GARMIN

G1000™

system overview for
Mooney M20M & M20R

Record of Revisions			
Revision	**Date of Revision**	**Revision Page Range**	**Description**
A	05/16/05	------	Initial release.

2.1 SYSTEM DESCRIPTION

This document is designed to provide an overview of the G1000 Integrated Cockpit System as installed in Mooney M20M & M20R aircraft.

The G1000 system includes the following Line Replaceable Units (LRUs):

- GDU 1040 Primary Flight Display (PFD)
- GDU 1040 Multi Function Display (MFD)
- GIA 63 Integrated Avionics Units (2)
- GEA 71 Engine/Airframe Unit
- GDC 74A Air Data Computer (ADC)
- GRS 77 Attitude and Heading Reference System (AHRS)
- GMU 44 Magnetometer
- GMA 1347 Audio System with integrated Marker Beacon Receiver
- GTX 33 Mode-S Transponder
- GDL 69/69A Data Link

The LRUs are further described in the following section. All LRUs have a modular design, which greatly eases troubleshooting and maintenance of the G1000 system. A top-level G1000 block diagram is given in Figure 2.2.1. Additional or optional interfaces are depicted in Figure 2.2.2.

NOTE: Please refer to the Pilot's Guide Appendices for detailed specifications regarding the G1000 LRUs.

2.2 LINE REPLACEABLE UNITS

- **GDU 1040 –** The GDU 1040 features a 10.4-inch LCD display with 1024 x 768 resolution. The left display is configured as a PFD and the right display is configured as an MFD. Both GDU 1040s link and display all functions of the G1000 system during flight. The displays communicate with each other through a High-Speed Data Bus (HSDB) Ethernet connection. Each display is also paired via an Ethernet connection with a GIA 63 Integrated Avionics Unit.

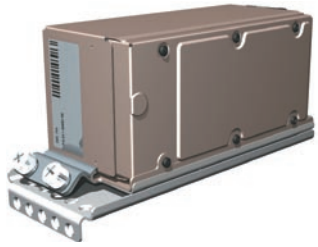
- **GMA 1347 –** The GMA 1347 integrates NAV/COM digital audio, intercom system and marker beacon controls. The GMA 1347 also controls manual display reversionary mode (red **DISPLAY BACKUP** button) and is installed between the MFD and the PFD. The GMA 1347 communicates with both GIA 63s using an RS-232 digital interface.

- **GIA 63 –** The GIA 63 is the central Integrated Avionics Unit (IAU) of the G1000 system. The GIA 63 functions as a main communication hub, linking all LRUs with the PFD and the MFD displays. Each GIA 63 contains a GPS receiver, VHF COM/NAV/GS receivers, and system integration microprocessors. Each GIA 63 is paired with a respective GDU 1040 display through Ethernet. The GIAs are not paired together and do not communicate with each other directly.

- **GRS 77 –** The GRS 77 is an Attitude and Heading Reference System (AHRS) that provides aircraft attitude and heading information to both the G1000 displays and the GIA 63s. The unit contains advanced sensors, accelerometers and rate sensors. In addition, the GRS 77 interfaces with both the GDC 74A Air Data Computer and the GMU 44 Magnetometer. The GRS 77 also utilizes GPS signals sent from the GIA 63. Attitude and heading information is sent using an ARINC 429 digital interface to both GDU 1040s and GIA 63s. AHRS modes of operation are discussed later in this document.

- **GMU 44 –** The GMU 44 Magnetometer measures local magnetic field information. Data is sent to the GRS 77 AHRS for processing to determine aircraft magnetic heading. This unit receives power directly from the GRS 77 and communicates with the GRS 77 using an RS-485 digital interface.

- **GDC 74A –** The GDC 74A Air Data Computer processes information from the pitot/static system as well as the outside air temperature (OAT) sensor. The GDC 74A provides pressure altitude, airspeed, vertical speed and OAT information to the G1000 system, and communicates with the GIA 63s, GDU 1040s and GRS 77 using an ARINC 429 digital interface.



