TABLE OF CONTENTS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND IT'S SYSTEMS

TABLE OF CONTENTS (continued)

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND IT'S SYSTEMS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

7.1 THE AIRPLANE

The Seminole is a twin-engine, all metal, retractable landing gear airplane. It has seating for up to four occupants and has a two hundred pound capacity luggage compartment.

7.3 AIRFRAME

The basic airframe is constructed of aluminum alloy, with steel engine mounts, and landing gear, fiberglass nose cone, cowling nose bowls and wing tips, and ABS thermoplastic or fiberglass extremities (tail fin, rudder and stabilator). Aerobatics are prohibited in this airplane since the structure is not designed for aerobatic loads.

The fuselage is a semi-monocoque structure with a passenger door on the forward right side, a cargo door on the aft right side and an emergency egress door on the forward left side.

The wing is a semi-tapered design and employs a modified laminar flow NACA airfoil section. The main spar, located at approximately 40% of the chord, is attached to the fuselage by inserting the butt ends of the spar into a spar box carry-through. Bolting the spar ends into the spar box carry-through structure (located under the rear seats), effectively creates a continuous main spar. The wings are also attached by auxiliary front and rear spars. The rear spar, in addition to taking torque and drag loads, provides a mount for flaps and ailerons. The four-position wing flaps are mechanically controlled by a handle located between the front seats. When fully retracted, the right flap locks into place to provide a step for cabin entry. Each nacelle contains one fuel tank.

7.3 AIRFRAME (continued)

A vertical stabilizer, an all-movable horizontal stabilator, and a rudder make up the empennage. The stabilator is mounted on top of the vertical fin and incorporates an anti-servo tab which provides longitudinal stability and trim. This tab moves in the same direction as the stabilator but with increased travel. Rudder effectiveness is increased by an anti-servo tab on the rudder.

7.5 ENGINES AND PROPELLERS

Engines

The Seminole is powered by two Lycoming four-cylinder, direct drive, horizontally opposed fuel injected engines, each rated at 180 horsepower @ 2700 RPM at sea level. The engines are air cooled and are equipped with oil coolers with low temperature bypass systems and engine-mounted oil filters. A winterization plate is provided to restrict air during winter operation. (See Winterization in Section 8.) Asymmetric thrust during takeoff and climb is eliminated by the counter-rotation of the engines: the left engine rotates in a clockwise direction when viewed from the cockpit, and the right engine rotates counterclockwise.

The engine oil dipstick is accessible through a door located on the upper cowl of each nacelle.

The engines are accessible through removable cowls. The upper cowl half is attached with quarter-turn fasteners. Engine mounts are constructed of steel tubing, with dynafocal isolators to reduce vibration.

Induction Air System

The induction air box incorporates a manually operated two-way valve, allowing either filtered induction air or unfiltered heated air into the engine fuel injection servo inlet. Selecting alternate air provides heated air to the fuel injection servo inlet in the event of induction system icing, and also bypasses the air filter if it becomes blocked with ice, snow, freezing rain, etc. Since the air is unfiltered, alternate air should not be used during ground operation when dust or other contaminants might enter the system. The primary (filtered) induction source should always be used for takeoffs.

7.5 ENGINES AND PROPELLERS (continued)

Propellers

Counter-rotating propellers provide balanced thrust during takeoff and climb which eliminates the critical engine factor in single-engine flight.

Two blade, constant speed, controllable pitch and feathering Hartzell propellers are installed as standard equipment. The propellers mount directly to the engine crankshafts.

Pitch is controlled by oil and nitrogen pressure. Oil pressure drives the propeller toward the high RPM or unfeather position; nitrogen pressure and a large spring drives the propeller toward the low RPM or feather position and also prevents propeller overspeeding. The recommended nitrogen pressure is listed on placards on the propeller domes and inside the spinners. This pressure varies with ambient temperature at the time of charging. Although dry nitrogen gas is recommended, compressed air may be used provided it contains no moisture. For more detailed instructions, see Propeller Service in Section 8 of this handbook.

A propeller governor on each engine supplies engine oil at various pressures through the propeller shaft to maintain constant RPM settings. The governor controls engine speed by varying the pitch of the propeller to match load torque to engine torque in response to changing flight conditions.

Each propeller is controlled by the propeller control levers located in the center of the power control quadrant. Feathering a propeller is accomplished by moving the control fully aft through the low RPM detent into the FEATHER position. Unfeathering is accomplished by moving the propeller control forward. This releases oil accumulated under pressure and moves the propeller out of the FEATHER position.

7.5 ENGINES AND PROPELLERS (continued)

Unfeathering Accumulators

Unfeathering accumulators store engine oil under pressure from the governors, which is released back to the governors for propeller unfeathering when the propeller control lever is moved out of the feathered position.

A feathering lock, operated by centrifugal force, prevents feathering during engine shutdown by making it impossible to feather any time the engine speed falls below 950 RPM. For this reason, when feathering a propeller in flight, the pilot must move the propeller control into the FEATHER position before the engine speed drops below 950 RPM.

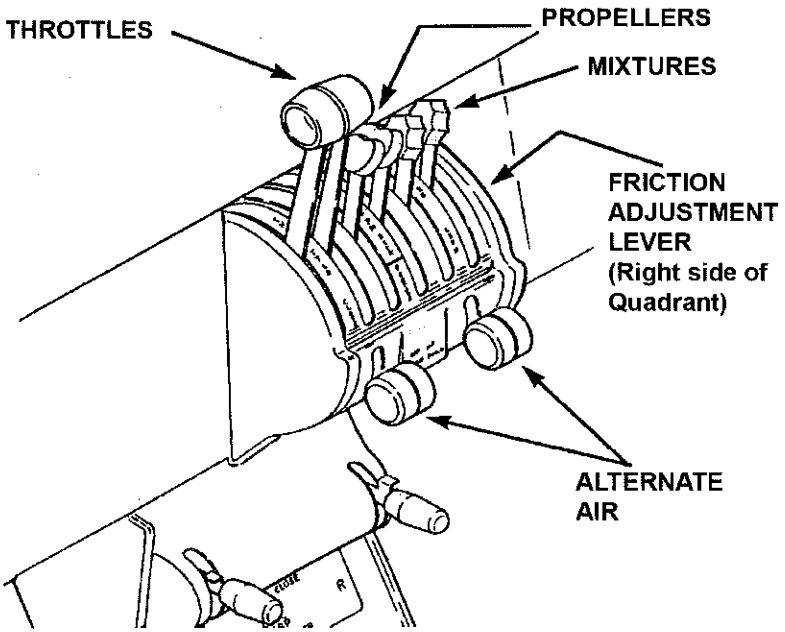
7.7 ENGINE CONTROLS

Engine controls consist of a throttle, a propeller control and a mixture control lever for each engine. These controls are located on the control quadrant on the lower center of the instrument panel where they are accessible to both the pilot and the copilot (Figure 7-1). The controls utilize teflon-lined control cables to reduce friction and binding.

The throttle levers are used to adjust the engine manifold pressure. A gear up warning system, triggered by low manifold pressure, is intended to alert the pilot of an impending gear up landing. Whenever manifold pressure drops below 14 in Hg with the landing gear not down and locked, a CHECK GEAR CAS message is activated along with a continuous CHECK GEAR aural alert. If the airplane is higher than approximately 400 feet AGL, the CAS CAUTION is triggered. Below 400 feet AGL, the CAS WARNING is triggered. Since this low manifold condition might be experienced during normal descent, the CHECK GEAR aural alert may be muted by pressing the appropriate acknowledge softkey on the PFD. Once muted, the aural alert is silenced, but the associated CHECK GEAR CAS text message will remain present until manifold pressure is increased, or the gear is deployed.

All throttle operations should be made with a smooth, not too rapid movement to prevent unnecessary engine wear or damage to the engines.

7.7 ENGINE CONTROLS (continued)



CONTROL QUADRANT
Figure 7-1

The propeller control levers are used to adjust the propeller speed from high RPM (low pitch) to feather (high pitch).

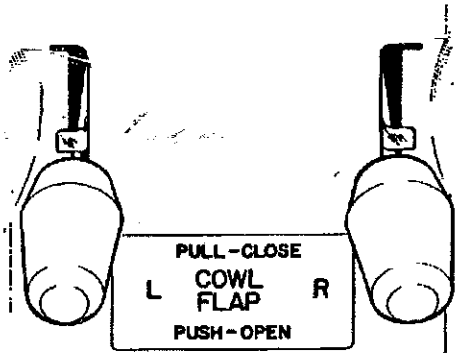
The mixture control levers are used to adjust the air to fuel ratio. An engine is shut down by the placing of the mixture control lever in the full lean (cut-off) position.

The friction adjustment lever on the right side of the control quadrant may be adjusted to increase or decrease the friction holding the throttle, propeller, and mixture controls, or to lock the controls in a selected position.

7.7 ENGINE CONTROLS (continued)

The alternate air controls are located on the control quadrant just below the engine control levers. When an alternate air lever is in the up, or CLOSE, position the engine is operating on filtered air; when the lever is in the down, or OPEN, position the engine is operating on unfiltered, heated air.

The cowl flap control levers (Figure 7-3), located below the control quadrant, are used to regulate cooling air for the engines. The levers have three positions: full open, full closed, and intermediate. A lock incorporated in each control lever, locks the cowl flap in the selected position. To operate the cowl flaps, depress the lock and move the lever toward the desired setting. Release the lock after initial movement and continue movement of the lever. The control will stop and lock into place at the next setting. The lock must be depressed for each selection of a new cowl flap setting.



COWL FLAP CONTROLS
Figure 7-3

7.9 GARMIN G1000 AVIONICS SYSTEM

NOTE

Refer to the latest appropriate revision and -XX part number of the Garmin G1000 Pilot's Guide for the Piper PA-44 Seminole, (Garmin P/N 190-02198-00) for complete descriptions of the G1000 integrated avionics system and operating procedures.

The Garmin G1000 Integrated Avionics System consists of a Primary Flight Display (PFD), a Multi-Function Display (MFD), an Audio Panel, an Attitude and Heading Reference System (AHRS), an Air Data Computer (ADC), and the sensors and computers to process flight and engine information for display to the pilot. The system contains dual GPS WAAS receivers, dual VOR/ILS receivers, dual VHF communications transceivers, a transponder, and an integrated crew alerting system (CAS) to alert the pilot of advisory, caution and warning messages. The G1000 system also provides System Message Advisories, which alert the pilot to abnormalities associated with the G1000 system. The G1000 system also has a terrain proximity system, Traffic Information Service (TIS) and FliteCharts. Optional avioncs equipment include ADF, DME, Class B TAWS, Traffic Advisory System (TAS), SurfaceWatch, Jeppesen ChartView, Synthetic Vision, AOPA Facilities Directory, Flight Stream 510 WiFi and Bluetooth® connectivity, and the Garmin Datalink (GDL) for XM weather and music.

Primary Flight Display

The Primary Flight Display (PFD) displays airspeed, attitude, altitude, and heading information in a traditional format. Slip information is shown as a trapezoid under the bank pointer. One width of the trapezoid is equal to one ball width slip. Rate of turn information is shown on the scale above the rotating compass card; a standard rate turn is accomplished when the turn rate trend vector stops at the second tick mark (standard rate tick mark). OAT information is presented in the lower left corner of the PFD. The measured value of OAT is adjusted for probe recovery factor and ram air effects to indicate static air temperature.

7.9 GARMIN G1000 AVIONICS SYSTEM (continued)

Primary Flight Display (continued)

The primary function of the PFDs is to provide attitude and heading data from the Attitude and Heading Reference System, air data from the Air Data Computer, and navigation and alerting information. Synthetic Vision and Pathways may be utilized to increase situational awareness.

The following controls are available on the PFD (clockwise from top right):

- Communications frequency volume and squelch knob
- Communications frequency transfer button
- Communications frequency set knobs
- Altimeter (BARO) setting knob (large knob)
- Course knob (small knob)
- Map range knob and cursor control
- FMS control buttons and knob
- Flight planning buttons
- PFD softkey buttons
- Altitude reference set knob
- Heading bug control
- Navigation frequency set knobs
- Navigation frequency transfer button
- Navigation frequency volume and Identifier knob

The primary function of the VHF Communication portion of the G1000 is to enable external radio communication. The primary function of the VOR/ILS Receiver portion of the equipment is to receive VOR, Localizer, and Glide Slope signals. The primary function of the GPS portion of the system is to acquire signals from the GPS and WAAS satellites and process this information in real-time to obtain the user's position, velocity, and time. This GPS WAAS is certified under TSO C146a and therefore is qualified as a primary navigation system. The PFD also displays autopilot status and mode annunciation, at the top, center of the display.

Primary Flight Display (continued)

Attitude and Heading Reference System (AHRS)

The AHRS uses rate sensors, air data, GPS data and magnetic variation to calculate pitch, roll, heading and sideslip. The AHRS incorporates internal monitors to continually validate the information it sends to the flight displays. If a failure is detected, a red X will be displayed in place of the incorrect information. If the pilot suspects the validity of an indication that has not been invalidated by the internal monitors, he should cross check related indications on the PFD and the standby instrument to verify the suspect information.

If the entire AHRS unit fails, a red X will be displayed over the attitude and heading indicators. The AHRS may be re-set in-flight and will align while the airplane is in motion. Alignment will occur quicker if the wings are kept level during the alignment process. Note that if the AHRS fails, the course pointer on the HSI will point straight up. The CDI will still function properly and course may still be set using the digital window.

Air Data Computer (ADC)

The ADC provides airspeed, altitude, vertical speed, and air temperature to the display system, the traffic systems and the flight management system.

The ADC incorporates internal monitors to continually validate the information it sends to the flight displays. If a failure is detected, a red X will be displayed in place of the incorrect information. If the pilot suspects the validity of an indication that has not been invalidated by the internal monitors, he should cross check related indications on the PFD and the standby instrument to verify the suspect information.

If the entire ADC unit fails, a red X will be displayed over altitude and airspeed indicators, and a yellow X will be displayed over the vertical speed indicator.

Primary Flight Display (continued)

Crew Alerting System (CAS) Messages

The Crew Alerting System (CAS) consists of Master Warning and Master Caution indicators operating in conjunction with CAS messages and aural alerts. The Master Warning and Caution indicators are located on the lower right softkey of the PFD.

CAS messages appear on the lower right side of the PFD during normal and reversionary mode operations. They are categorized as warning, caution or advisory and are prioritized in the following order:

Warning (Red) Messages - appear at the top of the message stack

Caution (Amber) Messages - appear in the middle of the stack

Advisory (White) Messages - appear at the bottom of the stack

Warning (Red) Messages

Warning conditions are conveyed via a flashing (red) Master Warning indicator, a repeating triple chime and either a flashing (inversely red on white) CAS message or a flashing EIS gage indication.

Warnings may be acknowledged by pressing the lower right softkey on the PFD. When acknowledged, the Master Warning indicator will extinguish, and the aural chime will silence. If applicable, the CAS message will stop flashing and will revert to normal (red on black) text. Warning CAS messages persist until the initiating condition is removed.

A Warning is triggered whenever a gage on the Engine Indication System (EIS) exceeds a red line. In this event, the Master Warning indicator and triple chime are triggered (and acknowledged) normally, but without an accompanying Warning CAS message. Instead, the appropriate EIS gage will flash until the exceedance is removed.

Primary Flight Display (continued)

Crew Alerting System (CAS) Messages (continued)

Caution (Amber) Messages

Caution conditions are conveyed via a flashing (amber) Master Caution indicator, a non-repeating double chime and either an inverse (black on amber) CAS message or a flashing EIS gage indication.

Cautions may be acknowledged by pressing the lower right softkey on the PFD. When acknowledged, the Master Caution indicator will extinguish, and if applicable, the CAS message will will revert to normal (amber on black) text. Caution text messages persist until the initiating condition is removed.

A Caution is triggered whenever a gage on the Engine Indication System (EIS) enters the yellow range. In this event, the Master Caution indicator and double chime are triggered (and acknowledged) normally, but without an accompanying Caution CAS message. Instead, the appropriate EIS gage will flash until the exceedance is removed.

Advisory (White) Messages

Advisory messages are conveyed via a non-repeating single chime and a (white on black) text message.

Advisory CAS messages do not require acknowledgment and will persist until the initiating condition is removed.

System Annunciations

System Annunciations do not trigger Warning or Caution indications and do not require pilot action to acknowledge. These annunciations are typically divided into two categories:

- Hardware or functional failures, indicated graphically with text or yellow "X" over the failed display.
- Optional systems alerts such as those generated by terrain awareness or traffic avoidance systems. These annunciations and alerts are indicated in accordance with their system descriptions.

