GARMIN®

G1000™

pilot's training guide

Garmin International, Inc., 1200 East 151st Street, Olathe, Kansas 66062, U.S.A.
Tel: 913/397.8200 Fax: 913/397.8282

Garmin AT, Inc., 2345 Turner Road SE, Salem, Oregon 97302, U.S.A.
Tel: 503.391.3411 Fax 503.364.2138

Garmin (Europe) Ltd., Unit 5, The Quadrangle, Abbey Park Industrial Estate, Romsey, Hampshire S051 9DL, U.K.
Tel: 44/1794.519944 Fax: 44/1794.519222

Garmin Corporation, No. 68, Jangshu 2nd Road, Shijr, Taipei County, Taiwan
Tel: 886/02.2642.9199 Fax: 886/02.2642.9099

Web Site Address: www.garmin.com

November 2004 Printed in the U.S.A.

This page intentionally left blank.

G1000 Integrated Cockpit System

The G1000™ is a completely integrated avionics system designed to fit a broad range of aircraft models. It is an all-glass flight deck that presents flight instrumentation, location, navigation, communication and identification data on large-format, high-resolution displays. The digital data presentation on the G1000 puts all flight-critical information literally at the pilot's fingertips.

Purpose

This Pilot's Training Guide is provided to help the pilot transition to Garmin G1000-equipped aircraft. Use this study guide in combination with the G1000 Simulator and/or the G1000 Pilot's Guide as well as your flight instructor's guidance and feedback to maximize your G1000 training before taking delivery of your new G1000-equipped aircraft.

NOTE: *Ground lessons should be completed before starting flight training.*

NOTE: *In this training guide, each lesson contains exercises as well as a list of resources that are recommended before completing these exercises.*

Flight and Ground Instruction

It is important to coordinate your ground lessons with a properly trained flight instructor. Work with your instructor to make sure that you fully understand the system. This training guide works best if you involve your instructor from the very beginning.

Work with your instructor to ensure that your flight lessons cover all appropriate material. Note that your instructor may determine that additional training is required to review aircraft systems, procedures, airspace, or other knowledge areas. Do practice until both you and your instructor are confident in your proficiency with the G1000 system.

Level of Knowledge Attained

The material contained in the Pilot's Training Guide is designed to help you progress from basic to advanced levels of knowledge. The basic skills of interpreting the Primary Flight Display, tuning the radios and operating the audio panel are covered early on in the training material. Later sections cover navigation, terrain and other more complex material. The Pilot's Training Guide was designed in this manner so that you and your instructor could begin basic training quickly.

NOTE: *It is not necessary to complete the Navigation portion of the material before taking off on a local training flight.*

This page intentionally left blank.

Ground Lesson 1

INTRODUCTION AND G1000 SYSTEM OVERVIEW

Objectives

Upon completion of this lesson, the pilot should be able to do the following:

- Describe the basic components of the G1000 Integrated Avionics System
- Describe the communication between G1000 components

Resources

- G1000 Pilot's Guide
- Aircraft AFM and AFM supplements
- Aeronautical Information Manual
- Federal Aviation Regulations

Exercise 1.1: Terminology and Review of Pertinent Federal Aviation Regulations

1. Define the following navigation terms:
   - TRK
   - DTK
   - VNAV
   - CTS
2. Explain the use of and limitations of a TSO-C129a GPS during instrument approaches per the AIM.
3. When filling a flight plan, what suffix is used when you have a current GPS database?
4. When can GPS be used in lieu of DME and ADF?
5. Describe the differences between a fly-by and a fly-over GPS waypoint and draw their respective symbols.
6. What does RAIM stand for? Describe its purpose.
7. You are on the RNAV(GPS) 17 approach into KIXD (New Century Aircenter, Olathe, KS) and the system displays the "RAIM UNAVAIL" alert inside the Final Approach Fix. The weather is reported as 500 feet overcast with 2 statute miles of visibility. What action(s) do you take and why?

