SECTION III
INSTRUMENTATION AND AVIONICS
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CONTENTS (Continued)

INSTRUMENTATION

The Citation II Bravo is equipped with a dual Primus 1000 Display and Flight Guidance system with multifunction display. This system enables logical grouping and compact display of the various data required by the pilots to control the airplane. Data which were previously displayed on various separate instruments can now be electronically grouped together on one cathode ray tube indicator (primary flight display), simplifying and improving instrument cross-check, and making more data available on a selectable, as needed basis. The airspeed indicators, instantaneous vertical speed indicators, and altimeters which in previous systems displayed their data on separate instruments are now presented on the pilot's and copilot's electronic flight instrument system (EFIS) primary flight displays (PFDs) along with the airplane attitude and navigation information.

The pilot's and copilot's AZ-850 micro air data computers (MADCs) are fed pitot-static information by two independent primary pitot-static systems (see below). The air data computers convert the pneumatic data into digital information and transmit it through the system to the DU-870 Primary Flight Display Units (PFDs) which convert the information into electronic data for display and present it on the primary flight displays. The heart of the Primus 1000 system is the IC-600 Display Guidance Computer (DGC), which will be described later in this section. The DGCs each contain a flight director, and the left one contains the autopilot computer.

Both pilot's positions are equipped with interchangeable single-tube DU-870 Primary Flight Displays which have a conventional slip/skid indicator attached to the bottom of the display. The multifunction display, mounted on the center instrument panel can be used to display navigation or weather data, or can be used as a backup primary flight display.

The paths through the system followed by airspeed, altitude, and vertical speed data, which are generated by the AZ-850 Micro Air Data Computers, are essentially the same, but are separately covered below in a recapitulation of what would be the conventional separate instrument indications.

PITOT-STATIC SYSTEMS

The airplane is equipped with three separate and independent pitot-static systems. The two primary systems serve the pilot's and copilot's systems. The third (backup) system provides pitot and static air pressure to the backup airspeed indicator/altimeter on the center instrument panel and to the landing gear warning horn pressure switch, and provides a source of static pressure for the cabin pressure differential pressure gage.

Pitot pressure from the tube on the left side of nose of the airplane supplies pressure to the pilots AZ-840 micro air data computer which, after converting the information into digital information, forwards the data through the system to the pilot's primary flight display. The pitot tube on the right side of the nose of the airplane serves the same function in the copilot's system.

The pitot tube on the right side of the fuselage, below and forward of the emergency exit hatch, provides pitot pressure to the backup airspeed indicator/altimeter and the landing gear warning horn pressure switch.

Three static ports are located on each side of the airplane. The lower port on the left side and the upper port on the right side provide the static source for the pilot's system. The upper port on the left side and the lower port on the right side provide the static source for the copilot's system. The center ports on each side provide static pressure for the backup pitot-static system.

The two pitot tubes and four static ports of the primary pitot-static systems, as well as the two static ports and single pitot tube of the backup system, are electrically heated for ice protection.

PITOT-STATIC SYSTEM SCHEMATIC

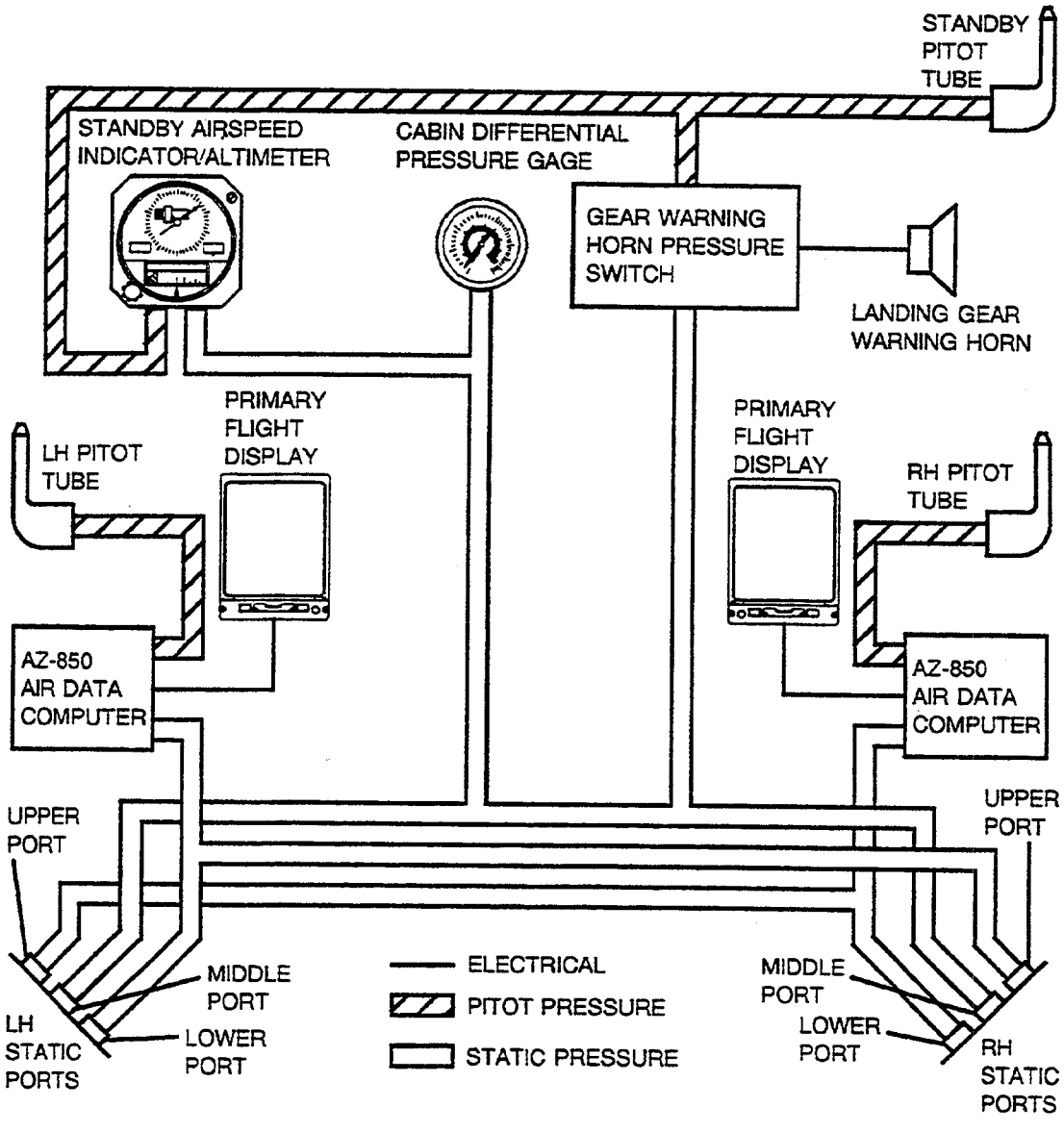

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Figure 3-1

ALTIMETER AND AIRSPEED INDICATIONS

Altitude and airspeed data to the primary flight displays (PFD) are provided by information generated by the AZ-850 micro air data computers which is transmitted in digital form through the IC-600 Display Guidance Computers to the pilots' primary flight displays. The altitude and airspeed are then presented in color on the display in the PFDs. The micro air data computers also generate the altitude information which is used by the mode C function of the transponders, and for the optional Traffic Collision Avoidance System(TCAS) if it is installed.

AIRSPEED INDICATION

The indicated airspeed display is to the left of the attitude display on the primary flight display. The display consists of a "rolling digit" window in the center of an airspeed vertical tape. The resolution of the rolling digits is one knot. The moving vertical tape moves behind the window and displays digital airspeed at 20 knot intervals, with the larger numbers at the top of the scale. The range of the airspeed scale is 40 to 450 knots with tick marks at ten knot intervals.

An airspeed trend vector, which displays an indication of the direction and rate of airspeed change, extends vertically from the apex of the current airspeed value display window. It extends upward for acceleration and downward for deceleration. The trend vector represents a prediction of what the airspeed will be in ten seconds if the current change in airspeed is maintained.

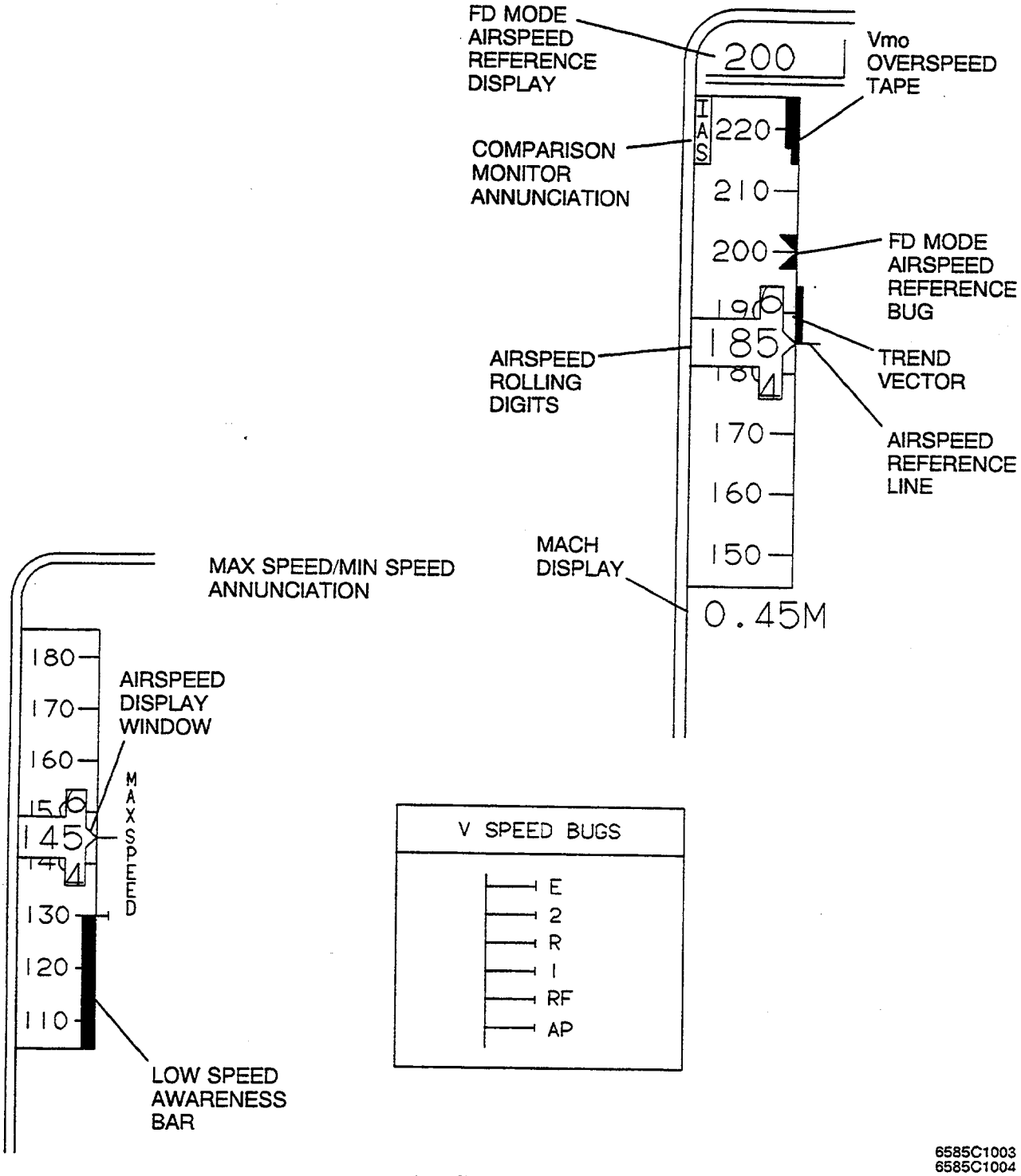
"Bugs" for six V-speeds are provided to allow pilot selection of key airspeeds by means of the multifunction display (MFD) bezel buttons. They are labeled 1, (V_1) R (V_R), 2, (V_2) and E (V_{ENR}) (this airspeed is automatically displayed whenever V_1, V_R, or V_2 is selected for display) and RF (V_{REF}) and AP (V_{APP}). When the speeds are selected digital indications appear at the bottom of the PFD display as well as the bugs being placed into position. The bugs are positioned on the right outside edge of the airspeed tape. They consist of a horizontal T-shaped symbol with its respective label positioned to the right of the symbol. All the takeoff set bugs will be removed from the display when the airplane airspeed exceeds 230 knots and the landing speed bugs are removed at power down.

When the airspeed is below 40 knots, V_1, V_R, V_2, and V_E are displayed in the bottom portion of the airspeed tape in the form of a digital readout. The digital readout of the set value is displayed along with the bug symbol and are labeled in ascending order, starting with V_1. Upon power up, the digital readouts for the set bugs will be amber dashes. As the V speeds are set on the MFD menu, the digital readouts will follow the readout on the MFD and set accordingly. The digital readouts are removed from the display when the first V speed value comes into view on the airspeed tape.

Low Airspeed Awareness

A red, amber, and white thermometer type display located on the inside of the airspeed scale gives indication of low airspeed. The white extends from 1.3 V_{S1} to 1.2 V_{S1}, the amber band extends from 1.2 V_{S1} to 1.1 V_{S1} (approximately stick shaker speed), and the red extends from stick shaker speed to the smaller airspeeds on the tape.

AIRSPEED DISPLAY (TYPICAL)



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6585C1004

Figure 3-2

Overspeed Indications

Between sea level and 800 feet altitude the limiting airspeed (V_{MO}) is 260 KIAS; above 27,880 feet the limiting Mach is 0.700 (indicated). At higher altitudes (above approximately 28,000 feet) there is a sliding scale at which the changeover between the Mach and airspeed limits occurs. When one of these limits is exceeded, the airspeed indication in the window to the left of the attitude display in the PFD will be changed to red and an amber annunciation, also to the left of the attitude sphere, will announce MAX AIRSPEED. A red thermometer type tape is also presented on the inside of the airspeed scale. The thermometer extends from V_{MO}/M_{MO} to larger airspeeds on the tape and appears in the indication as the airspeed reaches into near V_{MO}/M_{MO} range . When the limiting airspeed is exceeded the overspeed warning (V_{MO}/M_{MO}) horn will sound until the airspeed is reduced below the limit speed.

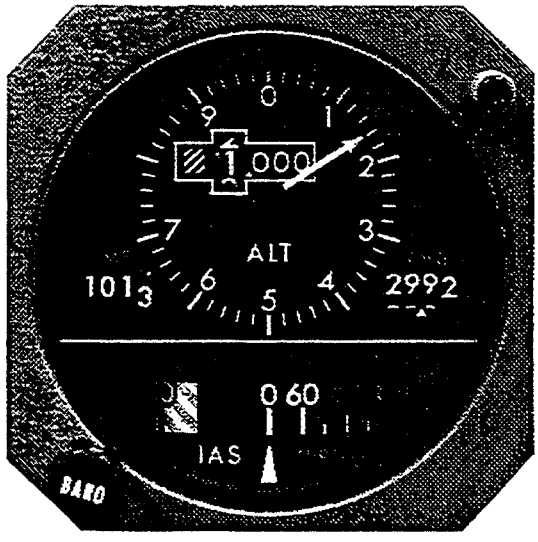
MACH NUMBER DISPLAY

A digital readout of indicated Mach number is displayed below the airspeed dial. The Mach number will come up on the display when Mach exceeds 0.390, and is removed when it is falls below 0.380 Mach. Resolution of the Mach display is 0.01 Mach.

STANDBY AIRSPEED AND ALTITUDE INDICATION (AIRPLANES -0801 THRU -0808)

Conventionally generated altitude and airspeed will always be available, in case of complete electrical failure, from the standby altimeter and airspeed indicator which operate directly from the standby pitot-static system. The only electrical power used by the combination instrument is DC power to operate the instrument vibrator, which comes from the emergency DC bus. An airspeed limit placard is located below the standby indicator. Airplanes -0809 and on have a cathode ray tube combination standby airspeed indicator/altimeter/attitude indicator, similar to the pilots' flight displays, which is discussed below in this section.

STANDBY AIRSPEED INDICATOR/ALTIMETER (AIRPLANES -0801 THRU -0808)



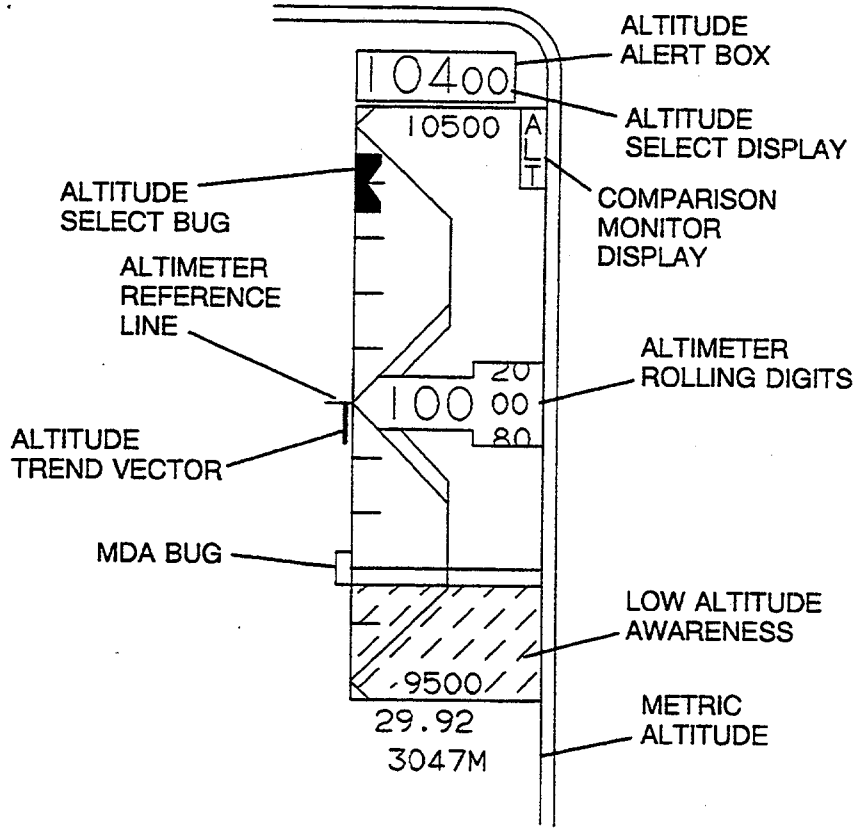
6718P1234

Figure 3-3

ALTITUDE INDICATION

The altitude display is located to the right of the attitude display on the primary flight display. The altitude is indicated by means of a vertical tape display which has a "rolling digit" window in the center of an altitude vertical tape. The resolution of the digits to 20 feet. The hundreds, thousands, and ten thousands digits are larger digit numerals than the others. The vertical tape moves behind the window and displays a tape 550 feet both above and below the present indicated altitude, with the larger numbers at the top of the scale. The range of the altitude window is from -1,000 to 60,000 feet with tick marks located at 500 foot increments. The scale is labeled in 500 foot intervals and single line chevrons are located at each 500 foot increment. Double line chevrons are located at each 1000 foot increment. The chevrons extend back to the approximate midpoint of the altitude tape and are connected with each other by a vertical line. The left side of the "rolling digit" window will has the same angle as the chevrons.

ALTITUDE DISPLAY (TYPICAL)



6585C1005

Figure 3-4

Information for the altitude indications is digitally developed, in the AZ-850 micro air data computers, from pitot and static air and and transmitted through the system to the primary flight displays

The barometric pressure setting is controlled by a BARO knob at the bottom right of the primary flight display. A button (IN/HPA) on the DC-550 display controller allows selection of inches of mercury (IN) or millibars (HPA-Hectopascals). A STD button, located next to the BARO knob, allows a change to a baro setting of 29.92 in. Hg. (or 1013 millibars) by simply pressing it. The baro correction setting display is located just below the altitude dial. When set to in.Hg. the BARO knob will change the altitude correction by 0.01 in. Hg. per click; when set to millibars (Hectopascals), turning the BARO knob will change the altitude correction by 1 millibar per click. Millibars and Hectopascals are numerically the same.

An altitude trend vector is displayed on the left edge of the altitude tape and provides an indication of the rate of altitude change. The trend vector extends vertically from the apex of the current altitude display window. The vector extends up for positive vertical trends and down for negative values. The vector represents a prediction of what the altitude will be in six seconds if the current vertical speed is maintained.

Standby altitude indications are always available from the standby airspeed indicator/altimeter, which is discussed under Airspeed Indication, above.

VERTICAL SPEED INDICATION

Vertical speed data is developed in the AZ-850 Micro Air Data Computers, which sense the rate-of-change of altitude from inputs of the static system. The computers convert the data into digital form and transmit it through the digital data bus system to the IC-600 Display Guidance Computers, which forward it to the DU-870 Primary Flight Displays where it is generated into a visual display.

VERTICAL SPEED DISPLAY

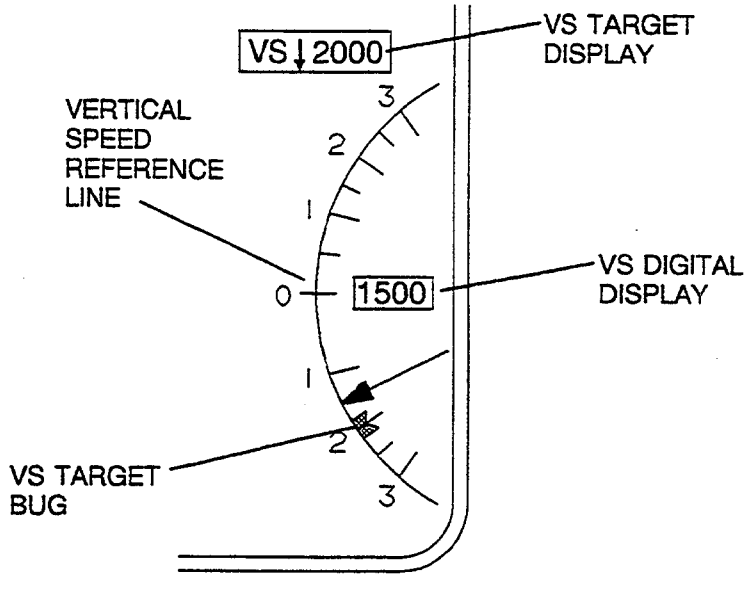


Figure 3-5

The vertical speed display is a fixed scale meter movement type display; a pointer rotates about a point which is outside of the actual display. The scale is non-linear, which provides increased resolution around zero vertical speed. In the center of the scale a digital readout of the actual vertical speed is displayed. The digital display has a resolution of 50 feet per minute and can accommodate rates of climb or descent of 9999 feet per minute. The pointer limits are plus or minus 3500 feet per minute. On the display scale tick marks are located at the positive and negative values of 500, 1000, 1500, 2000, 2500, and 3000 feet per minute. The pointer will continue to move up to plus or minus 6600 feet per minute but will have a reduced sensitivity. The digital display and the digital readout box will be removed from the display for vertical speeds of plus or minus 550 feet per minute, leaving only the meter type display.

INCLINOMETER

A conventional inclinometer (turn and slip indicator) is fixed to the lower edge of the case of both of the primary flight displays.

ENGINE INSTRUMENTS

Each engine is equipped with the following instruments located on the center instrument panel:

Fan RPM
Inter-Turbine Temperature (ITT)
Turbine RPM
Fuel Flow
Oil Temperature
Oil Pressure

All engine instruments are of the vertical tape readout design except for the turbine RPM and fuel flow, which are digital readout only The gages are powered by 28 VDC through circuit breakers on both cockpit circuit breaker panels. The fan tachometer also has a digital RPM display as well as the vertical tape. The digital display is provided above the N_1 tape for a more accurate readout. The loss of DC power or instrument failure is indicated by OFF flags in each instrument, except the fan (N_1) and turbine (N_2) digital tachometers.

The fan RPM (% RPM N_1) is calibrated in percent from 0-110% (100% Fan RPM = 15,750; 100% Turbine RPM = 32,150) (maximum takeoff and maximum continuous turbine RPM is 100%). The fan (N_1) tachometers are are powered from the emergency bus (circuit breakers on the respective left and right circuit breaker panels) and are thus available in case of electrical system failure. They are powered by engine monopoles (magnetic speed sensors) mounted on the applicable engine shaft and require airplane electrical power for gage operation. The N_2 gage will illuminate the small red lights just below the digits and flash the display if a turbine overspeed occurs.

The ITT gage is calibrated in degrees centigrade from 200-750. The temperature displayed is a synthetic inter-turbine temperature which is computed by measuring the exhaust gas temperature and then adding to it three times the temperature rise across the bypass duct.

The FUEL FLOW gage displays fuel flow in pounds per hour. Readings are accurate at stabilized power settings.

The FUEL QUANTITY gage is calibrated in pounds of fuel and accurately displays fuel remaining in the left and right tanks.

The face of the OIL TEMPERATURE gage is calibrated in degrees centigrade (°C) and that of the OIL PRESSURE gage in pounds per square inch (PSI); showing system limitations with red, yellow and green markings.

OUTSIDE AIR TEMPERATURE INDICATOR

An indicated outside air temperature (IOAT) indicator (identified as a R.A.T. [ram air temperature] indicator) is located on the upper right side of the center instrument panel. It displays air temperature uncorrected for ram rise. Either Celsius or Fahrenheit readings may be selected by a switch on the face of the instrument.

MAGNETIC COMPASS

A standard liquid filled magnetic compass is mounted above the glareshield.

FLIGHT HOUR METER

The quartz hour meter displays the total flight time on the airplane in hours and tenths. The landing gear squat switch activates the meter when the weight is off the gear. A small indicator on the face of the instrument rotates when the hour meter is in operation.

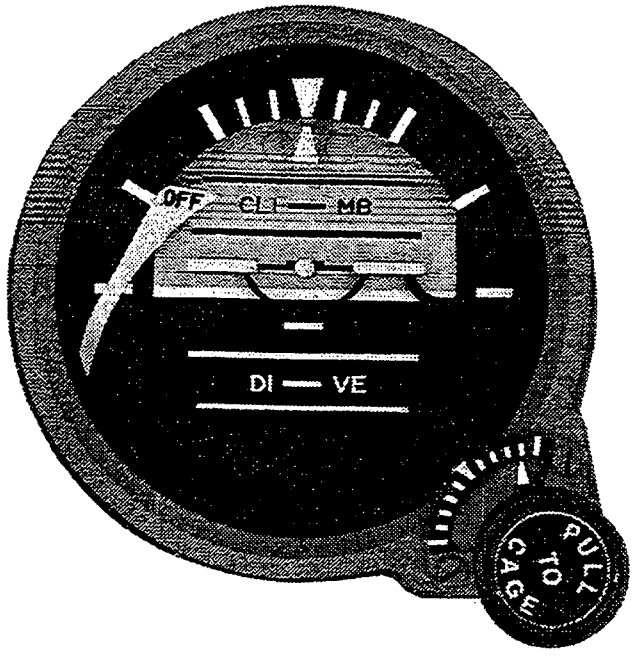
STANDBY ATTITUDE INDICATOR (AIRPLANES -0801 THRU -0808)

The standby attitude indicator is located on the upper left side of the center instrument instrument panel. The gyro normally operates on 28 volts direct current (VDC) power from the number one main bus. It is powered through a circuit breaker marked STBY GYRO on the left circuit breaker panel. Power to the gyro is controlled by a switch marked STDBY GYRO/OFF/TEST located on the pilot's lower instrument panel. The gyro has an emergency source of power from an emergency battery pack located in the nose avionics compartment of the airplane. If the airplane bus voltage falls below a minimum amount, the standby gyro relay will activate and gyro power will be supplied from the battery pack. This battery pack also provides emergency instrument lighting for the standby gyro, the dual fan (N_1) tachometers, the interturbine temperature (ITT) indicators, the standby airspeed indicator/altimeter, and the standby horizontal situation indicator (HSI).

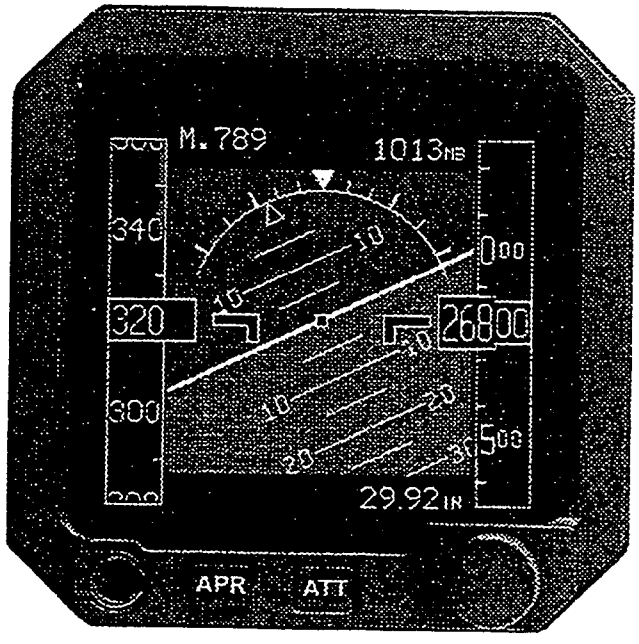
The battery pack is constantly charged by the airplane's electrical system, and should therefore be fully charged in the event of an electrical power failure. The gyro power switch must be ON for automatic transfer to battery power to occur. The standby gyro will operate for a minimum of 30 minutes on battery power. An amber POWER ON light next to the STDBY GYRO switch illuminates when the gyro is turned ON and the airplane's electrical system is not charging the emergency power supply batteries. When the STDBY GYRO switch is held to the spring-loaded TEST position, a self-test of the battery and circuits is accomplished. The green GYRO TEST light, also next to the STDBY GYRO switch, will illuminate if the test is satisfactory and the battery is sufficiently charged.

The gyro is caged by pulling the PULL TO CAGE knob and rotating it clockwise.

STANDBY ATTITUDE INDICATOR AIRPLANES -0801 THRU -0808



STANDBY AIRSPEED/ALTITUDE/ATTITUDE INDICATOR AIRPLANES -0809 AND ON



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6585X6131

Figure 3-6

SECONDARY FLIGHT DISPLAY SYSTEM (AIRPLANES -0809 AND ON)

Airplanes -0809 and on are equipped with a Meggitt Avionics Secondary Flight Display System (SFDS). This DC-powered active matrix LCD indicator combines standby attitude indicator, altimeter, and airspeed indications into one composite instrument. A Mach indication is also included in the instrument.

The secondary flight display (SFD) contains solid state inertial sensors for the measurement and presentation of aircraft pitch and bank attitudes. Application of 28-volt DC power to the display system initiates the attitude initialization process, which is identified by the display of the message "attitude initializing" in yellow on the SFD. The duration of the initialization process is 180 seconds. The airplane must remain stationary during the initialization process.

The attitude display has an instantaneous display range of 360° of bank and 50° of pitch. A moving tape on the right side of the display includes a "rolling digit" depiction of altitude; the tape is calibrated in 100 foot increments. Baro data is set in the altitude display by a knob on the bottom right of the bezel; clockwise rotation increases the pressure setting and counterclockwise decreases it. The setting is displayed simultaneously in hectopascals (millibars) at the top right of the display and in inches of mercury at the bottom right. On the left side of the display is a moving tape showing airspeed. The tape is marked in one knot increments with a "rolling digit" display in the center. The airspeed display becomes active at 40 knots. The Mach number is displayed in the upper left corner of the display. The Mach display range is 0.35 to 0.99 Mach.

Failure flag indications for airspeed and altitude are red crosses covering the appropriate tape box, with all indications removed from within the box. The failure flags for the Mach indication and Baro Setting are a series of four red dashes in the appropriate display area.

A light sensor is located on the bottom left side of the instrument case. It provides ambient light level data to the backlight control system to ensure optimum display brightness. The lighting level can still be controlled manually from the center instrument panel light rheostat control.