Primary Flight Display (continued)

Aural Alerts

The G1000 system generates the following aural alerts:

- Master Warning - Repeating triple chime.
- Master Caution - Non-repeating double chime.
- Advisory - Non-repeating single chime.
- Autopilot disconnect and preflight test complete (warble tone).
- TAWS, Terrain, and Obstacle cautions/warnings and various voice alerts.
- Traffic System various voice alerts.
- Airspeed greater than VNE - "Airspeed...Airspeed" voice alert.
- Low airspeed - Airspeed voice alert of an impending underspeed condition (if equipped with optional Underspeed Protection).
- Stall Warning - "Stall...Stall" voice alert.
- "Five-hundred" voice alert - when aircraft descends within 500 feet above the terrain or runway threshold.
- "Minimums..Minimums" voice alert - when the aircraft reaches MDA/DH if set by the pilot.
- "SurfaceWatch" voice alerts (if SurfaceWatch installed).
- "Timer Expired" voice alert when countdown timer reaches zero.
- "Vertical Track" voice alert when aircraft is one minute from VNAV Top of Descent.
- "CHECK GEAR" voice alert - In flight when the manifold pressure is 14 inches of mercury or below and the landing gear selector is not in the DOWN position.
- "CHECK GEAR" voice alert - In flight when the flaps are extended more than 10° and the landing gear selector is not in the DOWN position.
- "CHECK GEAR" voice alert - On the ground when the landing gear selector is in the UP position.
- "Engaging Autopilot" voice alert when autopilot automatically engages in LVL mode. (if equipped with optional Electronic Stability and Protection)

Primary Flight Display (continued)

System Message Advisories

The G1000 system generates several System Message Advisories. These messages are annunciated by flashing the PFD lower right softkey label, and are accessed/hidden by depressing that softkey. For a complete list of these messages, see the Garmin G1000 Cockpit Reference Guide.

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Primary Flight Display (continued)

Reversionary Mode - PFD

If a failure is detected in the MFD, the G1000 automatically enters reversionary mode. In reversionary mode, critical flight instrumentation, autopilot annunciations, CAS display and the inset map are combined with engine instrumentation on a single display.

If an undetected display failure occurs, the pilot may manually activate reversionary display mode by depressing the red DISPLAY BACKUP button on the audio panel.

NOTE

See Reversionary Mode - MFD for description of reversionary mode following a PFD failure.

Primary Flight Display (continued)

Synthetic Vision System (SVS) - Optional

The Synthetic Vision System (SVS) is a visual enhancement to the G1000. Terrain-SVS is displayed on the PFD as a forward-looking depiction of the topography immediately in front of the aircraft. The depicted imagery is derived from the aircraft attitude, heading, GPS three-dimensional position, and a database of terrain, obstacles, and other relevant information. The following SVS enhancements appear on the PFD:

- Pathways
- Flight Path Marker
- Horizon Heading Marks
- Traffic Displays
- Airport Signs
- Runway Displays
- Terrain Alerting
- Obstacle Alerting
- Water
- Zero-Pitch Line

Optional Terrain Awareness and Warning System - Class B (TAWS-B) or standard Terrain-SVS information is integrated within SVS to provide visual and audible alerts of terrain threats relative to the projected flight path. In addition to the standard TAWS or Terrain-SVS alerts, Terrain-SVS offers a three dimensional view of terrain and obstacles. Terrain and/or obstacles that pose a threat to the aircraft are shaded yellow or red. SVS is activated from the PFD softkey located along the display bezel.

Multi-Function Display

The Multi-Function Display (MFD) is located in the center of the instrument panel, and displays the following:

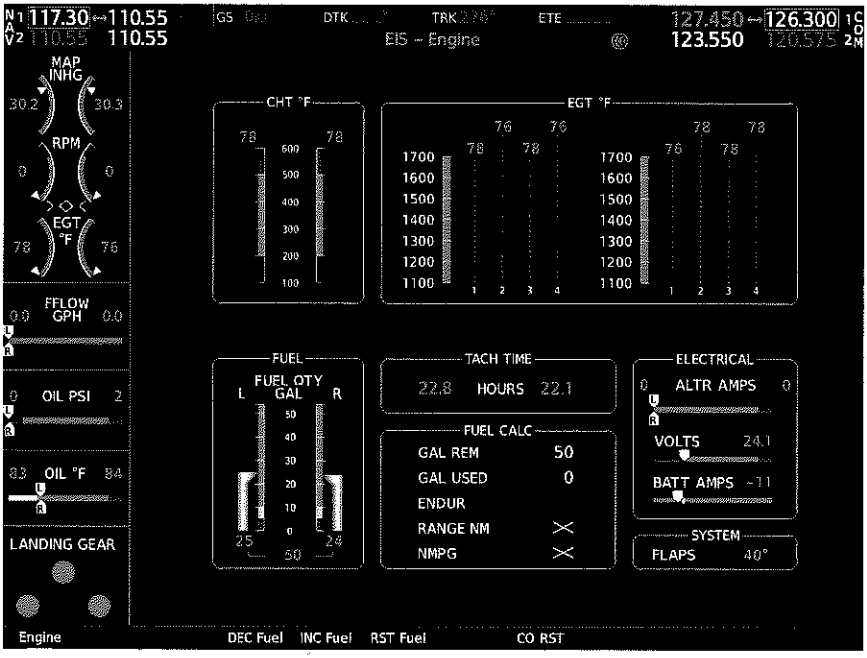
- Engine parameters
- Aircraft system parameters
- Various map and system status pages for Navigation, Traffic Map, Weather Datalink, and TAWS-B

The MFD also displays waypoint information, auxiliary information, flight plan information, and nearest information.

All engine and systems indications necessary for control and monitoring are continuously displayed along the left edge of the MFD display. This area is called the Engine Indication System (EIS) display. A dedicated Engine page is also provided on demand, showing all engine and systems indications in an expanded format (Figure 7.5).

MFD controls are identical to the PFD controls with the addition of GFC700 controls on the lower left bezel.

Multi-Function Display (continued)



TYPICAL ENGINE PAGE
Figure 7-5

Multi-Function Display (continued)

Reversionary Mode - MFD

If the PFD becomes inoperative, the MFD will not automatically switch to reversionary mode. The pilot may elect to use the standby instrument for primary flight instruments, or may manually select the MFD to reversionary mode by pressing the red DISPLAY BACKUP button on the audio panel. In reversionary mode, critical flight instrumentation is combined with engine instrumentation on a single display.

If an undetected display failure occurs, the pilot may manually activate reversionary display mode by depressing the red DISPLAY BACKUP button on the audio panel.

NOTE

See Reversionary Mode - PFD for description of reversionary mode following an MFD failure.

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Multi-Function Display (continued)

Traffic Information Service (TIS)

NOTE

If the G1000 system is configured to use the optional Traffic Advisory System (TAS), TIS will not be available for use.

Traffic Information Service (TIS) provides a graphic display of traffic advisory information to the pilot. The G1000 system performs an automatic test of the TIS system upon power-up. If the TIS power-up test is passed, it will enter STANDBY mode while on the ground. If the TIS power-up test is failed, a failure annunciation will be indicated in the center of the Traffic Map page. The TIS will automatically switch to OPERATE mode once the aircraft is airborne and will provide a voice or tone audio output and a graphic display of traffic.

TIS uses the Mode S transponder for the traffic data link and is available only when the aircraft is within the service volume of a TIS-capable, ground based, terminal radar site. Updates are available to the pilot in 5 second intervals. Aircraft without a transponder are invisible to TIS and aircraft without altitude reporting capability are shown without altitude separation data or climb/descent indication.

Traffic Map Page

The Traffic Map page, located in the Map Group on the MFD, is selectable from 2 nm to 12 nm. The G1000 system can display up to eight traffic targets within a 7.5 nm radius, from 3000 feet below to 3500 feet above the requesting aircraft. The altitude difference between the requesting aircraft and other aircraft is displayed above/below the traffic symbol in hundreds of feet. If the traffic target is above the requesting aircraft, the altitude separating text appears above the traffic symbol; if below, the altitude separation text appears below the traffic symbol. An altitude trend up/down arrow is displayed to the right of the traffic target symbol when the relative climb or descent speeds are greater than 500 ft/min in either direction. TIS also provides a vector line showing the direction in which the traffic is moving, to the nearest 45°.

Multi-Function Display (continued)

Traffic Information Service (TIS) (continued)

Traffic Map Page (continued)

Traffic is overlaid on the following pages:

- Navigation Map Page
- Traffic Map Page
- Trip Planning Page
- Nearest Pages
- Active Flight Plan Page
- PFD Inset Map

TIS Alerts

Traffic is displayed according to TCAS symbology using three different symbols:

1. Non-Threat Traffic – An open white diamond with black center that indicates traffic is beyond a 5 nm range and greater than ±1200 feet from the requesting aircraft.
2. Traffic Advisory (TA) – A solid yellow circle that indicates that traffic has met the criteria for a traffic advisory.
3. Traffic Advisory Off Scale - On the Traffic Map page a half TA symbol indicating a traffic advisory (TA), which is detected but is outside the range of the map will be displayed at the edge of the scale on the azimuth of the detected traffic. On the map page the off-scale traffic advisory is provided in a text box located on the lower left corner of the map.

Traffic information for which TIS is unable to determine the bearing (non-bearing traffic) is displayed in the center of the Traffic Map Page or in a banner at the lower left corner of map pages other than the Traffic Map Page on which traffic can be displayed.

TIS customization options are available to the pilot by depressing the MENU key while on the Navigation Map Page, and then selecting "Map Setup" then "Traffic" Group. TIS traffic may also be displayed on the Navigation Map page by selecting the MAP softkey and then selecting the TRAFFIC softkey.

Multi-Function Display (continued)

Traffic Advisory System (TAS) – Optional

Traffic Advisory System

The optional Garmin GTS 800 is a Traffic Advisory System (TAS). It enhances flight crew situation awareness by displaying ADS-B and non-ADS-B traffic information from transponder-equipped aircraft. The system also provides visual and aural traffic alerts including voice announcements to assist in visually acquiring traffic.

The GTS 800 provides a system test mode to verify the TAS system is operating normally. The test must be initiated from STANDBY mode with ADS-B selected off, and takes 10 seconds to complete. When the system test is initiated, a test pattern of traffic symbols appears on the Traffic Map page. Upon completion of the test, the system announces, "TAS System Test". If the system test does not pass, the TAS status in the upper corner of the map will be TAS: FAIL. When the system test is complete, the traffic system enters STANDBY mode.

After power-up, the GTS 800 automatically enters STANDBY mode and no traffic depictions or alerts will be given. The GTS 800 must be in OPERATE mode for traffic to be displayed and for traffic advisories (TA) to be issued. The pilot can manually change the system between STANDBY mode and OPERATE mode at any time via softkeys on the Traffic Map page. If the pilot does not manually select a mode of operation, the system will automatically transition from STANDBY to OPERATE mode 8 seconds after becoming airborne and transition from OPERATE to STANDBY 24 seconds after landing. TAS aural alerts are muted when GPS altitude is less than 400 ft above ground level (AGL).

Multi-Function Display (continued)

Traffic Advisory System (TAS) – Optional (continued)

Traffic Map Page

The Traffic Map page, located in the Map Group on the MFD, is selectable from 2 nm to 12 nm. The GTS 800 is capable of tracking up to 45 intruding aircraft equipped with Mode A or C transponders, and up to 30 intruding aircraft equipped with Mode S transponders. A maximum of 30 aircraft with the highest threat potential can be displayed simultaneously over a range of 2 nm to 12 nm at altitudes of 10,000 feet below to 10,000 feet above the requesting aircraft. No TAS surveillance is provided for aircraft without operating transponders. The altitude difference between the requesting aircraft and other aircraft is displayed above/below the traffic symbol in hundreds of feet. If the traffic target is above the requesting aircraft, the altitude separating text is preceded by a "+" symbol and appears above the traffic symbol; if below, the altitude separation text is preceded by a "-" symbol and appears below the traffic symbol. An altitude trend up/down arrow is displayed to the right of the traffic target symbol when the relative climb or descent speeds are greater than 500 ft/min in either direction.

Traffic is overlaid on the following pages:

- Navigation Map Page
- Traffic Map Page
- Trip Planning Page
- Nearest Pages
- Active Flight Plan Page
- PFD Inset Map
- PFD Forward Looking Depiction Area (when SVS is selected ON)

Multi-Function Display (continued)

Traffic Advisory System (TAS) – Optional

Traffic Advisory System

The optional Garmin GTS 800 is a Traffic Advisory System (TAS). It enhances flight crew situation awareness by displaying ADS-B and non-ADS-B traffic information from transponder-equipped aircraft. The system also provides visual and aural traffic alerts including voice announcements to assist in visually acquiring traffic.

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Multi-Function Display (continued)

Traffic Advisory System (TAS) – Optional (continued)

Traffic Map Page

The Traffic Map page, located in the Map Group on the MFD, is selectable from 2 nm to 12 nm. The GTS 800 is capable of tracking up to 45 intruding aircraft equipped with Mode A or C transponders, and up to 30 intruding aircraft equipped with Mode S transponders. A maximum of 30 aircraft with the highest threat potential can be displayed simultaneously over a range of 2 nm to 12 nm at altitudes of 10,000 feet below to 10,000 feet above the requesting aircraft. No TAS surveillance is provided for aircraft without operating transponders. The altitude difference between the requesting aircraft and other aircraft is displayed above/below the traffic symbol in hundreds of feet. If the traffic target is above the requesting aircraft, the altitude separating text is preceded by a "+" symbol and appears above the traffic symbol; if below, the altitude separation text is preceded by a "-" symbol and appears below the traffic symbol. An altitude trend up/down arrow is displayed to the right of the traffic target symbol when the relative climb or descent speeds are greater than 500 ft/min in either direction.

Traffic is overlaid on the following pages:

- Navigation Map Page
- Traffic Map Page
- Trip Planning Page
- Nearest Pages
- Active Flight Plan Page
- PFD Inset Map
- PFD Forward Looking Depiction Area (when SVS is selected ON)

Multi-Function Display (continued)

Traffic Advisory System (TAS) – Optional (continued)

TAS Alerts

Traffic is displayed according to TCAS symbology using four different symbols.

1. Non-Threat Traffic – An open white diamond with black center indicates traffic is beyond a 6 nm range and greater than ± 1200 feet from the requesting aircraft.
2. Proximity Advisory (PA) – A solid white diamond indicating that the intruding aircraft is within ± 1200 feet and 6 nm range, but is still not considered a TA threat.
3. Traffic Advisory (TA) – A solid yellow circle that indicates that traffic has met the criteria for a traffic advisory and is considered to be potentially hazardous. A yellow TRAFFIC annunciation is displayed at the top left of the attitude indicator on the PFD and an alert is heard in the cockpit, advising "Traffic", along with additional voice information about the bearing, relative altitude, and approximate distance from the intruder that triggered the TA. For example, the voice alert "Traffic, 11 o'clock high, three miles" would indicate that the traffic is in front of and slightly to the left of the own aircraft, above own altitude, and approximately three nautical miles away. A TA will be displayed for a minimum of 8 seconds, even if the condition(s) that triggered the TA are no longer present.
4. Traffic Advisory Off Scale – On the Traffic Map page, a half TA symbol indicating a traffic advisory (TA), which is detected but is outside of the range of the map, will be displayed at the edge of the scale on the azimuth of the detected traffic. On the map page the off-scale traffic advisory is provided in a text box located on the lower left corner of the map.

Traffic information for which TAS is unable to determine the bearing (non-bearing traffic) is displayed in the center of the Traffic Map Page or in a banner at the lower left corner of maps other than the Traffic Map Page on which traffic can be displayed.

ADS-B traffic will be displayed with similar TAS symbology in the shape of an arrow head. Range of ADS-B traffic will be limited to the TAS surveillance volume. See the G1000 NXi pilot's guide for more information.

Multi-Function Display (continued)

TAS customization options are available to the pilot by depressing the MENU key while on the Navigation Map Page, and then selecting "Map Setup" then "Traffic" Group. TAS traffic may also be displayed on the Navigation Map by selecting the MAP softkey and then selecting TRAFFIC softkey.

Terrain Proximity

NOTE

If the G1000 system is configured to use the optional Terrain Awareness and Warning System (TAWS), Terrain Proximity will not be available for use.

G1000 Terrain Proximity is a terrain awareness system that increases situational awareness and aids in preventing controlled flight into terrain (CFIT). It is similar to the Terrain Awareness and Warning System (TAWS) but does not comply with TSO-C151b certification standards. Terrain Proximity does not provide warning annunciations or voice alerts but it does provide color indications on map displays when terrain and obstacles are within a certain altitude threshold from the aircraft. Although the terrain and obstacle color map displays are the same, TAWS uses a more extensive database and more sophisticated algorithms to assess aircraft distance from terrain and obstacles. The terrain and obstacles database may not contain all obstructions, so the information provided should be used as an aid to situational awareness and should never be used to navigate or maneuver around terrain.