Exercise 1.2: Component Review

1. Define the following equipment terms:
   - AHRS
   - ADC
   - TIS
   - Terrain
2. Describe the function of the following components of the G1000 Integrated Avionics System:
   - GRS 77
   - GMU 74
   - GIA 63
   - GDU 1040
   - GTX 33
   - GMA 1347
3. What is the primary interface used between the G1000 components?

Ground Lesson 2

TRANSITION TO THE PRIMARY FLIGHT DISPLAY (PFD)

Objectives

Upon completion of this lesson, the pilot should be able to read, understand and interpret the primary six (6) instruments that are displayed on the PFD and that indicate airspeed, attitude, altitude, vertical speed, turn rate/coordination and heading.

Resources

- G1000 Pilot's Guide
- G1000 cockpit poster

After reviewing the material listed above, the pilot should complete the following exercises.

Exercise 2.1: Instrumentation Layout

In the space provided below, sketch the primary six (6) instruments as displayed on the PFD.

Exercise 2.2: Instrumentation Depiction

Assume that your aircraft is flying with the following indications and fill in the appropriate fields on your sketch with this data.

- Airspeed = 120 KIAS
- True Airspeed = 135 KTAS
- Altitude = 9,000 ft
- Vertical Speed = 0 fpm
- Heading = 95°
- Barometer = 29.82" Hg

Ground Lesson 3

POWER-UP, SELF-TEST, CHECKLIST

Objectives

Upon completion of this lesson, the pilot should be able to correctly identify proper alignment of the AHRS/ADC, complete a system self-test and verify the database data.

Resources

- G1000 Pilot's Guide
- G1000 PC-based simulator

Exercise 3.1: System Initialization

1. Is the aircraft required to remain stationary while the AHRS and ADC align?

2. Is there any warm-up time required for the engine instrumentation to be accurate?

3. What is the pilot action that should be taken if the MFD system self-test does not pass?

4. Where can you verify the effective dates of the Jeppesen database during the initial system start-up?

5. If the Jeppesen database is not current in the G1000, can the system still be used for IFR flight?

6. You are planning a flight to KAPA (Centennial Airport, Denver, CO) from KCOU (Columbia, MO). When you arrive at the aircraft, you notice that the Jeppesen database data is out of date by 3 cycles (84 days).

   6a. Can you make the flight under Instrument Flight Rules (IFR)?

   6b. What enroute flight planning considerations do you have to make?

   6c. What destination flight planning considerations do you have to make?

Ground Lesson 4

TRANSPONDER OPERATION

Objectives

Upon completion of this lesson, the pilot should be familiar and comfortable with the operation of the integrated transponder controls located on the PFD of the G1000 system; this includes the selection of the transponder operating mode, squawk code entry and IDENT activation.

Resources

- G1000 Pilot's Guide
- G1000 PC-based simulator

Exercise 4.1: Operating Modes and Code Entry

1. Which transponder mode of operation does the G1000 system default to when it is first powered up if it is equipped with the Garmin mode S transponder (GTX 33)?

2. Describe the process for entering a newly assigned transponder code.

Exercise 4.2: Practice (Optional)

Using the G1000 PC-based simulator, review the start-up process while verifying the Jeppesen database effective dates and then practice entering various transponder codes and operating modes using the PFD softkeys.

Ground Lesson 5

COM RADIO AND AUDIO PANEL OPERATION

Objectives

Upon completion of this lesson, the pilot should be comfortable tuning and selecting communication frequencies using the manual and database tuning features of the G1000 system, while properly configuring the selections on the GMA 1347 audio panel.

Resources

- G1000 Pilot's Guide
- G1000 cockpit poster
- G1000 PC-based simulator

Exercise 5.1: COM Operation and Methods of Frequency Tuning

1. Is the active frequency being used displayed to the inside or to the outside relative to the bezel of the G1000 navigation displays (GDU 1040)?

2. In what color is the active frequency displayed?

3. Which key should be pressed to change between the standby and active frequency? Draw this key.

4. If the COM radio frequency toggle key is held for 2 seconds, what occurs?

5. When manually tuning a frequency, what is the purpose of the large COM knob? What is the purpose of the small COM knob?