- **GEA 71 –** The GEA 71 receives and processes signals from the engine and airframe sensors. Sensor types include engine temperature and pressure sensors as well as fuel measurement and pressure sensors. The GEA 71 communicates with both GIA 63s using an RS-485 digital interface.

- **GTX 33 –** The GTX 33 is a solid-state, Mode-S transponder that provides Modes A, C and S operation. The GTX 33 is controlled through the PFD and communicates with both GIA 63s through an RS-232 digital interface.

- **GDL 69/69A –** The GDL 69/69A is an XM satellite radio receiver that provides real-time weather information to the G1000 MFD. The GDL 69A also provides digital audio entertainment in the cockpit. The GDL 69/69A communicates with the MFD on the High-Speed Data Bus. A subscription to the XM Satellite Radio service is required for the GDL 69/69A to be used.

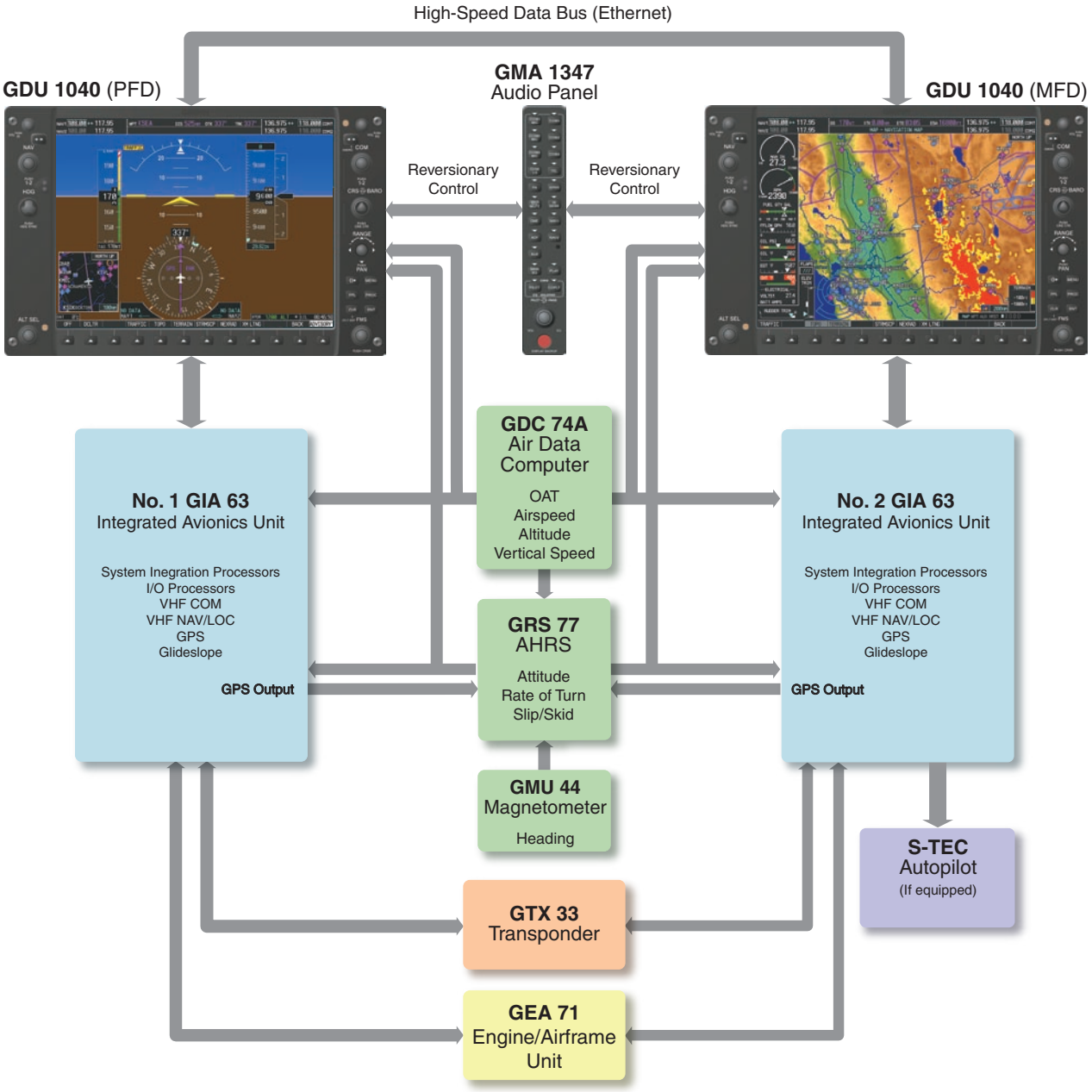


Figure 2.2.1 Basic G1000 System (Mooney)