GPS altitude is derived from satellite position and may differ from baro-corrected altitude read from the altimeter. It is converted to mean sea level (MSL) - based altitude (GPS-MSL altitude) and is used in conjunction with GPS position to calculate and predict the aircraft's flight path in relation to the surrounding terrain and obstacles, whose altitudes are also referenced to MSL.

Multi-Function Display (continued)

Terrain Proximity (continued)

System Status:

Terrain Proximity requires the following components to operate properly:

- valid 3-D GPS position
- valid terrain/obstacle database

If Terrain Proximity does not have a valid 3-D GPS position, a yellow "No GPS Position" text will be displayed at the center of the Terrain Proximity Page and on the PFD inset map if terrain is selected. If there is not a valid terrain/obstacle database, the system will not display the yellow and red colors associated with the offending obstacles and terrain.

Operation of Terrain Proximity:

Terrain is displayed on the following pages:

- Navigation Map Page
- Terrain Proximity Page
- Trip Planning Page
- Flight Plan Page
- PFD Inset Map

To display terrain data on maps other than the Terrain Proximity page, select the MAP softkey (select INSET softkey for the PFD inset map) on the Navigation Map Page and then select the TERRAIN softkey. When Terrain Proximity is selected on maps other than the Terrain Proximity Page, an icon to indicate the feature is enabled for display, and a legend for Terrain Proximity colors is shown.

Terrain customization options are available by pressing the MENU key while on the Navigation Map page, and then selecting "Map Setup" then "Map" group. Options selected on the Navigation Map page will be used on other map pages (less the Terrain Proximity page itself) that display terrain information. Additional information about obstacles can be displayed by panning over the display on the map. The panning feature is enabled by depressing the RANGE knob then pushing the knob in the desired direction until it is over the obstacle of interest. There is no inhibit function associated with Terrain Proximity, as there are no aural or visual alerts to inhibit.

Multi-Function Display (continued)

Terrain Proximity (continued)

Terrain Proximity Page:

The Terrain Proximity page is specialized to show terrain and obstacle data in relation to the aircraft's current altitude, without clutter from the basemap. Aviation data (airports, VORs, and other NAVAIDs) can be displayed for reference.

Aircraft orientation on this map is always heading up unless there is no valid heading. Two views are available relative to the position of the aircraft: the 360° default display and the radar-like ARC (120°) display. Map range is adjustable with the RANGE Knob from 1 to 200 nm, as indicated by the map range rings (or arcs).

Operation of Terrain Proximity:

The Terrain Proximity Page is located in the Map Page Group on the MFD.

On all pages that display terrain data, obstacles and terrain are depicted with the following colors:

- Red - above or within 100 feet below the aircraft altitude.
- Yellow - between 100 feet and 1000 feet below the aircraft altitude.
- Black - more than 1000 feet below the aircraft altitude.

Terrain Proximity Alerts:

Terrain Proximity does not provide warning annunciations or voice alerts associated with obstacles or terrain.

Terrain Awareness and Warning System (TAWS -B) – Optional

The Terrain Awareness and Warning System (TAWS-B) is an optional feature used to increase situational awareness and aid in reducing CFIT. TAWS-B provides visual and aural cautions and warning alerts when terrain and obstacles are within a given altitude threshold from the aircraft. The displayed alerts and warnings are advisory in nature only. TAWS-B satisfies TSO-C151b Class B certification requirements whereas the more limited Terrain Proximity does not.

Multi-Function Display (continued)

Terrain Awareness and Warning System (TAWS -B) – Optional (cont.)

TAWS-B uses terrain and obstacle information supplied by government sources. Terrain information is based on terrain elevation information in a database that may contain inaccuracies. Individual obstructions may be shown if available in the database. The data undergoes verification by Garmin to confirm accuracy of the content per TSO-C151b standards, however, the displayed information should never be understood as being all-inclusive, and data may be inaccurate.

For additional safety, the terrain system incorporates Garmin's WireAware™ wire obstacle information. The system shows wire obstacles such as power lines on maps as well as the Synthetic Vision display. For the Terrain-SVT and TAWS-B only, this system can also issue cautions or warnings for potential impact with wire obstacles.

WireAware database information includes Hazardous Obstacle Transmission (HOT) power lines which are typically high voltage transmission lines depicted on VFR Sectional charts, and are considered of special interest to fixed-wing pilots. These include power lines which may span rivers, valleys, canyons, or be in close proximity to airports.

WireAware database coverage is mostly limited to tall transmission lines and their associated support structures. It does not typically have information for the smaller utility poles or lines. WireAware obstacle database coverage exists mainly in the United States; with limited coverage in portions of Canada and Mexico. The height of the wire obstacles is commonly estimated and should not be relied upon for maneuvering decisions.

TAWS-B uses information provided from the GPS receiver to provide a horizontal position and altitude. GPS altitude, derived from satellite measurements, is converted to the height above geodetic sea level (GSL), which is the height above MSL calculated geometrically. GPS position and GSL altitude is used to generate TAWS-B terrain and obstacle alerts. GSL altitude accuracy is affected by satellite geometry, but is not subject to variations in pressure and temperature that normally affect pressure altitude sensors. GSL altitude does not require local altimeter settings to determine MSL altitude.

Multi-Function Display (continued)

Terrain Awareness and Warning System (TAWS-B) – Optional (continued)

System Status:

During G1000 power-up, TAWS-B conducts a self-test of its aural and visual annunciations. The system test can also be manually initiated by selecting the TAWS-B page then depress the MENU key, then select the "Test TAWS" option. An aural alert "TAWS System Test OK" or "TAWS System Failure" is issued at test completion regardless of whether the test was initiated automatically or manually. TAWS-B System Testing is disabled when ground speed exceeds 30 knots.

TAWS-B requires the following to operate properly:

- A valid terrain/obstacle/airport terrain database
- A valid 3-D GPS position solution

If a valid 3-D GPS position solution and vertical accuracy requirements are not attained, or the aircraft is out of the database coverage area, a TAWS N/A annunciation will appear on the TAWS-B page and the aural annunciation "TAWS Not Available" is heard. When the GPS signal is re-established and the aircraft is within the database coverage area, the aural message "TAWS Available" is heard.

Operation of TAWS-B:

Terrain is displayed on the following pages:

- Navigation Map Page
- TAWS Page
- Trip Planning Page
- Flight Plan Page
- PFD Inset Map

To display terrain data on maps other than the TAWS-B page, select the MAP softkey (select INSET softkey for the PFD inset map) on the Navigation Map page and then select the TERRAIN softkey. When TAWS-B is selected on maps other than the TAWS-B page, an icon to indicate the feature is enabled for display and a legend for TAWS-B terrain colors is shown.

Multi-Function Display (continued)

Terrain Awareness and Warning System (TAWS-B) – Optional (continued)

Operation of TAWS-B (continued)

Terrain customization options are available by pressing the MENU key while on the Navigation Map page, and then selecting "Map Setup" then "Map" group. Options selected on the Navigation Map page will be used on other map pages (less the TAWS-B page itself) that display terrain information. Additional information about obstacles can be displayed by panning over the display on the map. The panning feature is enabled by depressing the RANGE knob then pushing the knob in the desired direction until it is over the obstacle of interest.

To inhibit the aural and visual Premature Descent Alert (PDA) and Forward Looking Terrain Awareness (FLTA) alerts (RTC, ITI, RLC, ILI, ROC, and IOI), press the INHIBIT softkey on the TAWS-B page, or depress the MENU key then select "Inhibit TAWS" or "Enable TAWS" depending on the current state. In either case, inhibiting and enabling TAWS alerts depends on the status of the INHIBIT softkey as the INHIBIT softkey performs both functions. Use caution when inhibiting TAWS as the system should be enabled when appropriate. Once TAWS is inhibited, a TAWS INH alert annunciation is displayed on the TAWS-B page of the MFD and at the upper left corner of the altitude tape on the PFD.

NOTE

If the TAWS system has failed or the TAWS alerts are inhibited manually when the Final Approach Fix is the active waypoint on a GPS WAAS approach, a LOW ALT annunciation may appear on the PFD next to the altimeter if the current aircraft altitude is at least 164 feet below the prescribed altitude at the Final Approach Fix.

Alert Type	PFD/MFD Alert Annunciation	MFD Pop-Up Alert	Aural Message	*Response Technique
Excessive Descent Rate Warning (EDR)	PULL-UP	PULL-UP	"Pull Up"	WARNING
Reduced Required Terrain Clearance Warning (RTC)	PULL-UP	TERRAIN - PULL-UP	"Terrain, Terrain; Pull Up, Pull Up"	WARNING
Imminent Terrain Impact Warning (ITI)	PULL-UP	TERRAIN AHEAD - PULL-UP	"Terrain Ahead, Pull Up; Terrain Ahead, Pull Up"	WARNING
Reduced Required Line Clearance Warning (RLC)	PULL-UP	WARNING - WIRE	"Wire, Wire; Pull Up, Pull Up"	WARNING
Imminent Line Impact Warning (ILI)	PULL-UP	WIRE AHEAD - PULL-UP	"Wire Ahead; Pull Up, Pull Up"	WARNING
Reduced Required Obstacle Clearance Warning (ROC)	PULL-UP	OBSTACLE - PULL-UP	"Obstacle, Obstacle; Pull Up, Pull Up"	WARNING
Imminent Obstacle Impact Warning (IOI)	PULL-UP	OBSTACLE AHEAD - PULL-UP	"Obstacle Ahead, Pull Up; Obstacle Ahead, Pull Up"	WARNING
Reduced Required Terrain Clearance Caution (RTC)	TERRAIN	CAUTION - TERRAIN	"Caution, Terrain; Caution, Terrain"	CAUTION
Imminent Terrain Impact Caution (ITI)	TERRAIN	TERRAIN AHEAD	"Terrain Ahead; Terrain Ahead"	CAUTION
Reduced Required Line Clearance Caution (RLC)	TERRAIN	CAUTION - WIRE	"Caution, Wire; Caution, Wire"	CAUTION
Imminent Line Impact Caution (ILI)	TERRAIN	WIRE AHEAD	"Wire Ahead; Wire Ahead"	CAUTION
Reduced Required Obstacle Clearance Caution (ROC)	TERRAIN	CAUTION - OBSTACLE	"Caution, Obstacle; Caution, Obstacle"	CAUTION
Imminent Obstacle Impact Caution (IOI)	TERRAIN	OBSTACLE AHEAD	"Obstacle Ahead; Obstacle Ahead"	CAUTION
Premature Descent Alert Caution (PDA)	TERRAIN	TOO LOW - TERRAIN	"Too Low, Terrain"	CAUTION
Altitude Callout "500"	None	None	"Five-Hundred"	N/A
Excessive Descent Rate Caution (EDR)	TERRAIN	SINK RATE	"Sink Rate"	CAUTION
Negative Climb Rate Caution (NCR)	TERRAIN	DON'T SINK	"Don't Sink"	CAUTION

* See associated Response Techniques checklists on page 7-32.

TAWS-B Alert Types
Table 7-1

Multi-Function Display (continued)

Terrain Awareness and Warning System (TAWS-B) – Optional (continued)

TAWS-B Page:

The TAWS-B page is located in the Map Page Group on the MFD.

The TAWS page is specialized to show terrain, obstacle, and potential impact point data in relation to the aircraft's current altitude without clutter from the base map. Aviation data (airports, VORs, and other NAVAIDs) can be displayed for reference. If an obstacle and the projected flight path of the aircraft intersect, the display automatically zooms in to the closest potential point of impact on the TAWS-B page.

Aircraft orientation on this map is always heading up unless there is no valid heading. Two views are available relative to the position of the aircraft: the 360° default display and the radar-like ARC (120°) display. Map range is adjustable with the RANGE knob from 1 to 200 nm, as indicated by the map range rings or arcs.

On all pages that display terrain data, the obstacles and terrain are depicted with the following colors:

- Red - above or within 100 feet below the aircraft altitude.
- Yellow - between 100 feet and 1000 feet below the aircraft altitude.
- Black - more than 1000 feet below the aircraft altitude.

TAWS-B Alerts:

Alerts are issued when flight conditions meet parameters that are set within TAWS-B software algorithms. TAWS-B alerts typically employ a CAUTION or a WARNING alert severity level, or both. When an alert is issued, visual annunciations are displayed on the PFD and MFD, and aural alerts are simultaneously issued. The TAWS-B Alert Annunciation is shown at the upper left of the altimeter tape on the PFD and below the Terrain Legend on the MFD. If the TAWS-B page is not displayed at the time, a pop-up alert appears on the MFD. To acknowledge the pop-up alert:

- Press the CLR Key (returns to the currently viewed page), or
- Press the ENT Key (accesses the TAWS-B page).

TAWS-B alert types are shown in Table 7-1.

Multi-Function Display (continued)

Terrain Awareness and Warning System (TAWS-B) – Optional (continued)

TAWS-B Alerts (continued)

Response Technique – WARNING:

1. Level the wings while simultaneously adding maximum power.
2. Smoothly pitch up at a rate of 2° to 3° per second towards an initial target pitch attitude of 15°.
3. Adjust pitch attitude to ensure terrain clearance while respecting stall warning. If the flaps are extended, retract flaps to the up position.
4. Continue climb at best angle of climb speed (Vx) until terrain or obstacle clearance is assured.
   - Only vertical maneuvers are recommended unless operating in Visual Meteorological Conditions (VMC) or the pilot determines, after using all available information and instruments, that a turn, in addition to the vertical escape maneuver, is the safest course of action.
   - Pilots are authorized to deviate from an air traffic control (ATC) clearance to the extent necessary to comply with a TAWS warning. Pilots should notify ATC of any deviation after the TAWS threat is eliminated.

Response Technique – CAUTION:

1. Take positive corrective action until the alert ceases.
2. Based on analysis of all available instruments and information:
   - Stop descending, or
   - Initiate a climb, and/or
   - Turn as necessary.

Multi-Function Display (continued)

Garmin Datalink (GDL) – Optional

SiriusXM Weather and SiriusXM Satellite Radio® entertainment services is provided through the optional GDL 69eA, a remote-mounted data-link satellite receiver. SiriusXM Satellite Weather and SiriusXM Satellite Radio® services, available by subscription, have coded IDs unique to the installed unit. These coded ID's must be provided to activate service. These ID's are located on the label on the back of the data link receiver and on the SiriusXM Information Page on the MFD and in the SiriusXM Satellite Radio Activation Instructions included with the unit. SiriusXM uses the coded IDs to send an activation signal that allows the G1000 system to display weather data and/or entertainment programming.

NOTE

Pulling the XM circuit breaker will disable the Garmin Datalink (GDL), which include SiriusXM weather.

SiriusXM Weather:

Received graphical weather information and associated text is displayed on the Multi Function Display (MFD) and the Primary Flight Display (PFD) inset map. SiriusXM satellite weather operates in the S-band frequency range and provides continuous reception capabilities at any altitude throughout North America.

The primary map for viewing SiriusXM Weather data is the Weather Data Link page in the Map page group. This is the only G1000 map display capable of showing information for all available SiriusXM weather products.

Selecting the products for display on the Weather Data Link page is made by pressing the softkey associated with that product. The label for the product is shown in capital letters in the Weather Products column in Table 2. When a weather product is selected for display, the corresponding softkey label changes to gray to indicate the product is enabled. Unavailable weather products have subdued softkey labels (softkeys are disabled from selection).

Multi-Function Display (continued)

Garmin Datalink (GDL) – Optional (continued)

SiriusXM Satellite Weather (continued)

NOTE

Echo Tops and Cloud Tops are not selectable at the same time due to their color similarities.

The following pages can display various portions of XM Weather data:

- Navigation Map
- Weather Datalink Page (able to display all XM Weather data)
- Weather Information Page
- AUX - Trip Planning Page
- Nearest Pages
- Flight Plan Pages
- PFD Inset Map

When a weather product is active on the Weather Data Link page or the Navigation Map page, the age of the data is displayed on the screen. The product age shown on the display is the elapsed time (in minutes) since the weather data provider compiled the weather product. This age can be significantly different (newer) than the actual age of the weather contained within the weather product. Weather products are broadcast at specific intervals.

If for any reason, a weather product is not refreshed within the broadcast rate intervals, the system removes the expired data from the display and shows dashes instead of the product age. This ensures that the displayed data is consistent with what is currently being broadcast by SiriusXM weather service. If more than half of the expiration time has elapsed, the color of the product age changes to yellow. If the data for a weather product is not available, the system displays "N/A" instead of product age next to the weather product symbol.

Table 2 shows the weather product symbols, the expiration time and the broadcast rate. The broadcast rate represents the interval at which SiriusXM weather service transmits new signals that may or may not contain updated weather products. It does not represent the rate at which weather information is updated or new data is received by the Data Link Receiver. Weather data are refreshed at intervals defined and controlled by XM Satellite Radio and their data vendors.