6. When the NRST softkey is pressed on the PFD, a list of the nearest airports appears, with runway length and tower/CTAF frequencies listed. How can the frequency be tuned in directly without manually tuning it into the COM radio?

Exercise 5.2: Practice (Optional)

Using the G1000 PC-based simulator, power up the system.

1. Verify the Jeppesen database effective dates and note those dates in the space provided below.
2. Enter the transponder code "3470" and set the transponder to "ALT" mode.
3. In COM 1, enter 124.30 MHz as the active frequency and 133.00 MHz as the standby frequency.
4. In COM 2, enter 135.325 MHz as the active frequency and 118.90 MHz as the standby frequency.

Exercise 5.3: Audio Panel Operation

1. Which key should be used on the audio panel (GMA 1347) to monitor a COM radio frequency without using it to transmit on?
2. Describe how the split COM feature works and provide a sample scenario of its use.
3. Describe the function of the digital clearance recorder.
4. What purpose does the red button located at the bottom of the audio panel (GMA 1347) serve?
5. When the PILOT ICS key is pressed, can the other passengers in the aircraft communicate with each other via the intercom?
6. Does the COM MIC key selection have any impact on the display of the COM frequencies on the PFD or MFD? Explain.
7. You are flying a long cross-country flight and encounter bad weather. Another pilot is sitting in the right seat. You want to get a weather update, but you are struggling to get on frequency and be heard because the ARTCC frequency is very busy handling multiple reroutes. What tools are available to you to get the necessary weather information to continue the flight?

Ground Lesson 6

NAVIGATION

Objectives

Upon completion of this lesson, the pilot should be able to navigate using ground-based navaids and GPS, while manually tuning VOR/LOC/ILS frequencies and creating direct-to and flight-plan-based GPS navigation.

Resources

- G1000 Pilot's Guide
- G1000 cockpit poster
- G1000 PC-based simulator

Exercise 6.1: Land-based Navigational Aids

1. Is the process to manually tune in the NAV frequency the same as it is to manually tune in a COM frequency?

2. When using the database to tune in a NAV frequency, is the process the same as it is for tuning a COM frequency?

3. What type of information is provided about a ground-based navigation aid when it is highlighted by panning on the MFD map and pressing the ENT key?

4. How and where do you select the CDI information displayed on the HSI for the NAV 1 or NAV 2 frequencies?

5. Does the G1000 system automatically attempt to identify the tuned NAV frequency? How is this visually presented?

Exercise 6.2: Practice (Optional)

Using the G1000 PC-based simulator, power up the system and configure the G1000 as needed for the following IFR clearance out of KAPA (Centennial Airport, Denver, CO): "**N12345 is cleared to the Goodland, KS airport via the Thurman VOR, Byers VOR, then direct. Climb and maintain eight thousand, expect one-two thousand in ten minutes. Departure frequency is 126.75, squawk 3470**."

Exercise 6.3: GPS Navigation

1. Can you create a direct-to navigation/flight plan using the GPS on both the PFD and the MFD or must you use one or the other – and if so, which one?

2. Describe the process for cancelling a direct-to GPS navigation.

3. Describe the process for entering a Flight Plan.

4. When using the Flight Plan function, does the unit auto-sequence the waypoints and does the autopilot continuously fly the programmed route?

5. Describe some of the advantages to using the Flight Plan function as opposed to continuous direct-to navigation.

Exercise 6.4: Practice (Optional)

Using the G1000 PC based simulator, power up the system.

1. Verify the Jeppesen database effective dates and note those dates in the space provided below.
2. Enter the transponder code "1252" and set the transponder to "ALT" mode.
3. In COM 1, enter the ATIS frequency for KAPA as the active frequency and the ground control frequency as the standby frequency.
4. In COM 2, enter the KAPA Tower frequency as the active frequency and the Departure frequency for an eastbound departure as the standby frequency.
5. Tune in and place the Thurman, CO VOR (TXC) into the active NAV 1 frequency; tune in and place the Beyers, CO VOR (BVR) into the active NAV 2 frequency.
6. Create a Flight Plan from KAPA to KIXD via Thurman, Goodland, Hill City, Salina, Topeka VORs and the RUGBB intersection.

