

# **G1000<sup>TM</sup>**

*system overview for  
the Diamond DA40*

**Record of Revisions**

<b>Revision</b>	<b>Date of Revision</b>	<b>Revision Page Range</b>	<b>Description</b>
A	02/14/05	2-1 – 2-15	Initial release.

## 2.1 SYSTEM DESCRIPTION

This document is designed to provide an overview of the G1000 Integrated Cockpit System as installed in the Diamond DA40 aircraft.

The G1000 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 & Heading Reference System (AHRS)
- GMU 44 Magnetometer
- GMA 1347 Audio System with integrated Marker Beacon Receiver
- GTX 32 or 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:** Refer to the G1000 Pilot's Guide Appendices for detailed specifications regarding the G1000 LRUs.

## 2.2 LRU DESCRIPTIONS

- **GDU 1040** – The GDU 1040 has 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 a 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 with an Ethernet connection to 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 is the main communications 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 GDU 1040 display through an Ethernet connection. The GIAs do not communicate with each other directly.



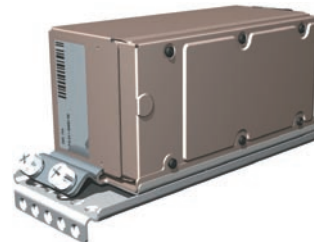
- **GRS 77** – The GRS 77 is an Attitude and Heading Reference System (AHRS) that provides aircraft attitude and heading information to both the G1000 displays and the GIA 63s. The unit contains advanced sensors, accelerometers, and rate sensors. In addition, the GRS 77 interfaces with the GDC 74A Air Data Computer and the GMU 44 Magnetometer. The GRS 77 also utilizes two GPS signal inputs sent from the GIA 63s. Attitude and heading information is sent using an ARINC 429 digital interface to both GDU 1040s and GIA 63s. The 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 received from the pitot/static system and 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.



- **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.



- **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.