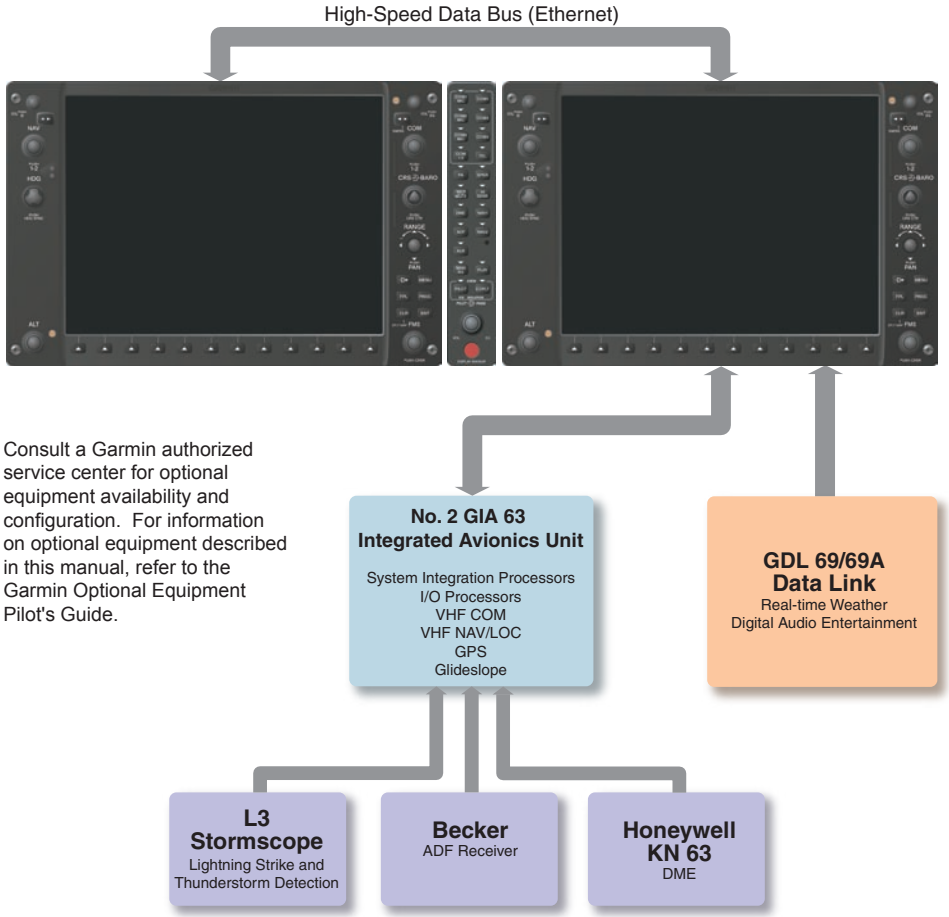


Figure 2.2.2 G1000 Optional Equipment

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