Exercise 6.5: Instrument Approaches

1. When first selecting an approach, what is the default option that appears when you select the PROC key?

2. What is the difference in how the HSI presents data between selecting Vectors-to-Final and selecting an Initial Approach Fix during an instrument approach?

3. Describe the CDI sensitivity scaling that occurs when flying a GPS approach.

4. When navigating using the GPS, if an ILS, LOC, or VOR approach is selected, where is the frequency for the primary approach navigational aid automatically placed?

5. When flying an ILS approach, where do the glide-slope indicator and marker beacon annunciation appear on the PFD?

6. Can GPS be used to shoot a VOR approach?

7. Does GPS provide guidance data to the autopilot to allow it to fly a coupled holding pattern?

8. Can GPS be used in lieu of DME when flying a DME arc associated with a VOR, LOC, or ILS approach procedure?

9. What key must be pressed to access the ability to add a departure procedure (DP or SID) and/or arrival procedure (AP or STAR) to a flight plan?

10. When navigating in NAV1 or NAV2 mode, if an ILS, LOC, or VOR approach is selected, where is the frequency for the primary approach navigational aid automatically placed?

Exercise 6.6: Practice (Optional)

Using the G1000 PC-based simulator, power up the system.

1. Verify the Jeppesen database effective dates and note those dates in the space provided below.
2. Enter the transponder code "5455" and set the transponder to "ALT" mode.
3. In COM 1, enter the ATIS frequency for KAPA as the active frequency and the ground control frequency as the standby frequency.
4. In COM 2, enter the KAPA Tower frequency as the active frequency and the Departure frequency for an eastbound departure as the standby frequency.
5. Assume that you are departing KAPA and select and load the Plains Two Departure, Goodland Transition (PLAIN2.GLD) with the rest of the flight plan going from KAPA to KMKC via the Hill City and Salina VORs with the Jayhawk Five Arrival via the Emporia Transition (EMP.JHAWK5) and expect the ILS 3 Approach into Kansas City Charles B. Wheeler Downtown Airport.
6. Load VOR frequencies as appropriate to monitor the progress of the flight along with the GPS navigation.
7. Initiate the flight on the simulator. Enroute just east of Goodland, you receive the following amended clearance from ARTCC: "***N12345, I am showing level-4 radar returns on my radar over the Hill City VOR, in a line that runs from 40 miles to the southwest of Hill City to 150 miles to the northeast. The entire storm appears to be moving east at 30 knots***." You were planning on stopping for fuel in Salina, but you realize that the storm will be on top of the airport by the time you arrive there. Note that your aircraft is not equipped with a Stormscope or datalink weather. What are your options? Rank these options from best to worst.

Ground Lesson 7

MULTI FUNCTION DISPLAY (MFD) OPERATION

Objectives

Upon completion of this lesson, the pilot should be able to locate, use and configure data on the MFD during flight operations.

Resources

- G1000 Pilot's Guide
- G1000 cockpit poster
- G1000 PC-based simulator

Exercise 7.1: MFD Configuration and Controls

1. Which main type of data is presented on the default MFD display?
2. What data types can be overlaid on the moving map? Where are the controls for this data overlay located?
3. Which MFD page group and page must be accessed to verify the status of the two (2) GPS receivers?
4. How do you access the Nearest (NRST) pages?
5. What types of information can be accessed via the Waypoint (WPT) pages?
6. From which page and via which key can the map display be changed between north-up and track-up presentations?
7. When panning on the Map page, where does information appear about the terrain location over which the cursor arrow is?
8. Which page should be accessed in order to change the data field options at the top of the MFD display?
9. Which key should be pressed and held for 2 seconds to automatically and quickly return to the Navigation Map page?