The navigation display is selected by the APR button on the bottom of the display bezel. Pressing the button results in display of ILS localizer and glideslope information from NAV 1 receiver. The ILS can be flown by reference to the ILS localizer and glideslope display on the standby horizontal situation indicator.

APPROACH CAPABILITY (AIRPLANES -0809 THRU -0820 INCORPORATING SB550-34-64 AND -0821 AND ON)

With the number one navigation radio tuned to and receiving an ILS frequency, pressing the APR button once will enable the LOC and GS course deviation bars to come into view. Pressing the APR button a second time will enable the BC course deviation bar to come into view. Pressing the APR button a third time will revert the display back to the non-approach format. LOC and GS flags will appear if the navigation signal is lost, navigation radio malfunction occurs, or the navigation radio is retuned to a VOR frequency. The BC course deviation bar shows correct sensing.

NOTE

- VOR navigation is not available in the APR mode.
- LOC and GS course deviation bars present raw data and should not be mistaken for flight director command bars.

Power to the secondary flight display system is controlled by a switch marked STDBY GYRO/OFF/TEST located on the pilot's lower instrument panel. The SFD has an emergency source of power from an emergency battery pack located in the nose avionics compartment of the airplane. If the airplane bus voltage falls below a minimum amount, the standby gyro relay will activate and gyro power will be supplied from the battery pack. This battery pack also provides emergency instrument lighting for the secondary flight display system, the dual fan (N_1) tachometers, the interturbine temperature (ITT) indicators, and the standby horizontal situation indicator (HSI).

The battery pack is constantly charged by the airplane's electrical system, and should therefore be fully charged in the event of an electrical power failure. The standby instrument power switch must be ON for automatic transfer to battery power to occur. The SFD will operate for a minimum of 30 minutes on battery power. An amber POWER ON light next to the STDBY GYRO switch illuminates when the SFD is turned ON and the airplane's electrical system is not charging the emergency power supply batteries. When the STDBY GYRO switch is held in the spring loaded TEST position for five seconds and the green GYRO TEST light stays illuminated, a self-test of the battery circuits is accomplished. If the green GYRO TEST light extinguishes before the five second test is completed, the battery pack must be recharged before flight.

When NAV 1 is tuned for ILS operation, pressing the APR button will select ILS localizer and glideslope display. Pressing the button a second time will provide back course display, and pressing it a third time will revert the display to non-ILS format.

The ATT button provided is analogous to a CAGE knob on a mechanical gyro. If the datum is lost, pressing the ATT button and holding it for at least one second will cause the display to re-datumize.

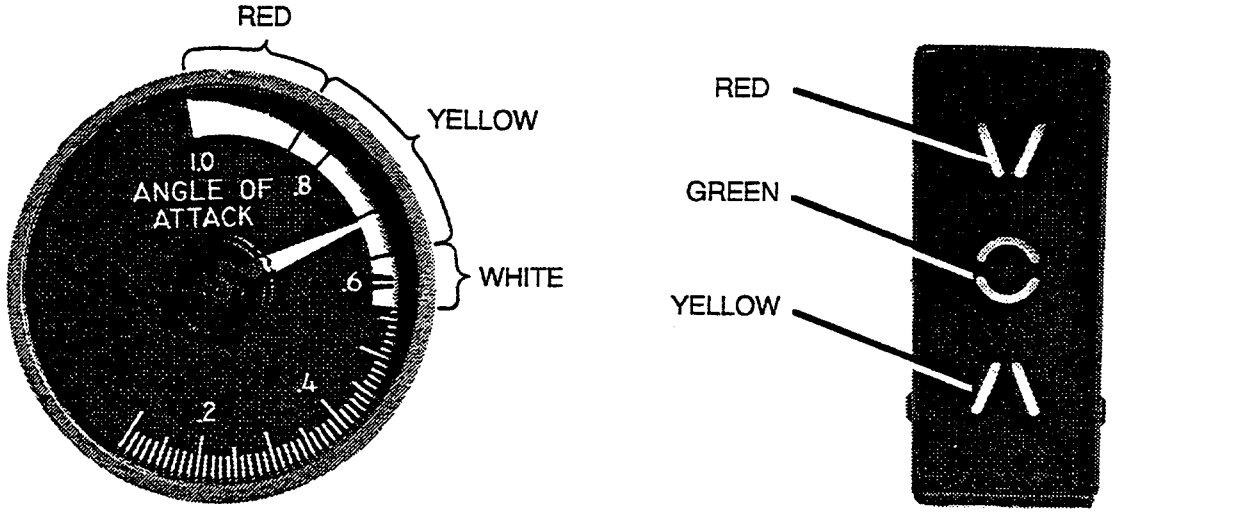
Maximum allowable airspeed (V_{MO}) is displayed in analog form by a red warning strip on the airspeed tape. When V_{MO} is reached, the numerals on the numeric airspeed display change from white to red. When the maximum allowable Mach number (M_{MO}) is reached, the numeric Mach number display will also change from white to red.

A built-in test system (BIT) will automatically detect any failure of the display at power up or during continuous operation. If a failure is detected, the appropriate part of the display is replaced with a message indicating the failure. Where it is not possible to display an appropriate message, the display backlight is switched off.

ANGLE-OF-ATTACK AND STALL WARNING SYSTEM

The angle-of-attack system is powered by 28 volts direct current (DC) from the left main DC bus and incorporates an angle-of-airflow sensor, a signal summing unit, a vane heater monitor, an angle-of-attack indicator, and an optional indexer.

ANGLE-OF-ATTACK INDICATOR AND INDEXER



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6285X6059

Figure 3-7

The vane type angle-of-airflow sensor, which is located on the forward right side of the fuselage, detects the angle of airflow and deflects accordingly. The wedge-shaped vane streamlines with the relative airflow and causes a transducer, at which it is mounted, to send signals to the signal summing unit (computer) located under the floor of the aft cabin baggage compartment. Signal inputs concerning flap position are also received by the signal summing unit. It then compensates for that variable and transmits the information to the angle-of-attack indicator, the low airspeed awareness indicators in the primary flight displays (PFDs), and the optional indexer. Indications are accurate throughout the weight and CG range of the airplane.The full range type indicator is calibrated from 0.1 to 1.0., and marked with red, yellow and white arcs. Lift information is displayed on the indicator with 0.1 representing near zero lift and 1.0 representing stall. Lift being produced is displayed as a percentage and, with flap position information, is valid for all airplane configurations and weights. At 1.0 where full stall occurs, 100 percent of the available lift coefficient is being achieved. At the bottom of the scale (0.1) near zero lift is being produced.

The area at the lower part of the scale (0.57 to 0.1) represents the normal operating range of the airplane, except for approach and landing. The narrow white arc (0.57 to 0.63) covers the approach and landing range and the middle of the white arc, 0.6, represents the optimum landing approach (V_{APP} or V_{REF}). The yellow range (0.63 to 0.85) represents a caution area where the airplane is approaching a critical angle-of-attack. The red arc (0.85 to 1.0) is a warning zone that represents the beginning of low speed buffet followed by full stall. Low speed buffet for the Model 550 Bravo begins at approximately 0.85 on the angle-of-attack indicator. If the angle-of-attack system loses power or becomes inoperative for other reasons the needle will deflect to the top of the scale and stow at a 1.0 indication. A red X will also appear at the EADI slow/fast indication. The airplane may not be flown if the stick shaker is found to be inoperative on the preflight check, or if the angle-of-attack system is otherwise inoperative. The stick shaker is located on the pilot's control column about 9 inches down from the control wheel and on the forward side. The stick shaker provides tactile warning of impending stall. The angle-of-attack transmitter causes the stick shaker to be powered when the proper threshold is reached.

WARNING

IF THE ANGLE-OF-ATTACK VANE HEATER FAILS AND THE VANE BECOMES ICED, THE STICK SHAKER MAY NOT OPERATE OR MAY ACTIVATE AT NORMAL APPROACH SPEEDS.

An optional approach indexer, mounted on the pilot's glareshield, provides a "heads up" display of deviation from the approach reference. The display is in the form of three lighted symbols (red-green-yellow) which are used to indicate the airplane angle-of-attack. High angle-of-attack is analogous to low airspeed; low angle-of-attack is analogous to high airspeed.

Illumination of the symbols is progressive as the airplane angle-of-attack changes. When the airplane speed is on reference the center circle will be illuminated. As the speed decreases from reference (.6) the circle illumination will dim and the top chevron illumination will increase until the top chevron is fully illuminated and the circle is extinguished. As the angle-of-attack becomes high the top chevron will begin to flash.

When the airplane is accelerating from the on-speed reference the illumination of the circle will dim and illumination of the bottom chevron will increase until the circle is extinguished and only the bottom chevron is illuminated.

The top chevron points down, indicating that the angle-of-attack must be decreased to eliminate the deviation. The bottom chevron points up to indicate that the angle-of-attack must be increased to eliminate the deviation.

The indexer is active any time the nose gear is down and locked and the airplane is not on the ground. There is a twenty second delay after takeoff before the indexer will activate.

DIGITAL CLOCK

One model M877 digital clock is mounted on the left side of the pilot's instrument panel and one on the right side of the copilot's panel. The clock can be made to display four time functions: local time, GMT, flight time and elapsed time. Two versions of the elapsed time function may be selected: count up or count down.

The clock has two control buttons: SEL (select) and CTL (control). The SEL button is used to select the desired function, and the CTL button to start and reset the selected mode.

For normal operation, either local time or Greenwich Mean Time (GMT) may be selected. GMT is displayed only in 24-hour format, and local time is 12-hour format. Pressing the SEL button sequentially displays GMT, local time, flight time and elapsed time. The displayed mode is annunciated GMT, LT, FT and ET, as applicable, under the time display window.

DIGITAL CLOCK

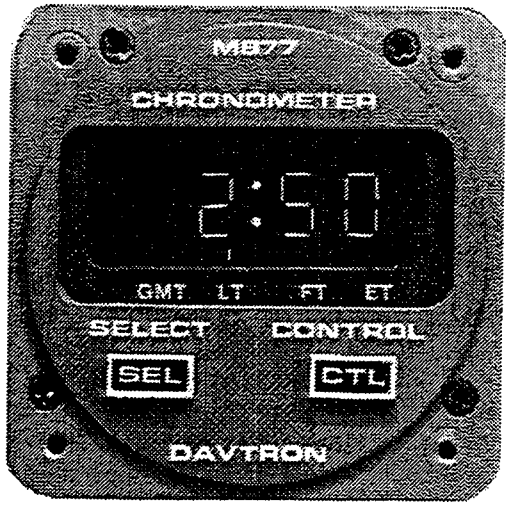

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Figure 3-8

To set GMT or local time, select the desired function by pressing the SEL button. Simultaneously press both the SEL and the CTL buttons to enter the set mode. The tens of hours digit will start flashing and may be incremented by pressing the CTL button. The next digit is then selected by pressing the SEL button, and similarly set by means of the CTL button. When the last digit has been set, press the SEL button to exit the set mode. At that time the clock will start running and the lighted annunciator will resume flashing. When no airplane power is applied to the clock, the SEL and CTL buttons will not operate.

To use the clock as a stop watch to time approaches, etc., select ET with the SEL button and press the CTL button to start the timing. The clock will start counting elapsed time in minutes and seconds up to 59 minutes and 59 seconds. It will then switch to hours and minutes and continue up to 99 hours and 59 minutes. Pressing the CTL button will reset the elapsed time to zero.

To use the clock for an elapsed time "count down" display, select ET for display and enter set mode by pressing both buttons simultaneously. A maximum count down time of 59 minutes and 59 seconds can be set. The time from which it is desired to count is entered in the same manner as setting GMT or local time. When the last digit is set, press the SEL button to exit the set mode. Pressing the CTL button will start the countdown. The display will flash when the time reaches zero. After reaching zero, the ET counter will count up. Pressing the CTL button again resets ET to zero.

A flight time alarm mode is provided which will flash the clock display when the desired flight time is reached. To set the alarm function, select FT with the SEL button and enter the set mode by pressing both buttons simultaneously. Enter the desired alarm time in the identical manner that GMT or local time is set. When flight time equals the alarm time, the display will flash. If FT is not being displayed when the alarm time is reached, the clock will automatically select FT for display. Pressing either the SEL or CTL button will turn off the alarm and reset the alarm time to zero. Flight time is unchanged and continues counting. The clock display may be tested when power is on the airplane by holding the SEL button down for three seconds. The display will show 88:88 and activate all four annunciators.

AVIONICS

The standard avionics package includes dual audio control panels (amplifiers), dual VHF COMM transceivers, dual NAVs, dual remotely mounted marker beacon receivers, dual DMEs, dual transponders, ADF, automatic flight guidance system, dual electronic flight instrument system (EFIS), which is part of the flight guidance system, a GNS-X/LS flight management system with GPS capability, a standby horizontal situation indicator, a cockpit voice recorder, a standby airspeed indicator/altimeter, and weather radar. Included as part of the automatic flight guidance system is altitude preselect, altitude alerting, and altitude reporting. The vertical navigation (VNAV) function is advisory and does not couple to the autopilot/flight director. The flight guidance system provides Category II equipment capability. An optional traffic collision avoidance system (TCAS I), a second ADF, a flight data recorder, and an emergency locator transmitter (ELT), are available.

The two COMMs, two NAVs, two transponders, and single ADF receiver are mounted in a stacked arrangement behind the consolidated control panel located in the center instrument panel. Two fans cool the communications rack; fan 1 (internally located in the rack and composed of two units) and fan 2 (located beneath the cockpit floor and providing cooling air through ducts). The FAN 1 and FAN 2 annunciators, located at the top right of the panel, will illuminate to warn of a malfunction of the cooling fans.

The marker beacon receivers display their information on the pilot's and copilot's electronic flight instrument system (EFIS) primary flight displays (PFDs). For an explanation of the displays, refer to the Electronic Attitude Director Indicator (EADI) discussion in this section.

VHF COMM TRANSCEIVERS

Dual KY 196A transceivers and controls are mounted at the top of the consolidated control panel located on the center instrument panel. Each radio is a very high frequency (VHF) unit with a frequency range from 118.000 to 136.975 megahertz (MHz) with 25 kHz spacing. The frequency displays are self-dimming seven-segment gas discharge digital readouts.

During ground operation, radio transmissions can be blocked by surrounding terrain or structures. This may possibly be overcome by using the other COMM, because of airplane antenna location. The COMM 1 antenna is on top of the vertical fin and the COMM 2 antenna is on the underside of the fuselage. When flying through dry precipitation, it is possible for static electricity to build-up and cause the VHF COMMs to automatically squelch to a point where reception range is greatly reduced. Disabling the automatic squelch by pulling out the on/off/volume control (OFF PULL/TEST) knob will cause background static in the speaker or headset, but normal reception range will be restored. Pushing the knob back in will restore the automatic squelch. If the headset microphone fails to function properly, check the side console switch in MIC HEADSET, and verify that the hand microphone is fully engaged in its socket.

KY-196A CONTROLS

The KY-196A control uses two digital readouts to display the controlling (USE) frequency and a pilot selected preset (STBY) frequency. It has four modes of operation; Frequency mode; Channel mode; Channel Programming mode; and direct Tuning mode. The frequency mode of operation allows the pilot to tune a frequency in the standby frequency display and

then "flip-flop" the standby and active frequencies by pressing the frequency transfer (double arrow) button. The Channel mode allows up to nine frequencies and the corresponding channel numbers to be recalled from memory. During channel mode of operation, the channel number is displayed in the CHAN window, and rotation of either the small or large knob will increase or decrease the channel number and the corresponding frequency in the STBY window, one channel at a time. The channel display will "roll over" at either end of the corresponding channel selection. The channel programming mode allows the pilot to program desired frequencies for use in the channel mode of operation. The direct tuning mode is a back-up mode which allows frequency changes to be made directly into the active frequency display. The use (USE) display is the left window and the standby (STBY) display is the right window. Dimming of the digital readouts is automatic and controlled by the background lighting. Refer to Figure 3-9 for a depiction of the COMM controls.

The KY-196's "flip flop" preselect feature enables the pilot to store one frequency in the standby display while operating on another and then interchange them instantly with the touch of a button. Both the active (USE) and the standby (STBY) frequencies are stored in a circuit component called EAROM (Electrical Alterable Read Only Memory) that provides a non-volatile storage of frequencies and programmed channels, so that when the radio is turned off and then back on, channel information is retained.

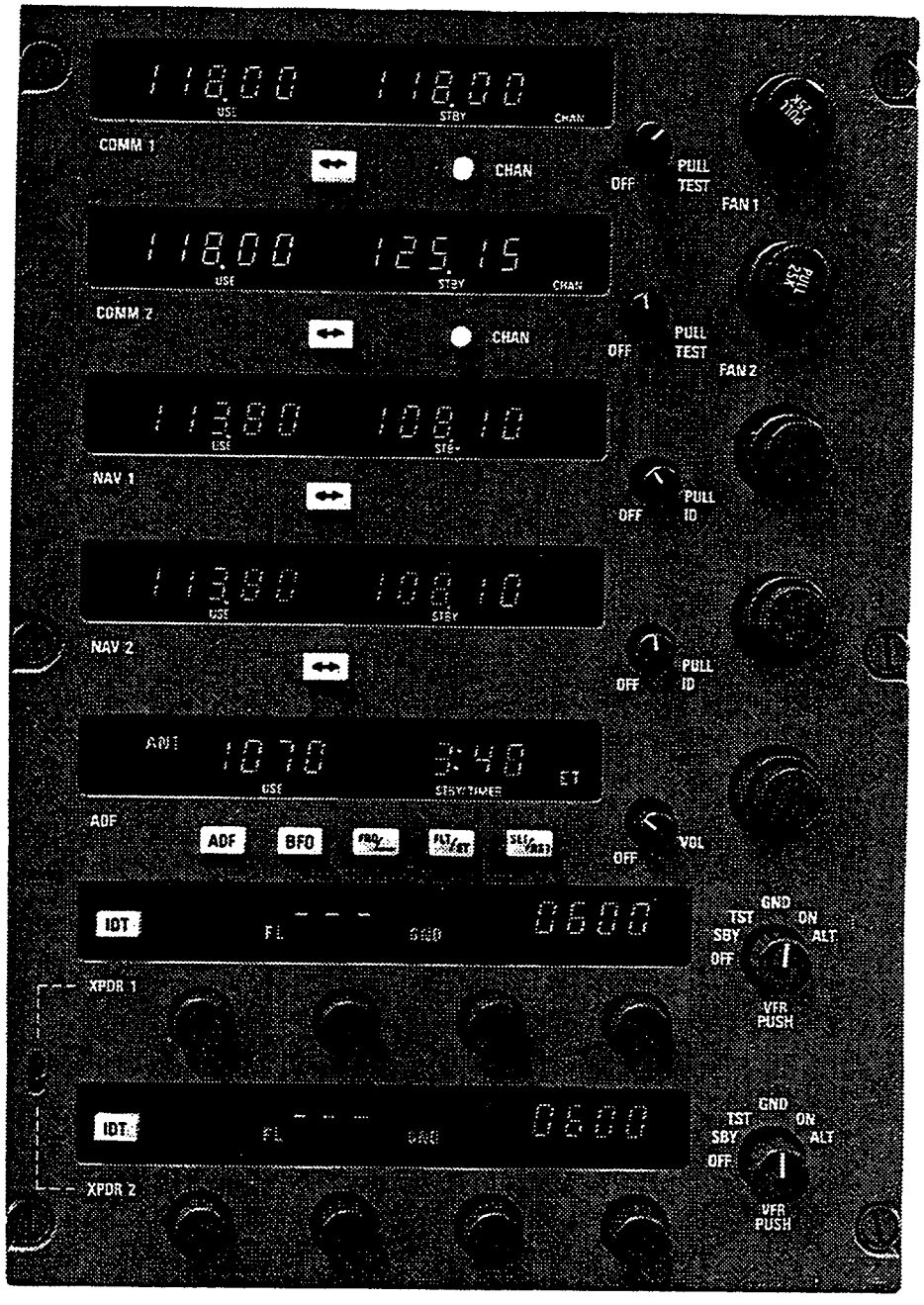
When the transmitter is in operation an illuminated "T" will appear in the center of the digital display.

Mode/Frequency/Channel Selector

In the frequency mode of operation the outer, larger, selector knob of the two concentric knobs located to the right of the display is used to change the MHz portion of the frequency display; the smaller knob (PULL 25K) changes the kHz portion. This smaller knob is designed to change the indicated frequency in steps of 50-kHz when it is pushed in and in 25-kHz steps when it is pulled out. At either band edge the frequency will "wrap-around"; thus it is not required to move completely across the frequency display in order to select a much lower or higher frequency. In the frequency mode of operation the tuning knobs control the frequency in the STBY window, which may then be transferred to the active (USE) window by pressing the frequency transfer (double arrow) button.

The channel mode of operation is entered by momentarily pressing the CHAN button while in the frequency mode. (Channel programming mode is discussed below.) If there is no activity for approximately five seconds the radio will return to the frequency mode of operation. In this case the channel frequency will be placed in the STBY window. The system may also be returned to the frequency mode by pressing the CHAN button again before five seconds have elapsed, and the status of the frequency mode will remain the same as it was prior to entering the channel mode. When CHAN is selected the last active frequency will remain tuned and displayed in the USE window. The last used channel number (1 to 9) will be displayed in the CHAN window unless no channels have been programmed, in which case the system defaults to channel 1 and dashes are displayed in the STBY window. When either end of the display is reached the display will "roll over" and start again at the respective end of the display.

CONSOLIDATED CONTROL PANEL



6385P6003

Figure 3-9

The CHAN button is pressed and held for three seconds to enter the channel programming mode. The last used channel number will flash in the CHAN window and the last used active frequency will remain displayed in the USE window. Channel numbers from 1 thru 9 can then be selected by rotating either the small or large knob. Pressing the frequency transfer button (double arrow) will cause the frequency associated with that channel to flash; the frequency select knobs will then change the frequency as described in the frequency mode of operation, above, with the exception that between the rollover points dashes are displayed. To exit the channel programming mode, press the CHAN button, or after twenty seconds of no programming activity, the system will automatically exit the mode.

To enter the direct tuning mode of operation, the frequency transfer (double arrow) button must be depressed for more than two seconds. The standby window frequency will disappear, and the window will remain blank; the tuning knobs will then tune the active (USE) frequency directly. Increments and decrements of the tuning knobs will be as explained in the frequency mode of operation, above.

The KY-196A is also equipped with a stuck-microphone indicator. If the mic switch remains keyed for two minutes the display will begin flashing and the transmitter will shut down, preventing jamming of the frequency.

HF COMMUNICATION

HF KHF-950 WITH KFS 594 CONTROL (OPTIONAL)

The KHF-950 with KFS 594 Control is a 150-watt transceiver system that provides 280,000 frequencies at 100 Hz increments with 19 channel preset capability in the HF band (2.0000 to 29.9999.9 MHz). It operates in AM and single sideband. Upper sideband (USB) is normally used for sideband operation, but lower sideband (LSB) is available where that mode may be used.

In TEL (A3J) mode, any of the ITU telephone channels (401 through 2241) may be selected.

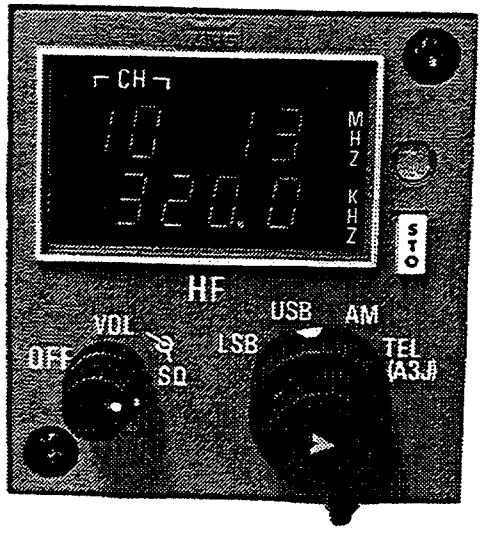
CONTROLS AND INDICATORS

All controls and indicators are located on the radio set control, which is mounted at the top right of the center instrument panel. The smaller left most knob controls power to the receiver/transmitter and controls the volume of the received audio. Clockwise rotation turns the unit on and increases the volume.

The larger left most knob controls the threshold of the received signal above which the audio is enabled (squelch). Turning the knob clockwise reduces the signal threshold (decreases the squelch).

The larger right most knob selects the emission modes; LSB, lower sideband; USB, upper sideband; AM, amplitude modulation; and TEL (A3J, or ITU mode). When LSB, USB, or AM is selected, the radio is set to the corresponding mode and a frequency is displayed in the control head, which may be directly selected on one of the 19 user programmable channels. When TEL (A3J) is selected, the radio is set to the corresponding mode and an ITU channel is displayed in the control head.

HF COMM KFS 594 CONTROL (OPTIONAL)



5685P6003

Figure 3-10

The smaller right-most knob, when pushed in, moves the cursor (represented by a flashing digit) from left to right. One push increments the cursor one digit to enable that digit to be selected as required. When the small knob is turned, it increments or decrements the digit selected by the cursor.

The STO button is used to perform four separate functions. (1) When in the channel mode (NOT in program mode - program mode is annunciated by the flashing dash adjacent to the channel number), pressing and holding the STO button causes the control to display the letters "TX" and the tuned transmit frequency while the receiver monitors the transmit frequency. This enables the pilot to listen for signals on the transmit frequency of duplex channels. (2) If STO is pushed while the microphone is keyed, a 1000 Hz tone is broadcast, which may be used to break the squelch of some stations. (3) In the program mode, selected by incrementing the cursor until the dash appears in flashing mode, the selected frequency may be entered into the channel appearing under the CH designation on the display. (4) Pressing STO will clear many error conditions, annunciated by a flashing "E" being displayed for more than three seconds.

In order to program any one of the 19 user programmable channels, proceed as follows: (1) Select the channel to be programmed. (2) Step the cursor to the frequency digits, as described above, and set in the desired frequency. Changing the displayed frequency of a programmable channel will automatically place the control head in program mode, as indicated by the flashing dash adjacent to the channel number. (3) Press STO to transfer the frequency into the T/R unit receiver. The flashing "TX" will appear in the upper right of the display and the cursor will move to the 10/1 MHz digits. (4) Change the display to the desired transmit frequency (if different from the receive frequency). (5) Press STO again. When the transmit frequency is accepted, the letters "TX" and the cursor will disappear.

If the user desires to operate the radio in the directly tuned mode without a channel number annunciated or a flashing dash, he may tune the channel selector to zero and then tune a frequency. The zero will disappear and the annunciated frequency will be relocated. Other frequencies may be selected in like manner as long as a channel other than zero is not selected.

A photocell activated dimming circuit adjusts the brightness of the display to compensate for changes in the ambient light level.

FLITEFONE VI (OPTIONAL)

The Flitefone system provides air-to-ground telephone communication. It operates in the ultra high frequency (UHF) band and is a frequency modulated (FM) unit. The operating frequency is in the 450 MHz range. Twelve telephone channels are provided plus one ground-to-air selective calling channel (SEL CALL).

The standard cabin location of the Flitefone is in the armrest of passenger seat number six, located at approximately mid cabin. The standard cockpit location of the Flitefone is on the cockpit divider near the copilot's right shoulder.

The base of the Flitefone is equipped with a switch (HF/BELL OFF/PHONE) which may be used to silence the bell if the passenger does not wish to be disturbed, to select Flitefone function (PHONE), or to connect the Flitefone's push-to-talk (PTT) switch located on the side of the handset to the high frequency (HF) radio in order to key the HF microphone, allowing the Flitefone to be used in the HF mode. For the Flitefone to be used in HF mode, the HF COCKPIT/HF CABIN switch on the instrument panel must have HF CABIN selected.

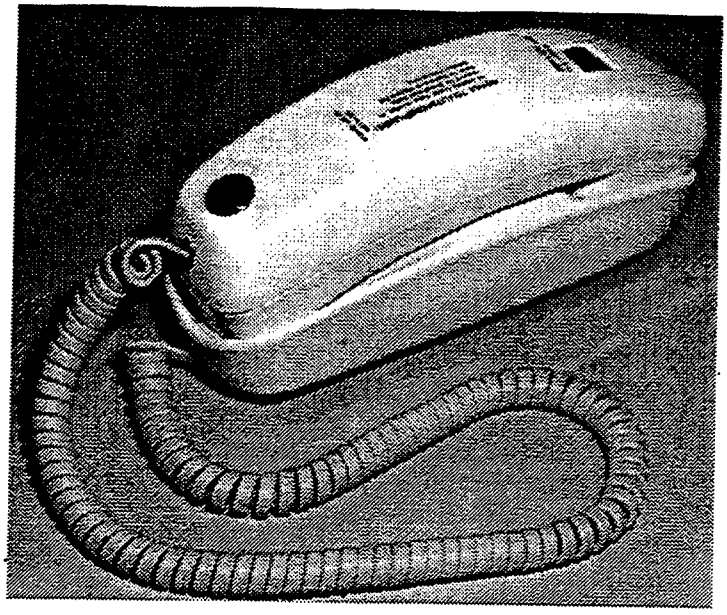
The Flitefone also serves as a cabin/flight compartment interphone. To use the system as an interphone, dial 4(I) - 2(C) - # Key. The audio signal will sound in the other unit and the IC indicator light will illuminate and remain on as long as the handset is off the cradle. The intercom system can be used at any time, even while in queue.

To place a telephone call, ascertain that the system is in Flitefone mode (PHONE). The airplane must be within range of a ground station in order to complete a call. The Flitefone VI offers the capability to dial directly from the airplane if desired, however, not all ground stations have direct dial capability and the airplane may not be in range of such a station. The direct dial (D/Dial) LED in the base of the Flitefone will illuminate if the ground station contacted has that capability. If a dial tone is heard and the direct dial LED is illuminated, a direct dial AGRAS (Air Ground Radio telephone Automated Service) call may be made.

To initiate the call, remove the handset from the base, observe the D/Dial light and listen for a dial tone. If a regular dial tone is heard and the D/Dial light illuminates, dial 1(or 0) + area code + the desired number + # + #. (Dialing 0 first allows billing to a long distance credit card number.) If a pulsed dial tone is heard and the D/Dial light illuminates, it indicates a busy channel and that queuing is necessary. Dial 1(or 0) + area code + desired number + # + #; listen to the audio; an alternating tone will be heard in a few seconds. Hang up the handset. When the call in progress is completed, the ground station will complete the call and will call you. The queue may be cancelled by pressing the * key.

If the handset is removed from the base, the D/Dial light does not illuminate and there is a high pitched tone in the handset, it indicates that direct dialing is not available. Dial 8 + 9 + # Key. The ground station attendant will respond, requesting billing information and desired number.

FLITEFONE VI



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5685P6067A

Figure 3-12

If a voice is heard when the handset is removed from the base, momentarily depress the hookswitch. If a voice is still present, place the call later. If a standard busy signal is heard, place the call later.

If in range of a station with direct dial capability but a manual (operator assisted) call is desired, ascertain that the D/Dial light is on and that the dial tone is present; then dial 8 + 9 + # Key. The ground station attendant will respond.

Manual selection of a desired channel is possible, if desired. Dial the channel number (there are 12 channels available) + # Key. If that channel is available at that location, a dial tone, high pitched tone, etc, will be heard as described above, and the call is completed using the appropriate procedure described for the tone heard. If silence or voice conversation is heard, dial another channel and proceed until a usable station is available.

A rapid busy signal (re-order tone) indicates faulty dialing or other difficulty. If such a signal is heard, hang up and try the procedure again.

If in range of a ground station offering automatic dialing capability, and when properly dialed, the Flitefone VI will automatically scan and lock onto the best available ground station, process the number dialed, complete the connection and the call is ready. Should the number be busy, the last number called will be stored in memory for automatic redial.