2.3 PFD/MFD CONTROLS

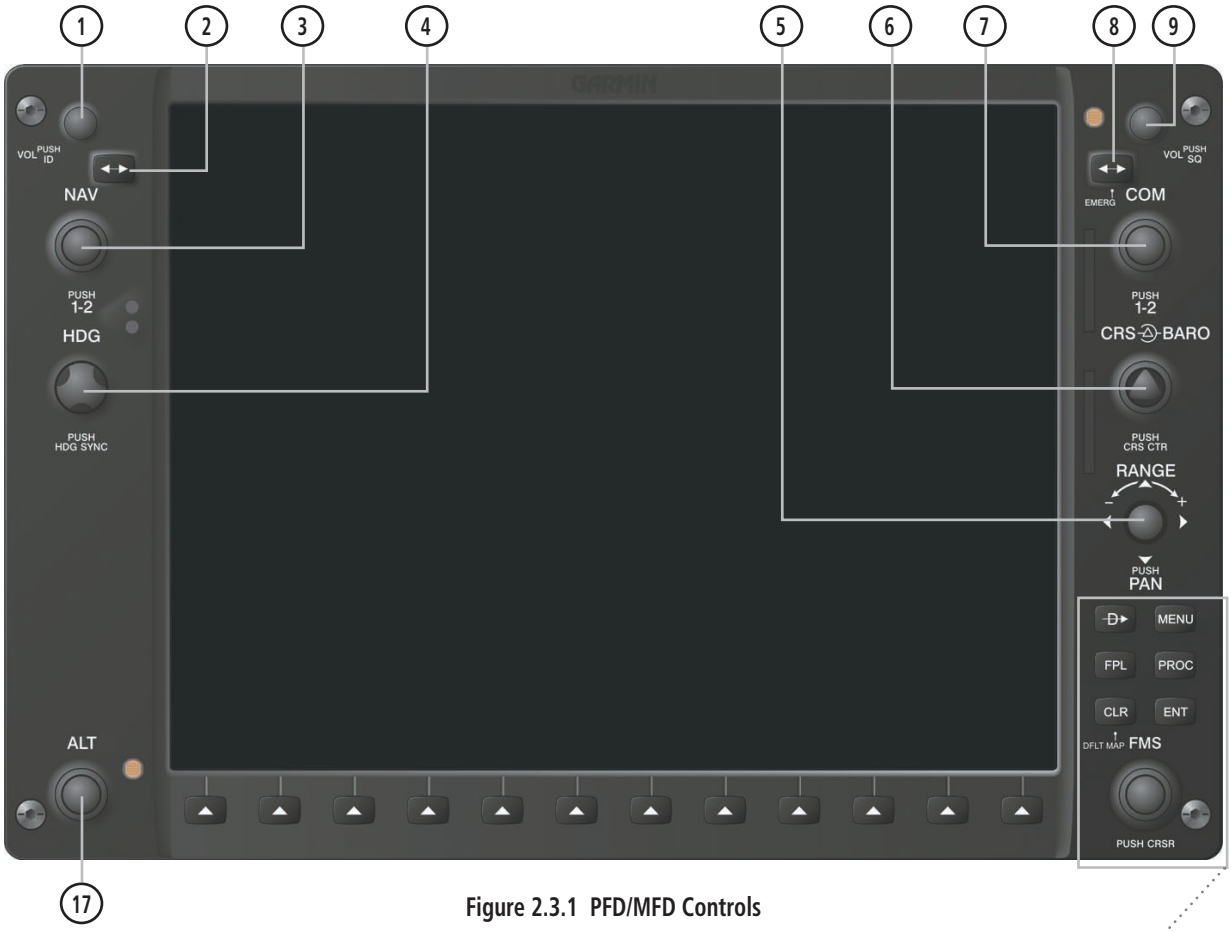
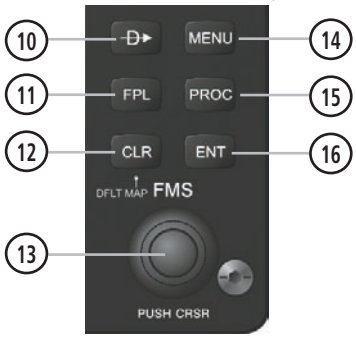