Multi-Function Display (continued)

Garmin Datalink (GDL) – Optional (continued)

SirusXM Satellite Weather (continued)

Weather Product	Symbol	Expiration Time (minutes)	Broadcast Rate (minutes)
NEXRAD		30	5 (U.S.) 10 (Canada)
Cloud Top (CLD TOP)		60	15
Echo Top (ECHO TOP)		30	7.5
SirusXM Lightning (XM LTNG)		30	5
Cell Movement (CELL MOV)		30	5
SIGMETs/AIRMETs (SIG/AIR)		60	12
METARs		90	12
City Forecast (CITY)		60	12
Surface Analysis (SFC)		60	12
Freezing Levels (FRZ LVL)		60	12
Winds Aloft (WIND)		60	12
County Warnings (COUNTY)		60	5
Cyclone Warnings (CYCLONE)		60	12
Icing Potential (CP and SLD) (ICING)		90	22
Pilot Weather Report (PIREPs)		90	12
Air Report (AIREPs)		90	12
Turbulence (TURB)		180	12
No Radar Coverage (RADAR CVRG)	No product image	30	5
TFRs	No product image	60	12
TAFs	No product image	60	12

Weather Product Symbols, Expiration Times and Broadcast Rates

Table 2

Multi-Function Display (continued)

Garmin Datalink (GDL) – Optional (continued)

SirusXM Satellite Weather (continued)

Customizing the Weather Data Link page is possible by selecting Weather Data Link page from the Map group, press the MENU key, select Weather Setup option from the Page Menu and press the ENT key. Turn the large FMS knob to scroll to a weather product of interest then rotate the small FMS knob to scroll through the options for each product (ON/OFF, range settings, etc.). Press the ENT key to select the option then press the FMS knob or the CLR key to return to the Weather Data Link page with the changed settings.

Customizing Weather Data Link options is also available on the Navigation Map page. Proceed to the Navigation Map page, depress the MENU key, highlight the Map Setup option and press the ENT key, turn the small FMS knob to highlight the Weather group, turn the large FMS knob to highlight and move between the product selections. When an item is highlighted, turn the small FMS knob to select the option and press the ENT key. Press the FMS knob or the CLR key to return to the Navigation Map page with the changed settings.

Data Logger:

An optional GDL 59 may be installed to provide a Wi-Fi transceiver for transmitting data collected from the G1000 for trend monitoring and maintenance planning. The stored data logs can include engine trend and exceedance data, system maintenance data, and crew advisory system (CAS) messages. The system can store up to two gigabytes of data. Post flight reports can be sent wirelessly to a Wi-Fi hotspot through the GDL 59's Wi-Fi transceiver either manually via the MFD or configured for automatic upload.

Multi-Function Display (continued)

Garmin Datalink (GDL) – Optional (continued)

SirusXM Radio Entertainment:

The optional SirusXM Satellite Radio can receive the S-band, SirusXM Satellite Radio® entertainment services at any altitude throughout the Continental U.S. Based on signals from satellites, coverage far exceeds land-based transmissions.

XM Radio is never muted for the cabin passengers unless a stereo input to the stereo input jack is installed. XM Radio is automatically muted for the front seat crew members during the following conditions:

- Aircraft radio reception
- Push-to-talk switch activation
- AIRSPEED voice alert
- STALL voice alert
- CHECK GEAR voice alert
- Marker beacon audio activity
- Master caution and master warning chimes
- Audible system messages

The XM Radio Page provides information and control of the audio entertainment features of the SirusXM Satellite Radio. To get to the XM Radio page, proceed to the AUX Page Group on the MFD, turn the small FMS knob to the AUX-XM Information page and select the RADIO softkey.

Databases

The G1000 utilizes several databases. Database titles display in yellow if they have expired. Database cycle information is displayed on the MFD at power up, but more detailed information is available on the AUX pages. Internal database validation prevents incorrect data from being displayed.

The upper Secure Digital (SD) data card slot is typically vacant as it is used for software maintenance and navigational database updates. The lower data card slot should contain a data card with the system's terrain/obstacle information and optional data such as Safe Taxi, FliteCharts and JeppView electronic charts.

Safe Taxi Database

The Garmin Safe Taxi database contains detailed airport diagrams for selected airports. These diagrams aid in the following of ground control instructions by accurately displaying the aircraft position on the map in relation to taxiways, ramps, runways, terminals and services. This database is updated on a 56-day cycle and has no expiration date.

Terrain Database

The terrain databases are updated periodically and have no expiration date. Coverage of the terrain database is between North 75° latitude and South 60° latitude in all longitudes. Coverage of the airport terrain database is worldwide.

Obstacle Database

The obstacle database contains data for obstacles that are 200 feet and higher. Coverage of the obstacle database includes the United States and Europe. This database is updated on a 56-day cycle and has no expiration date. It is important to note that not all obstacles are charted and therefore may not be in the obstacle database.

Navigation Database

Navigation database coverage options include the Americas, International, or Worldwide. This database is updated on a 28-day cycle.

Databases (continued)

FliteCharts Database

The Garmin FliteCharts database contains procedure charts for the purchased coverage area. This database is updated on a 28-day cycle. If not updated within 180 days of the expiration date, FliteCharts will no longer function.

JeppView Database

The Jeppesen JeppView electronic charts database contains procedure charts for the purchased coverage area. An own-ship position icon will be displayed on these charts. This database is updated on a 14-day cycle. If not updated within 70 days of the expiration date, JeppView will no longer function.

7.10 GFC 700 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

AUTOPILOT CONTROLS

Controls for selecting lateral and vertical flight director modes and for engaging/disengaging autopilot and flight director, are located on the MFD bezel. Additional autopilot related functions are controlled by the following:

A/P DISC / TRIM INTER Switch – Autopilot Disconnect and Trim Interrupt switch located on the control wheel. Depressing this red switch interrupts the electric pitch trim and disconnects the autopilot.

Electric Pitch Trim Switch – Split switch located on the control wheel. Commands nose up or nose down pitch trim when both halves of the switch are operated simultaneously.

CWS Switch – Control Wheel Steering switch located on the control wheel. While this switch is depressed, the autopilot servos are disconnected, allowing the pilot to fly the airplane manually.

TO/GA Switch – Optional Takeoff/Go-Around switch located in the left throttle lever. Depressing this switch commands the flight director to an initial takeoff or go-around pitch attitude.

LVL Switch - Optional Level mode switch located on the instrument panel above the MFD. Depressing this blue switch activates the autopilot Level Mode, which engages the autopilot and commands the airplane to level pitch and roll attitudes.

7.10 GFC 700 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS) (continued)

AUTOPILOT OPERATION

When the AVION MASTER switch is selected ON, the GFC700 automatically conducts a self-test, as indicated by a white boxed PFT on the PFD. Successful completion of this self-test is indicated by extinguishing the PFT with no AP failure indications and an autopilot "warble" tone (the same tone as autopilot disconnect). If the GFC700 preflight test is not completed successfully, the autopilot and electric pitch trim will not function.

Selected autopilot modes are displayed on the AFCS Status Box at the top of the PFD. Lateral modes are displayed on the left, autopilot status is in the middle, and vertical modes are on the right. All active modes are shown in green and armed modes are white.

Pressing the AP key activates the autopilot and flight director in the default ROL and PIT modes. Pressing the FD key activates only the flight director in default ROL and PIT modes. Pressing any key associated with a valid lateral or vertical mode activates that mode and the default mode in the opposing axis. For example, pressing the ALT key activates the flight director in ALT hold mode with the default lateral (ROL) mode. Re-selection of any valid lateral or vertical mode toggles between the selected mode and the default mode for that axis.

If the information required to compute a flight director mode becomes invalid or unavailable, the flight director automatically reverts to the default mode for that axis. A flashing amber mode annunciation and annunciator light indicate loss of sensor (ADC) or navigation data (VOR, LOC, GPS, VNV, WAAS) required to compute commands. If the loss occurs in the lateral axis, the system defaults to ROL mode and rolls wings level. If the loss occurs in the pitch axis, the system defaults to PIT mode and maintains the current pitch attitude. The flashing annunciation stops when the affected mode key is pressed, another mode for the axis is selected, or after 10 seconds, if no action is taken.

7.10 GFC 700 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS) (continued)

Autopilot Disengagement Methods:

The autopilot can be disengaged manually by the following "normal" methods which are indicated by an amber flashing AP annunciation:

- Pressing the A/P DISC / TRIM INTER switch on the control wheel
- Activation of either half or both halves of the manual electric pitch trim switch on the control wheel
- Pressing the AP key on the MFD
- Pressing the TO/GA switch on the throttle (if optional Underspeed Protection not installed)

The autopilot can be disengaged manually by the following "abnormal" methods which are indicated by a red flashing AP annunciation:

- Pulling the AUTOPILOT or PITCH TRIM circuit breaker
- Activation of the stall warning system (if optional Underspeed Protection not installed)

The autopilot can be momentarily disengaged by pressing and holding the CWS switch on the control wheel.

The autopilot will disengage automatically under the following conditions which are indicated by a red flashing AP annunciation:

- Internal autopilot system failure
- Total AHRS failure
- Total ADC failure
- Inability to compute default flight director modes

After any autopilot disengagement, the aural disconnect alert can be canceled by pressing the A/P DISC switch or manual electric pitch trim switches

AUTOPILOT FEATURES

Overspeed Recovery Mode

Overspeed Recovery attempts to prevent the aircraft from exceeding VNE by providing a flight director pitch up command whenever the airspeed trend vector exceeds VNE. If flying manually, the pilot may follow the pitch up commands, or if engaged, the autopilot will follow the command. The pitch up command will not exceed that for level flight; to decelerate more rapidly the pilot should reduce engine power. When Overspeed Recovery is active, an

AUTOPILOT FEATURES (continued)

Overspeed Recovery Mode (continued)

amber MAXSPD is displayed above the airspeed tape. Overspeed Recovery is not active in ALT or GS modes and the airspeed reference (FLC) cannot be adjusted while in Overspeed Recovery mode.

Takeoff Mode (Optional)

Takeoff Mode allows the pilot to manually follow the flight director command bars after takeoff rotation. Takeoff Mode is activated by pressing the TO/GA switch on the left throttle lever while on the ground. Whenever Takeoff Mode is active, "TO" will be displayed as the lateral and vertical modes in the AFCS status box.

Go-Around Mode (Optional)

Go-Around Mode allows the pilot to manually follow the flight director command bars during a go-around maneuver. Go-Around Mode is activated by pressing the TO/GA switch on the left throttle lever while in flight. Whenever Go-Around Mode is active, "GA" will be displayed as the lateral and vertical modes in the AFCS status box. Autopilot coupled Go-Around is available as an optional feature. During a coupled go-around the autopilot remains engaged and the pilot must add power and reduce drag according to the Go-Around checklist (Section 4).

Underspeed Protection (Optional)

Underspeed Protection (USP) is a flight director function that provides low speed awareness and prevents the airplane from stalling. The autopilot must be engaged for USP to function. An AIRSPEED aural alert and an amber MINSPD annunciation activates to indicate a low airspeed condition. If airspeed continues to decrease, a USP ACTIVE CAS warning is triggered and the airplane pitches down. If the flight director is in a non-altitude critical mode (VS, VNAV, PIT, LVL or FLC) the airplane pitches down to maintain airspeed above the stall warning speed. If the flight director is in an altitude critical mode (ALT, GP, GS, TO or GA) the airplane may decelerate to stall warning. After stall warning the airplane rolls wings level and pitches down to achieve and maintain a speed approximately two knots above stall warning. When in USP mode, the flight director modes remain unchanged, and the pitch mode annunciation turns white. In all cases, the pilot should take action to exit the underspeed condition by increasing engine power and decreasing drag as appropriate.

AUTOPILOT FEATURES (continued)

Level Mode (Optional)

WARNING

Do not press the LVL switch if an autopilot or pitch trim malfunction is suspected.

Level Mode commands the airplane to wings level and zero vertical speed. It is activated by pressing the blue switch (labeled LVL) at the top center of the instrument panel. Level Mode may be activated at anytime with the autopilot engaged or disengaged. Activation is indicated by green LVL and LVL for lateral and vertical modes respectively. Level mode should not be relied upon if the autopilot is operating in any failure condition.

Electronic Stability and Protection (Optional)

Electronic Stability and Protection (ESP) provides a control force feedback to deter the pilot from operating outside a defined envelope. ESP functions only when the autopilot is operable, but is disengaged. As the aircraft approaches the defined operating limits, the autopilot servos automatically engage to nudge the aircraft back to the nominal operating envelope. The pilot can easily overpower the restoring tendency, and may interrupt ESP with the AP disconnect or CWS switches. At any time (usually for training reasons), the ESP function may be disabled from the AUX – SYSTEM SETTINGS page on the MFD. When disabled in this manner, ESP OFF is displayed. ESP will automatically re-enable after each electrical power cycle. If ESP has failed, an ESP FAIL system message will be displayed under the Messages softkey on the PFD.

Expanded Engagement Envelope (Optional)

Expanded engagement envelope allows autopilot engagement up to the pitch and roll attitudes shown in the autopilot limitations of Section 2. If the autopilot is engaged at a pitch or roll attitude within the expanded engagement envelope but beyond the maximum autopilot command limits, the airplane will be pitched or rolled to the maximum autopilot command limits.

Audio Panel

The audio panel contains traditional transmitter and receiver selectors, as well as an integral intercom and marker beacon system. The marker beacon lights appear on the PFD and the marker beacon audio can be heard over the headsets or cockpit speaker. In addition, a clearance recorder records the last 2½ minutes of received audio. Lights above the audio panel selection buttons indicate which selections are active. If a failure of Com 1 and Com 2 occurs, a fail-safe communications path is available between the pilot's headset/ microphone and Com 1. The fail-safe communications path is activated by pulling the AUDIO MKR circuit breaker located on the circuit breaker panel.

The PILOT knob located towards the bottom of the audio panel allows switching between volume and squelch control as indicated by illumination of VOL or SQ. Turn the knob to adjust intercom volume or squelch. The MAN SQ key must be selected to allow squelch adjustment.

The red DISPLAY BACKUP button at the bottom of the audio panel allows manual selection of the reversionary display mode. Reversionary mode is selected when the red button is extended, normal display mode is selected when the button is depressed.

Transponders

The standard equipment GTX 335R transponder provides Mode A, Mode C, Mode S and ADS-B Out capabilities. The optional GTX345R transponder includes all standard features, plus ADS-B In capabilities, TIS-B traffic and FIS-B weather.

STANDBY INSTRUMENT

The aircraft may be equipped with either an Aspen standby instrument or Garmin G5 standby instrument. Both instruments are fully digital, independent flight instrument displays which provide attitude, barometric altitude, airspeed, heading, vertical speed, slip/skid and turn rate indications. The purpose of these standby flight instruments is to provide a reference to crosscheck the G1000 system information for system reliability and to display basic flight information during a G1000 system failure.

The standby instrument is located to the left of the PFD in direct view of the pilot. During normal operation, power is provided by the essential bus. During an alternator failure, the standby instrument will continue to operate on the essential bus until the primary battery is depleted. The standby instrument will then operate on the emergency battery/bus for 30 minutes permitting the pilot to find a suitable landing location.

Aspen Standby Instrument

In the event of a complete electrical failure of the alternator, primary and emergency batteries; the Aspen standby instrument will revert to its internal battery allowing approximately 30 additional minutes of operation. In this occurrence the Aspen standby instrument will illuminate an "ON BAT" annunciation and display an estimated battery charge state. For a detailed system description of the Aspen standby unit, refer to Aspen Evolution Backup Display (EBD) Pilot's Guide P/N 091-00027-001, Revision A, or later appropriate revision.

Garmin G5 Standby Instrument

In the event of a complete electrical failure of the alternator, primary and emergency batteries; the Garmin G5 standby instrument will revert to its internal battery allowing approximately four hours of additional operation. In this occurrence the Garmin G5 standby instrument will display a battery status indicator showing battery endurance in hours and minutes.

STANDBY INSTRUMENT (continued)

Garmin Standby Instrument Operation

The Garmin G5 standby instrument will power on with the application of aircraft power. The display will automatically power down when aircraft power is removed during aircraft shutdown. If there is a desire to power down the G5 standby unit without removing aircraft power, press and hold the power button.

The Garmin G5 standby knob performs the following functions:

Press	Press to access the Menu.
	From the Menu, press to select the desired menu item.
	Press to accept the displayed value when editing numeric data or selecting from a list.
Turn	From the Menu, turn the knob to move the cursor to the desired menu item.
	Turn to select the desired value when editing numeric data or selecting from a list.
	Turn to adjust the baro setting.