VOICE PRIVACY

To activate the voice privacy option (if installed), simply place a direct dial call and press 8(V) - 7(P) - #Key. When voice privacy is engaged, a slight warbling in the background will be heard, or if voice privacy is unavailable, 5 rapid "beeps" will be heard. To switch off the voice privacy, press 8(V) - 7(P) - *Key, and voice privacy function will disengage after ten seconds. The voice privacy function will also automatically disengage at the end of a call if the operator simply hangs up the handset.

OPERATOR'S MANUAL

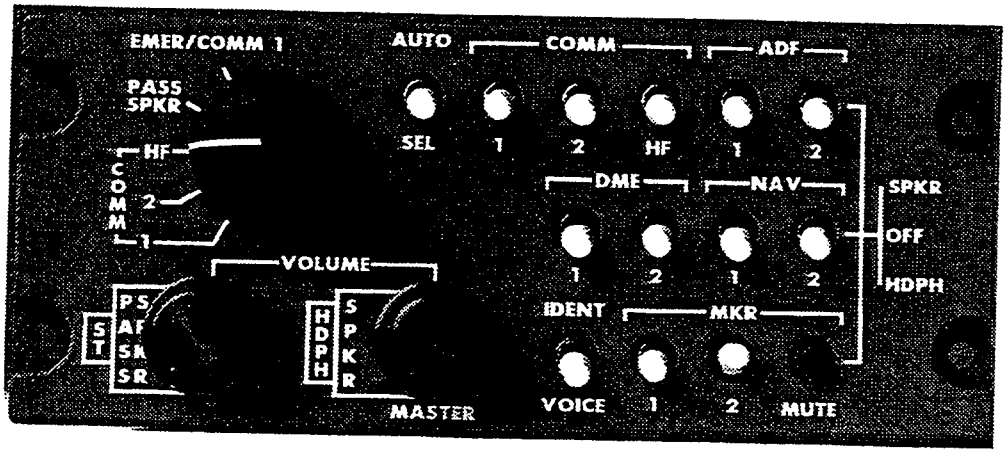
For detailed information concerning operation of the Flitefone VI, consult the Flitefone VI Operator's Manual, Revision E, or later revision, of the Global - Wulfsberg Systems Division of Sundstrand Data Control Inc.

AUDIO CONTROL PANELS

Two audio control panels are installed to provide individual audio selection by each pilot. Three-position switches (SPKR-OFF-HDPH) enable all audio inputs to be selected to the speakers or headphones. A two-position IDENT/VOICE switch is used in conjunction with the NAV and ADF switches to monitor either voice or coded identifiers. Two concentric MASTER VOLUME knobs control the headset or speaker volume of all selected audio sources. A PASS SPKR VOLUME knob controls the output volume of the passenger compartment speaker.

A rotary microphone selector switch has four standard positions. COMM 1 or COMM 2 connects the microphone in use to the respective VHF transmitter. PASS SPKR allows for announcements to passengers through the cabin speakers, but in PASS SPKR position, the COMM 1, COMM 2 and HF AUDIO are muted. EMER/COMM 1 provides for use of COMM 1

AUDIO CONTROL PANEL (TYPICAL)



5685P6084

Figure 3-13

when operating with the battery switch in EMER position. The EMER/COMM 1 bypasses the audio amplifier, necessitating the use of a headset to receive, and volume control is available only at the radio. Transmitting remains normal from all microphone sources. An optional audio control panel has a fifth position to be used for the HF system, if installed.

A side tone control knob, which is concentric to the passenger speaker volume control knob, is located on the lower left side of the audio control panel. The side tone control allows the pilot and copilot to select individual side tone volumes within certain limits. The side tone cannot be completely removed; some side tone will always remain. When the operator positions the control knob, side tone volume for all of the transmitters being operated from the respective audio control panel, and the interphone side tone, will be set.

A three-position AUTO SEL switch (SPKR-OFF-HDPH) automatically selects the proper speaker or headphone to match the position of the rotary microphone selector switch. All audio sources can be monitored at any time by use of the appropriate SPKR-OFF-HDPH switch regardless of the microphone selector switch or the AUTO SEL switch positions. A MKR MUTE button, when pressed, silences the marker beacon audio for approximately 30 seconds.

A two-position switch on the control wheel has MIC position for keying the transmitters and INPH for interphone communication when using the lip microphone or oxygen mask microphone. If a hand-held microphone is used, transmission is determined by the position of the microphone selector switch.

The copilots audio panel is powered by the emergency bus, causing battery power to always be available to that panel when the BATT switch is in any position except OFF. In EMER position of the battery (BATT) switch the audio normal/emergency relay relaxes and connects the pilot's audio panel to the emergency bus; thus in case of loss of both generators both audio panels will continue to operate with the battery switch in the EMER position. COMM 1 transmit and audio will be operative and NAV 1 audio may be received.

VHF NAV

Dual KN-53 navigation receivers provide VOR, localizer and glideslope capability. The receivers are mounted with other avionics navigation and communication (NAV/COM) equipment in the center of the consolidated control panel, which is located on the right side of the center instrument panel. The controls/receivers of both NAV radios are one-piece units.

Each system has 200 VOR/LOC operating frequencies and 40 glideslope frequencies. VOR and localizer (VOR/LOC) frequencies are from 108.00 to 117.95 MHz. Glideslope frequencies are from 329.15 to 335.00 MHz. The localizer/glideslope frequencies are paired and are automatically tuned together. When the published localizer frequency is tuned, the glideslope frequency is also tuned. Multiple outputs drive the Flight Director, HSIs, and autopilot. All the basic functions have a built-in self-test.

KN-53 CONTROLS

The KN-53 controls use two seven-digit gas discharge displays for the controlling (USE) frequency and a pilot-selected preset (STBY) frequency. The displays are dimmed automatically by means of automatic photo sensing. Dual concentric frequency select knobs control the display. The larger (outer concentric) knob increments or decrements the MHz portion of the display in one MHz steps. The small tuning knob (inner concentric) increments or decrements in 50 kHz steps. The frequency will roll over or under, as applicable, at the end of the tuning band so that tuning completely across the band to a much higher or lower frequency is not required. Tuning of the NAV frequencies in normal mode of operation is done in the STBY window and then "flip-flopped" into the USE window by pressing the frequency transfer (double arrow) button. This allows the pilot to pretune the desired frequency and then interchange the old and new frequencies with a touch of a button. The STBY window is then available for a new pretuned frequency.

The OFF PULL/ID knob operates as an on/off/volume control as well as a control for selecting voice/code identification (ID), or only code ID signals of VOR stations. Pulling the knob out allows the station identification tone signals to be heard, as well as the station voice announcements. Pushing it in will allow only NAV voice signals to be heard. Rotation of the knob allows volume control of the audio signals; complete counterclockwise rotation turns off power to the NAV receiver.

Interface of the NAV receivers with other equipment which use and display NAV signals is also discussed in the various parts of this sections. Controls and displays of the distance measuring equipment (DME), the standby horizontal situation indicator (HSI), and the pilots' primary flight displays are discussed separately.

The pilot or copilot can display NAV 1 or NAV 2 on their respective primary flight displays (PFDs) by selecting either NAV by means of the NAV push button on the respective DC-550 display controller. Upon power up NAV 1 will be selected; selection progression is then NAV 2, NAV 1, NAV 2, etc, as the button is pressed. The NAV selected by means of the NAV

button is displayed on the respective PFD in the horizontal situation indicator (HSI) portion of the display. It provides course guidance to the flight director and autopilot if they are engaged. NAV 1 may be selected on the " O " bearing needle and NAV 2 may be selected on the " ◇ " bearing needle, by the applicable " O " or " ◇ " bearing selector knobs. Selections made by means of the bearing knobs are for display on the EHSI only; they cannot interface with the flight director or autopilot. The pilot's IC-600 display guidance computer (DGC) provides the autopilot control function as well as guidance for the pilot's flight director (FD 1). The copilot's DGC contains the copilot's flight director (FD 2) guidance function but has no autopilot guidance component of its own, however, the copilot's attitude, heading, and NAV course commands can be switched to the pilot's IC-600 integrated avionics computer (IAC) (see AP XFER/FD 1/AP XFER/FD2 switch, below) if desired. Selections made on the copilot's flight director will then be controlling the autopilot and flight director.

If the same NAV (VOR) selections are made on both DC-550s, the selection will be annunciated on the PFDs in amber.

A switch (AP XFER/FD 1/AF XFER/FD 2) is installed to enable selection of either flight director to control the autopilot. If FD 1 Is selected, navigation is being provided by the NAV selection made on the pilot's DC-550. If FD 2 is selected, the selection must be made on the copilot's DC-550.

A red X will appear in the center of the PFD if course information is unreliable or not present.

Selecting NAV 1 or NAV 2 on the EFIS display controller also automatically selects the distance measuring equipment (DME) display on the EFIS to that of the NAV selected. The display in the DME indicator will also be from the same NAV as displayed on the EFIS, and will be so annunciated in the indicator. The DME will follow the selection NAV 1 or NAV 2, and cannot be otherwise tuned. A "hold" function is incorporated which allows a DME station to be held when the VOR is retuned. This is discussed under the distance measuring equipment (DME) section.

Glideslope frequencies are paired with localizer frequencies so that the correct glideslope channel is automatically selected when the localizer is tuned. Glideslope deviation will be displayed on the pilots' PFDs when ILS frequency is tuned and the airplane is within range of the ILS. If the localizer signal is unreliable or absent, a red X will appear in the center of the PFD, If glideslope information is absent or unreliable, a red X will appear at the glideslope indication on the pilots' PFDs.

Refer to Figure 3-9 for a depiction of the KN-53 NAV controls.

KMR-675 MARKER BEACON RECEIVERS

The KMR-675 marker beacon receiver system (receiver 1 and receiver 2) is remotely mounted in the lower forward part of the nose avionics compartment. The two marker beacon receivers provide marker beacon signals to the pilots through the marker beacon presentations on the respective electronic attitude director indicators (EADIs). The marker

beacon receivers are in operation whenever the avionics power switches are on and power is available. They operate on a frequency of 75.00 MHz.

Marker Beacon 1 provides signals to the following:

1. Marker beacon data to the pilot's marker beacon annunciators on the center right side of the primary flight display (PFD).
2. VOR, localizer (ILS), and marker beacon signals to the audio control panels.

Marker Beacon 2 provides signals to the following:

1. Marker beacon data to the copilot's marker beacon annunciators on the center right side of the primary flight display (PFD).
2. VOR, localizer (ILS), and marker beacon signals to the audio control panels.

The annunciators in the pilots' primary flight displays are part time displays. A white box. located in the center right of the display, identifies the location of the marker beacon annunciator when a localizer frequency is tuned. The marker beacons are annunciated by the appropriately colored letters: a blue 0 for outer marker, an amber M for middle marker, and a white I for inner marker. The letters appear in the white box when the marker beacon receiver is activated. A marker beacon tone is transmitted to the audio control panel and will be heard in the speaker/headset, if selected. A 400 Hz tone is heard at the outer marker, a 1300 Hz tone at the middle marker, and a 3000 Hz tone for the inner marker.

The audio muting system (MKR MUTE) provides the pilots with a method of temporarily cutting out the marker beacon audio. When pressed, the marker beacon signal is muted for approximately 30 seconds. The MKR MUTE switches (push buttons) are located on the audio control panels.

The marker beacon antenna is mounted near the trailing edge of the right wing beneath the fuselage.

AUTOMATIC DIRECTION FINDER - KR-87

The KR-87 ADF is a single-unit receiver/control mounted in the consolidated control panel on the right side of the center instrument panel. The automatic direction finder system operates in the frequency range of 200 to 1799 kHz. The KR-87 control panel uses two gas-discharge digital readouts to display the controlling (active) frequency and a pilot-selected preset (STBY) frequency. The system is comprised of a receiver, a built-in electronic timer, the bearing indicator on the pilots' primary flight display (PFD) (which must be selected on the respective DC-550 display controller), and a KA-44B combined loop and sense antenna. The control of audio signals from the ADF is discussed under Audio Control Panels in this section. Refer to Figure 3-9 for a depiction of the ADF control panel.

Power to the system is controlled by the ON/OFF/VOL knob on the control panel Rotating the knob clockwise from the detented position applies power to the ADF. Rotation of the control also adjusts audio volume. Control of the frequency is by the two concentric knobs on the right side of the control panel. The inner knob controls the "1" digits when pulled out, and the "10" digits when pushed in. The outer concentric knob controls the 100 and 1000 digits up to a frequency of 1799 kHz. When FRQ is annunciated in the display the frequency select knobs control the tuning of the standby (STBY) window digits. Once tuned, the standby frequency may then be inserted into the active window by pressing the FRQ (double arrow) button which will "flip-flop" the standby and active frequencies.

OPERATING MODES

Two modes of operation are selected by the ADF button ("push-in, push-out") on the control face. When the button is out antenna (ANT) mode is selected and will be annunciated. ANT mode provides improved audio signal reception for tuning and is used for identification. In ANT mode the ADF pointer will park at 90-degrees to the airplane heading. When the ADF button is in the depressed position ADF mode is selected and annunciated, and relative bearing will be indicated, which will also cause magnetic bearing to be indicated on the electronic horizontal situation indicator (EHSI) of the PFD.

The BFO (beat frequency oscillator) mode is selected by pressing in the BFO button on the face of the control. BFO will then be annunciated. BFO mode is used to better identify coded station identifier signals from stations which are unmodulated.

To perform a pre-flight or in-flight test of the ADF system, select ANT mode which will cause the pointer to park. Tune and identify a station with a strong usable signal and select ADF mode. the pointer should seek the station without hesitation. Wavering, hesitation, or reversals indicate that the station is too weak or that there is a system malfunction.

Timer Operation

The flight timer incorporated into the ADF will always be reset when the power to it is interrupted, either by the ON/OFF switch, the avionics master switch, or the loss of power to the system. Flight time should be read before shutdown for that reason. Flight time may also not be accurate since it is time from electrical power on. The timer has two functions - flight time and elapsed time. Flight time and elapsed time are displayed and annunciated alternately by depressing the FLT/ET button on the control panel. The flight timer continues to count up until the unit is turned off. The elapsed timer may be set back to :00 by pressing the SET/RESET button on the control panel. It will then start counting up again. Pressing the SET/RESET button will reset the elapsed time whether it is being displayed or not. There is also a countdown mode in the elapsed time function. To enter the countdown mode, the SET/RESET button is depressed for about two seconds, or until the ET annunciation begins to flash. When the annunciation flashes it indicates that the system is in ET set mode and a time of up to 59 hours and 59 minutes may be preset into the elapsed timer, with the concentric knobs. The preset time will be displayed and remain unchanged until SET/RESET is pressed again, which will start the countdown from the preset time. When the timer reaches :00 it will begin to count up and the display will flash for about 15 seconds.

While flight time (FLT) or elapsed time (ET) modes are being displayed, the standby frequency is kept in memory. It may be called back by pressing the FRQ button, and then transferred to the active frequency by pressing the FRQ button again.

While FLT or ET is displayed, the in use frequency on the left side of the display may be directly changed by using the frequency select knobs, without any effect on the stored standby frequency or the other modes. This feature is useful when tuning for stations the exact frequency of which the operator may not know.

A second KR-87 ADF may be installed, in which case the first system is duplicated with a second complete system, and operation of the second ADF is identical to the first. If a second ADF is installed, its bearing information will be controlled on the PFDs by the right most knob (BRG ◇) on the DC-550 display controller. The second antenna will be mounted on top of the fuselage.

C-14D COMPASS SYSTEM (PILOT'S)

The pilot's C-14D directional gyro provides information to the electronic horizontal situation indicator (EHSI) in the pilot's primary flight display (PFD) via the pilot's IC-600 display guidance computer. It also provides gyro stabilized magnetic heading information to the standby horizontal situation indicator (HSI). The system consists of a directional gyro, a flux detector, two control switches, a remote compensator, and a slaving indicator on the PFD. The directional gyro operates on 28 volts DC from the emergency bus, therefore power is available whenever the battery switch is placed in the BATT position or the EMER position. In the event of a DC power failure, placing the battery switch to the EMER position will regain the pilot's C-14D and provide gyro stabilized heading information through the standby HSI. The gyro control switches (2) are located on the bottom section of the left switch panel and are labeled LEFT GYRO SLAVE. The left switch is labeled MAN/AUTO, and the right one L/R. In MAN position, the C-14D gyro operates in unslaved (gyro) mode. In the AUTO position, it operates in slaved (gyro stabilized magnetic) mode. When MAN is selected, the EHSI compass card can be moved left or right at a rate of 30 degrees per minute by toggling the L/R switch, to the L (counterclockwise) or R (clockwise) position. Manual (MAN) operation gives accurate short term heading reference when magnetic information is unreliable.

Under normal operating conditions, the C-14D gyro slave switch should be left in the AUTO position. Fast slaving in the AUTO mode occurs at a minimum rate of 30 degrees per minute and will continue at that rate until the gyro is slaved to the magnetic compass heading. It will then continually maintain a slow slaving rate of 2.5 to 5.0 degrees per minute. If the gyro slave switch is in AUTO position at power-up, the system will slave itself. If the gyro has obtained operating speed in the MAN position, or is otherwise unslaved while operating, the L/R switch must be activated to start fast slaving action in the AUTO mode.

If HDG REV (heading reversion) is selected on the pilot's HDG REV push button switch, it means that the copilots C-14D is providing heading information for the pilot's and copilot's heading indicators. In this case the source annunciations in the EHSI will be in yellow, to inform the crew that the two selected heading sources are identical.

C-14D COMPASS SYSTEM (COPILOT'S)

The copilot's C-14D compass system is the same as the pilot's C-14D. The copilot's C-14D system provides information to the electronic horizontal situation indicator (EHSI). on the copilot's primary flight display (PFD) via the copilot's IC-600 display guidance computer. Since the copilot's IC-600 does not have an autopilot computer, when AP XFER FD 2 is selected (switch illuminated) on the autopilot transfer switch, it provides heading guidance from the copilot's C-14D to the autopilot through the pilot's IC-600 display guidance computer. In this case the autopilot is using the copilot's side flight director for its guidance.

Two RIGHT GYRO SLAVE switches, labeled right GYRO SLAVE are located low on the copilot's instrument panel. The left switch is labeled MAN/AUTO, and the right one L/R. Operation of the switches is the same as described above in the pilot's C-14D system.

If HDG REV (heading reversion) is selected on the copilot's HDG REV push button switch, it means that the pilots C-14D is providing heading information for the copilot's and pilot's heading indicators. In this case the source annunciations in the EHSI will be in yellow, to inform the crew that the two selected heading sources are identical.

STANDBY HORIZONTAL SITUATION INDICATOR (HSI)

The standby horizontal situation indicator is a three-inch instrument located on the left side of the center instrument panel. It provides navigational guidance in case of PFD/flight director failure.

The standby HSI displays compass heading, glideslope and localizer deviation and airplane position relative to VOR radials. The compass card is graduated in 5-degree increments and a lubber line is fixed at the fore and aft positions. Azimuth markings are fixed at 45, 135, 225, 270, and 315 degrees on the compass face. A fixed reference airplane is in the center of the HSI, aligned longitudinally with the lubber line markings.

The course cursor is set by a knob on the instrument. Once set, the cursor rotates in its set position with the compass card. The course deviation bar, which forms the inner segment of the course cursor, rotates with the course cursor.

A blue ADF needle, which displays ADF 1 bearings, rotates around the outer portion of the dial.

A heading (HDG) flag will appear in the instrument when the compass system is OFF, the heading signal from the directional gyro (DG 1) becomes invalid, primary power to the indicator is lost, or the error between the displayed heading and the received signal becomes excessive.

The course deviation bar moves laterally in the HSI, in relation to the course cursor. Course deviation dots in the HSI act as a displacement reference for the course deviation bar. When tracking a VOR, the outer dot represents 10 degrees, while on an ILS localizer it represents 2-1/2 degrees. White TO-FROM flags point to or from a station along the VOR radial when operating on a VOR. A red warning flag comes into view when power is OFF, when NAV information is unreliable, or when signals from the NAV receiver are not valid. The standby HSI displays only NAV 1 information.

STANDBY HORIZONTAL SITUATION INDICATOR (HSI)

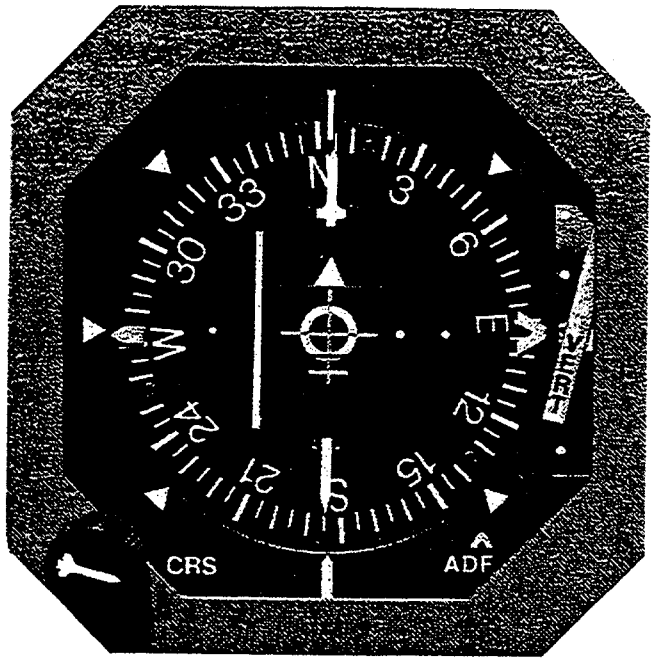


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Figure 3-14

The glideslope deviation pointer is located to the right side of the display. When receiving glideslope information during an ILS approach, the green deviation pointer will be uncovered by the red VERT warning flag which will otherwise be in evidence. If an ILS frequency is not tuned and being received, or the ILS signal is unusable or unreliable, the deviation pointer will be covered by the red warning flag.

The standby HSI is powered by the emergency bus, and NAV 1 supplies the VOR/ILS information to it. Since its heading information is provided by DG 1, which is also powered by the emergency bus, the standby HSI will function with the battery switch in EMER position; the only feature that will not be available in that case will the the ADF, since it is not powered by the emergency bus.

COCKPIT VOICE RECORDER

A A-200S cockpit voice recorder system provides a continuous 120-minute record of all voice communications originating from the cockpit as well as sounds from warning horns and bells. The system is protected by a 5-ampere circuit breaker (CVR) located on the right circuit breaker panel.

COCKPIT VOICE RECORDER CONTROL PANEL

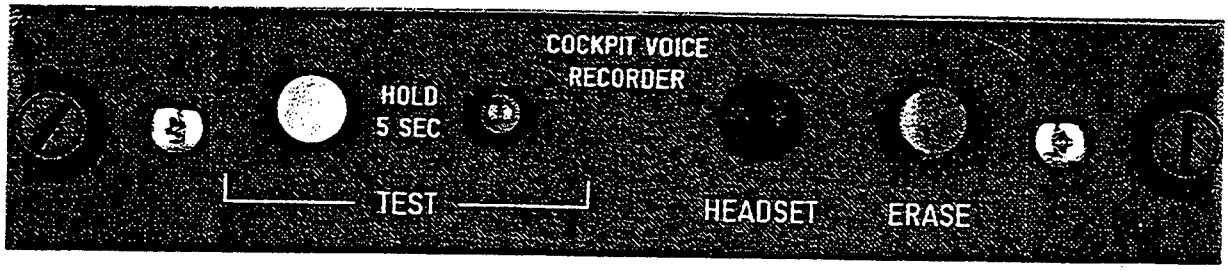

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Figure 3-15

The sensitive microphone is located to the left side of the fire tray and annunciator panel. The system is energized when the battery switch is in the BATT position. The control panel, located low on the right instrument panel, contains a TEST button, and an ERASE button. System operation is checked by pressing the TEST button. When the TEST button is held down for five seconds illumination of the green light on the control panel indicates correct functioning of the voice recorder system. Pressing the ERASE button for approximately 2 seconds will cause the entire record to be erased. Erasure can only be accomplished on the ground with the main entry door opened.

The installation is equipped with a five-G switch which will activate any time the airplane is subjected to a five-G force; this will disable the system's erasure mechanism until a reset button on the G-switch is pressed. The switch, and the unit, is located above the tailcone baggage compartment. Access to the switch is a maintenance function, since the overhead panel in the baggage compartment must be removed. The ELT is equipped with an underwater locator device which is located with the recorder mechanism in the tailcone baggage compartment.

DIGITAL FLIGHT DATA RECORDER (OPTIONAL)

On Citation 550 Bravo airplanes which are equipped with more than 9 passenger seats and are operated under FAR Part 91 or FAR Part 135, a digital flight data recorder, which continuously records at least 16 parameters of airplane and systems operation, is required. Airplanes operated under other conditions may also be optionally equipped A continuous recording of 8 hours is also required. The optional flight data recorder (FDR) installed in the Model 550 Bravo records the information digitally by a solid state method, and far exceeds the minimum requirements of number of parameters and recording time.

The flight data recorder system consists of a solid state flight data recorder, a G switch, and a remotely mounted accelerometer. The flight data recorder interfaces with the flight guidance system in order to obtain airplane system and flight data information. The accelerometer provides information directly to the FDR. The G switch is a power interrupt switch, which removes power from the flight data recorder, in order to prevent recording over data in an airplane mishap, if the recorder should still have power available. The system contains an automatic delayed shutdown feature. This will disable its recording function after a period of eight to ten minutes upon the condition of loss of oil pressure in the left and right engines. In order to restart flight data recording and to reset the shutdown timer, the electrical power must be recycled.

An underwater locating device is attached to the CSMU, to aid rescue/recovery personnel with sonar type equipment in locating the CSMU. If the airplane is submerged, the underwater locater will activate within four hours.

Recorder operation begins upon airplane power-up and continues until electrical power is shut off. Recorder operation requires no attention from crew members. Continuous internal checking of the transcribed data is accomplished by the installation to ascertain that correct data is being recorded. An amber annunciator light (FLT DATA RCDR FAIL) on the annunciator panel will illuminate to warn the crew if the flight data recorder malfunctions or if power to the system fails.

An Event Marker button is located on the instrument panel. Its purpose is to mark the location in the progress of the flight of an event the pilot may wish to have recorded for later reference. The flight data recorder receives its power from the right main DC bus through a 5-ampere circuit breaker (FDR) on the right circuit breaker panel.

EMERGENCY LOCATOR BEACON (Optional)

The optional locator beacon (Artex 110-4) system consists of a two-frequency emergency locator transmitter (ELT) designed to assist in locating a downed airplane. The ELT has a self-contained battery pack which must be changed every three years when one cumulative hour of operation is logged on the battery pack. The system is activated automatically, by an impact of 5 +2, -0 G's along the flight axis of the airplane, or manually by a switch (ON/ARMED/RESET) on the right instrument panel. When the ELT is activated, a modulated omni-directional signal is transmitted simultaneously on the VHF and UHF emergency frequencies of 121.5 and 243.0 MHz, respectively. The modulated signal is a downward swept tone signal which starts at approximately 1600-1300 Hz and sweeps down to 700 Hz every two to four seconds continuously and automatically.

The locator beacon system is normally controlled from the guarded ON/ARMED/RESET switch located on the right instrument panel. The ON position activates the emergency locator transmitter (ELT) and the ARMED position arms the impact switch. The RESET position on the switch is used to electronically reset the ELT transmitter if it has been energized by the G (impact) switch because of a hard landing, sudden stop, or some other cause. RESET will turn off the transmitter and rearm the G switch. If the ELT becomes activated a light will flash in the cockpit.

The ELT is installed in the airplane aft tailcone area, being bolted into aft section of the dorsal fin above the fuselage. It is housed in a sealed case, and when connected to the airplane system, is powered by the airplane 28-volt DC system. It can be powered by the airplane batteries. When removed from the airplane, or if activated when there is no power available from the airplane system, it operates on its own 14-ampere-hour 9-volt alkaline battery pack, which has a lifetime of at least fifty hours of operation. Removing the ELT from the airplane requires gaining access to the ELT by removing a cover on the right side of the aft part of the dorsal fin, by removing approximately twenty screws, and then reaching aft through a hole in the bulkhead and removing two ELT screws and disconnecting the external antenna connector and the power leads. The ELT can then be pulled through the opening in the bulkhead and removed from the airplane. It can be used as a portable installation, since its battery pack is self contained and a master switch is included on the transmitter, however, the installation was not specifically designed for the ELT to be used as a portable unit. A two-position ON/ARMED - OFF switch is located on the unit, as well as an indicator light which will blink when it is transmitting. Proper operation is indicated by a series of quick flashes followed by a flash rate of once every three seconds. The ELT will start transmitting after a thirty-second delay after being turned on. The ON/ARMED - OFF switch must be turned OFF before the unit is removed from the airplane or it will begin to transmit, since the switch is automatically activated by a magnetic switch upon removal.

The external antenna for the emergency locator beacon system is located on top of the aft fuselage just aft and to the left of the forward tip of the dorsal fin.

Airplane system power for the ELT is from a 5-ampere circuit breaker in the right hand power junction box.

GROUND PROXIMITY WARNING SYSTEM (Optional)

The optional Allied Signal ground proximity warning system (GPWS) (with MK VI warning computer) monitors the airplane's flight path with respect to the terrain at radio altitudes from -20 to 2500 feet. If projected flight paths could result in impact with the terrain, unique aural and visual warnings are issued to the flight crew. The system is powered whenever power is applied to the airplane and it operates automatically in any one of six flight modes. The warning for the first flight mode consists, depending upon flight conditions, of a red PULL UP annunciator and a voice warning "PULL UP", and/or the words "SINK RATE" or "GLIDESLOPE, SINK RATE" repeated every three seconds. The warning continues over the earphones and speakers until it is cleared by a positive pull up out of the danger area.

The MK VI warning computer utilizes airspeed, altitude, and vertical speed signals from the micro air data computers as well as signals from the radio altimeter, glideslope indicators, landing gear position, flap position, angle-of-attack system, and the selected decision height to output the various aural and visual warnings.

There are two switch-annunciators in the system, A flap norm/override switch and a below glideslope switch (GPWS FLAP OVRD//GPS FLAP OVRD ON and BELOW G/S//G/S CANCLD). The normal selection for the flap norm/override Switch is GPWS FLAP OVRD. If it is desired to make approaches or landings with no flaps, nuisance warnings may be avoided by placing the switch to the GPWS FLAP OVRD ON position. If the pilot desires to purposely descend below the glideslope, the mode can be inhibited if the BELOW G/S switch/annunciator is pressed below 1000 feet above ground level. In this case GS CANCLD will illuminate.

The MARK VI Sundstrand Ground Proximity Warning system provides a visual and aural warning of terrain proximity in six flight modes:

1. Excessive rate-of-descent with respect to terrain.
2. Excessive closure rates to terrain.
3. Descent after takeoff (negative climb) before acquiring a predetermined terrain clearance after takeoff or missed approach.
4. Insufficient terrain clearance based on airplane configuration (a flap override switch is provided to disable the flap configuration input to the system to prevent nuisance warnings when landing with less than full flaps).
5. Inadvertent descent below the glideslope (ILS or MLS).
6. Aural altitude callouts such as "MINIMUMS - MINIMUMS", "200 FEET", "500 FEET", "BANK ANGLE".

The flight modes and envelopes which will cause the system to activate are not linear for modes one, two, and three, and vary considerably with airplane altitude, attitude, and airspeed. In general, the closer the airplane is to the ground, the higher the airspeed, and the farther the airplane is from level flight will cause the onset of warnings to occur sooner and more assertively. Modes four, five, and six are more stable in their onset and in the limits which cause the warnings to occur. They are described in more detail. The warnings for the different system flight modes are listed below:

Mode 1 - Excessive Sink Rate (SINK RATE Envelope)

The sink rate is measured barometrically and registers in a flight envelope determined by the radio altimeter. If this flight envelope is entered, an aural warning SINK RATE will be announced. When the airplane is below the glideslope on an ILS, approach mode 1 sensitivity is increased.