(exercise continued on next page)

10. You are on a flight from KAPA (Centennial Airport, Denver, CO) to KGJT (Grand Junction Airport, Grand Junction, CO) over the mountains. Weather is predicted to be MVFR with scattered rain over the entire route of flight. How would you configure the MFD to give you the best presentation of data for this flight? Assume that a GDL-69 weather datalink is installed in the aircraft.

Ground Lesson 8

PRIMARY FLIGHT DISPLAY (PFD) OPERATION

Objectives

Upon completion of this lesson, the pilot should be able to configure and interpret data presented on the PFD during all phases of flight operations.

Resources

- G1000 Pilot's Guide
- G1000 cockpit poster
- G1000 PC-based simulator

Exercise 8.1: PFD Configuration and Controls

1. Where is the control for cycling between the GPS, NAV1 and NAV2 CDI selections that appear on the HSI?

2. Name the two (2) types of presentation that are available for the HSI?

3. What type of data can be overlaid on the Map Inset?

4. Can the data fields located at the top of the PFD be changed by the pilot?

5. From the PFD, can the pilot enter, view and edit a flight plan?

6. Where is the course selection knob or OBS (omni-bearing selector) knob located?

7. What happens when the HDG knob is pressed?

8. What happens when the CRS knob is pressed?

9. Where is the control for the altimeter barometric pressure located?

10. How many feet of altitude and how many knots of airspeed make up the ranges of the altimeter and airspeed indicator, respectively?

(exercise continued on next page)

11. You are flying through the Rocky Mountains and decide to land at KASE in Aspen, CO. You are assigned the RNAV (GPS) 15 approach via radar vectors. It is daytime, although visibility is limited to a few miles with cloud tops at 10,000 feet MSL. What options do you select to display on the PFD map inset?

Ground Lesson 9

WEATHER, TERRAIN AND TRAFFIC AWARENESS

Objectives

Upon completion of this lesson, the pilot should be able to accurately interpret terrain awareness and Traffic Information Service (TIS) data while both incorporating this information into the aeronautical decision making process and understanding the limitations of these systems.

Resources

- G1000 Pilot's Guide

Exercise 9.1: Weather, Terrain and TIS Operation

1. When flying an aircraft with the WX-500 Stormscope installed, where can the lightning data be displayed?
2. How is the data presented by the G1000 system for the WX-500?
3. When a lightning bolt is changed to a "+" symbol, what does this change denote?
4. Describe the service volume for the Traffic Information Service.
5. Is the terrain awareness feature in the G1000 system certified to allow deviations from ATC assigned altitudes?
6. In the terrain awareness feature, what do the colors red and yellow each represent?
7. Finish the following sentence: "TIS traffic and the terrain awareness feature of the G1000 are ___________ ____________ tools".
8. With TIS, when does the G1000 system provide an audible alert of "Traffic"?

Ground Lesson 10

EMERGENCY PROCEDURES

Objectives

Upon completion of this lesson, the pilot should be able to navigate using ground-based navaids and GPS while manually tuning VOR/LOC/ILS frequencies and creating direct-to and flight-plan-based GPS navigation.

Resources

- G1000 Pilot's Guide
- G1000 cockpit poster
- G1000 PC-based simulator

Exercise 10.1: Emergencies and Failure Modes

1. If one display fails, which mode does the system automatically go into?

2. How is an AHRS failure indicated on the G1000?

3. When the AHRS and/or ADC fail, what remedial action should be taken by the pilot?

4. What information is presented to the pilot when a display is operating in Reversionary mode?

5. Describe the aircraft on-board power sources that remain in case of alternator failure and also provide an explanation as to their operation, including a basic description of each power bus.

6. In flight, during a cross country, an AHRS failure occurs (failure indicated by a red X over the attitude indicator). Note: your aircraft is equipped with an autopilot which has its own rate-based gyro as well.

    6a. Aside from the backup attitude indicator, what items can you use to ensure safe flight?