Figure 2.3.1 PFD/MFD Controls



1. NAV VOL/ID Knob
2. NAV Frequency Toggle Key
3. NAV Knob
4. Heading Knob
5. Range Joystick
6. Course/Baro Knob
7. COM Knob
8. COM Frequency Toggle Key
9. COM VOL/SQ Knob
10. Direct-to Key
11. Flight Plan Key
12. Clear Key
13. Flight Management System Knob
14. Menu Key
15. Procedure Key
16. Enter Key
17. Altitude Knob

The G1000 controls and keys have been designed to simplify the operation of the system and minimize workload as well as the time required to access sophisticated functionality. The following list provides an overview of the controls located on the display bezel.

- **(1) NAV VOL/ID Knob –** Controls the NAV audio level. Press to toggle the Morse code identifier ON and OFF. Volume level is shown in the field as a percentage.
- **(2) NAV Frequency Toggle Key –** Toggles the standby and active NAV frequencies.
- **(3) Dual NAV Knob –** Tunes the MHz (large knob) and kHz (small knob) standby frequencies for the NAV receiver. Press to toggle the tuning cursor (cyan box) between the NAV1 and NAV2 fields.
- **(4) Heading Knob –** Manually selects a heading when turned. Synchronizes the heading bug with the compass lubber line when pressed.
- **(5) Joystick –** Changes the map range when rotated. Activates the map pointer when pressed.
- **(6) CRS/BARO Knob –** The **large** knob sets the altimeter barometric pressure and the **small** knob adjusts the course. The course is only adjustable when the HSI is in VOR1, VOR2, or OBS/SUSP mode. Pressing this knob centers the CDI on the currently selected VOR.
- **(7) Dual COM Knob –** Tunes the MHz (**large** knob) and kHz (**small** knob) standby frequencies for the COM transceiver. Pressing this knob toggles the tuning cursor (cyan box) between the COM1 and COM2 fields.
- **(8) COM Frequency Toggle Key –** Toggles the standby and active COM frequencies. Pressing and holding this key for two seconds automatically tunes the emergency frequency (121.5 MHz) in the active frequency field.
- **(9) COM VOL/SQ Knob –** Controls COM audio level. Pressing this knob turns the COM automatic squelch ON and OFF. Audio volume level is shown in the field as a percentage.
- **(10) Direct-to Key () –** Allows the user to enter a destination waypoint and establish a direct course to the selected destination (specified by the identifier, chosen from the active route, or taken from the map cursor position).
- **(11) FPL Key –** Displays the active Flight Plan Page for creating and editing the active flight plan, or for accessing stored flight plans.
- **(12) CLR Key (DFLT MAP) –** Erases information, cancels an entry, or removes page menus. To display the Navigation Map Page immediately, press and hold **CLR** (MFD only).
- **(13) Dual FMS Knob –** Used to select the page to be viewed (only on the MFD). The **large** knob selects a page group (MAP, WPT, AUX, NRST), while the **small** knob selects a specific page within the page group. Pressing the **small** knob turns the selection cursor ON and OFF. When the cursor is ON, data may be entered in the different windows using the **small** and **large** knobs. The **large** knob is used to move the cursor on the page, while the **small** knob is used to select individual characters for the highlighted cursor location. When the G1000 displays a list that is too long for the display screen, a scroll bar appears along the right side of the display, indicating the availability of additional items within the selected category. Press the **FMS/PUSH CRSR** knob to activate the cursor and turn the **large FMS** knob to scroll through the list.
- **(14) MENU Key –** Displays a context-sensitive list of options. This list allows the user to access additional features, or to make setting changes that relate to certain pages.