Mode 1 - Excessive Sink Rate (PULL UP Envelope)

A flight envelope, beginning at a preset barometric rate-of-descent at a radio altimeter altitude in the upper range of the radio altimeter envelope ranging down to slightly below 200 feet above ground level, will produce a voice warning PULL UP and illumination of a red PULL UP annunciator. The PULL UP warning will continue until it is cleared by a positive pull up out of the danger area.

Mode 2 - Excessive Terrain Closure Rate

Terrain closure rate during cruise operation is sensed by the radio altimeter. The speed and closure rate decrease linearly to near approach speed, at a preset rate. The faster the airplane is traveling, the sooner the excessive closure rate alerts are given. The aural message is TERRAIN, TERRAIN, followed immediately by PULL UP until the closure rate is no longer present and the curve is exited. To avoid false warnings during landing approaches, the mode dynamics are altered by lowering the flaps. The mode two curve is also altered by selecting GPWS FLAP OVERRIDE, if the pilot desires to desensitize the warning.

Mode 3 - Descent after Takeoff

After takeoff, a negative rate-of-climb for a specific altitude loss will trigger an aural warning of DON'T SINK. The amount of altitude loss varies according to the radio altitude the airplane has attained. The ratio of altitude gained to altitude lost which will activate the warning on climbout after takeoff or go-around is approximately ten percent. The mode can be desensitized for training or special pattern work by selecting GPWS FLAP OVERRIDE at an altitude in excess of fifty feet. When mode 3 becomes inactive it is replaced by a warning floor below the airplane, based on airplane speed and configuration (i.e., gear up; flaps up)

Mode 4 - Inadvertent Proximity to Terrain and Airplane Not in Landing Configuration

There are three conditions and messages in this mode. If the airplane descends below 500 feet above ground level at approximately approach speed (below 178 knots) with the landing gear not down, an aural warning of TOO LOW - GEAR will be repeated every 3/4 seconds until the situation is corrected or the airplane is flown out of the envelope. If the same set of circumstances occurs with the landing gear down but the flaps not down, a warning of TOO LOW - FLAPS will be heard (if the flaps are not in the landing position) at an altitude envelope starting at approximately 750 feet AGL. The TOO LOW - FLAPS warning will occur (with flaps not in landing position) below 170 feet above ground level (AGL) at any airspeed, unless GPWS OVERRIDE is selected. If the airspeed is in excess of 150 knots the warning TOO LOW, TERRAIN will occur. In each of these cases a PULL UP warning will be announced if the parameters are within the mode 1 (PULL UP) limits. The flap feature can be deactivated by pressing the GPWS FLAP OVRD switch/annunciator, to prevent nuisance warnings when landing with less than full flaps. In this case the amber GPWS FLAP OVRD ON annunciator will illuminate. At speeds above 200 knots a TOO LOW, TERRAIN alert will be given if the airplane flies within 750 feet of terrain. At slower speeds the alert will occur at lower altitudes corresponding to the slower speeds.

Mode 5 - Inadvertent Descent Below Glideslope

Repeated aural warnings of GLIDESLOPE and illumination of the amber BELOW G/S switch/annunciator are initiated if the airplane descends below more than approximately one dot below the instrument landing system glideslope. This area is considered the "soft" warning and can be silenced by returning to the glideslope. When the airplane is more than two dots below the glideslope and is between 300 and 150 feet above ground level, the warning becomes "hard" as evidenced by the voice warning GLIDESLOPE being repeated louder and faster. The "hard" warning can only be silenced by a positive pull up. Below 150 feet of radio altitude, the amount of glideslope deviation that will produce a warning is increased, in order to preclude nuisance warnings. Mode 5 can be inhibited by pressing the BELOW G/S switch/annunciator while in the "soft" warning areas. Climbing to a radio altitude of above 1000 feet or descending below fifty feet will reset mode 5 if it has been cancelled. If the pilot desires to purposely descend below the glideslope, during training or other flights, mode 5 can be inhibited by pressing the BELOW G/S switch/annunciator. The mode is automatically armed when the pilot selects an ILS frequency, the gear is down, and the airplane is below 925 feet AGL.

Mode 6 - Minimums

An audible message of MINIMUMS is repeated twice when the airplane passes through the altitude set in the barometric decision height (DH) (or minimum descent altitude, [MDA]) in the pilot's PFD. A callout of "BANK ANGLE" advises of excessive bank angle and occurs at 50 degrees of bank above 190 feet AGL, reducing progressively to 15 degrees of bank at zero altitude. The "BANK ANGLE" warning is active at any altitude above 190 feet AGL. It is repeated every three seconds until the bank angle is reduced below the warning threshold. Other mode 6 messages are listed below. Since there are fourteen different messages and the possibility exists that more than one warning situation could occur at one time, a message priority system has been established. A list of the messages is presented below by priority, along with the associated mode(s):

PRIORITY	MESSAGE	MODE
1 and 2	PULL UP (immediately repeated)	1 and 2
3	TERRAIN-TERRAIN (once)	2
4	TERRAIN (every 3 secs.)	2
5	TOO LOW - TERRAIN	4
6	MINIMUMS-MINIMUMS	6
7	FIVE HUNDRED (1 message per appr.)	6
8	TOO LOW - GEAR	4
9	TOO LOW - FLAPS	4
10	GLIDESLOPE, SINKRATE(every 3 secs.)	1 and 5
11	SINKRATE (every 3 secs.)	1
12	DON'T SINK (every 3 secs.)	3
13	GLIDE SLOPE (variable delay)	5
14	BANK ANGLE (every 3 secs.)	6
15	TWO HUNDRED (1 message per appr.)	6

The message with the highest priority will always be provided. If a message is being presented and a higher priority occurs, the message will immediately switch to the higher priority one. If a situation requiring a higher priority message is terminated, the higher priority message will complete before switching to a lower priority one.

The system is self tested by pressing the green GPWS TEST switch. GPWS self test is inhibited in flight. During system self-test MK VI warnings will be evidenced by the below listed annunciations and voice announcements:

1. Amber GPWS INOP, amber FLAP OVRD ACTIVE, and amber G/S CANCELLED annunciators will illuminate immediately.
2. The amber BELOW G/S annunciator illuminates after approximately 0.5 seconds. One "GLIDESLOPE" aural warning is produced.
3. Red PULL UP annunciator illuminates after approximately 2 seconds and at least two "PULL UP" aural warnings are produced.

Between initiating successive MK VI GPWS self-tests a minimum of thirty seconds should elapse, in order to ensure proper computer initialization.

The ground proximity warning system receives power through a five-amp circuit breaker (GPWS) on the right circuit breaker panel.

ALLIEDSIGNAL CAS66A TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM I (TCAS I)

The TCAS I system is an on board collision avoidance and traffic display system with computer processing to identify and display potential and predicted collision targets. From the transponder replies, TCAS I determines range, bearing, and the relative altitude (if the target is reporting altitude, i.e., aircraft equipped with a mode C or S transponder) of intruding traffic. From this, TCAS I will determine the threat using standardized algorithms. Threat aircraft with mode A transponders will not provide altitude information; however, the TCAS I will still issue a traffic advisory. TCAS will assume that non-altitude reporting aircraft are at the same altitude as own airplane and will issue an advisory when threat criteria are met. The TCAS I will not detect aircraft without operating transponders.

NOTE

Pilots must not maneuver the aircraft solely based on the traffic display. The traffic display is intended to assist in visually locating other air traffic. The traffic display lacks the resolution necessary for use in evasive maneuvering. Evasive maneuvers based solely on TCAS traffic advisories, without visual acquisition of intruders, are not recommended.

The TCAS I is a single system installation consisting of one TCAS I processor, one top-mounted bearing antenna, and one bottom mounted bearing antenna; it uses the multifunction display (MFD) as the traffic advisory (TA) display. Aural alerts are available through the headphones and individual pilot's and copilot's speakers. This system is controlled through the CP66B control panel. The TA display is informative only, displaying area traffic without attempting to provide any form of conflict resolution. If TCAS cannot establish an azimuth, it will issue a NO BEARING message on the screen when the system computes that the intruder is close enough to become a threat.

If traffic gets to within 15 to 30 seconds of a projected Closest Point Of Approach (CPA), and/or meets other range and closure criteria it is then considered a potential threat, and an aural and visual traffic advisory is issued. This level advisory calls attention to a potential collision threat using the traffic advisory display and voice message, "TRAFFIC TRAFFIC". At the same time a visual presentation (an amber filled circle) will appear on the multifunction display (MFD). Upon notification of the traffic advisory the crew should conduct a visual search based upon the visual TCAS indication. Once the traffic is visually acquired, safe traffic separation can be maintained.

TCAS I is intended as an aid to the see and avoid concept. Once an intruder is visually acquired, it is the pilot's responsibility to maneuver as necessary to maintain safe separation.

TCAS I does not perform algorithmic, bearing accuracy, or track rate computations which are incorporated in TCAS II or TCAS III that are necessary for evasive maneuvering (rapid changes in pitch, roll, normal acceleration, thrust or speed). In general, TCAS I does not provide adequate information for pilots to determine reliably which horizontal or, in some cases, vertical direction to move to increase separation, and there is some likelihood that such maneuvers will actually result in reduced separation.

The system may be preflight tested by pushing the TST button on the TCAS I control panel. The aural annunciation "TCAS SYSTEM OK" advises that the minimum required equipment for system operation is available and operational. If "TCAS SYSTEM TEST FAIL" is announced, the minimum required equipment for system operation is not available. If initiated in flight the self-test will affect normal TCAS operation for up to twelve seconds.

TCAS I CONTROL PANEL

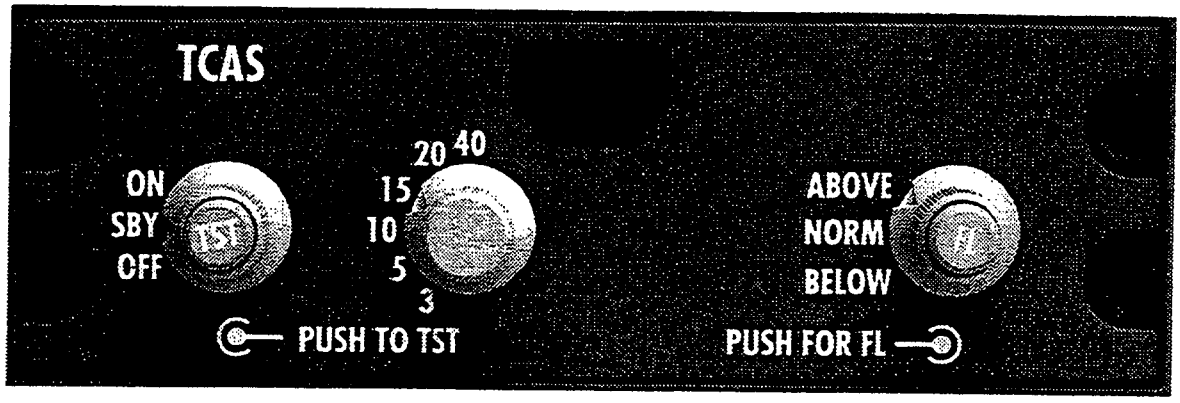

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Figure 3-16

The range selected for operation of the TCAS I has no effect on the logic which the system uses for traffic advisories (TA). It is recommended that a 10 nautical mile (or lower) range be selected for takeoff, low altitude climb, approach and landing, and below 10,000 feet. A range greater than 10 miles may be selected for high altitude cruise.

When the airplane is below 600 feet AGL while climbing or below 400 feet descending, the TA voice message will be inhibited. Airplanes on the ground are not displayed by the TCAS system.

TCAS 1 has two sensitivity levels; SL A and SL B. SL A is invoked when the airplane is below 2000 feet AGL, based on radio altimeter altitude. SL B is all other flight conditions. SL A is less sensitive, to preclude nuisance advisories in the area of airports and terminal areas, where the traffic density is highest, and airspeed is usually slower.

There are three modes of altitude display limits: ABOVE, NORMAL, and BELOW. ABOVE mode displays traffic that is between 8700 feet above and 2700 feet below your own airplane. ABOVE is typically used during the climb phase of flight. NORMAL mode displays traffic that is between 2700 feet above and 2700 feet below your own airplane, and is normally used for cruise flight. BELOW mode displays traffic that is between 2700 feet above and 8700 feet below your airplane. BELOW is normally used during the descent phase of flight.

A TCAS DSP AUTO SEL/TCAS DSP MAN SEL switch/light is installed in the system. When MAN SEL is selected, if the MFD is being used to display the weather radar, for instance, the announcement "TRAFFIC, TRAFFIC" warns of either proximity or threat traffic; the TCAS I display is then selected and the traffic will be displayed on the multifunction display (MFD). If AUTO SEL is selected and proximity traffic or a traffic threat is detected, the TCAS I display will be automatically displayed

It is possible to see an aircraft flying the same course and direction as your own airplane, yet TCAS may not consider it a threat. TCAS calculates the closure rate of the intruder, and derives the time to the closest point of approach (CPA). If there is no closure rate, no advisory will be issued, unless the intruder is very close (within approximately 0.2 mile). However, traffic at the same altitude very far ahead (about 10 miles) may be shown as a TA by TCAS because of a very rapid closure rate.

The TCAS system is powered through a 5-ampere circuit breaker (TCAS) on the right circuit breaker panel.

The AlliedSignal CAS66A TCAS I Pilot's Guide (AlliedSignal part number 006-08746-0000 Revision 1 dated August 1993, or later revision), must be readily available to the flight crew when operating the CAS66A TCAS I system.

FLIGHT GUIDANCE

PRIMUS 1000 INTEGRATED AVIONICS SYSTEM

The Primus 1000 Integrated Avionics system is an autopilot/flight director and electronic flight instrument system (EFIS) which is integrated into one complete automatic flight control system. The primary component of the system is the IC-600 Display Guidance computer (DGC) which contains the symbol generator (the autopilot operates from the Pilot's IC-600 only), the flight director, and the autopilot computer. The entire system is comprised of the flight director, automatic pilot, pilot's and copilot's electronic attitude director indicators (EADIs) and electronic horizontal situation indicators (EHSIs) colocated in one single primary flight display (PFD) for each pilot, dual air data computers with associated outputs, autopilot controller, a vertical navigation (VNAV) mode including altitude alerter and altitude preselect, touch control steering, dual rate gyros, and the autopilot servos. The air data system provides pressure altitude, indicated and true airspeed, altitude reporting, altitude preselect, IAS hold, vertical speed hold, and it provides overspeed warning. A multifunction display (MFD) provides a display for the weather radar returns and for flight management system (FMS) navigation data, as well as for the electronic checklist presentation. It also serves as a backup PFD.

The system may be flown manually or automatically.

MODE ANNUNCIATION

Flight director mode annunciations are integral to the primary flight displays. The vertical and lateral modes are annunciated along the top of the display. Armed vertical and lateral modes are annunciated in white and appear slightly to the left of the position of the captured vertical and lateral mode annunciations, which are presented in green. Lateral mode annunciations are located to the left of top center and vertical modes are annunciated to the right of top center. A white box appears around a capture or hold mode for five seconds after mode transition. Lateral and vertical mode annunciations and transitions are listed below:

VOR	A NAV mode (VOR) is armed or has been captured and is being tracked.
HDG	Heading select mode engaged.
LOC	Localizer has been armed or captured.
VAPP	VOR approach selected or course capture has occurred.
GS	Glideslope armed or captured.
ASEL	Altitude preselect armed.
ALT	Altitude hold mode engaged.
BC	Back course armed or captured.
VS	Vertical speed hold has been selected and captured.
IAS or MACH*	Indicated airspeed (or Mach) hold has been selected and captured.
V-NAV	V-NAV mode is armed or captured.
LNAV	Long range NAV (FMS) mode has been selected.
GA	Go-around mode has been selected.

*IAS or MACH will be annunciated automatically, depending upon airplane altitude. Transition

from IAS to Mach is automatic as the airplane reaches a speed of Mach 0.520 in a climb. Below a speed of Mach 0.510 and/or below an altitude of 27,900 feet, IAS hold will be automatically selected and annunciated.

Lateral Transitions	Vertical Transitions
VOR arm to VOR cap	VNAV arm to VNAV cap
LOC arm to LOC cap	VNAV cap to ALT
BC arm to BC cap	ASEL arm to ASEL cap
VAPP arm to VAPP cap	ASEL cap to ALT
ASEL arm to ALT	GS arm to GS cap

MISCELLANEOUS ANNUNCIATIONS:

ATT1 (or ATT2) — Attitude Source (amber for "cross-selection"). Respective ATT REV button, near bottom of each instrument panel controls.

MIN — Illuminates when the airplane reaches the preset minimum altitude (decision height - DH, minimum descent altitude - MDA, or desired selected altitude). (Annunciated in amber in the upper left side of EADI display.) A white box is drawn around the indication when DH is reached. MIN will flash for 10 seconds and then remain steady.

AP ENG — AUTOPILOT ENGAGED (green). A green arrow will point either left or right, indicating to which flight director (pilot's or copilot's) the flight director is coupled.

TCS ENG — Illuminates in amber to Indicate touch control steering is engaged.

AP TEST — Illuminates in amber when the autopilot is in test mode. Annunciation is automatic immediately after power up.

TRN KNB — Illuminates in amber when the autopilot turn knob is out of center. The autopilot will not engage when the turn knob is out of center.

AP FAIL — Illuminates in amber to indicate automatic flight control system (AFCS) failure.

MAG1 (MAG2) — Heading Source, in mid left-center of PFD. MAG annunciation if AUTO selected on.

DG1 (DG2) — gyro slave switch; DG if MAN selected. Annunciation in amber. No annunciation if normal selections are made. DG REV button controls.

SG1 (SG2) — Amber, in upper left side of primary flight display (PFD) (annunciated only in case of reversion selection). Primary Flight Display DU-870 No. 1 (or No. 2) is providing symbol generator for both displays. Selection is made on the SG1/NORM/SG2 switch on the MFD controller. In SG1 position SG2 will be a duplicate of SG1; in SG2 position SG1 will be a duplicate of SG2.

ADC1 (ADC2)

Amber, in upper left side of PFD (annunciated only in case of reversion selection). ADC1 (ADC2) is the source of air data information for both displays, or a cross-selection of both systems (ADC2/ADC1) has been made. Selection is accomplished by means of the respective ADC REV button located near the bottom of each instrument panel.

CAT2

Green CAT2 annunciation indicates that the excessive ILS deviation monitors are active on the PFD. Amber annunciation of CAT2 occurs when deviations of parameters required for CAT 2 approaches are out of limits. For the monitors to become active APR mode must be selected, both NAV radios must be tuned to the same frequency, and both radio altimeters must be set to 100 feet.

FLIGHT DIRECTOR MODE SELECTOR

The flight director mode selector consists of eight push-on, push-off switches that select various flight director/autopilot modes of operation. The green mode activation light in the switch (button) will be illuminated if the corresponding mode is in the arm or capture state.

The status of the selected mode is displayed in white letters (annunciations) in the primary flight display (PFD) when armed, and in green when capture has occurred (or when selected on, for those modes where capture occurs immediately).

MS-560 MODE SELECTOR PANEL

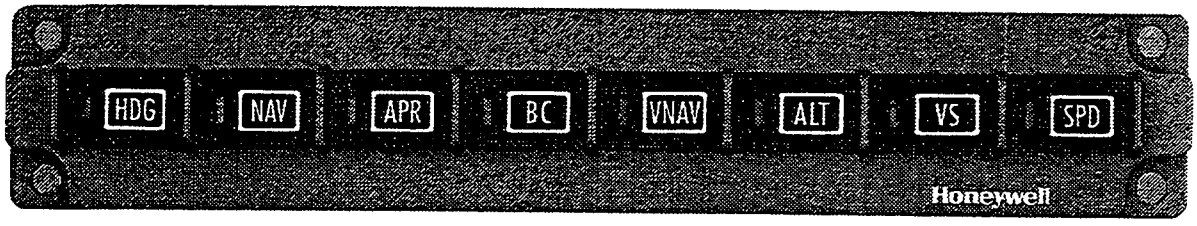

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Figure 3-17

The flight director can be selected off by deselecting all of the modes on the MS-560 Flight Director Mode Selector. The command bars will bias out of view. If single-cue flight director operation is selected on the DC-550 Display Controller the flight director/autopilot will not engage if only a vertical mode is selected. If no modes are selected on the MS-560 mode selector the autopilot will engage in a basic heading hold/pitch hold mode which will be annunciated (PIT and ROL) in the primary flight display (PFD).

Operation of the various modes is explained under Primus 1000 System Operation below. The pilot and copilot may select either NAV 1 or NAV 2 for display on their respective primary flight displays (PFD) by means of the NAV button on the DC-550 display controller. The respective NAV will be automatically selected upon power up; the sequence of selection will then be NAV2/NAV1/NAV2 etc. for the pilot and NAV1/NAV2/NAV1 etc. for the copilot. If both sides have been selected to the same source, the annunciation of VOR 1, etc., in the PFD will be in amber. The selection of NAV 1, NAV 2 or FMS is annunciated in the upper right corner of the HSI display as VOR 1, VOR 2 and FMS respectively.

The selection of NAV 1, NAV 2 or FMS on the DC-550 display controller push-buttons controls the source of navigation information to the flight director, as well as selects the source of navigation information displayed on the EFIS course deviation indicator (CDI) of the PFD. A switch (AP XFER FD1/AP XFER FD2) is installed to determine which flight director controls the autopilot. The position of this switch can be changed with the autopilot engaged or disengaged, however, the flight director modes will drop out. The autopilot will remain engaged, if it is already engaged, but will revert to basic autopilot modes of pitch and heading hold.

AUTOPILOT CONTROL PANEL

The autopilot control panel, mounted on the pedestal, provides the means of engaging the autopilot and yaw damper, as well as manually controlling the autopilot through the turn knob and pitch wheel.

The autopilot (AP) engage switch is used to engage the autopilot and yaw damper. The yaw damper (YD) switch is used to engage and disengage the yaw damper without the autopilot. Use of the yaw damper while manually controlling the airplane aids in airplane stability and passenger comfort. The push-on push-off AP and YD switches are illuminated green when engaged. Pressing the AP switch on the autopilot control when the autopilot is engaged will disengage the autopilot but leave the yaw damper engaged. The yaw damper and autopilot may also be disengaged with the red AP TRIM DISC button on the pilot's and copilot's control wheels or by operating the electric trim switch on either control wheel. Pressing the go-around (GA) button on either throttle will disconnect the autopilot and force the flight director into go-around mode; the yaw damper will remain engaged.

The pitch wheel allows manual pitch control of the airplane proportional to the rotation of the wheel and in the direction of wheel movement. Movement of the wheel also cancels altitude hold mode or altitude preselect capture. The turn knob allows manual bank control of the airplane proportional to and in the direction of knob movement. Turns with a maximum bank angle of 27 degrees can be performed with the turn knob. The turn knob must be in the center detent position before the autopilot can be engaged. Rotation of the turn knob out of detent cancels any other previously selected lateral mode.

AUTOPILOT CONTROL PANEL

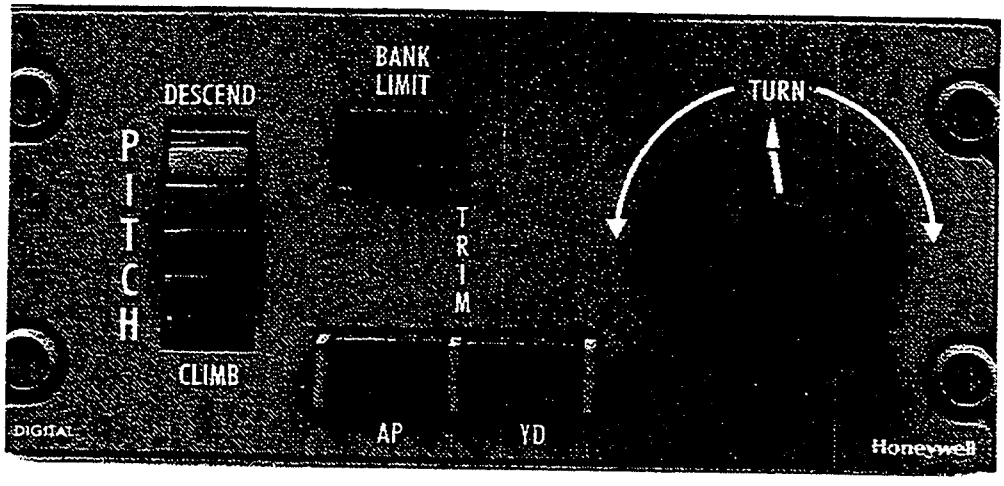

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Figure 3-18

The elevator trim indicator shows an out of trim condition, in the direction indicated by illumination of UP or DN in the TRIM annunciator, when a sustained trim input is being applied to the elevator servo. The indicator should be OFF before engaging the autopilot. If the TRIM annunciator is illuminated and the autopilot must be disengaged, the pilot must be prepared for an out-of-trim condition in the annunciated direction. A separate additional amber AP PITCH MIS-TRIM/AP ROLL MIS-TRIM annunciator is located on the annunciator panel where

it is more readily visible to the pilots. The AP PITCH MIS-TRIM annunciator is a repeat of the TRIM annunciator on the autopilot control panel. The AP ROLL MIS-TRIM annunciator indicates to the pilot that a sufficient level of roll mis-trim is present that the pilot must be prepared for an out-of-trim roll condition if the autopilot is disconnected. The bank limit (LOW) mode may be selected if it is desired to limit the maximum bank angle during autopilot operation. The mode is limited to use inconjunction with heading (HDG) mode only. When the bank limit mode is engaged, the autopilot maximum bank angle is limited to 14 degrees. When the mode is engaged, LOW will annunciate in the pushbutton. Low bank mode will be automatically selected when above 34,000 feet altitude, and automatically cancelled when descending through 33,750 feet. If heading mode is selected and then deselected while low bank is engaged low bank mode will be disengaged and the engage light will extinguish during the time heading mode is disengaged, but low bank mode will re-engage and the LOW annunciator will reilluminate when heading mode is re-engaged.

The autopilot is normally disengaged in one of three ways: (1) depressing the AP/TRIM DISC switch on either yoke, (2) electrically trimming the elevator trim system, or (3) depressing the go-around button on either throttle. Actuation of the touch control steering button on the yoke will interrupt the pitch and roll servos until the switch is released; the yaw damper will remain engaged. If the autopilot is disengaged by any of the above three ways, a warning tone will sound for one second and the amber AUTOPILOT OFF light will illuminate for one second. Any other disconnect will cause the warning horn to sound for one second and the amber AUTOPILOT OFF light to stay illuminated. The amber light can be turned off by holding the AP/TRIM DISC switch for two seconds, or by pressing the electric trim switch or the go-around (GA) button on either throttle. The autopilot will also disengage if an overriding force (sustained torque) is applied to the vertical or horizontal axis for a minimum preset time. Disconnect will be annunciated by the one-second disconnect tone and illumination of the autopilot disconnect light, until the light is extinguished by one of the above methods.

ALTITUDE ALERT

An altitude alerting system provides a visual indication of when the airplane is within 1000 feet of a preselected altitude and normalizes when the airplane is within 250 feet of the preselected altitude. After capture, the system will reactivate if the airplane departs more than 250 feet from the selected altitude. As the airplane approaches within 1000 feet of the preselected altitude, which has been set into in a white box the lower right corner of the multifunction display (MFD), by the knob on the lower right side of the display bezel, the color of the altitude display will change to to amber and the altitude warning horn will sound for one second. As the airplane approaches to within 250 feet of the selected altitude, the display will change back to blue. If the airplane again deviates from the selected altitude by more than 250 feet, the altitude display will change to amber and the altitude alert horn will sound for one second. The display will remain amber until the airplane returns to within 250 feet of the altitude, or until the altitude selection is reset.

The altitude alert function works in conjunction with altitude preselect (ASEL) mode, which is described below. The only difference in operation of altitude alert function alone is that the flight director and/or autopilot need not be engaged for altitude alert to function. The altitude alert annunciations are controlled by the pertinent flight director, which is selected by the autopilot couple switch (AP XFER FD1/AP XFER FD2), and are therefore based on the barometrically corrected altitude displayed on the same side of the cockpit. If the altitude set knob is moved or the glide slope capture mode is active, the annunciations of altitude alert will be cancelled.

PRIMUS 1000 SYSTEM OPERATION

The Primus 1000 system incorporates a wide variety of capabilities that produces one of the most precise, flexible and easy to use systems in airplanes today. The flight director and autopilot can be used independently or together. The airplane may be flown manually, using the guidance provided by the modes selected on the flight director, or when the autopilot is engaged and coupled to the flight director it will control the airplane using the commands generated by the flight director computer. Disengagement of the autopilot will have no effect on the FD modes in operation at the moment of disengagement, except when using the go-around button, in which case a wings level 12-degree nose up attitude will be commanded and all other FD modes will be reset. When the autopilot is engaged without any mode selected, manual pitch and roll commands may be made by means of the turn knob and pitch wheel on the autopilot controller. Touch control steering (TCS) can be used to maneuver the airplane or to modify the commands to the FD and AP. If the autopilot is not engaged, the TCS button can be used to synchronize the command bars to the airplane attitude. If HDG mode has been selected, BANK LIMIT mode may be engaged and the maximum bank angle will be limited to approximately 14 degrees.

The Primus 1000 system in the Citation II Bravo operates through displays of the pilot's (or copilot's) electronic flight instrument system (EFIS). The systems of autopilot and EFIS are integrated, and unnecessary system redundancy has thereby been eliminated. The result is an overall simplification over previous systems, and greatly simplified interface requirements for the flight director function. If a particular EFIS unit is operational, the flight director will also be operational, and conversely if the EFIS has failed, the flight director will also be failed. The display is available as a single-cue or a double-cue (cross-pointer) presentation, the selection of which is made by means of the SC/CP button on the DC-550 Display Controller. The presentation upon power-up is single-cue. Glideslope and VNAV vertical path information are presented on the right side of the electronic attitude director indicator (EADI) section of the primary flight display (PFD). The pertinent command bar(s) of the flight director can be brought into view, when double cue display is selected, by selecting any mode. If single cue mode is selected, selection of only a vertical mode will not bring the command bars into view.

The autopilot may be switched to the pilot's flight director (FD 1) or the copilot's flight director (FD 2) by means of an illuminated selector switch (AP XFER FD 1/AP XFER FD 2) located on the left side of the center instrument panel. This switch determines only which flight director system provides guidance to the autopilot.

BASIC AUTOPILOT

The basic autopilot, without any inputs from the flight director system, can be used for pitch, roll and heading hold. The autopilot will hold the pitch attitude existing at the moment of AP engagement and the pitch attitude existing at the moment of disengagement of a vertical mode. In basic autopilot mode PIT and ROL will be annunciated in the PFD.

The autopilot can be engaged in any reasonable attitude; however, unless touch control steering (TCS) is used in conjunction with autopilot engagement, the autopilot will roll wings level if engaged while in a bank. If the bank is less than six degrees at engagement, the autopilot will hold the heading indicated when the autopilot is engaged. If the bank is over six degrees at engagement, it will hold the heading indicated when the airplane rolls through six degrees of bank on the way to wings level. If a lateral mode is disengaged, the autopilot will

hold the heading existing at the moment of disengagement. If the turn controller is out of the center detent position, the autopilot will not engage. If the autopilot is operating in basic mode (PIT, ROL annunciated) and a vertical mode is selected, the autopilot will command roll hold.

VNAV MODE

The vertical navigation mode (VNAV) mode provides a means to define a climb or descent path to a vertical waypoint ahead of the airplane and to track the path to that waypoint. The waypoint is defined based on a distance reference (bias distance) "TO" or "FROM" a short range VORTAC station waypoint, or the next FMS waypoint if the FMS system is being used for navigation. Upon arrival at the waypoint/altitude the mode automatically changes to altitude select (ASEL) capture mode and then to altitude hold (ALT) mode when it levels at the selected altitude.