Backlight Intensity Adjustment:

The Garmin G5 powers up in the Auto adjustment mode.

To select Manual backlighting mode from Auto backlighting mode:

1. While the unit is turned on, press the Power button.
2. Turn the knob to manually adjust the backlight intensity.
3. Press the knob to close the backlight page.

To select Auto backlighting mode from Manual backlighting mode:

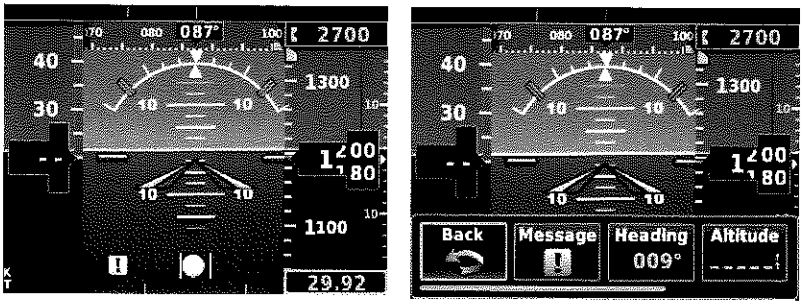
1. While the unit is turned on, press the Power button.
2. Press the Power button again to select Auto.
3. Press the knob to close the backlight page.

STANDBY INSTRUMENT (continued)

System Messages

The Garmin standby has the capability of displaying system messages to the crew along the bottom of the display. A system message is indicated through a white ⚿ indication on the G5.

Messages can be displayed by pressing the Garmin G5 standby knob, and selecting the Message menu item.



Refer to Garmin G5 Electronic Flight Instrument Pilot's Guide for Certified Aircraft, part number 190-01112-12 Rev D (or later approved revisions), for a list of system messages and description of the Garmin G5 standby flight instrument. This reference material is not required to be on board the aircraft but does contain a more in depth description of all the functions and capabilities of the Garmin G5 standby instrument.

NOTE

The standby instrument must be checked for proper operation prior to flight. IFR flight is prohibited when any component of the standby instrument is inoperative.

7.11 LANDING GEAR

The Seminole is equipped with hydraulically operated, fully retractable, tricycle landing gear. On takeoff, the gear should be retracted before an airspeed of 109 KIAS is exceeded. The landing gear may be lowered at any speed up to 140 KIAS.

NORMAL OPERATION

Hydraulic pressure for gear operation is furnished by an electrically powered, reversible hydraulic pump (refer to Figures 7-9 and 7-11). The pump is activated by a two-position gear selector switch located to the left of the control quadrant on the instrument panel (Figure 7-7). The gear selector switch which has a wheel-shaped knob must be pulled out before it is moved to the UP or DOWN position. When hydraulic pressure is exerted in one direction the gear is retracted; when it is exerted in the other direction the gear is extended. Gear extension or retraction normally takes six to seven seconds.

CAUTION

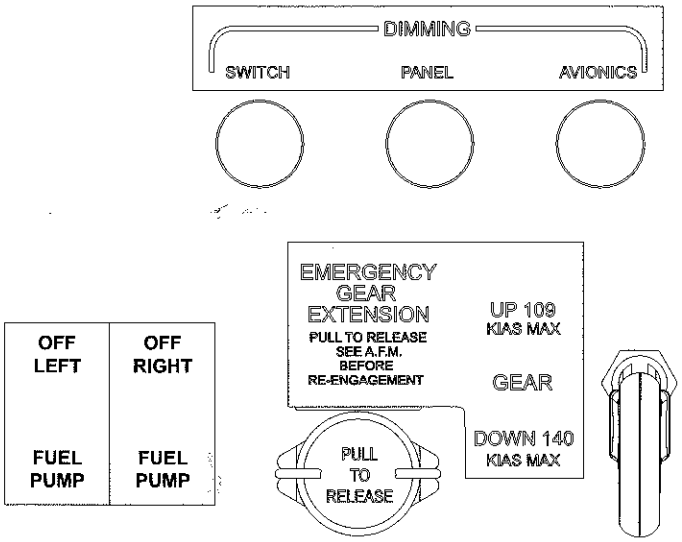
If the landing gear is in transit and the hydraulic pump is running , do not move the gear selector switch to the opposite position before the gear has reached its full travel limit. A sudden reversal may damage the hydraulic pump.

7.11 LANDING GEAR (continued)

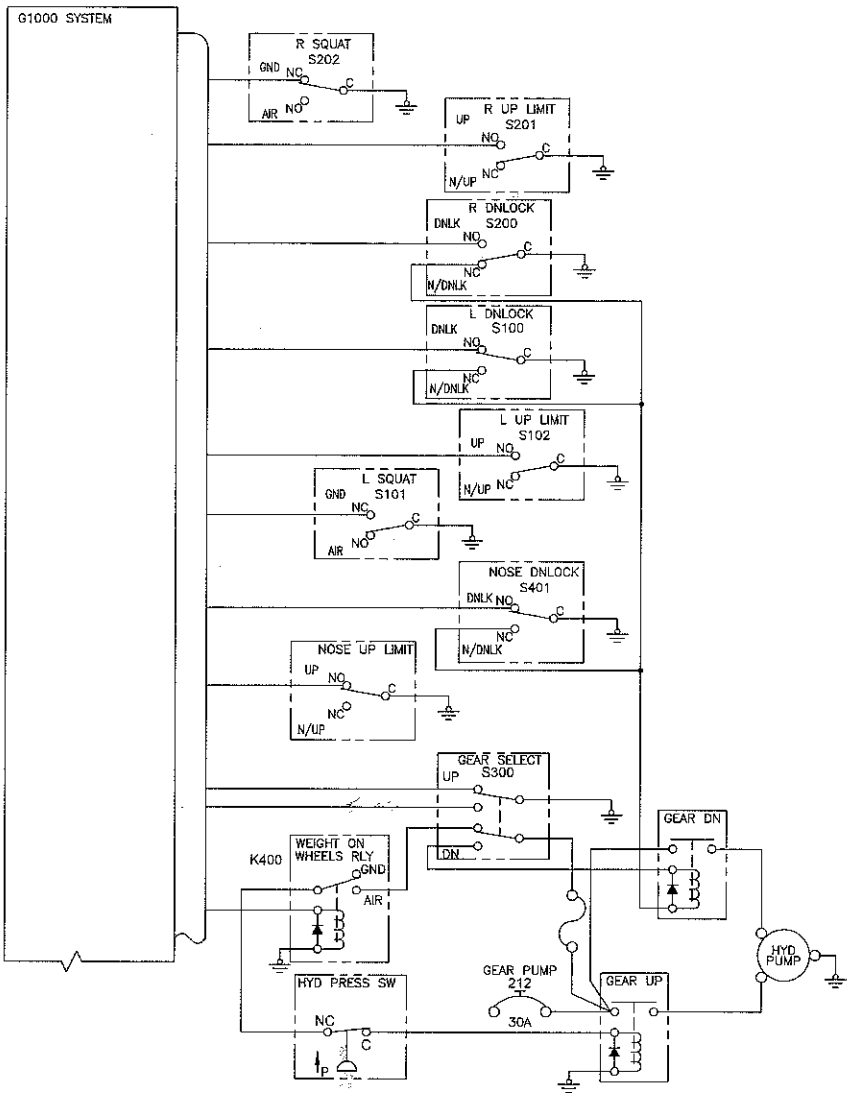
When the gear is fully extended or fully retracted and the gear selector is in the corresponding position, electrical limit switches stop the flow of current to the motor of the hydraulic pump.

When the landing gear is retracted, the main wheels retract inboard into the wings and the nose wheel retracts aft into the nose section. Springs assist in gear extension and in locking the gear in the down position. After the gear are down and the downlock hooks engage, springs maintain force on each hook to keep it locked until it is released by hydraulic pressure.

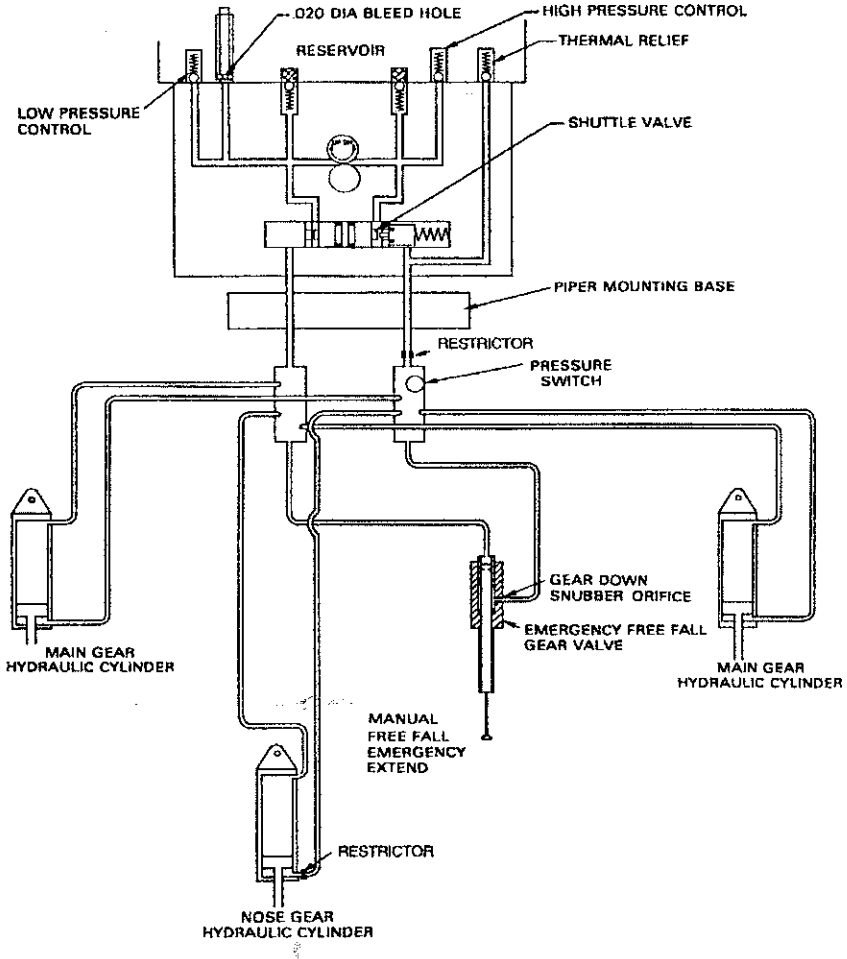
A convex mirror on the left engine nacelle serves as a taxiing aid and allows the pilot to visually confirm the position of the nose gear.



LANDING GEAR SELECTOR
Figure 7-7



LANDING GEAR ELECTRICAL SYSTEM SCHEMATIC
Figure 7-9



LANDING GEAR HYDRAULIC SYSTEM SCHEMATIC
Figure 7-11

7.11 LANDING GEAR (continued)

Landing Gear Indications

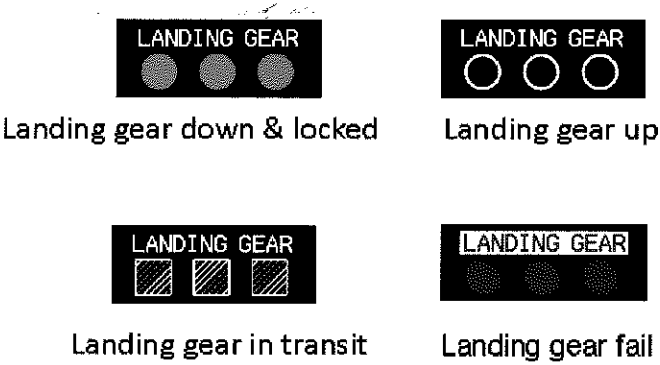
Landing gear indications on the MFD can be any of the following:

- gear down: solid green circle
- gear up: hollow white circle
- gear in transit: crosshatched square
- abnormal/unknown gear position: solid red circle

Microswitches located in the landing gear system determine when the gear are in the full up position or in the down and locked position.

The signals from these microswitches are used to display the appropriate landing gear position on the MFD (or reversionary mode display).

The landing gear selector position is monitored. When the gear selector disagrees with the position of the landing gear, a GEAR SYS CAS message is displayed (warning if on the ground and caution if in flight). If the position of the landing gear are unknown (due to disagreement of the microswitch signals), the landing gear indications on the MFD become solid red circles and a Master Warning or Master Caution is activated (warning if on the ground and caution if in flight).



LANDING GEAR INDICATIONS
Figure 7-13

Gear Position Unsafe

Should the throttle be placed in a low manifold pressure setting and/or the flaps extended while the gear is retracted, a CHECK GEAR CAS message alerts the pilot that the gear is retracted. The CHECK GEAR CAS message is activated under the following conditions:

(a) The gear is not down and locked down and the manifold pressure is below 14 inches on either one or both engines.
(b) The gear selector switch is in the UP position when the airplane is on the ground.
(c) The gear is not down and locked and wing flaps are extended to the second or third notch position.

The CHECK GEAR CAS message is a Caution in flight above approximately 400 feet AGL and becomes a Warning when below approximately 400 feet AGL.

Altitude above ground level (AGL) is determined by comparing GPS altitude and position to a terrain database.

CHECK GEAR Mute

The CHECK GEAR aural alert may be muted by pressing the WARNING or CAUTION softkey. If the aural alert is muted, the CHECK GEAR CAS message remains in the CAS window as a reminder.

The CHECK GEAR aural alert may only be muted if it was triggered by low manifold pressure. The CHECK GEAR aural alert triggered by flap position can only be silenced by retracting the flaps or by extending the gear.

7.11 LANDING GEAR (continued)

SAFETY SWITCH

If the gear selector is placed in the UP position when the airplane is on the ground, a squat switch located on the left main gear will prevent the hydraulic pump from actuating when the battery master switch is turned on. On takeoff, when the landing gear oleo strut drops to its full extension, the safety switch closes, allowing the hydraulic pump to raise the gear. Prior to initiating the preflight check, be sure the landing gear selector is in the DOWN position and that the three green gear indicators are displayed once the G1000 system is operating.

EMERGENCY EXTENSION

The landing gear is designed to extend even in the event of hydraulic failure. The gear is held in the retracted position by hydraulic pressure. If the hydraulic system lost pressure, gravity will extend the gear. To extend and lock the gears in the event of hydraulic failure, it is necessary only to relieve the hydraulic pressure. An emergency gear extension knob, located below and to the left of the gear selector switch is provided for this purpose. A guard across the knob prevents inadvertant movement. Moving the guard aside and pulling the emergency gear extension knob releases the hydraulic pressure holding the gear in the up position and allows the gear to fall free. Before pulling the emergency gear extension knob, place the landing gear selector switch in the DOWN position to prevent the pump from trying to raise the gear.

NOTE

If the emergency gear knob has been pulled out due to a gear system malfunction, leave the control in its extended position until the airplane has been put on jacks and proper function of the hydraulic and electrical systems have been verified. See the Maintenance Manual for proper landing gear system check out procedures.

NOTE

If the emergency gear extension is used for training purposes the emergency gear extension knob may be pushed in again when desired, if there has not been any apparent malfunction of the landing gear system.

HYDRAULIC RESERVOIR

The hydraulic reservoir for landing gear operation is an integral part of the gear hydraulic pump. Access to the combination pump and reservoir is through a panel in the baggage compartment. For filling instructions, see the Maintenance Manual.

GROUND OPERATION

The nose gear is steerable through a 30 degree arc either side of center by use of a combination of full rudder pedal travel and brakes. A gear centering spring, incorporated in the nose gear steering system, prevents shimmy tendencies. A bungee assembly reduces ground steering effort and dampens shocks and bumps during taxiing. When the gear is retracted, the nose wheel centers as it enters the wheel well, and the steering linkage disengages to reduce pedal loads in flight.

TIRES

The main landing gear carries 6.00 x 6, 8-ply tires. The nose wheel has a 5.00 x 5, 6-ply tire. For information on servicing the tires, see TIRE INFLATION in Section 8 of this Handbook.

STRUTS

Struts for the landing gear are air-oil assemblies. Strut exposure should be checked during each preflight inspection. If a need for service or adjustment is indicated, refer to the instructions printed on the units. Should more detailed landing gear service information be required, refer to the Maintenance Manual.

7.13 BRAKE SYSTEM

NORMAL OPERATION

The brake system is designed to meet all normal braking needs. Two single-disc, double puck brake assemblies, one on each main gear, are actuated by toe brake pedals mounted on both the pilot's and copilot's rudder pedals. A brake system hydraulic reservoir, independent of the landing gear hydraulic reservoir, is located on the upper right side of the bulkhead in the nose compartment. Brake fluid should be maintained at the level marked on the reservoir. For further information see BRAKE SERVICE in Section 8 of this Handbook.

PARKING BRAKE

The parking brake is engaged by depressing the toe brake pedals and pulling out the parking brake knob located on the lower instrument panel below the left control column. The parking brake is released by depressing the toe brake pedals and pushing in the parking brake knob.