- **(15) PROC Key –** Selects approaches, departures and arrivals from the flight plan. If a flight plan is used, available procedures for the departure and/or arrival airport are automatically suggested. If a flight plan is not used, the desired airport and the desired procedure may be selected. This key selects IFR departure procedures (DPs), arrival procedures (STARs) and approaches (IAPs) from the database and loads them into the active flight plan.
- **(16) ENT Key –** Accepts a menu selection or data entry. This key is used to approve an operation or complete data entry. It is also used to confirm selections and information entries.
- **(17) Dual ALT Knob –** Sets the reference altitude in the box located above the Altimeter. The **large** knob selects the thousands, while the **small** knob selects the hundreds.

NOTE: *The selected COM (displayed in green) is controlled by the COM MIC key on the audio panel (GMA 1347).*

2.4 SECURE DIGITAL CARDS

The GDU 1040 data card slots use Secure Digital (SD) cards. SD cards are used for aviation database updates and terrain database storage.

To install an SD card:

1. Insert the SD card in the SD card slot located on the right side of the display bezel (the front of the card should be flush with the face of the display bezel).

To remove an SD card:

1. Gently press on the SD card to release the spring latch and eject the card.

NOTE: *Please refer to the Pilot's Guide Appendices for instructions on updating the aviation database.*

2.5 SYSTEM POWER-UP

The G1000 system is integrated with the aircraft electrical system and receives power directly from electrical busses. The Garmin G1000 PFD/MFD and supporting sub-systems include both power-on and continuous built-in test features that exercise the processor, RAM, ROM, external inputs and outputs to provide safe operation.

While the system begins to initialize, test annunciations are displayed to the pilot at power-up, as shown in the figure below. All system annunciations should be cleared within one (1) minute of power-up. The GMA 1347 also annunciates all bezel lights briefly upon power-up.

NOTE: *Please see the Aircraft Flight Manual (AFM) for specific procedures concerning avionics power application and emergency power supply operation.*

On the PFD, the AHRS system displays the 'AHRS ALIGN: Keep Wings Level' message and begins to initialize. The AHRS should display valid attitude and heading fields within one (1) minute of power-up. The AHRS can align itself both while taxiing and during level flight.

NOTE: *Please refer to the Pilot's Guide Appendices for AHRS initialization bank angle limitations.*

NOTE: *See the Annunciations and Alerts Pilot's Guide for additional information regarding system annunciations and alerts.*

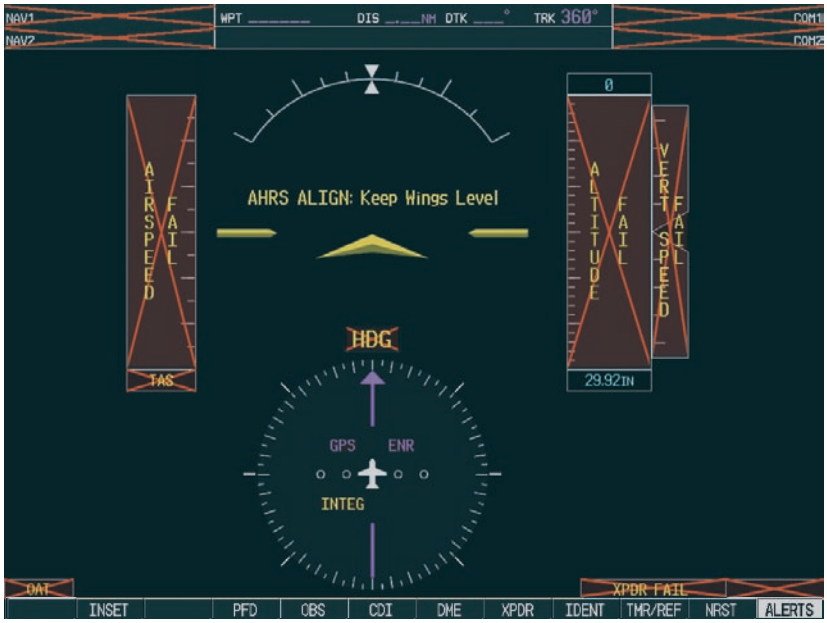


Figure 2.5.1 PFD Initialization

When the MFD powers up, the MFD Power-up Page displays the following information:

- System version
- Copyright
- Checklist filename
- Land database name and version
- Obstacle database name and version
- Terrain database name and version
- Aviation database name, version and effective dates

When this information has been reviewed for currency (to ensure that no databases have expired), the pilot is prompted to continue. Current database information is displayed with the valid operating dates, cycle number and database type.

Press the **ENT** key to acknowledge this information and proceed to the Navigation Map Page. When the system has acquired a sufficient number of satellites to determine a position, the Navigation Map Page appears, showing the aircraft current position.

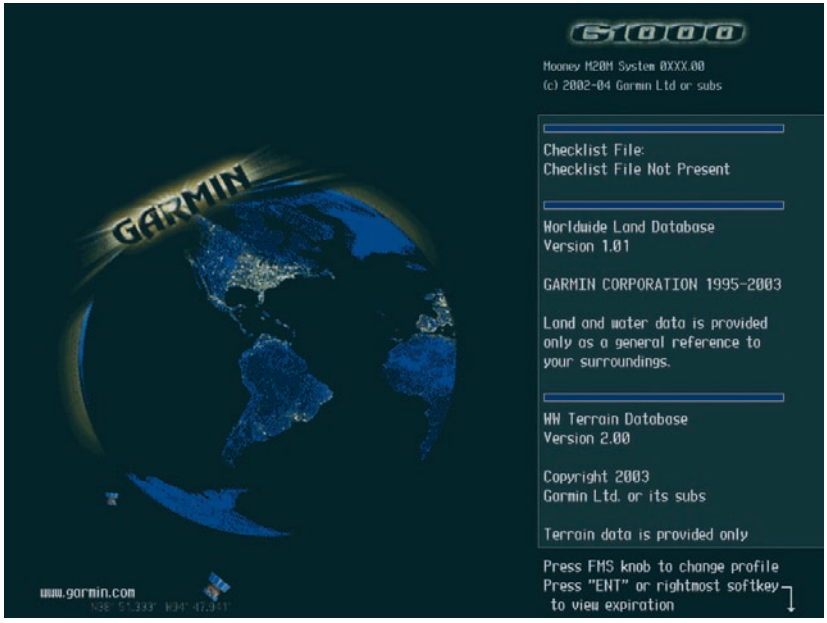


Figure 2.5.2 MFD Power-up Page

2.6 DISPLAY BACKLIGHTING

The G1000 PFD and MFD displays use photocell technology to automatically adjust for ambient lighting conditions. Photocell calibration curves are pre-configured to optimize display appearance through a broad range of cockpit lighting conditions. The PFD, MFD, and GMA 1347 bezel/key lighting is normally controlled directly by the existing instrument panel dimmer bus.

If desired, the PFD and MFD display backlighting may be adjusted manually. The PFD, MFD and GMA 1347 bezel/key brightness can also be adjusted manually. The GMA 1347 bezel/key brightness is directly tied to the MFD bezel/key adjustment.

NOTE: *Please refer to the Primary Flight Display Pilot's Guide for instructions on adjusting backlighting manually.*

2.7 SYSTEM OPERATION

NORMAL MODE

The PFD and MFD are connected together on a single Ethernet bus, allowing for high-speed communication between the two units. Each GIA 63 is connected to a single display, as shown in Figure 2.2.1. This allows the units to share information, thus enabling true system integration.