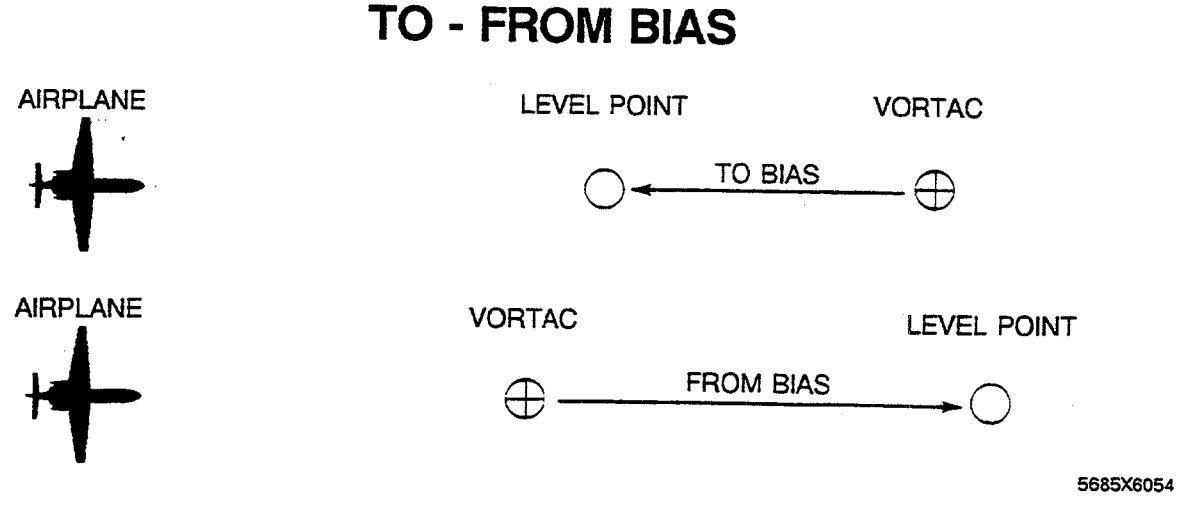

Figure 3-19

VNAV DEFINITIONS AND OPERATION

Desired Altitude (ALT) - The altitude at which the airplane will level at the completion of the climb or descent.

Station Elevation (STA EL) - The elevation above sea level of the VORTAC station that the VOR and DME are receiving. Does not apply to FMS waypoints when used for VNAV.

TO/FROM Bias (TO/FR) - The distance set into the VNAV that moves the point for completion of the problem away from the VORTAC or FMS waypoint being used.

TO bias moves the point closer to the airplane than the VORTAC or FMS waypoint being used.

FROM bias moves the point farther from the airplane than the VORTAC or FMS waypoint being used.

During VNAV operation overspeed protection is provided based on the V_{MO} speed limit. If this speed is reached a special submode will engage and will override the VNAV mode until the speed situation is corrected. If a deviation of 1000 feet from the computed path occurs, VNAV mode will cancel.

VNAV operation will be cancelled if another vertical mode is selected, the air data information from the micro air data computer (MADC) becomes invalid, the DME signal is lost for five seconds, an overspeed as described above occurs, the PFD NAV source is changed, glide slope capture or level off at the waypoint occurs, or in case of the detection of various system faults by the system monitors.

In order for VNAV mode to operate the airplane must be proceeding along a direct path towards or away from the short range NAV (VORTAC) (or to the next FMS NAV waypoint) which has been selected as a reference. If a VORTAC is being used, the VOR azimuth and DME must be locked onto the VORTAC station for VNAV computation. The desired altitude, station elevation (VORTAC only) to the nearest 100 feet, and the TO/FROM bias (if required) must be set into the VNAV system. If the FMS is being used for navigation, the next waypoint may be used, with or without TO or FROM bias, and station elevation (STA EL) data is not required. Attempts to insert VNAV problems behind the airplane or outside the parameters of the system will be ignored by the system.

PROGRAMMING

Programming is possible when a VOR station is tuned, lock-on of azimuth and DME occurs, and the waypoint desired is within selectable parameters, or when FMS navigation is in use and the next waypoint is used to define the VNAV problem. Arming of the VNAV to any waypoint consists of selection of the desired waypoint, and selection of waypoint data which will enable the flight director computer to compute a viable VNAV problem.

The VNAV problem is defined by using the menu buttons along the bottom of the multifunction display. Pressing the second button from the left (VNAV) will bring up the VNAV menu, which may be used to set up the parameters for the desired VNAV profile. This function is separate from the VNAV function in any flight management system (FMS) which may be installed. VNAV programming is also discussed under MFD in this section.

Using short range NAV, when a VORTAC station is tuned, identified, and lock-on is achieved, the VNAV selections can be made. If TO or FROM (FR) bias is required the second button from the left on the bezel of the multifunction display (MFD) is pressed, which will result in display of a box into which may be set the TO or FR bias by turning the left knob on the MFD. TO or FROM is selected before the distance selection is made by toggling the button, resulting in annunciation of TO or FR above the selection window. Station elevation (STA EL) of the VORTAC station in use is then set by pressing the second button from the right and setting the correct elevation, to the nearest 100 feet, into the window above it. Set the desired altitude in the preselect window. The VNAV problem is now established, and VNAV may be selected. If long range NAV is used the problem is similarly defined; FMS must be selected on the DC-550, which will result in long range data being displayed on the menu at the bottom of the MFD display, and therefore being selected by the respective knobs discussed above. If FMS is being used, station elevation (STA EL) is not required.

If a valid problem has been defined, the computed angle will be displayed on the MFD VNAV menu located at the bottom right of the MFD display. A VNAV problem is valid only if the vertical angle is less than a positive or negative 6°. The flight director computer will continually compute the vertical angle based on aircraft position and update the display on the vertical path indicator on the PFD. If the pilot desires he can rotate the VNAV set knob and increase the vertical angle up to a maximum of 6°, which will create a vertical path intercept point some distance ahead of the aircraft. Once a valid VNAV problem has been defined, the pilot can select the VNAV mode on the MS-560 Mode Selector. VNAV mode will, however, not activate until it is selected, or selection is affirmed by a pilot action.

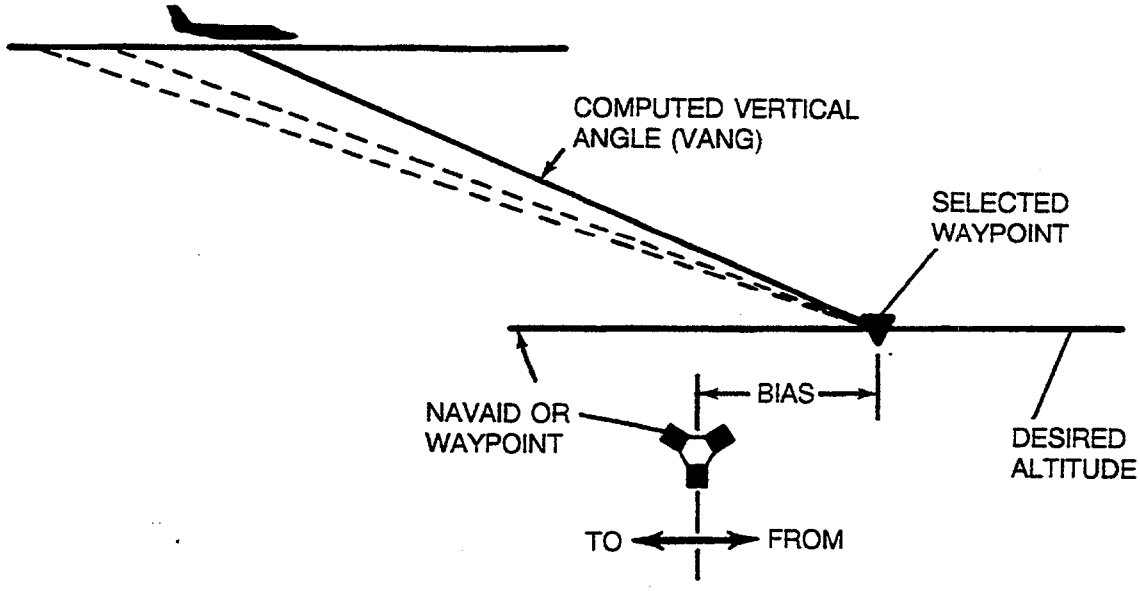

Figure 3-20. Vertical Angle Computation

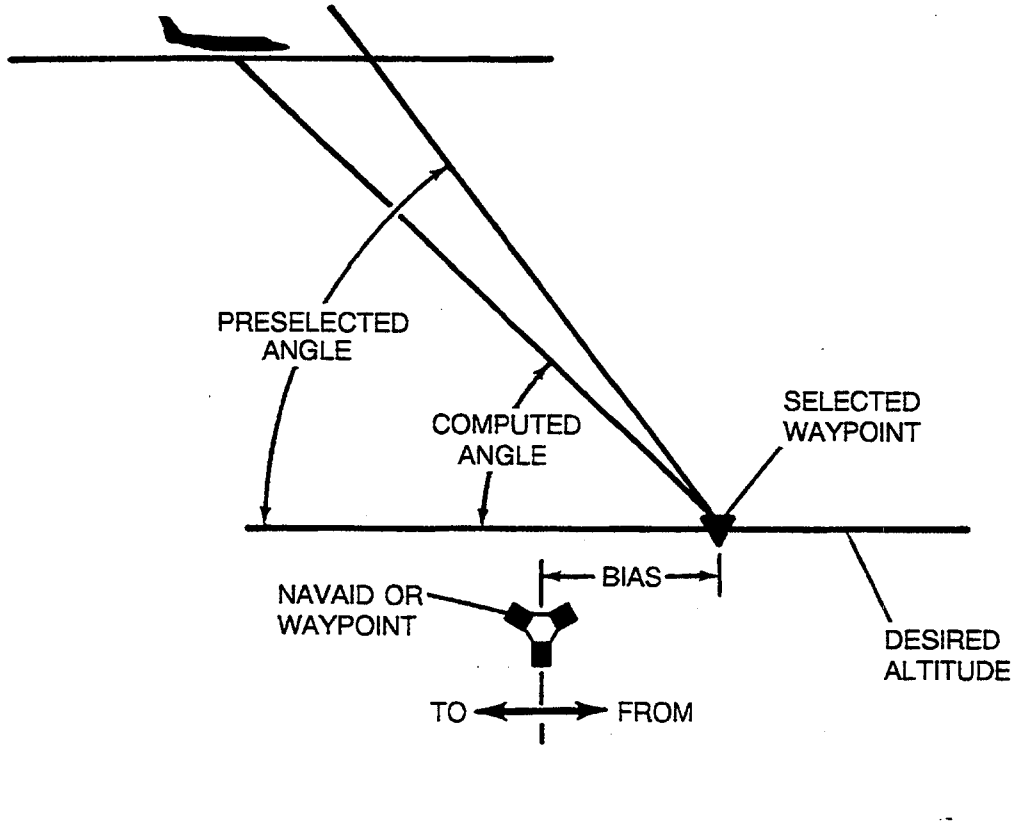

Figure 3-21. Intercepting Preset Angle

If the pilot has selected an intercept point ahead of the airplane by increasing the vertical angle before selecting the VNAV mode, the flight director will remain in the previous mode until the appropriate time. Approximately one minute prior to the flare point the altitude alert horn will sound two short beeps. The vertical track alert (VTA) will flash on the PFD and the VNAV annunciator will flash on the MS-560 Mode Selector. A pilot action is required before the VNAV capture phase can commence. The pilot must press the flashing VNAV button on the mode selector before it stops flashing, to allow the mode to capture. Once the button is pressed, the annunciation in the mode selector will stop flashing and remain on, as with the VTA annunciator on the PFD. If the pilot wishes to cancel the mode he can press the VNAV button twice on the mode selector when it flashes, or he can do nothing and wait for the flashing to stop, at which time the mode will automatically disengage.

When the VNAV mode is engaged, the VNAV parameters are frozen. This includes STA EL, TO, FROM, and VANG; changing the ALT SEL value will also cause the mode to drop out. The pilot may still view any of these parameters but the set knob will have no affect. After the airplane has leveled off at the waypoint altitude and transitioned into altitude hold mode the VNAV parameters for the current problem are erased.

If the pilot deselects the VNAV mode by pressing the VNAV button, the flight director cancels the mode but the data for the current waypoint are retained. The angle from the present position to the waypoint will still be tracked but the parameters will no longer be frozen and can be modified as desired by the pilot. The VNAV mode can be reselected as long as the problem remains valid.

ALTITUDE ALERTING SYSTEM

The altitude alerting system is automatically engaged in conjunction with the altitude preselect mode (ASEL) and the vertical navigation (VNAV) mode. The desired altitude is set into the system for use of the VNAV or ASEL modes. In both cases the altitude is set into the lower right corner of the MFD with the right knob on the MFD bezel. The desired flight director mode which is to be used to reach the designated altitude is then selected on the flight director/autopilot mode control panel. Refer to Altitude Hold and Altitude Preselect, below. If the pilot does not desire to select a flight director mode, the airplane can be flown manually and the altitude alerting system will still provide the appropriate annunciations.

TOUCH CONTROL STEERING

Touch control steering (TCS) enables the airplane to be maneuvered manually during autopilot operation without cancellation of any selected flight director modes. To use touch control steering, press the TCS button, maneuver the airplane and release the TCS button. TCS is operable with all autopilot modes. During TCS operation the yaw damper will remain engaged.

If the autopilot is engaged in a bank and it is desired to hold the bank, press the TCS button, engage the autopilot and release the TCS button. The bank will be maintained if it is in excess of six degrees. The airplane may be rolled level with the turn knob. The memory function holding the autopilot in a bank will be canceled when the turn knob is moved out of detent.

In the case of speed (SPD) (IAS or MACH annunciated) mode, vertical speed (VS) mode or altitude hold (ALT) mode, the TCS button may be depressed and the airplane maneuvered to a new reference. When the TCS button is released, the flight director/autopilot will maintain the new reference.

HEADING MODE (HDG)

The heading mode (HDG - annunciated in green letters in the top right of the EADI) can be used with the flight director (FD) only, or in conjunction with the autopilot. When the heading (HDG) mode is selected on the MS-560 Mode Selector, the command bars will come into view and display a steering command that is controlled by the HDG cursor (bug) on the EHSI. The heading bug is set by means of the RI-553 Remote Instrument Controller located on the pilot's pedestal. The command bars will synchronize vertically to the pitch attitude at the time of HDG selection. Heading mode will be engaged automatically if another lateral mode is selected and the airplane is outside the capture parameters of that mode. In this case, HDG mode will remain ON until the airplane arrives at a point where capture can occur. The selected mode will then capture and be annunciated in the mode selector and in green letters at the top left side of the EHSI, and HDG will cancel. If the autopilot is also engaged, the autopilot will receive steering commands according to the selected mode(s). NAV and APR modes can be armed with the HDG mode ON. When intercepting a VOR radial or localizer course with the NAV or APR modes selected, the system will switch from ARM to CAP when within the capture limits and the armed mode will be captured. When conducting autopilot coupled heading operations, the roll mistrim annunciator (AP ROLL MISTRIM) may illuminate momentarily when the heading bug is slewed from a left turn immediately followed by a right turn or vice-versa.

RI-553 REMOTE INSTRUMENT CONTROLLER

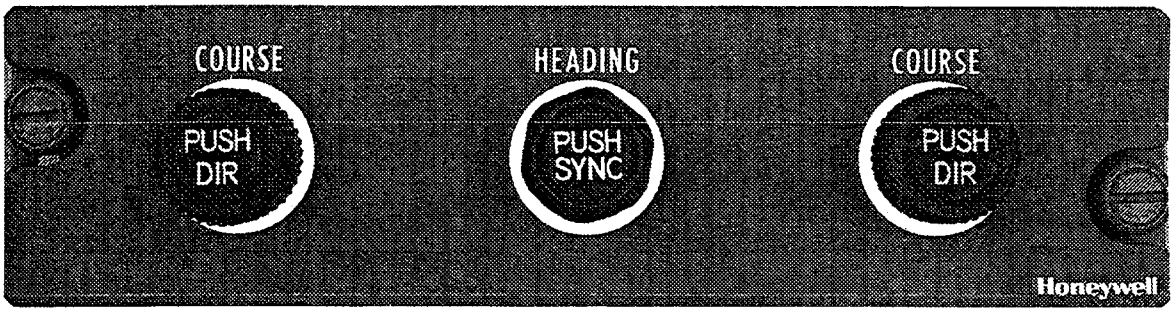

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Figure 3-22

NAV (VOR) AND NAV APR (VAPP) MODES

Two different modes of capture and tracking a VOR signal are used in the Primus 1000 system. One method is used for normal enroute navigation (VOR) and the other for a VOR approach (VAPP).

For enroute navigation, the desired VOR frequency is selected on a NAV receiver, the course bearing set on the EHSI, the heading bug is set to an intercept heading for the selected course (if not on course), and NAV mode is selected on the MS-560 Flight Director Mode Selector. The small green light in the mode selector will illuminate, and if the airplane is outside the NAV capture limits, VOR will be annunciated in white at the top left of the EADI and HDG will be annunciated in green at the top right of the EADI. As the airplane is maneuvered within the capture limits, HDG will extinguish and VOR will illuminate in green at the top left of the EADI. When the mode is transitioning to capture, a white box will be drawn around the mode for five seconds.

For a VOR approach (VAPP mode), the desired VOR frequency is selected on the NAV receiver, the course bearing set on the EHSI, the heading bug on the HSI is set to an intercept heading for the selected course, and the APR mode is selected on the flight director mode selector. The green light will illuminate in the APR button and, if outside the capture limits, VAPP will illuminate in white on the top left side of the EADI. HDG will annunciate in green in the top right side of the EADI. When the airplane maneuvers into capture range, HDG mode will cancel and VAPP will annunciate in green in the top left side of the EADI. A white box will be drawn around the capturing mode for five seconds.

In both NAV and APP modes, a station passage feature is provided that incorporates bank angle limits and a course hold (plus wind drift) mode. The station passage mode for enroute tracking (NAV mode) is of long enough duration to provide smooth transition of a VOR station at any altitude. The station passage mode for APP mode is of short duration to provide approach accuracy. This does not provide the degree of ride smoothing that is present in the enroute case.

Autopilot coupling during VOR approaches is limited to airports at elevations at or below 3,300 feet. Pilot flown approaches with flight director guidance may be conducted, however.

ILS APPROACH (LOC) OR (LOC GS)

With a localizer frequency selected in a NAV receiver, operation is similar to capturing and tracking a VOR radial. Selecting APR on the mode control panel with a localizer frequency tuned, arms both the LOC and GS modes and engages HDG, if not previously selected and the airplane is outside the capture parameters of the mode. HDG will be displayed in green at the top right of the EADI and the green light in the APR button of the mode selector will illuminate; LOC and GS will be illuminated in white on the upper left and right, respectively, of the EADI. When inside the LOC capture limits, LOC will illuminate in green at at the top left of the EADI and HDG will extinguish. At glideslope capture (approximately 1/2 dot), GS will illuminate in green on the EADI. During transition to both the LOC and GS capture modes a white box will be drawn around the respective mode annunciations. During ILS approaches, the FD gain is progressively adjusted during the approach using GS deviation, radio altitude, and middle marker passage for gain programming. If the radio altimeter is not operational, this function is performed as a function of glideslope capture and middle marker passage.

The capture limits for VOR and LOC captures are variable depending on DME distance, speed and intercept angle. Glideslope capture is locked out until localizer capture occurs. If the localizer mode becomes invalid for any reason, the glideslope mode will also be cancelled. The glideslope mode will also cancel if there is an invalid glideslope signal for greater than five seconds.

The glideslope mode will cancel if SPD, ALT, or VS modes are selected, a preselected altitude is captured, or if go-around mode is selected.

The glide slope indicator, located on the right side of the EADI presentation, is green unless there is a cross-side selection, in which case it will be yellow.

BACK COURSE LOCALIZER APPROACH

A back course localizer approach capability is provided using either flight director or autopilot or both.

With a localizer frequency set in the selected NAV, selecting BC on the mode selector arms the system for a back course localizer approach. The front course of the ILS must be set into the EHSI to give proper indications on the course deviation bar and for the flight director computer to compute correct back course corrections during the approach. If the the back course is set on the EHSI the command bars and autopilot will be given incorrect steering commands. When BC is selected on the mode selector, the green light in the button will illuminate and BC will be annunciated in white on the left top side of the EHSI. HDG may illuminate in the top right side of the EADI if the airplane is outside of capture parameters for the mode and heading mode engages in order to effect capture. When the back course is captured, BC will be illuminated in green on the top left side of the EADI and HDG will extinguish if heading mode was engaged to accomplish intercept.

In BC mode the outer marker has no function in the changing of system sensing.

ALTITUDE HOLD (ALT) AND ALTITUDE PRESELECT (ASEL)

Selecting altitude hold (ALT) provides steering commands to maintain the altitude at the moment of engagement. An altitude preselect (ASEL) mode is also incorporated which provides a preprogramming capability. To use altitude preselect, the desired altitude is set into the ALT window at the lower right corner of the multifunction display (MFD) (and at the same time in the upper right corner of the PFD) by means of the knob on the bottom right of the MFD bezel. ASEL will illuminate in white in the top right side of the EADI to indicate that the altitude preselect mode is armed. The airplane may be maneuvered toward the desired altitude using any of several methods: the autopilot pitch wheel, touch control steering, FD pitch sync, speed hold or vertical speed hold. If the airplane is flown manually, the flight director will guide the pilot onto the selected altitude. As the airplane approaches the desired altitude, the altitude preselect will capture at an altitude corresponding to approximately 1/5 the rate-of-climb/descent; i.e., at 2000 feet/minute climb rate, the system will capture approximately 400 feet prior to the selected altitude.

At capture, the mode ASEL will illuminate in green on the EADI. The flight director will perform a smooth level-off at the selected altitude. At level-off altitude, ALT mode will be automatically selected and displayed in green on the EADI. Once altitude hold is captured, the touch control steering (TCS) button on the control wheel can be used to change or trim the selected altitude. TCS operates in conjunction with the flight director or the autopilot or both. Once ALT mode is engaged, resetting the BARO setting on the pilot's altimeter will cause the airplane to climb or descend to recapture the same indicated altitude. Moving the autopilot pitch wheel will cause ALT or ASEL CAP modes to be canceled if either is selected.

Selection of a vertical mode without a lateral mode will provide autopilot tracking of the mode but the FD command bars will not be in view.

AIRSPEED HOLD AND VERTICAL SPEED HOLD

Speed (SPD) hold (IAS or MACH - mode selectable depends upon altitude) and vertical speed (VS) hold are selected by pressing the appropriate mode button (SPD or VS) on the MS-560 Flight Director Mode Control Selector. The flight director, autopilot, or both will hold the airspeed, (Mach if appropriate), or vertical speed indicated at the moment of engagement. The green light in the respective mode selector button will illuminate and VS or IAS (or Mach), as appropriate, will illuminate in green on the EADI. When initially selecting speed mode, the speed target will synchronize to the existing indicated airspeed at speeds below 0.510 Mach and/or altitudes below 27,900 feet. The target will automatically switch from indicated airspeed to Mach number as the airplane reaches a speed of 0.520 in a climb. It will automatically switch from Mach number to indicated airspeed as the airplane descends through 28,700 feet. Upon initially selecting vertical speed hold mode, the vertical speed will synchronize to the existing vertical speed. Once the vertical speed mode is selected with the autopilot engaged, the pilot can select a different vertical speed with the pitch wheel on the autopilot controller. If the autopilot is engaged after VS mode is selected, the vertical speed must be resynchronized.

The autopilot pitch wheel may be used to change the reference speeds for both the speed mode and the vertical speed mode. The touch control steering (TCS) button may also be used to temporarily release the autopilot clutches and maneuver the airplane to a new reference. The airspeed, Mach, or vertical speed established when the (TCS) button is released will become the new reference.

A lower limit of 120 KIAS is established, below which the SPD mode will not engage. At the opposite end of the speed spectrum, V_{MO} or M_{MO}, as appropriate, will not be exceeded. If an upper limiting speed is attained the system will maintain the limiting speed, thus speed hold mode can be used to fly V_{MO} or M_{MO} descents.

Selection of the speed hold (SPD) mode will cancel all other vertical modes except altitude preselect arm (ASEL - green annunciation) and glide slope arm (GS - green annunciation). Selection of altitude hold (ALT) mode will cancel SPD mode, as will altitude preselect capture, glideslope capture, selection of go-around mode, or invalid air data.

GO-AROUND MODE

A go-around mode (GA) is available through buttons on the left and right throttles. Depressing one of the buttons will drop all other FD modes and disconnect the autopilot except, for the yaw damper. The FD command bars will command a wings level and a twelve-degree nose up climb attitude. GA will illuminate in green on the EADI. After go-around has been selected, the selection of any lateral mode will cancel the wings level roll command but the pitch-up command will remain. The go-around mode is canceled by selecting another pitch mode, pressing the TCS button, or engaging the autopilot.

PITCH SYNCHRONIZATION

When flying the airplane manually and using the flight director, the command bars may be matched to the existing pitch attitude, or if a vertical mode has been selected, the mode reference may be changed, by pressing the touch control steering (TCS) button. When the TCS button is released, the command bars will synchronize to the airplane attitude existing at the moment of release. If a vertical mode is selected (ALT, VS, SPD), the flight director/autopilot will hold the vertical reference existing at the time of release.

ELECTRONIC FLIGHT INSTRUMENT SYSTEM

The electronic flight instrument system (EFIS) is an integral part of the Primus 1000 Flight Guidance System. The EFIS system consists of three DU-870 electronic primary flight displays (PFDs) (the pilot's and copilot's are identical and interchangeable), and the center instrument panel mounted DU-870 Multifunction Display (MFD), a DC-550 Display Controller for each pilot, an MC-800 Multifunction Display Controller, an MS-560 Mode Selector for each pilot, and an RI-553 Remote Instrument Controller. An AZ-850 micro air data computer in each system also provides inputs which are used and displayed by the EFIS system; cross selection (ADC1/ADC2 on the display controller) of micro air data computers is possible, which provides system redundancy. The heart of each pilot's system is an IC-600 Display Guidance Computer. It contains the flight director computer; the pilot's IC-600 also contains the autopilot controller. The symbol generator receives and processes airplane sensor inputs and transmits the data to the electronic primary flight displays (PFDs) in its system. In case of malfunction of a symbol generator, which is located in the IC-600, reversion is possible through a selection (SG1/NORM/SG2) on the MC-800 Multifunction Display Controller.

Other parts of the system are discussed under different headings, since some of the sub-systems must be covered individually, and components of the EFIS system also comprise parts of those systems. The C-14D directional gyro and the VG-14A vertical gyro, for example, also are important parts of the integrated system, however, they are discussed under separate headings.

A conventional slip/skid indicator is attached to the PFD of each pilot. Both primary flight displays and the multifunction display can be dimmed manually by means of knobs on the respective controllers and the relative brightness will then be maintained photoelectrically.

Selections for navigation sources and bearing needle presentations are controlled by means of buttons and knobs on the display controller (DC). The selected sources are annunciated on the primary flight displays. Each pilot may choose FULL or ARC mode (ARC mode also displays weather radar) for compass display, single cue or cross pointer flight director display, a display of ground speed (GS) or time-to-go (TTG), and elapsed time (ET); he may select either micro air data computer (ADC 1 or 2) as a source of system air data information. NAV 1 or NAV 2, or FMS may be selected for navigation display and control of the flight director These functions are explained under Display Controller below. Additional knobs which select various navigation equipment for display (only) on the EFIS are also discussed below.

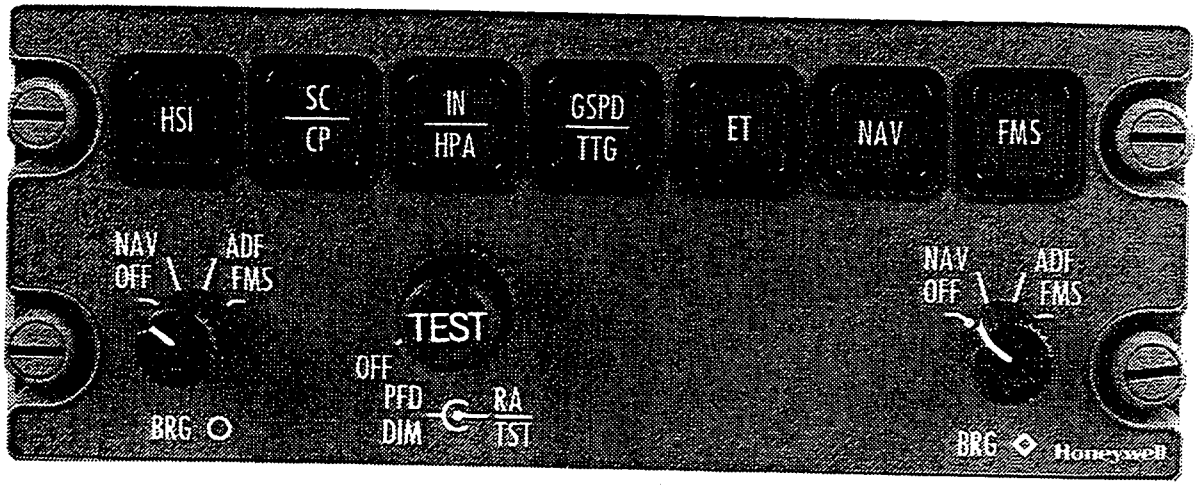
Operation of the EFIS is similar to a standard flight director system except for the presentation of additional information on the small format of three electronic display units (2 PFDs and one MFD). More information is available in a more compact arrangement and the format is variable as desired. Presentations that are not necessary or desired at any one time can be removed and replaced with more appropriate data for the existing flight conditions. The units of the system are discussed below.

The MC-800 multifunction display controller (MFD) is installed in the center pedestal. The MFD controller provides for the selection and control of the MFD formats, modes, and waypoint designator. The multifunction display controller is also discussed below in this section.

DISPLAY CONTROLLER

The display controller, located on the left and right, respectively, of the PFD on the pilot's and copilot's instrument panels, allows selection of the different formats and provides for selection of required navigation sources and bearing data. If a failure is detected in the DC-550, "MENU INOP" will be displayed on the MFD.

DISPLAY CONTROLLER (DC-550)



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The individual controls are:

HSI Button: Controls full or WX (partial compass display). Displays 360 degrees in FULL mode and 90 degrees in WX (ARC) mode. Successive pushes change the mode back and forth. WX returns can be displayed on the PFD when in WX mode.

SC/CP: Selects flight director command mode. Alternate action toggling between single cue and cross pointer flight director display. Power up state is single cue. Airplanes with European configurations do not have the crosspointer selection.

IN/HPA Selects the altimeter BARO correction display in terms of inches of mercury or hectopascals (millibars). When HPA is selected, altitude digits near the BARO display show altitude in meters.

GS/TTG Button: Ground speed (GS) or time-to-go (TTG) is displayed in the lower right center of the EHSI. Pressing the GS/TTG button provides alternating selection of GS or TTG to next station or waypoint. GSPD is the power up mode.

ET Button: Controls elapsed timer that appears in the EHSI location dedicated to GSPD/TTG. Initial actuation enters the mode at the previous position. If elapsed time is being displayed, stops the display. Sequence of the ET button is: Reset - Elapsed Time - Stop - Repeat.