    6b. What are your next actions concerning the completion of the flight? Note that, depending on the circumstances, the following action items may occur in a different order.

    6c. When the AHRS fails, what is the other piece of information that is lost besides attitude?

This page intentionally left blank.

THE G1000 INTEGRATED AVIONICS SYSTEM AND CONSIDERATIONS OF ITS USE TO ENHANCE THE AERONAUTICAL DECISION MAKING (ADM) PROCESS AND SINGLE-PILOT RESOURCE MANAGEMENT (SRM).

The Garmin G1000 Integrated Avionics System has brought a number of improvements in cockpit technology to the General Aviation (GA) aircraft. These improvements range from longer life and greater reliability of the primary instruments to a simplified pilot interface. With the addition of new technologies, the G1000 system is capable of providing the pilot with a wider variety of information about the flight environment, thereby leading to greater situational awareness and reduced pilot workload. The G1000 system allows the pilot to focus on aeronautical decision making (ADM) and single-pilot resource management (SRM).

The majority of GA flight operations are single-pilot operations. The single-pilot, IFR, cross-country flight is often regarded as one of the most challenging flight operations. The need to communicate and navigate while relying solely on the aircraft instruments makes the single-pilot cockpit a busy and stressful environment. Since the inability to manage these demands effectively can prove life threatening, understanding and using all of the tools available in the cockpit is key to overcoming the challenges presented by single-pilot IFR flights.

The autopilot is a fundamental tool that is often overlooked in the current aviation training environment. As an SRM tool, no other piece of avionics is as valuable in reducing pilot workload as the autopilot. Pilots should routinely practice using the autopilot and gain a full understanding of their particular system. Using the autopilot allows the pilot to focus on other flight management tasks such as route deviation planning and general aircraft system monitoring without reaching a point of sensory overload.

In the case of system failures or emergencies, the autopilot relieves the pilot of the workload of manually flying the aircraft and thus allows the problem to be addressed. It is important to note that many GA aircraft are equipped with a rate-based autopilot that receives roll inputs from an electric turn-coordinator. In aircraft equipped with a vacuum-driven attitude indicator, failure of the vacuum pump should prompt the pilot to immediately change to a partial panel scan and to engage the autopilot in at least a roll and pitch mode. In aircraft equipped with a GPS coupled to the autopilot, the pilot should activate GPS direct-to navigation to the nearest suitable airport, then place the autopilot in NAV mode to fly straight to the airport. In either case, the autopilot reduces pilot workload by helping to ensure that the wings remain level and that standard rate turns are used.

At initial release, the G1000 system will interface with the third party, rate-based autopilot installed in the aircraft. These autopilots are linked to a remote-mounted rate-based gyro that is independent of the G1000 system; therefore, the above-mentioned methodology still applies if attitude information is lost. Indeed, using the autopilot in roll-control or navigation mode at the point of attitude failure allows the pilot to maintain control of the aircraft while taking appropriate emergency actions. Again, the use of the autopilot reduces pilot workload and should allow the pilot to better manage the emergency. Nonetheless, it is imperative that the pilot double-check all autopilot inputs in order to avoid mode confusion and monitor them to ensure that the intended operation is taking place.

While the autopilot is the single most valuable tool for SRM, it is also important that the pilot develop a consistent approach to using the communication and navigation tools present in the G1000 system. The two COM and NAV receivers combined with the ability to tune COM and NAV frequencies from the Jeppesen database give the pilot a streamlined process for frequency selection and management.

A typical methodology for COM/NAV frequency management is to designate COM1 and NAV1 as the primary airborne and enroute frequencies. COM2 can then be reserved for both weather (ATIS, ASOS, AWOS) and ground frequencies. Meanwhile, NAV2 is set as the backup to NAV1. If established as part of a standard operating procedure, these selections help to minimize the confusion over which COM and/or NAV is selected and active. When a consistent approach to frequency management is not used, the pilot is more likely to run into mode confusion concerning the use of the audio control panel; this can in turn lead to missed radio calls and/or transmissions on the incorrect frequency.