# SYSTEM OVERVIEW

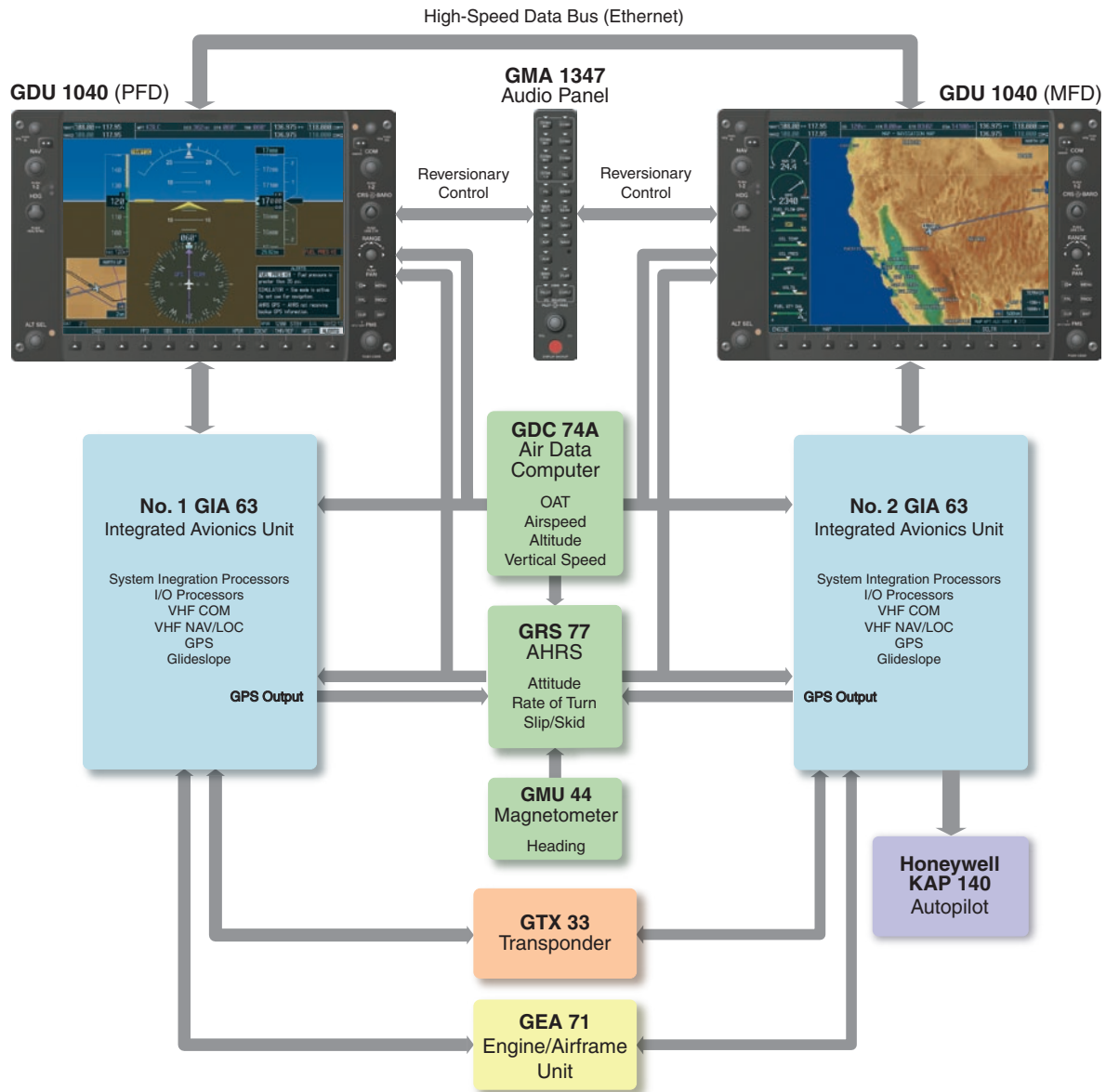


Figure 2.2.1 Basic G1000 System

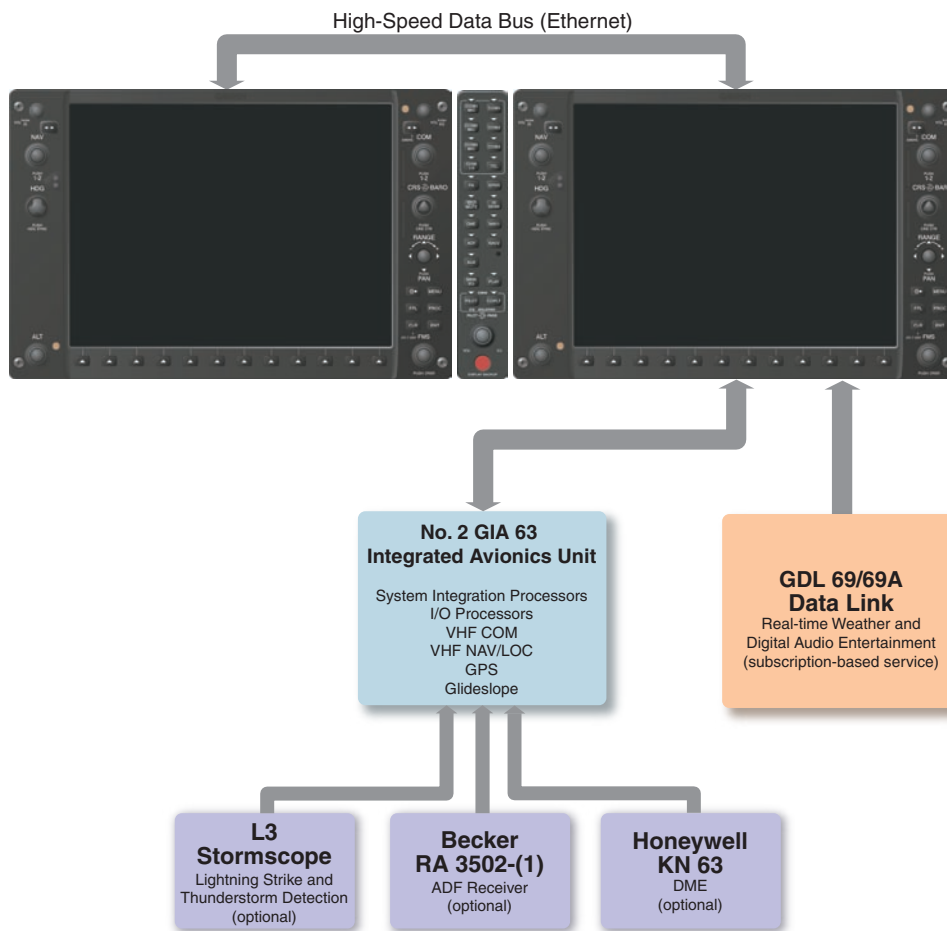


Figure 2.2.2 G1000 Optional Features



**NOTE:** For information on all optional equipment shown in the above figure, consult the applicable optional interface user's guide. This document assumes that the reader is already familiar with the operation of this additional equipment.