Figure 3-23 (Sheet 1 of 3)

Display Controller Individual Controls (Continued)

NAV Button:	Pressing the NAV button selects the VOR for display on the EHSI course deviation indicator (CDI). Pressing the button alternately selects NAV 1 and NAV 2 (annunciated VOR 1 and VOR 2 on the center right side of the EHSI; ILS 1 and ILS 2, if ILS frequency is tuned in NAV). The flight director interfaces with the NAV that is selected and displayed on the EHSI.
FMS	Selects flight management system (FMS) for display on the EHSI; the flight director will interface with the FMS. The EHSI course needle represents FMS course information on the bearing pointer. If two FMSs are installed the switch will toggle between the two.
PFD DIM (Outer Concentric)	The DIM knob sets the overall brightness of the PFD. When the pilot sets the reference level, photoelectric sensors will maintain the relative brightness under various lighting conditions. Full counterclockwise OFF position turns off the PFD, and will revert the display, through an EFIS backup mode, to the multifunction display. EFIS backup is provided by the MFD as an addition to the existing symbol generator (EFIS) reversionary modes. In case of failure of a primary flight display (PFD) cathode ray tube, selection of an EFIS backup mode can be accomplished by turning OFF the the PFD DIM button on the affected PFD. The MFD will then take up the display selected on that controller. If both PFDs are OFF, the copilot's PFD will have priority on the MFD display.
Decision Height (Inner Concentric - "DH")	Rotation of the "DH" knob adjusts the decision height display on the EADI. Rotating the knob fully counterclockwise removes the decision height information from the display. The pilot's control sets the minimums announcement; the copilots control has no input to that function; although it sets the DH display in the copilot's PFD.
Test Function (TEST)	Pressing and holding the TEST button causes the displays to enter the test mode. Flags, cautions, and all flight director and mode annunciations are tested and presented on the display. As the test button is held down an autopilot (left display only) and flight director system checks will be accomplished. Satisfactory or unsatisfactory test results will be annunciated on the display. The test will also result in a self-test of the radio altimeter system; 50 feet will be indicated in green at the bottom of the EADI display and the decision height (DH) horn will sound. The TEST button is wired through a squat switch and is completely active only when the airplane is on the ground. The Primus 1000 test is not active in flight, but a self-test of the radio altimeter system may be made in flight if the GS capture mode is not active. The EFIS system will also automatically self-test when it is powered up. If the test is not satisfactory it will be so annunciated. By setting the DH to 600 feet or more and pressing the TEST button and the GSPD/TTG on the PFD display controller simultaneously when the airplane is on the ground. The PFD will display maintenance data for the IC-600 display guidance computer (DGC) and various sensor inputs.

Figure 3-23 (Sheet 2)

Display Controller Individual Controls (Continued)

Bearing " O " Knob — This knob has four positions. The OFF position removes the bearing pointer from the display. In NAV position, VOR 1 bearing information is displayed. In ADF position, ADF 1 bearing is displayed. Selecting FMS displays FMS (FMS 1 if two FMSs are installed).

Bearing " ◇ " Knob — This knob has four positions. The OFF position removes the bearing pointer from the display. In NAV, NAV 2 bearing is displayed. In ADF position, ADF 2 (if installed) bearing is displayed. FMS position is dedicated to FMS 2 (if installed).

Figure 3-23 (Sheet 3)

HEADING REVERSION SWITCH (HDG REV)

The heading reversion switch is an auxiliary push button switch located low on the pilot's and copilot's instrument panels which allows selection of the opposite side C-14D as an alternate (reversion) heading source for the pilot's or copilot's flight director. MAG 2 (MAG 1) or DG 2 (DG 1) will be annunciated in amber in the center-left of the PFD. The annunciation of MAG or DG will be controlled by the position of the respective GYRO MAN/AUTO switch on the pilot's or copilot's instrument panel. If there is no reversion selection and both systems are selected to their own respective sources, there will be no annunciation. If there is a cross-selection on both sides, the annunciation will be in white. If the same C-14D is selected as a heading source on both sides, the heading source annunciation will be in amber, to apprise the pilots that both indicators are selected to the same heading source.

ATTITUDE REVERSION SWITCH (ATT REV)

The attitude reversion switch is an auxiliary push button switch on the pilot's and copilot's instrument panel which allows selection of the opposite side VG-14A as an alternate (reversion) attitude source for the pilot's or copilot's attitude indicator. ATT 2 or ATT 1 will be annunciated in amber in the upper-left of the PFD. If the same VG-14A is selected as an attitude source for the attitude indicators on both sides, the attitude source annunciation will be in amber; if both systems are selected to their respective sources there will be no annunciation. If there is a cross-selection on both sides the annunciation will be in white. In case of a reversion selection, the annunciation is in amber to apprise the pilots that both indicators are selected to the same attitude source.

AIR DATA COMPUTER REVERSION SWITCH (ADC REV)

The air data computer reversion switch is an auxiliary push button switch located low on the pilot's and copilot's instrument panels which allows selection of the opposite side air data computer to provide ADC inputs to the respective side of the Primus 1000 system. ADC 2 or ADC 1 will be annunciated in amber in the center-left of the PFD. If there is no reversion selection and both systems are selected to their own respective sources, there will be no annunciation. If there is a cross-selection on both sides, the annunciation will be in white. If the same air data computer is selected as a data on both sides, the ADC source annunciation will be in amber, to apprise the pilots that both sides are selected to the same air data computer. At power up, the pilot's and copilot's systems are each automatically selected to its respective side ADC. Selection progression of the push button after power up is: first push - opposite side, second push - original on- side selection.

MULTIFUNCTION DISPLAY SYSTEM

The Multifunction Display (MFD), the central DU-870 cathode ray tube, serves as the weather radar indicator. It can be used to display the horizontal navigation situation, either short range (VORTAC) or long range (FMS), and to display electronic checklists. It also provides backup capability to the EFIS systems, with a major sub-function. If a symbol generator on one side fails the pilot can, through the SG1/NORM/SG2 control on the MFD controller (MC-800), select the opposite side symbol generator to take over the failed side's display, and operation of the EFIS in that position will continue as before, with the selected symbol generator powering all three displays.

The multifunction display system expands on the navigation mapping capability of the EFIS, especially in conjunction with the flight management system (FMS). The MFD display may be used independently for navigation and mapping information without disturbing the EHSIs, which may be then used without additional displays which would result in more "clutter" on the EHSI. The weather radar display may be selected independently (by selecting off all of the navigation functions) or overlaid on the navigation display provided by the flight management system, in order to show the airplane route with respect to the displayed weather returns.

MULTIFUNCTION DISPLAY CONTROLLER (MC-800)

The EFIS multifunction display (MFD) controller, located at the forward end of the pilots' pedestal, allows mode selections, display control, and symbol generator reversion control of the pilot's and copilot's systems. In addition to its navigation, reversion, and checklist functions the MFD control also provides for control of the display of the optional Traffic Collision Avoidance System (TCAS) when installed.

MULTIFUNCTION DISPLAY CONTROLLER (MC-800) (TYPICAL)

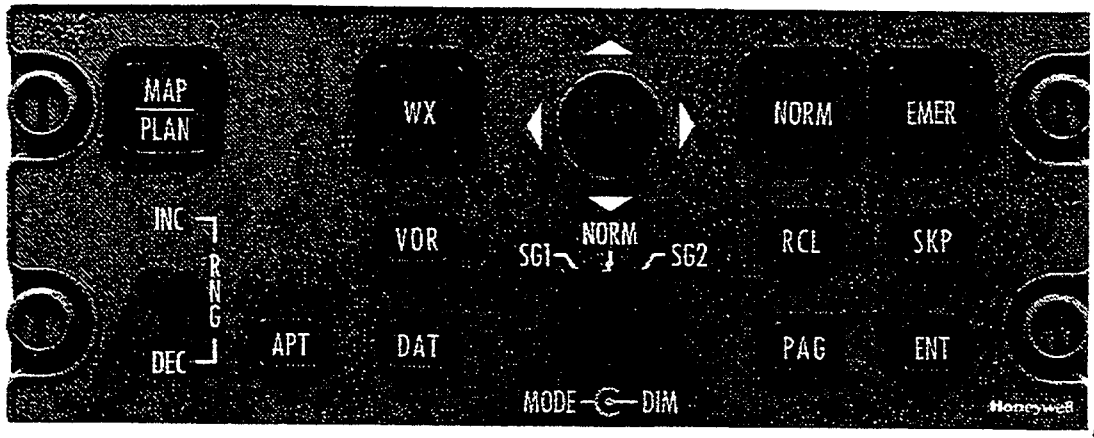

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Figure 3-24

MFD Modes of Operation

The different modes of operation available to the multifunction display system are discussed below. The modes are: MAP/PLAN; WX; Checklist, with Normal and Emergency

Procedures; and backup symbol generator modes for either of the primary flight displays (PFDs). The optional Traffic Collision Avoidance System (TCAS) also operates through displays presented on the multifunction display. If the TCAS system is installed, the MFD controller will have an additional (TCAS) button located to the right of the MAP/PLAN button.

MAP Mode

The MAP function is a partial arc airplane heading up display which is selected by the alternate action MAP/PLAN push button. The MFD display cycles from MAP to PLAN as the MAP/PLAN button is pressed. The MAP format allows totally independent use of the MFD display for navigation mapping and allows increasing the maximum range, beyond normal radar range, on the display which normally serves as the radar indicator. Power up mode is the MAP mode. To add weather to the display, press the WX button on the MFD controller.

The MAP format is always oriented to the airplane heading and the airplane symbol is located at the center of the display. When coupled to the FMS, the NAV route, with up to ten waypoints, can be displayed to the range limit. When weather returns are selected, range control defaults to the WC-650/WC-660 Weather Radar Controller.

PLAN Mode

In PLAN mode the top of the display is oriented to North; a three-inch range ring is displayed and centered horizontally on the display area. An aircraft symbol is plotted at present position (if present position is on the display) and is oriented with respect to heading. The PLAN mode display encompasses 360°. Weather radar returns cannot be presented in the PLAN mode.

Traffic Collision Avoidance System (TCAS I) (Optional)

The TCAS mode allows the TCAS window to be displayed when TCAS is installed in the airplane. If TCAS I is installed TCAS traffic advisories will be displayed on the PFD; the TCAS display is selected by the TCAS button found to the right of the MAP/PLAN button on the display controller. The button operates as a "push-on, push-off" switch for the display, which will appear at the lower part of the MFD display. The TCAS display is the same field that is used for the checklist display, with the checklist having higher priority. TCAS traffic displays will not overlay the normal flight plan display information. The TCAS window will display a 2-mile ring made up of twelve small circles, and an outer ring up to 25-mile range display, at which time the 2-mile ring will be replaced with a half-mile ring. TCAS mode annunciations are displayed in the upper left corner of the TCAS window.

Weather (WX) Mode

The WX mode allows the MFD display to be used as a weather radar indicator. In WX mode, weather data is presented on the MFD and is superimposed upon the normal navigation display. Weather radar can only be selected for display on the MFD if MAP mode is selected. If the MFD is in PLAN mode, selection of WX mode will force the display into MAP mode. Range selection is controlled by the weather radar control on the center pedestal. When the WX button is toggled, the progression of selection is: WX on - WX off. Annunciation of weather mode annunciations, warnings, and antenna tilt angle are provided at the lower middle left of the MFD display. Annunciations are color coded in magenta, green, and amber according to the importance of the display. Operation of the weather radar with the weather radar control is discussed in this section. The MFD has a dedicated box in the lower left corner of the display, with five lines of display which include related WX mode annunciations plus antenna tilt angle and stabilization annunciation.

Checklist Mode

The NORM button on the MC-800 provides entry into the normal checklist display function. The normal checklists are arranged in the order of standard flight operations. Button actuations cause presentation of the normal checklist index page that contains the lowest order incomplete and unskipped checklist with the active selection at that checklist.

The RCL, SKP, PAG, and ENT buttons and the joystick on the MC-800 provide control of this function and are discussed under "Controls" below.

The EMER button on the MC-800 provides entry into the emergency checklist display function. Actuation of EMER results in the presentation of the first page of the emergency checklist index with the active selection at the first checklist. The RCL, SKP, PAG, and ENT buttons and the joystick provide control of this function and are described in "Controls" below. These controls perform as described for NORM with the exception of the action taken upon completion of the checklist. All checklist items are removed from the page and "EMERGENCY PROCEDURE COMPLETE" is written below the amber checklist title. This will be cleared when the index is selected. The SKP, PAG and ENT buttons will be inoperative.

EFIS Backup Modes

In case of a symbol generator (SG) failure, the side having the failure may be selected to the opposite side SG. If SG1 is selected, it means that the pilot's symbol generator in his IC-600 is driving all three PFD displays. SG2 means the symbol generator in the copilot's IC-600 is driving all three PFD displays. In these cases the MFD will be normal and both PFD displays will have the same format. The multifunction display (MFD) has no complete symbol generator function of its own and its symbol generator is therefore not selectable. The MFD operates from IC-600 number one.

MFD Controls

Dim — This knob controls overall MFD CRT dimming in addition to the automatic dimming feature accomplished by CRT mounted photodiodes. Counterclockwise dims display. The WX display is dimmed at the same time.

Joystick — The function of the joystick depends upon the type of MFD display:

MAP or PLAN: Moves the designator in the directions shown.

TEXT:

a. Vertical actuations of the joystick act as a cursor control by changing the active line. This provides an additional means of skipping lines or returning to a previously skipped line.

b. Horizontal actuations of the joystick control paging. Actuation to the right increases the page number, and actuation to the left decreases the page number.

MAP/PLAN — Pressing the MAP/PLAN button selects the MAP MFD display mode. Pressing it again selects North-up PLAN mode.

WX

Weather radar data may be displayed with the MAP mode. The toggling sequence of this button is: WX on WX off. If PLAN mode is selected, selection of MAP mode will be forced when WX mode is selected.

VOR

This button is used to display the four closest VORs, that are not on the active flight plan list, on the MFD MAP and PLAN displays. The first push of the button inserts the VORs with identifications. The second push removes the identification, and the third push removes the VORs from the display.

APT

The APT button is used to display the four closest airports, that are not on the active flight plan list, to the MFD MAP and PLAN displays. The first push of the APT button adds the airports with their identifiers. The next push of the button removes the airport identifiers . A third push of the button removes the airports from the MFD display.

DAT

This button is used to add long range NAV information to the MFD MAP and PLAN displays. The first push adds waypoint identifications and the second push removes them.

Range Controls

The MFD range controls are active only when WX is not selected for display.

(INC and DEC)

Selectable ranges are 2.5, 5, 12.5, 25, 50, 100, 200, 300, and 600 NM. The switch position labeled INC increases the selected range, and the DEC decreases the selected range.

NORM

When this button is pressed, the MFD will display the index page containing the lowest numbered uncompleted or unskipped checklist with the active line at that checklist.

While operating in this mode, as a checklist is completed, the system will automatically step to the next uncompleted procedure of the index.

EMER

Actuation results in the display of the first page of the emergency checklist index.

RCL

The function of this button depends upon the type of MFD display:

MAP or PLAN:

Recalls the designator to its home position, or if the is the designator is at its home position, it moves it to present position.

TEXT:

Recalls the lowest numbered skipped line in a checklist by changing the active page and/or line.

(Continued Next Page)

MFD Controls (Continued)

SKP — The function of this button depends upon the type of MFD display:

- MAP or PLAN: Skips the designator to the next waypoint. If the designator is not at the home position, the displacement line will be moved to the next waypoint.
- TEXT: Actuation skips the active line in a checklist or index and advances the active selection to the subsequent line. If the line skipped is the last line, the active selection will revert to the lowest numbered skipped line.

PAG — Actuation advances the page count and places the active line selection at the first line of the page. Actuation with the last page displayed will result in display of the lowest numbered page containing a skipped line with the active line selection at the lowest numbered skipped line.

ENT — The function of this button depends upon the type of MFD display:

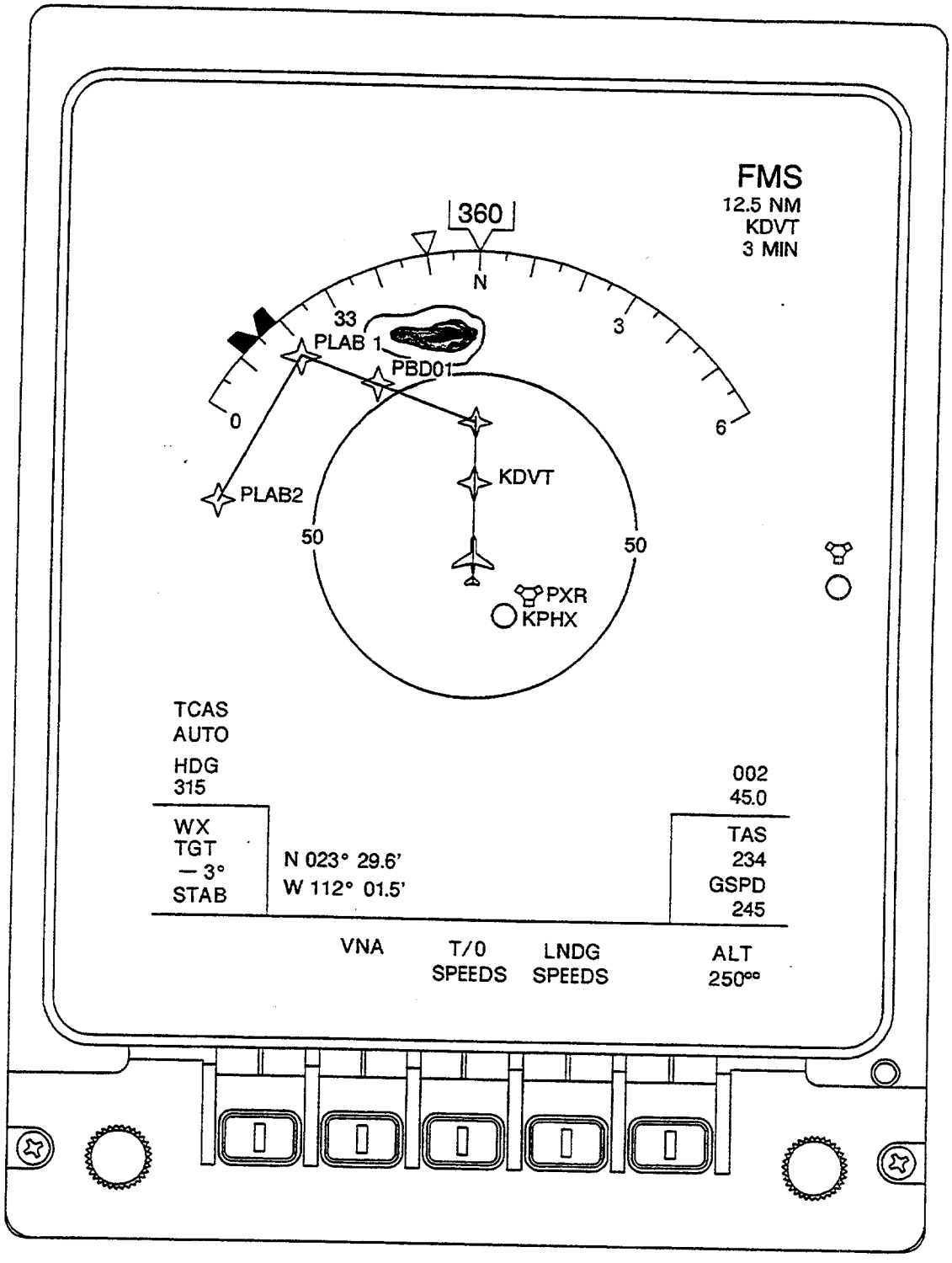
- MAP or PLAN: With the designator moved from its home position, actuation of these buttons will enter the designator LAT/LON as a waypoint in place of the TO waypoint.
- TEXT: Actuation checks off a line in a checklist or selects an index line item for display.

Auxiliary EFIS Annunciators

Indications in Upper Left of the Multifunction display

IC-1 HOT	Indicates Pilot IC-600 Display Guidance Computer Overtemperature Condition.
IC-2 HOT	Indicates Copilot IC-600 Display Guidance Computer Overtemperature Condition.
IC-1-2 HOT	Indicates Overtemperature Condition of Both IC-600 Display Guidance Computers.
IC-1 FAN	Indicates Failure of Pilot's IC-600 Cooling Fan.
IC-2 FAN	Indicates Failure of Copilot's IC-600 Cooling Fan.
IC-1-2 FAN	Indicates Failure of Both Pilot's and Copilot's IC-600 Cooling Fans.
CHK PFD1	IC-600 Display Guidance Computer Detects a Wrap-around Failure in PFD 1.
CHK PFD2	IC-600 Display Guidance Computer Detects a Wrap-around Failure in PFD 2.
CHK PFD1-2	IC-600 Display Guidance Computers Detect a Wrap-around Failure in Both PFDs.

MULTIFUNCTION DISPLAY (TYPICAL)



6585C1001

MAP MODE WITH WEATHER DISPLAYED

Figure 3-25

MFD Bezel Button Menus

VNAV

Five buttons are located on the bezel of the multifunction display (MFD), along with two rotary knobs. The function of each bezel button normally changes with each MFD menu (the MFD has a total of four different menus: the top which allows selection of any of three submenus; the VNAV submenu; the takeoff speed submenu; and the landing speed submenu. For each menu, the function of each button is displayed directly above it at the bottom of the MFD display. The left rotary knob is used to enter/change values for the item presently selected by the bezel buttons in each submenu (but has no function with the top menu), while the right knob is dedicated full-time to the altitude preselect.

Primus 1000 system VNAV programming requires definition of certain values, all of which are defined using the VNAV submenu page on the MFD. These submenu buttons control the VNAV function in the Primus 1000 flight control system, They do not interface with the VNAV profiles which can be flown with the installed flight management system (FMS). Once the submenu is selected by pressing the VNAV button the values can be set for TO distance, station elevation (ST EL), vertical angle (VANG), vertical speed (VS), and altitude (ALT). Once the pilot has entered the necessary data, a display of predicted vertical speed (not adjustable by the pilot) will be displayed until the VNAV mode is captured. All VNAV menu parameters will have amber dashes displayed until the VNAV problem has been defined by the crew. The fifth button on the bezel (RTN, annunciated when top menu not selected) provides a means to return to the top menu. The FMS system VNAV function is advisory only, and does not interface with the autopilot/flight director.

Takeoff Speed reference

This submenu is used to set three different airspeed references (V_1, V_R, V_2) which will be displayed as reference bugs on the airspeed tapes, for both primary flight displays (PFDs). When this submenu is first selected each airspeed will have cyan dashes displayed. As each reference is selected using the bezel buttons, each will have a minimum value displayed as a starting point. V_1 (labeled 1 on the airspeed tape) has a minimum value of 40 knots when first selected. V_R (bug labeled R) starts at 40 knots unless V_1 has already been set, in which case its minimum becomes the set value for V_1. V_2 (labeled 2) is 40 knots or V_R, whichever is greater. Each entered airspeed is displayed both at the bottom of the airspeed tape while airspeed is under 40 knots, and as a bug on the right side of the airspeed tape. All the takeoff airspeed reference bugs are automatically removed from the PFD airspeed tapes when the airplane exceeds 230 knots. One button is again dedicated to the return function to get back to the top menu.

Landing Speed Reference

The crew can select two different airspeed references (V_{REF} and V_{APP}) in this submenu. They are displayed as bugs on the PFD airspeed tapes, similar to the takeoff reference bugs. V_{REF}, whose bug is labeled RF on the airspeed tape, has an automatic minimum value of 40 knots when it is first selected for adjustment on the submenu. V_{APP}, labeled AP on the airspeed tape, has an automatic minimum value of 40 knots, or V_{REF}, If V_{REF} has a value defined. Another button returns the display to the top menu.

Left Knob

The left knob on the bezel of the MFD is dedicated to setting numerical values which have been selected by means of the above described bezel buttons.

ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI)

The electronic attitude director indicator (EADI) and the electronic horizontal situation indicator (EHSI) are both presented on the primary flight display (PFD). Certain displays form a permanent part of the electronic attitude director indicator (EADI) portion of the Primary Flight Display (PFD). The displays are: the blue and brown sphere, the pitch and roll attitude reference marks, the airplane symbol, and the inclinometer which is fixed to the lower part of the PFD. Some annunciations which are presented in the EADI display are annunciations for other systems which are discussed under the headings of those systems, since they are not associated with EADI information. The flight director command bars will be in view on power up unless there is no lateral mode selected. The single-cue flight director presentation is the power-up mode.

Other displays are present when selected or during certain phases of a flight. When not in use, the displays are removed from view. These displays are listed below.

Electronic Attitude Director Indicator (EADI) Displays:

Radio Altitude - When at an altitude within operational range of the radio altimeter, the radio altitude display appears in green in the lower section of the EADI sphere. The radio altitude (RA) is a three-digit display identified "RA" (white) (a radio altitude decision height) in the lower center-right side of the EADI presentation. The value of the radio altitude is identified in blue numbers. It is set by rotating the RA set knob on the DC-550 display controller. Full counterclockwise rotation removes the display from view. A radio altitude (decision height) annunciation (MIN in amber inside a white box) appears in the lower left center of the EADI display at radio altitudes less than or equal to the selected setting and flashes for ten seconds. The MIN decision height will not be annunciated until it is armed. Arming occurs when the "weight on wheels" switch senses "in air" and a radio altitude of 100 feet greater than the selected altitude for at least five seconds. Radio altitude will be displayed digitally in the center of the electronic attitude director indicator when the airplane is at an altitude of 2500 feet or less, and the radio altimeter has not been selected off on the RA knob.

Flight Director Mode Annunciators - Armed mode annunciations appear in white at the top left (lateral modes) and the top right (vertical modes) of the EADI presentation. Captured mode annunciations appear in green. When a mode is not selected, the annunciation is not present. As a mode transitions from armed to captured, a white box is drawn around the annunciation for five seconds.

Marker Beacon - Marker beacon information appears below the glideslope indicator when ILS is tuned. A white box, in which the appropriate letter will flash when a marker beacon is passed, will be located in that position when a localizer frequency is tuned on the NAV control. Outer marker is identified with a blue "O", middle marker by an amber "M" and inner marker by a white "I". Aural identification may be selected on the audio control panel.

Electronic Attitude Director Indicator (EADI) Displays (Continued)

Comparison Monitors - Amber radio altitude comparison monitor warnings (RA), attitude comparison monitor warnings (ROL, PIT, ATT), and localizer and glideslope comparison monitor warning (LOC and GS) are located at the lower left side of the attitude display. Parameters for the illumination of comparator warnings are discussed under Comparison Monitor, below.

Category Two Approach - (Not Approved) CAT2 (green), annunciated at the upper right of the EADI presentation, indicates that category two approach parameters have been met and the excessive deviation monitor has been enabled. A green category two approach window will be displayed around the center of the glide slope indicator. After a CAT2 condition has been established, if any one of several conditions should go invalid (except for autopilot engaged) the green CAT2 annunciator will be replaced by a flashing CAT2 amber legend, which will flash for ten seconds and then go steady. The CAT2 annunciation will be removed if the radio altitude goes below 80 feet, the flight director senses a go-around capture, the indicated airspeed goes below 50 knots.

Low Altitude Awareness - A "Low altitude awareness" indication of a solid brown raster band will appear on the altitude tape as the radio altitude drops below 550 feet. When the airplane is on the ground the brown band will cover the lower half of the altitude tape. A yellow line will be drawn at the intersection of the brown and grey band of the altitude tape. There will be no written information displayed in the brown raster tape.

Glideslope/Vertical Path - When an ILS frequency is tuned, glideslope information will appear. Indication is conventional in appearance. Green color of the vertical scale pointer identifies the information as glide slope information. When tuned to other than an ILS frequency, the glideslope disappears. When the Primus 1000 VNAV is being used for vertical navigation, VNAV will be displayed above the glideslope pointer; the VNAV can be coupled to the autopilot/flight director which will follow the vertical navigation information developed by the VNAV computer. When FMS is selected,and a VNAV problem has been defined on the FMS, VNAV vertical path data will be displayed; the pointer will be magenta and VTA (vertical Track Alert) will be displayed above the FMS annunciation at the upper right of the vertical path indicator. The FMS VNAV function does not couple to the autopilot, and is advisory only.

NOTE

When the back course (BC) mode is selected on the flight director (BC button depressed on the mode selector) the glide slope indication will be locked out and will not be present.

(Continued Next Page)

PRIMARY FLIGHT DISPLAY

6585M6129

Figure 3-26

Electronic Attitude Director Indicator (EADI) Displays (Continued)

Vertical Track Alert - When the Primus 1000 VNAV function is selected, a cyan VNV will be displayed at the glideslope/vertical path annunciation. A vertical track alert message (VTA) will be displayed in amber above the glideslope/vertical path annunciation when VNAV function of FMS is selected for display. A white FMS will also be annunciated above the vertical deviation scale.

(Continued Next Page)

Electronic Attitude Director Indicator (EADI) Displays (Continued)

Vertical Navigation Display - When VNAV mode is selected on the mode selector panel and NAV or FMS is selected on the display controller as a navigation source, the vertical navigation display comes into view. The magenta (FMS) or green (VORTAC) pointer indicates the center of the computed climb or descent angle.

Flight Director Command Cue - The magenta flight director command cues can be selected in single cue or cross pointer format by pressing the SC/CP button on the DC-550 display controller. In the single cue format, if a lateral mode is not selected, the command bars will remain biased out of view. Power up default selection is single cue. European certified airplanes do not have the double cue selection.

Source Annunciations - Source annunciations (ADC1 and ADC2, ATT1 and ATT2, SG1 and SG2) will be displayed to indicate the sources of air data, attitude and symbol generator information, respectively. If the pilot and copilot are using their normal sources, there is no source annunciated. "Cross-selections" will be annunciated in white, and when both displays are selected to the same source the annunciation will be in amber, to remind the pilots of the single source selection. Annunciation is in the upper left section of the EADI display.

Flight Director Couple Arrow - The green flight director couple arrow is positioned at the top, center of the PFD. The arrow is left pointing or right pointing to indicate which flight director the autopilot is coupled to. (This display is always present.)

Comparison Monitor

Selected pilot and copilot input data are compared in the symbol generator. If the difference between the data exceeds predetermined levels, the out-of-tolerance symbol will be displayed in amber. A list of the compared signals and the displayed cautionary symbols is given below. When the compared pitch and roll attitude or glideslope and localizer signals are out of tolerance, a combined level (ATT or ILS) will be displayed.

Compared Parameter	Annunciation	Triggering Difference
1. Pitch Attitude	"PIT"	5°
2. Roll Attitude	"ROL"	6°
3. Heading	"HDG" *	6° (12° if > 6° of roll)
4. Localizer	"LOC"**	Approximately $\frac{1}{2}$ dot
5. Glideslope	"GS"**	Approximately $\frac{3}{4}$ dot
6. Pitch and Roll Attitude	"ATT"	5° & 6° respectively
7. Localizer and Glideslope	"ILS"**	$\frac{1}{2}$ & $\frac{3}{4}$ dot respectively
8. Indicated Airspeed	"IAS"***	5 Knots
9. Altitude	"ALT"***	200 Feet

* If the compared heading sources are not the same (both MAG or TRU) the comparison monitor is disabled.

** These comparisons are only active during flight director, localizer, and glideslope capture with both NAV receivers tuned to a LOC frequency.

*** Airspeed and altitude displays will flash for ten seconds and then go steady.

NOTE

Extended turns at low bank angles (<5°) may result in pitch and/or roll miscompare.

Excessive Attitude Displays

Excessive attitude displays occur when the airplane exceeds 65° of roll attitude and/or pitch exceeds 30° nose up or 20° nose down. The display is "decluttered" to assist in recovery from the undesired attitude. Excessive pitch chevrons are displayed and much of the symbology not necessary for the immediate control of the airplane is removed from the display. When the airplane returns to an attitude of less than 63° of roll, less than 28° nose up, or less than 18° nose down, the minimum altitude annunciator and the box symbols will be restored. As the airplane assumes a normal attitude the rest of the removed symbology will be further restored.

EADI CAUTION OR FAILURE ANNUNCIATIONS

Flight Director Failure - If the flight director fails, the flight director command bars disappear and an amber FD FAIL warning appears in the top left center of the display. All FD mode annunciators will be removed.

Internal Failures - A large red X will cover the face of the primary flight display.