In normal operating mode, the PFD displays graphical flight instrumentation in lieu of the traditional gyro instruments. Attitude, heading, airspeed, altitude and vertical speed are all shown on one display. The MFD shows a full-color moving map with navigation information. Both displays offer control for COM and NAV frequency selection, as well as for the heading, course/baro and altitude reference functions. On the left of the MFD display, the Engine Indication System (EIS) cluster shows engine and airframe instrumentation. Figure 2.7.1 gives an example of the G1000 system in normal mode.

Figure 2.7.1 Normal Mode

REVERSIONARY MODE

Should a failure occur in either display, the G1000 automatically enters reversionary mode. In reversionary mode, all important flight information is shown on the remaining display. An example of reversionary mode entry due to a failed PFD is shown in Figure 2.7.2.

If a display fails, the GIA 63-GDU 1040 Ethernet interface is cut off. Thus, the GIA can no longer communicate with the remaining display (refer to Figure 2.2.1), and the NAV and COM functions provided to the failed display by the GIA are flagged as invalid on the remaining display, as a result. The system reverts to using backup paths for the GRS 77, GDC 74A, GEA 71 and GTX 33, as required. The change to backup paths is completely automated for all LRUs, and no pilot action is required.

NOTE: *The system alerts the pilot when backup paths are utilized by the LRUs. Refer to the Annunciations and Alerts Pilot's Guide for further information regarding these and other system alerts.*

Reversionary mode may also be manually activated by the pilot if the system fails to detect a display problem. Reversionary mode is activated manually by pressing the red **DISPLAY BACKUP** button at the bottom of the GMA 1347. Pressing this button again deactivates reversionary mode.

Figure 2.7.2 Reversionary Mode (Failed PFD)

AHRS OPERATION

In addition to using internal sensors, the GRS 77 AHRS uses GPS information, magnetic field data and air data to assist in attitude/heading calculations. In normal (primary) mode, the AHRS relies upon GPS and magnetic field measurements. If either of these external measurements is unavailable or invalid, the AHRS uses air data information for attitude determination. Four AHRS modes of operation are available (see table below) and depend upon the combination of available sensor inputs. Loss of air data, GPS, or magnetometer sensor inputs is communicated to the pilot by message advisory alerts.

GPS Input Failure

The G1000 system provides two sources of GPS information. If a single GPS receiver fails, or if the information provided from one of the GPS receivers is unreliable, the AHRS seamlessly transitions to using the other GPS receiver. An alert message informs the pilot of the use of the backup GPS path. If both GPS inputs fail, the AHRS continues to operate in reversionary 'No GPS' mode so long as the air data and magnetometer inputs are available and valid.

Air Data Input Failure

A failure of the air data input has no effect on AHRS output while AHRS is operating in normal/primary mode. A failure of the air data input while the AHRS is operating in reversionary 'No GPS' mode results in invalid attitude and heading information on the PFD (as indicated by red 'X' flags).

Magnetometer Failure

If the magnetometer input fails, the AHRS transitions to one of the reversionary 'No Magnetometer' modes and continues to output valid attitude information. However, the heading output on the PFD does become invalid (as indicated by a red 'X').

NOTE: *Please refer to the Annunciations and Alerts Pilot's Guide for specific AHRS alert information.*

NOTE: *Pilots should be aware that aggressive maneuvering in any of the three reversionary modes listed below can degrade AHRS accuracy.*

AHRS Mode	Available AHRS Functions			Available Sensor Inputs		
	Pitch	Roll	Heading	GPS Input (At least one)	GMU 44 Magnetometer	GDC 74A Air Data Computer
Normal/Primary	X	X	X	X	X	X
Reversionary: No GPS	X	X	X	-	X	X
Reversionary: No Magnetometer	X	X	-	X	-	X
Reversionary: No Magnetometer No Air Data	X	X	-	X	-	-

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190-000442-01 Rev. A