## 2.3 PFD/MFD CONTROLS

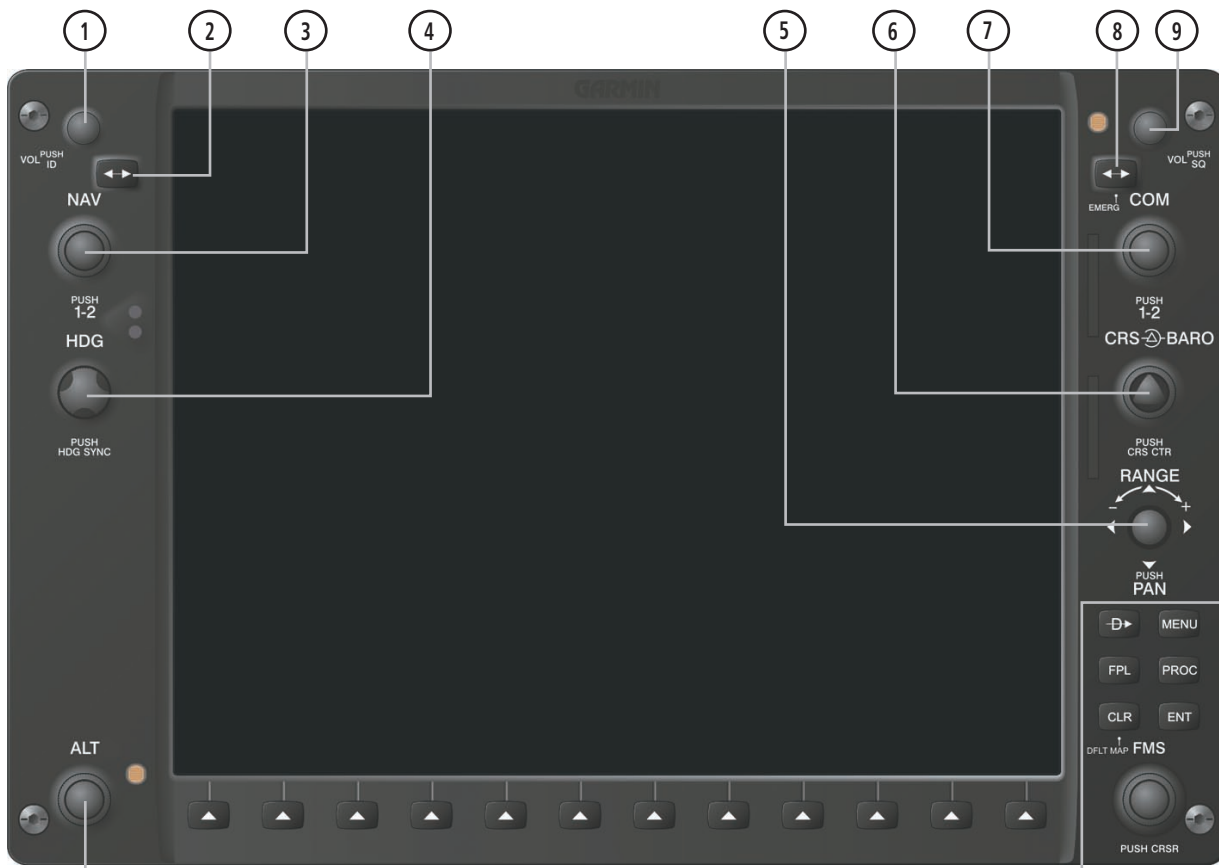
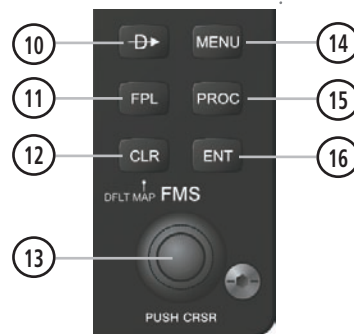