7.15 FLIGHT CONTROL SYSTEM

Dual flight controls are installed as standard equipment. The controls actuate the control surfaces through a cable system.

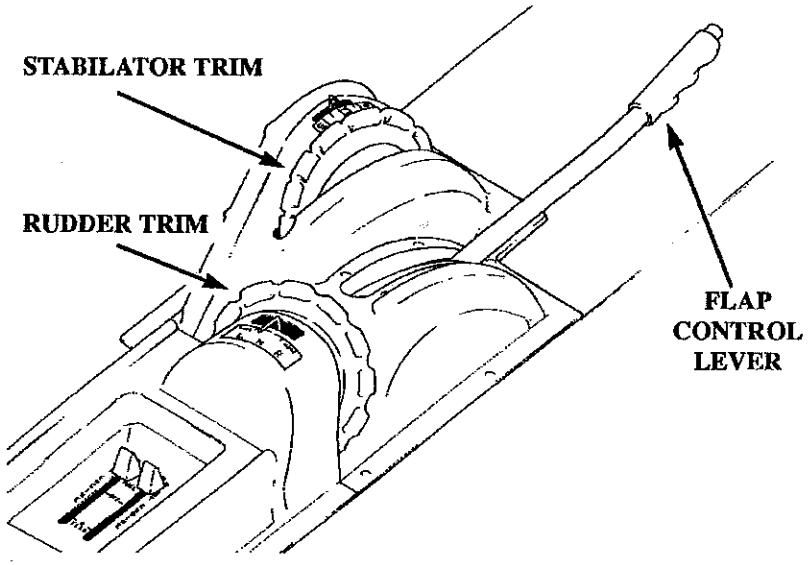
EMPENNAGE

The horizontal tail surface (stabilator) is of the all movable slab type with an anti-servo tab mounted on the trailing edge. This tab, actuated by a control mounted on the console between the front seats, also acts as a longitudinal trim tab (refer to Figure 7-15).

The vertical tail is fitted with a rudder which incorporates a combination rudder trim and anti-servo tab. The rudder trim control is located on the control console between the front seats.

FLAPS

The flaps are manually operated and spring loaded to return to the retracted (up) position. A four-position flap control handle (Figure 7-15) located on the console between the front seats adjusts the flaps for reduced landing speeds and glide path control.



FLAP AND TRIM CONTROLS
Figure 7-15

To extend the flaps, pull the handle up to the desired setting - 10, 25 or 40 degrees. To retract, depress the button on the end of the handle and lower the control.

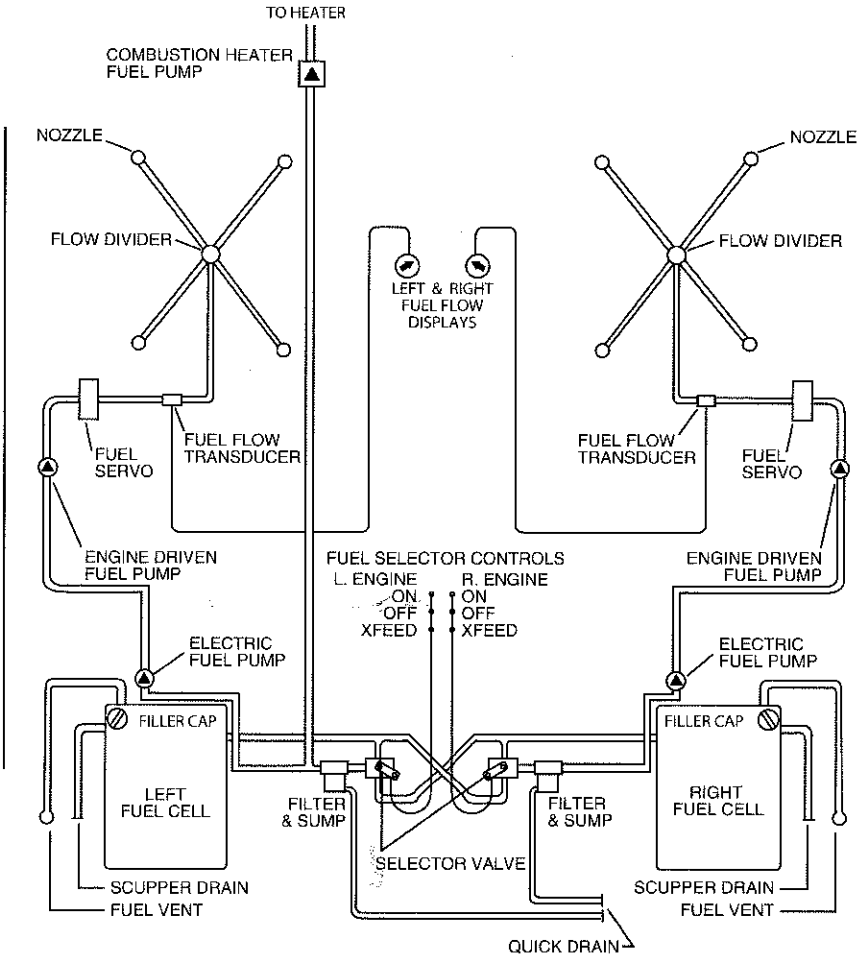
An over-center lock incorporated in the actuating linkage holds the right flap when it is in the retracted (up) position so that it may be used as a step.

NOTE

The right flap will support a load only in the fully retracted (up) position. When loading and unloading passengers, make sure the flaps are in the fully retracted (up) position.

7.17 FUEL SYSTEM

Fuel is stored in two 55 gallon fuel tanks, one in each nacelle (Figure 7-17). One gallon of fuel in each nacelle is unusable, giving a total of 108 usable gallons. The minimum fuel grade is 100 octane. The fuel tank vents, one installed under each wing, feature an anti-icing design to prevent ice formation from blocking the fuel tank vent lines.



FUEL SYSTEM SCHEMATIC
Figure 7-17

FUEL PUMPS

Normally, fuel is supplied to the engines through engine-driven fuel pumps. Auxiliary electric fuel pumps serve as a back-up feature. They are controlled by rocker switches on the switch panel below and to the right of the pilot's control column. The electric fuel pumps should be ON during takeoff and landing.

FUEL GAUGES

Fuel quantities and fuel flows are indicated on displays located on the MFD EIS window or Engine page. There is a separate fuel quantity display for each tank.

A calibrated fuel dipstick is provided with the airplane. To visually check the quantity of fuel in a tank, insert the dipstick to the bottom of the tank, close off the protruding end with a finger, withdraw the dipstick, and read the fuel level. The most accurate reading will be obtained with the airplane on level ground.

FUEL DRAINS

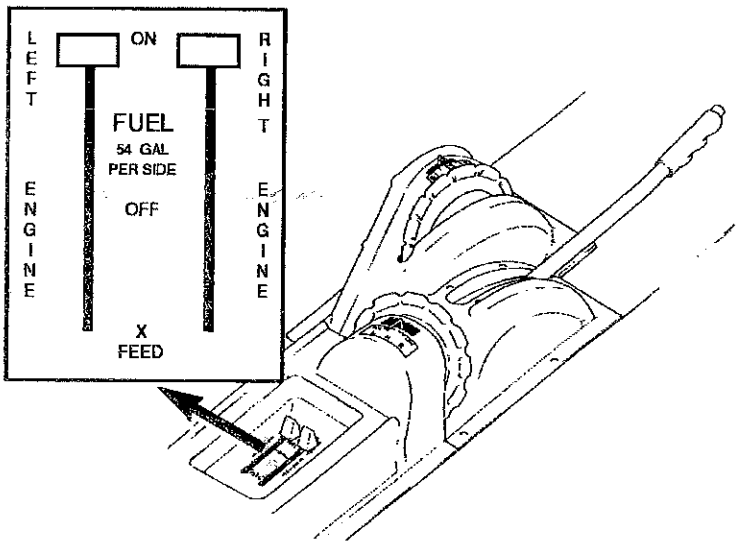
Before each flight, fuel must be drained from the low points in the fuel system to ensure that any accumulation of moisture or sediment is removed from the system. A fuel drain is provided for each half of the fuel system. The fuel drains are located on the right side of the fuselage just forward of the entrance step. (Refer to fuel draining procedure in paragraph 8.21, Fuel System.)

FUEL CONTROLS

Fuel management controls are located on the console between the front seats (Figure 7-19). There is a control lever for each engine, and each is placarded ON - OFF - XFEED. During normal operation, the levers are in the ON position, and each engine draws fuel from the tank on the same side as the engine. When the XFEED position is selected, that engine will draw fuel from the tank on the opposite side, in order to extend range, keep fuel weight balanced or during single-engine operation. The OFF position shuts off the fuel flow to that engine.

NOTE

When one engine is inoperative and the fuel selector for the operating engine is on XFEED the selector for the inoperative engine must be in the OFF position. Do not operate with both fuel selectors on XFEED except as required in the BEFORE TAXIING checklist. Do not take off with a selector on XFEED.



FUEL SYSTEM CONTROLS
Figure 7-19

7.19 ELECTRICAL SYSTEM

The electrical system is a negative-ground, dual-fed, split-bus system capable of supplying sufficient current for complete night IFR equipment.

ALTERNATORS

The primary electrical power is supplied by two belt-driven 28 volt, 65 ampere alternators (Figure 7-25), one mounted on each engine. The alternator provides full electrical power output even at low engine rpm.

VOLTAGE REGULATORS

Each alternator is protected by an alternator control unit which incorporates a voltage regulator and an overvoltage relay. The regulators maintain effective load sharing while regulating electrical system bus voltage to 28-volts. An overvoltage relay in each alternator circuit prevents damage to electrical and avionics equipment by taking an alternator off the line if its output exceeds 32-volts. If this should occur, the appropriate ALTR FAIL CAS WARNING will be activated.

BATTERY

A 13.6 ampere-hour, 24-volt battery provides current for starting, for use of electrical equipment when the engines are not running, and for a source of stored electrical power to back up the alternator output. The battery, which is located in the nose section is normally kept charged by the alternators. If it becomes necessary to charge the battery, it should be removed from the airplane.

EMERGENCY BATTERY

The electrical system includes an emergency battery, which provides electrical power to the emergency bus during a complete electrical failure, or when electrical power from the primary electrical system is insufficient. With the EMERG BATT switch in the ARM position, power is applied to this equipment automatically after a total electrical failure. The emergency bus powers the standby instrument, as well as all PFD functions (except Com2 and Nav2). The emergency battery is sized to provide this functionality for a minimum of 30 minutes.

The emergency battery is isolated from emergency bus equipment by a relay, which is controlled by the EMERG BATT switch. The emergency battery is diode isolated from the electrical power generating system. This allows the generating system to charge the emergency battery during normal operations.

7.19 ELECTRICAL SYSTEM (continued)

EMERGENCY BATTERY (continued)

CAUTION

The emergency battery voltage (E VOLTS) must be a minimum of 23.3 volts prior to flight.

SWITCHES

A series of switch banks are located in various places on the instrument panel. Engine switches are located on the lower left corner of the panel, below the left control yoke. The left engine switches (left and right magnetos) are separated from the right engine switches (left and right magnetos) by the horizontally mounted engine start switch. Pushing the left or right side of this switch, engages the starter on each engine respectively. The lower part of the magneto switches are guarded, to prevent them from being turned off inadvertently.

The left and right electric fuel pump switches are located on the lower panel below and to the right of the left control yoke.

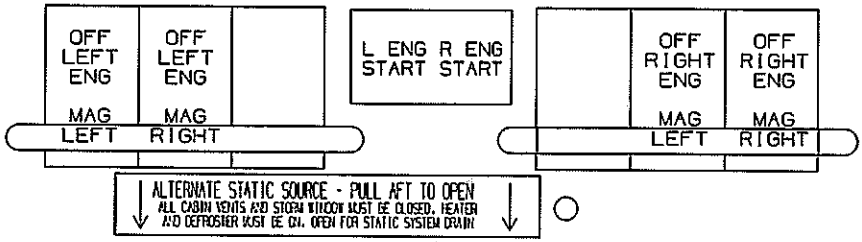
Switches for the battery master, alternators, avionics master and emergency battery are located in a bank to the left of the throttles. The lower part of the emergency battery switch is guarded, to prevent it from being turned off inadvertently.

Switches for the pitot heat and lights (nav, recognition, landing and strobe) are located in a bank to the right of the throttles.

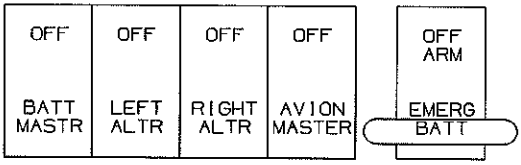
Controls for the cabin heat and ventilation fan are located on the far right side of the panel.

Lighting intensity for the back-lit switches, instrument panel lights, and avionics, are controlled by three rotary controls located on the instrument panel below the PFD.

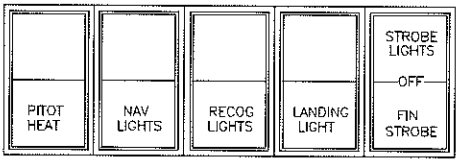
SWITCHES (continued)



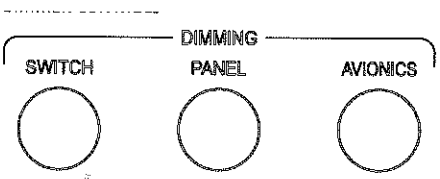
Engine Switches



Left Switch Bank



Right Switch Bank

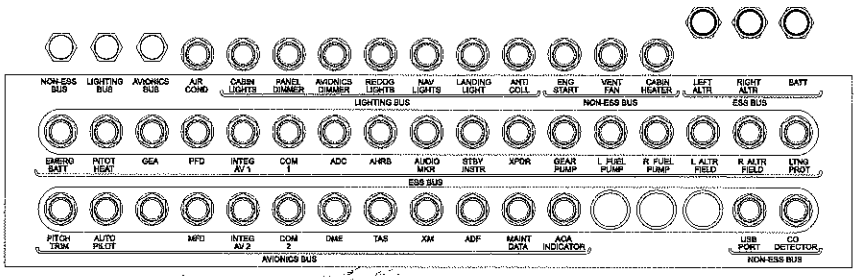


Dimmer Controls

ELECTRICAL POWER SWITCHES
Figure 7-21

CIRCUIT BREAKERS

The electrical system and equipment are protected by circuit breakers located on a circuit breaker panel on the lower right side of the instrument panel (Figure 7-23). The circuit breaker panel is provided with blank spaces to accommodate additional circuit breakers if extra electrical equipment is installed. In the event of equipment malfunctions or a sudden surge of current, a circuit breaker can trip automatically. The pilot can reset the breaker by pressing it in (preferably after a few minutes cooling period). The circuit breakers can be pulled out manually.



TYPICAL CIRCUIT BREAKER PANEL
Figure 7-23

POWER DISTRIBUTION

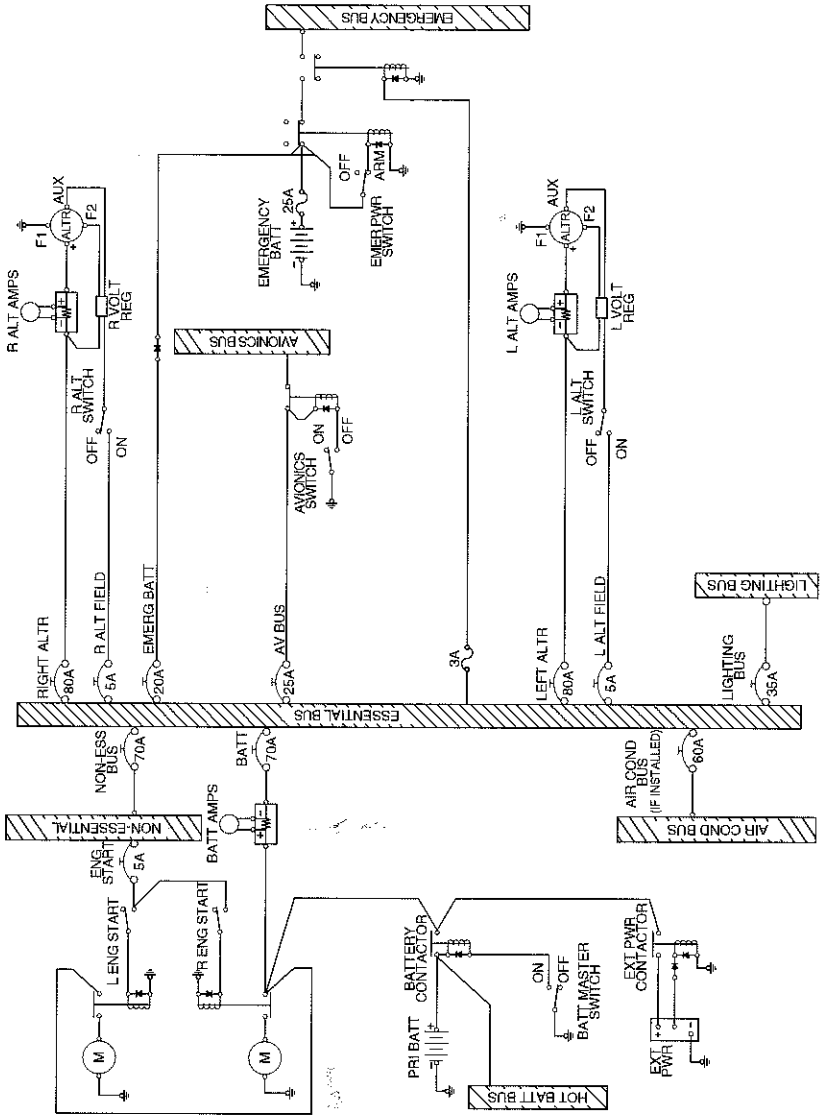
A battery bus (Figure 7-25), located in the battery compartment, provides a continuous source of power to the clock, the engine Hobbs meter, the flight-time Hobbs meter and the heater Hobbs meter. Because the battery bus is connected directly to the battery, power is available even when the battery master switch is OFF. Fuses located on the battery bus are used to protect these circuits.