While managing frequencies for ground-based navaids is important, proper use of the GPS flight plan function can also prove beneficial. Rather than performing continuous direct-to navigation with the GPS, taking the time on the ground to enter a full flight plan allows the G1000 to enhance the navigation experience. First, the pilot will be able to visually inspect the route of flight on the MFD map, once at altitude, so as to verify both terrain clearance (using the terrain awareness overlay) and active airspaces (if active, MOAs and Restricted areas would call for a re-routing from ARTCC). Secondly, using the flight plan function allows for seamless autopilot turn anticipation. Finally, taking a moment to program the flight plan on the ground makes it easier to react quickly to in-flight routing changes. Pilots should program the flight plan on even short cross-country flights.

Likewise, the maps on both the Multi Function Display (MFD) and the Primary Flight Display (PFD) help the pilot to manage the navigation functions of the system. By using the maps to verify GPS navigation inputs, the pilot is able to visually cross-check data entry by looking at the course lines drawn on the map. This visual representation of the active navigation is the quickest way to determine whether all of the correct waypoints were entered for the intended route of flight.

In this discussion so far, the focus has been on SRM. Now, attention will be turned to leveraging the various data inputs from the on-board weather sensors, datalinks, traffic awareness and terrain awareness functions. Proper understanding of both the operation of these various tools and their integration with the pilot's aeronautical decision making (ADM) process can bring significant safety gains to the GA fleet.

Weather datalink and airborne lightning detection equipment have brought unprecedented weather avoidance capabilities to the GA aircraft. While these weather tools provide valuable information, they do have limitations that must be considered and they should thus be used appropriately by the pilot in the ADM process.

The primary limitation with both datalink weather and airborne lightning detection equipment is that neither device is to be used for storm penetration. Instead, these planning tools should be used to help the pilot make a timely and well-informed decision on how to proceed with the flight. Indeed, datalink weather receivers can bring a wide variety of information into the cockpit besides the well-known Nexrad radar images.

While avoiding strong thunderstorms and other areas of heavy precipitation is desirable, the ability to also review textual weather information for enroute and destination allows the pilot to maintain better situational awareness for airport selection in case of an emergency. The capability to review textual weather data from ground reporting stations while enroute also allows the pilot to evaluate all approach options based on ceilings at the destination airport and to decide whether a diversion should instead be made to an alternate airport much earlier in the flight. This, coupled with the ability to review weather information well outside of the transmission range of ATIS/AWOS/ASOS systems, enables the pilot to better prepare for arrival and reduces last-minute workload.

Thunderstorms are typically used as the main selling point for datalink weather receivers due to their visual Nexrad presentation, whereas ice – the other main weather concern for flight – is often not emphasized enough. However, it should be stressed that the potential for icing is also provided textually and in some cases, graphically, via datalink weather. This becomes a very powerful tool in the winter months. The ability to bring more information about the icing potential in either format type (textual or graphical) is a significant improvement to the overall safety of flight.[1]

Overlaying both the Nexrad and lightning images on either the G1000 MFD or PFD map inset serves to corroborate information on the location of the strongest storms. When lightning detection equipment is installed in the aircraft, the unique strike-aging capability of the G1000 provides additional visual cues as to the current state/stage of the storm. Indeed, continuously growing strike rate counts as well as an increase in the number of lightning bolts (bold or normal) often denotes a developing severe thunderstorm. On the other hand, decreasing strike rates combined with a growing number of "plus" (+) symbols indicates a decrease in the strength of the storm and its possible dissipation.[2]

While this type of information is very powerful and convincing, it is important to use it to plan the flight path and not to try to penetrate an area of weather. Indeed, the data should be used to plan a deviation well clear of the storm in order to ensure that the remainder of the flight can be safely executed. One should always remember that discretion is often the better part of valor and that no technology can depict actual meteorological conditions with 100% accuracy.