Figure 2.3.1 PFD/MFD Controls

- 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 to minimize workload as well as the time required to access sophisticated functionality. The following list provides an overview of the primary function(s) of the keys and knobs 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 this knob is pressed, a window displaying a digital heading momentarily appears to the left of the heading indicator and the heading bug synchronizes with the compass lubber line.
- **(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 the 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 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 immediately display the Navigation Map Page, press and hold the **CLR** key (MFD only).
- **(13) Dual FMS Knobs** – 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 a combination of 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 of information that is too long for the display screen, a scroll bar appears along the right side of the display to indicate the availability of additional items within the selected category. Press the **FMS/PUSH CRSR** knob to activate the cursor and turn the **large** knob to scroll through the list.
- **(14) MENU Key** – Displays a context-sensitive list of options. This option 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. When using a flight plan, 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 to complete data entry. It is also used to confirm selections and information entries.
- **(17) Dual ALT Knob** – Sets the reference altitude in the window located above the Altimeter. The **large** knob selects the thousands, while the **small** knob selects the hundreds.




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

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## 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.




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

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## 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 clear within one (1) minute of power-up. The GMA 1347 also annunciates all bezel lights briefly upon power-up.

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 while the aircraft is taxiing or during level flight.



**NOTE:** Refer to the approved Airplane Flight Manual Supplement (AFMS) for specific procedures concerning avionics power application and emergency power supply operation.



**NOTE:** Refer to the G1000 Pilot's Guide Appendices for AHRS initialization bank angle limitations.



**NOTE:** Refer to the Annunciations and Alerts Pilot's Guide for more 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 data:

- 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 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. 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. PFD, MFD, and GMA 1347 bezel/key brightness can also be adjusted manually as well. GMA 1347 bezel/key brightness is directly tied to the MFD bezel/key adjustment.



**NOTE:** Refer to the *Primary Flight Display Pilot's Guide* for instructions on how to manually adjust the backlighting.

## 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, enabling true system integration.

In normal operating mode, the PFD displays graphical flight instrumentation in lieu of 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 G1000 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. Figure 2.7.2 shows an example where the PFD fails.

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. 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 G1000 Reversionary Mode (Failed PFD)

## AHRS MODES OF 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 external measurement is unavailable or invalid, the AHRS uses air data information to assist in attitude determination. Four AHRS modes of operation are available (see table below) and depend upon the combination of the sensor inputs available. 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 transitions seamlessly 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 air data and magnetometer inputs are available and valid.

### Air Data Input Failure

A failure of the air data input has no effect on the 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 is flagged as invalid with a red 'X'.



**NOTE:** Refer to the G1000 Annunciations and Alerts Pilot's Guide for specific AHRS alert information.



**NOTE:** 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
<b>Normal/Primary</b>	X	X	X	X	X	X
<b>Reversionary: No GPS</b>	X	X	X	–	X	X
<b>Reversionary: No Magnetometer</b>	X	X	–	X	–	X
<b>Reversionary: No Magnetometer No Air Data</b>	X	X	–	X	–	–

## 2.8 CHECKLISTS

The G1000 MFD is able to display electronic checklists customized for the Diamond DA40. The G1000 accesses the Diamond DA40 checklists from an SD card which is inserted into a slot on the bezel.

**If the SD card contains a valid checklist file**, the Power-up Page displays both the aircraft make and model to which the checklist applies (DA40, DIAMOND AIRCRAFT INDUSTRIES) and copyright information.

### With the Checklist Page displayed:

- **If the SD card contains an invalid checklist file**, the page displays 'INVALID CHECKLIST'.
- **If the SD card does not contain any checklist**, the page displays 'CHECKLIST NOT PRESENT'.

**If a valid checklist file exists**, pressing the **CHKLIST** softkey allows access to all checklists. Pressing the **EXIT** softkey exits the Checklist Pages and displays the page last viewed.