When the battery master switch is turned ON, the battery solenoid contactor closes, enabling current to flow from the battery to both the starter contactors and the essential bus. Essential bus overcurrent protection is provided by a 70 amp BATT circuit breaker. The essential bus (Figure 7-23 and Figure 7-25), distributes power to other systems through circuit breakers.

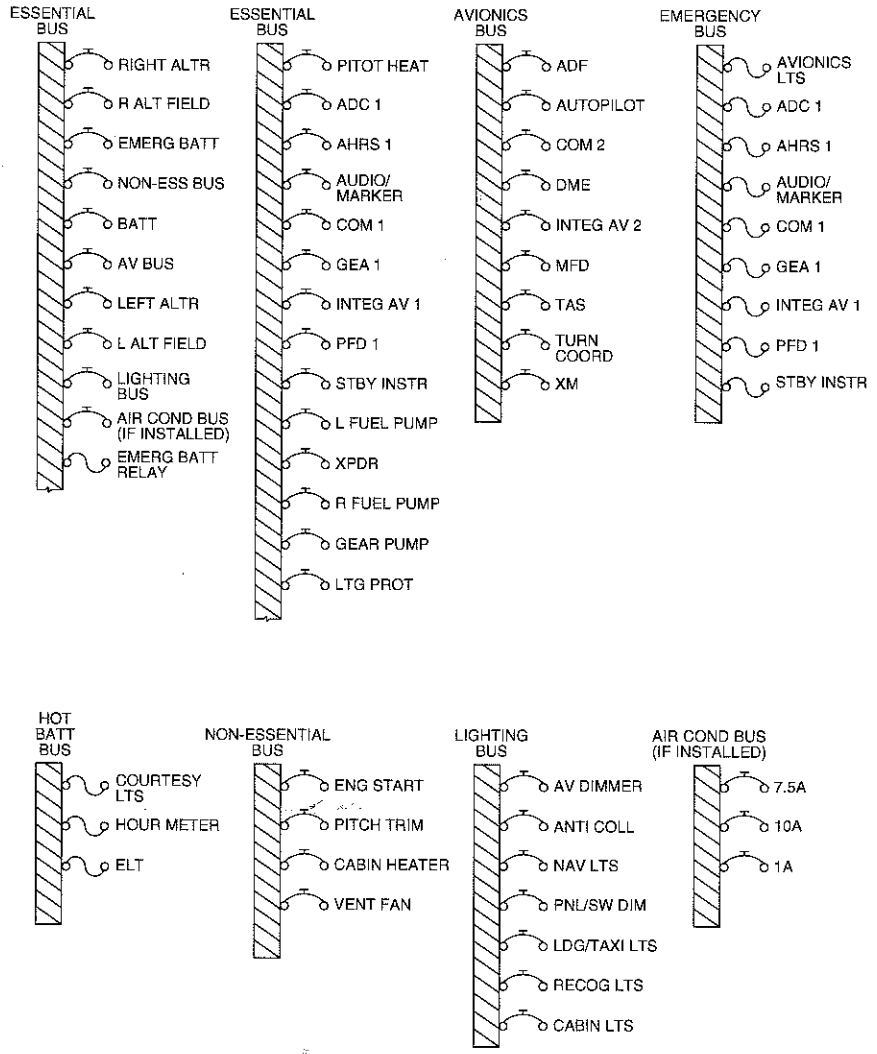
Each alternator system has an independent ON-OFF rocker switch and a solid state voltage regulator that automatically regulates alternator field current. When selected ON, the positive output of each alternator is fed through individual shunts to the tie bus. Overcurrent protection is provided by the 80 amp tie bus L ALTR and R ALTR circuit breakers.

A main bus, a non-essential bus and an avionics bus, with associated circuit breakers, are located at the circuit breaker panel.

Current from the tie bus is fed to the avionics bus through a solenoid contactor. When the avionics master switch is selected ON, the solenoid contactor closes, permitting current flow to the avionics bus. Avionics bus overload protection is provided by the 25 amp AVIONICS BUS circuit breaker. The non-essential bus is also fed from the tie bus. Overload protection is provided by the tie bus 70 amp NON-ESS BUS circuit breaker.



ELECTRICAL POWER DISTRIBUTION SYSTEM
Figure 7-25
Sheet 1 of 2



ELECTRICAL POWER DISTRIBUTION SYSTEM

Figure 7-25
Sheet 2 of 2

LIGHTING

Interior lighting consists of a glareshield mounted light strip, internally lit placards and switches and back-lit avionics displays. Lighting intensities are controlled by three rotary switches located on the instrument panel below the PFD.

A floodlight, mounted in the overhead panel, provides additional instrument and cockpit lighting for night flying. The light is controlled by a rheostat switch located adjacent to the light. A map light window in the lens is actuated by an adjacent switch.

Exterior lighting systems include landing/taxi lights, navigation lights, strobe/anti-collision lights, and recognition lights. The wing tip recognition light system consists of two lights; one in each wing tip.

WARNING

Anti-collision lights should not be operating when flying through cloud, fog or haze, since the reflected light can produce spatial disorientation. Strobe lights should not be used in close proximity to the ground, such as during taxiing, takeoff or landing.

EXTERNAL POWER RECEPTACLE

Should the airplane's battery be depleted, a receptacle located on the lower right side of the fuselage, aft of the wing allows connection of an external battery for engine start.

CAUTION

External power is supplied directly to the electrical bus. Turn off all electrical equipment before applying or removing external power.

Turn the battery master switch and all electrical equipment OFF. Connect the power connector plug assembly to an appropriate external battery. Insert the plug into the external power receptacle. This completes a circuit which permits current to flow from the external power source directly to the starter contactors and the tie bus. Instructions on a placard located on the cover of the receptacle should be followed when starting with external power. For instructions on the use of the external power, refer to Starting Engines - Section 4. For further information see EXTERNAL POWER RECEPTACLE in Section 8 of this Handbook.

7.21 PITOT STATIC SYSTEM

Static and total pressure is sensed by a single pitot head installed on the bottom of the left wing. Independent pressure lines are plumbed from the pitot head to the Garmin air data computer and to the standby instrument (Figure 7-27).

The control valve for the alternate static source is located below the left side of the instrument panel. When the valve is set in the alternate position, the Garmin air data computer and standby instrument uses cabin static pressure. The storm window and cabin vents must be closed and the cabin heater and defroster must be on during alternate static source operation. Altimeter error with alternate static pressure, is less than 50 feet unless otherwise placarded.

To prevent bugs and water from entering the pitot and static pressure holes when the airplane is parked, a cover should be placed over the pitot head. A partially or completely blocked pitot head will give erratic or zero readings on the instruments.

NOTE

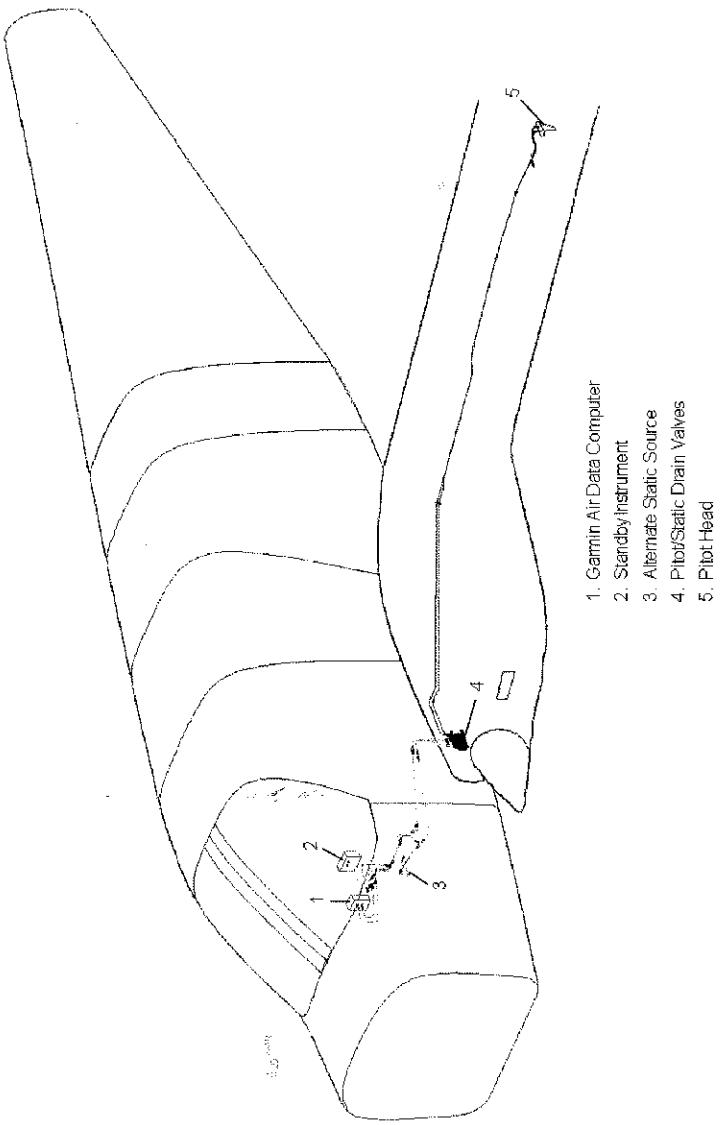
During preflight, check to make sure the pitot cover is removed.

Pitot and static lines can be drained through separate drain valves located on the lower left sidewall adjacent to the pilot.

The heated pitot head reduces problems with icing or heavy rain. The pitot heat switch is located in the switch bank to the right of the throttles. The system has a separate circuit breaker located in the circuit breaker panel and labeled PITOT HEAT. The pitot heat system should be checked during preflight inspection.

CAUTION

Care should be exercised when checking the heated pitot head. The unit becomes very hot. Ground operation of pitot heat should be limited to 3 minutes maximum to avoid damaging the heating units.



PITOT AND STATIC PRESSURE SYSTEM
Figure 7-27

7.23 HEATING, VENTILATING AND DEFROSTING SYSTEM

HEAT

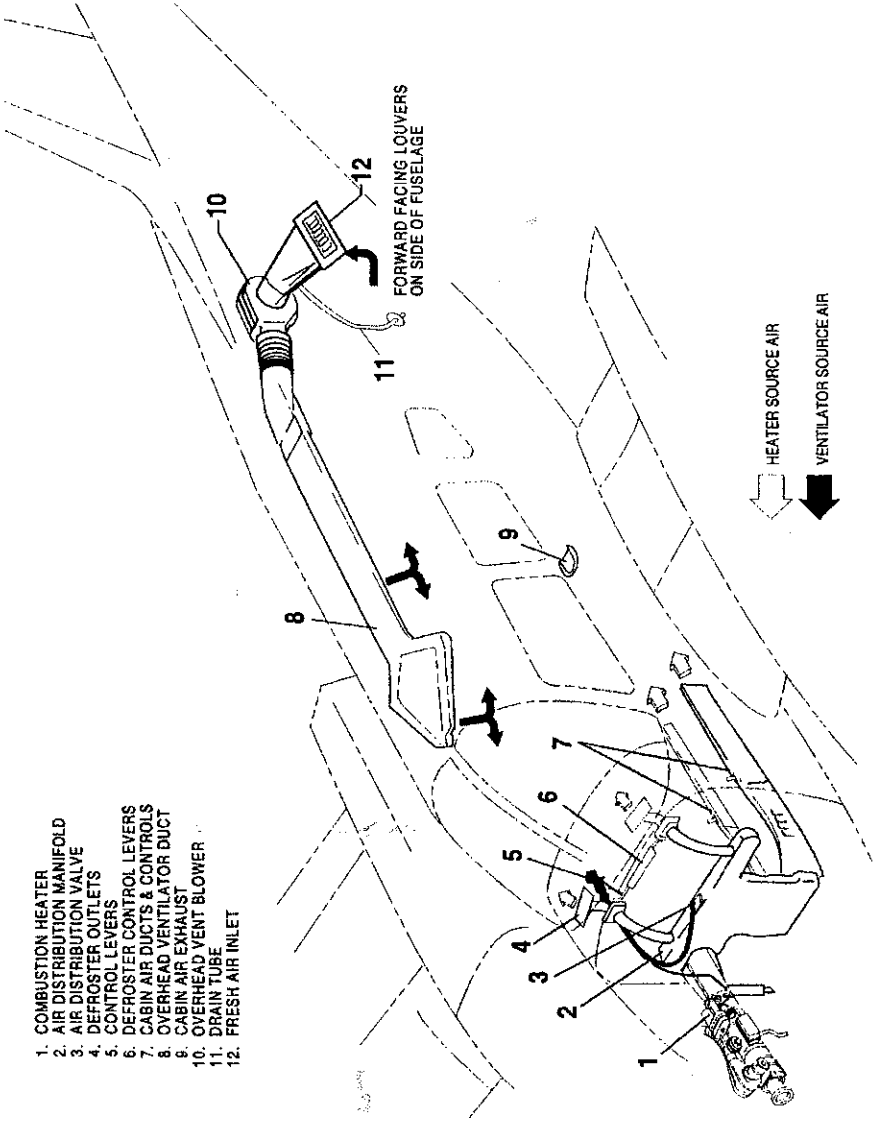
Heated air for cabin heat and windshield defrosting is provided by a Janitrol combustion heater located in the forward fuselage (Figure 7-29). Air from the heater is distributed by a manifold, through ducts along the cabin floor to outlets at each seat. Heated air from the manifold is also directed through two ducts to the defroster outlets.

Operation of the combustion heater is controlled by a three-position switch located on the instrument panel (Figure 7-31) and labeled CABIN HEAT - FAN. Airflow and temperature are regulated by the three levers to the right of the switch. The upper lever regulates AIR INTAKE and the center lever regulates cabin temperature. Cabin comfort can be maintained as desired through various combinations of lever positions. Passengers have secondary control over heat output by individually adjustable outlets at each seat location. The third lever on the instrument panel controls heated airflow to the windshield defrosters.

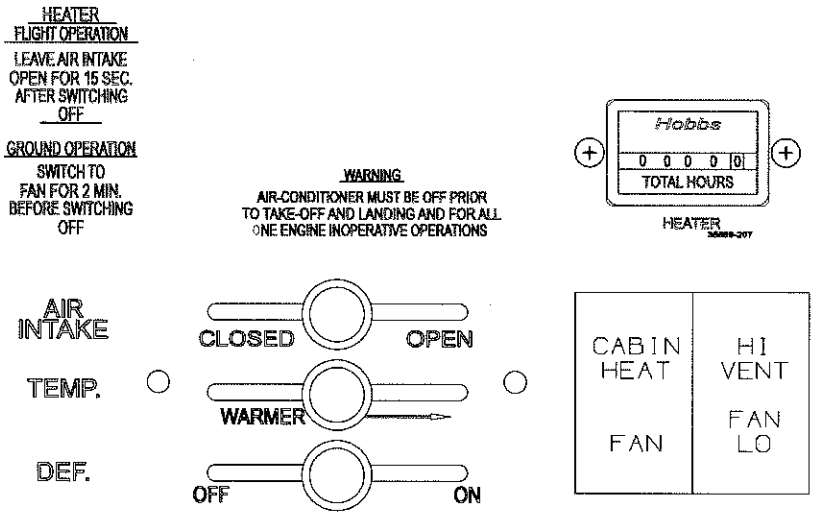
For cabin heat, the AIR INTAKE lever on the instrument panel must be partially or fully open and the three-position switch set to the CABIN HEAT position. This simultaneously starts fuel flow and ignites the heater. During ground operation, it also activates the ventilation blower which is integral to the combustion heater. With instant starting and no need for priming, heat should be felt within a few seconds. When cabin air reaches the temperature selected on the cabin temperature lever, the heater cycles automatically to maintain that temperature.