Radio Altimeter Failure - If the radio altimeter fails, the radio altitude readout will be replaced by an amber RA. If the low altitude awareness indication is present, it will be removed.

Pointer/Scale Failures Glide Slope (Vertical Deviation),Altitude, Airspeed, and Vertical Speed - Failure of pointers/scales is indicated by: Replacing the digital readouts with dashes, drawing a red X through the scale (IAS, ALT, GS only), and removing the pointer (GS and VS only).

Attitude Failure - Attitude failure is annunciated by appearance of ATT FAIL in red in the middle of the attitude sphere. The sphere will change to solid blue, and the pitch scale and roll pointer will disappear.

ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)

The displays in the EHSI portion of the PFD are discussed below in three categories: FULL TIME which are always present, PART TIME which are sometimes present, and the arc mode.

Full Time Displays

Certain displays are always present on the EHSI or are always present when certain navigation equipment is in operation. The airplane symbol is always present and provides a quick visual cue of airplane position relative to a selected course or heading.

The other full time displays are discussed serially below. The angular presentations are all similar to those seen on a mechanical HSI.

Heading Dial and Digital Heading Readout - Heading information is presented on standard type compass dial format and digital heading readout is shown in green above the heading dial when in the ARC mode.

Heading Select Bug and Heading Select Readout - The heading bug is positioned around a compass dial with HDG knob on the remote instrument controller. The bug then retains its position in relation to the dial. A digital heading select readout is provided at the lower left of the display (cyan digits, white HDG label). The heading bug provides a heading error signal to the flight director.

Course Deviation Indicator - Navigation or localizer course. Course deviation and airplane position relationships are depicted as on a mechanical HSI instrument. The course deviation indicator also operates in conjunction with the long range NAV system. Refer to Part Time Displays, below, for Desired Track information. The CDI is positioned by the course knob on the remote instrument controller. The course knob is not functional when FMS mode is selected. The CDI is magenta when FMS course information is presented, green when on-side NAV information is being presented, and yellow when off-side NAV information is being presented.

TO/FROM Annunciator - Indicator points along selected course depicting whether the course will generally take the airplane to or from the selected station or waypoint. Indicator does not appear during localizer operation.

Distance Display - Located in the upper right of the HSI. Indicates nautical miles to selected station or waypoint. Distance display is in 0-512 NM for selection of short range navigation equipment and 0-4095 NM format for long range equipment. DME HOLD is indicated by an amber H next to the readout.

Navigation Source Annunciators - NAV source annunciations are displayed in the upper right corner of the EHSI presentation. Long range sources are in magenta and short range sources are in green or yellow. A yellow indication means an "offside" selection or that both sources are the same. The label identification will always be white. A yellow annunciation of FMS indicates that both pilots are selected to the FMS.

Heading Source Annunciation - Heading source is annunciated at top left center of the EHSI presentation. A green annunciation indicates a normal selection and yellow indicates an "off-side" selection or that both selections are the same.

Heading SYNC Annunciator - The heading SYNC annunciation is located to the left of the heading source annunciation in the upper left side of the EHSI presentation. The bar in the indicator represents commands to the compass to slew in the indicated direction. Plus indicates an increase in heading and zero indicates a reduction in heading. Slow oscillation indicates normal operation.

Part Time Displays

Part time displays are present when selected on the display controller or the flight director mode selector panel. The mode and bearing pointers available depend upon optional equipment installed and may not be present in all installations. Some annunciations also concern other systems, which will be discussed under headings pertaining to those systems.

Bearing Pointer and Source Annunciation - The bearing pointers indicate relative bearing to the selected navaid and can be selected as desired on the display controller. Bearing pointers appear on the compass rose when they are selected by means of the knobs on the display controller, and the bearing pointer source annunciations are in the lower left of the EHSI display. If NAV source is invalid or LOC frequency is tuned, the NAV bearing pointer and the annunciation will disappear. The "O" bearing pointer is always NAV 1, ADF 1, or FMS (FMS 1, if two FMSs are installed). The "◇" bearing pointer is always NAV 2, ADF 2 (if installed) or FMS 2 (if installed).

Elapsed Time Annunciation - Shows elapsed time in hours and minutes or minutes and seconds. Selection is made on display controller.

Time-to-Go and Ground Speed - Pressing the GS/TTG button on the display controller alternates time-to-go (to next waypoint or navaid) and ground speed displays.

Desired Track - When long range navigation is selected, the course pointer becomes a desired track pointer. The long range nav system will position the desired track pointer. A desired track (DTRK) digital display will appear in the upper left corner of the EHSI display. When FMS is selected, the course selection knob on the remote instrument controller is inactive.

NAV Source Annunciation - Appears in the upper right side on the EHSI presentation when a NAV (NAV), ILS (ILS), or FMS (FMS) source is selected as a navigation source. Distance to next waypoint or to selected VORTAC appears below the annunciation. Annunciated source will be displayed on the EHSI course deviation indicator (CDI).

Wind Display - The wind display (magenta direction and arrow) is located at the lower left-center of the display when FMS is selected for navigation.

Weather Radar Modes - Along the left top side of the EHSI display are the displays of the weather radar modes. These modes and displays are discussed under Weather Radar in this section.

Arc Mode (Partial Compass Format)

During operation in the arc (WX) mode, additional presentations are available which enhance navigation and safety of flight. Pressing the HSI button on the display controller toggles the display between the full and partial compass display. Additional features presented in partial display are:

Range Rings - Display of the range rings aids in the use of radar returns when (WX) mode is selected. Center half-range ring represents the selected radar range. Range is controlled by the weather radar controller.

Weather - Weather radar returns are displayed on the EHSI when WX mode (HSI button pressed) is selected on the display controller. WX mode forces the PFD into arc display if it was not already selected. Radar mode annunciations are presented on the upper left side of the EHSI presentation and on the lower left side of the multifunction display (MFD).

EHSI Caution or Failure Annunciations

Amber caution annunciations will appear to indicate the following situations:

DME Hold - When the DME is selected to HOLD, an amber H will appear to the left of the DME readout on the EHSI.

FMS Alert Messages - Waypoint (WPT), GPS integrity GPS), dead reckoning (DR), or Degrade (DGR) messages appear in amber at the upper center-left of the EHSI presentation to indicate, respectively, that a waypoint is being passed, the FMS is in dead reckoning, or the FMS navigation has become degraded for any of various reasons. MSG annunciated in amber at the top center-right of the EHSI display indicates that the FMS has a message on the FMS CDU.

Digital Display Cautions - When DME, ground speed (GSPD), time-to-go (TTG), or elapsed time (ET), digital readouts fail, the digital display will be replaced by dashes.

Target Alerts - An amber TGT on the left of the EHSI indicates weather radar target alert. A green TGT annunciation indicates that target mode has been enabled on the weather radar. An amber annunciation means that a level three weather return has been detected.

Digital Readouts - Failure of the course or heading select signals will cause these displays to be replaced by amber dashes. They are also dashed when the heading display is invalid.

Heading Source and Navigation Source - When both the pilot and copilot select the same heading source or NAV source, the source annunciators will be yellow. If the NAV or heading sources are cross-switched, i.e., pilot to copilot and vice versa, the annunciation will also be in yellow. All NAV information will be displayed in yellow as well. Normal selections are not annunciated.

Heading Comparator Warning - HDG annunciated in amber at the top center-left of the EHSI display indicates that the comparator system has detected an excessive difference between the two heading indicators.

Red failure annunciations will appear in the following instances and locations:

Heading Failure - A heading failure will result in the following indications: heading and bearing annunciations and bearing pointers will disappear; HDG FAIL appears at top of heading dial. HDG, CRS SEL, and DTRK will dash.

Deviation Indicator Failures - A failure in the vertical deviation, course deviation, or glideslope system will result in removal of the applicable pointer and a red X being drawn through the scale.

Vertical Speed Display - A red X will be drawn through the scale.

Navigation Indicator Failures A red X will be drawn through the scale of the bearing pointer of the selected failed equipment.

EFIS Equipment Failure Checklist

Failure of equipment feeding information to EFIS will be annunciated by flags or dashes. Failure effects of EFIS equipment are listed below.

FAILURE	ANNUNCIATION	FLIGHT DIRECTOR	PILOT ACTION
Symbol Generator Failure	Red **X** on PFD or display blank	All modes cancel	Select opposite symbol generator on MFD display controller to drive all displays.
Display Controller Failure	Display cannot be changed	N/A	Select opposite symbol generator on MFD display controller to drive all displays.
Display Failure	Display goes blank	None	Revert display to the MFD display. (Refer to NOTE below).
Heading Failure (DC)	Red HDG FAIL on EHSI, map, bearing pointers etc. removed	Command Bars out of view	Select opposite heading gyro by pressing appropriate HDG REV button.
Heading Failure (AC)	HDG flashes in amber on EHSI and heading searches	Command bars search	Select opposite heading gyro by pressing appropriate HDG REV button.
Attitude Failure	ATT FAIL annunciation; No pitch scale or roll pointer, sphere all blue	None	Select opposite vertical gyro by pressing appropriate ATT REV button.
Course Deviation Failure	Red **X** through scale and course deviation pointer removed	Command bars, CDI pointer and applicable bearing pointer off	Revert display to the MFD display. (Refer to NOTE).
Flight Director Failure	FD FAIL on PFD	FD Cues and Mode Annunciations Removed	Select opposite flight director on AP XFER FD1/AP XFER FD2 Switch and select opposite SG on MFD SG1/SG2 switch. Mode and display selections must be made on opposite Mode Selector and Display Controller respectively.

Figure 3-27. EFIS Equipment Failure Checklist

NOTE

Full counterclockwise OFF position of the DIM knob turns off the failed display and selects the respective display to the multifunction display (MFD) tube.

For detailed information concerning operation of the Honeywell Primus 1000 system, consult the Honeywell P-1000 Integrated Flight Control System Pilot's Manual for the Cessna Citation II, P/N AD-432552 Revision NL, or later revision.

PULSE EQUIPMENT

KT-70 TRANSPONDER

The KT-70 Mode S transponder system consists of two panel mounted-units, two external antennas mounted on the left (no. 1) and right (no. 2) sides of the bottom of the airplane nose section, and a control wheel mounted XPDR IDNT switch for each pilot. The transponder receives interrogating pulse signals on 1030 MHz and transmits coded pulse-train replay signals on 1090 MHz. It can reply to Mode A (aircraft identification) and Mode C (altitude reporting) interrogations on a selective reply basis on any of 4096 information code selections. The altitude reporting capability is provided by the mated altimeter (air data computer) to each transponder set. The pilot's air data computer electronically transmits the altitude information to transponder one, and the copilot's air data computer provides like data for the number two transponder. The encoding altimeters are not "switchable" between the two transponders. The transponders have mode S capability, which enables the ground station to individually select the airplane by its preprogrammed aircraft address, which is assigned to the airplane by the FAA. A XPDR 1/XPDR 2 switch, located on the control panel to the left of the two transponder controls, selects which transponder is operating. The non-selected transponder is placed in forced standby mode so that it can be selected at a moment's notice, if required. A landing gear squat switch removes power from the transponder circuit when the airplane is on the ground and disables both mode A and mode C, so that it is not necessary to select SBY on the ground. Refer to Figure 3-9 for an illustration of the transponder control panel.

KT-70 Control Panel

The KT-70 uses a digital readout to display the pilot selected transponder code. The four-digit code is set into the display by four knobs - one for each digit. A photocell on the face of the control automatically dims the display according to ambient cabin light. Power and mode of operation are controlled by the power and mode switch which has OFF, SBY, TST, GND, ON and ALT positions. OFF removes power from the system. SBY applies power to the system for warmup and allows momentary power interruptions which may be desired without having to turn the system OFF. When a transponder is in standby, either because of the SBY position being selected on the power and mode switch or because of the selection on the XPDR 1/XPDR 2 switch, SBY will be annunciated in the center of the digital display. In ON, the transmitter is enabled for normal operation, except that the altitude information of the mode C reply and the altitude fields of the mode S reply are suppressed. ALT position causes transmission of uncorrected barometric altitude (based on a barometric pressure of 29.92, which is supplied by the air data computer) in mode C and mode S interrogations. ON or ALT will be annunciated respectively when either of those selections are made. TST and GND positions are discussed below.

The TST position initiates a system self-test. To test the system, select the desired transponder and turn the selector to TST position. The TST position causes the selected transponder to respond to internal interrogation, verifying memory data and making hardware and squitter checks. The transmitter is disabled. All display segments will illuminate. Should a squitter error occur, the transmitter is considered inoperative and the message "FO 1" will appear in the altitude display. Should a memory error occur, the message "FO 2" (internal) or "FO 3" (external) will appear. Should a hardware failure occur, normal operation is prohibited and the message "FO 4" will appear. If no errors are detected, the unit will remain in the test mode.

GND mode is designed to be used only when the airplane is on the ground. GND position turns the set on and enables the transponder to transmit Mode S reply pulses. The ID 4096 code is shown on the right side of the display with altitude shown on the left side. "GND" is annunciated in the display in this mode. Mode A and C interrogations are inhibited.

An IDT switch (button) is located on the front of each transponder control. These switches perform the same function as the XPDR IDNT switches on the pilots' control wheels. Pressing either button (control wheel or IDT button on active transponder) will cause a distinctive return to appear on a ground controller's radar screen for approximately 30 seconds after the IDENT button is pressed and released. It should not be depressed unless requested by a ground controller.

When the transponder is turned from OFF to any other selection the unit will display the installer programmed aircraft address and maximum airspeed, in three two-second segments, according to a preprogrammed sequence.

The function selector has a PUSH VFR function which may be preprogrammed. Momentarily depressing the function selector knob causes the preprogrammed VFR code to supersede whatever code was previously entered. The ID code will immediately be accepted for interrogation reply sequence. The VFR code is programmed by the following sequence: 1) Place the unit in standby mode (SBY); 2) Select the desired code, (VFR, 1200, for instance); and 3) Depress the VFR pushbutton (function select knob) while holding the IDT button depressed.

If the VFR pushbutton (function select knob) is inadvertently pressed, the previous non-programmed 4096 code may be retrieved by pressing the VFR pushbutton again for three seconds.

The KT-70 transponder has an altitude (FL) display in the left side of the digital readout. It is in hundreds of feet and FL is annunciated to indicate that the display is of a "flight level", which is an altitude which corresponds to an altitude above sea level (above the "standard datum plane") with the altimeter set at 29.92 inches of mercury. It corresponds to the altitude which is being transmitted to air traffic control, and will seldom agree exactly to the indicated altitude on the altimeter. The altitude display will only be active when altitude reporting is enabled in ALT and GND modes.

An "R" reply indicator is also on the digital display. The R will illuminate when the transponder is replying to a valid interrogation by a ground station, and will illuminate for approximately 18 seconds after the initiation of an "ident".

MST-67A TRANSPONDERS (Optional on Airplanes with TCAS II)

NOTE

The Transponders are an integrated part of the TCAS II system. This synopsis covers only the transponder portion of the entire system. For a complete overview of Transponder/TCAS II operation, refer to the TCAS II CAS 67A/81A Pilot's Guide provided with the airplane and Supplement 18 to the Airplane Flight Manual.

The MST-67A Mode S Transponder System is used in conjunction with the AlliedSignal TCAS II installation to provide both transponder and collision avoidance functions. The transponder portion of the system consists of two nose mounted transponders, a cockpit mounted control unit and four fuselage mounted antennas (two upper and two lower).

The transponder receives interrogating pulse signals on 1030 MHz (from either top or bottom antennas) and transmits coded pulse-train replay signals on 1090 MHz (using either top or bottom antennas). It can reply to Mode A (aircraft identification) and Mode C (altitude reporting) interrogations on a selective reply basis on any of 4096 information code selections. The altitude reporting capability is provided by the mated air data computer to each transponder. The transponders have mode S capability, which enables the ground station to individually select the airplane by its preprogrammed aircraft address, which is assigned to the airplane by the FAA. A 1/2 switch, located on the control unit, selects which transponder is operating. The non-selected transponder is placed in forced standby mode so that it can be selected at a moment's notice, if required.

NOTE

Transponders also send (and receive) appropriate information to the TCAS II processor as part of the transponder's TCAS II function. This data is used by the TCAS II processor to access potential threats to the airplane and advise the crew of appropriate responses through aural and/or visual indications.

KFS-578A CONTROL UNIT

The control unit is designed to allow the operator to control both transponders and the TCAS II from a single point. The operating modes for the transponder portion of the control unit are 1/2, TST, SBY, ON and ALT. The control unit is illustration in Figure 3-27A

NOTE

This synopsis covers only the transponder portion of the control unit. For a complete overview of control unit operation, refer to the TCAS II CAS 67A/81A Pilot's Guide provided with the airplane.

(Continued)

KFS-578A CONTROL UNIT (Continued)

The control unit is designed to allow the operator to control both transponders and the TCAS II from a single point. The operating modes for the transponder portion of the control unit are as follows:

1/2	Toggling the switch up or down selects one of two Mode S transponders to be under control of the control unit. The non-selected transponder is placed in standby mode. Either 1 or 2 is annunciated in the display window.
TST	Rotating the function knob to the TST position initiates a comprehensive self-test lasting approximately 12 seconds. All segments of the display are illuminated for two seconds, then the code window will display the encoded altitude for four seconds, then the control unit will return to the previously selected mode. If the transponder determines a failure that will cause the system not to function for air traffic control purposes, the control unit will blink FAIL in the squawk code area of the display. The selected transponder will be placed in the Standby mode and the function knob will be disabled from going clockwise to other modes. TST and SBY will be the only modes allowed. A different transponder must be selected to get air traffic control functions to return.
SBY	Rotating the function knob to the SBY position places transponder power on, but transponder does not transmit or reply to interrogations. SBY is annunciated in the display window.
ON	Rotating the function knob to the ON position activates the transponder without altitude reporting. ON is annunciated in the display window.
ALT	Rotating the function knob to the ALT position activates the altitude reporting feature of the transponder. ALT is annunciated in the display window.
IDT	Pressing the IDT button initiates the IDENT feature for air traffic control purposes.
VFR	Rotating the function knob to the VFR position for more than 3 seconds changes the ATC code to the pre-programmed VFR code (typically 1200). VFR is annunciated in the display window for 3 seconds prior to switching the preprogrammed code.
SQUAWK CODES	Squawk codes are set using a combination of the PUSH FL/inner concentric knob on the right side. First digit is entered by pressing the PUSH FL knob inward and observing the cursor flashing at the first position of the display window. Rotate the inner concentric knob to the desired setting. Pressing the PUSH FL knob inward will move the cursor to the second digit, which is also entered by rotating the inner concentric knob. Third and fourth digits are set in the same manner.

KFS 578A CONTROL UNIT

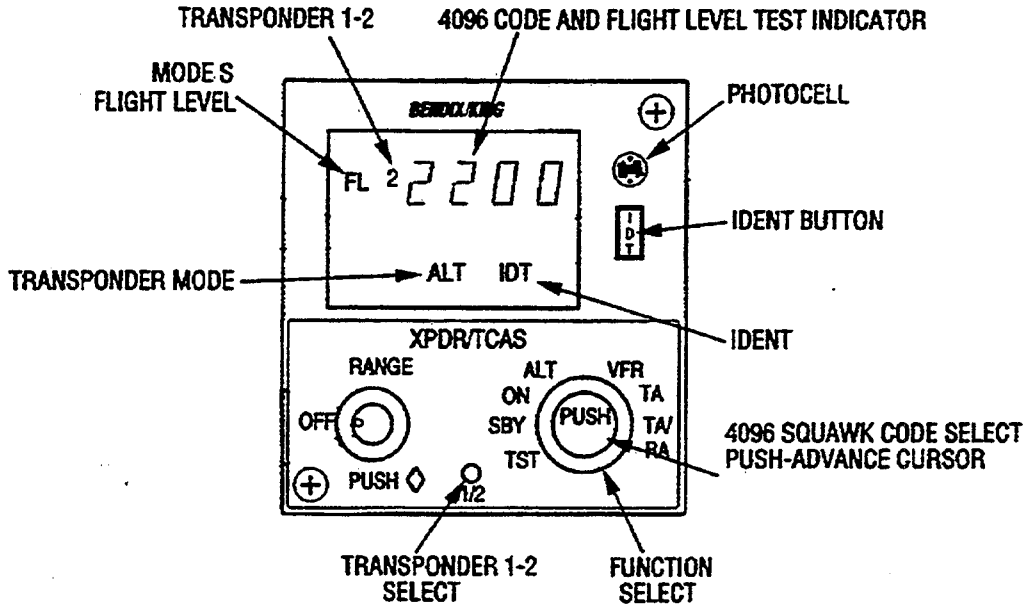


Figure 3-27A

DISTANCE MEASURING EQUIPMENT

DM-441B WITH KDI-572 INDICATORS

The standard DME installation consists of two DM-441B receiver-transmitters, two KDI-572 indicator/controls, and two antennas. The receiver-transmitters are mounted low in the nose avionics compartment, the KDI-572 indicator/controls are mounted on the center instrument panel (pilot's) and the right instrument panel (copilot's). The antennas are mounted on the bottom of the forward fuselage below the cabin, one forward of the other. The DMEs are turned ON and OFF by the ON/OFF/HOLD rotary switch on each indicator/control. Each DME is "hard-wired" to its respective VOR (1 or 2); there is no provision for switching the DMEs except for the HOLD function on the rotary switch.

The DM-441B transmits interrogating pulse pairs between 1025 MHz and 1150 MHz; it receives associated ground-to-air replies between 962 MHz and 1213 MHz. The KDI-572 digitally displays distances in nautical miles, ground speed in knots, and time-to-station in minutes. All displays are in self-dimming gas discharge numerics.

The VOR/DME tuning is controlled by the KN-53 NAV receiver on the consolidated control panel. When a VOR station is tuned the DME frequency is automatically tuned. The DME ident can be verified by selecting the appropriate DME on the DME selector switch on the audio control panel.

DME information is also displayed on the pilot's EHSI by pressing the NAV button on the DC-550 EFIS display controller. If the pilot selects NAV 1 on the display controller, the DME information displayed on the EHSI will be from NAV 1 (DME 1), and so annunciated (NAV 1) on the EFIS display. If NAV 2 is selected, the selected DME will be DME 2, and NAV 2 will be displayed and annunciated on the EFIS. Pressing the NAV button alternately selects NAV 1 and NAV 2, along with their respective DMEs, for display. If the pilot selects NAV 2 on the EFIS controller and the copilot also has selected NAV 2, the NAV annunciation (VOR 2) will be in amber, to indicate that both NAVs are selected to the same side; VOR 1 annunciates similarly if both sides are selected to to NAV 1. The selected DME presented on the PFD will always be the same as the NAV source (VOR). In case of a "cross-selection", i.e., pilot selects VOR 2 and copilot selects VOR 1, the annunciations will be in white.

KDI-572 INDICATOR

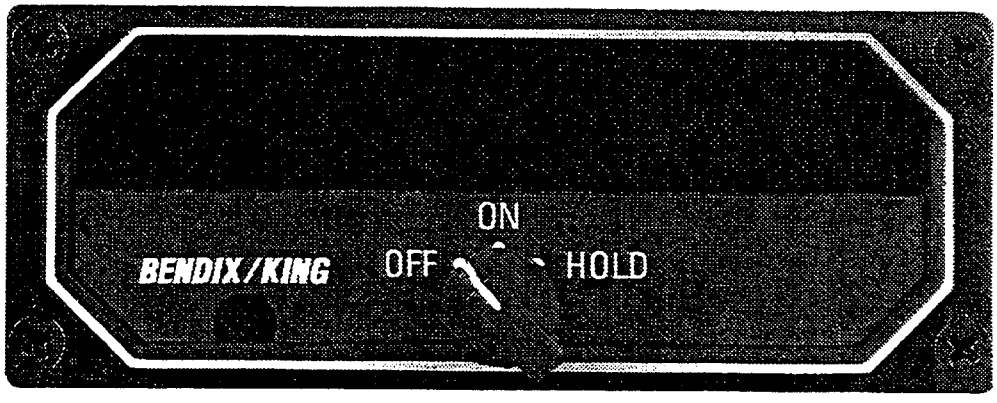


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Figure 3-28

If the pilot desires to retune the KN-53 NAV control but to retain the DME readout of the present station, HOLD is selected by placing the OFF/ON/HOLD switch on the desired indicator/control to HOLD and the receiver retuned; the DME will be held to the previous station even though the bearing will indicate from the new station. "H" will be annunciated in amber to the left of the distance display on the EHSI to indicate the DME frequency and information are being held. "H" will be also annunciated in the KDI-572 display to warn the pilot that the DME is in the hold mode.

Distance Measuring Equipment (DME) ground speed or time to station readouts are only accurate when the airplane is proceeding directly to or from the selected station. Since it is slant range that is computed, ground speed or time to station accuracy increases with distance from the station. The readouts can be considered reasonably close to actual speed or time when distance from the station in miles is equal to or greater than the airplane altitude in thousands of feet.

The distance display on the DME indicator is in 0.1 nautical mile increments up to 99.9 nautical miles, then in increments of one nautical mile to a maximum of 389 nautical miles. The groundspeed display can indicate a maximum range of 999 knots, and the time-to-station indication has a maximum indication of 99 minutes.

RADIO ALTIMETER

COLLINS ALT-55B

The Collins ALT-55B radio altimeter displays radio altitude at all times up to an absolute altitude of 2500 feet. The system becomes operational when the airplane electrical system is powered up and it remains operational throughout the flight. Radio altitude is displayed in green digits in the bottom center of the attitude sphere in the EADI displays,

The altitude display in the EADIs operates from -20 to 2500 feet. Between 200 and 2500 feet, the display is in ten-foot increments. Below 200 feet, it is in 5-foot increments. Above 2500 feet, the display will disappear.

Decision height (or radio altitude [RA]) selection is displayed digitally in the lower right side of the EADI display. The display is altitude followed by RA (XXXRA). It is selected by means of the RA/TST knob on the DC-550 display controller. The EADI radio altitude range is from 0 to 990 feet in 10-foot increments. Full counterclockwise rotation of the RA/TST knob on the DC-550 display controller removes the RA display. A radio altitude (RA) decision height warning horn will sound when the airplane reaches the radio altitude set on the pilot's EADI. The tone will fade as the airplane descends through the altitude.

The radio altitude (RA or decision height) warning horn is controlled only by the RA setting in the pilot's EADI. The copilot's EADI (RA) decision height selection has no effect on the sounding of the RA warning horn. The associated visual displays will be identical to those of the pilot.

When the airplane descends below an altitude of 100 feet above selected RA, a black framed white box appears in the upper left side of the EADI. When the selected radio altitude is reached, an amber MIN appears inside the box. The display flashes for ten seconds and then goes steady.

A "low altitude awareness display", which is a brown strip along the right side of the DU-870 primary flight display, is used as a visual annunciation of the airplane's nearness to the ground. The low altitude awareness display is inside the bottom part of the altitude display and begins to appear when an altitude of less than 550 feet is reached. At touchdown, the low altitude awareness display reaches the horizon line

If radio altimeter information is invalid, the radio altitude and decision height displays will be amber dashes.

Outputs from the radio altimeter system are used to desensitize the flight director and autopilot as the airplane passes 1100 feet AGL with the glideslope engaged during an ILS approach. If the radio altitude is invalid, gain programming becomes a function of nose gear extended, glideslope capture, time, and airspeed.

Functional testing of the radio altimeter system and the EADI display digital readout is accomplished on the ground by depressing the TEST button on the DC-550 Display Controller. The following displays will occur: a radio altitude of 50, +5, -5 feet will be indicated until the button is released, at which time the actual altitude will be displayed. The decision height window displays dashes when the TEST button is held down, and then displays the current set altitude for the remainder of the test. The radio altimeter TEST cannot be accomplished when APR CAP function of the flight director is in operation. A radio altimeter system check will result if the test is accomplished from either the TEST button on the optional conventional indicator or the TEST button on the DC-550 Display Controller, however, the horn check will depend on the DH altitude set on the pilot's EADI display. Testing the radio altimeter system with the TEST button on the DC-550 display controller will also test the EFIS failure flags and annunciators (lamps) in the MS-560 Flight Director Mode Selector.

WEATHER RADAR

PRIMUS 650/660 COLOR WEATHER RADAR

NOTE

The Primus 650 was standard equipment on airplanes -0801 thru -0844. Beginning at -0845 and On, the Primus 660 is offered as standard equipment. Primary differences between the two units are an approximate 6 fold wattage increase on the newer units. Some minor operating differences may not be covered in this synopsis. For complete operating procedures, refer to the appropriate pilot's operating manual provided with the airplane.

WARNING

ON THE PRIMUS 650 SERIES RADAR, THE AREA WITHIN 15 FEET OF AN OPERATING WEATHER RADAR SYSTEM CONSTITUTES A HAZARDOUS AREA. ON THE PRIMUS 660 SERIES RADAR, THE AREA WITHIN 30 FEET OF AN OPERATING WEATHER RADAR SYSTEM CONSTITUTES A HAZARDOUS AREA. DO NOT OPERATE THE RADAR SYSTEM WITHIN 15 FEET (650) OR 30 FEET (660) OF PERSONNEL OR FLAMMABLE OR EXPLOSIVE MATERIAL OR DURING FUELING OPERATIONS. FOR GROUND OPERATION OF A RADAR SYSTEM, POSITION THE AIRPLANE FACING AWAY FROM BUILDINGS OR LARGE METAL STRUCTURES THAT ARE LIKELY TO REFLECT RADAR ENERGY BACK TO THE AIRPLANE.

The Primus 650/660 Color Weather Radar System is an X-band alphanumeric digital radar with display designed for weather location and analysis and for ground mapping. The radar system can also be operated in conjunction with Electronic Flight Instrument Systems (EFIS) and the Multifunction Display (MFD) to provide radar video to the EFIS EHSI display and the MFD. The MFD display serves as the primary indicator for the weather radar display, which is controlled by the WC-650 Remote Radar Controller. The system detects storms along the flight path and gives the pilot a visual indication, in color, of storm intensity. Storm intensity is displayed at five color video levels with black representing weak or no returns and green, yellow, red and magenta showing progressively stronger returns. In ground mapping mode, video levels of increasing reflectivity are displayed as black, cyan, yellow and magenta.