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**NOTE:** *The checklists cannot be edited from within the system. Refer to the Garmin Aviation Checklist Editor (ACE) User's Guide for information on creating and editing checklists.*

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The Checklist Page displays the following data:

- Selected checklist group
- Selected checklist title
- Selected checklist text, including:
  - Plain text
  - Notes
  - Cautions
  - Warnings
  - Challenge/Response pairs
  - Challenges with no responses
  - Check state of each checkable item
  - Checklist complete indicator



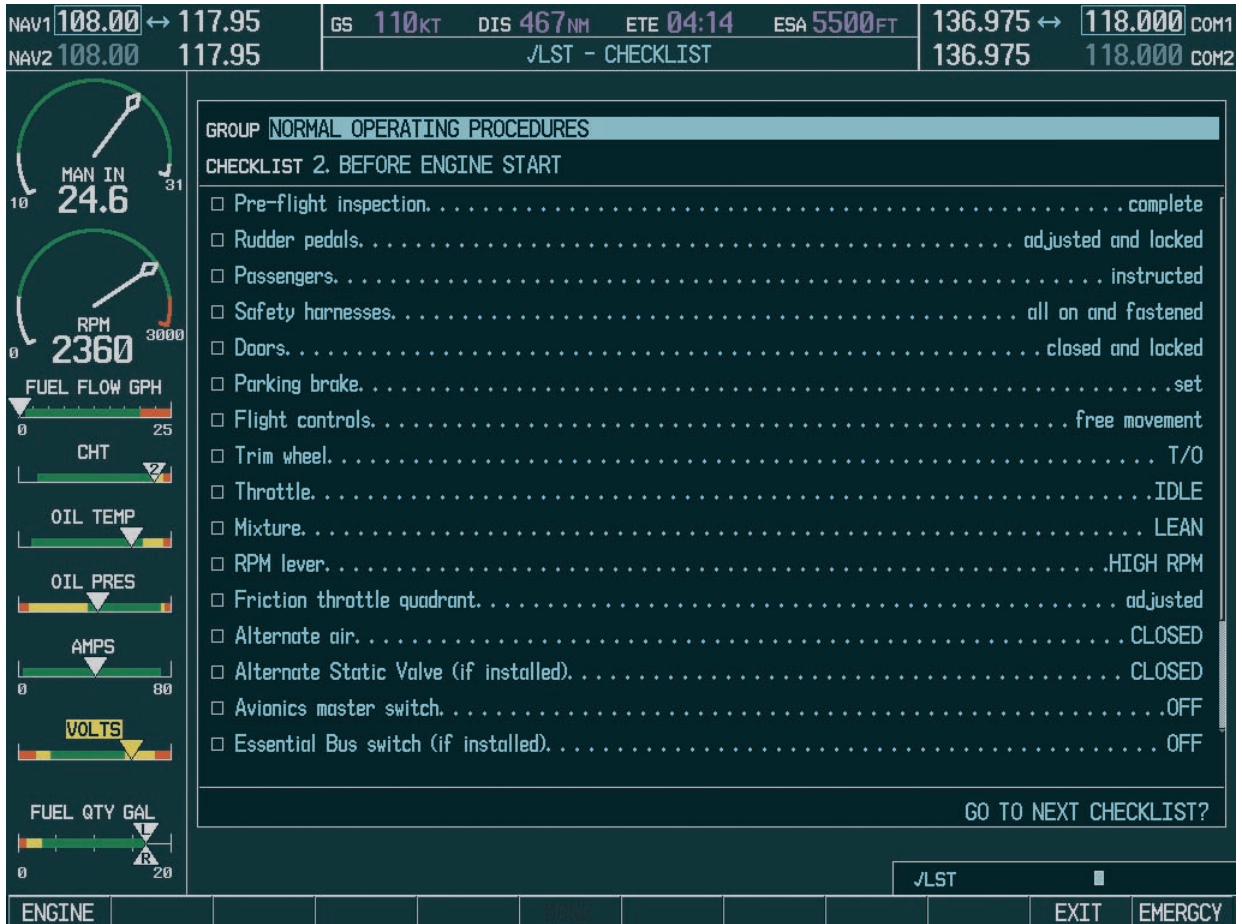


Figure 2.8.1 Sample Checklist



Garmin International, Inc.  
1200 East 151st Street  
Olathe, KS 66062, U.S.A.  
p: 913.397.8200 f: 913.397.8282

Garmin AT, Inc.  
2345 Turner Road SE  
Salem, OR 97302, U.S.A.  
p: 503.391.3411 f: 503.364.2138

Garmin (Europe) Ltd.  
Unit 5, The Quadrangle  
Abbey Park Industrial Estate  
Romsey, SO51 9DL, U.K.  
p: 44/0870.8501241 f: 44/0870.8501251

Garmin Corporation  
No. 68, Jangshu 2nd Road  
Shijr, Taipei County, Taiwan  
p: 886/2.2642.9199 f: 886/2.2642.9099

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