The combustion heater uses fuel from the airplane fuel system. An electric fuel pump draws fuel from the left tank at a rate of approximately one-half gallon per hour. Fuel used for heater operation should be considered when planning for a flight.

Hours of combustion heater operation can be monitored from an instrument panel mounted Hobbs meter (Figure 7-31). The meter is located above and to the right side of the panel, above the heater control switches.



ENVIRONMENTAL SYSTEM
Figure 7-29



ENVIRONMENTAL CONTROLS AND ANNUNCIATORS
Figure 7-31

Safety Switches

Two safety switches, activated by the intake valve, prevent both fan and heater operation when the air intake lever is in the closed position. When the landing gear is retracted, a micro switch turns off the ventilation blower so that in flight the cabin air is circulated by ram air pressure only.

Overheat Switch and Annunciator

An overheat switch in the heater unit acts as a safety device to turn the heater off if a malfunction occurs. Should the switch deactivate the heater, the HTR OVRHEAT CAS warning will activate. To restore heater operation, reset the red button located on the heater shroud in the nose compartment.

To prevent activation of the overheat switch during ground operation, turn the three-position switch to FAN for two minutes with the air intake lever in the open position, before turning the switch to OFF. During flight, leave the air intake lever open for a minimum of fifteen seconds after turning the switch to OFF.

VENTILATION

When heat is not desired during ground operation, place the three-position switch in the FAN position and the ventilation fan will blow fresh air through the heater duct work for cabin ventilation and windshield defogging. To introduce fresh, unheated air into the cabin during flight, the air intake should be open and the heater off. Ram air enters the system and can be individually regulated at each floor outlet.

Overhead outlets also supply fresh air for cabin ventilation. The occupant of each seat can manually adjust an outlet in the ceiling to regulate the flow of fresh air to that seat area. A fresh air blower is installed in the overhead ventilation system to provide additional fresh air flow during ground operation. Operation of the fresh air blower is controlled by a three-position switch located ajacent to the cabin heat switch, (Figure 7-31) and labeled VENT FAN.

7.25 INSTRUMENT PANEL

The instrument panel (Figure 7-33) is designed to accommodate the Garmin G1000 avionics, the standby instrument, all avionics options and required switches. See Figure 7-33 for location of each item/ detail.

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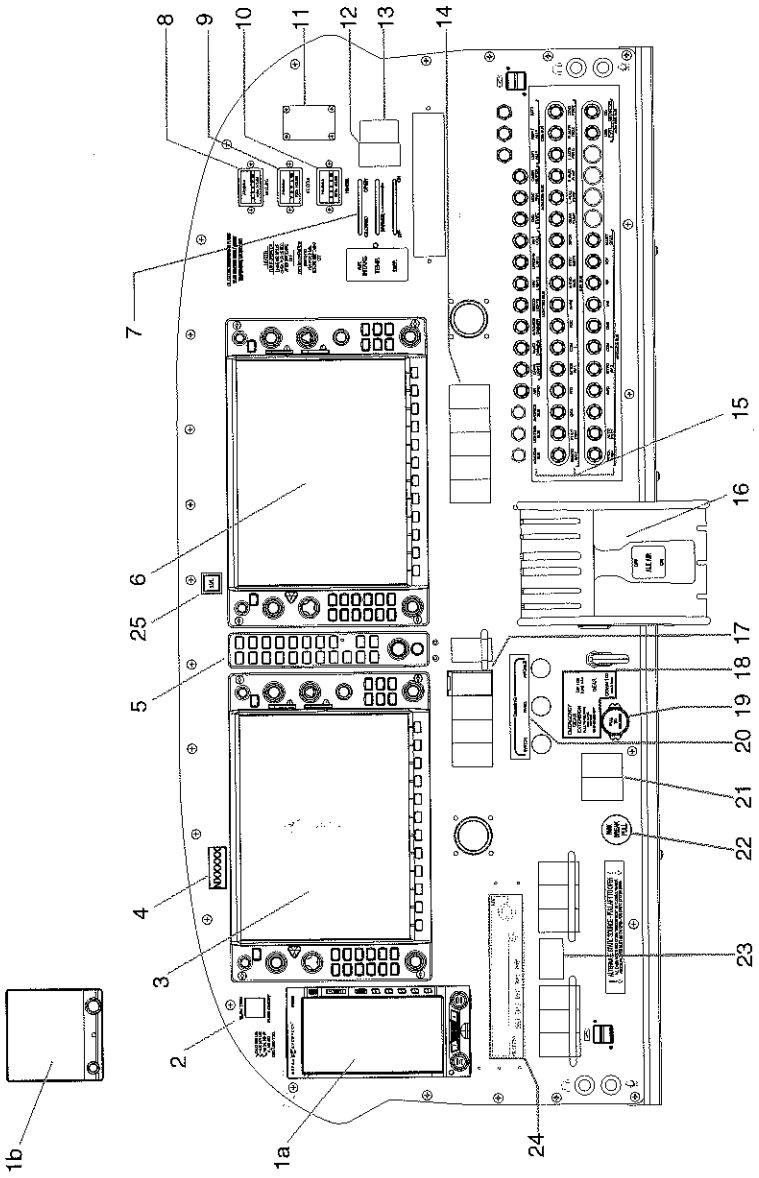


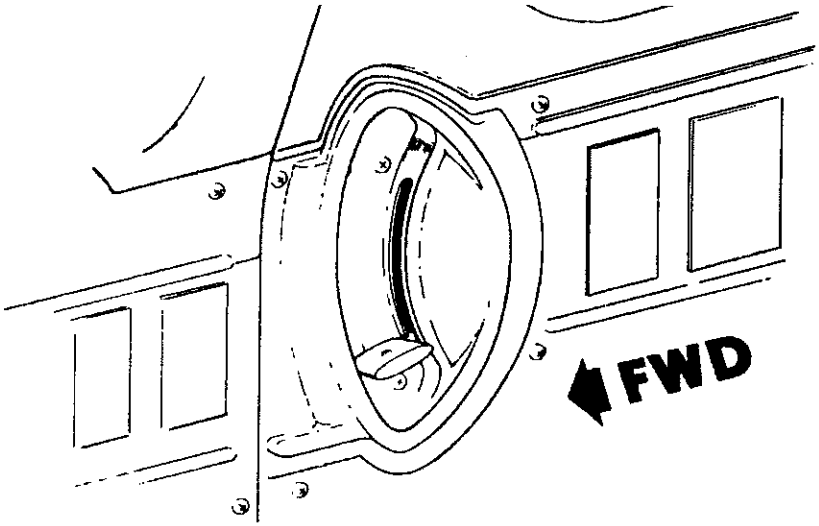
INSTRUMENT PANEL
Figure 7-33
(Sheet 1 of 2)

1. Standby instrument
   a. Aspen EBD-1000
   b. Garmin G5
2. Elevator Trim switch
3. PFD
4. Registration Number plate
5. Audio Panel
6. MFD
7. Environmental controls (See Figure 7-31)
8. HOBBS meter - Billing - Optional
9. HOBBS meter - Maintenance or Flight
10. HOBBS meter - Heater
11. ELT switch
12. Cabin heater fan
13. Ventilation fan
14. Right switch bank (L to R) (See Figure 7-21)
    a. Pitot Heat
    b. Nav lights
    c. Recognition lights
    d. Landing light
    e. Strobe light
15. Circuit Breakers
16. Throttle quadrant
17. Left switch bank -- (L to R, See Figure 7-21)
    a. Battery Master
    b. Left Alternator
    c. Right Alternator
    d. Avionics Master
    e. Emergency Battery
18. Landing gear selector
19. Emergency gear extension knob & guard
20. Dimmer controls (L to R)
    a. Switches
    b. Panel
    c. Avionics
21. Left and right fuel pump switches
22. Parking brake
23. Engine switches (L to R)
    a. Left engine switches (left and right magneto)
    b. Left engine starter
    c. Right engine starter
    d. Right engine switches (left and right magneto)
24. ADF (optional)
25. Level Mode (LVL) switch (opional)

INSTRUMENT PANEL (continued)
Figure 7-33
(Sheet 2 of 2)

7.27 CABIN FEATURES

Cabin entry is made through the cabin door on the right side. The cabin door is double latched. To close the cabin door, hold the door closed with the armrest while moving the lower door latch (Figure 7-35) down to the LATCHED position. Then engage the upper latch to the LATCHED position. Both latches must be secure before flight.

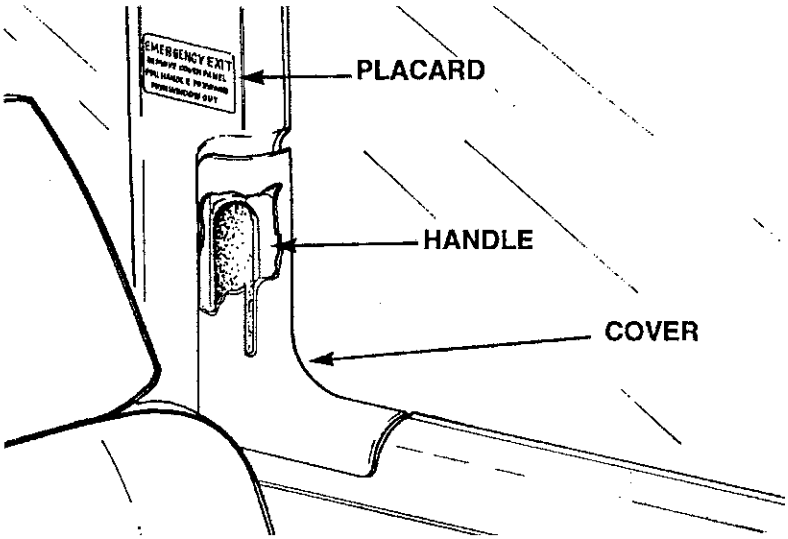


CABIN DOOR LOWER LATCH
Figure 7-35

The pilot's left side window is an emergency exit. The emergency exit release handle is located beneath the thermoplastic cover on the vertical post between the first and second left side windows (Figure 7-37).

CAUTION

The emergency exit is for ground use only. When released, the window will fall free from the fuselage.



EMERGENCY EXIT
Figure 7-37

STANDARD FEATURES

Standard front cabin features include cabin and baggage door locks, a pilot's storm window, map pockets, and sun visors. An armrest is located on the side panel adjacent to each front seat. Additional standard cabin items are pockets on the front seat backs, a portable fire extinguisher, a special cabin sound-proofing package, a coat hanger support bar and baggage restraint straps in the aft baggage area.

A worktable is available and can be attached to the rear of either the pilot or copilot seat. The worktable is stored along the left side in the baggage area. It is secured with a strap.

SEATS

All seat backs have three positions: normal, intermediate and recline. An adjusment lever is located at the base of each seat back on the outboard side.

The two front seats are adjustable fore, aft and vertically. The seats are adjustable fore and aft by lifting the bar below the seat front and moving to the desired position. Release the handle and move the seat until the locking pin engages. To raise the vertically adjustable pilot and copilot seats, push back on the pushbutton located at the lower right of each seat, relieve the weight from the seat and it will rise. To lower the seat, push the button and apply weight until the proper position is reached.

The rear seats are easily removed to provide room for bulky items. Rear seat installations incorporate leg retainers with latching mechanisms, which must be released before the rear seats can be removed. Releasing the retainers is accomplished by depressing the plunger behind each rear leg.

NOTE

To remove the rear seats, depress the plunger behind each front leg and slide seat to rear.

SEAT BELTS AND SHOULDER HARNESSES

Seat belts and adjustable shoulder harnesses with inertial reels are standard on all four seats. The pilot should adjust this fixed seat belt strap so that all controls are accessible while maintaining adequate restraint for the occupant. The seat belt should be snugly fastened over each unoccupied seat.

The shoulder harness is routed over the shoulder adjacent to the window and attached to the seat belt in the general area of the occupant's inboard hip. A check of the inertial reel mechanism is made by pulling sharply on the strap. The reel should lock in place and prevent the strap from extending. For normal body movements, the strap will extend or retract as required.

FIRE EXTINGUISHER

A portable, handheld, fire extinguisher, is mounted between the pilot and copilot seats, behind the fuel selector console. Read the instructions on the nameplate and become familiar with the unit before an emergency situation.

7.29 BAGGAGE AREA

The 24 cubic foot baggage compartment, located aft of the seats, has a weight capacity of 200 pounds. This compartment is loaded and unloaded through a separate 22 x 20 inch baggage door, and the compartment is accessible during flight. Tie-down straps are provided and they should be used at all times. The baggage compartment door and passenger door use the same key.

NOTE

It is the pilot's responsibility to be sure when baggage is loaded that the airplane C.G. falls within the allowable C.G. range. (See Weight and Balance Section.)

7.31 FINISH

The standard exterior finish is painted with acrylic enamel. To keep the finish attractive, economy size spray cans of touch-up paint are available from Piper Dealers.

7.33 STALL WARNING

An approaching stall is indicated by a STALL.....STALL aural alert which is activated between five and ten knots above stall speed. Mild airframe buffeting and gentle pitching may also precede the stall. Stall speeds are shown on the Stall Speed vs Angle of Bank graph in Section 5.

The stall warning alert is activated by two lift detectors on the leading edge of the left wing, outboard of the engine nacelle. The inboard detector activates the alert when the flaps are in the 25 and 40 degree positions, the outboard when the flaps are in positions less than 10°.

7.35 EMERGENCY LOCATOR TRANSMITTER

The Emergency Locator Transmitter (ELT), is located in the aft portion of the fuselage and is accessible through a rear closeout panel on the right side of the fuselage. This panel is attached with slotted-head nylon screws for ease of removal; these screws may be readily removed with a variety of common items such as a dime, a key, a knife blade, etc. If there are no tools available in an emergency the screw heads may be broken off by any means.

A battery replacement date is marked on the transmitter. To comply with FAA regulations, the battery must be replaced on or before this date. The battery must also be replaced if the transmitter has been used in an emergency situation or if the accumulated test time exceeds one hour, or if the unit has been inadvertently activated for an undetermined time period.

NOTE

If for any reason a test transmission is necessary, the test transmission should be conducted only in the first five minutes of any hour and limited to three audio sweeps. If the tests must be made at any other time, the tests should be coordinated with the nearest FAA tower or flight service station.

7.35 EMERGENCY LOCATOR TRANSMITTER (continued)

ARTEX ELT 1000 OPERATION

There is a three position switch (placarded ON ARM/OFF, and TEST) on the ELT unit. The switch is set to ARM/OFF when the ELT is installed at the factory, and it should remain in that position whenever the unit is installed in the airplane.

A remote switch (placarded ON ARM/OFF, and TEST) is located on the copilot's instrument panel to allow the transmitter to be armed or turned on from inside the cabin. The switch is normally in ARM /OFF position. Moving the switch to ON will activate the transmitter. A warning light located above the remote switch will alert you when ever the ELT is activated.

The Artex ELT 1000 (406 MHz) is equipped with a warning buzzer. This warning buzzer, which receives power from the ELT itself, is mounted in the tailcone. Whenever the ELT is activated the buzzer "beeps" periodically. The time between pulses lengthens after 12 hours. The objective is to hear the buzzer from outside the aircraft while the engine is not running.

Should the ELT be activated inadvertently it can be reset by either positioning the cockpit remote switch or the local ELT box switch to ON then immediately switching it to the ARM position. The ELT cannot be reset if either the cockpit remote switch or the ELT local switch is in the ON position.

The transmitter can be activated manually at any time by placing either the remote switch or the ELT switch to the ON position.

NOTE

A monthly functional check is recommended to verify operational status of the ELT. Prior to testing, the aircraft must be located to receive GPS signals with avionics on. Within the first 5 minutes after the hour, select the cockpit remote switch to the test position for ~ 1 second and then return to the ARM/OFF position. The remote switch LED light and buzzer should then activate for ~ 2 seconds. If the 2 second LED light and buzzer indication is not received, refer to the ARTEX ELT 1000 maintenance manual.

7.35 EMERGENCY LOCATOR TRANSMITTER (continued)

ARTEX ELT 1000 OPERATION (continued)

The ARTEX ELT 1000 should be checked during postflight to make certain the unit has not been activated. Check by selecting 121.50 MHz on an operating receiver. If a downward sweeping audio tone is heard the ELT may have been activated. Set the remote switch to ON. If there is no change in the volume of the signal, your airplane's ELT is probably transmitting. Setting the remote switch back to ARM/OFF will automatically reset the ELT and should stop the signal being received on 121.50 MHz.