
5. Disengaging FD

NOTE

CPLD DOES NOT INHIBIT SUBSEQUENT ENGAGEMENT OF HDG.

C. Navigation (NAV):

Engaged By:
1. Toggling it on (When compass valid).

Disengaged By:
1. Engaging APPR. APPR does not inhibit subsequent engagement of NAV.
2. Engaging GA. Subsequent engagement of of NAV allowed.
3. Engaging HDG with CPLD present.
4. Toggling it off.
5. Disengaging FD.
6. Compass invalid.

D. Approach (APPR):

Engaged By:
1. Toggling it on (when compass valid).

Disengaged By:
1. Engaging NAV. NAV does not inhibit subsequent engagement of APPR.
2. Engaging GA. Subsequent engagement of APPR allowed.
3. Engaging HDG with CPLD present.
4. Toggling it off.
5. Disengaging FD.
6. Compass invalid.

E. Back Course (BC):

Enabled By:
1. The presence of APPR and LOC FREQ.

Engaged By:
1. Toggling it on if APPR on first.

Disengaged By:
1. Toggling it off.
2. Disengaging APPR.
3. Loss of LOC FREQ.
4. Disengaging FD.
5. Compass invalid.

F. Altitude Mode (ALT):

Engaged By:
1. Toggling it on or upon reaching selected altitude in systems with altitude preselect.

Disengaged By:
1. Toggling it off.
2. Initial presence of GSC. Subsequent engagement of ALT is allowed.
3. Initial presence of GA. Subsequent engagement of ALT is allowed.
4. Disengagement of FD.

NOTE

THE ALT HOLD, AN INTERNAL SUBMODE OF ALT MODE, WILL GO OFF, ENABLING RESYNC TO EXISTING ALTITUDE WHEN CWS IS ENGAGED.

G. Altitude Preselect (ALT ARM):

Engaged By:
1. Toggling it on.

Disengaged By:
1. Depressing ALT ARM
2. Engagement of ALT HOLD
3. Presence of GSC
4. Disengagement of FLT DIR

H. Go Around (GA):

Enabled By:
1. The absence of vertical trim.

Engaged By:
1. Momentarily activating GA switch (mode latches on).

Disengaged By:
1. ALT
2. Pitch Attitude Trim (PAT)
3. Disengaging FD
4. CWS

NOTE

INITIAL ENGAGEMENT OF GA WILL DUMP ALL OTHER MODES EXCEPT FD. ALL LATERAL MODES (I.E. APPR, NAV AND HDG) MAY BE REENGAGED WITHOUT CAUSING GA VERTICAL MODE TO DISENGAGE. GA WILL INHIBIT GSC.

I. Autopilot (AP):

Enabled By:
1. Adapter board presence in KC 295, gyro excitation valid, compass valid when in compass modes, gyro valid, power valid, absence of manual trim, flight director mode in flight director system.

Engaged By:
1. AP Switch ON if FD mode on in Flight Director Syste. AP Switch ON (no modes on) in an AP only system.

Disengaged By:
1. AP Switch OFF
2. Manual trimming either UP or DOWN, unless control wheel steering is engaged.
3. Gyro is invalid.
4. Gyro excitation invalid.
5. Loss of +28 or +14 A/C voltage.
6. Loss of power valid.
7. GA mode initializing (if option used). Susequent engagement of AP allowed.
8. Automatic disconnect from monitor such as KA 132 or KA 141.

NOTE

AP DISENGAGEMENT FOR ANY REASON FLASHES AP LIGHT AS WARNING. FD WILL NOT BE ALLOWED TO GO OFF AS LONG AS AP IS ENGAGED. ENGAGEMENT OF CWS WILL DISENGAGE THE SERVO CLUTCHES BUT NOT THE AP MODE. NEWER SYSTEMS HAVE AURAL ALERT WITH AP DISCONNECT.

J. Glideslope (GS):

Enabled By:	1. Presence of LBC 2. Presence of GS valid 3. Presence of GS sensor, if initial acquisition. 4. Presence of APPR 5. Absence of BC
Engaged By:	1. Initially by all enabling conditions.
Disengaged By:	1. Engagement of another vertical mode (i.e. ALT, GA or PAT). 2. Engagement of BC.

K. GSC Warning Signal (GS Flashing):

If GS valid is lost after initial acquisition of GS, the GS mode will go off and transfer the vertical mode to PAH, while flashing the GS as a warning after which the GS light will go off. Upon re-acquisition of GS valid, the vertical mode will transfer back to GS without the necessity of the GS sensor enabling. Therefore, a momentary loss of GS valid will not require a recrossing of beam center for re-acquisition of glideslope control.

L. Lateral Beam Capture (CPLD):

Enabled/Engaged By:	1. Presence of LBC sensor with APPR or NAV engaged. 2. Engaging APPR or NAV with LBT sensor on. This is necessary for beam center engagement of LBC (LBT inhibited until all track criteria sequence performed - necessary to block track due to possibility of angled crossing of beam center at instant of engagement of NAV or APPR).

M. Lateral Beam Track (LBT):

Enabled By:	1. High banking and presence of CPLD.
Engaged By:	1. Presence of LBT sensor with low bank subsequent to high bank.

N. Lateral Beam Armed (ARM):

Enabled By:	1. Absence of both LBC sense and LBT sense.
Engaged By:	1. Toggling on either NAV or APPR.
Disengaged By:	1. Disengage of mode. 2. Transfer to CPLD.

O. Approach Extension (MMG - Middle Marker Gain):

Condition for Enabling:	1. Presence of LBC. 2. Presence of GS Valid. 3. Presence of APPR. 4. Absence of BC Mode.
Engaged By:	1. Presence of MM Sensor (latched on).
Disengaged By:	1. Engagement of vertical mode, i.e., ALT, PAT or GA. 2. Engagement of BC.

NOTE

SUBSEQUENT DISENGAGEMENT OF GS CPLD WILL NECESSITATE THE CYCLING OF APPR TO ENABLE THE REENGAGEMENT OF EXTENSION.

P. Pitch Attitude Hold (PAH):

PAH is required to come on when there is an absence of the following modes: CWS, ALT, GSC and GA with the presence of FDR.

PAH will resync with CWS and will continuously sync when on any other mode.

Q. Pitch Attitude Trim (PAT):

PAT when engaged will trim pitch attitude unless ALT mode is engaged (for which the altitude is trimmed). If any other vertical mode (i.e. GS or GA) is engaged, PAT will dump that mode and replace it with PAH and PAT.

5.3.3 KC 296 MODE OPERATION

Mode logic of the KC 296 Yaw Computer is described as follows:

A. YD Engaged By:
1. Toggling YD on at KC 291
2. Toggling AP on at KC 290

B. YD Disengaged By:
1. Toggling YD off at KC 291
2. Depressing AP emergency disconnect switch
3. Loss of DC power to Yaw Computer