MULTIFUNCTION DISPLAY/PRIMUS 650/660 COLOR RADAR INDICATOR

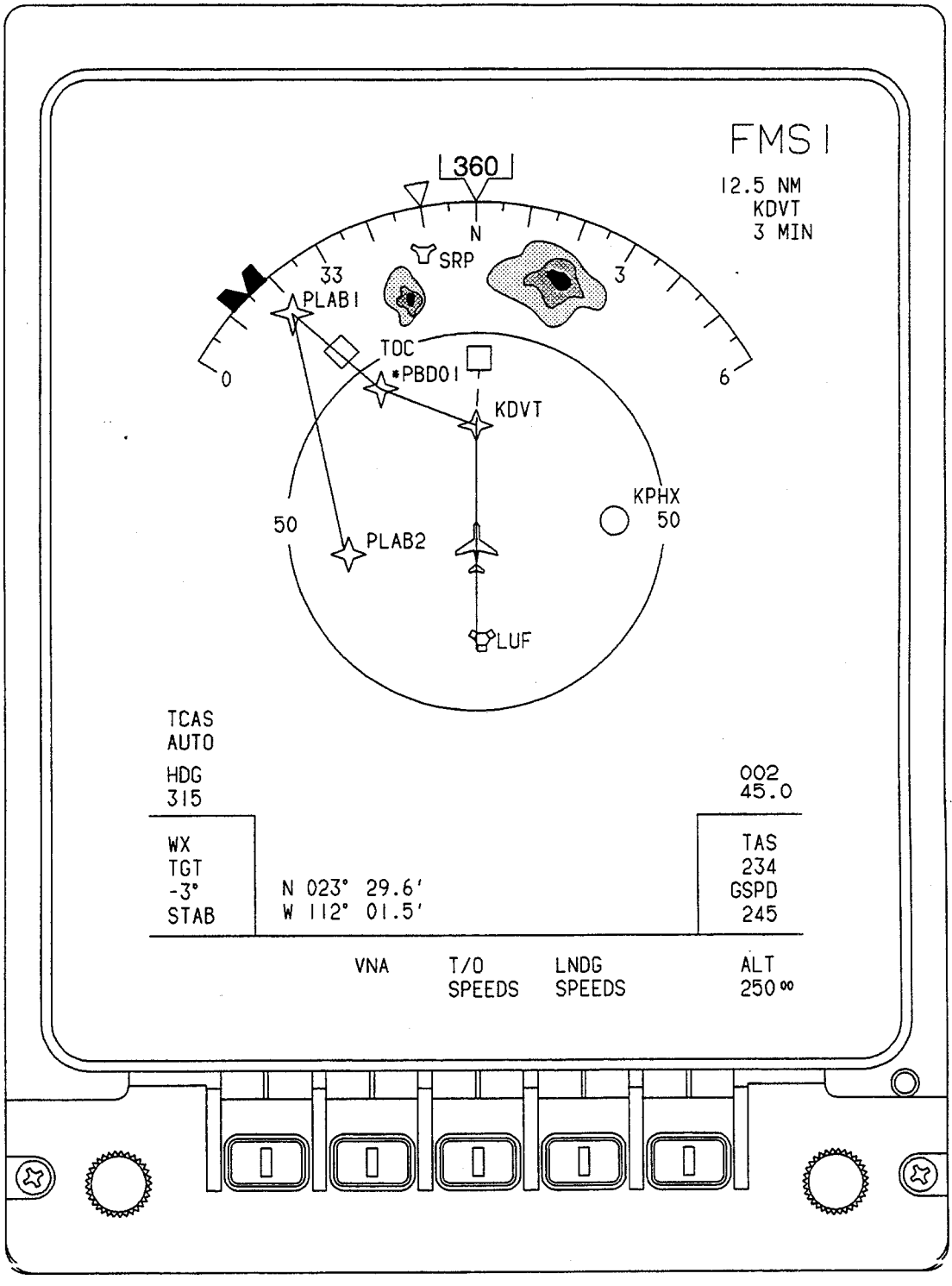

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Figure 3-29

PRIMUS 650/660 COLOR RADAR CONTROLLER

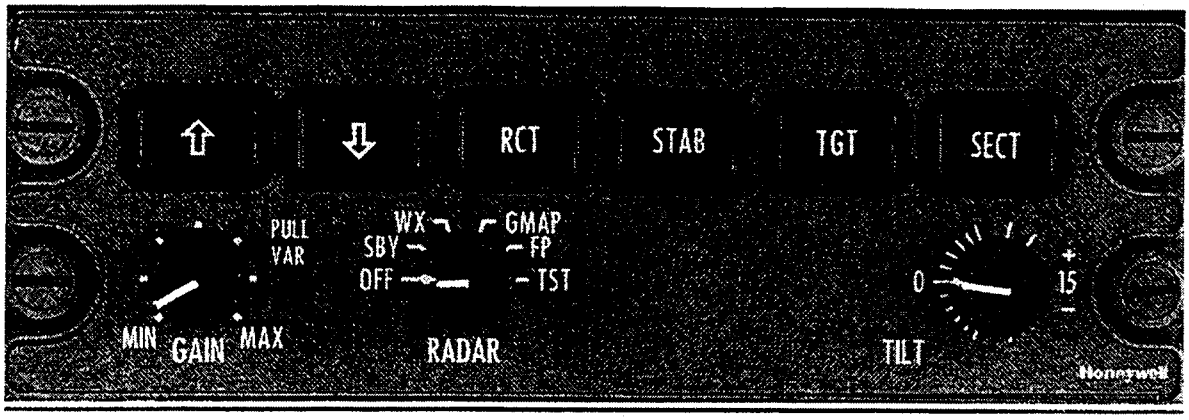

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Figure 3-30

CONTROLS

TILT — Rotary control used to select tilt angle of antenna beam with relation to earth plane. Tilt range is 15 degrees upward to 15 degrees downward.

FULL/WX — On DC-550 EFIS display controller. Two-position rotary switch selects weather or map display on either primary flight display (PFD). WX selects arc mode as well as adds weather to the display.

WX — On MC-800 multifunction display controller. Selects radar weather mode for display on the multifunction display (MFD). If MFD is in PLAN mode, selecting MAP mode will force the display into the MAP mode for weather display.

MODE SWITCH Six-Position Rotary Switch

- OFF — Removes power from the system.
- SBY — Standby. System will warm up but antenna is stowed and transmitter is disabled.
- WX — Places system in the operational mode selected by FULL/WX switch on the DC-550 EFIS display controller.
- GMAP — Places system in ground mapping mode. Ground targets are enhanced. Do not use GMAP for weather detection, because weather type targets are not calibrated in GMAP mode.
- FP — Flight Plan. Provides extended range display of navigational data. No radar data is presented; the system is put into standby mode.
- TEST — Activates the self-test mode and displays a test pattern. Transmitter is on and radiating.

GAIN — Rotary control used to adjust sensitivity of radar receiver. Receiver gain is fixed and calibrated in the PRESET position. Selection of REACT (RCT) overrides the gain control setting causing the receiver gain to be fixed and calibrated.

(Continued Next Page)

CONTROLS (Continued)

RANGE — A two-push button range selection system permits range selection from 5 to 300 nautical miles full scale in the ON mode, or 5 to 1200 nautical miles in the Flight Plan mode. The UP arrow button selects increasing ranges while the DOWN arrow selects decreasing ranges. 100-nautical mile range is presented when system is initially turned on. The last range selected will be remembered when switching between ON and FP. WX range overrides the RNG/INC/DEC switch on the MC-800 multifunction display controller when WX mode is selected on that controller.

RCT — Alternate action pushbutton enables the Rain Echo Attenuation Compensation Technique (REACT) blue background field to indicate ranges at which the receiver calibration has been exceeded. The REACT OFF condition is annunciated above the button.

STAB — Alternate action pushbutton permits disabling the antenna stabilization causing the display to vary with airplane attitude. When disabled, the OFF condition is annunciated above the pushbutton. On 660 Series Radar, pressing the STAB button four times in quick succession will remove the unit from forced standby (FSBY) back to normal operation.

TGT — Alternate action pushbutton enables the target alert function.

SECT — Alternate action pushbutton selects either full azimuth scan angle (120 degrees) or sector scan (60 degrees). Fourteen looks per minute versus 28 looks per minute.

WARNING

THE SYSTEM PERFORMS ONLY THE FUNCTIONS OF WEATHER DETECTION AND GROUND MAPPING. IT SHOULD NOT BE USED OR RELIED UPON FOR PROXIMITY WARNING, ANTI-COLLISION OR TERRAIN AVOIDANCE.

The system consists of a receiver-transmitter-antenna and a remote operating control panel mounted on the center pedestal. The multifunction display controller (MC-800) is also installed at the forward end of the pilot's pedestal. Some functions of the multifunction display interface with the radar; these are also discussed under Electronic Flight Instrument System in this section.

DISPLAY ANNUNCIATIONS

The different mode annunciations shown below in Figure 3-30 are annunciated in the mode field. The mode field is on the lower left side of the PFD display. Below the mode field is the antenna tilt angle display which is preceded by a blank for positive values and a "- " for negative values. Directly below the tilt display are the target mode annunciation or the variable gain indicator. When target mode is selected, a green TGT annunciation appears on this line. When the receiver/transmitter (R/T) detects an alert condition the TGT turns to amber as long as the alert condition persists. Variable gain indication is annunciated by an amber VAR in the same field as the target alert, however, target mode/alert has the higher priority. When full compass mode and WX are turned on, a magenta TX will be displayed in the mode field. Also, if WX is failed and in test mode, an amber FAIL will be displayed in the mode field, and a failure code in the tilt field. If more than one code is associated with the failure, the numbers toggle between different fault codes.

PFD WX RADAR OPERATING MODE ANNUNCIATIONS

OPERATING MODE	FEATURE SELECTED	DISPLAY	
		MODE ANNUNCIATION	"TGT" AREA
WAIT	ANY SELECTION	WAIT (Green)	---
STANDBY	---	STBY (Green)	---
FORCED STANDBY	---	FSBY (Green)	---
TEST	---	TEST (Green) or FAIL (Amber)	---
WX	NONE VAR TGT RCT RCT/TGT	WX (Green) WX (Green) WX (Green) RCT (Green) RCT (Green)	--- VAR (Amber) TGT --- TGT
FLIGHT PLAN	NONE FPLN/TGT	FPLN (Green) FPLN (Green)	--- ---
GMAP	NONE VAR	GMAP (Green) GMAP (Green)	--- VAR (Amber)

Figure 3-31

PRIMUS 870/880 COLOR RADAR

NOTE

The Primus 870 was optional equipment on airplanes -0801 thru -0844. Beginning at -0845 and On, the Primus 880 is offered as optional equipment. Primary differences between the two units are an approximate 6 fold wattage increase on the newer units. Some minor operating differences may not be covered in this synopsis. For complete operating procedures, refer to the appropriate pilot's operating manual provided with the airplane.

WARNING

ON THE PRIMUS 870 SERIES RADAR, THE AREA WITHIN 15 FEET OF AN OPERATING WEATHER RADAR SYSTEM CONSTITUTES A HAZARDOUS AREA. ON THE PRIMUS 880 SERIES RADAR, THE AREA WITHIN 30 FEET OF AN OPERATING WEATHER RADAR SYSTEM CONSTITUTES A HAZARDOUS AREA. DO NOT OPERATE THE RADAR SYSTEM WITHIN 15 FEET (870) OR 30 FEET (880) OF PERSONNEL OR FLAMMABLE OR EXPLOSIVE MATERIAL OR DURING FUELING OPERATIONS. FOR GROUND OPERATION OF A RADAR SYSTEM, POSITION THE AIRPLANE FACING AWAY FROM BUILDINGS OR LARGE METAL STRUCTURES THAT ARE LIKELY TO REFLECT RADAR ENERGY BACK TO THE AIRPLANE.

The Primus 870/880 digital weather radar system is an advanced multicolor radar that provides the pilot with all the traditional weather displays plus the additional function of turbulence detection. A technique of pulse-pair processing is used. The system senses targets of varying rainfall intensity, as well as senses the random motion of raindrops which is caused by the presence of turbulent air currents.

The 870/880 Weather Radar System employs a flat plate antenna which is integrated into a single-unit receiver-transmitter-antenna (RTA) assembly which has the receiver-transmitter unit mounted on the rear of the antenna, with the remaining circuitry mounted in the RTA assembly base. The radar indicator is mounted on the center instrument panel, and in standard installations includes the system controls on the face of it. The multifunction display replaces the traditional radar indicator and the radar is then controlled by a WC-870/WC-880 weather radar controller mounted on the center pedestal. A dual WC-870/WC-880 installation is also available.

The color radar indicator enables the pilot, through the color coded display, to receive current information on cloud formation, thunderstorms, rainfall rate and turbulence. The radar system cannot, however, detect clear air turbulence

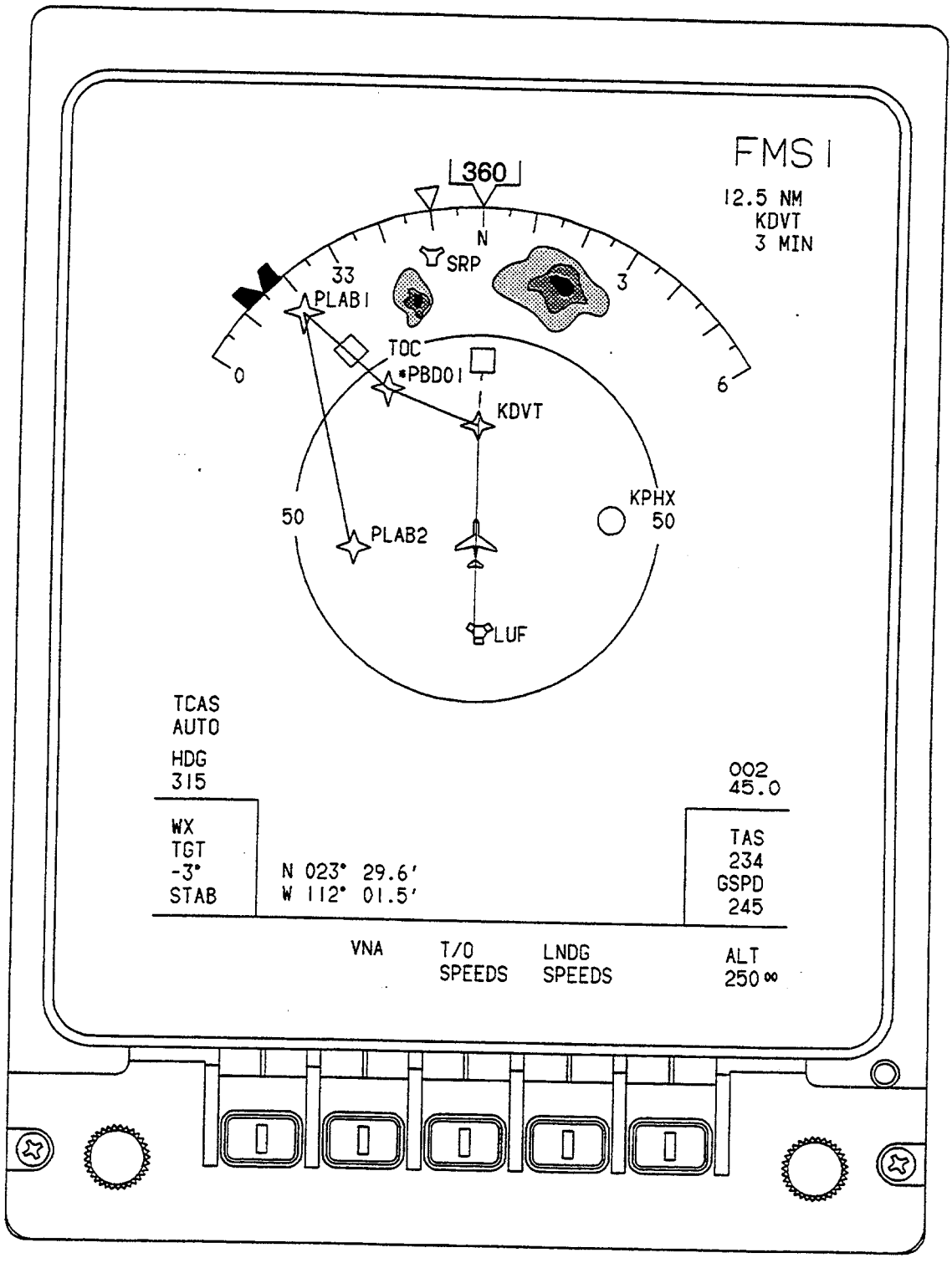
In weather detection mode, target returns are displayed at one of five video levels (0, 1, 2, 3, 4), with 0 being represented by a black screen because of weak or no returns, and levels 1, 2, 3 and 4 being represented by green, yellow, red, and magenta to show progressively stronger returns. Areas of high turbulence are shown in soft white (grey-white). In ground-mapping mode, video levels of increasing reflectivity are displayed as black, cyan (sky blue), yellow, and magenta.

The ground-mapping mode (GMAP) permits display of prominent topographical features such as lakes, bays, islands, shorelines, high ground, cities, etc.

WARNING

THE SYSTEM PERFORMS ONLY THE FUNCTIONS OF WEATHER DETECTION AND GROUND MAPPING. IT SHOULD NOT BE USED OR RELIED UPON FOR PROXIMITY WARNING, ANTI-COLLISION OR TERRAIN AVOIDANCE.

PRIMUS 870/880 COLOR RADAR DISPLAY



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MAP MODE WITH WEATHER DISPLAYED

Figure 3-32

PRIMUS 870/880 COLOR RADAR CONTROLLER

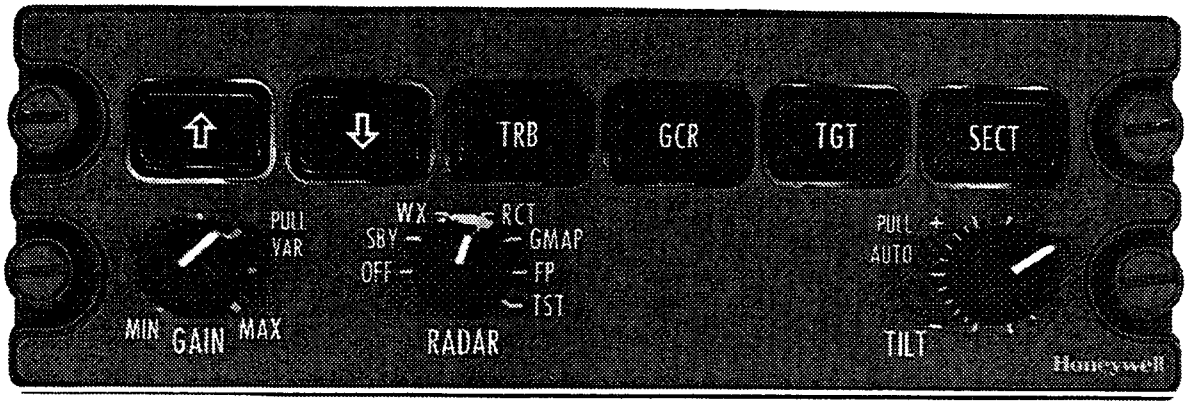

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Figure 3-33

The WC-870/WC-880 controller is used to control the Primus weather radar system display on the multifunction display (MFD). The functions and operations performed by the controller switches are very similar to those performed by conventional switches which would be found on a standard radar indicator. A short description of controller operation and switch functions is included below.

CONTROLS

TILT		Rotary control used to select the tilt angle of antenna beam in relation to the earth plane. Tilt range is between 15 degrees upward (clockwise rotation) and 15 degrees downward (counterclockwise rotation). A digital readout of the antenna angle is displayed on the EFIS.
AUTO TILT (PULL)		Pulling out the tilt control knob places the system into AUTO TILT mode. In this mode the antenna automatically adjusts, based upon inputs received from barometric altitude and selected range. Changes in altitude and range selection will result in antenna tilt changes. The tilt setting can still be controlled to a maximum of plus two or minus two degrees with the tilt control.
RADAR		The RADAR, function switch controls selection of the primary radar modes of operation.
	OFF	Removes power from the system.
	SBY	Places system in Standby. Antenna scan is stopped, the transmitter is inhibited and the display memory erased. "STBY" is displayed in white in the mode field (lower left) of the display.
WX		Select Weather mode for enroute weather detection. "WX" is displayed in white in the mode field of the display.

CONTROLS (Continued)

RCT — Selects REACT (Rain Echo Attenuation Compensation Technique) circuits. REACT compensates for attenuation of the radar signal when it passes through precipitation. When the signal cannot be compensated a cyan (sky blue) field indicates a dangerous area. Any target detected within the cyan field cannot be calibrated and should be considered very dangerous. RCT is available in WX mode only. RCT forces the system to preset gain. "RCT" is displayed in the REACT field of the display, which is located above the mode field.

GMAP — Selects Ground Mapping Mode. Returns from ground targets are enhanced in this mode. As a constant reminder that GMAP is being displayed, the blue GMAP legend is displayed and the color scheme is changed to cyan, yellow, and magenta. Cyan represents the least reflective return, yellow is a moderate return, and magenta is a strong return. GMAP is displayed in white in the mode field of the display.

WARNING

WEATHER TYPE TARGETS ARE NOT CALIBRATED WHEN THE RADAR IS IN GMAP MODE. BECAUSE OF THIS,THE PILOT SHOULD NOT USE THE GMAP MODE FOR WEATHER DETECTION.

FP — Selects Flight Plan Mode. The indicator screen is cleared of radar data and navigation displays may be presented from the flight management system (FMS). Target alert may be used in this mode in order to maintain an alert for potentially dangerous weather. A green "TGT" will be displayed. If a target is detected within 7.5 degrees of dead ahead the TGT annunciator will change to amber. "FLT PLN" is displayed in the mode field.

TST — Selects Radar Test Mode. Displays a test pattern to allow verification of system operation. "TEST" is displayed in the mode field.

WARNING

- **THE TRANSMITTER IS ON AND RADIATING IN TEST MODE.**
- **THE SYSTEM PERFORMS ONLY THE FUNCTIONS OF WEATHER DETECTION OR GROUND MAPPING. IT SHOULD NOT BE RELIED UPON FOR PROXIMITY WARNING OR ANTI-COLLISION PROTECTION.**

FSBY (Not on Control) — FSBY is an automatically selected radar mode which operates when the Weight-on-Wheels squat switch is activated. Antenna scan and transmitter are inhibited. Simultaneously pressing both range buttons will restore normal operation on the 870 Series Radar. On 880 Series Radar, pressing the STAB button four times in quick succession will restore normal operation.

CONTROLS (Continued)

GAIN — When control is pushed in, the receiver gain is preset and calibrated. When pulled out the control manually varies the RTA receiver gain. Minimum gain is set with the control at its fully counterclockwise position. Gain increases as the control is rotated in a clockwise direction from full counterclockwise to the 12:00 o'clock position. At the 12:00 o'clock position both the gain and the sensitivity time control (STC) are at their maximum values. Additional clockwise rotation removes STC. At the fully clockwise position, the gain is at maximum and the STC is at minimum. the full clockwise position produces maximum gain. Selection of RCT (Rain Echo Attenuation compensation Technique), on the RADAR function switch, overrides the variable gain setting, causing the receiver gain to be fixed and calibrated at a preset value. Selection of low gain settings on the variable gain may eliminate hazardous targets from the display.

RANGE — Two momentary-contact switches which permit range selection of from 5 to 300 nautical miles in the ON mode and from 5 to 1000 nautical miles in the FP mode. Activation of the UP arrow increases the range and activation of the DOWN arrow decreases the range. Power-up range is 100 nautical miles. When switching from WX mode to FP mode and back, the system will remember the WX mode range selection.

TRB — Momentary alternate-action pushbutton which enables and disables the Turbulence Detection mode of operation. TRB mode can only be selected when WX mode is selected and the selected range is 50 nautical miles or less. Areas of moderate or greater turbulence are shown in soft white (grey-white). WX/T is annunciated in the mode field. The radar cannot detect clear air turbulence. Undetected turbulence may exist within any storm cell. Selecting the 100, 200, or 300-mile range turns off the turbulence detection. The "/T" is deleted from the mode annunciation and variable gain is engaged if it was previously selected. Subsequent selection of ranges of 50 miles or less will re-engage the turbulence detection.

WARNING

UNDETECTED TURBULENCE MAY EXIST WITHIN ANY STORM CELL. TURBULENCE CAN ONLY BE DETECTED WITHIN AREAS OF RAINFALL.

CONTROLS (Continued)

GCR — Momentary alternate-action pushbutton which enables and disables the Ground Clutter Reduction mode. Selectable only when WX mode is selected and the range selection is 50 nautical miles or less. Ground clutter returns are reduced, making it easier to discern the remaining targets which are more likely to be weather. "GCR" is annunciated above the mode field.

The GCR feature has the following limitations: It does not remove all of the ground but it does remove some of the weather. It is most effective dead ahead, and its effectivity is reduced as the antenna scans away from dead ahead. The circuit logic assumes reasonable tilt settings for proper operation.

Selecting the 100, 200, or 300-mile range, or the TURB mode turns off ground clutter reduction (GCR). The GCR legend is deleted from the mode annunciation and variable gain is engaged, if previously selected. Subsequent selection of ranges of 50 miles or less re-engages GCR. If not already selected, GCR forces the radar into preset gain.

WARNING

- **DO NOT LEAVE THE RADAR IN THE GCR MODE.**
- **GCR REMOVES MOST OF THE GROUND TARGETS FROM THE DISPLAY, BUT AT THE SAME TIME IT REMOVES SOME OF THE WEATHER TARGETS.**

TGT — Momentary alternate-action pushbutton which enables and disables the Target Alert function. Target Alert monitors the area beyond the range selection within 7.5 degrees of dead ahead. It is selectable in all but the 300 mile range. If a return with certain characteristics is detected in the monitored area, the target alert changes from the blue armed condition to an amber 'T' warning condition. When this amber warning is displayed, the pilot should select a longer range to view the questionable target. Target alert is inactive within the selected range.

SECT — Momentary alternate-action pushbutton which selects either the normal full azimuth scan of 120 degrees, or the faster 60 degree sector scan. Fourteen looks per minute versus 28 looks per minute.

AREA NAVIGATION

GNS-X_{LS} FLIGHT MANAGEMENT SYSTEM

The GNS-X_{LS} Flight Management System is a comprehensive navigation management system which integrates multiple systems and sensors into an integrated whole, which is capable of precise navigation and aircraft performance computations. The system takes information from various navigation sources (DME, VOR, and GPS sensors), considers the strengths, weaknesses and signal strengths of each system and sensor in use, and computes a most likely position for the airplane. The GPS sensor has priority unless degraded sensor accuracy has been detected by the system. It accomplishes these computations with a minimum of attention by the flight crew, and advises them of components or systems requiring attention, as well as other irregularities such as loss of enough sensors to compute a valid position. In the latter situation, if sensor loss endures over a set length of time, the system will enter DR (dead reckoning) mode and so inform the pilot through a message on the control display unit (CDU). The GPS sensor will normally be the dominant sensor during position blending; due to the excellent characteristics of the GPS sensor, during availability of the receiver autonomous integrity monitoring system (RAIM) the GPS sensor will be the sole contributor to the composite position.

The GNS-X_{LS} provides steering information to the pilot through the IC-600 Integrated Display Guidance Computer and Primary Flight Display (PFD). When connected to the autopilot, it provides roll steering commands. The NAV computer additionally computes fuel flow information, providing a current fuel status and airplane gross weight throughout the flight, if the fuel and gross weight are updated prior to takeoff.

The system also provides navigation data outputs which enable the active flight plan to be displayed on the multifunction display (MFD).

The following components comprise the GNS-X_{LS} system: a control display unit (CDU) which houses its own global positioning system (GPS) sensor, a configuration module unit, and an antenna. The GPS antenna is mounted on top of the fuselage near the cabin door.

The CDU is the heart of the system, possessing the computer, the VORTAC positioning unit (VPU), the navigation data bank (NDB), and the memory capability, as well as the GPS receiver. The NDB maintains 50,000 navigation points in its data base as well as up to 999 operator generated waypoints. Fifty-six flight plans with up to fifty waypoints each may be stored. The NAV data base must be updated every twenty-eight days by means of a memory card. The card is inserted into in a personal Computer Memory card International Association (PCMCIA) slot under the lower portion of the alpha keyboard on the CDU.

The FMS will supply waypoint (WPT) information to the IC-600 Display guidance Computer for use in micro air data computer vertical navigation (VNAV) computations, which are displayed on the multifunction display (MFD). An advisory vertical navigation capability is also provided through the GNS-X_{LS} CDU. Vertical waypoints may be programmed and viewed on the CDU, and used as indicators for climb and descent points. The altitude changes may be programmed both with and without vertical path angles. The FMS VNAV function will not couple to the autopilot/flight director.

GNS-X_{LS} CONTROL DISPLAY UNIT

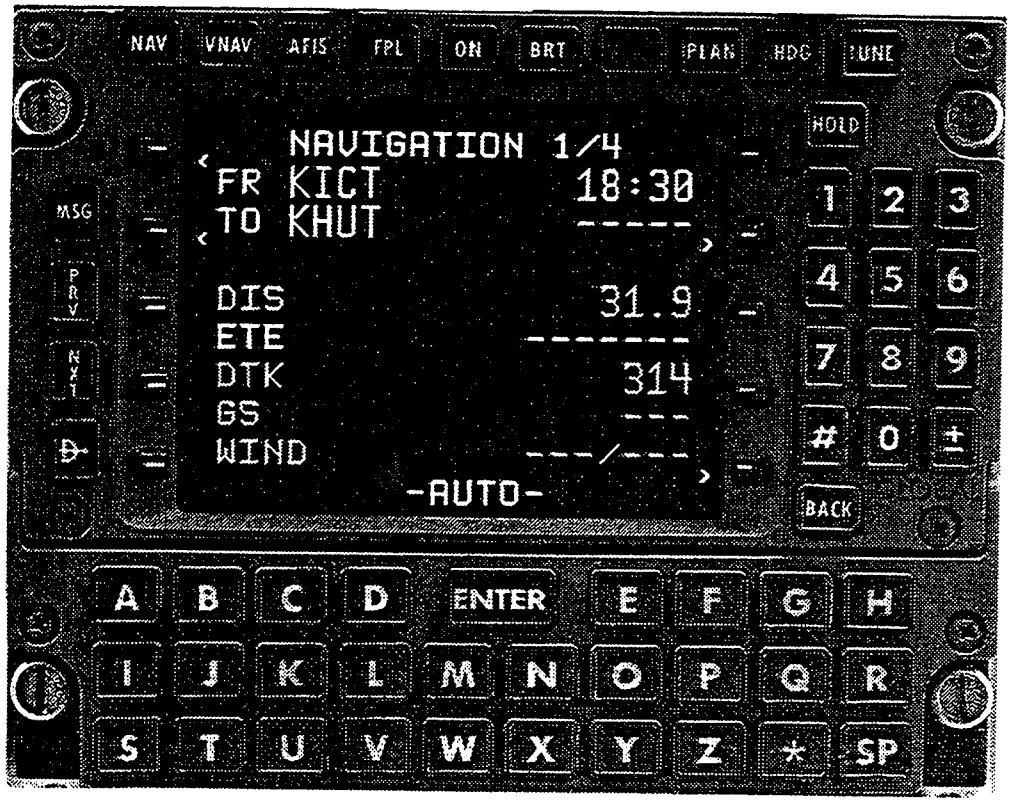

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Figure 3-34

The CDU provides the pilot's interface with the system. It has a compact full alpha keyboard with a color cathode ray tube (CRT) to provide system readouts and to accept pilot inputs into the system.

Operator's Manual

For detailed operating information, consult Revision 2 of the Global Wulfsberg GNS-X_{LS} Flight Management System Operator's Manual, Report Number 006-08845-0000, Revision 2, issued 2 January, 1996 or later revision.

Limitations

The single installation of the GNS-X/LS, with GPS sensor, is not approved as a sole means of navigation; therefore, when the GNS-X_{LS} is to be used as the primary means of navigation, or when coupled to the autopilot, flight director or primary flight display (PFD), the navigation equipment required by the FARs applicable to the specified type of operation being conducted must be installed and operating. Refer to the airplane flight manual for additional limitations and operating information.

AIRBORNE FLIGHT INFORMATION SYSTEM (AFIS) (OPTIONAL)

The Global Airborne Flight Information System (AFIS) interfaces the flight planning and performance management functions of the standard GNS-X_{LS} Flight Management System with Global Data Center Computers. AFIS interfaces with various VHF and satellite communications facilities, thereby providing the computer data link between the airplane and the Global Data Center, by which transfer of digital data concerning flight plans, weather, and message traffic is possible.

The Model 550 Bravo AFIS installation consists of a Data Management Unit (DMU), a configuration module, a data transfer unit (DTU), a satellite communications unit (SCU), an antenna switching unit (in installations having a shared antenna), and an antenna. The Global Data Center, with its VHF/satellite/ground telephone system interface, makes up the ground portion of the system. The global data system provides the services of flight planning, aviation, weather, and flight related message forwarding, thru its "mainframe" computers which accept and process digital data, and provides the requested information on a real time basis.

OPERATOR'S MANUAL

For detailed operating information, consult Section Seven of the Global Wulfsberg GNS-X_{LS} Flight Management System Operator's Manual (Revision 2), Report Number 006-08845-0000, issued 2 January, 1996 or later revision. This section constitutes the Airborne Flight Information System and Satellite Data Communications System Supplement for the AFIS system.