Traffic Collision and Avoidance Systems (TCAS) represent another technological advance that has been made in the area of traffic avoidance. Originally developed for large commercial aircraft, TCAS technology is now starting to trickle down features and capabilities to the GA fleet. For example, the GTX 33 Mode-S transponder can be used as an optional component in G1000-equipped aircraft and brings Traffic Information Service (TIS) data directly to the cockpit.[3]

TIS data is provided and transmitted by the FAA over Mode-S terminal radar sites and is derived from the actual transponder returns of aircraft as seen on the air traffic controller's scope. A key difference between TIS and a TCAS system is that TIS should only be used as an additional tool to see and avoid traffic. Therefore, the pilot should not become reliant on TIS and try to avoid traffic solely by reference to the traffic display in the cockpit. First, deviations should not be performed until the pilot has visually acquired the threat traffic. Secondly, Mode-S radar coverage and TIS service are only available in areas equipped with Mode-S terminal radar. Since TIS service may not always be available in the enroute environment, the pilot should not entirely depend on this tool to acquire traffic visually and should always scan for traffic.

The last tool to be discussed given its benefit to the ADM process is the new generation of GA terrain awareness systems. Terrain awareness systems are split into two generic classes, that is, certified systems and non-certified systems. The certified systems are the TAWS-A and TAWS-B devices. These systems provide a number of terrain avoidance features that are not available in the non-certified terrain awareness systems. The G1000 includes a non-certified terrain awareness feature that can be displayed on both the MFD map and the PFD map inset. TAWS-B will be available as an option for the G1000 system.

The colors used to depict dangerous terrain elevations based on aircraft altitude are red and yellow. Red indicates that the aircraft is within 100 feet of or below the terrain level. Yellow indicates that the aircraft is within 1,000 feet of the terrain. These two colors allow the pilot to look at the planned route and then decide which altitude seems optimal for the completion of the flight. This color scheme also brings additional situational awareness during the critical approach phases of the flight in both VFR and IFR conditions. With the interest in preventing Controlled Flight Into Terrain (CFIT) accidents, even simple situational awareness tools such as the G1000 terrain awareness feature can provide yet another helpful input to the ADM process.

In conclusion, as GA aircraft and pilots transition to 21st-century technology, the G1000 Integrated Avionics System brings a number of safety enhancing benefits. Although automation in the cockpit should be embraced, both its positive and negative impacts on the safety of flight should be recognized and understood. Proper autopilot use is key to enhancing safety by reducing pilot workload - this is particularly true in certain emergency situations. In addition, the ability to develop a methodical approach to other cockpit tasks, even as simple as COM/NAV frequency selection and GPS management, can help the pilot to maintain better situational awareness while minimizing the overall cockpit workload.

The ability to view weather, traffic and terrain information to improve the ADM process represents another significant benefit brought to the cockpit by the G1000 Integrated Avionics System. Indeed, from satellite downlink weather with both Nexrad radar images and textual weather to real-time lightning detection data, the pilot now has access to a wealth of information directly from the cockpit. Although the combination of weather, TIS and terrain awareness information can increase the safety of flight, it is also critical that the pilot use this information properly and consistently. Too often, human beings rely on technology alone to provide the solution to hazardous situations. However, in the dynamic, three-dimensional flight environment, it is the pilot who represents the most significant component of the avionics system. It is from the cockpit that the most important calculations are made using the information and inputs provided by the avionics to ensure a safe flight. These calculations are enhanced both by regular recurrent training and by the full understanding of the strengths and limitations of the various data inputs. Good ADM and SRM practices are of critical importance to the long-term improvement of the GA safety record.

[1] G1000 GDL-69/69A uses XM Satellite Radio with WxWorx data. Please, refer to http://www.wxworx.com/ for more information on available weather data products.
[2] Please, refer to the appropriate manufacturer documentation concerning the complete operation of lightning detection equipment.
[3] For more information on the TIS system, please refer to: http://www.tc.faa.gov/act310/projects/modes/tis.htm

This page intentionally left blank.

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: 44/1794.519944 f: 44/1794.519222

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

www.garmin.com

190-00368-00 Rev. D